GROUP

Powertrain 3

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SPECIFICATIONS

General Specifications — 2.0L

Item	Specification
Displacement in liters	2.0
Number of cylinders	4
Bore and stroke mm	84.8 x 88
Firing order	1-3-4-2
Oil pressure (hot 2000 RPM) kPa (psi)	240-450 (35-65)
Drive belt tension in Newton	178-311
Compression ratio	9.2:1 ± 0.25
Coolant capacity in liters	5.0-5.8
Cylinder head and valve train	
Valve guide inner diameter (I.D.) mm	8.063-8.094
Intake and exhaust mm	8.063-8.094
Valve seats width-intake and exhaust mm	1.75-2.32
Angle degrees runout (total indicated runout) mm	45 0.064 MAX.
Bore diameter (insert counterbore diameter) intake mm	39.940 MIN. 39.965 MAX.
Bore diameter (insert counterbore diameter) exhaust mm	34.940 MIN. 34.965 MAX.
Gasket surface flatness mm	0.04/26 0.08/156 0.15 Total
Head face surface finish mm	0.2/2.5 0.8
Valve stem to guide clearance intake mm	0.020-0.069
Valve stem to guide clearance exhaust mm	0.046-0.095
Valve head diameter intake mm	38.9-39.1
Valve head diameter exhaust mm	33.91-34.11
Valve face runout limit intake and exhaust mm	0.05
Valve face angle degree	45.6
Valve stem diameter standard (STD) intake mm	8.025-8.043
Valve stem diameter standard (STD) exhaust mm	7.996-8.017
Valve springs compression pressure (N @ mm) loaded	892.7 @ 27.71

(Continued)

General Specifications — 2.0L

Item	Specification
Valve springs compression pressure (N @ mm) unloaded	422 @ 37.1
Valve springs assembled height mm service limit, pressure lost @ specified height %	36.9-37.5 5
Valve springs free length	47.2
Valve springs installed spring height mm	35.99-39.19
Rocker arm	
Ratio	1.65
Valve tappet, hydraulic diameter (STD) mm	22.200-22.212
Valve tappet, hydraulic diameter clearance to bore mm	0.023-0.065
Valve tappet roundness mm	0.013
Finish micro mm	0.2
Valve tappet service limit mm	0.127
Collapsed tappet gap mm	0-4.5
Tappet bore diameter mm	22.25 ± .015
Camshaft bore inside diameter mm No. 1, 2, 3, 4 and 5 mm	45.796-45.821
Camshaft	
Lobe lift intake mm	6.23
Lobe lift exhaust mm	6.23
Allowable lobe lift loss mm	0.127
Theoretical valve maximum lift intake mm	10.28
Theoretical valve maximum lift exhaust mm	10.28
End play mm	0.02-0.20
Service limit mm	0.20
Journal to cylinder head bearing surface clearance mm	0.0335-0.0835
Journal diameter standard mm runout limit	0.127 (Runout of center bearing relative to bearing Nos. 1 and 5)
Journal diameter standard mm out-of-round	0.08

(Continued)

SPECIFICATIONS (Continued)

General Specifications — 2.0L

Item	Specification
Camshaft drive assembled gear face runout crankshaft mm	0.65
Camshaft drive assembled gear face runout camshaft mm	0.275
Cylinder block	
Head gasket surface overall flatness mm	0.076
Head gasket surface finish roughness height (CLA) mm	3.8-2.0
Head gasket surface finish roughness height cutoff mm	0.8
Dowel height chamfer mm total mm	0.8x30 degrees 12.5
Cylinder bore diameter mm	84.8
Piston to cylinder bore clearance mm	0.020 -0.040
Surface finish (RA) each bore min.	15-38
Average of all bores of a cylinder block (RA) min.	20-30
Out of round limit mm	0.025
Taper limit mm	0.013
Main bearing bore diameter @ ± 30 degrees PF bearing cap P/L mm	62.2835-62.3145
Other than above mm	62.2935±.0100
Crankshaft	
Main bearing journal diameter mm	57.98-58.0
Out of round limit mm	0.008
Taper limit mm	0.008 per 25.4
Journal runout limit mm	0.05
Runout of bearings 2, 3, and 4 crankshaft end play mm	0.100-0.300
Surface finish (RMS) micro mm	0.3
Clearance to crankshaft mm	0.020-0.065
Thrust bearing journal length mm	28.825-28.854
Connecting rod journal diameter mm	43.89-43.91
Out of round limit	0.008
Taper limit mm	0.008 per 25.4

(Continued)

General Specifications — 2.0L

Item	Specification
Surface limit (RMS) micro mm	0.6 Rear 0.9 Front
Main bearing thrust face surface finish (RMS) micro mm	0.6
Rear micro mm	0.9
Front runout limit (T.I.R.) mm	0.025
Flywheel clutch face runout limit (T.I.R.) mm	0.180
Flywheel ring gear lateral runout (T.I.R.) manual transmission mm	0.64
Flywheel ring gear lateral runout (T.I.R.) automatic transmission mm	1.5
Crankshaft end play mm	0.100-0.300
Connecting rod	
Connecting rod bearings clearance to crankshaft mm	0.020-0.065
Bearing wall thickness (STD) mm	1.476-1.488
Clearance of crankshaft w/o cylinder head mm	Desired 0.0457-0.0660 Allowable 0.0461-0.0859
Clearance of crankshaft w/cylinder head mm	Desired 0.0279-0.0483 Allowable 0.0276-0.0674
Bearing wall thickness mm	2.117-2.129
Connecting rod piston pin bore diameter mm	20.570-20.610
Crankshaft bearing bore diameter mm	46.89-46.91
Out-of-round limit piston pin bore mm	0.008
Taper limit piston pin bore mm/mm	0.0038/25.4
Length (center to center) mm	131.905-131.975
Out-of-round limit - bearing bore mm	0.010
Taper limit - bearing bore mm	0.010
Alignment bore to bore (max. differential) twist mm (bend mm)	0.05 (0.038)
Side clearance (assembled to crank) std. mm (service limit mm)	0.092-0.268 (0.356)

(Continued)

SPECIFICATIONS

General Specifications — 2.0L

Item	Specification
Displacement in liters	2.0
Number of cylinders	4
Bore and stroke mm	84.8 x 88
Firing order	1-3-4-2
Oil pressure (hot 2000 RPM) kPa (psi)	240-450 (35-65)
Drive belt tension in Newton	178-311
Compression ratio	9.2:1 ± 0.25
Coolant capacity in liters	5.0-5.8
Cylinder head and valve train	
Valve guide inner diameter (I.D.) mm	8.063-8.094
Intake and exhaust mm	8.063-8.094
Valve seats width-intake and exhaust mm	1.75-2.32
Angle degrees runout (total indicated runout) mm	45 0.064 MAX.
Bore diameter (insert counterbore diameter) intake mm	39.940 MIN. 39.965 MAX.
Bore diameter (insert counterbore diameter) exhaust mm	34.940 MIN. 34.965 MAX.
Gasket surface flatness mm	0.04/26 0.08/156 0.15 Total
Head face surface finish mm	0.2/2.5 0.8
Valve stem to guide clearance intake mm	0.020-0.069
Valve stem to guide clearance exhaust mm	0.046-0.095
Valve head diameter intake mm	38.9-39.1
Valve head diameter exhaust mm	33.91-34.11
Valve face runout limit intake and exhaust mm	0.05
Valve face angle degree	45.6
Valve stem diameter standard (STD) intake mm	8.025-8.043
Valve stem diameter standard (STD) exhaust mm	7.996-8.017
Valve springs compression pressure (N @ mm) loaded	892.7 @ 27.71

(Continued)

General Specifications — 2.0L

Item	Specification
Valve springs compression pressure (N @ mm) unloaded	422 @ 37.1
Valve springs assembled height mm service limit, pressure lost @ specified height %	36.9-37.5 5
Valve springs free length	47.2
Valve springs installed spring height mm	35.99-39.19
Rocker arm	
Ratio	1.65
Valve tappet, hydraulic diameter (STD) mm	22.200-22.212
Valve tappet, hydraulic diameter clearance to bore mm	0.023-0.065
Valve tappet roundness mm	0.013
Finish micro mm	0.2
Valve tappet service limit mm	0.127
Collapsed tappet gap mm	0-4.5
Tappet bore diameter mm	22.25 ± .015
Camshaft bore inside diameter mm No. 1, 2, 3, 4 and 5 mm	45.796-45.821
Camshaft	
Lobe lift intake mm	6.23
Lobe lift exhaust mm	6.23
Allowable lobe lift loss mm	0.127
Theoretical valve maximum lift intake mm	10.28
Theoretical valve maximum lift exhaust mm	10.28
End play mm	0.02-0.20
Service limit mm	0.20
Journal to cylinder head bearing surface clearance mm	0.0335-0.0835
Journal diameter standard mm runout limit	0.127 (Runout of center bearing relative to bearing Nos. 1 and 5)
Journal diameter standard mm out-of-round	0.08

(Continued)

SPECIFICATIONS (Continued)

General Specifications — 2.0L

Item	Specification
Pistons	
Piston to bore clearance rebuild mm	0.020-0.040
Piston to bore clearance service mm	0.020-0.070
Piston diameter mm	84.77-84.80
Pin bore diameter mm	20.632-20.641
Ring groove width compression (top) mm	1.53 -1.55
Ring groove width (bottom) mm	1.53-1.55
Oil ring groove width mm	4.008-4.032
Compression ring (top) to ring groove clearance mm	0.04-0.08
Compression ring (bottom) to ring groove clearance mm	0.06-0.09
Squish height mm	0.908-1.858
Piston pin length mm	66.2-67.0
Piston pin diameter standard mm	20.622-20.631
Piston to pin clearance mm	0.0007-0.013
Pin to rod clearance kilo-Newton	Press-fit-8
Piston rings ring width compression top mm	1.47-1.49
Compression (bottom) mm	1.46-1.49
Oil ring service limit mm	Side seal (snug fit) (side clearance) 0.15
Ring gap compression (top) mm	0.25-0.28
Ring gap compression (bottom) mm	0.25-0.28
Ring gap oil ring (steel rail) mm	0.04-1.68
Side clearance 1st ring mm	0.04-0.08
Side clearance 2nd ring mm	0.04-0.09
Lubrication system	
Oil pump relief valve spring tension N @ mm	41.4-45.8 @ 28.1
Relief valve to bore clearance mm	0.02-0.08
Oil pump type	Gerotor
Rotor clearance outer gear to housing clearance mm	0.074-0.161

(Continued)

General Specifications — 2.0L

Item	Specification
Inner and outer gear to cover clearance (end play) mm	0.013-0.089
Inner to outer gear tip clearance mm	0.05-0.18
Oil capacity with filter in liters	3.76 (4)

General Specifications — 2.5L

Item	Specification
Displacement	2.5L (153 CID)
Number of cylinders	6
Bore and stroke	82.4 x 79.5
Firing order	1-4-2-5-3-6
Oil pressure (hot 1500 RPM)	138-310 kPa (20-45 psi)
Cylinder head and valve train	
Combustion chamber volume	44.5 ±1.5 cc
Valve seats - width intake	1.1-1.4 mm
Width exhaust	1.4-1.7 mm
Angle	44.75 degrees
Runout (T.I.R.) max	0.04 mm
Valve stem to guide clearance intake	0.020-0.069 mm
Valve stem to guide clearance exhaust	0.045-0.094 mm
Valve head diameter intake	32 mm
Valve head diameter exhaust	26 mm
Gauge diameters	31 and 24.5 mm
Valve face runout limit	0.05 mm
Valve face angle	45.5 degrees
Valve stem diameter (STD) intake	5.975-5.995 mm
Valve stem diameter (STD) exhaust	5.950-5.970 mm
Valve springs compression pressure (N @ spec length) intake	680 N @ 30.19 mm
Valve springs compression pressure (N @ spec length) exhaust	680 N @ 30.19 mm
Free length (approximate) intake	46.8 mm

(Continued)

SPECIFICATIONS (Continued)

General Specifications — 2.5L

Item	Specification
Free length (approximate) exhaust	46.8 mm
Installed pressure (N @ spec length) intake	228 N @ 39.99 mm
Installed pressure (N @ spec length) exhaust	228 N @ 39.99 mm
Service limit	10% Pressure Loss @ 30.09
Out of square limit	1%
Rocker arm ratio	1.8:1
Hydraulic valve tappet diameter (STD)	16-15.988 mm
Clearance to bore	0.018-0.069 mm
Service limit	0.016 mm
Hydraulic leakdown rate	5-25 seconds
Collapsed valve tappet gap - desired	0.50-1.11 mm
Camshaft	
Lobe lift	
Intake (primary)	4.79 mm
Intake (secondary)	4.79 mm
Exhaust	4.79 mm
Allowable lobe lift loss	0 mm
Theoretical valve lift @ zero lash	
Intake (primary)	9.80 mm
Intake (secondary)	9.80 mm
Exhaust	9.80 mm
End play	
Standard	0.025-0.165 mm
Service limit	0.190 mm
Journal to bearing clearance	
Standard	0.025-0.076 mm
Service limit	0.121 mm
Journal diameter (all)	26.926-26.936 mm
Bearing inside diameter (all)	27.012-26.897 mm
Cylinder block	
Head gasket surface	
	Head gasket surface flatness - cylinder block: 0.025 / 25 x 25.050/ 150 x 150
	Head gasket surface flatness-cylinder head: 0.025 / 25 x 25.050/ 150 x 150

(Continued)

General Specifications — 2.5L

Item	Specification
	Head gasket surface flatness-cylinder block: 0.025 / 25 x 25.050/ 150 x 150
Head gasket surface finish	
	Head gasket surface flatness-cylinder head: 0.025 / 25 x 25.050/ 150 x 150
Main bearing bore diameter	68.998-69.022 mm
Cylinder bore	
Diameter	Grade 1: 82.4-82.410 mm grade 2: 82.411-82.421 mm grade 3: 82.420-82.430 mm
Surface finish (RMS)	0.2-0.6 microns
Out-of-round limit	0.015 mm
Out-of-round service limit	0.020 mm
Taper service limit	0.006 mm
Crankshaft	
Main bearing journal diameter	62.968-62.992 mm
Connecting rod journal diameter	49.970-49.990 mm
Crankshaft free play	0.110-0.232 mm
Crankshaft runout to rear face of cylinder block	0.050 mm max
Connecting rod bearings	
Clearance to crankshaft	0.028-0.066 mm
Bearing wall thickness (STD) 0.250 mm undersize - add 0.125 mm to standard or grade 2 thickness	1.503
Main bearings	
Clearance to crankshaft-desired	0.025-0.045 mm
Clearance to crankshaft-allowable	0.025-0.050 mm
Bearing wall thickness - grade 1	2.501 mm
Bearing wall thickness - grade 2	2.505 mm
Bearing wall thickness - grade 3	2.510 mm
Connecting rod	
Piston pin bore diameter	21.071-21.032 mm
Length (center to center)	138.06-138.4 mm

(Continued)

SPECIFICATIONS (Continued)

General Specifications — 2.5L

Item	Specification
Alignment (bore to bore max difference)	Pin bore and crankshaft bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of a 203 mm bar, 101.5 mm on each side of the centerline
Twist	0.050 mm per 25
Band	0.038 mm per 25
Side clearance (assembled to crank)	
Standard	0.100-0.30 mm
Service limit	0.35 mm max.
Pistons	
Diameter	Measured at 43 mm from outer perimeter top of piston to the pin axis
Coded grade 1	82.390-82.410 mm
Coded grade 2	82.398-82.442 mm
Coded grade 3	82.410-82.430 mm
Piston to bore clearance	0.012 to 0.022 mm
Pin bore diameter	21.008-21.012 mm
Ring groove width	
Compression (top)	
Compression (bottom)	
Oil ring	3.030-3.055 mm
Piston pin	
Length	55.05-55.47 mm
Diameter	21.011-21.013 mm
Pin to piston clearance	-0.005 to +0.001 mm
Pin to rod clearance	
Standard	0.004-0.020 mm

(Continued)

General Specifications — 2.5L

Item	Specification
Service limit	0.035 mm
Side clearance	
Compression (top)	0.040-0.075 mm
Compression (bottom)	0.040-0.085 mm
Oil ring	Snug fit
Service limit	0.10 mm
Piston ring gap	Specification 82.4 mm diameter gauge
Compression (top) - gauge diameter	0.100-0.250 mm
Compression (bottom) - gauge diameter	0.27-0.42 mm
Oil Ring (steel rail) - gauge diameter	0.15-0.65 mm
Compression (top) service limit	0.50 mm max
Compression (bottom) - service limit	0.65 mm max
Oil ring (steel rail) - service limit	0.90 mm max
Lubrication system	
Oil capacity with filter change	5.5 liter
Drive belt tension	
Note: Belts have differing tension specifications depending on whether they are new installed or used	Automatic tensioners
6 Rib front end accessory drive (FEAD)-Water pump belt	Automatic tensioners
3 Rib rear end accessory drive (READ)-Water pump belt	No adjustment required

DESCRIPTION AND OPERATION

Engine

Engine/Transaxle Variants

There is a choice of two engines and two transmissions giving two different power ratings.

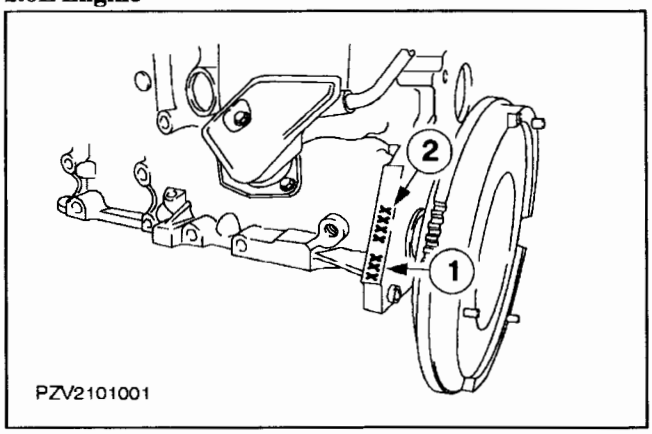
- 2.0L Zetec Engine
  - — MTX-75 Manual Transaxle
  - — CD4E Automatic Transaxle
- 2.5L Duratec Engine
  - — MTX-75 Manual Transaxle
  - — CD4E Automatic Transaxle

The engines meet all the requirements placed on the latest generation of engines concerning fuel consumption, smoothness of running, flexibility and performance.

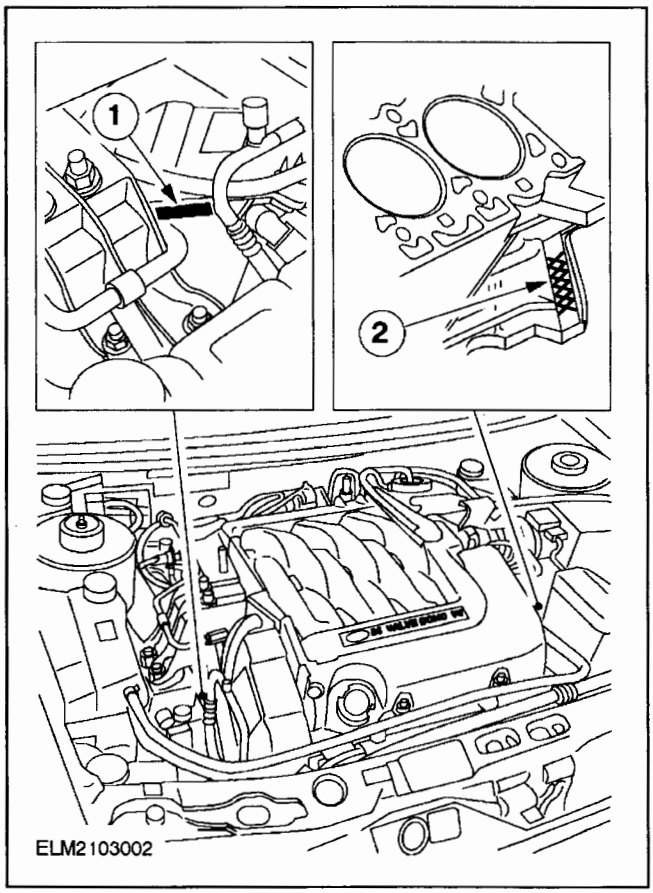
DESCRIPTION AND OPERATION (Continued)

Location of the Serial Number

2.0L Engine

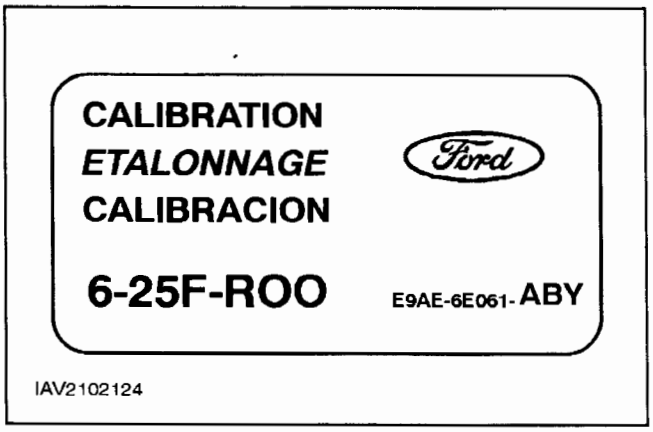


2.5L Engine



Item	Part Number	Description
1	—	Engine code and serial number (engraved)
2	—	Engine code and serial number (stamped)

Exhaust Emissions - Calibration Sticker



The exhaust emissions calibration sticker is located on the left-hand drivers door or the B pillar. It provides information on:

- The engine type.
- The engine code and the emission standard.

This information is needed to check the engine calibration and when ordering spare parts.

SPECIFICATIONS (Continued)

General Specifications — 2.5L

Item	Specification
Alignment (bore to bore max difference)	Pin bore and crankshaft bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of a 203 mm bar, 101.5 mm on each side of the centerline
Twist	0.050 mm per 25
Band	0.038 mm per 25
Side clearance (assembled to crank)	
Standard	0.100-0.30 mm
Service limit	0.35 mm max.
Pistons	
Diameter	Measured at 43 mm from outer perimeter top of piston to the pin axis
Coded grade 1	82.390-82.410 mm
Coded grade 2	82.398-82.442 mm
Coded grade 3	82.410-82.430 mm
Piston to bore clearance	0.012 to 0.022 mm
Pin bore diameter	21.008-21.012 mm
Ring groove width	
Compression (top)	
Compression (bottom)	
Oil ring	3.030-3.055 mm
Piston pin	
Length	55.05-55.47 mm
Diameter	21.011-21.013 mm
Pin to piston clearance	-0.005 to +0.001 mm
Pin to rod clearance	
Standard	0.004-0.020 mm

(Continued)

General Specifications — 2.5L

Item	Specification
Service limit	0.035 mm
Side clearance	
Compression (top)	0.040-0.075 mm
Compression (bottom)	0.040-0.085 mm
Oil ring	Snug fit
Service limit	0.10 mm
Piston ring gap	Specification 82.4 mm diameter gauge
Compression (top) - gauge diameter	0.100-0.250 mm
Compression (bottom) - gauge diameter	0.27-0.42 mm
Oil Ring (steel rail) - gauge diameter	0.15-0.65 mm
Compression (top) service limit	0.50 mm max
Compression (bottom) - service limit	0.65 mm max
Oil ring (steel rail) - service limit	0.90 mm max
Lubrication system	
Oil capacity with filter change	5.5 liter
Drive belt tension	
Note: Belts have differing tension specifications depending on whether they are new installed or used	Automatic tensioners
6 Rib front end accessory drive (FEAD)-Water pump belt	Automatic tensioners
3 Rib rear end accessory drive (READ)-Water pump belt	No adjustment required

DESCRIPTION AND OPERATION

Engine

Engine/Transaxle Variants

There is a choice of two engines and two transmissions giving two different power ratings.

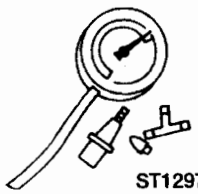
- 2.0L Zetec Engine
  - — MTX-75 Manual Transaxle
  - — CD4E Automatic Transaxle
- 2.5L Duratec Engine
  - — MTX-75 Manual Transaxle
  - — CD4E Automatic Transaxle

The engines meet all the requirements placed on the latest generation of engines concerning fuel consumption, smoothness of running, flexibility and performance.

DIAGNOSIS AND TESTING

Engine

Special Tool(s)

 ST1300-A	12 Volt Master UV Diagnostic Inspection Kit 164-R0756
 ST1297-A	Vacuum/PressureTester 164-R0253

Inspection and Verification

Since diagnosis and testing actually begins when repairs are taken on, the following procedure is recommended:

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage. If the concern cannot be reproduced, carry out a road test and/or a visual check with the aid of the following table.

Visual Inspection Chart

Mechanical
• Coolant leaks • Oil leaks • Leaks in the fuel system • Visibly damaged or worn parts • Loose or missing nuts or bolts

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Difficult to start during hot or cold start	• Worn piston.	• INSTALL a new piston.
	• Piston ring(s) worn, damaged or sticking.	• INSTALL new piston ring(s).
	• Worn cylinder.	• INSPECT and REPAIR the cylinder.
	• Head gasket damaged.	• INSPECT the head gasket.
	• Fuel system damaged or inoperative.	• REFER to Section 303-04A or Section 303-04B.
	• Ignition system inoperative.	• REFER to Section 303-07B.
• Poor idling	• Restricted exhaust system.	• INSPECT the exhaust system. REFER to Section 309-00.
	• Vacuum leak.	• CARRY OUT the Intake Manifold Vacuum Test in this section. REPAIR or INSTALL new components as necessary.
	• Burned valve(s).	• INSPECT the valve(s).
	• Incorrect valve to valve seat contact.	• INSPECT the valve and valve seat.
	• Head gasket damaged.	• INSPECT the head gasket.
	• Fuel system damaged or inoperative.	• REFER to Section 303-04A or Section 303-04B.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart (Continued)

Condition	Possible Sources	Action
• Insufficient power	• Compression leakage from valve seat.	• INSPECT the valve or valve seat.
	• Valve sticking.	• INSPECT valve stem to valve guide clearance or carbon accumulation.
	• Valve spring weak or broken.	• INSPECT the valve spring.
	• Head gasket damaged.	• INSPECT the head gasket.
	• Cylinder head cracked or distorted.	• INSPECT the cylinder head.
	• Piston ring(s) worn, damaged or sticking.	• INSTALL a new piston ring(s).
	• Piston worn or cracked.	• INSTALL a new piston.
	• Fuel system damaged or inoperative.	• REFER to Section 303-04A or Section 303-04B.
	• Brakes dragging.	• REFER to Section 206-00.
	• Tire size incorrect.	• REFER to Section 204-04.
	• Restricted exhaust system.	• INSPECT the exhaust system. REFER to Section 309-00.
• Excessive or insufficient compression	• Valve(s) burnt or sticking.	• INSPECT the valve(s).
	• Valve spring(s) weak or broken.	• INSPECT the valve spring(s).
	• Worn piston.	• INSTALL a new piston.
	• Piston ring(s) worn, damaged or sticking.	• INSTALL a new piston ring(s).
	• Worn cylinder.	• INSPECT and REPAIR the cylinder.
	• Head gasket damaged.	• INSPECT the head gasket.
	• Carbon accumulation in combustion chamber.	• ELIMINATE carbon buildup.
	• Fuel system damaged or malfunctioning.	• REFER to Section 303-04A or Section 303-04B.
• Excessive oil consumption	• Piston ring groove worn.	• INSPECT the piston.
	• Piston ring sticking.	• INSPECT the piston ring.
	• Piston or cylinder worn.	• INSPECT the piston or cylinder block.
	• Valve stem seal worn or missing.	• INSPECT the valve or valve stem seal.
	• Oil leakage.	• REPAIR oil leakage.
	• Valve stem or valve guide worn	• INSPECT the valve stem or valve guide.
	• Incorrect oil viscosity.	• DRAIN and FILL with new oil.
	• Diluted oil.	• CHECK oil for dilution. DRAIN and FILL as necessary.
	• Crankcase overfilled.	• CHECK and adjust the oil level.
	• Incorrect oil pressure.	• CHECK the oil pressure. REPAIR as necessary.
	• Broken piston, pin or piston ring.	• INSTALL a new piston, pin or piston ring.
	• Oil baffle damaged inside of valve cover.	• INSTALL a new valve cover.
	• Oil separator damaged.	• INSTALL a new oil separator.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart (Continued)

Condition	Possible Sources	Action
• Engine noise	• Excessive crankshaft main bearing clearance.	• INSPECT the oil clearance. INSTALL a new crankshaft main bearings or REPAIR crankshaft.
	• Crankshaft main bearing heat damaged.	• INSPECT the crankshaft main bearings. INSTALL new crankshaft main bearings or REPAIR crankshaft.
	• Excessive crankshaft end play.	• INSPECT the crankshaft and crankshaft main thrust bearing.
	• Excessive connecting rod bearing oil clearance.	• INSPECT the oil clearance. INSTALL new connecting rod bearings and/or REPAIR the crankshaft.
	• Connecting rod bearings heat damaged.	• INSPECT the connecting rod bearings. INSTALL new connecting rod bearings and/or REPAIR the crankshaft.
	• Cylinder worn.	• INSPECT the cylinder block.
	• Piston or piston pin worn.	• INSPECT the piston or piston pin.
	• Piston ring damaged.	• INSPECT the piston ring.
	• Connecting rod bent.	• INSPECT the connecting rod.
	• Valve spring(s) broken.	• INSPECT the valve spring(s).
	• Excessive valve guide clearance.	• INSPECT the valve guide or valve.
	• Cooling system inoperative (water pump, vibration of radiator).	• REFER to Section 303-03.
	• Fuel system inoperative.	• REFER to Section 303-04A or Section 303-04B.
	• Excessive carbon buildup.	• ELIMINATE carbon buildup.
	• Exhaust gas leakage.	• REPAIR leakage. REFER to Section 309-00.
	• Incorrect drive belt tension.	• INSPECT the drive belt tension. REFER to Section 303-05.
	• Generator front bearing worn.	• REPAIR leakage. REFER to Section 309-00.
• Tappet noise when engine is started (does not continue for more than 10 minutes)	• Insufficient oil in engine.	• CHECK the engine oil level. ADD oil as necessary.
	• Deteriorated oil.	• DRAIN and FILL with new oil.
	• Insufficient oil in valve tappet.	• WARM the engine. DRIVE vehicle at 3000 RPM for 8 minutes.
• Tappet noise when engine is started (continues for more than 10 minutes)	• Insufficient oil in engine.	• CHECK the engine oil level. ADD oil as necessary.
	• Deteriorated oil.	• DRAIN and FILL with new oil.
• Tappet noise engine operation	• Insufficient oil in engine.	• CHECK the engine oil level. ADD oil as necessary.
	• Deteriorated oil.	• DRAIN and FILL with new oil.
	• Insufficient oil pressure.	• CHECK the oil pressure.

DIAGNOSIS AND TESTING (Continued)

Component Tests

Engine Oil Leaks

NOTE: Before installing new gaskets or oil seals, make sure that the fault is clearly established.

If the oil leak cannot be identified clearly by a visual inspection, carry out an UV test:

Fluorescent Oil Additive Method

1. Clean the engine with a suitable cleaning fluid (brake cleaner).
2. Drain the engine oil and refill with recommended oil, premixed with Diesel Engine Oil Dye or equivalent. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines. If oil is not premixed, fluorescent additive must first be added to the crankcase.
3. Run engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks use 12 Volt Master UV Diagnostic Inspection Kit or equivalent. A clear bright yellow or orange area will identify leak. For extremely small leaks, several hours may be required for the leak to appear.
4. As necessary, pressurize the main oil gallery system to locate leaks due to incorrectly sealed, loose or cocked plugs. If the flywheel bolts leak oil, look for sealer on the threads.
5. Repair all leaks as necessary.

Compression Test

General Remarks

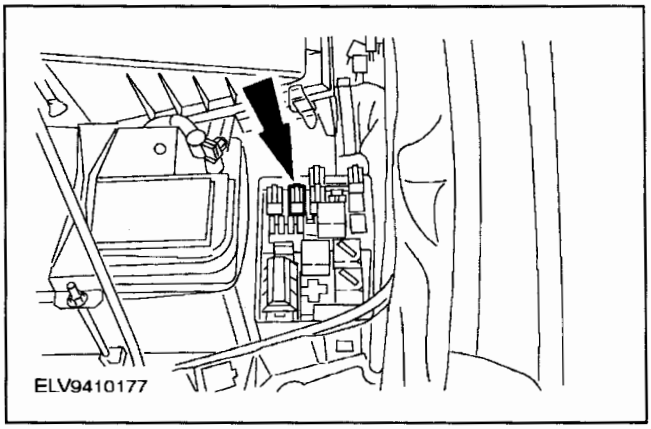
NOTE: Removing fuses and disconnecting electrical components causes the powertrain control module (PCM) to come up with an error message. After measurement has been carried out this error message should be cleared from memory by connecting NGS.

NOTE: Only check the compression pressure with the valves set to the prescribed clearance (if this can be adjusted).

The compression pressure should be checked with the engine at operating temperature.

Differing designs of compressor pressure recorder and varying starter motor speeds usually only make it possible to check that the compression is the same in all cylinders.

Check the compression pressure - 2.0L

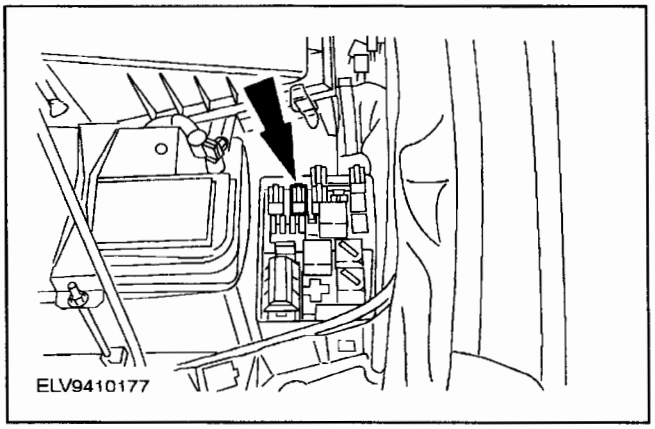


⚠ **WARNING: On manual transaxles shift the transaxle into neutral. On automatic transaxles select "P". Failure to follow this instructions will result in personal injury.**

1. Open the central junction box (CJB).
2. Remove the fuel pump relay (R8).
3. Start the engine - the engine will start up, run for a few seconds and then stall.
4. Remove the cover plate from the cylinder head cover.
5. Remove the spark plugs.
6. Pull off the spark plug connectors.
7. Pull off the ignition coil electrical connector.
8. Install auxiliary starter switch in starting circuit. With ignition switch OFF, using auxiliary starter switch, crank engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes required to obtain the highest reading.
9. Repeat test on each cylinder, cranking the engine approximately the same number of compression strokes.
10. Install the components in the reverse order, observing the specified tightening torques.
11. Reset the PCM fault memory.

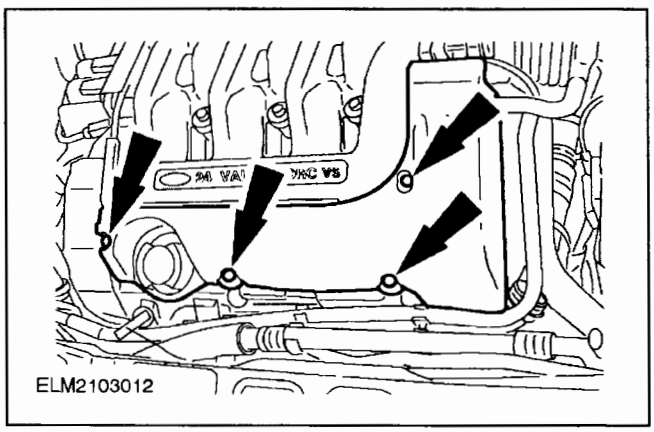
DIAGNOSIS AND TESTING (Continued)

Check the Compression Pressure - 2.5L

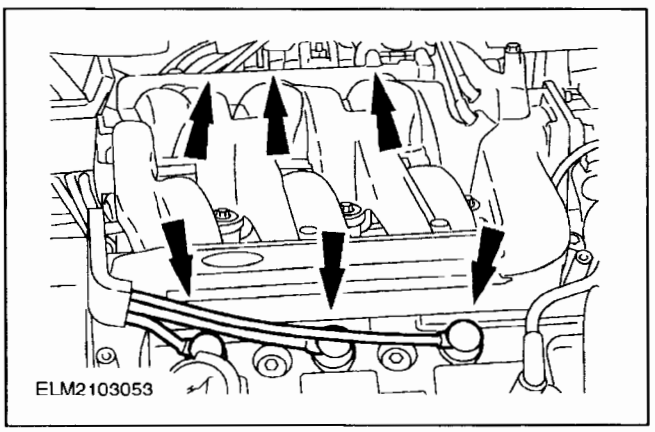


⚠ **WARNING: On manual transaxle shift the transaxle into neutral. On automatic transaxles select "P". Failure to follow this instructions will result in personal injury.**

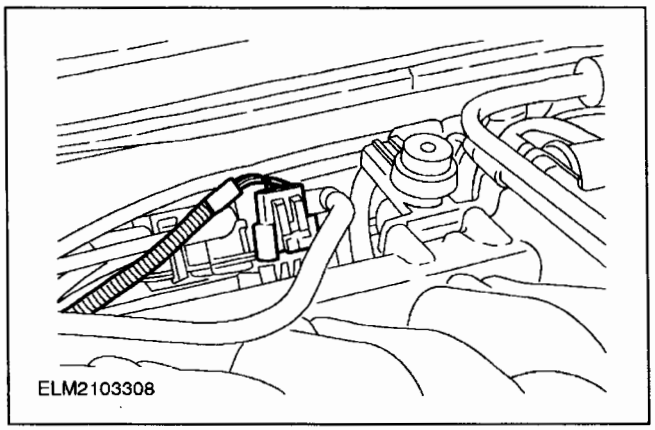
1. Open the central junction box (CJB).
2. Remove the fuel pump relay (R8).
3. Start the engine. The engine will start up, run for a few seconds and then stall.



4. Remove the engine cover.



5. Pull off the spark plug wires and remove the spark plugs.



6. Disconnect the electrical connector from the coil.
7. Install auxiliary starter switch in starting circuit. Within ignition switch OFF, using auxiliary starter switch, crank engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes required to obtain the highest reading.
8. Repeat test on each cylinder, cranking the engine approximately the same number of compression strokes.
9. Install the components in the reverse order, observing the specified tightening torques.
10. Reset the PCM fault memory.

Interpretation of the Results

The indicated compression pressure are considered within specification if the lowest reading cylinder is within 75 % of the highest reading.

⚠ **CAUTION: If engine oil is sprayed into the combustion chamber, after carrying out the measurement run the engine at 2000 rpm for about 15 minutes, in order to burn the oil and prevent damage to the catalytic converter.**

If the measurement on one or more cylinders is much lower than the specified value, spray some engine oil into the combustion chamber and repeat the compression measurement.

If the reading greatly improves then the piston rings are damaged.

If the reading stays the same then the cause is either bad valve seats or valve stem seals.

DIAGNOSIS AND TESTING (Continued)

If the measurements for two cylinders next to each other are both too low then it is very likely that the cylinder head gasket between them is burnt through. This can also be recognized by traces of engine oil in the coolant and/or coolant in the engine oil.

Excessive Engine Oil Consumption

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

— Trailer towing applications.

— Severe loading applications.

— Sustained high speed operation.

Engines need oil to lubricate the following internal components:

— Cylinder block cylinder walls.

— Pistons and piston rings.

— Intake and exhaust valve stems.

— Intake and exhaust valve guides.

— All internal engine components.

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned .

The following is a partial list of conditions that can affect oil consumption rates:

— Engine size.

— Operator driving habits.

— Ambient temperatures.

— Quality and viscosity of oil.

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the full mark on the oil level indicator due to dilution (condensation and fuel) in the engine crankcase. The vehicle then might be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked it may appear that a liter of oil was used in about 160 km (100 miles). This perceived 160 km (100 miles) per liter oil consumption rate is about 2400 km (1500 miles) per liter.

Make sure the selected engine oil meets Ford specification ESE-M2C153-E and the recommended API performance category "SG" and SAE viscosity grade as shown in the vehicle Owner's Guide. It is also important that the engine oil is changed at the intervals specified for the typical operating conditions.

Oil Consumption Test

The following diagnostic procedure is used to determine the source of excessive oil consumption.

NOTE: Oil use is normally greater during the first 16,100 km (10,000 miles) of service. As mileage increases, oil use decreases. Vehicles in normal service should get at least 1,450 km (900 miles) per liter after 16,100 km (10,000 miles) of service. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

1. Define excessive consumption, such as the number of miles driven per liter of oil used. Also determine customer's driving habits, such as sustained high speed operation, towing, extended idle and other considerations.
2. Verify that the engine has no external oil leaks as described under Engine Oil Leaks.
3. Verify that the engine has the correct oil level.

DIAGNOSIS AND TESTING (Continued)

4. Verify that the engine is not being run in an overfilled condition. Check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. In no case should the level be above the top of the cross-hatched area and the letter "F" in FULL. If significantly overfilled, carry out step 5, sub steps 1 through 4.
5. Carry out an oil consumption test:
   1 Drain engine oil, remove oil bypass filter and fill with one liter less than the recommended amount.
   2 Run the engine for three minutes (10 minutes if cold), and allow oil to drain back for at least five minutes with vehicle parked on level surface.
   3 Remove the oil level indicator and wipe clean. (Do not wipe with anything contaminated with silicone compounds.) Install the oil level indicator making sure to seat the oil level indicator firmly in the oil level indicator tube. Remove the oil level indicator and draw a mark on the back (unmarked) surface at the indicated oil level. (This level should be about the same as the ADD mark on the face of the oil level indicator.)
   4 Add one liter of oil. Start the engine and allow to idle for at least two minutes. Shut off the engine and allow the engine oil to drain back for at least five minutes. Mark the oil level dipstick, using the procedure above. (This level may range from slightly below the top of the cross-hatched area to slightly below the letter "F" in FULL.
   5 Record the vehicles mileage.
   6 Instruct the customer to drive the vehicle as usual and :
      - Check the oil level regularly at intervals of 160-240 km (100-150 miles).
      - Return to the service point when the oil level drops below the lower (ADD) mark on the oil level indicator.
      - Add only full liters of the same oil in an emergency. Note the mileage at which the oil is added.
   7 Check the oil level under the same conditions and at the same location as in steps 3 and 4.
      - Measure the distance from the oil level to the UPPER mark on the oil level indicator and record.
      - Measure the distance between the two scribe marks and record.
      - Divide the first measurement by the second.
      - Divide the distance driven during the oil test by the result. This quantity is the approximate oil consumption rate in kilometers per liter or in miles per quart.
      - If the oil consumption rate is unacceptable go to Step 6.
6. Check the positive crankcase ventilation (PCV) system. Make sure the system is not plugged.
7. Checked for plugged oil drain-back holes in the cylinder head and cylinder block.
8. If the condition still exists after carrying out the above tests go to step 9.
9. Carry out a cylinder compression test. Refer to Compression Test in this section. This can help determine the source of oil consumption such as valves, piston rings or other areas.
10. Check valve guides for excessive guide clearance. Install all valve stem seals new after verifying valve guide clearance.
11. Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of the spark plugs can be a clue to internal oil consumption. If internal oil consumption still persists, proceed as follows.
    1 Remove the engine from the vehicle and place it on an engine work stand. Remove the cylinder head and oil pan. Refer to Section 303-01A or Section 303-01B.
    2 Check the piston ring clearance, ring gap and ring orientation. Repair as necessary.
    3 Check the for excessive bearing clearance. Repair as necessary.

DIAGNOSIS AND TESTING (Continued)

12. Carry out oil consumption test as described to confirm oil consumption concern has been resolved.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester 164-R0253 or equivalent to the intake manifold. run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is performed. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1000 feet) of elevation above sea level.

The reading should be steady. As necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust damper until needle moves easily without excessive flutter.

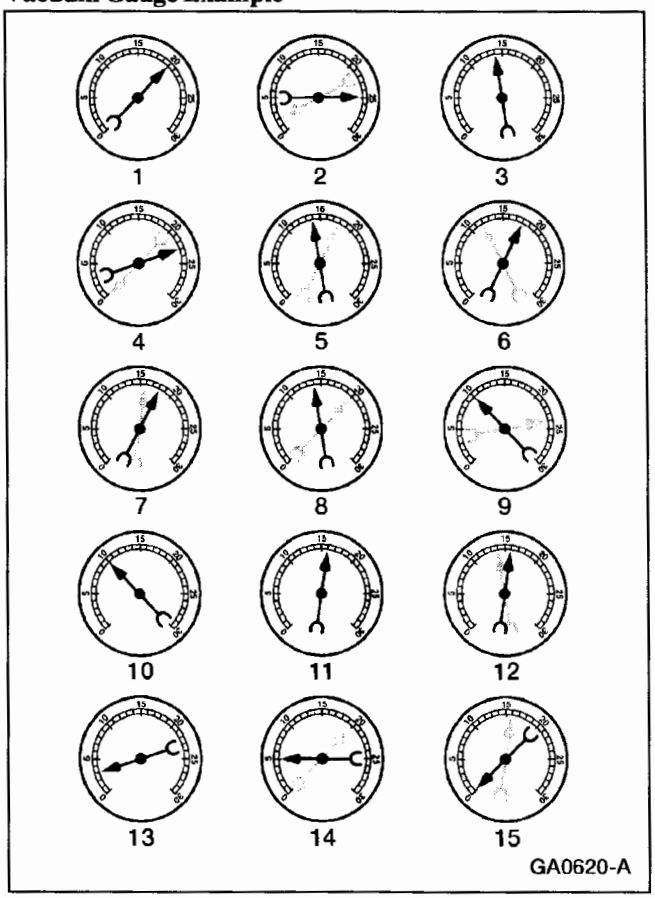
Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.

Vacuum Gauge Example



1. NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

DIAGNOSIS AND TESTING (Continued)

2. NORMAL READING DURING RAPID ACCELERATION: When engine is rapidly accelerated (dotted needle), needle will drop to a low (not to zero) reading. When throttle is suddenly released, the needle will snap back up to a higher than normal figure.
3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: Needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.
4. WORN RINGS OR DILUTED OIL: When engine is accelerated (dotted needle), needle drops to 0 kPa (0 in-Hg). Upon deceleration, needle runs slightly above 74 kPa (22 in-Hg).
5. STICKING VALVES: When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4in-Hg), one or more valves may be sticking.
6. BURNED OR BENT VALVES: A regular, evenly spaced, downscale flicking of the needle indicates one or more burned or damaged valves. Insufficient hydraulic valve tappet or hydraulic lash adjuster clearance will also cause this reaction.
7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating correctly.
8. WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, needle will become steady if guides are responsible.
9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine RPM is increased, weak valve springs are indicated. The reading at idle could be relatively steady.
10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.
11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady but somewhat low reading.
12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.
13. INTAKE LEAK: A low, steady reading which can be caused by an intake manifold or throttle body gasket leak.
14. BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head to cylinder block surface.
15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler, kinked tail pipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory until such as the power brake booster, the unit will not function correctly. Always fix vacuum leaks.

Flywheel Runout

Refer to Flywheel—Inspection in this section.

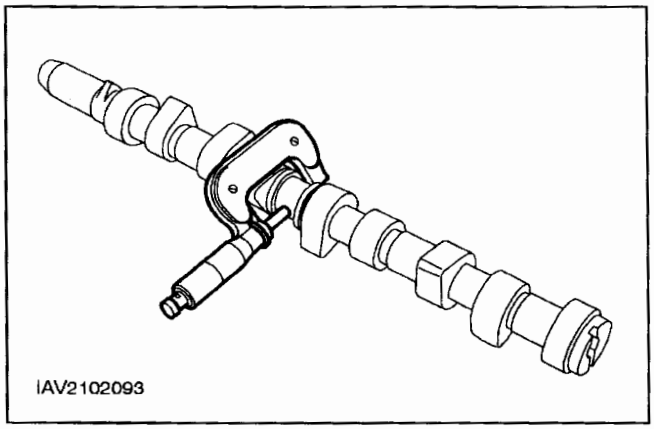
Static Valve Train Analysis (engine off)

Remove the cylinder head cover or the plenum section.

Check all components of the valve train for damage and wear. Make sure that only original parts are installed, and that they are tightened to the specified torque values.

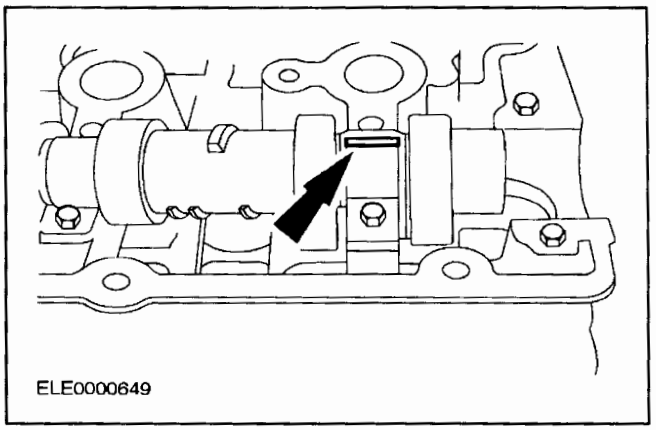
GENERAL PROCEDURES

Camshaft Journal Diameter


IAV2102093

1. Determine the diameter of the camshaft journals.
   - Using a micrometer measure the diameter at 90 degrees intervals to determine if the journals are out-of-round.
   - Measure at two different points on the journal to determine if there is any tapering.
   - If the measurements are out of the specified range, install a new camshaft.

Camshaft Journal Clearance


ELE0000649

1. **NOTE:** Make sure that the following stages are followed exactly. The tappets or followers must be removed to carry out this measurement.

   NOTE: Make sure that the camshaft is to specification.

   NOTE: The bearing caps and journals should be free from engine oil and dirt.

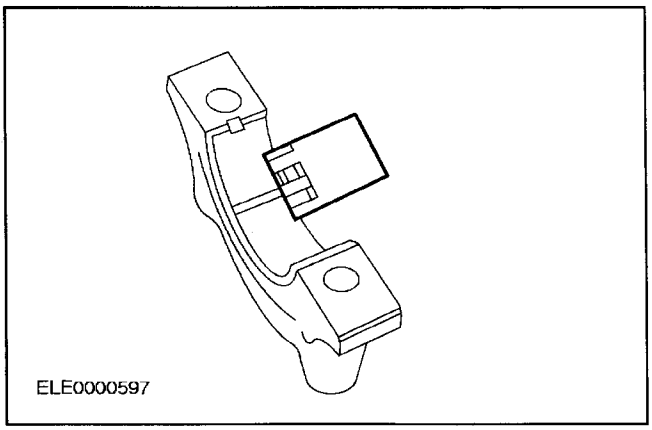
   Position on a length of plastigage on the bearing cap.
   - Insert the camshaft, without lubrication, into the cylinder head.
   - Position a plastigage strip, which should be equal to the width of the bearing cap, on the bearing journal.

2. Following the tightening specification, install the camshaft bearing caps. For additional information, refer to Section 303-01A or Section 303-01B.

3. **NOTE:** Do not strike the bearing caps.

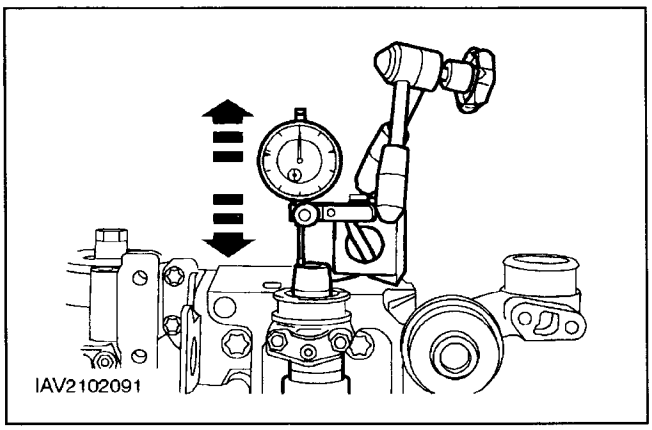
   Remove the camshaft bearing caps. For additional information, refer to Section 303-01A or Section 303-01B.

GENERAL PROCEDURES (Continued)



4. Using the Plastigage, read off the measurement.
   - Compare the length of plastigage with the plastigage scale.
   - The value that is read off is the bearing clearance.

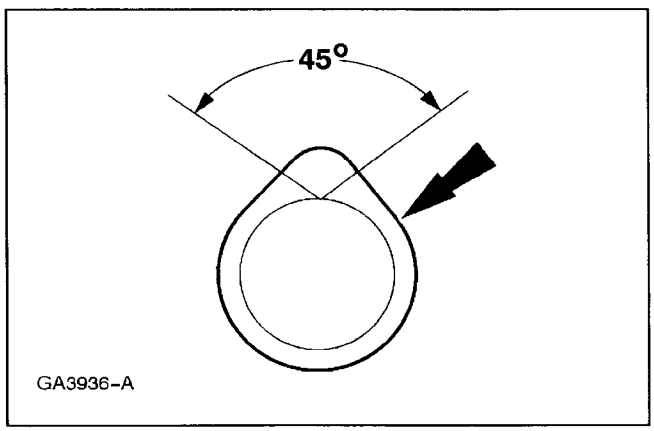
Camshaft End Play



1. **NOTE:** Make sure that the camshaft is to specification.

   Using a Dial Indicator Gauge, measure the end play.
   - Slide the camshaft in both directions. Read and note the maximum and minimum values on the Dial Indicator Gauge.
     - End play = maximum value minus minimum value
   - If the measurement is out of specification, install new components.

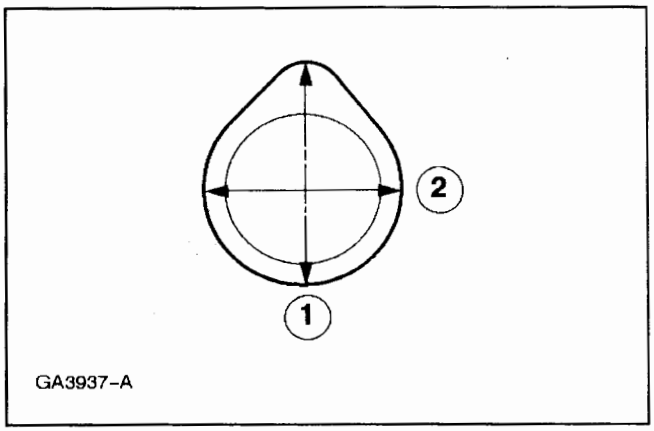
Camshaft — Lobe Surface



1. Inspect the camshaft lobes for pitting or damage in the active area. Minor pitting is acceptable outside the active area.

GENERAL PROCEDURES (Continued)

Camshaft — Lobe Lift

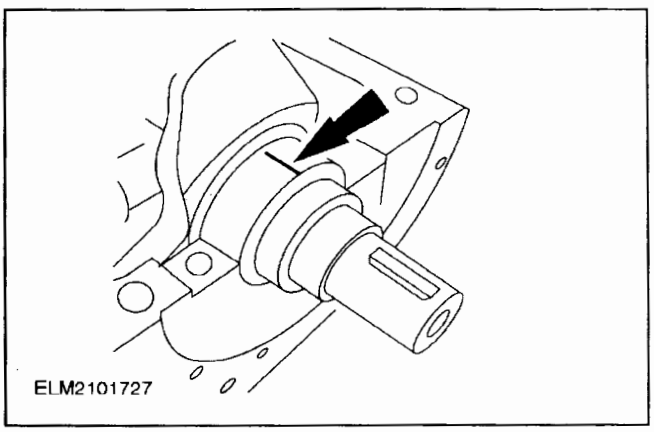


1. Measure the diameter (1) and diameter (2) with a vernier caliper. The difference in measurements is the lobe lift.

Crankshaft Main Bearing Journal Clearance

General Equipment

Plastigage



All vehicles

1. **NOTE:** Verify that the following stages are followed exactly. The crankshaft must be to specification.

   NOTE: The bearing shells and journals must be free from engine oil and dirt.

   NOTE: The measuring point should be near to the center.

   Position on a length of Plastigage on the bearing journal.

   - Insert the associated bearing shells, without lubrication, into the cylinder block.
   - Insert the crankshaft, without lubrication, into the cylinder block.
   - Position a strip of Plastigage, equal to the width of the bearing, on the bearing journal.

Vehicles with 2.0L engine

2. **NOTE:** Measure each bearing separately.

   Carry out the measurement.

   - One bearing cap at a time should be worked on; install the bearing cap of the bearing position to be measured and tighten it to the specified torque. For additional information, refer to Section 303-01A.

GENERAL PROCEDURES (Continued)

- **NOTE:** Do not hit the bearing cap.

  Remove the bearing cap.

Vehicles with 2.5L engine

3. **NOTE:** Measure all the bearings at the same time.

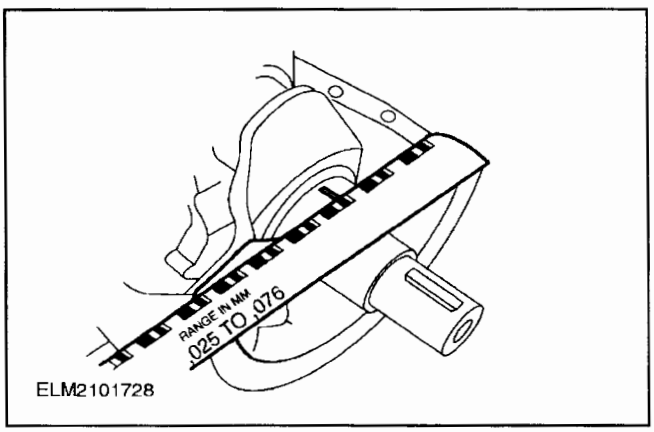
   Carry out the measurement.

   - Install the lower crankcase with bearing shells following the tightening specification. For additional information, refer to Section 303-01B.
   - **NOTE:** Do not hit the lower crankcase.

     Install the lower crankcase with bearing shells following the tightening specification. For additional information, refer to Section 303-01B.

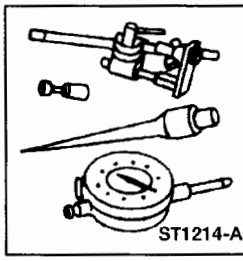
All vehicles

4. Read off the measurement.
   - Compare the length of plastigage with the Plastigage scale.
   - The value that is read off is the bearing clearance.
   - If the measurement is out of the specified range, change the bearing shells and repeat the measurement.

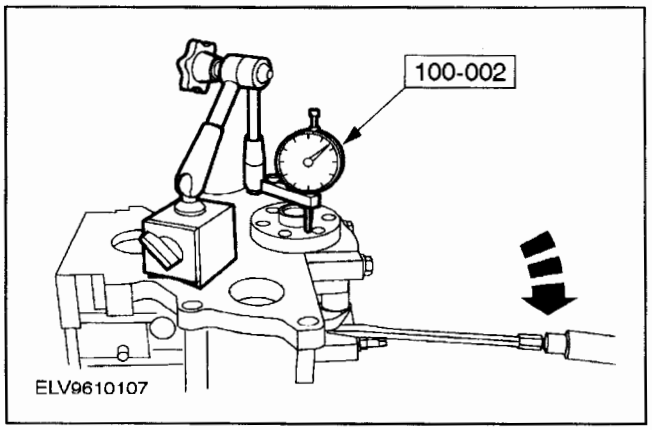


Crankshaft End Play

Special Tool(s)

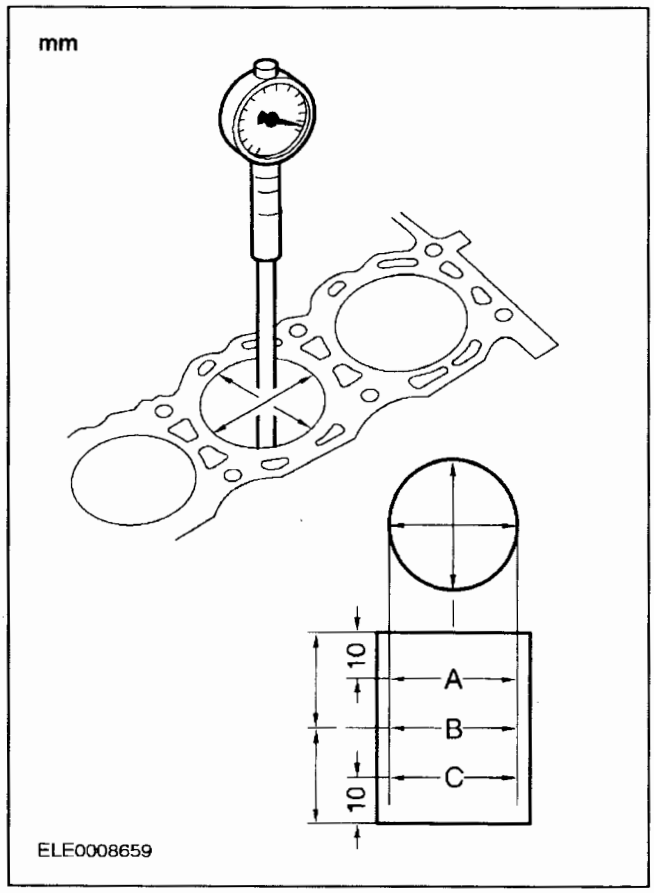
 ST1214-A	Dial Indicator Gauge with Bracketry 100-002 (TOOL-4201-C)

GENERAL PROCEDURES (Continued)



1. Using special tool, measure the end play (2.0L shown).
   - Measure the end play by lifting the crankshaft using a lever.
   - If the value is out of the specification, install new thrust half rings to take up the end float and repeat the measurement.

Cylinder Bore Taper

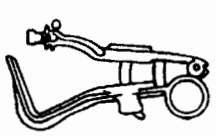


1. **NOTE:** The main bearing caps or lower crankcase must be in place and tightened to the specified torque; however, the bearing shells should not be installed.

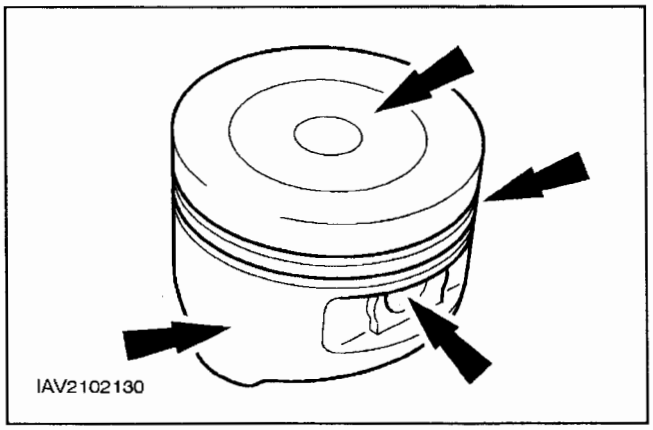
   Measure the cylinder bore with an internal micrometer.
   - Carry out the measurements in different directions and at different heights to determine if there is any out-of-roundness or tapering.
   - If the measurement is out of the specified range, install a new block or hone out the cylinder block (if applicable/allowed).

Piston Inspection

Special Tool(s)

 ST1279-A	303-D033 (D81L-6002-D)

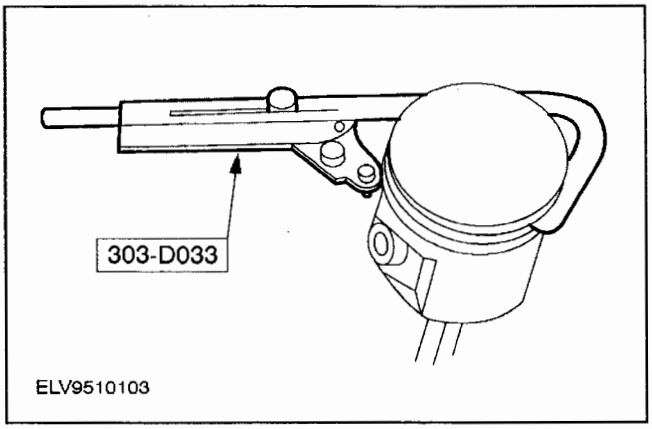
GENERAL PROCEDURES (Continued)



1. ⚠ **CAUTION: Do not use any aggressive cleaning fluid or a wire brush to clean the piston.**

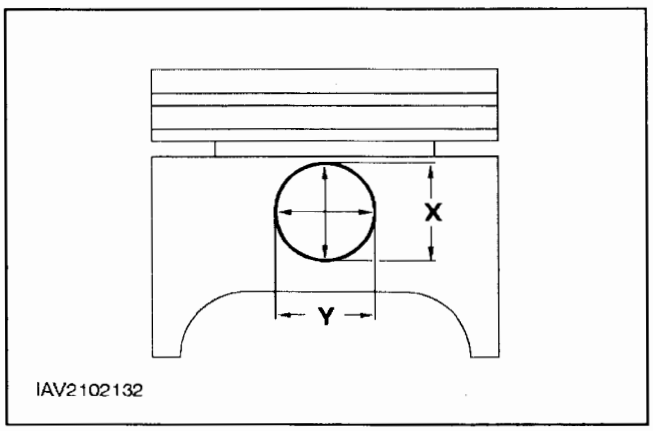
   Carry out a visual inspection.

   - Clean the piston skirt, pin bush, ring grooves and crown and check for wear or cracks.
   - If there are signs of wear on the piston skirt, check whether the connecting rod is twisted or bent.



2. Using the special tool clean the piston ring grooves.

Piston Pin To Bore Diameter



1. **NOTE:** The piston and piston pin form a matched pair. Do not mix up the components.

   Measure the diameter of the piston pin bore.

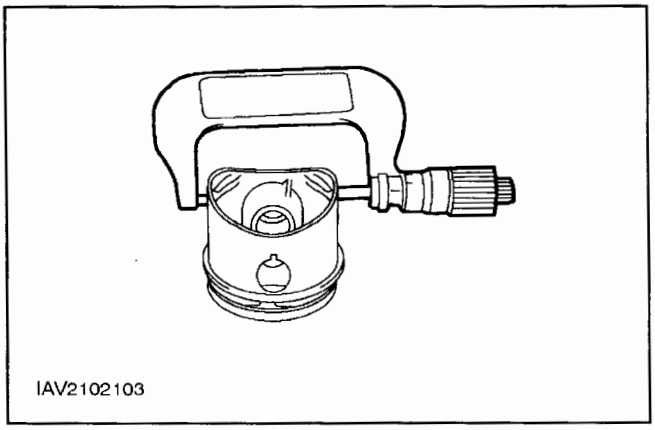
   - Measure the diameter in two directions.
   - If the values are not to specification, install both a new piston and a new piston pin.

Piston Diameter

General Equipment

Micrometer

GENERAL PROCEDURES (Continued)

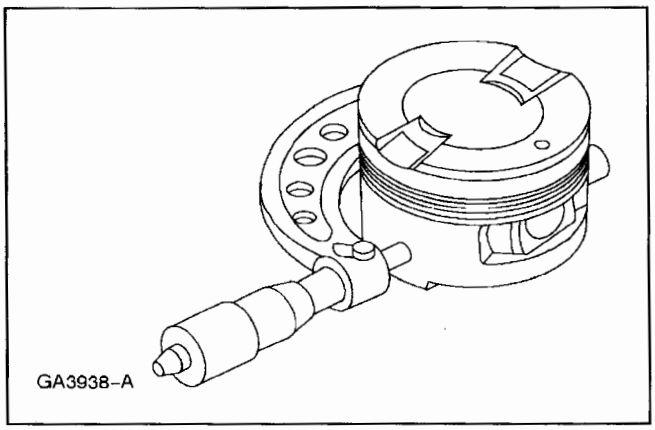

IAV2102103

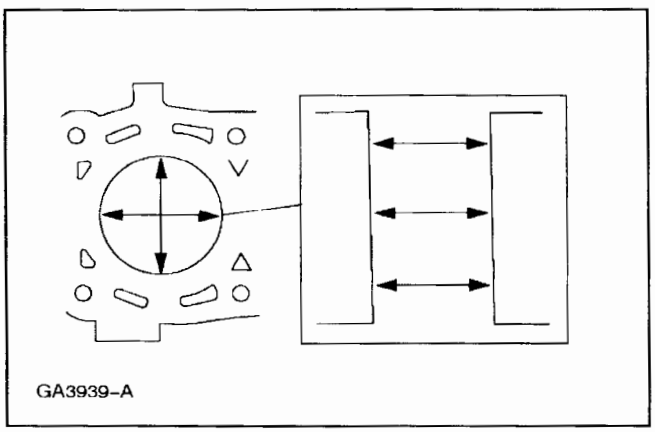
1. **NOTE:** Mark piston in case a piston has to be again installed.

   Using a Micrometer measure the piston in two directions.

   - Measure the piston diameter at the height of the piston pin bore, but offset by 90 degrees.

Piston To Cylinder Bore Clearance

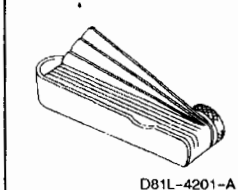

GA3938-A


GA3939-A

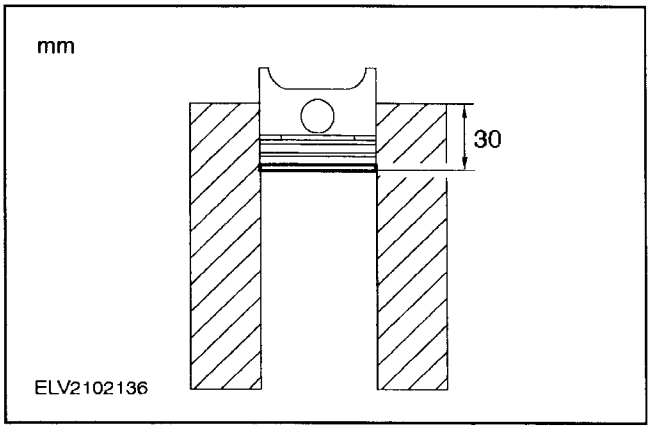
1. Subtract the piston diameter from the cylinder bore diameter to find the piston to cylinder bore clearance.

Piston Ring End Gap

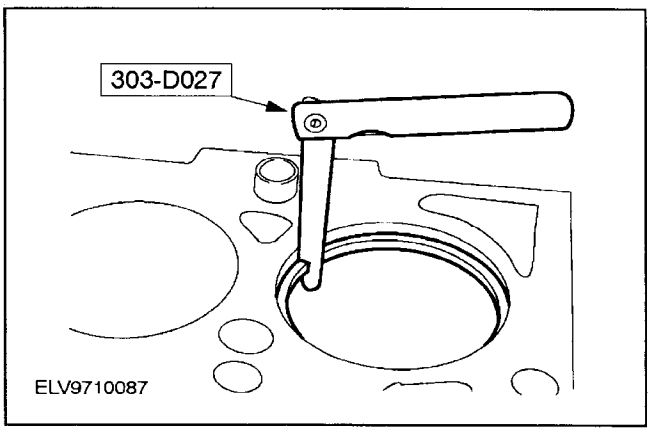
Special Tool(s)

 D81L-4201-A	303-D027 (D81L-4201-A)

GENERAL PROCEDURES (Continued)



1. Take the piston ring and use a piston without rings to push the piston ring about 30 mm into the cylinder bore.



2. ⚠ **CAUTION: Do not mix up the piston rings. Install the piston rings in the same position and location.**

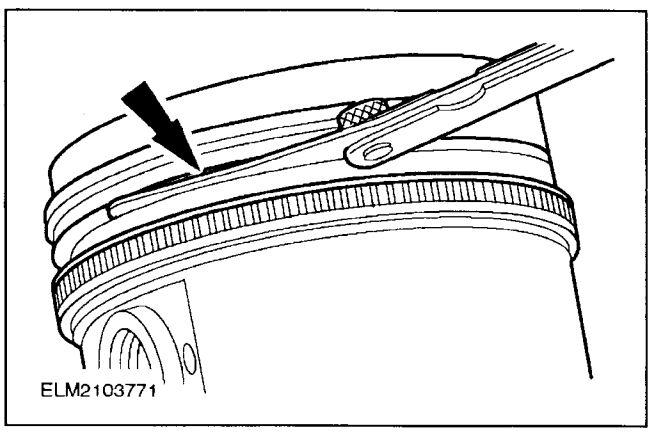
   Using the special tool, measure the piston ring gap.

   - The values given in the specification refer to a gauge ring used during production. If measured in the cylinder, these values can be exceeded by 0.15 mm.

Piston Ring-To-Groove Clearance

General Equipment

Feeler Gauge

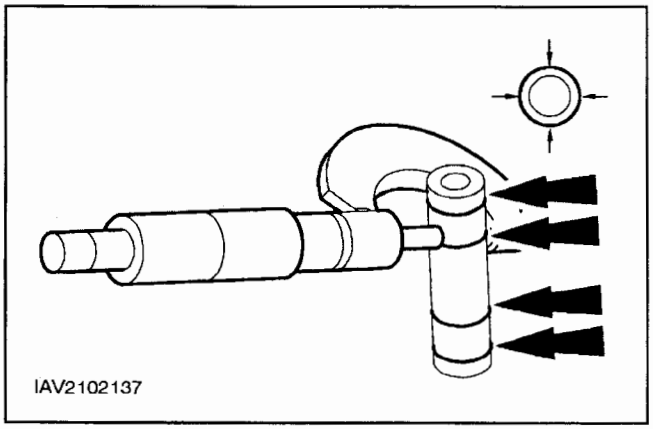


1. **NOTE:** The piston ring must protrude from the piston groove. To determine the piston ring clearance, insert the Feeler Gauge right to the back of the groove, behind the wear ridge.

   Using the Feeler Gauge, measure the piston ring clearance.

GENERAL PROCEDURES (Continued)

Piston Pin Diameter

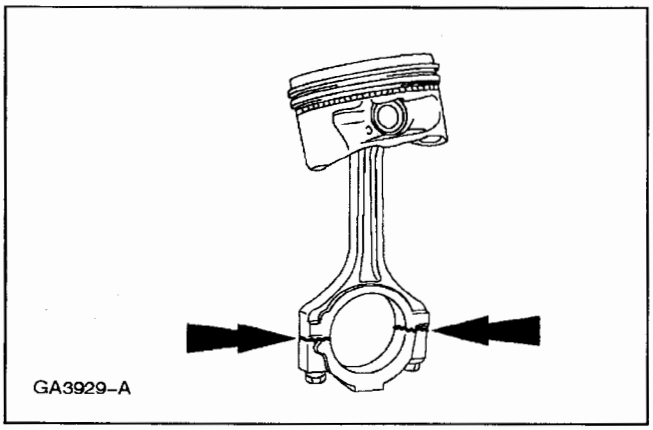

IAV2102137

1. **NOTE:** The piston and piston pin are a matched pair. Do not mix up the components.

   Measure the piston pin diameter.

   - Measure the diameter in two directions.
   - If the values are not to specification, install a new piston and a new piston pin.

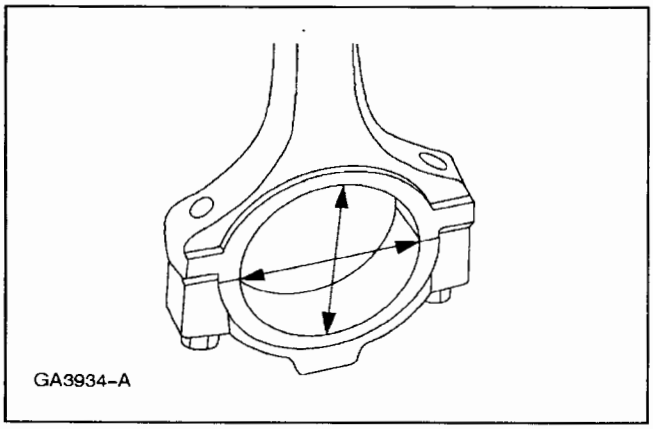
Connecting Rod Cleaning


GA3929-A

1. ⚠ **CAUTION: Do not use a caustic cleaning solution or damage to connecting rods may occur.**

   Mark and separate the parts and clean with solvent. Clean the oil passages.

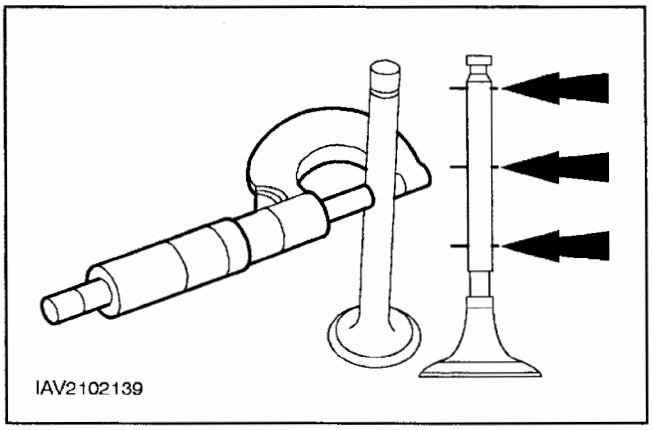
Connecting Rod Large End Bore


GA3934-A

1. Measure the bearing bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round and the bearing bore is within specification.

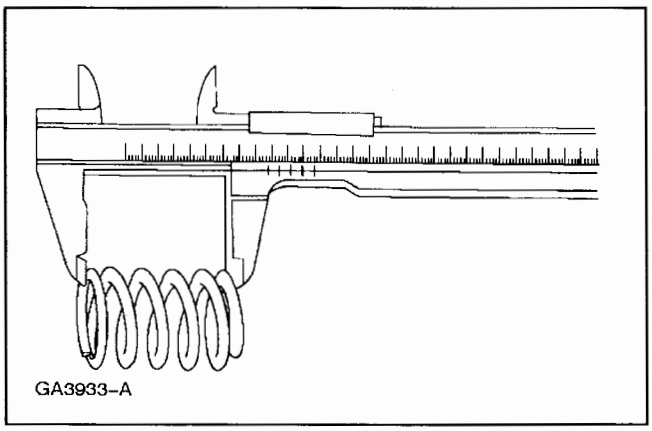
GENERAL PROCEDURES (Continued)

Valve Stem Diameter


IAV2102139

1. Using a micrometer measure the diameter of the valve stems.
   - If the measurements are not to specification, install a new valve.

Valve Spring Free Length

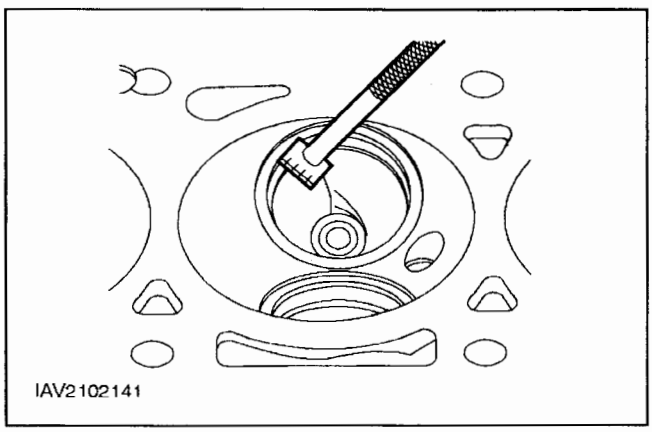

GA3933-A

1. Using a vernier gauge, measure the free length of each valve spring. Verify the length is within specification.

Valve Seat Inspection

General Equipment

Valve seat width scale

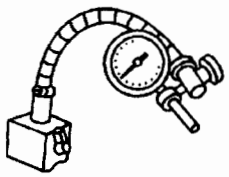

IAV2102141

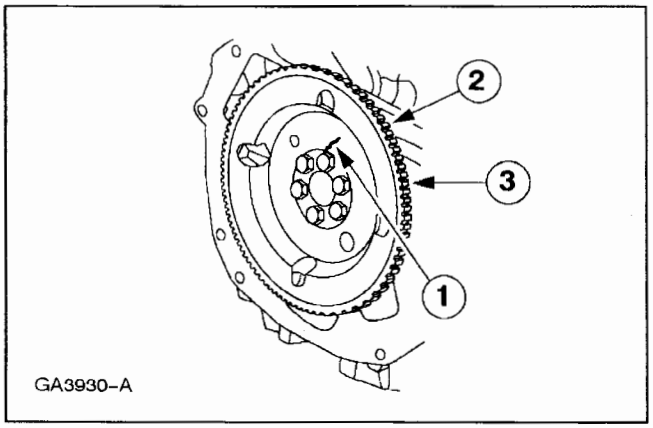
1. Measure the width of the valve seat.
   - Measure the valve seat width using the Valve seat width scale.
   - If the value is not to specification rework the valve seat.

GENERAL PROCEDURES (Continued)

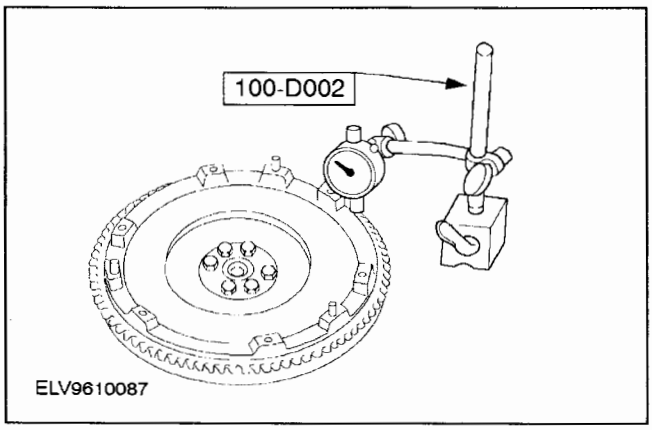
Flywheel — Inspection

Special Tool(s)

 ST1266-A	100-D002 (D78P-4201-B)



1. Inspect the flywheel for:
   1 Any cracks.
   2 Worn ring gear teeth.
   3 Chipped or cracked ring gear teeth.

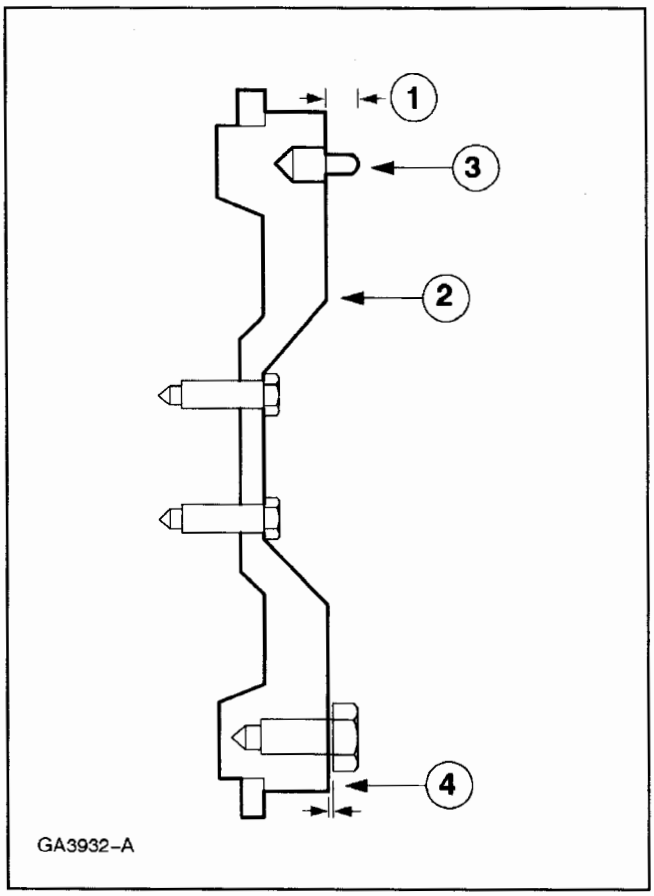


2. Using the special tool, inspect the flywheel ring gear runout.
   - Set the special tool on the flywheel ring gear surface and turn the flywheel to measure any runout.

Flywheel — Clutch Surface

1. Use a fine grade sandpaper (400 grit) for polishing or as necessary machine the flywheel surface to remove any defects.

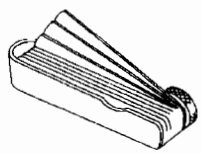
GENERAL PROCEDURES (Continued)



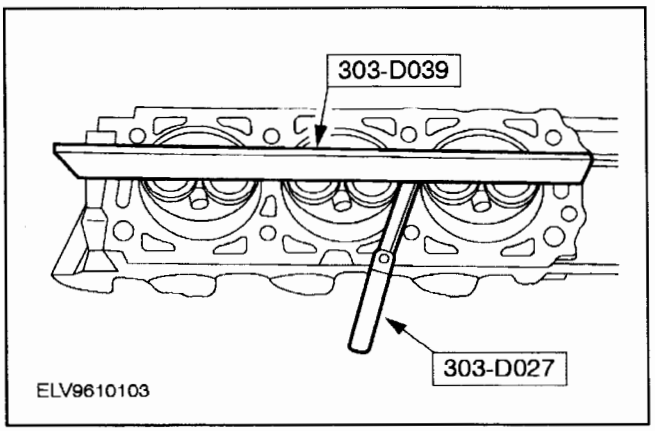
2. After resurfacing, the flywheel must be within specification.
   1 The surface runout must not exceed specification.
   2 The surface finish must be within specification.
   3 The major diameter of any dowel pin must be below the new flywheel surface.
   4 The clutch pressure plate bolts must screw into the flywheel by hand to within specification of the new flywheel surface.

Cylinder Head Distortion

Special Tool(s)

 D81L-4201-A	303-D027 (D81L-4201-A)
 D83L-4201-A	303-D039 (D83L-4201-A)

GENERAL PROCEDURES (Continued)



1. Measure the cylinder block/cylinder head distortion.
   - Using the special tool, measure the mating face distortion.
   - ⚠ **CAUTION: The mating face on the 2.5L engines must not be reworked.**

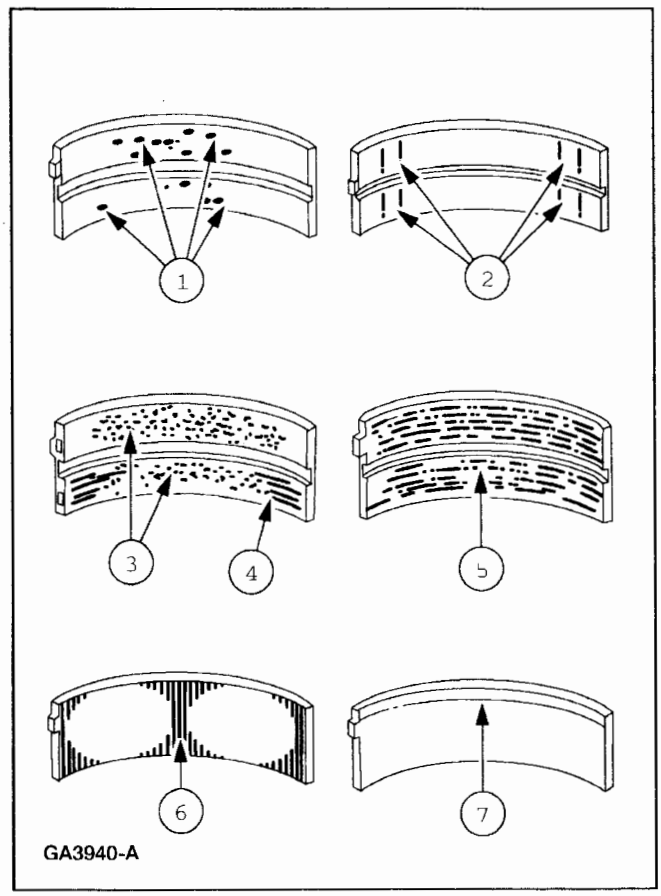
     If the value is not to specification rework the mating face.

Exhaust Manifold — Inspection

1. Inspect the cylinder head joining flanges of the exhaust manifold for evidence of exhaust gas leaks.

2. Inspect the exhaust manifold for cracks, damaged gasket surfaces, or other damage that would make it unfit for further use.

Bearing — Inspection



1. Inspect bearings for the following defects.
   1 Cratering - fatigue failure
   2 Spot polishing - incorrect seating.
   3 Imbedded dirt engine oil.
   4 Scratching - dirty engine oil.
   5 Base exposed - poor lubrication.
   6 Both edges worn - journal damaged.
   7 One edge worn - journal tapered or bearing not seated.

SECTION 303-01A Engine — 2.0L Zetec

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SPECIFICATIONS

Description	Engine Data
Engine management	EEC V/SEFI
Emission standard	EPA-OBD II
Fuel	95 RON unleaded
Firing order	1-3-4-2
Bore (mm)	84,8
Stroke (mm)	88,0
Cubic capacity (cm3)	1.989
Compression ratio	10,0:1
Engine power output (kW/PS)	97/130
Engine power output at (rpm)	6000
Torque (Nm)	180
Torque at (rpm)	4000
Maximum engine speed, at (rpm)	7000

General Specifications

Item	Specification
Lubricants	
Super Premium SAE 5W30 Motor Oil XO-5W30-QSP	WSS-M2C153-H
High-temperature grease	ESD-M1C220-A
Manual Transaxle Fluid	WSD-M2C200-C
MERCON® Multi-Purpose Automatic Transmission Fluid (automatic transaxle) XT-2-QDX	MERCON®
Extended Life Engine Coolant F6AZ-19544-AA	WSS-M97B44-A
Gasket Maker F8AZ-19B508-AB	WSK-M2G348-A5
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A
High Performance DOT3 Motor Vehicle Brake Fluid C6AZ-19542-AB	ESA-M6C25-A
High performance brake fluid DOT 4	SAM-6C9103-A
Capacities	
Engine oil, initial fill incl. filter	4.50
Engine oil, oil change incl. filter	4.25

(Continued)

General Specifications

Item	Specification
Engine oil, oil change excl. filter	3.75
Coolant	6.6
Transmission fluid (manual transaxle)	2.6
Transmission fluid (automatic transaxle with oil cooler) [a]	7.2[a]
Cylinder Block	
Number of main bearings	5
Cylinder bore diameter, class 1	84.800-84.810
Cylinder bore diameter, class 2	84.810-84.820
Cylinder bore diameter, class 3	84.820-84.830
Inside diameter-main bearing shells (installed)	58.011-58.038
Inside diameter-main bearing shells (installed) (main bearing shells graded by size)	58.008-58.031
Main bearing radial clearances	0.011-0.058
Main bearing radial clearances (main bearing shells graded by size)	0.0196-0.044
Main bearing parent bore	62.287-62.300
Crankshaft	
Main bearing journal dia.	57.980-58.000
Main bearing journal end float	0.09-0.26
Big-end bearing journal dia.	46.89-46.91
Lower Crankcase	
Required shim thickness where there is a gap between the cylinder block and the lower crankcase:	
0.26 mm to 0.50 mm	0.25
0.51 mm to 0.75 mm	0.50
Connecting Rods	
Bore diameter, big-end	49.89-49.91
Bore diameter, small end	19.951-19.981
Inside diameter-big-end bearing shells (fitted)	46.926-46.960

(Continued)

SPECIFICATIONS (Continued)

General Specifications

Item	Specification
Big-end bearing radial clearance	0.016-0.070
Big-end bearing axial clearance	0.090-0.320
Pistons	
Piston diameter, class 1	84,750-84,760
Piston diameter, class 2	84,760-84,770
Piston diameter, class 3	84,770-84,780
Piston clearance in cylinder	-0,010-0,030
Piston ring gaps (fitted)	
- Upper compression ring	0,22-0,37
- Lower compression ring	0,50-0,70
- Oil scraper ring	0,15-0,66
Ring gap positions	The piston ring gaps must be spaced evenly around the circumference of the piston. This also applies to the elements of the oil scraper ring. Stagger the ring gaps at 120 degrees to one other
Piston Pins	
Piston pin length	55.80-56.20
Piston pin diameter	19.997-20.000
Piston pin diameter, red	20.625-20.628
Piston pin clearance in connecting rod bore	0.016-0.049
Camshaft	
Number of camshaft bearings	5
Drive	Timing belt
Bearing journal diameter	25.960-25.980
Camshaft bearing radial clearance	0.020-0.070
Camshaft end float	0.080-0.220
Valves	
Valve clearance in valve guide	
- intake valve	0.017-0.064
- exhaust valve	0.017-0.064
Valve clearance-intake valve (at 20°C ± 5°C)	0.11-0.18
Valve clearance-exhaust valve (at 20°C ± 5°C)	0.27-0.34
Cylinder Head	
Maximum distortion (mating face)	0,1

(Continued)

General Specifications

Item	Specification
Mating face height	2.0 +0.12 -0.24
Mating face peak-to-valley height (reference length 2,5 mm at right angles to direction of grooves)	$R_{3Z} = 6.0$
Oil pressure at 800-850 rpm	1.3-2.5
Oil pressure at 4000 rpm	3.7-5.5

a New transaxles are pre-filled with 3.5 liters

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Hose clamps	4	—	35
Intake system	—	—	—
Intake manifold studs	10	—	89
Intake manifold bolts and nuts	18	13	—
Engine lifting eye with coolant hose brackets	18	13	—
Oil lever indicator tube	10	—	89
Throttle body	10	—	89
Heat shield to cylinder head (M6)	10	—	89
Heat shield to cylinder head and exhaust manifold (M8)	16	12	—
Exhaust manifold studs	10	—	89
Exhaust manifold nuts	16	12	—
Catalytic converter to exhaust manifold	41	30	—
Catalytic converter to exhaust	45	33	—
Catalytic converter bracket bolt	25	18	—
Right-hand front axle driveshaft center bearing	27	20	—
Front axle driveshaft bracket to engine	48	35	—
Generator to bracket	25	18	—
Generator bracket to cylinder block	65	48	—
Automatic transaxle flange bolts	48	35	—
Manual transaxle flange bolts	40	30	—
Starter motor to transmission	48	35	—

(Continued)

SPECIFICATIONS (Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Transaxle oil drain plug	27	20	—
Transaxle oil check plug	35	26	—
Automatic transmission fluid cooler lines	23	17	—
Flywheel/drive plate	112	83	—
Clutch pressure plate	29	21	—
Subframe to body	130	96	—
Steering gear to subframe	130	96	—
Radiator bracket to subframe	10	—	89
Air conditioning compressor to bracket	25	18	—
Air conditioning condenser to subframe	11	8	—
Right-hand engine support insulator to transaxle	84	62	—
Right-hand engine support insulator to subframe	48	35	—
Right-hand engine support insulator bracket to transaxle (MTX 75)	84	62	—
Left-hand engine support insulator bracket to transaxle (MTX 75)	84	62	—
Center bolt-left and right-hand support insulator	120	89	—
Rear engine mounting to transaxle	83	61	—
Front engine mounting bracket to engine and engine mounting	83	61	—
Hub nut	290	214	—
Wheel nuts	128	94	—
Suspension strut to body	46	34	—
Lower suspension arm ball joint to wheel knuckle	83	61	—
Tie rod to wheel knuckle	26	19	—
Stabilizer link rod to suspension strut	47	35	—
Power steering pump to bracket	47	35	—
Air conditioning compressor bracket/power steering pump to cylinder block	47	35	—

(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Steering gear heat shield	24	18	—
Steering gear to subframe	130	96	—
VCT oil feed flange to cylinder head	10	—	89
Camshaft position sensor to cylinder head	9	—	80
Cylinder head bolts (Stage 1)	20	15	—
Cylinder head bolts (Stage 2)	40	30	—
Cylinder head bolts (Stage 3)	90 degrees	90 degrees	—
Appearance cover	7	—	62
Camshaft bearing caps	15	11	—
Valve cover (Stage 1)	2	—	18
Valve cover (Stage 2)	7	—	62
Spark plugs	15	11	—
Retaining pin for timing belt tensioner spring	10	—	89
Timing belt tensioner	25	18	—
Intake camshaft timing pulley	68	50	—
Exhaust camshaft timing pulley (Stage 1)	60	44	—
Exhaust camshaft timing pulley (Stage 2)	120	89	—
Exhaust camshaft timing pulley blanking plug	37	27	—
Upper engine front cover	10	—	89
Lower engine front cover	8	—	71
Blanking plug, cylinder head oil channel	15	11	—
EI ignition coil bracket to cylinder head	21	15	—
Electronic power steering pump mounting plate to cylinder head	47	35	—
Thermostat housing	20	15	—
Engine lifting eye to cylinder head	16	12	—
Engine lifting eye to generator bracket	47	35	—
Engine oil drain plug	25	18	—
Oil pressure switch	27	20	—
Blanking plugs, cylinder block oil channels	25	18	—

(Continued)

SPECIFICATIONS (Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Heater pipe bracket to oil pan	10	—	89
Oil pan to lower crankcase	24	18	—
Lower crankcase to cylinder block	30	22	—
Lower crankcase to upper crankcase bolts	22	16	—
Lower crankcase to transmission bolts	40	30	—
A/C bracket bolts	25	18	—
Oil pump	11	8	—
Oil intake pipe to oil pump	10	—	89
Main bearing cap bolts	85	63	—
Connecting rod bearing cap bolts (Stage 1)	35	26	—
Connecting rod bearing cap bolts (Stage 2)	90 degrees	90 degrees	—

(Continued)

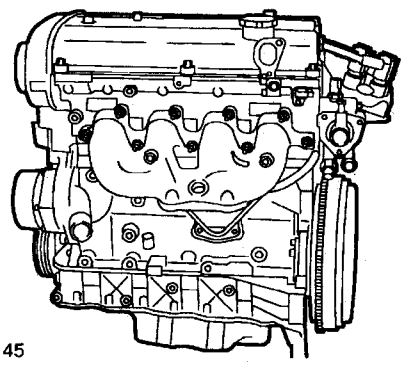
Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Water pump	18	13	—
Crankshaft rear oil seal carrier	30	22	—
Drive belt idler pulley	40	30	—
Crankcase ventilation tube to cylinder block	10	—	89
Crankcase ventilation to cylinder block	10	—	89
Water pump belt pulley	24	18	—
Crankshaft belt pulley	115	85	—
Crankshaft position sensor bracket to cylinder block	21	15	—
Crankshaft position sensor to bracket	8	—	71
Upper idler roller bearing	38	28	—
Lower idler roller bearing	38	28	—

DESCRIPTION AND OPERATION

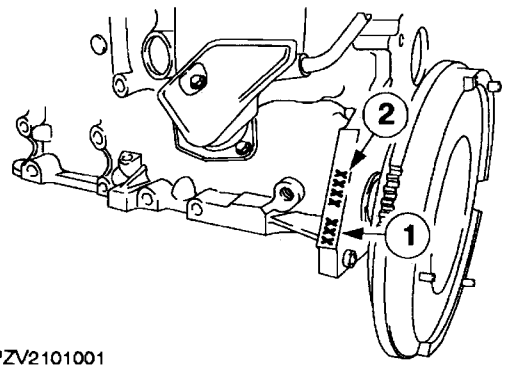
Engine

The name of this engine is 2.0L Zetec-VCT. The suffix VCT stands for variable camshaft timing. The transversely mounted engine is tilted forwards by eight degrees. As a result, a considerable space saving has been made in the engine compartment.



IAV2101145

Location of serial number on cylinder block



PZV2101001

DESCRIPTION AND OPERATION (Continued)

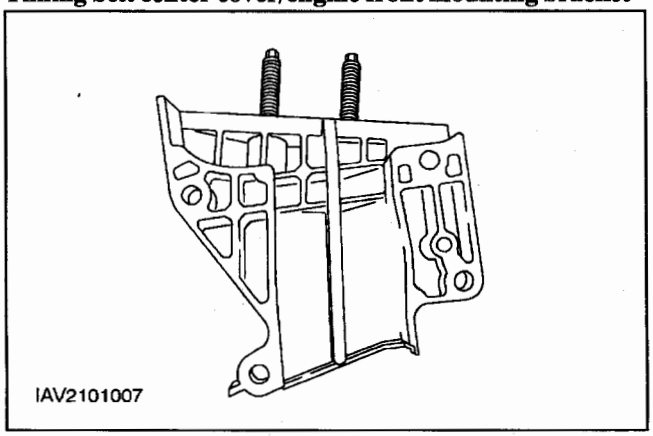
Design of the 2.0L engine

Basic concept

The 2.0L engine is a four cylinder in-line engine with double overhead camshafts and 16 valves. The 16 valve cylinder head improves volumetric efficiency, particularly at high engine speeds.

The cylinder head is made of aluminum alloy and the cylinder block of cast iron.

Timing belt center cover/engine front mounting bracket



The new timing belt cover has a vertical strengthening rib for additional reinforcement. As a result of this, the timing belt center cover (and therefore the front mounting) has to be removed in order to install a new timing belt.

Cylinder head

Combustion chamber

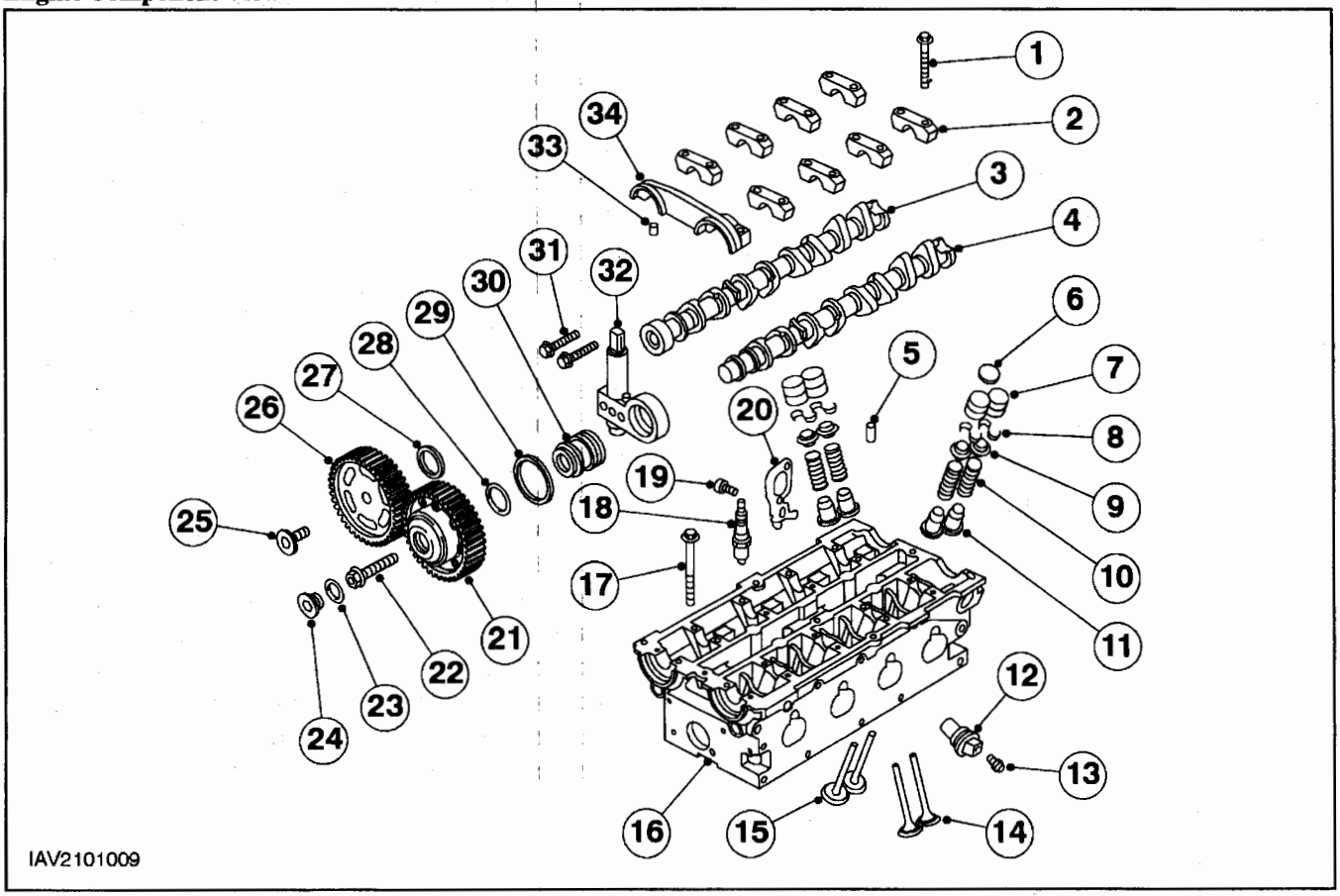
The spark plug is installed in the center of the fuel/air roof-shaped combustion chamber to ignite the mixture in the combustion chamber. The central location of the spark plug causes the flame front to be evenly spread across the combustion chamber, which also reduces the spark knock.

Valve train (vehicles build up to 06/1999)

Both camshafts are driven by a shared timing belt, and operate four valves per cylinder by means of adjustable tappets. One spring on each valve is used to close the valve. The spring on the exhaust valve is marked with a blue paint mark, and the spring on the intake valve with a red one. The adjusting shims in the valve tappets can be changed to correct the valve clearance. These are available in 52 different thicknesses. The shim thickness is stamped on the back of the shim in hundredths of a millimeter (Example: the number 222 means 2.22 mm). Because of space limitations in the cylinder head the camshafts have to be removed before the adjusting shims can be renewed. This means that a high degree of accuracy is required during adjusting to avoid repeated removal and installation of the camshafts. The camshaft cams run concentrically on the valve tappets. At engine speeds of above about 3000 rpm this causes the tappets to rotate, and they in turn transfer the rotation to the valves. This valve rotation is required because it produces an even valve seating and prevents the valves from wearing in a certain position which could cause them to leak.

DESCRIPTION AND OPERATION (Continued)

Engine Component View



Item	Part Number	Description
1	—	Camshaft bearing cap bolt
2	—	Camshaft bearing cap
3	—	Intake camshaft
4	—	Exhaust camshaft
5	—	Siphon valve
6	—	Adjusting shim-valve clearance
7	—	Valve tappets
8	—	Valve collets
9	—	Valve spring retainers
10	—	Valve springs (color coding: exhaust = blue, intake = red)
11	—	Valve stem seals
12	—	Camshaft position (CMP) sensor
13	—	CMP sensor bolt
14	—	Exhaust valves
15	—	Intake valves
16	—	Cylinder head

(Continued)

Item	Part Number	Description
17	—	Cylinder head bolt
18	—	Spark plug
19	—	Engine lifting eye bolt
20	—	Engine lifting eye
21	—	Exhaust camshaft pulley
22	—	Exhaust camshaft pulley bolt
23	—	Blanking plug O-ring seal
24	—	Blanking plug
25	—	Intake camshaft bolt
26	—	Intake camshaft pulley
27	—	Intake camshaft oil seal
28	—	O-ring seal
29	—	Exhaust camshaft oil seal
30	—	Oil feed ring
31	—	Oil feed flange bolts
32	—	Oil feed flange
33	—	Guide sleeve-front camshaft bearing cap
34	—	Fifth camshaft bearing cap

DESCRIPTION AND OPERATION (Continued)

Timing belt tensioner

⚠ CAUTION: Only tension the timing belt counterclockwise.

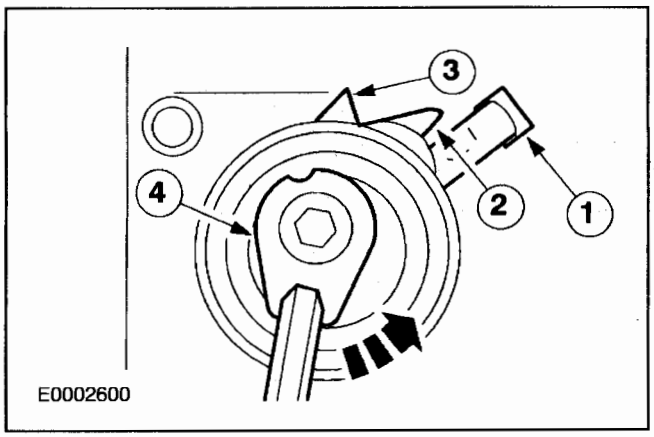
An automatic timing belt tensioner ensures the correct timing belt tension. When fitting a new timing belt move the tensioner into its basic position (pointer (3) and mark (2) line up). This basic adjustment is carried out by means of a cam (4). An additional spring-loaded cam provides correct belt tension during operation. The belt tensioner can operate 30 degrees either side of its central position.

NOTE: The timing belt must not be re-tensioned in case the operating range of the tensioner is exceeded. The basic adjustment of the belt tensioner only applies to new timing belts. Re-tensioning the belt can cause it to tear or flap.

⚠ CAUTION: Always install a new timing belt after slackening/removing it.

The basic adjustment of the belt tensioner can no longer be controlled after the aligning tools and adjusting pin have been taken out (the spring forces from the valve train exert pressure on the timing belt and alter the position of the belt tensioner).

Automatic belt tensioner



Item	Part Number	Description
1	—	Lug hooked into sheet metal cover
2	—	Mark
3	—	Pointer
4	—	Basic adjustment cam

(Continued)

Variable Camshaft Timing (VCT)

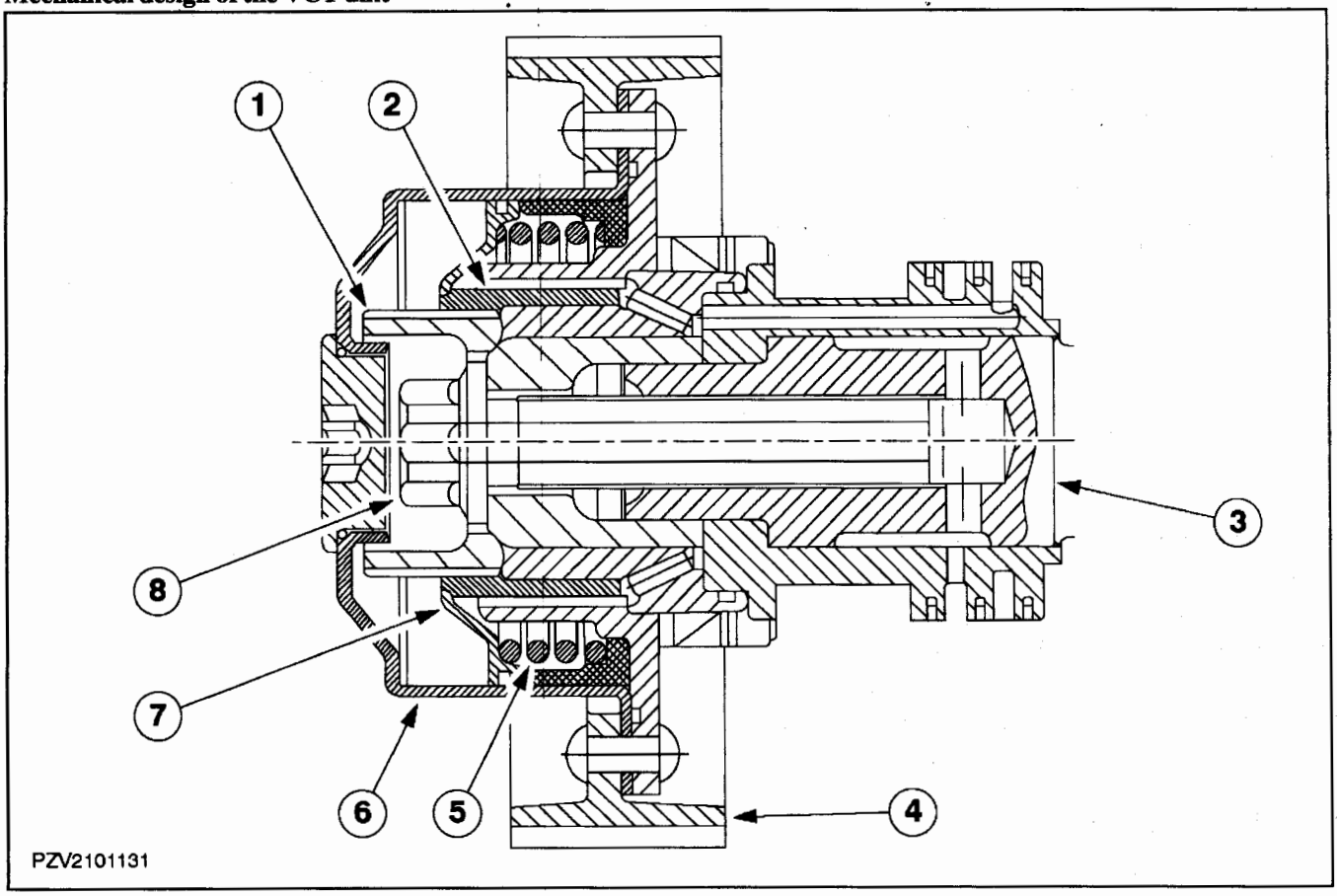
General

The use of the new variable camshaft timing optimizes the combustion procedure by improving gas exchange in the cylinders. As a result of this the exhaust emissions regulations can be met without the use of a pulse air system or an exhaust gas recirculation (EGR)system.

DESCRIPTION AND OPERATION (Continued)

Mechanical operation

Mechanical design of the VCT unit



Item	Part Number	Description
1	—	Exhaust camshaft pulley
2	—	Return spring
3	—	Hydraulic cylinder
4	—	Hydraulic piston (shown at maximum extension)

Item	Part Number	Description
5	—	Hollow bolt
6	—	Inner gear bush
7	—	Piston inner seal guide
8	—	Exhaust camshaft

(Continued)

DESCRIPTION AND OPERATION (Continued)

The mechanical principles behind variable camshaft timing (VCT) are relatively simple. The valve timing for opening and closing of the exhaust valves is influenced by a hydraulic cylinder (3) which is riveted to the pulley (1). This cylinder connects the pulley (1) with the camshaft (8) through a hydraulic piston (4) and inner gear bush (6). The hydraulic piston is guided along its axis by the helical gears (6,7) on the exhaust camshaft and the hydraulic cylinder. The helical gear transfers the up and down motion of the hydraulic piston into a rotary motion. As the pulley is fixed in place by the timing belt, the position of the exhaust camshaft is rotated in relation to the pulley, and the exhaust valve timing is therefore adjusted. The hydraulic piston is moved by supplying pressurized engine oil from the engine oil circuit to both pressure chambers of the hydraulic cylinder. The engine management system controls a solenoid valve which in turn supplies the pressurized oil to the pressure chambers.

The return spring (3) ensures that the hydraulic piston goes returns towards its original position when the engine is switched off.

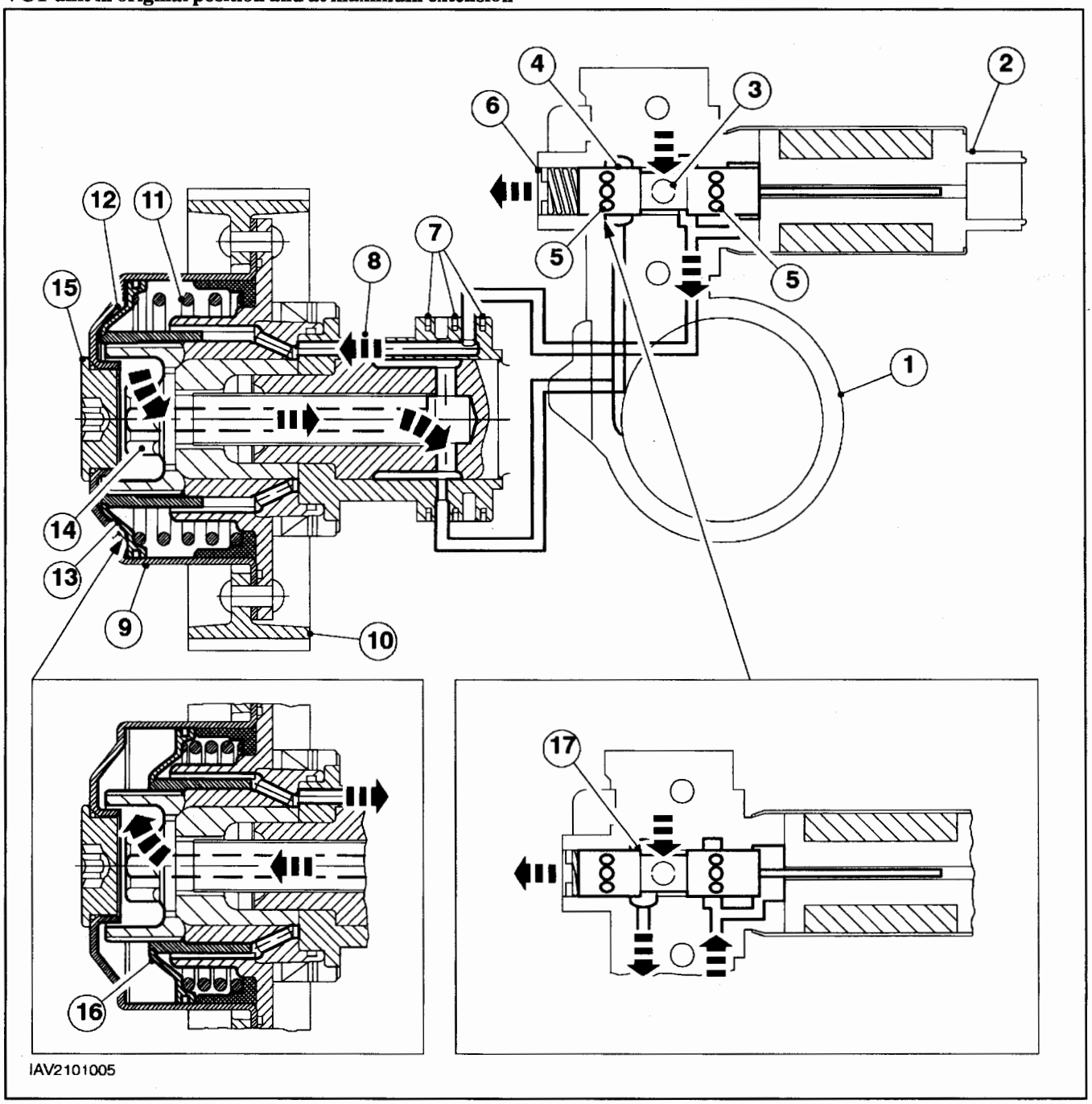
DESCRIPTION AND OPERATION (Continued)

Emergency mode:

- If oil pressure is to low, the VCT will be regulated to the "END-STOP" position.
- In cause of an electrical error, the solenoid will regulate to the "END-STOP" position.

Hydraulic operation

VCT unit in original position and at maximum extension



DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
1	—	Oil feed flange
2	—	Solenoid valve
3	—	Engine oil feed from engine oil circuit to the oil feed flange
4	—	Control piston in original position (rear pressure chamber is filled)
5	—	Control piston return bores (non-pressurized)
6	—	Control piston return spring and return hole to cylinder head (non-pressurized)
7	—	Oil seals-oil feed channels
8	—	Oil feed ring and camshaft bearing journal
9	—	Hydraulic cylinder
10	—	Exhaust camshaft pulley
11	—	Rear pressure chamber and return spring
12	—	Front pressure chamber
13	—	Hydraulic piston in original position
14	—	Hollow bolt (with oil channel) for securing the camshaft pulley to the camshaft.
15	—	Blanking plug and O-ring seal
16	—	Hydraulic piston at maximum extension
17	—	Control piston in end position (front pressure chamber is filled)

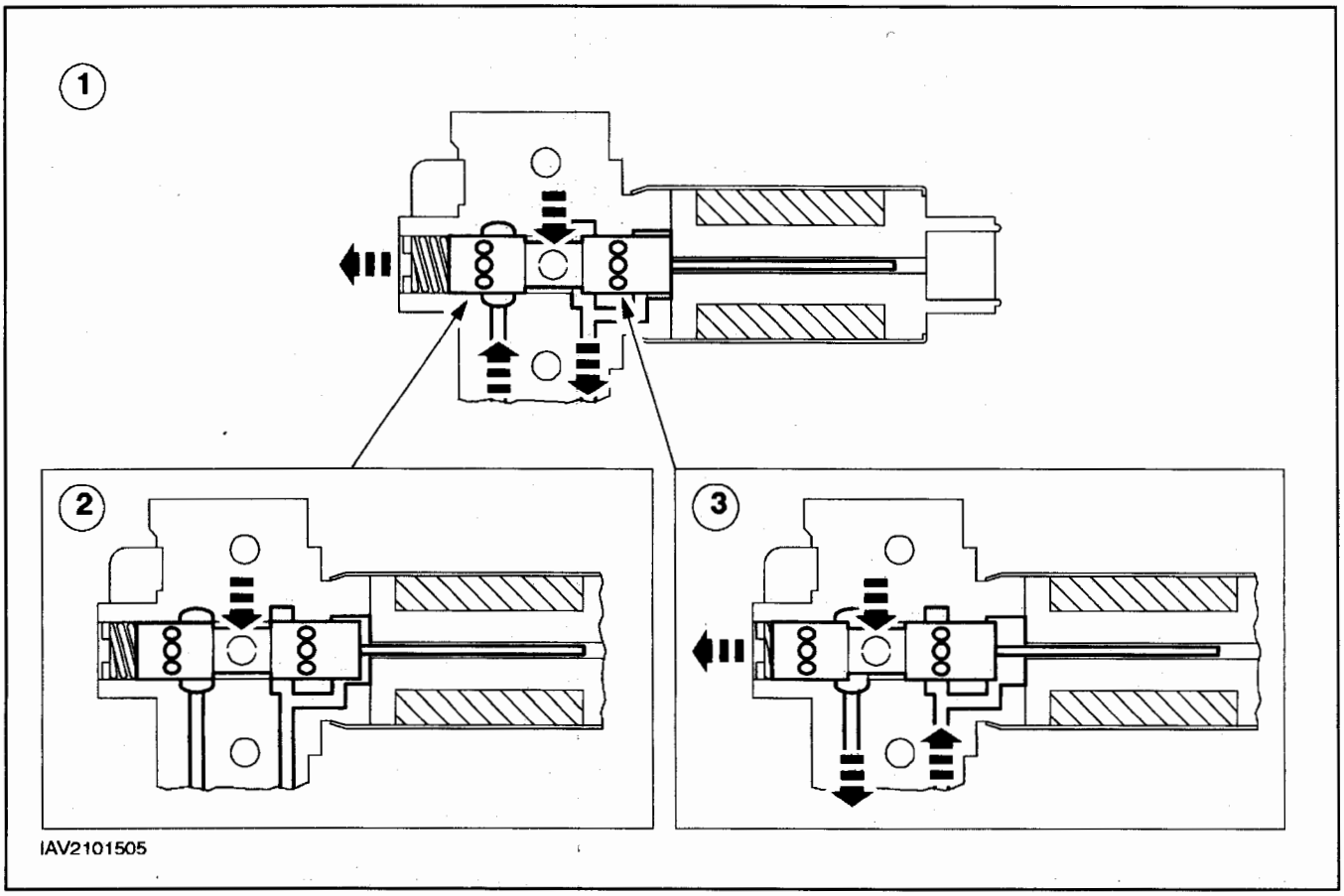
(Continued)

The VCT unit is supplied with engine oil (3) from the engine oil circuit and controlled by the engine management system. The engine management system regulates the solenoid valve (2) through a pulse width modulation (PWM) from 0-100%.

With rising current (0-1A) the displacement of the control piston (4) in relation to the return spring (6) increases, and vice versa. As a result of this motion the control edges and return bores (5) of the control piston open and close the oil flow to and from the two pressure chambers (11,12) of the hydraulic cylinder (9).

When the engine is switched off the return spring returns the control piston back to its original position. At the same time the return bores in the front pressure chamber (12) are opened, which allows the return spring (11) to slide back the piston in the hydraulic cylinder towards its original position.

DESCRIPTION AND OPERATION (Continued)



Item	Part Number	Description
1	—	Original position (0 Ampere) - return bores in the front pressure chamber and feed line to rear pressure chamber are open (hydraulic piston moves to or remains in original position - exhaust valves open and close early).
2	—	Intermediate position (0.6 Ampere) - all return bores and feed lines are closed (hydraulic piston is held in the position it was previously moved to).
3	—	End position (1 Ampere) - return bores in the rear pressure chamber and feed line to front pressure chamber are open (hydraulic piston moves to or remains at maximum extension - valves open and close late).

(Continued)

The hydraulic unit can be infinitely adjusted in the hydraulic cylinder. However, the control piston can only move into three positions.

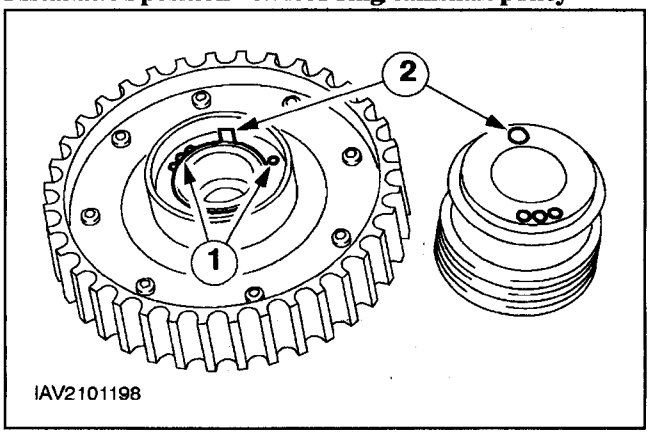
DESCRIPTION AND OPERATION (Continued)

Working on the VCT unit

When the engine is switched off the VCT unit is non-pressurized and therefore has no function. However, the hydraulic piston usually only returns right back to the original position if the VCT unit has been removed or the engine management system caused this to happen just before the engine was switched off. A complete return to the original position is prevented by friction on the cams and the spring forces due to the valve springs.

The VCT unit must be in its original position before the valve timing can be adjusted. Turn the exhaust camshaft in the normal direction of engine rotation to bring the VCT unit to its original position. When doing this the crankshaft must not be turned.

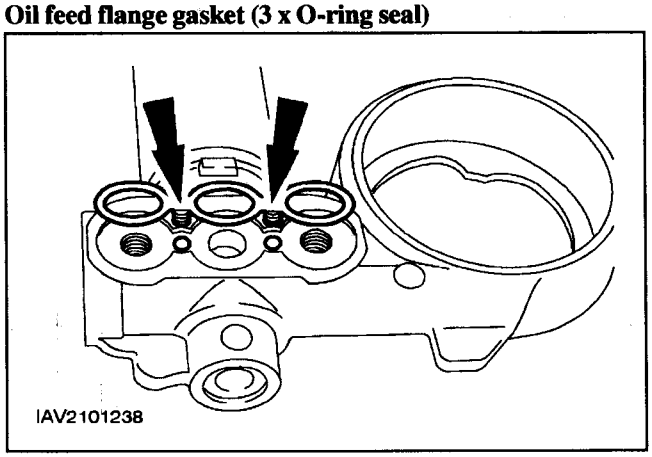
Installation position - oil feed ring/camshaft pulley



The triple oil bore of the oil feed ring and the camshaft pulley form a labyrinth on three levels. The oil bores of the oil feed ring and the two triple oil bores (1) on the hydraulic cylinder (one visible) are arranged at 120 degrees to each other. This prevents the hydraulic cylinder from running dry when the engine is switched off. This means that the VCT unit is ready to work shortly after starting the engine.

The lug (2) must be centered between the three oil bores (1) and the mark. If this is not the case install a new exhaust camshaft timing pulley and a new hydraulic cylinder. The lug (2) must locate in the bore when sliding the timing pulley onto the oil feed ring.

Oil feed flange gasket (3 x O-ring seal)



NOTE: Use a thumb to press the positioning pins on the 3 x O-ring seals into the oil feed flange in the positions shown.

A new oil feed flange gasket needs to be installed every time the oil feed flange is disassembled. Correct seating of the gasket make sure that the oil feed flange seals correctly and lies correctly on the sealing face (incorrect seating can cause tilting).

Components Attached to Cylinder Head

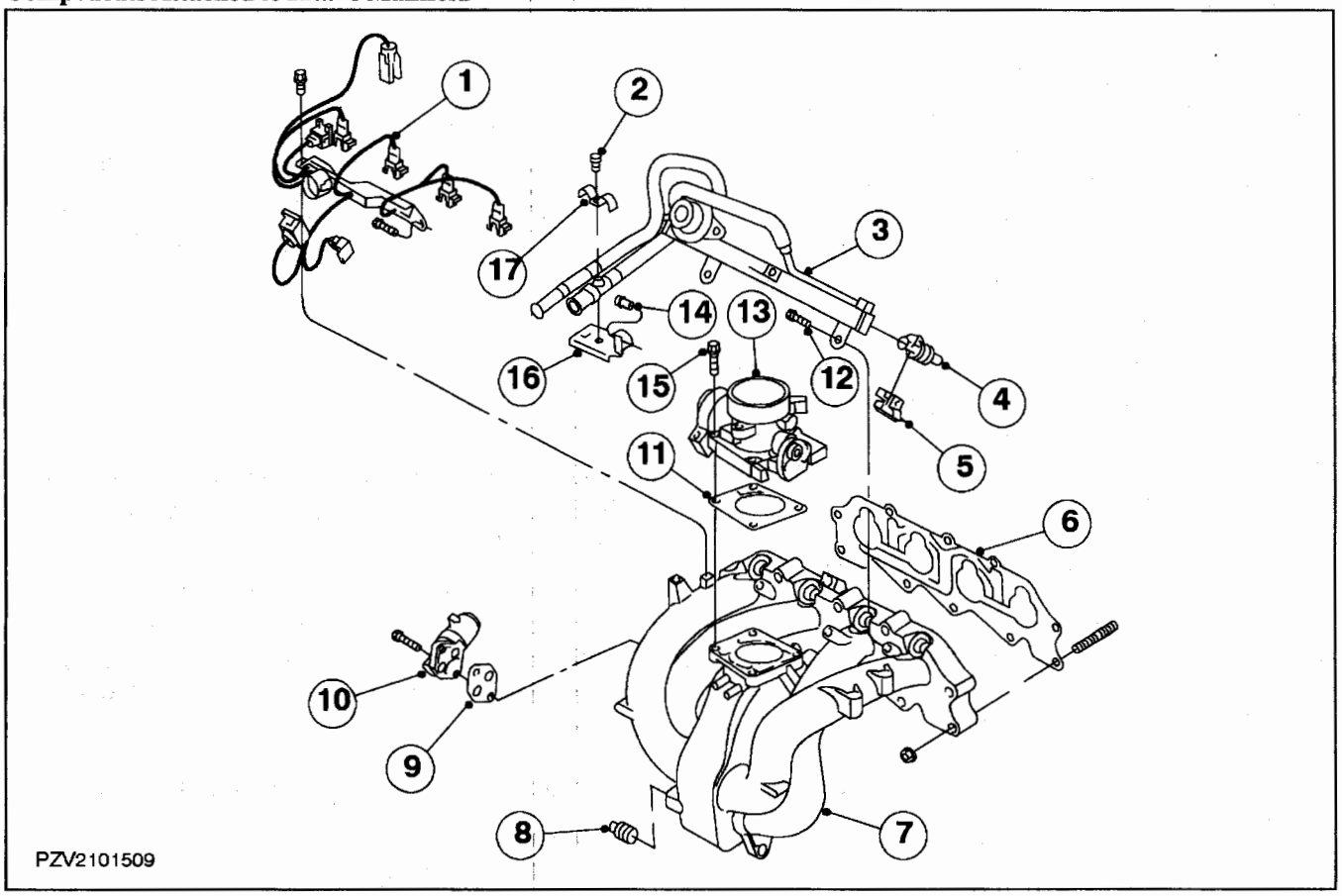
Intake manifold

The 2.0L engine is equipped with a glass fiber reinforced plastic intake manifold. The intake manifold ports are designed so that the intake paths are the same length for all the cylinders.

- This gives the following advantages:
  - — reduced heat transfer to the injectors, thereby avoiding vapor locks
  - — lighter weight
  - — reduction of fuel deposits on the intake pipe walls during cold starts
  - — less heating of the intake air when the engine is hot.

DESCRIPTION AND OPERATION (Continued)

Components Attached to Intake Manifold



Item	Part Number	Description
1	—	Injector connectors
2	—	Bolt of fuel line clamp
3	—	Fuel rail
4	—	Injector
5	—	Injector retaining ring
6	—	Intake manifold gasket
7	—	Intake manifold
8	—	Quick-release coupling of brake servo vacuum pipe

Item	Part Number	Description
9	—	Idle speed control valve gasket
10	—	Idle speed control (ISC) valve
11	—	Throttle plate gasket
12	—	Fuel rail bolt
13	—	Throttle body
14	—	Fuel line bracket bolt
15	—	Throttle body bolt
16	—	Fuel line bracket
17	—	Fuel lines clamp

(Continued)

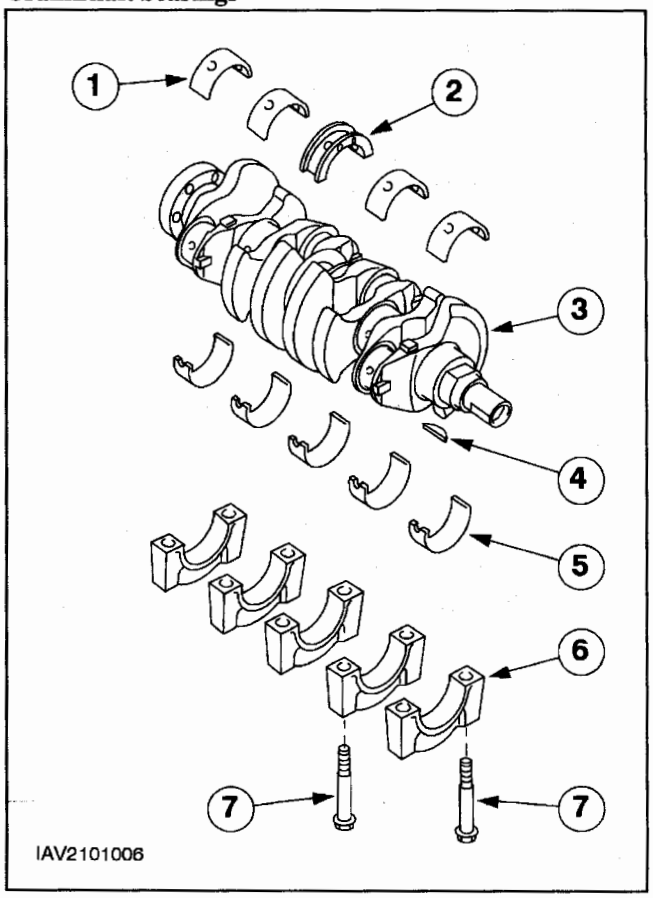
Cylinder Block

Crankshaft

The crankshaft runs on five bearings and has a counterweight for each cylinder. The central main bearing has two bearing half shells which guide the crankshaft along its axis as well as adjusting the end float.

DESCRIPTION AND OPERATION (Continued)

Crankshaft bearings



Item	Part Number	Description
1	—	Cylinder block main bearing shell
2	—	Main bearing shell with thrust half washers
3	—	Crankshaft
4	—	Woodruff key - crankshaft timing pulley
5	—	Main bearing shell bearing cap
6	—	Main pedestal
7	—	Main bearing cap bolt

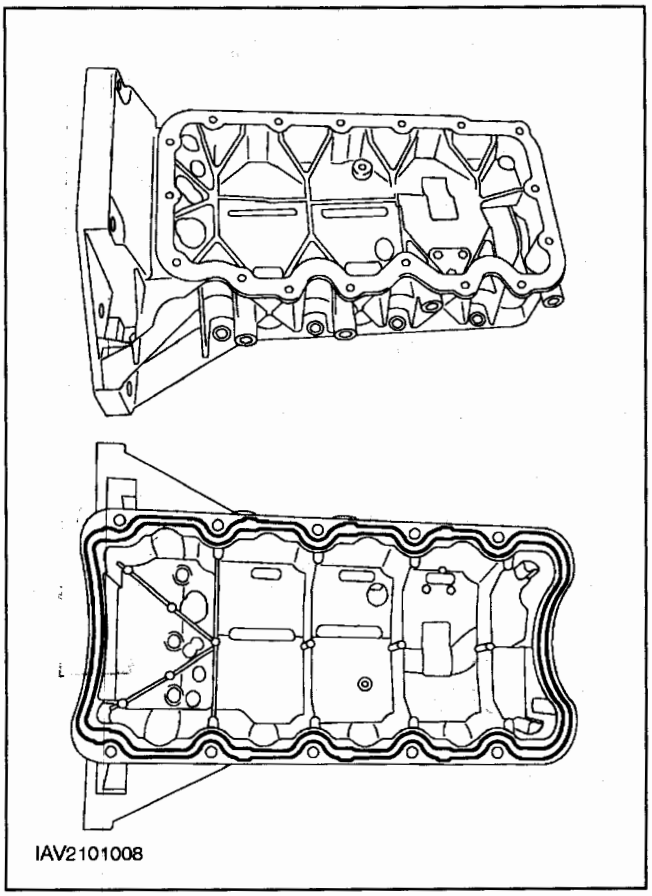
Connecting rod bearings

The connecting rods are numbered 1 to 4, starting at the timing connecting rod. It is almost impossible to mix up the big-end bearing caps and connecting rods, because they are forged as a unit in production and then broken apart. The join between each connecting rod bearing cap and connecting rod is therefore unique.

Lower crankcase and oil pan

Lower crankcase

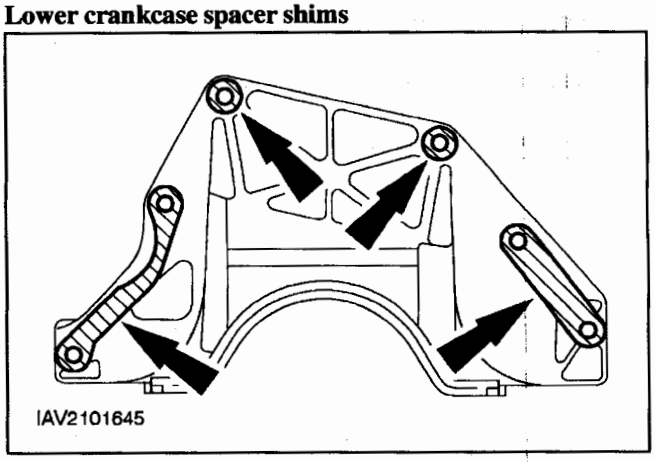
View of lower crankcase



The purpose of the lower crankcase is to reduce engine vibrations. This further reduces the level of noise inside the vehicle. There is a rubber gasket between the lower crankcase and the cylinder block.

DESCRIPTION AND OPERATION (Continued)

Lower crankcase spacer shims



Lower crankcase spacer shims are used to even out any excessively large gaps between the transaxle and the lower crankcase (see Specifications).

Oil pan

The engine is closed off at the bottom with a pressed steel oil pan which is directly attached to the lower crankcase. It is sealed with a 3 mm wide bead of sealer.

Engine Management

EEC V module

The EEC V module manages the 2.0L engine. The module requires a large amount of information about the current operating conditions of the engine and, where appropriate, the automatic transaxle (CD4E). The EEC V module obtains this information by means of sensors.

- The EEC V module controls:
  - — the variable camshaft timing (VCT) unit
  - — the fully electronic ignition (EI) system
  - — the sequential multiport fuel injection (SFI) system
  - — the air conditioning (A/C) system together with the cooling system
  - — the transaxle control for the CD4E automatic transaxle.

DIAGNOSIS AND TESTING

Engine

Refer to Section 303-00.

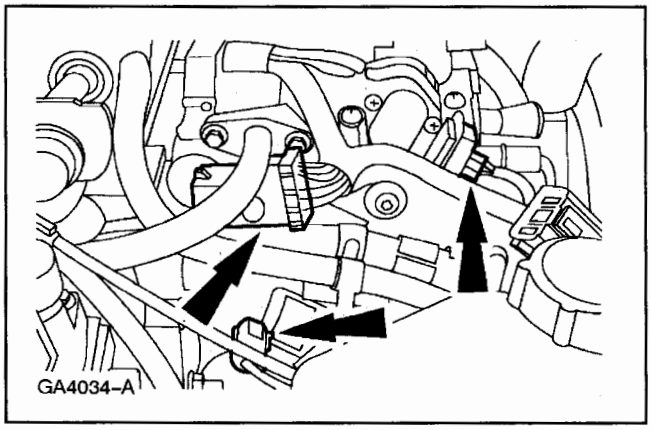
IN-VEHICLE REPAIR

Intake Manifold

Removal

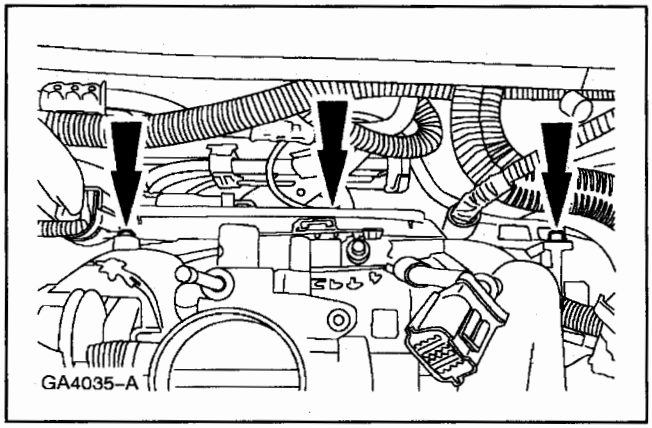
1. Remove the air cleaner (ACL) outlet tube. For additional information, refer to Section 303-12A.

IN-VEHICLE REPAIR (Continued)

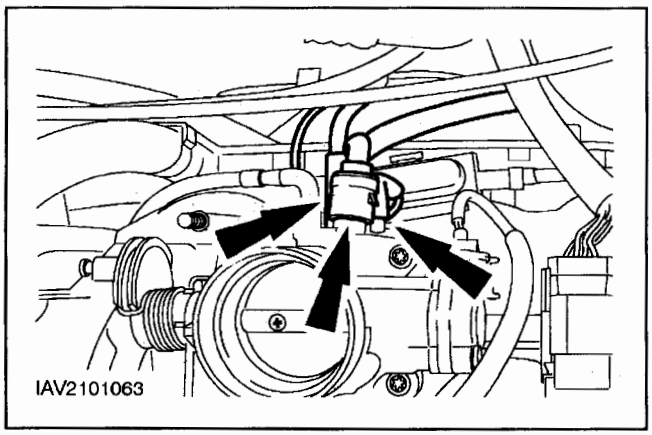


2. Disconnect the electrical connectors.
   - Throttle position (TP) sensor.
   - Idle air control (IAC).
   - Engine control sensor wiring.

3. Remove the fuel supply manifold. For additional information, refer to Section 303-04A.

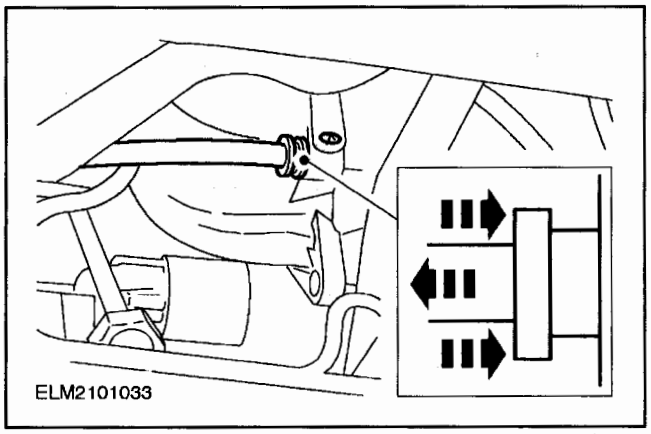


4. Detach the engine wiring harness and position to one side.



5. Disconnect the vacuum supply hoses from the intake manifold by squeezing the tabs, twisting the hoses and pulling away from intake manifold.

IN-VEHICLE REPAIR (Continued)

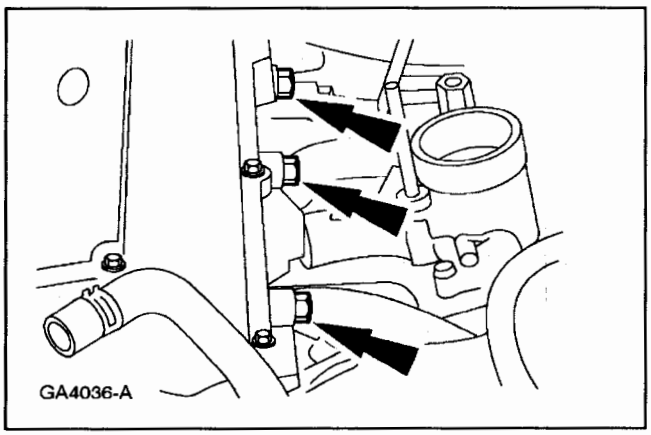


6. Disconnect the brake booster vacuum line from the intake manifold.
   - Disconnect the quick-release coupling and pull out the line.

7. Remove the fuel charging wiring. For additional information, refer to Section 303-04A.

8. Remove the accessory drive belt. For additional information, refer to Section 303-05.

9. Remove the generator bolts. Position generator to one side. For additional information, refer to Section 414-02.



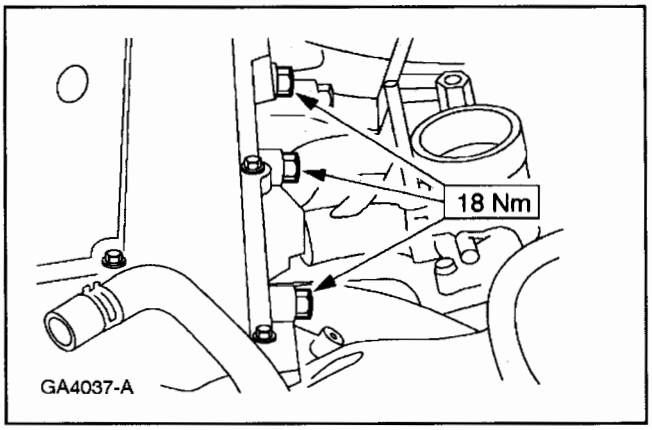
10. Remove the intake manifold.
    - Remove the seven bolts and two nuts.

11. Remove the manifold gasket. Discard the gasket.

Installation

1. Install a new intake manifold gasket.

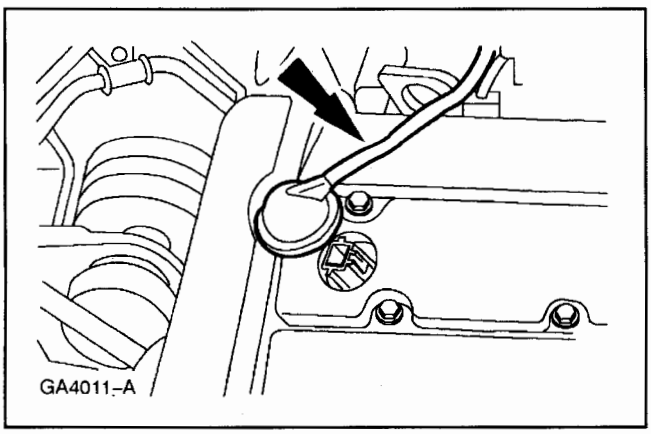
IN-VEHICLE REPAIR (Continued)



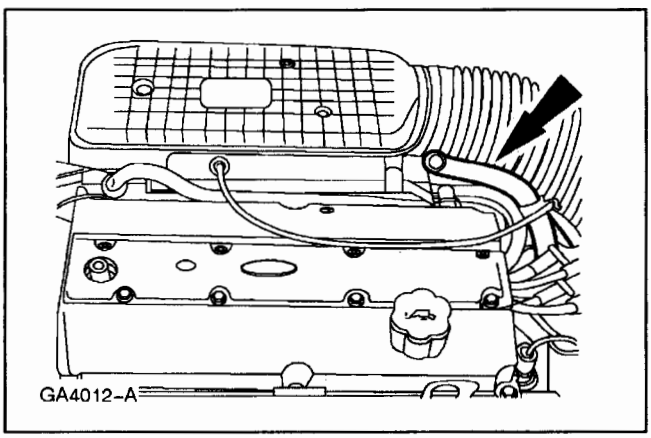
2. To install, reverse removal procedure.

Valve Cover

Removal

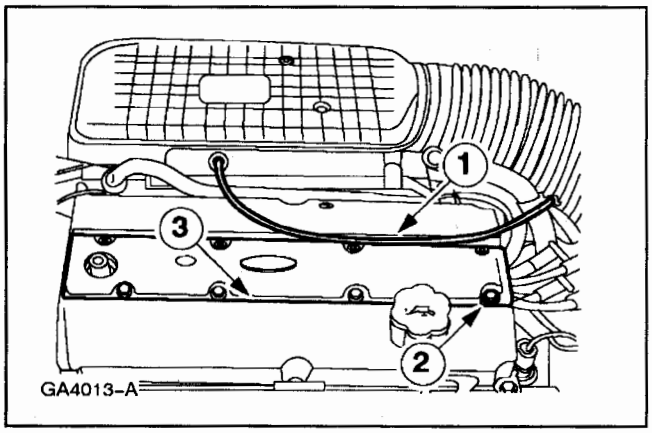


1. Disconnect the oil feed sensor electrical connector.

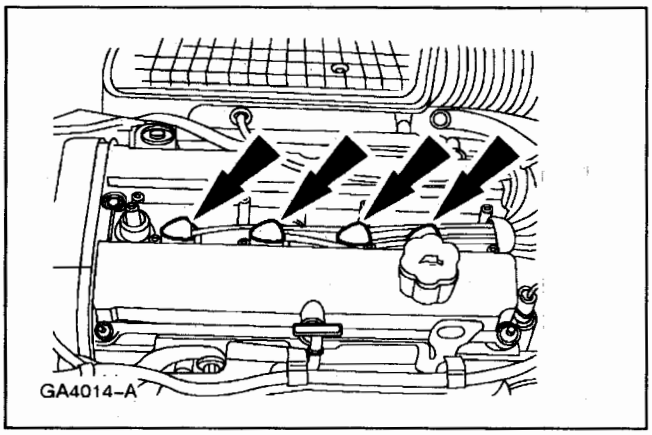


2. Disconnect the crankcase ventilation tube.

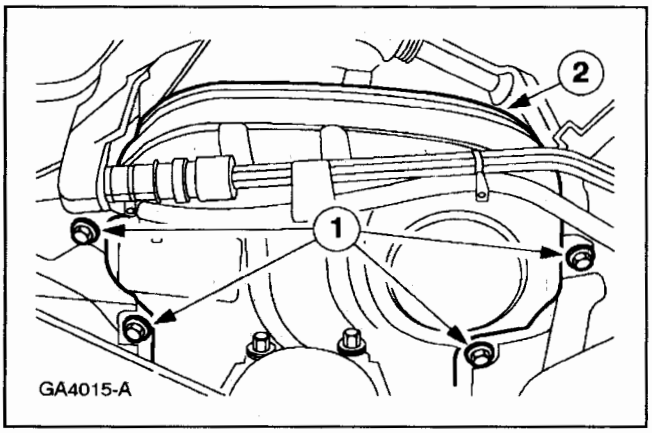
IN-VEHICLE REPAIR (Continued)



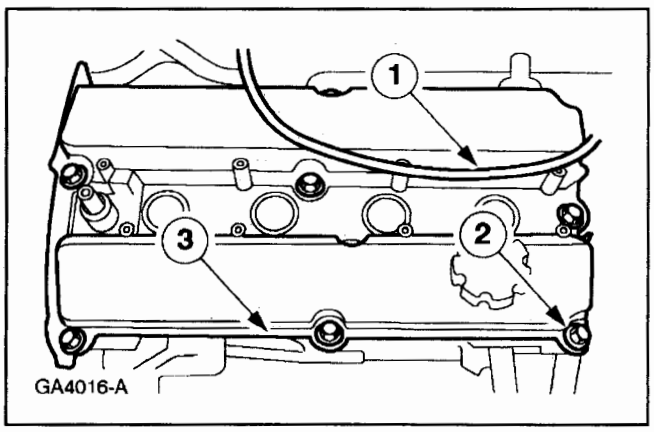
3. Remove the appearance cover.
   1 Position the throttle cable out of the way, and the speed control cable (if equipped).
   2 Remove the eight bolts.
   3 Remove the appearance cover.



4. Remove the spark plug wires.



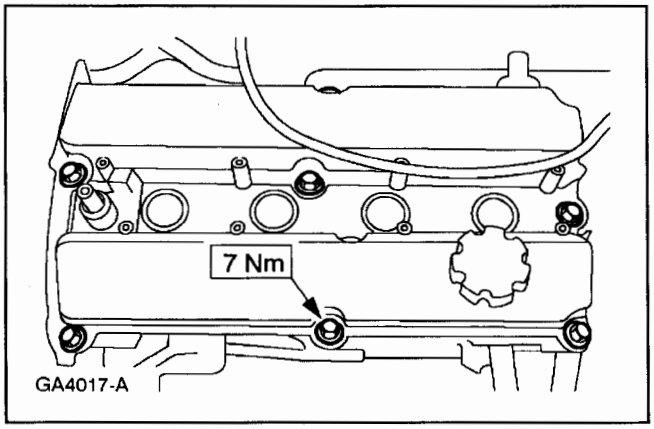
5. Detach the upper part of the engine front cover out of the way.
   1 Remove the four bolts.
   2 Position the front cover to one side.

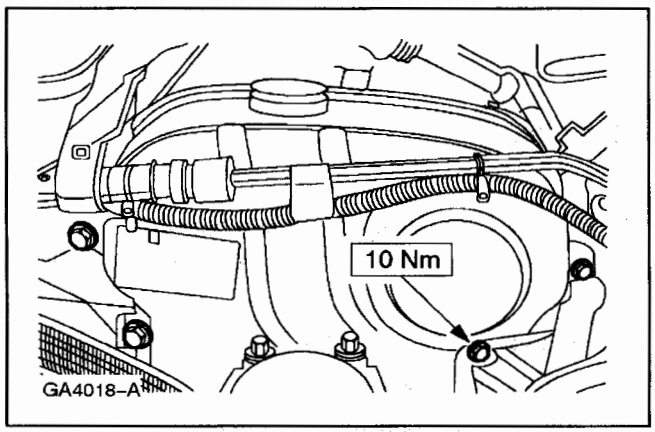


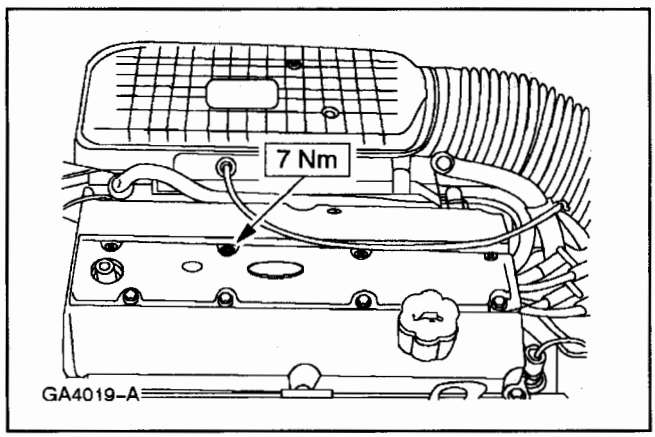
6. Remove the valve cover.
   1 Position the throttle cable to one side, and the speed control cable (if equipped).
   2 Remove the nine bolts.
   3 Remove the valve cover.

IN-VEHICLE REPAIR (Continued)

Installation





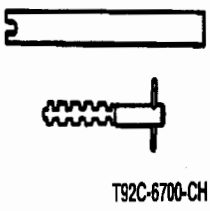
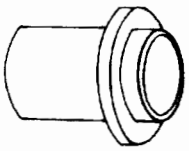


1. To install, reverse the removal procedure.

IN-VEHICLE REPAIR (Continued)

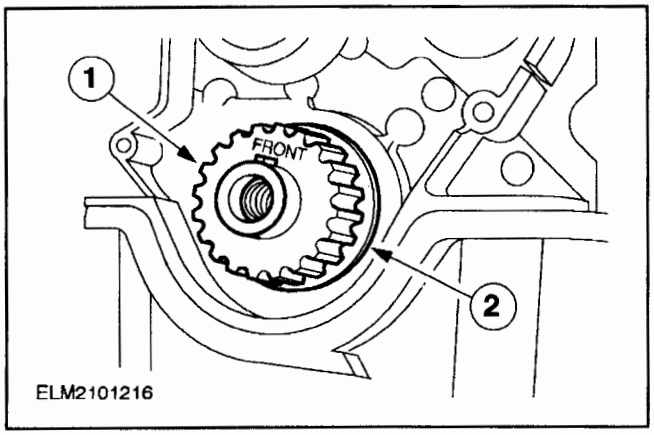
Crankshaft Front Oil Seal

Special Tool(s)

 T92C-6700-CH	Remover, Oil Seal, Crankshaft 303-409 (T92C-6700-CH)
 ST1504-A	Installer, Oil Seal, Timing Cover 308-164 (T81P-6700-A)

Removal

1. Remove the timing belt. For additional information, refer to Timing Belt in this section.

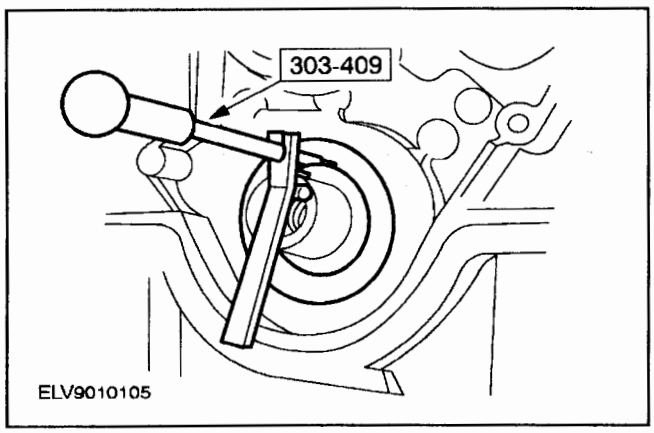


2. **NOTE:** FRONT marking and position of the timing belt thrust washer.

   Remove the crankshaft timing pulley.

   1 Remove the crankshaft timing pulley.

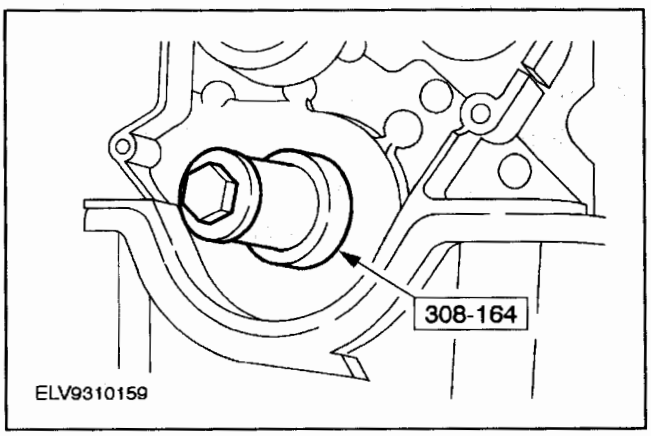
   2 Remove the timing belt thrust washer.



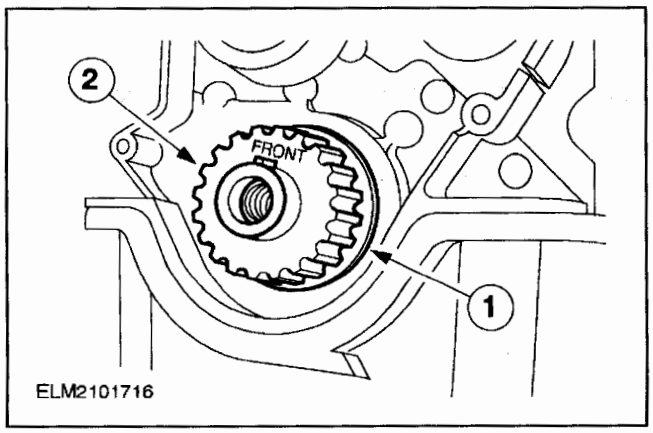
3. Using the special tool, remove the crankshaft front oil seal.

IN-VEHICLE REPAIR (Continued)

Installation



1. Using the special tool, install the crankshaft front oil seal.



2. **NOTE:** FRONT marking and position of the timing belt thrust washer.

   Install the crankshaft timing pulley.

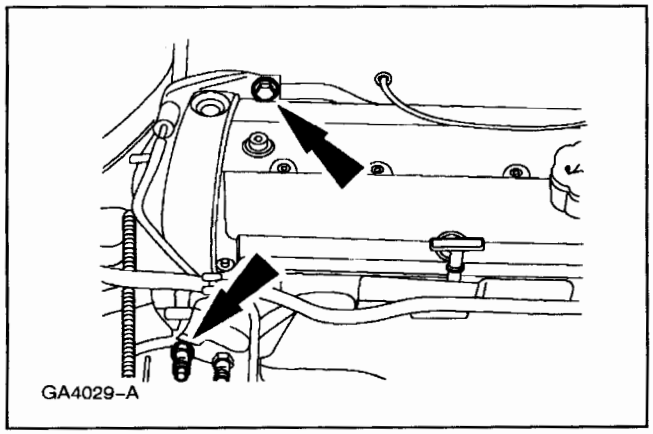
   1 Install the timing belt thrust washer.

   2 Install the crankshaft timing pulley.

3. Install the timing belt. For additional information, refer to Timing Belt in this section.

Timing Belt Cover

Removal

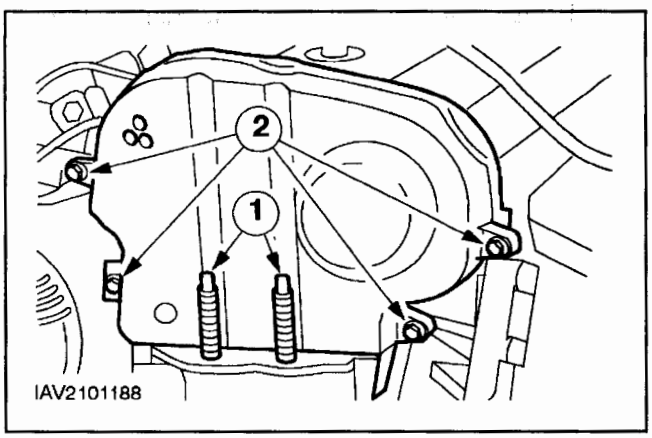


1. Disconnect the battery ground cable.

2. Remove the bolts and position the power steering line to one side.

IN-VEHICLE REPAIR (Continued)

3. Remove the engine front support insulator, For additional information, refer to Engine Support Insulators.

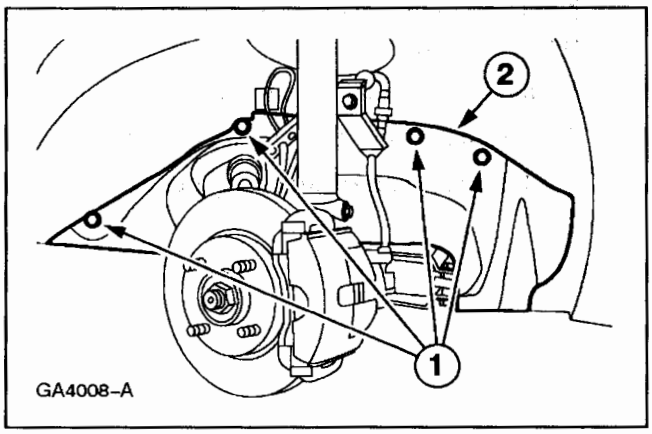


4. **NOTE:** Use a Torx E10.

   Remove the upper part of the engine front cover.

   1 Remove the studs.

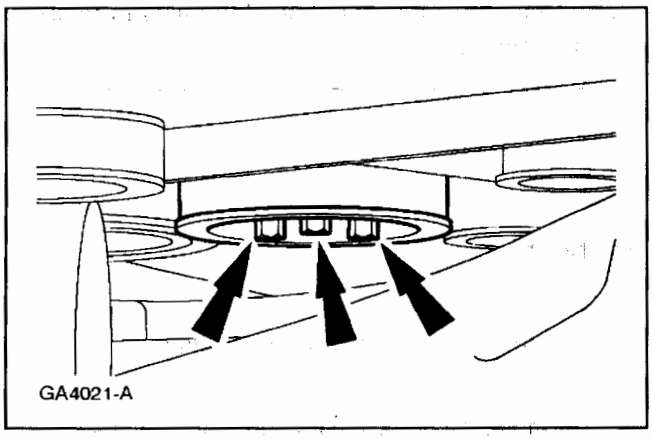
   2 Remove the bolts and the cover.



5. Remove the fender splash shields (wheel shown removed).

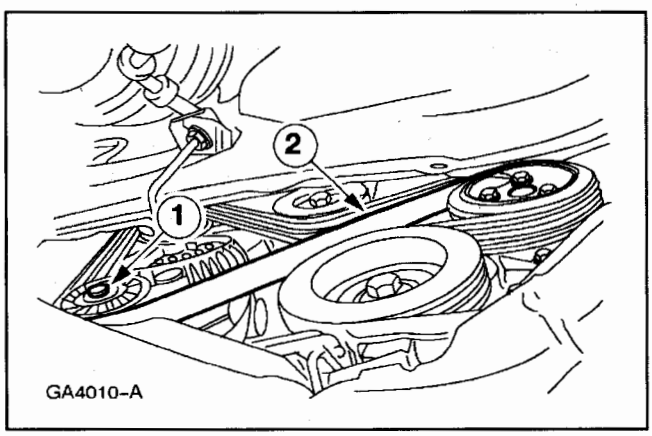
   1 Remove the bolts.

   2 Remove the splash shields.

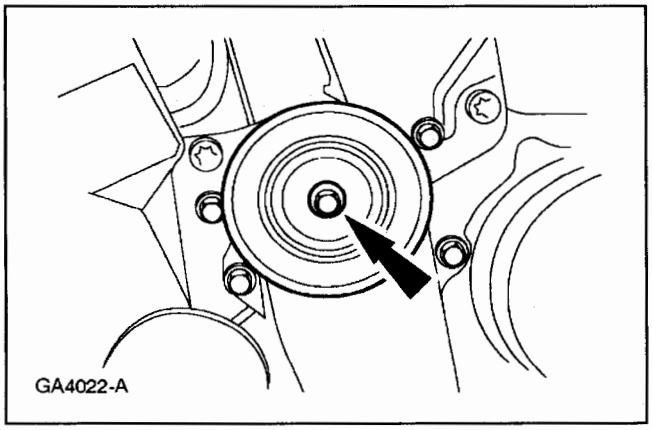


6. Loosen but do not remove the water pump pulley bolts.

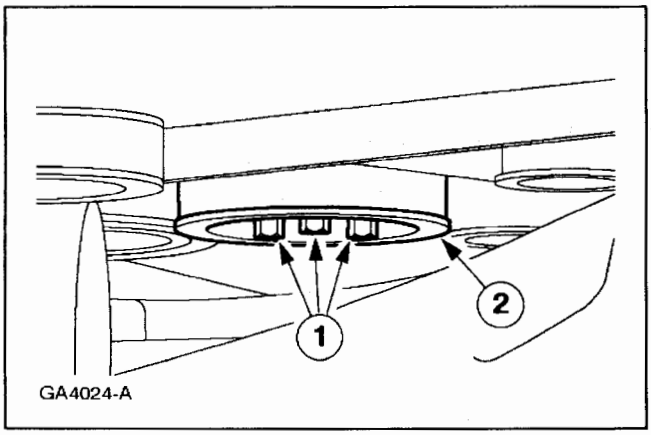
IN-VEHICLE REPAIR (Continued)



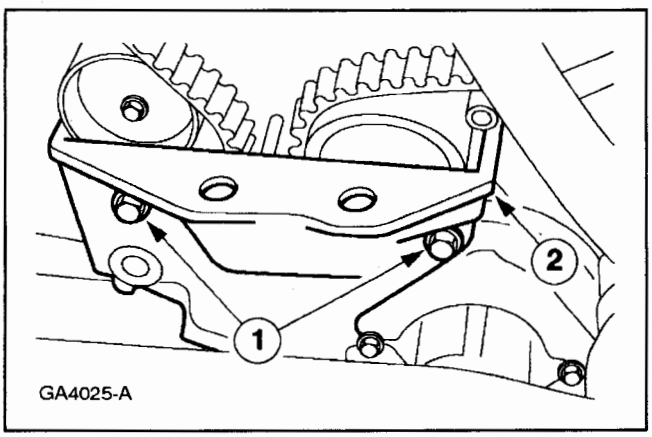
7. Remove the accessory drive belt.
   1 Turn the belt tensioner clockwise.
   2 Remove the accessory drive belt.



8. Remove the idler pulley.

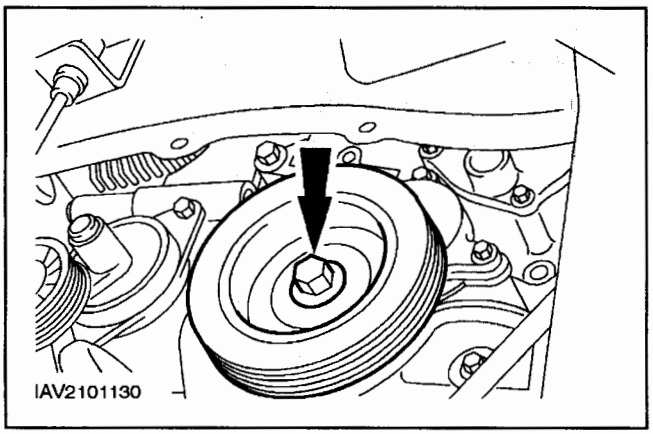


9. Remove the water pump pulley.
   1 Remove the bolts.
   2 Remove the water pump pulley.

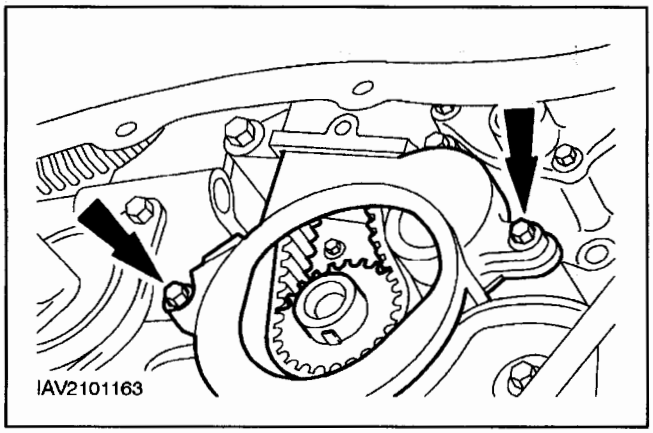


10. Remove the center part of the engine front cover.
    1 Remove the bolts.
    2 Remove the cover.

IN-VEHICLE REPAIR (Continued)

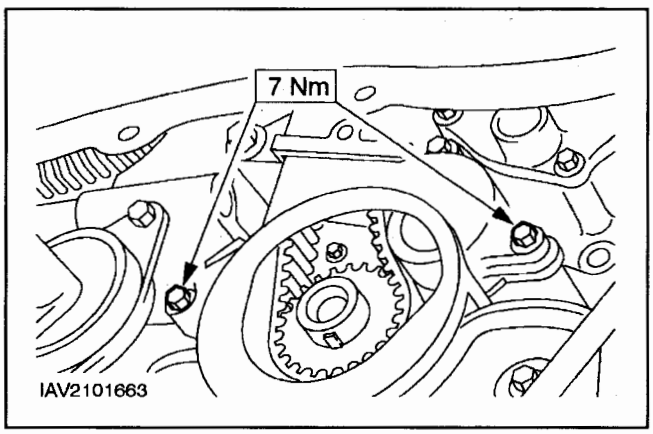


11. Remove the crankshaft pulley.

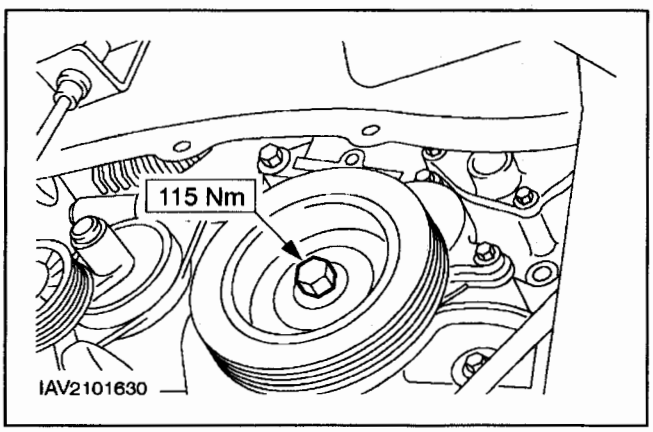


12. Remove the lower part of the engine front cover.

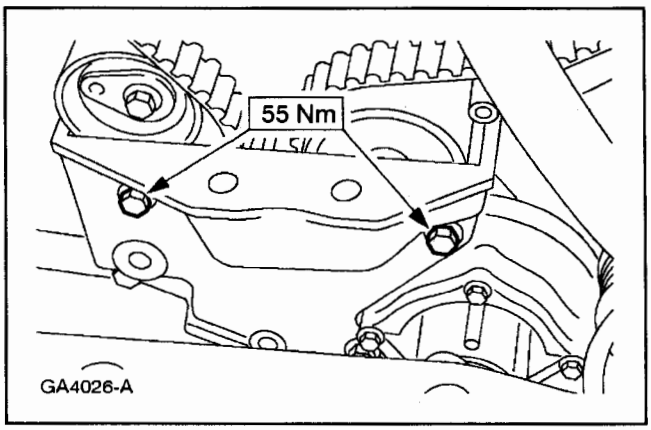
Installation

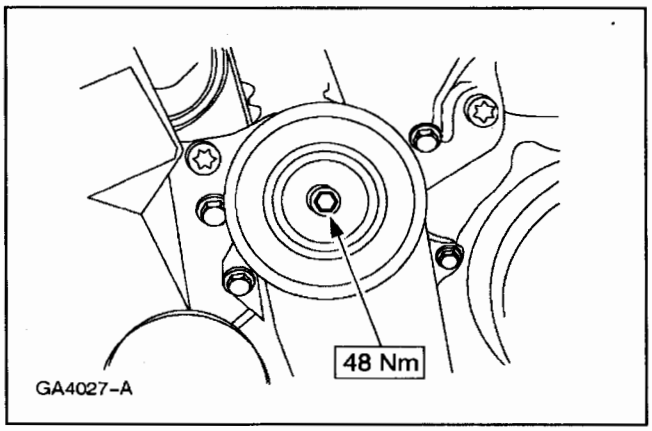


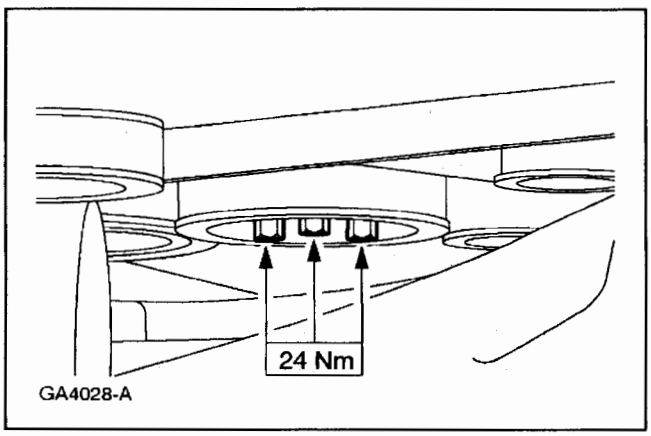
1. To install, reverse the removal procedure.



IN-VEHICLE REPAIR (Continued)



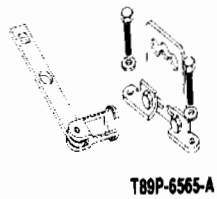
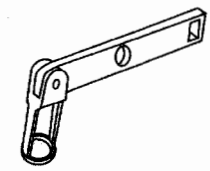


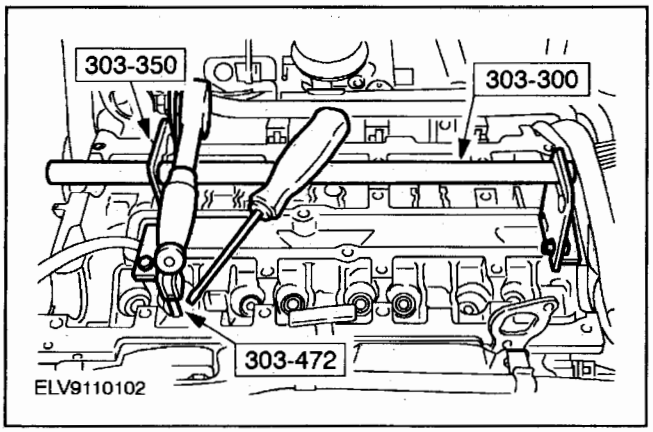


IN-VEHICLE REPAIR (Continued)

Valve Springs

Special Tool(s)

 T89P-6565-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 T87C-6565-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)



Removal

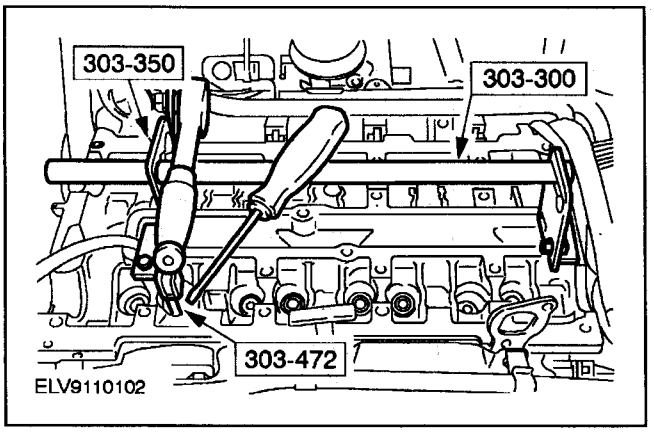
1. Remove the valve tappets. For additional information, refer to Valve Tappets in this section.

2. **⚠ WARNING: Always wear protective goggles when working with compressed air. This can prevent injury. Failure to follow these instructions may result in personal injury.**

   Using special tools, remove the valve springs.

   - Apply compressed air to the cylinders.
   - Compress the valve springs and remove the valve collets.
   - Remove the valve spring retainers and the valve springs and place them in order to one side. To remove the collets use some grease and a small screw driver.

IN-VEHICLE REPAIR (Continued)



Installation

1. **NOTE:** Check that there is no dirt or particles within the valve stem grooves. Check the seating of the valve collets.

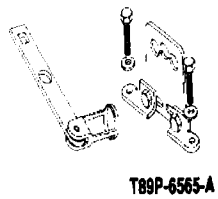
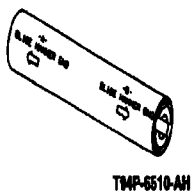
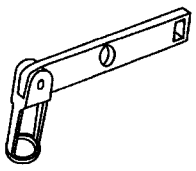
   Using special tools install the valve springs.

   - Insert the valve springs and the valve spring retainers.
   - Compress the valve springs and install the valve collets.
   - Disconnect and remove the air supply.

2. Install the valve tappets. For additional information, Valve Tappets in this section.

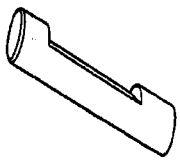
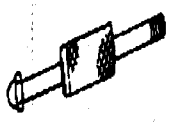
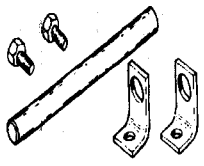
Valve Seals

Special Tool(s)

 T89P-6565-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 T94P-6510-AH	Remover, Oil Seal, Valve Stem 303-468 (T94P-6510-AH)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)

(Continued)

Special Tool(s)

 T94P-6510-CH	Installer, Oil Seal, Valve Stem 303-470 (T94P-6510-CH)
 T59L-100-B	Impact Slide Hammer 307-005 (T59L-100-B)
 T87C-6565-A	Compressor, Valve Spring 303-300 (T87C-6565-A)

Materials

Item	Specification
Engine oil —	WSS-M2C153-H

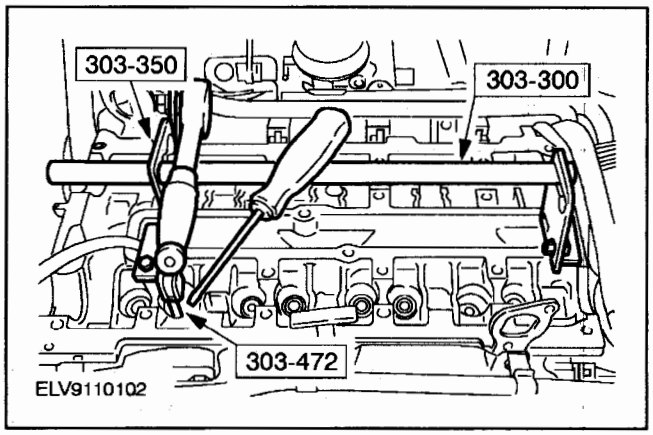
IN-VEHICLE REPAIR (Continued)

Removal

1. Remove the camshafts.
   - Remove the valve tappets and place them in order to one side.

2. ⚠ **WARNING: Always wear protective goggles when working with compressed air. This can prevent injury. Failure to follow these instructions may result in personal injury.**

   Unscrew the spark plug on cylinder No. 1 and connect the compressed air supply.

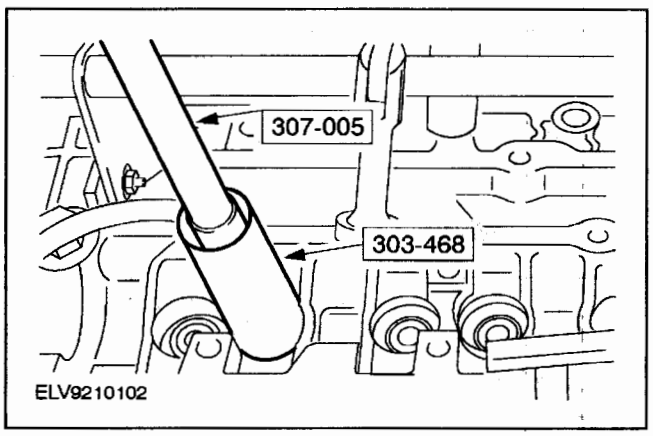


3. ⚠ **CAUTION: Use compressed air at 7 to 10 bars.**

   Using the special tools and apply compressed air to the cylinder.
   - Using the special tools, compress the valve springs and remove the valve collets using some grease and a small screwdriver.
   - Remove the valve spring retainers and the valve springs.

4. **NOTE:** Place all parts in order to one side.

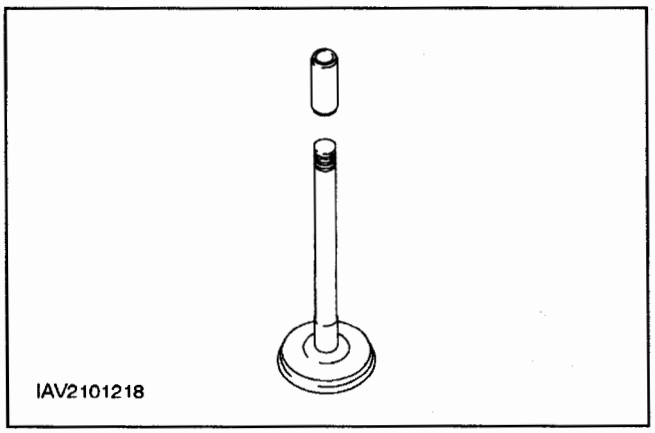
   Remove the valve springs.



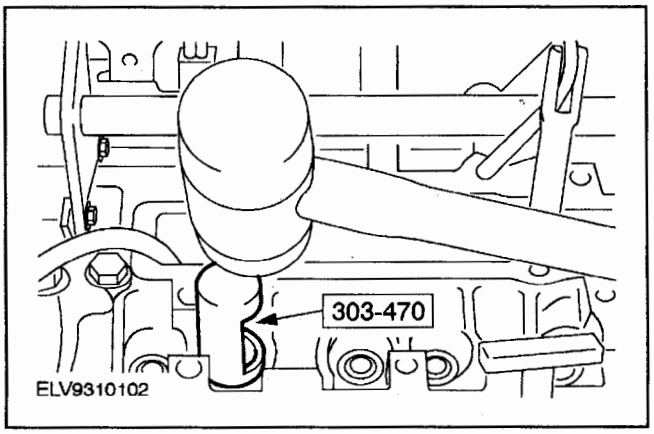
5. Using special tools, remove the valve stem seals.

IN-VEHICLE REPAIR (Continued)

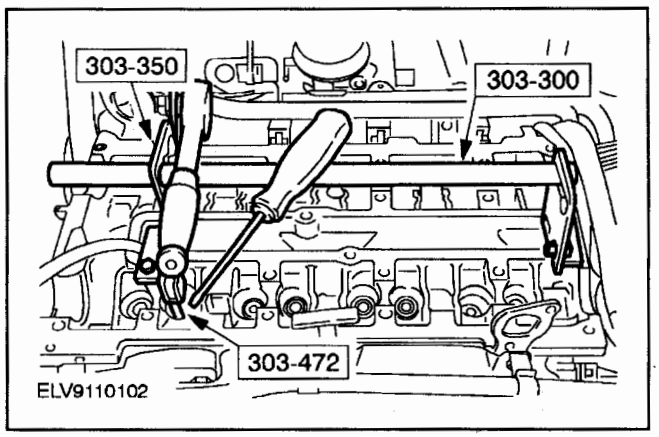
Installation



1. Valve stem seal installation sleeve.



2. Using the special tool, install the valve stem oil seals.



3. **NOTE:** Check the seating of the valve collets.

   Using the special tools, install the valve springs.
   - Insert the valve springs and the valve spring retainers.
   - Compress the valve springs and install the valve collets using some grease and a small screwdriver.

4. **NOTE:** Do not tighten the spark plug at this stage.

   Disconnect the compressed air supply and screw in the spark plug.

5. Repeat appropriate steps for all the other cylinders.

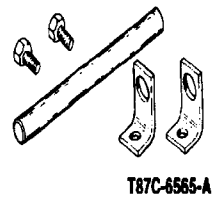
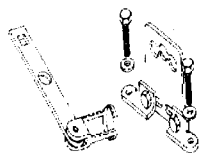
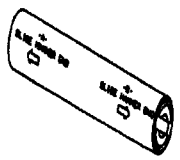
6. Coat the valve tappets with engine oil and insert them.

IN-VEHICLE REPAIR (Continued)

7. Install the camshafts. For additional information, refer to Camshaft in this section.

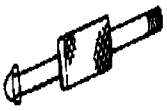
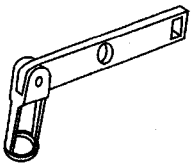
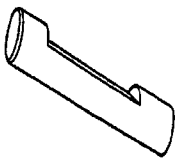
Valves

Special Tool(s)

 T87C-6565-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 T89P-6565-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 T94P-6510-AH	Remover, Oil Seal, Valve Stem 303-468 (T94P-6510-AH)

(Continued)

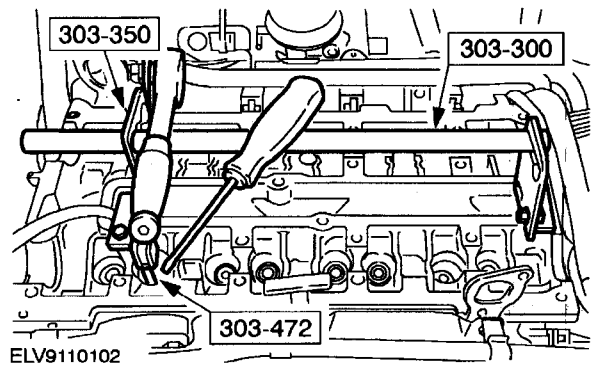
Special Tool(s)

 T59L-100-B	Impact Slide Hammer 307-005 (T59L-100-B)
 ST1902-A	Compressor, Valve Spring 303-472 (T94P-6565-AH)
 T94P-6510-CH	Installer, Oil Seal, Valve Stem 303-470 (T94P-6510-CH)

Materials

Item	Specification
Engine oil	WSS-M2C153-H
—	

Removal



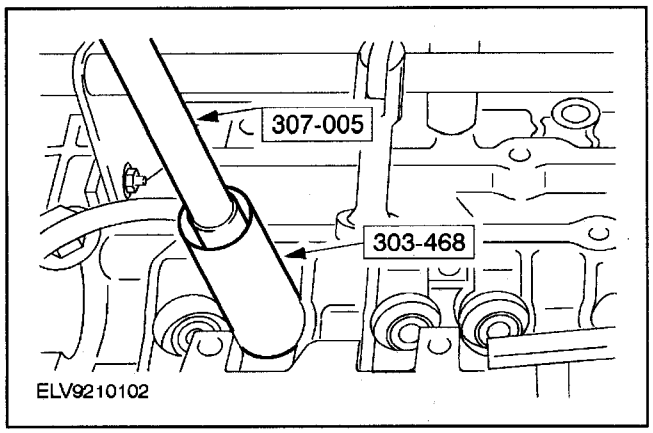
1. **NOTE:** Place the cylinder head onto a clean support on the workbench.

   NOTE: Place wooden wedges in the combustion chamber recesses in the cylinder head to stop the valves from opening during removal.

   Using the special tools, compress the valve springs.

   - Compress the valve springs and remove the valve collets using some grease and a small screwdriver.
   - Remove the valve spring retainers and the valve springs.

IN-VEHICLE REPAIR (Continued)



2. **NOTE:** Place all parts in order to one side.
   Remove the valve springs.

3. Using the special tools, remove the valve stem seals.

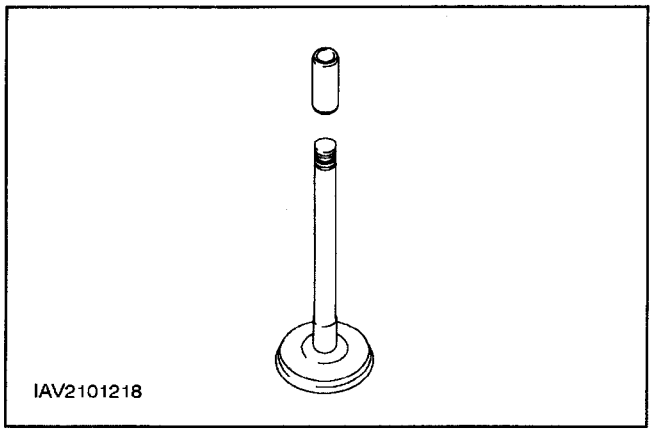
4. Remove the valves and place them in order to one side.

Installation

1. **NOTE:** Follow the procedure recommended by the grinding paste manufacturer.
   NOTE: Install each valve in the same position from which it was removed.
   Regrind the valves.

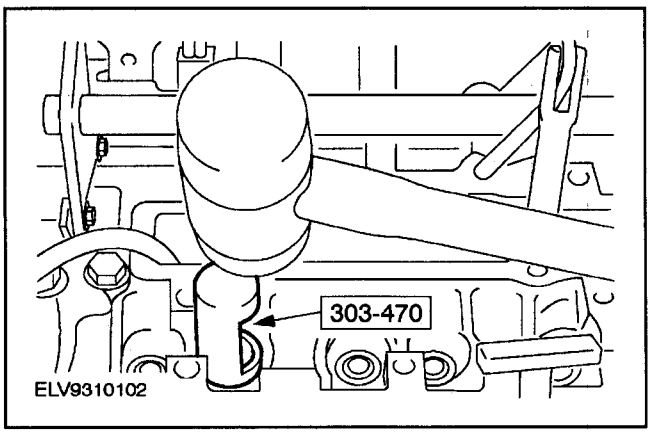
2. Thoroughly clean off any traces of sealer and grinding paste from all components.

3. Coat the valve stems with engine oil and insert them in the valve guides.

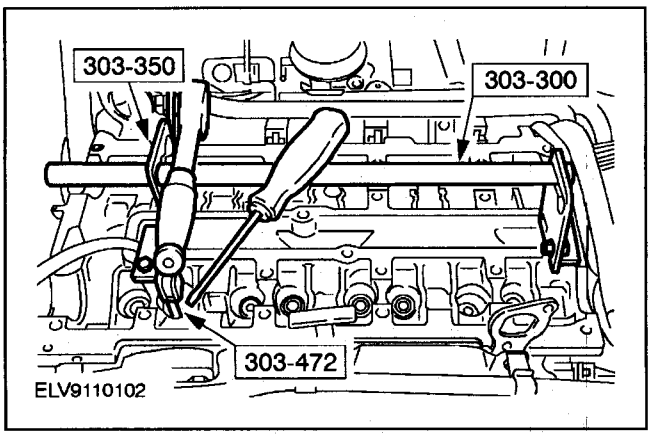


4. Valve stem seal installation sleeve.

IN-VEHICLE REPAIR (Continued)



5. Using the special tool, install new valve stem oil seals.



6. **NOTE:** Check the seating of the valve collets.

   Using the special tools, install the valve springs.

   - Insert the valve springs and the valve spring retainers.
   - Compress the valve springs and install the valve collets using some grease and a small screwdriver.

Valve Tappets

Special Tool(s)

 21008a01	Installer, Oil Seal, Timing Cover 303-160 (T81P-6292-A)

Materials

Item	Specification
Cable ties	
Super Premium SAE 5W30 Motor Oil XO-5W30-QSP	WSS-M2C153-H
Gasket Maker F8AZ-19B508-AB	WSK-M2G348-A5

IN-VEHICLE REPAIR (Continued)

Adjustment

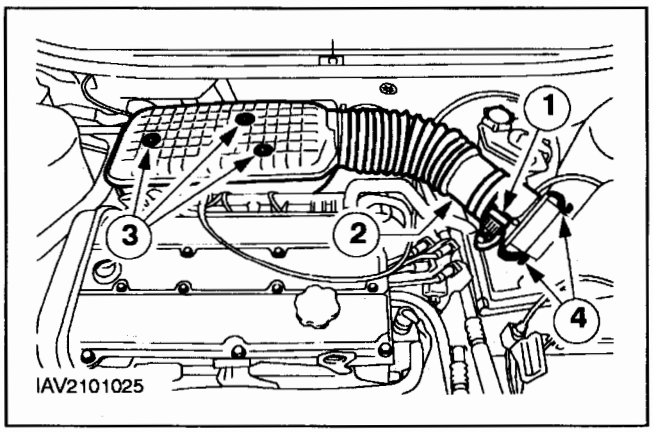
All vehicles

1. **CAUTION: It is necessary to change the adjusting shims to correct the valve clearance. This requires removal of the camshafts.**

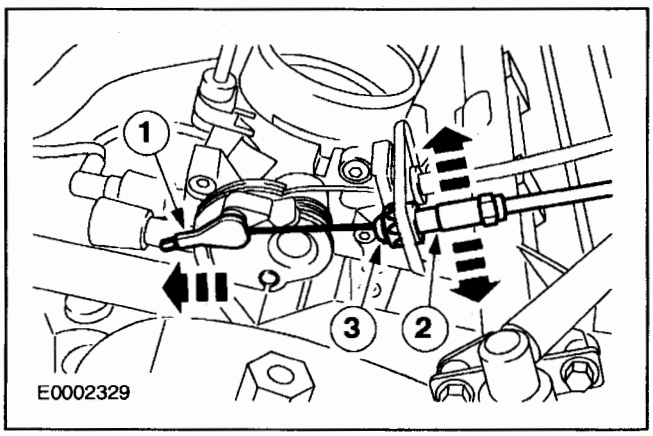
   NOTE: The locations of engine mountings and engine support insulators are described looking from the transaxle to the engine.

   NOTE: Steps which only apply to certain model variants and therefore do not apply to all vehicles are clearly marked.

   Disconnect the battery ground cable.

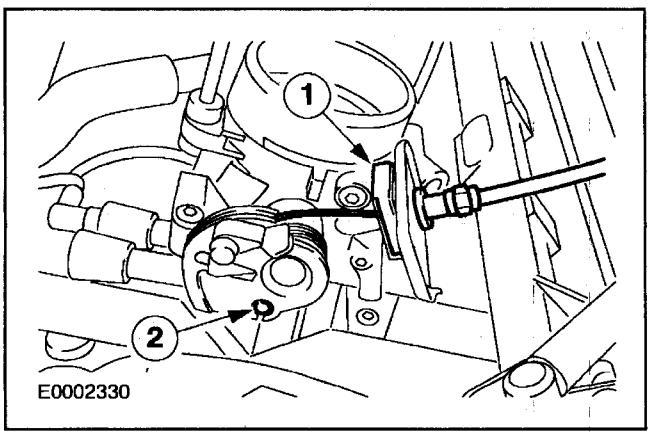


2. Remove the air cleaner resonator and air cleaner outlet pipe.
   1 Disconnect the mass air flow (MAF) sensor electrical connector.
   2 Disconnect the intake air temperature (IAT) electrical sensor.
   3 Remove the one bolt and two nuts.
   4 Release the retaining clips.

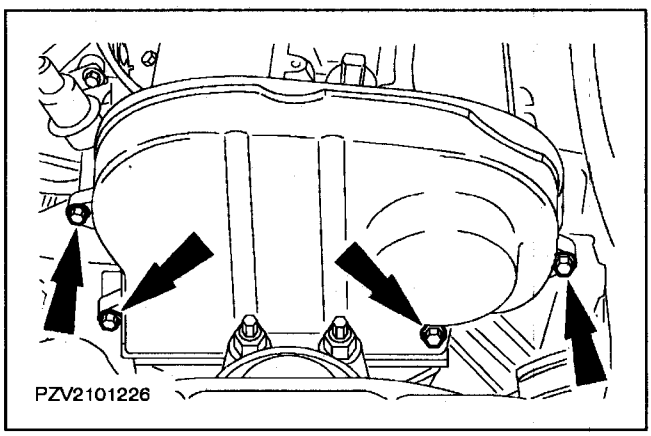


3. Disconnect the speed control cable.
   1 Disconnect the cable from the throttle valve.
   2 Move the cable up and down and pull it out of the retaining bushing.
   3 Press the retaining bushing out of the bracket.

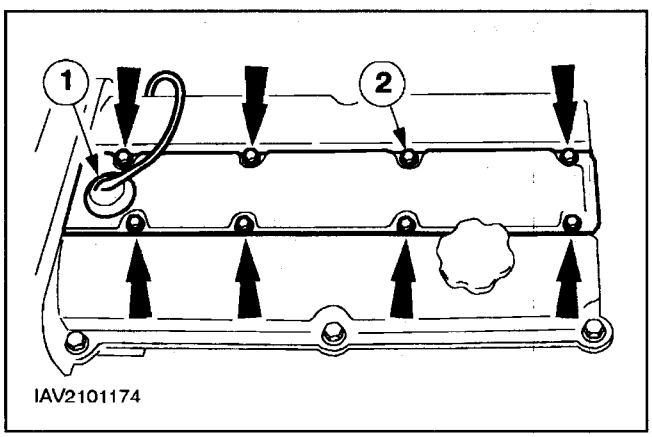
IN-VEHICLE REPAIR (Continued)



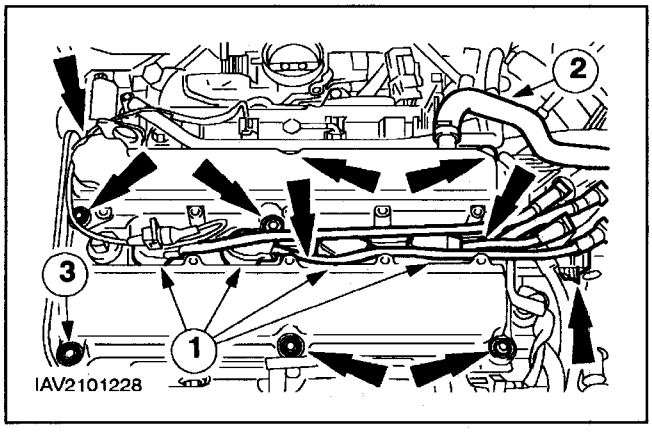
4. Disconnect the throttle cable.
   1 Remove the plastic retaining clip.
   2 Unhook the cable.



5. **NOTE:** Do not remove the upper part of the engine front cover.
   Remove the bolts.



6. Remove the appearance cover.
   1 Disconnect the solenoid valve electrical connector.
   2 Remove the eight bolts.



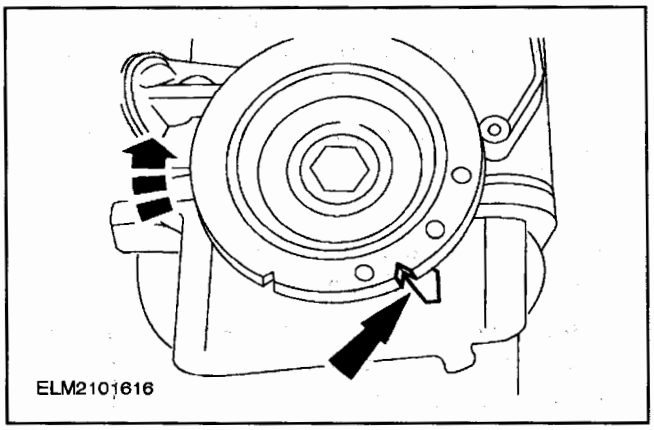
7. **NOTE:** Loosening sequence: From the outside inwards, working diagonally.
   Remove the valve cover.
   1 Disconnect the HT wires from the spark plugs.
   2 Disconnect the crankcase ventilation hose.
   3 Remove the 10 bolts.

8. Loosen the right-hand front wheel nuts.

IN-VEHICLE REPAIR (Continued)

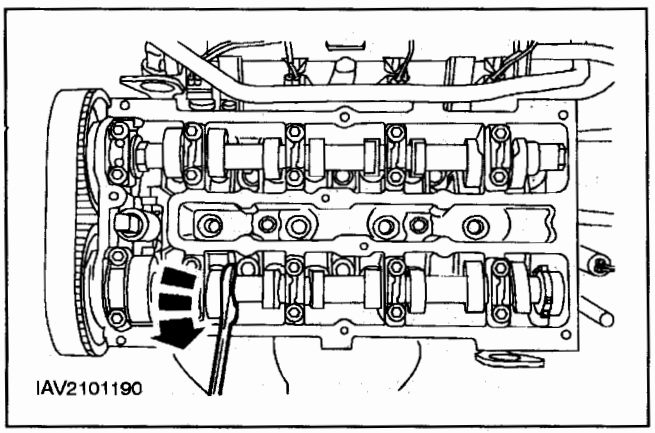
9. Raise and support the vehicle. For additional information, refer to Section 100-02.

10. Remove the right-hand front wheel.


ELM2101616

11. **CAUTION: Only turn the engine by the crankshaft and in the normal direction of rotation.**

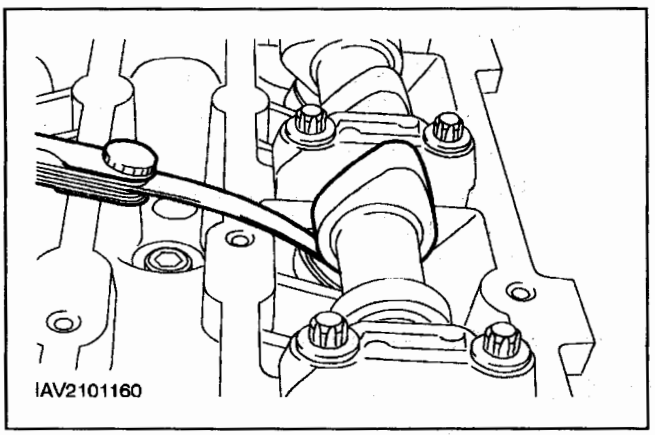
    Set the crankshaft to TDC on cylinder No. 1.


IAV2101190

12. **CAUTION: Do not rotate the engine.**

    NOTE: The variable camshaft timing (VCT) unit has no function when the engine is switched off.

    Using an open-ended wrench, gently turn the exhaust camshaft by the hexagon in the normal direction of rotation until the VCT unit reaches its stop.


IAV2101160

13. **CAUTION: Make a note of the measured valve clearances by cylinder and valve.**

    Measure the valve clearances with a feeler gauge.

    - Permissible valve clearance: intake 0.11-0.18 mm at 20°C ± 5°C
    - Permissible valve clearance: exhaust 0.27-0.34 mm at 20°C ± 5°C

IN-VEHICLE REPAIR (Continued)

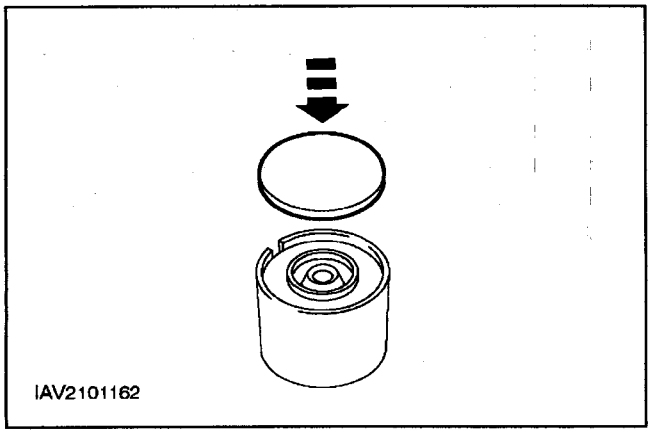
14. ⚠ **CAUTION: Only rotate the engine by the crankshaft.**

    Measure the valve clearances (continued).

    - Rotate the engine by the crankshaft in the direction of engine rotation through another 180 degrees. The sequence of measurements is given by the firing order: 1-3-4-2.
    - Measure the valve clearances on all other cylinders.

15. **NOTE:** Only carry out the following two steps if the valves need adjusting.

    If the required valve clearances are not obtained, remove the camshafts. For additional information, refer to Camshaft in this section.


IAV2101162

Vehicles built up to 6/1999

16. **NOTE:** A mid-range valve clearance is preferred (intake 0.15 mm; exhaust 0.30 mm).

    NOTE: The number on the shim corresponds to the shim thickness. Example: 222 = 2.22 mm

    Measure the required shim thickness.

    - Remove the adjusting shim from the tappets and read off the size from the back (if it is not legible measure it with a micrometer).
    - Measure and insert the shim of the required thickness.
        - Intake valves: required shim thickness = fitted shim thickness + measured valve clearance - 0.15 mm.
        - Exhaust valves: required shim thickness = fitted shim thickness + measured valve clearance - 0.30 mm.

Vehicles built 6/1999 onwards

17. **NOTE:** The number on the tappet corresponds to the tappet thickness.

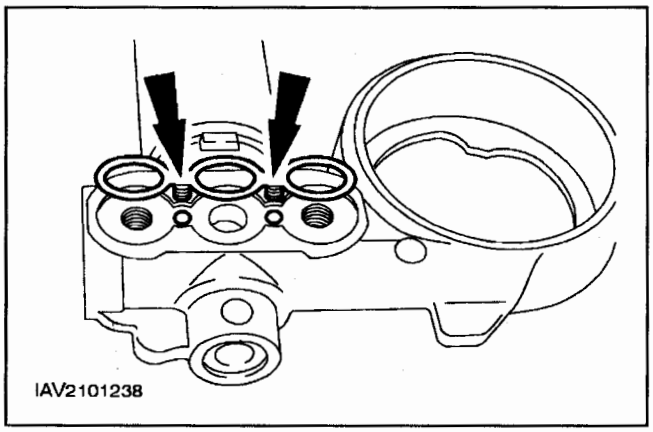
    Measure the required tappet thickness.

    - Remove the adjusting tappet and read off the size from the back face.
    - Determine the tappet thickness required and insert the correct tappet.
        - Intake valves: tappet thickness required = thickness of currently installed tappet+ measured valve clearance - 0.15 mm.

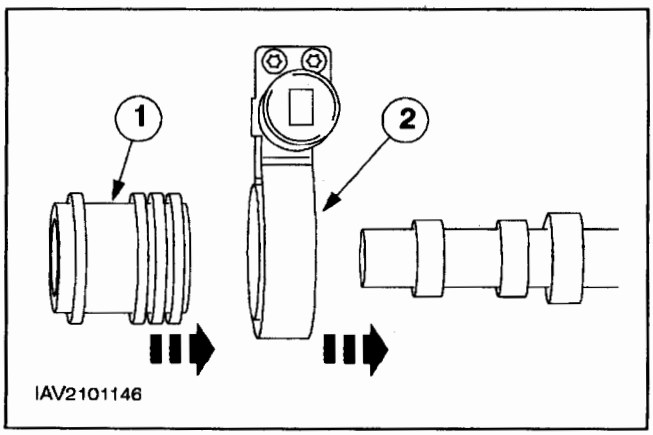
IN-VEHICLE REPAIR (Continued)

- Exhaust valves: tappet thickness required = thickness of currently installed tappet+ measured valve clearance - 0.30 mm.

All vehicles

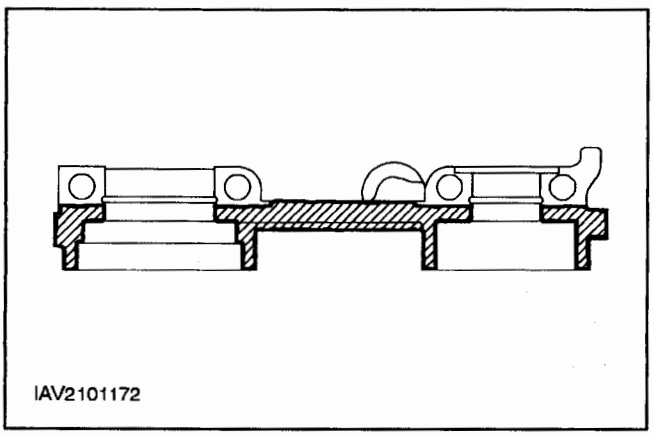

IAV2101238

18. **NOTE:** Use a thumb to press the locating pins of the gasket into the holes.
    Install a new gasket into the oil feed flange.



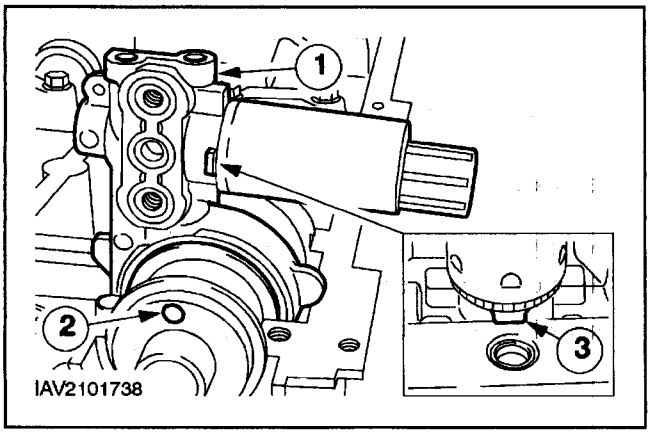
IAV2101146

19. Prepare the exhaust camshaft for installation.
    1 Insert the oil feed ring into the oil feed flange.
    2 Slide both components together onto the exhaust camshaft.


IAV2101172

20. Thinly coat camshaft bearing cap no. 5 with Gasket Maker F8AZ-19B508-AB meeting Ford specification WSK-M2G348-A5.

IN-VEHICLE REPAIR (Continued)



21. Insert the camshafts.
    - Lubricate the valve tappets with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H and insert them.
    - Lubricate the camshaft bearings with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H.
    - Insert the intake camshaft.

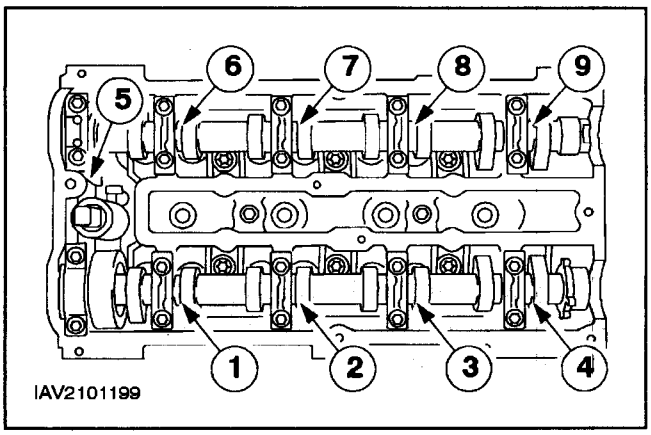
    1 Hold the oil feed flange upwards during installation of the exhaust camshaft.

    2 Position the oil feed ring hole right to the top.

    3 **NOTE:** Keep the oil feed flange away from the cylinder head when turning the flange to avoid damaging the gasket.

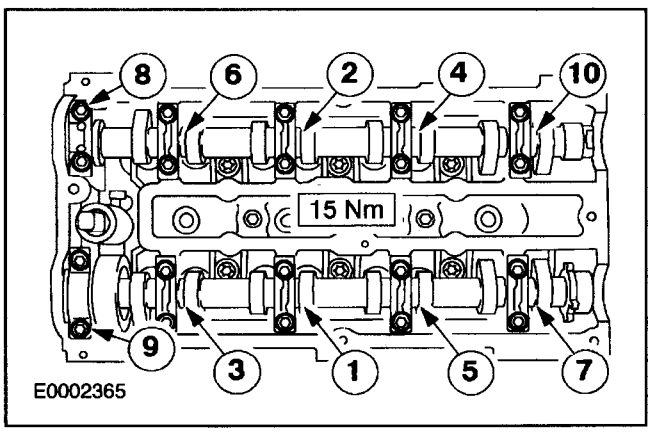
    Turn the oil feed flange till the locating lug is in installation position on the cylinder head.

22. Insert new exhaust camshaft oil seal.



23. **NOTE:** The numbering is on the outside of the camshaft bearing caps.

    Insert the camshaft bearing caps.



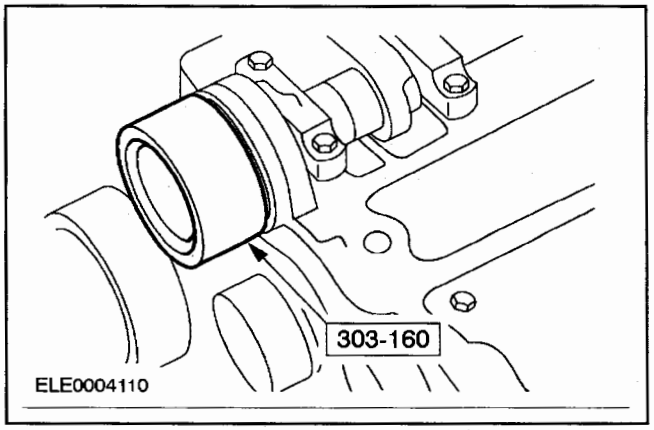
24. **NOTE:** Make sure the upright seat of the exhaust camshaft oil seal during tightening process of camshaft bearing caps.

    NOTE: Working evenly in several stages, screw in each bolt two turns at a time.

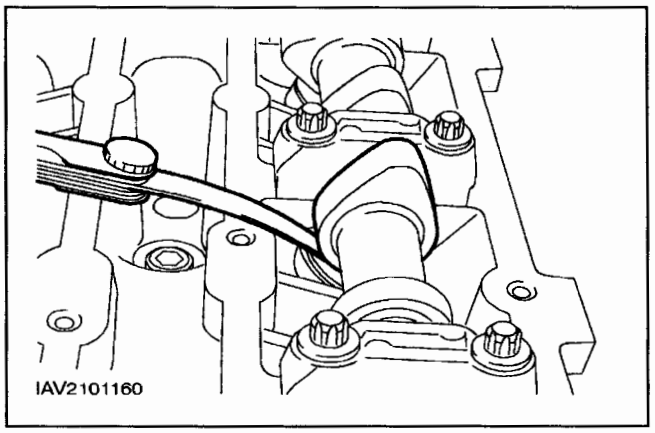
    NOTE: Tightening sequence.

    Tighten the camshaft bearing bolts.

IN-VEHICLE REPAIR (Continued)



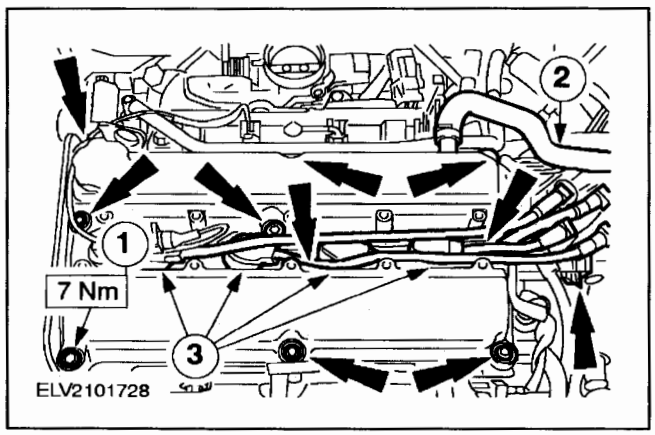
25. Using the special tool, install the intake camshaft oil seal.



26. Check the valve clearance.
    - **NOTE:** The measurement of the valve clearance is the same anywhere along the base circle of the cam.

      Using an open-ended wrench, turn the intake camshaft by the hexagon until the cams on cylinder No. 1 are vertical above the valve tappets. Hold the camshaft in this position, and measure and make note of the valve clearance.
    - Repeat the measurement on the exhaust camshaft and all the other cylinders.
    - Remove the camshafts, as necessary and repeat steps to until the required valve clearance is achieved.

27. Continue with the assembly. For additional information, refer to Camshaft in this section.



28. **NOTE:** Tightening sequence: From the inside outwards, working diagonally.

    Install the valve cover with a new gasket and a new solenoid valve oil seal.

    1 Install in the 10 bolts.

    2 Connect the crankcase ventilation hose.

    3 Connect the HT wires to the spark plugs.

IN-VEHICLE REPAIR (Continued)

Removal

⚠ **CAUTION: The maximum amount by which the engine management system will adjust the camshaft timing (VCT control unit) is limited to 2 degrees. As a result of this an extremely high degree of accuracy is required for any work which affects the valve timing.**

NOTE: Steps which only apply to certain model variants and therefore do not apply to all vehicles are clearly marked.

NOTE: The positions of the engine mountings and engine support insulators are described looking from the transaxle towards the engine.

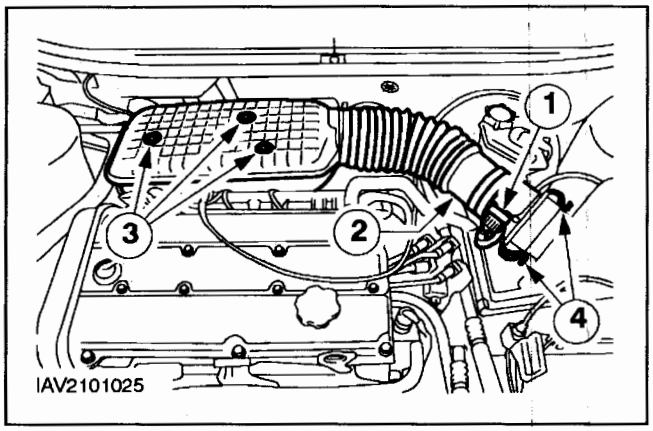
1. Remove the battery. For additional information, refer to Section 414-01.

2. Loosen the front right-hand wheel nuts.

3. Raise and support the vehicle. For additional information, refer to Section 100-02.

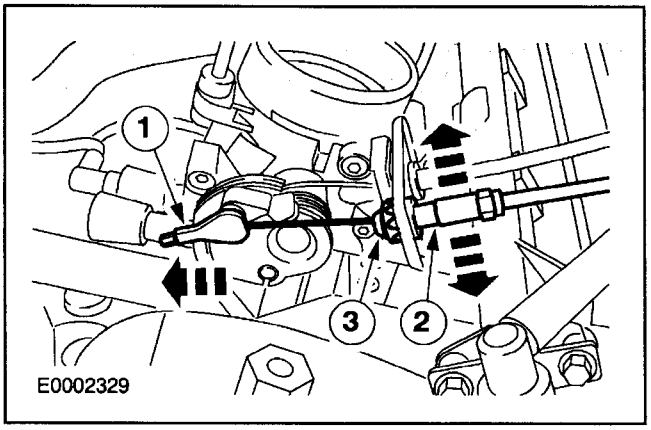
4. Remove the front right-hand wheel.

5. Lower the vehicle.

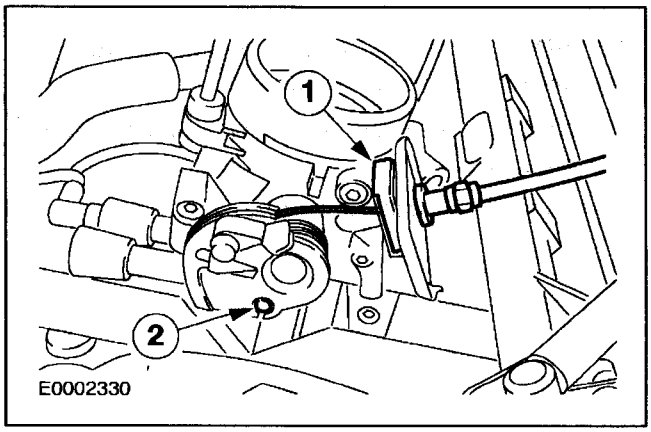


6. Remove the air cleaner resonator and air cleaner outlet pipe.
   1 Disconnect the mass air flow (MAF) sensor electrical connector.
   2 Disconnect the intake air temperature (IAT) electrical sensor.
   3 Remove the one bolt and two nuts.
   4 Release the retaining clips.

IN-VEHICLE REPAIR (Continued)

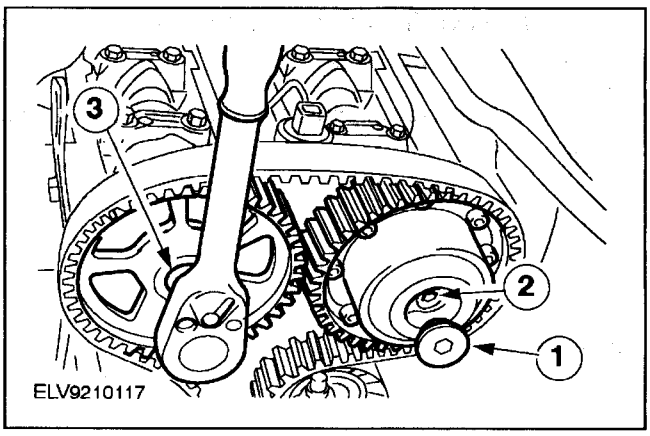


7. Disconnect the speed control cable.
   1 Disconnect the cable from throttle valve.
   2 Gently move the cable up and down and pull it out of the retaining bushing.
   3 Press the retaining bushing out of the bracket.



8. Disconnect the throttle cable.
   1 Remove the plastic clip.
   2 Unhook the cable.

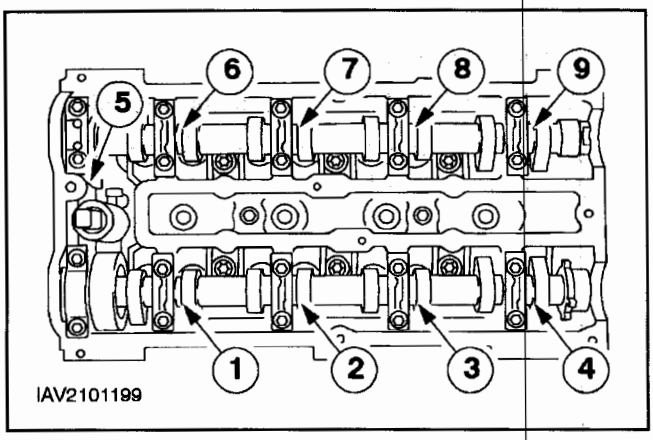
9. Remove the timing belt. For additional information, refer to Timing Belt in this section.



10. Remove the camshaft pulleys.
    1 Remove the timing belt.
    2 Remove the blanking plug from the exhaust camshaft pulley.
    3 Remove the exhaust camshaft pulley.
    4 **NOTE:** Hold the camshaft by the hexagon with an open-ended wrench to stop it from turning.

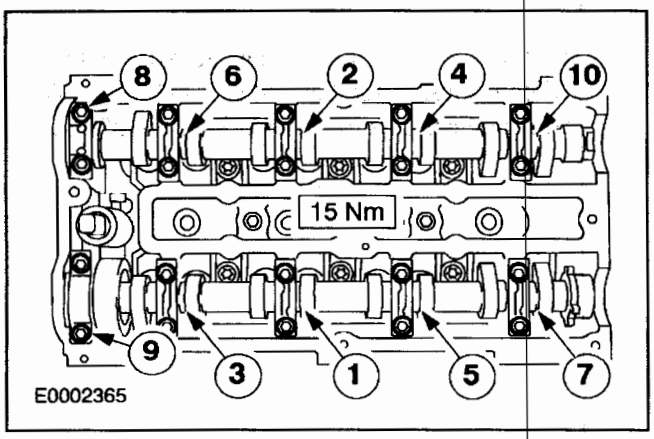
      Remove the intake camshaft timing belt pulley.

IN-VEHICLE REPAIR (Continued)



6. **NOTE:** The numbering is on the outside of the camshaft bearing caps.

   Insert the camshaft bearing caps.

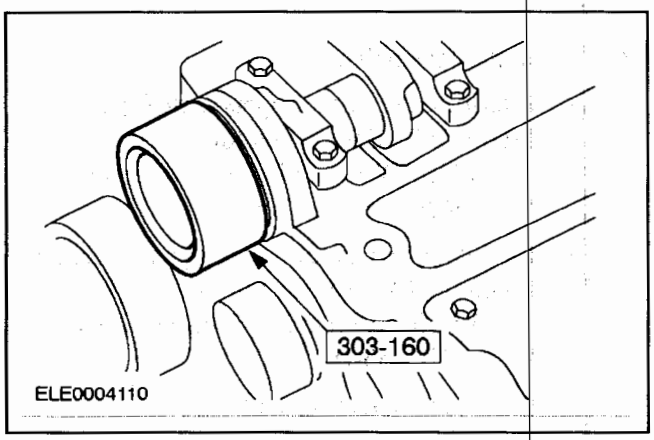


7. **NOTE:** Make sure the upright seat of the exhaust camshaft oil seal during tightening process of camshaft bearing caps.

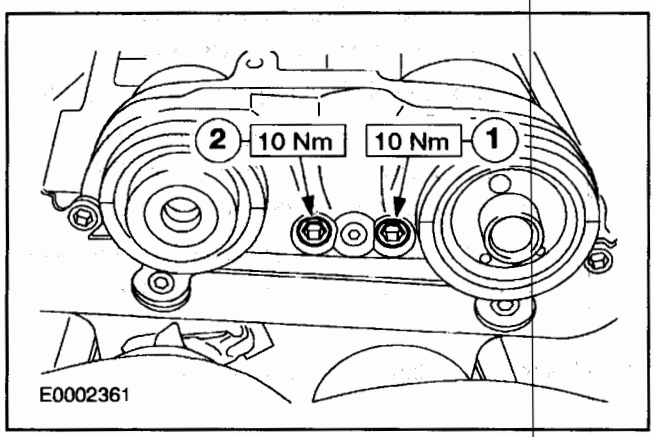
   NOTE: Working evenly in several stages, screw in each bolt two turns at a time.

   NOTE: Tightening sequence.

   Tighten the camshaft bearing bolts.



8. Using the special tool, press in the intake camshaft oil seal.



9. **NOTE:** Make sure the locating lug of the oil feed flange is in installation position on the cylinder head during installation.

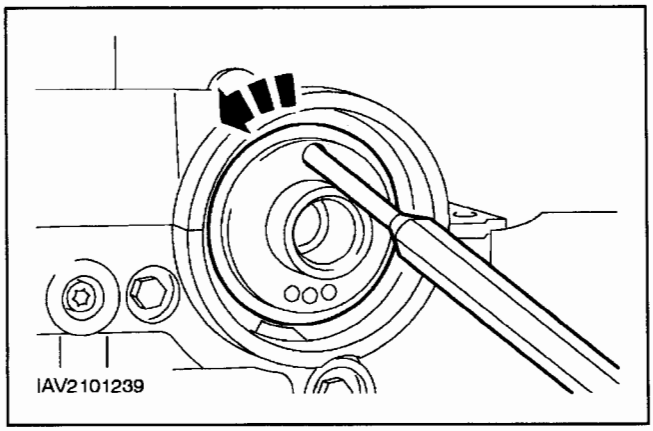
   Install the oil feed flange bolts.

   - Finger tighten the right-hand bolt.
   - Finger tighten the left-hand bolt.

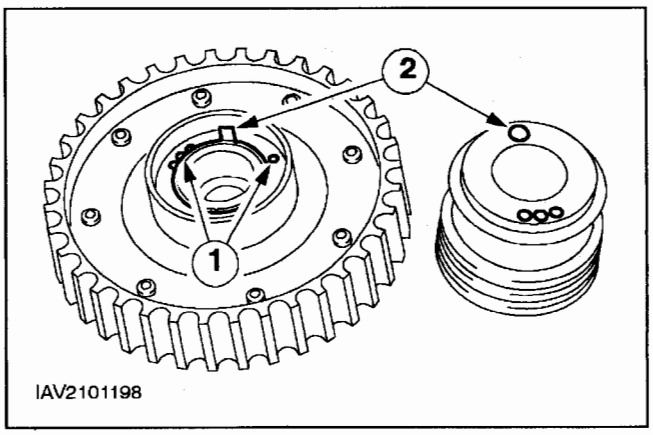
   1 Tighten the right-hand bolt.

   2 Tighten the left-hand bolt.

IN-VEHICLE REPAIR (Continued)


IAV2101239

10. Check that the oil feed ring moves freely.
    - If it is difficult to turn the oil feed ring, loosen the bolts on the oil feed flange and tighten them again as described in the step before.



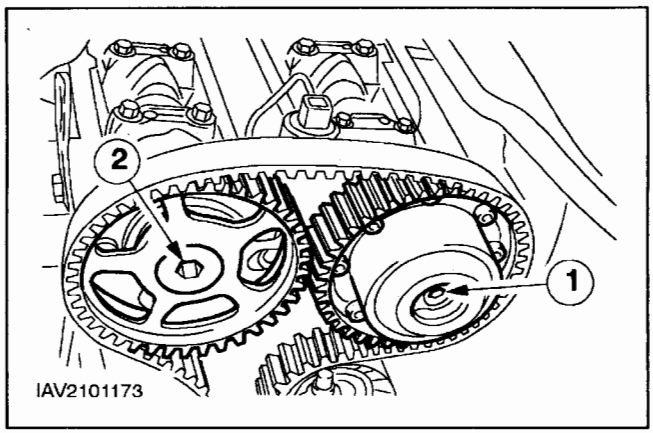
IAV2101198

11. **NOTE:** If the lug is bent or not centered between the oil bores and the mark, install a new exhaust camshaft pulley.

    Installation position of the exhaust camshaft pulley.

    1 The lug is centered between the oil bores and the mark.

    2 The lug must locate in the hole.



IAV2101173

12. **CAUTION: Do not rotate the crankshaft. Check that it is still resting against the special tool 303-574.**

    NOTE: Install the bolts in place but do not tighten them.

    NOTE: New O-ring seal for the exhaust camshaft pulley.

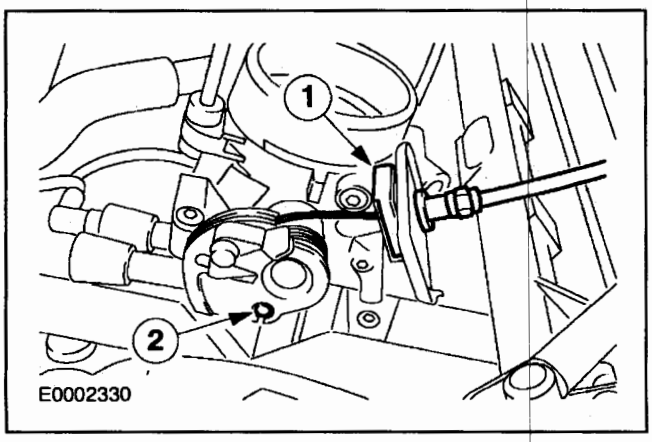
    Slide the camshaft pulleys onto the camshafts, screw in the bolts and position the new timing belt.

    1 Install the VCT unit bolt finger tight.

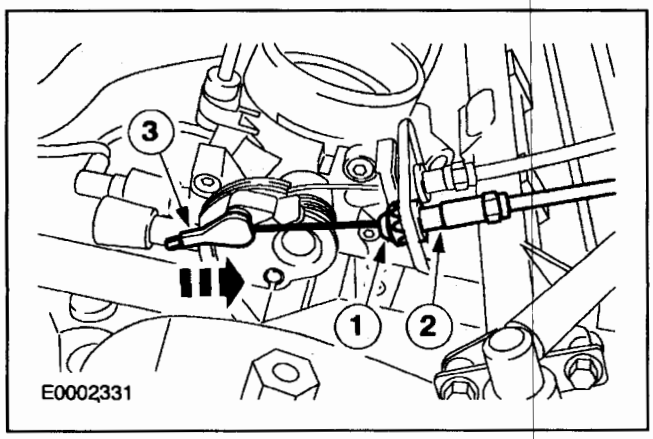
    2 Install the camshaft pulley bolt finger tight.

13. Install the timing belt. For additional information, refer to Timing Belt in this section.

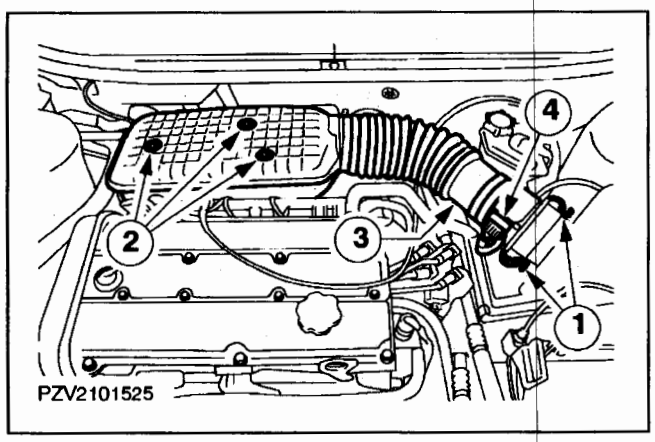
IN-VEHICLE REPAIR (Continued)



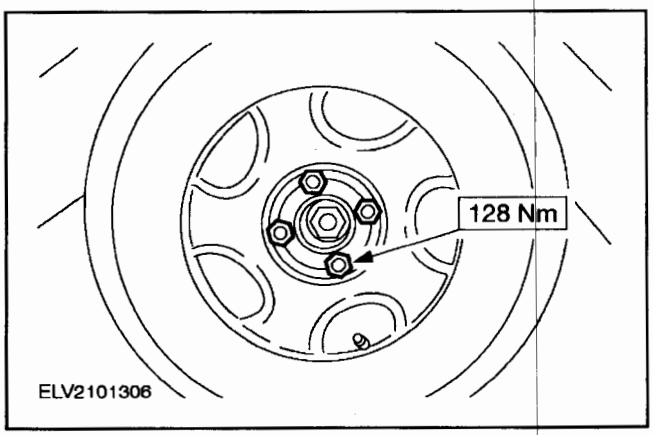
14. Connect the throttle cable.
    1 Install the cable in the bracket and slide on the plastic clip.
    2 Hook the cable in place.



15. Connect the speed control cable.
    1 Press the retaining bushing into the bracket.
    2 **NOTE:** An audible click indicates that it has snapped into place.
    Slide the cable into the retaining bushing.
    3 Connect the cable to the throttle valve.



16. Install the air cleaner resonator and air cleaner outlet tube.
    1 Position the resonator and outlet tube and secure.
    2 Install the one bolt and two nuts.
    3 Connect the IAT sensor electrical connector.
    4 Connect the MAF electrical connector.



17. Install the wheel.

IN-VEHICLE REPAIR (Continued)

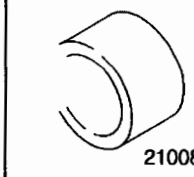
18. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 Km (10 miles) or more to relearn the strategy.
    Install the battery. For additional information, refer to Section 414-01.

19. Check the fluid levels and correct as necessary.

20. Check the routing of the vacuum hoses and wiring and secure them with cable ties.

Camshaft Oil Seal

Special Tool(s)

 21008a01	Installer, Oil Seal, Timing Cover 303-160 (T81P-6292-A)

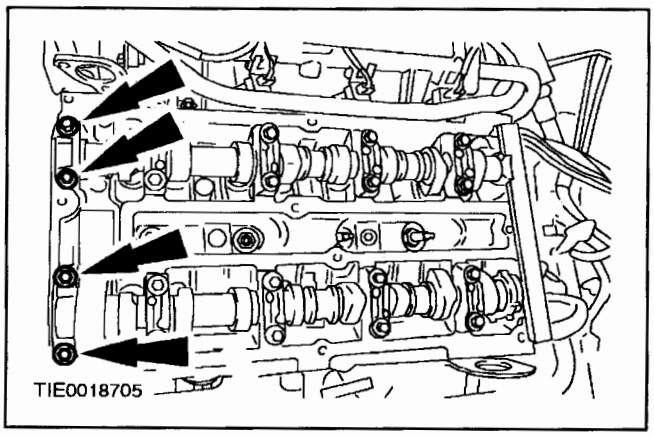
Materials

Item	Specification
Gasket Maker F8AZ-19B508-AB	WSK-M2G348-A5

Removal

1. Remove the timing belt.

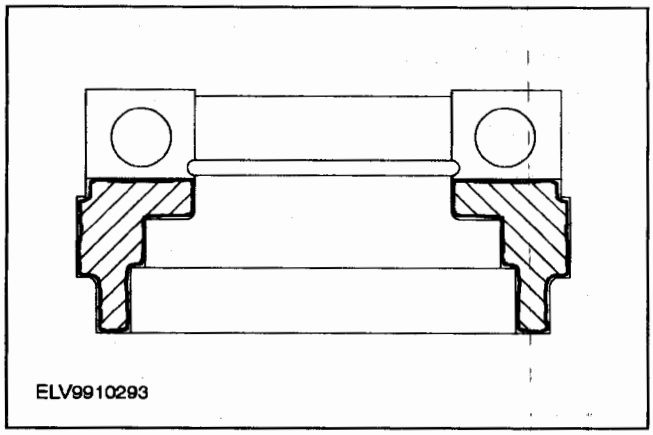
2. Remove the camshaft pulleys.
   - Remove the bolts.



3. Remove camshaft bearing caps numbers 0 and 5.
   - Remove the camshaft oil seals.

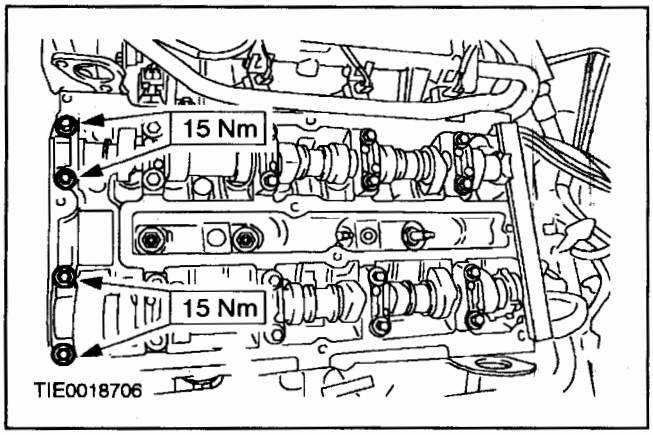
IN-VEHICLE REPAIR (Continued)

Installation


ELV9910293

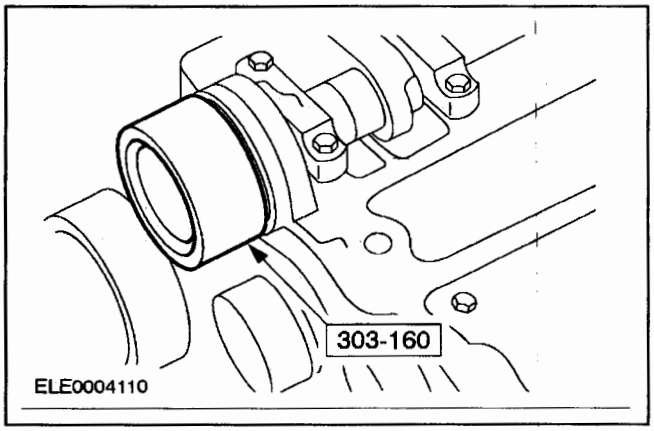
1. Thinly coat camshaft bearing caps numbers 0 and 5 with gasket maker.

2. Install a new exhaust camshaft oil seal.



TIE0018706

3. Install camshaft bearing caps numbers 0 and 5.



ELE0004110

4. Using the special tool, press in the intake and exhaust camshaft oil seals.

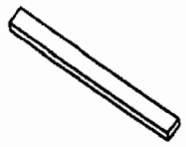
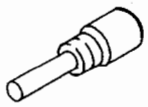
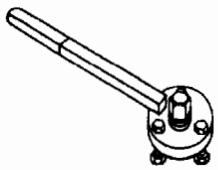
5. **NOTE:** Do not yet tighten the bolts.
   Slide the timing belt pulleys onto the camshafts and screw in the timing belt pulley bolts.

6. Install a new timing belt.

IN-VEHICLE REPAIR (Continued)

Timing Belt

Special Tool(s)

 T94P-6256-CH	Timing Tool, Camshaft Alignment 303-465 (T94P-6256-CH)
 T97P6000A	Timing Peg, Crankshaft Position 303-574 (T97P-6000-A)
 T74P-6256-B	Cam Sprocket Holding/Removing Tool 303-098 (T74P-6256-B)

Materials

Item	Specification
Cable ties	

Removal

All vehicles

1. **CAUTION: The maximum amount by which the engine management system will adjust the camshaft timing (VCT control unit) is limited to two degrees. As a result of this an extremely high degree of accuracy is required for any work which affects the valve timing.**

   NOTE: The locations of engine mountings and engine support insulators are described looking from the transaxle to the engine.

   NOTE: Operation steps which only apply to certain model variants and therefore do not apply to all vehicles are clearly marked.

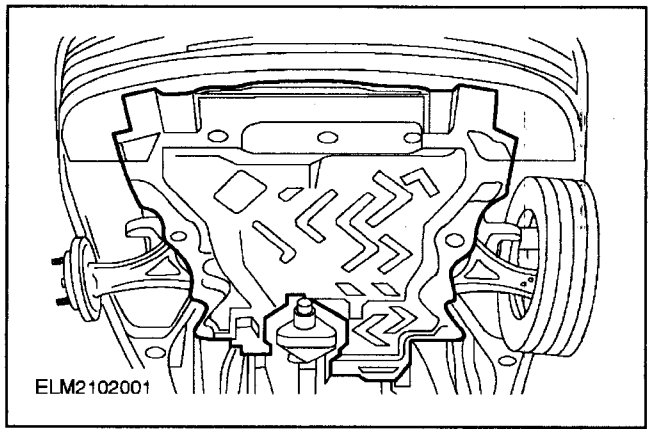
   Disconnect the battery ground cable.

2. Raise and support the vehicle. For additional information, refer to Section 100-02.

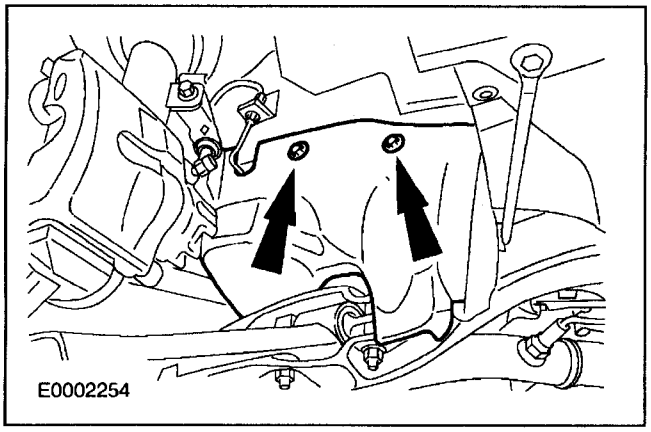
3. Loosen the right-hand front wheel nuts.

4. Remove the right-hand front wheel.

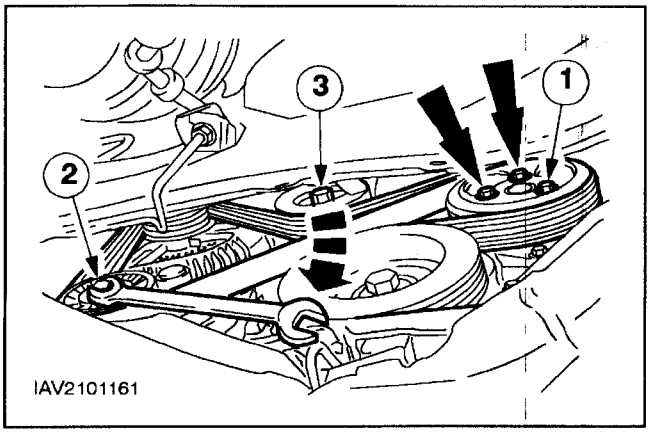
IN-VEHICLE REPAIR (Continued)



5. Remove the engine undershield (if equipped).



6. Remove the right-hand front splash shield.



7. **NOTE:** Mark the accessory drive belt direction if the belt is to be reused.

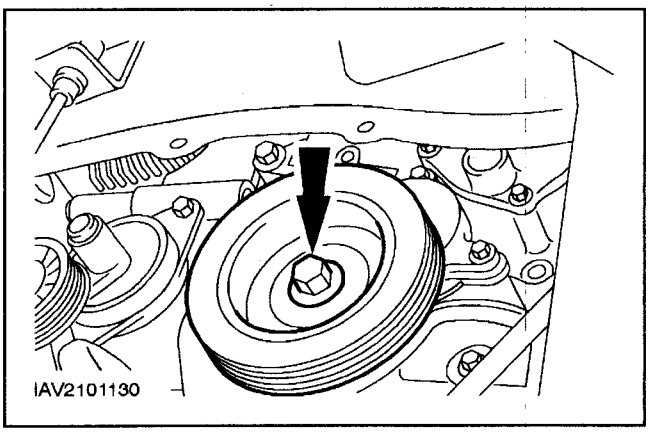
   Remove the accessory drive belt.

   1 Loosen the water pump pulley bolts.

   2 Working clockwise, loosen the belt and remove it.

   - Remove the water pump pulley.

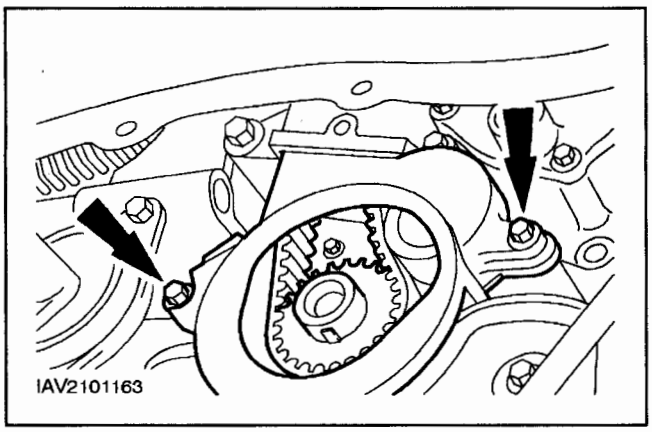
   3 Remove the belt idler pulley.



8. **NOTE:** Using the access hole in the bottom of transaxle case to stop rotation of engine.

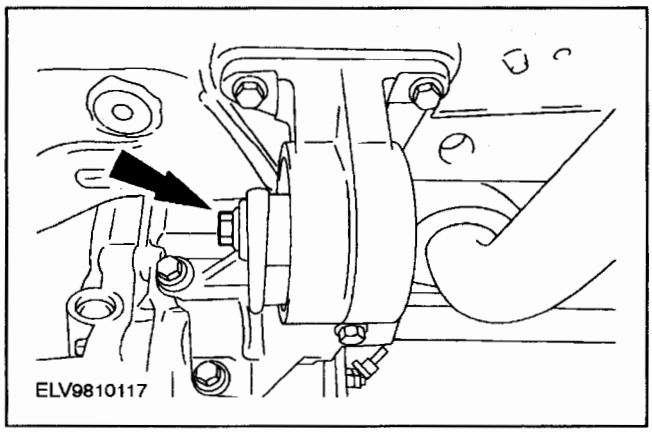
   Remove the crankshaft pulley/vibration damper.

IN-VEHICLE REPAIR (Continued)



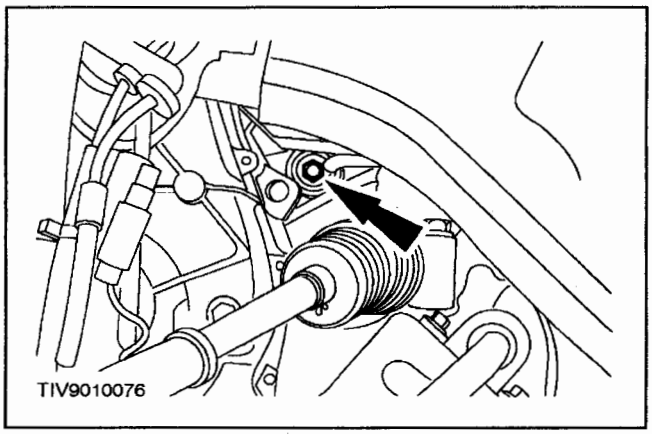
9. **CAUTION: The removal of the lower part of the engine front cover is necessary to avoid damage to the timing belt.**

   Remove the lower part of the engine front cover.



Vehicles with manual transaxle

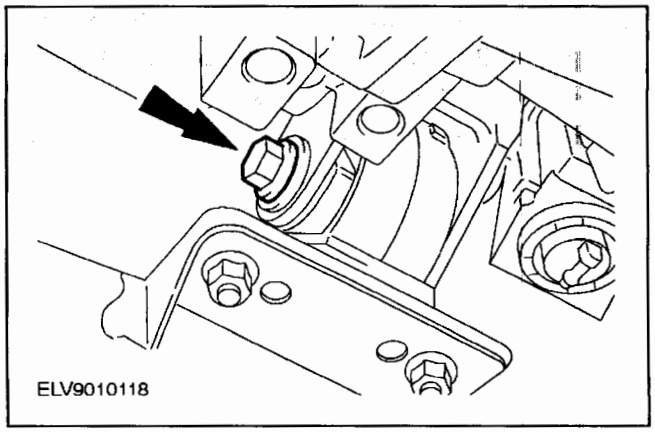
10. Loosen the center bolt of the right-hand engine support insulator two turns.



Vehicles with automatic transaxle

11. Loosen the center bolt of the right-hand engine support insulator two turns.

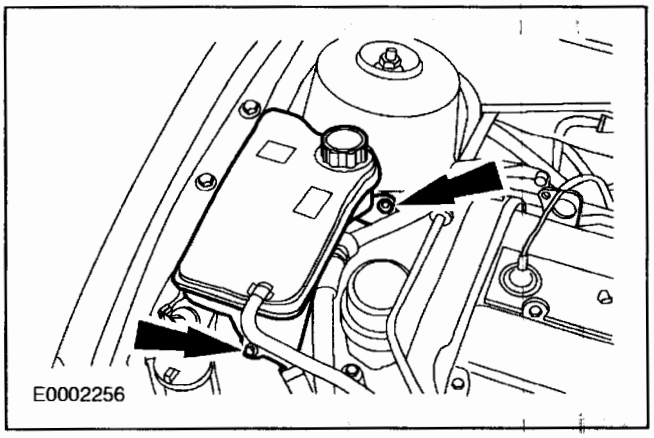
IN-VEHICLE REPAIR (Continued)



All vehicles

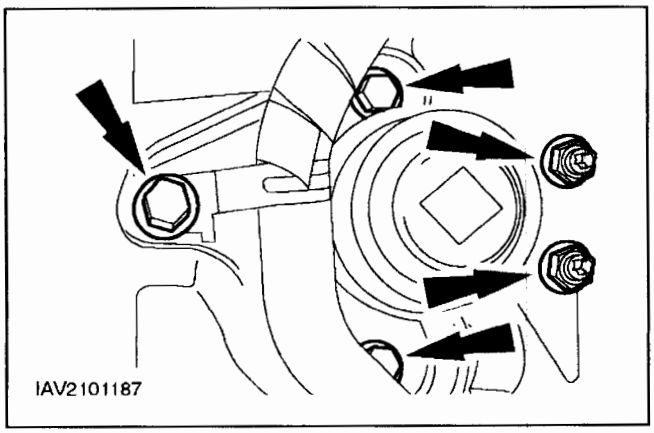
12. Loosen the center bolt of the left-hand engine support insulator two turns.

13. Lower the vehicle.



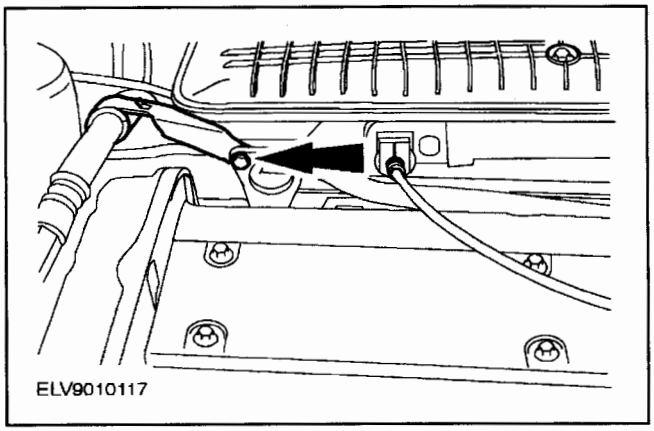
14. Detach the coolant expansion tank and position it to one side.
    - Disconnect the speed control cable (if equipped) from the coolant expansion tank.

15. ⚠ **CAUTION: Use a block of wood between the oil pan and the floor jack.**
    Position the floor jack under the oil pan and raise slightly to release the pressure on the front insulator.

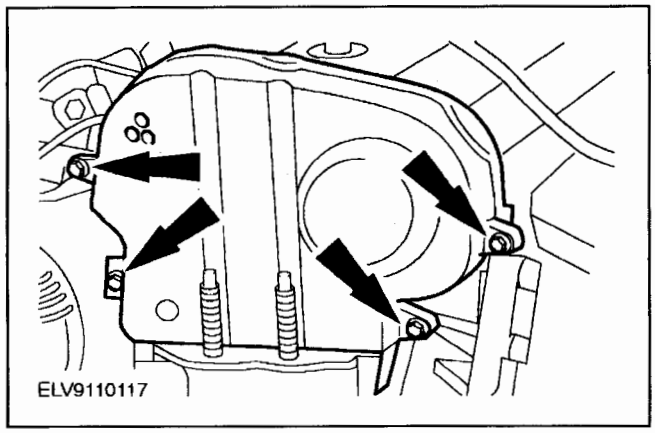


16. **NOTE:** Mark the mounting position.
    Remove the engine front support insulator.

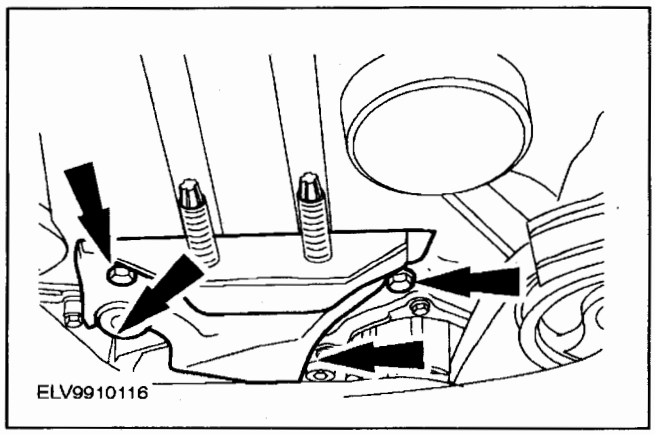
IN-VEHICLE REPAIR (Continued)



17. Detach the power steering pipe bracket from the engine lift eye.



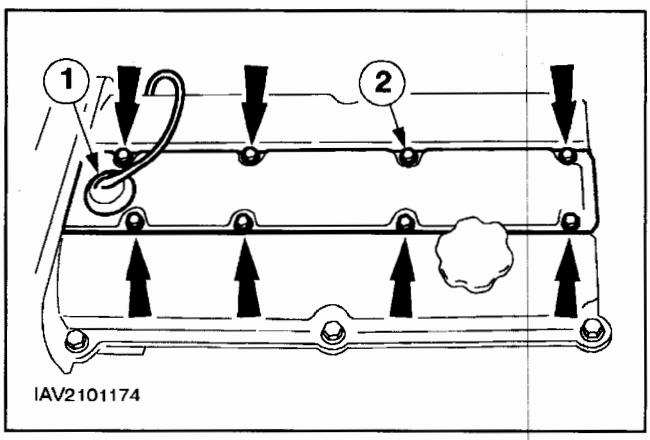
18. Remove the bolts.
    - Leave the timing belt cover in its installed position.



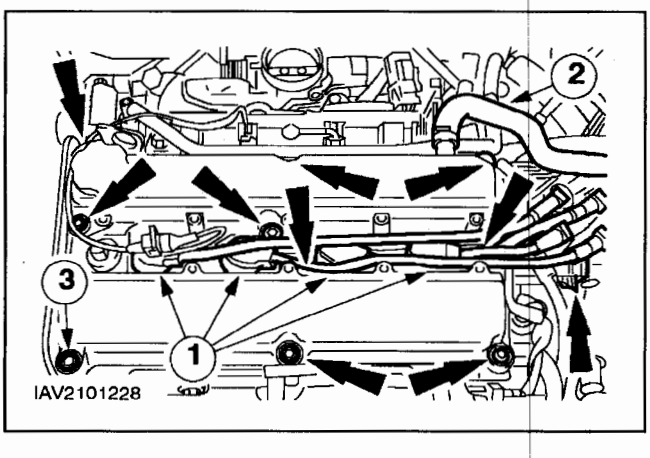
19. Remove the center part of the engine front cover/front engine mounting bracket.
    - Take off the upper and the center covers.

20. Unclip the throttle cable and the speed control cable from the cylinder head appearance cover.

IN-VEHICLE REPAIR (Continued)

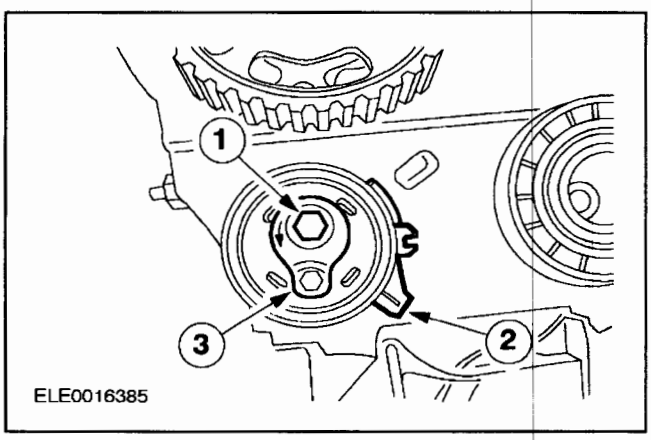


21. Remove the appearance cover.
    1 Disconnect the solenoid valve electrical connector.
    2 Remove the appearance cover.



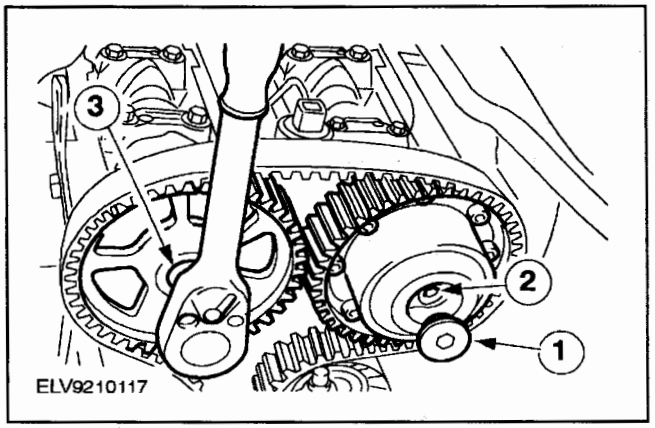
22. **NOTE:** Loosening sequence: From the outside inwards, working diagonally.
    Remove the valve cover.
    1 Disconnect the HT wires from the spark plugs.
    2 Disconnect the crankcase ventilation hose.
    3 Unscrew the 10 bolts.

23. ⚠ **CAUTION: The removal of the spark plug is necessary for the timing adjustment.**
    Remove the spark plugs.



24. **NOTE:** Set the crankshaft approximately to TDC on cylinder No. 1.
    Detension the timing belt.
    1 Unscrew the bolt four turns.
    2 Position the tensioner so the locating tab is at approximately the 4 o'clock position.
    3 Line up the hex key slot in the tensioner adjusting washer with the pointer that is located behind the pulley.

IN-VEHICLE REPAIR (Continued)



25. **NOTE:** To loosen the camshaft pulleys, hold the camshafts by the hexagon.

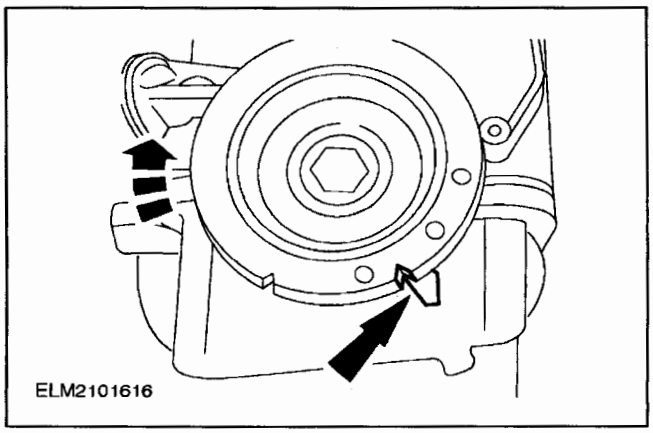
    Loosen the camshaft pulleys.

    1 Remove the blanking plug from the exhaust camshaft pulley.
    2 Loosen the exhaust camshaft pulley.
    3 Loosen the intake camshaft pulley.

26. Remove the timing belt.

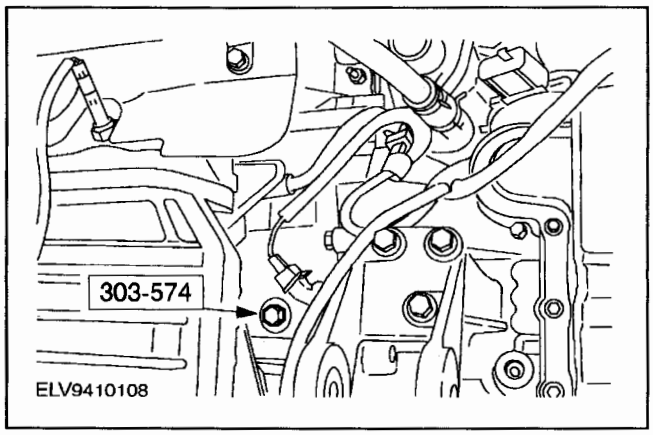
Installation

All vehicles



1. **NOTE:** Rotate the crankshaft clockwise.

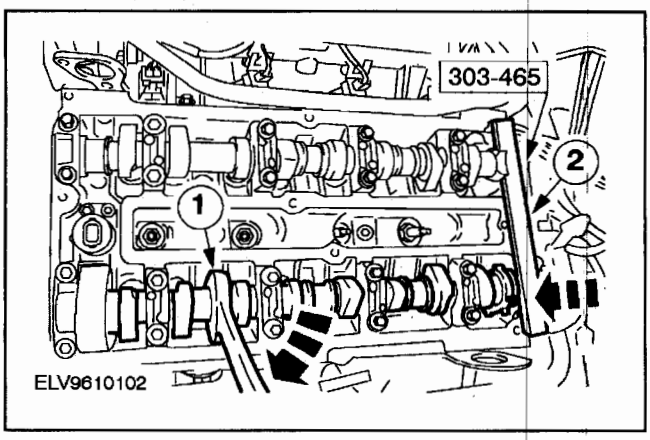
   Rotate the crankshaft to TDC on cylinder No. 1.



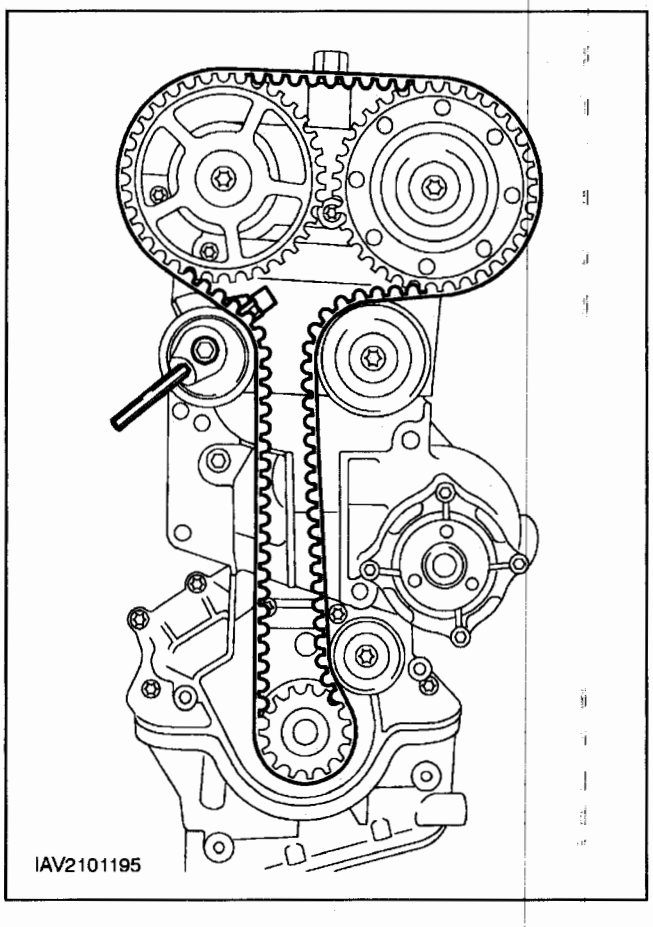
2. **NOTE:** Cylinders No. 1 and No. 4 are at TDC when the Woodruff key points straight up.

   Remove the blanking plug, completely screw in the special tool and auto-align the crankshaft to TDC.

IN-VEHICLE REPAIR (Continued)



3. Position cylinder No. 4 to valves overlap" and install the special tool.
   1 Hold the camshafts by the hexagon using an open-ended wrench and turn them in the direction of engine rotation.
   2 Slide the special tool onto the ends of both camshafts.



4. **⚠ CAUTION: Do not kink the timing belt (do not bend the timing belt less than a diameter of 35 mm).**

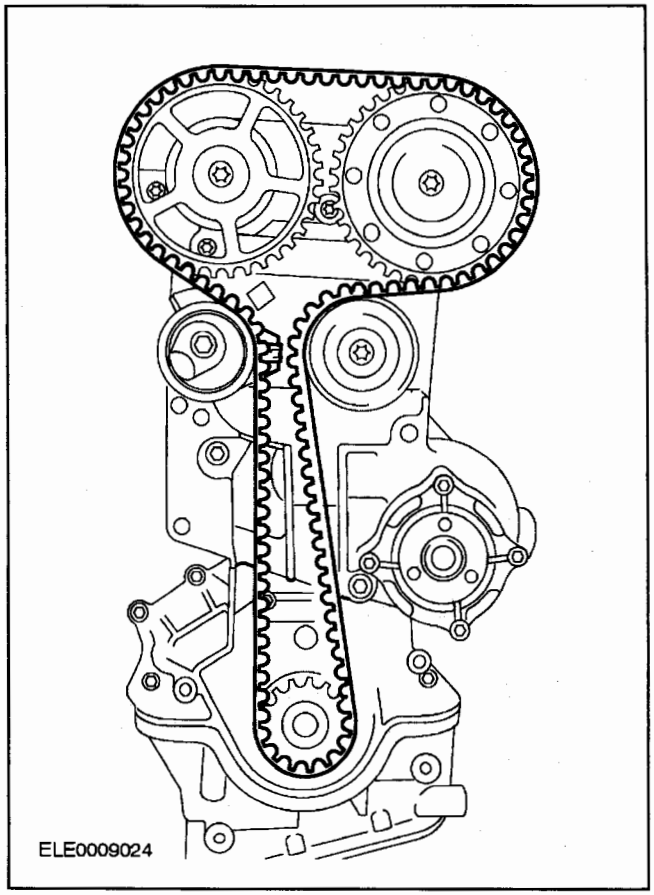
   ⚠ CAUTION: Do not rotate the crankshaft; as necessary check that it is still resting against the timing pin.

   NOTE: The lug of the belt tensioner should not be hooked in the sheet metal cover during timing belt installation.

   Position a new timing belt in place.

   - Starting from the crankshaft timing belt pulley and working counterclockwise, position the timing belt in place while keeping it under tension.

IN-VEHICLE REPAIR (Continued)

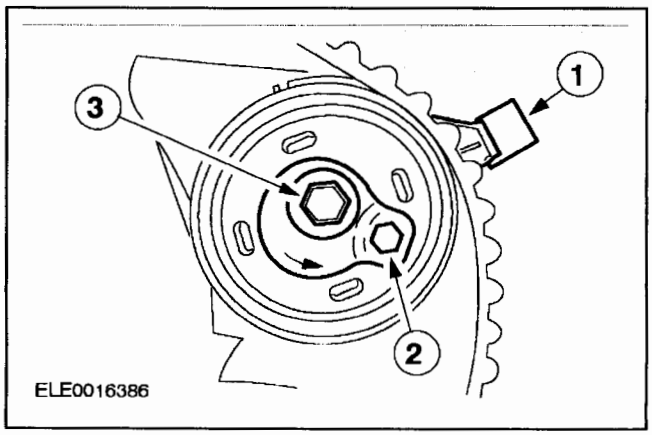


5. **CAUTION: Do not rotate the crankshaft; as necessary check that it is still resting against the timing pin.**

NOTE: The lug of the belt tensioner should not be hooked in the sheet metal cover during timing belt installation.

Position a new timing belt in place.

- Starting from the crankshaft timing belt pulley and working counterclockwise, position the timing belt in place while keeping it under tension.



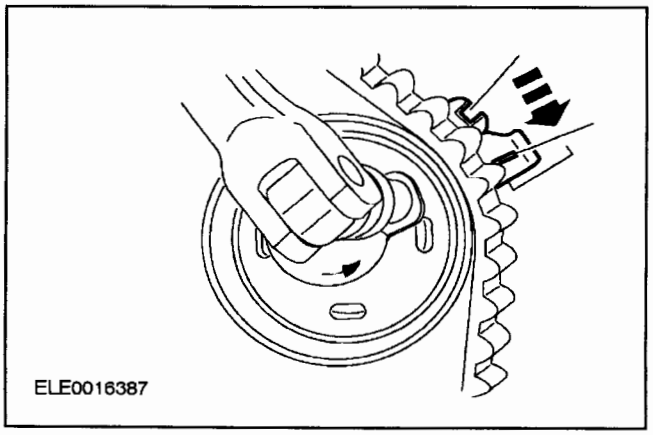
6. **NOTE:** Incorrect timing belt tension will cause incorrect valve timing.

Pre tension the timing belt.

1 Rotate the tensioner locating tab counterclockwise and insert the locating tab into the slot in the rear timing cover.

2 Position the hex key slot in the tensioner adjusting washer to the 4 o'clock position.

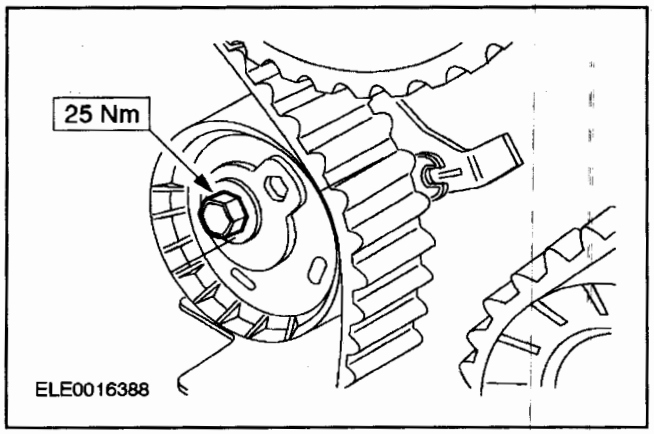
3 Tighten the attaching bold enough to seat the tensioner firmly against the rear timing cover, but still allow the tensioner adjusting washer to be rotated using a 6mm hex key.



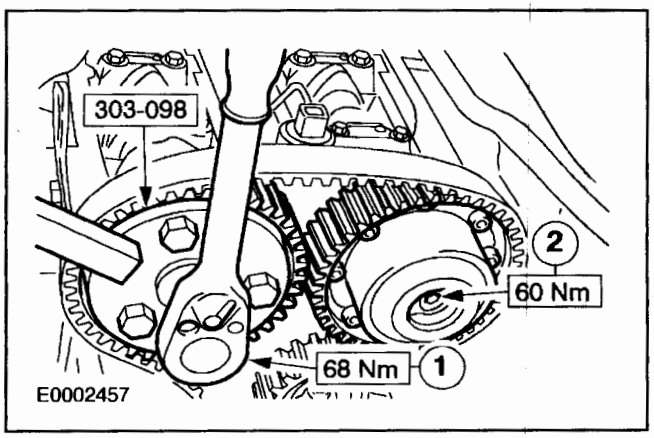
7. **CAUTION: Tension the timing belt, working counterclockwise.**

Using the hex key, rotate the adjusting washer counterclockwise until the notch in the pointer is centered over the index line on the locating tab (the pointer will move clockwise during adjustment).

IN-VEHICLE REPAIR (Continued)



8. While holding the adjusting washer in position, tighten the bolt.



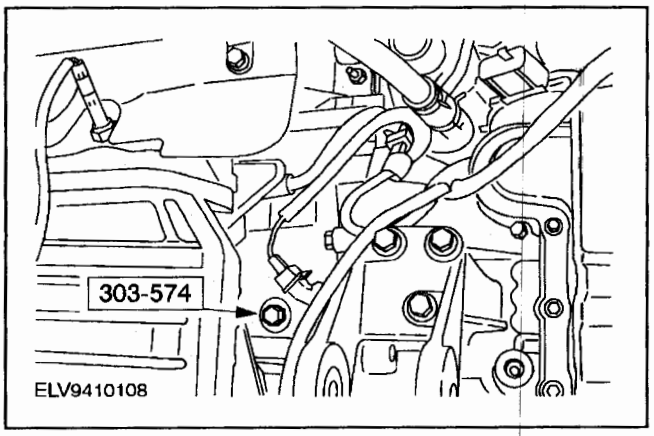
9. **NOTE:** Hold the intake timing belt pulley with special tool to stop it from turning.

   Tighten the timing belt pulleys.

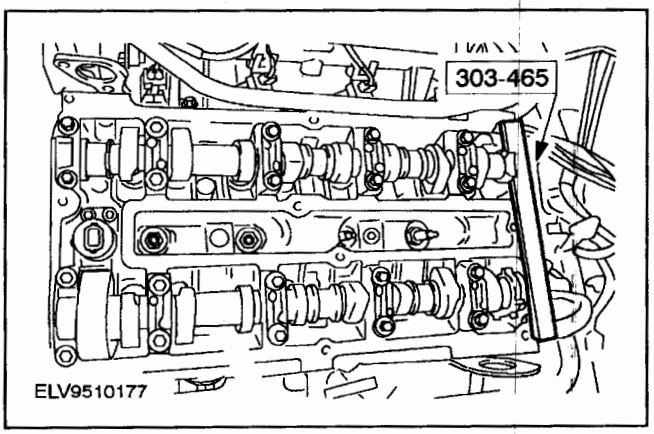
   1 Tighten the intake camshaft timing belt pulley bolt.

   2 **NOTE:** Hold the exhaust camshaft by the hexagon with an open-ended wrench to stop it from turning.

   Tighten the exhaust camshaft timing belt pulley bolt.

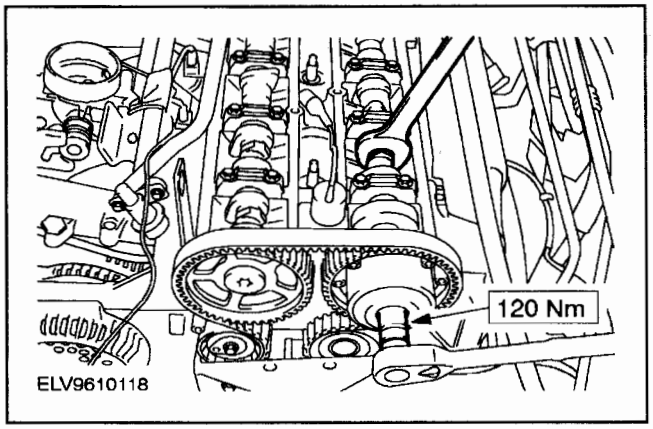


10. Remove the special tool.
    - Install the blanking plug.



11. Remove the special tool.

IN-VEHICLE REPAIR (Continued)



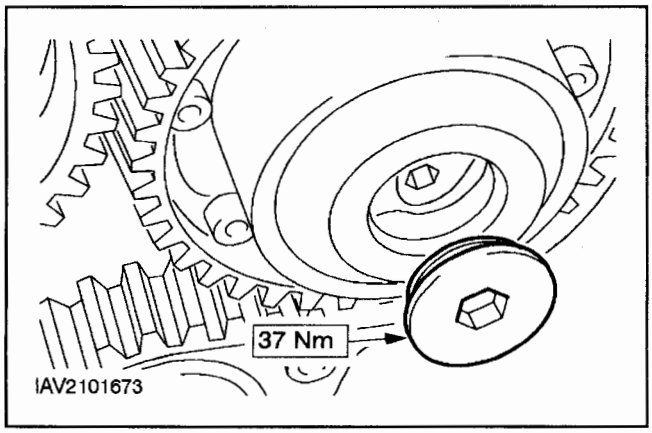
12. **NOTE:** Hold the camshaft by the hexagon with an open-ended wrench to stop it from turning.

    Tighten the exhaust camshaft to stage 2.

13. **NOTE:** Turn the crankshaft two revolutions in the normal direction of rotation.

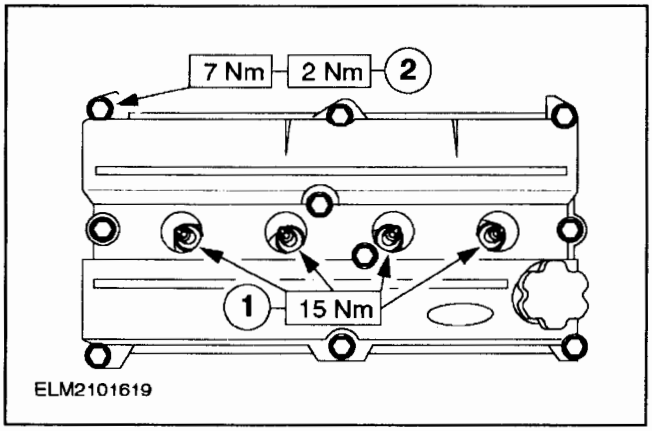
    Check the valve timing by inserting the special tool. Correct it, if necessary.

    - Screw in special tool 303-574 and make sure that the crankshaft is touching it.
    - Insert special tool 303-465 into the camshafts; if necessary loosen the timing pulleys and correct the camshaft alignment.
    - Detach the special tools.



14. **NOTE:** Use a new blanking plug.

    Install the blanking plug on the exhaust camshaft pulley.



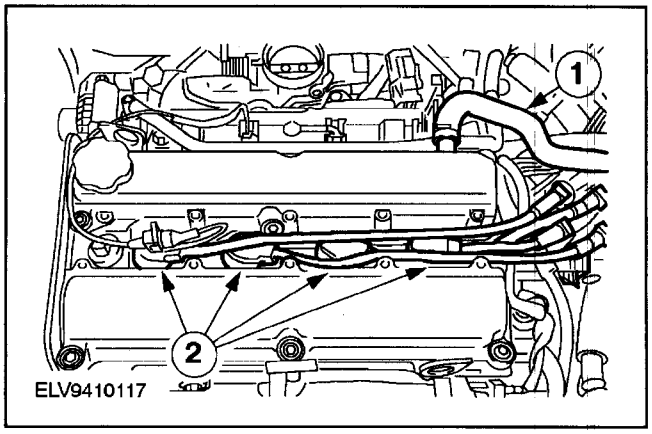
15. **NOTE:** Valve cover tightening sequence: From the inside outwards, working diagonally.

    Install the valve cover and spark plugs.

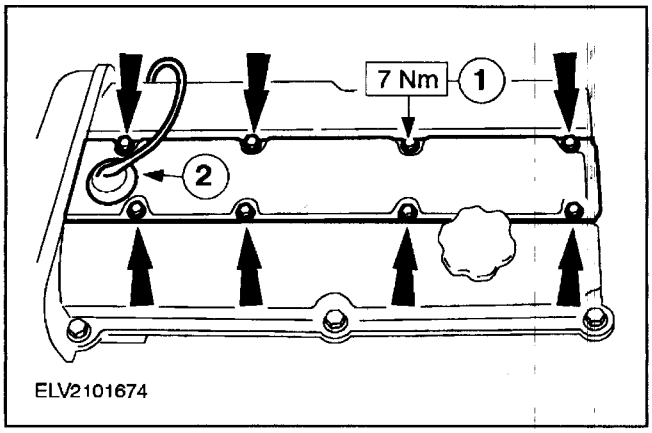
    1 Install the spark plugs.

    2 Install the valve cover.

IN-VEHICLE REPAIR (Continued)

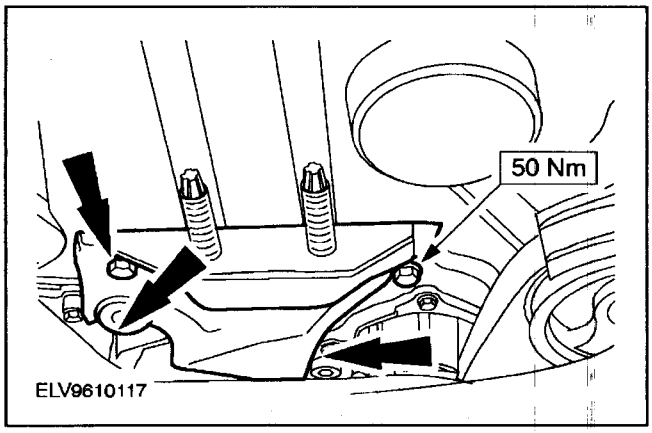


16. Install the HT wires and crankcase ventilation hose.
    1 Connect the crankcase ventilation hose.
    2 Connect the HT wires to the spark plugs.



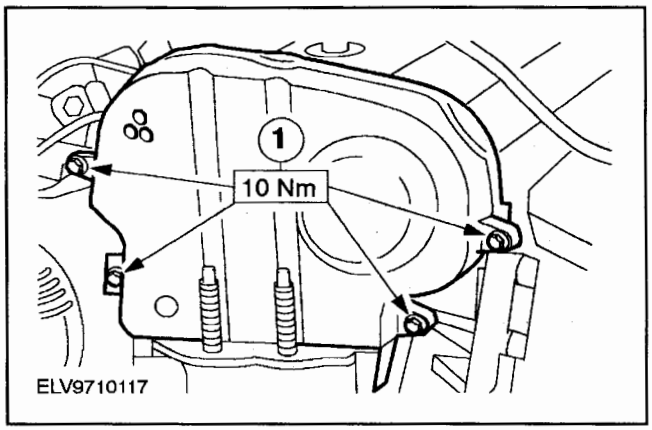
17. Install the appearance cover.
    1 Install the eight bolts.
    2 Connect the solenoid valve electrical connector and press in the rubber seal.

18. Clip the throttle cable and the speed control cable to the appearance cover.

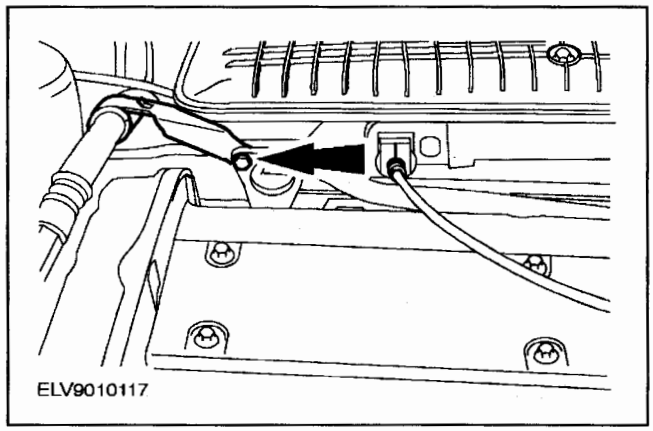


19. **NOTE:** Set the upper part of the engine front cover together with the center part in place.
    Install the center part of the engine front cover.

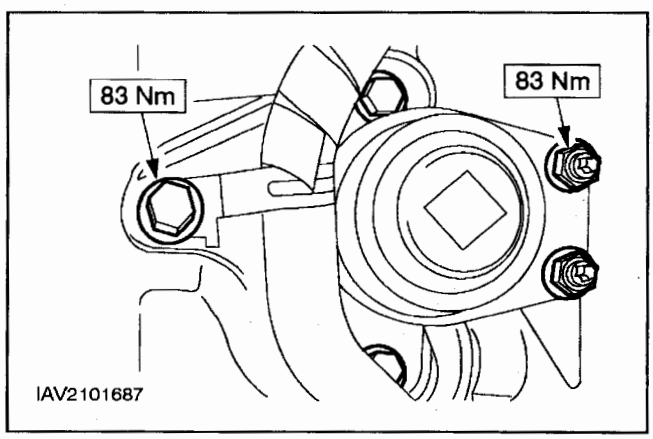
IN-VEHICLE REPAIR (Continued)



20. **NOTE:** Check the seating of the upper part of the engine front cover gasket and correct as necessary.
    Secure the upper part of the engine front cover.

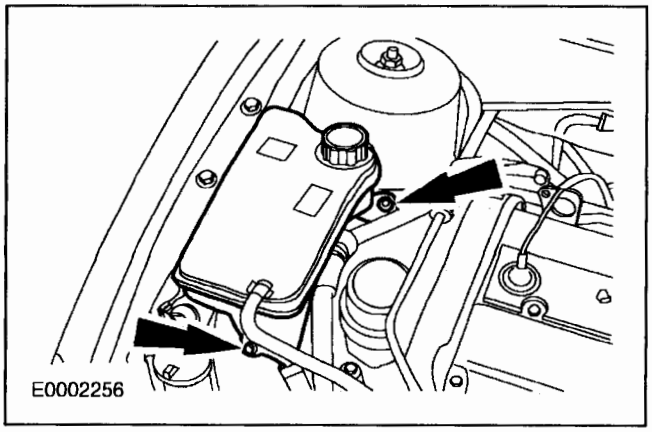


21. Install the power steering pipe bracket to the engine lift eye.



22. **NOTE:** One bolt also holds the power steering line bracket.
    Install the front support insulator.

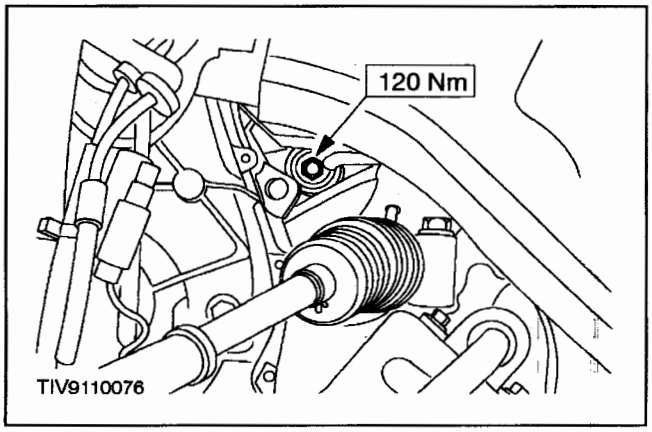
23. Remove the floor jack.



24. Install the coolant expansion tank.
    - Attach the speed control cable (if equipped) to the coolant expansion tank.

IN-VEHICLE REPAIR (Continued)

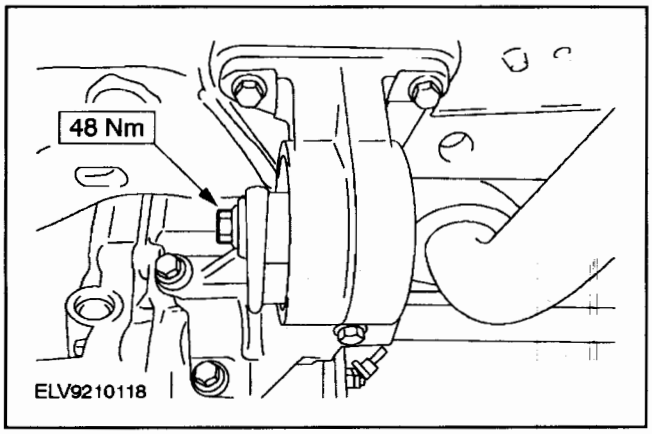
25. Raise and support the vehicle. For additional information, refer to Section 100-02.



Vehicles with automatic transaxle

26. **NOTE:** Verify that the center bolt is centered in the support insulator.

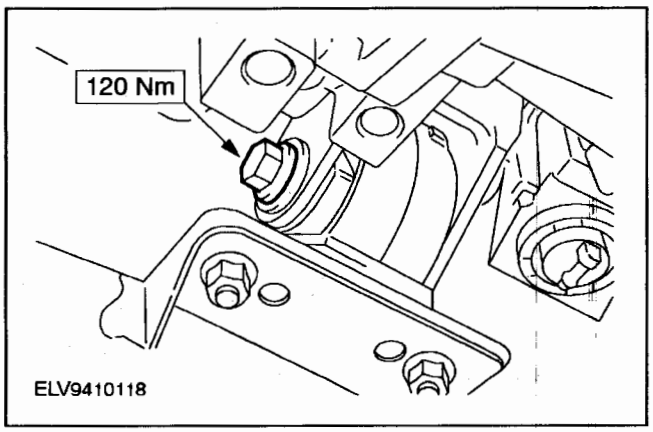
    Tighten the center bolt of the right-hand engine support insulator.



Vehicles with manual transaxle

27. **NOTE:** Verify that the center bolt is centered in the support insulator.

    Tighten the center bolt of the right-hand engine support insulator.

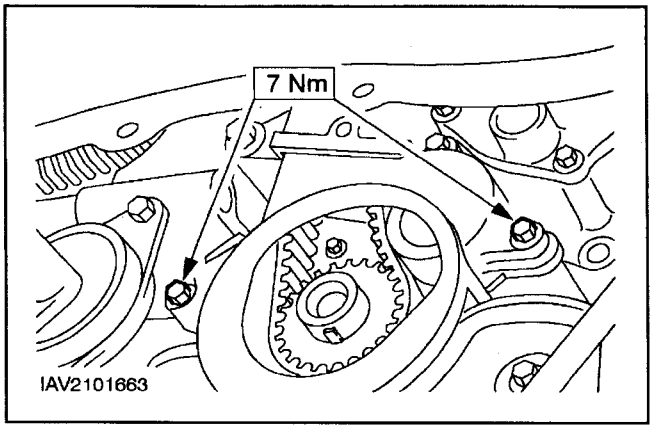


All vehicles

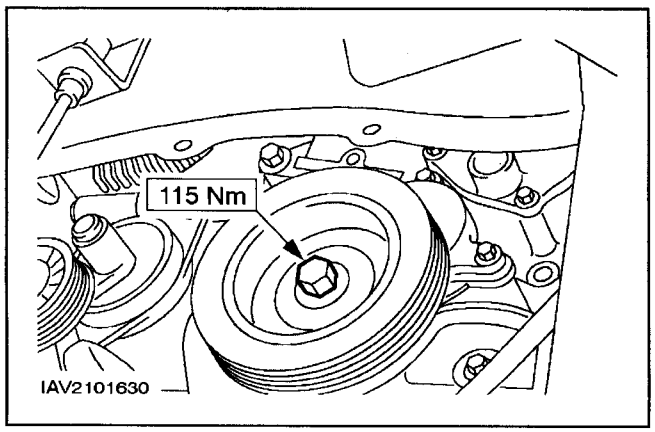
28. **NOTE:** Verify that the center bolt is centered in the support insulator.

    Tighten the center bolt of the left-hand engine support insulator.

IN-VEHICLE REPAIR (Continued)

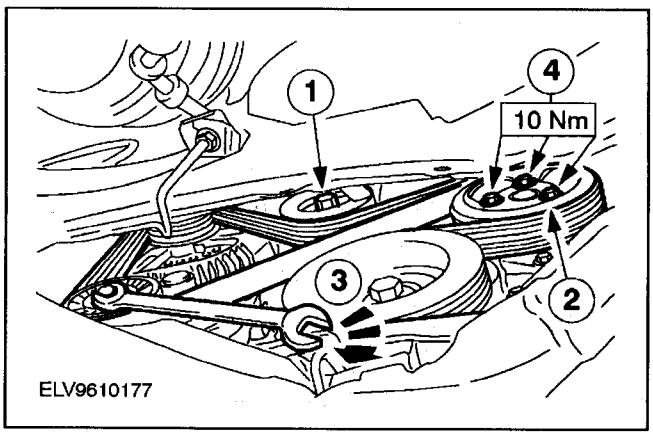


29. Install the lower part of the engine front cover.



30. **NOTE:** Use the access hole in the bottom of transaxle case to stop engine rotating.

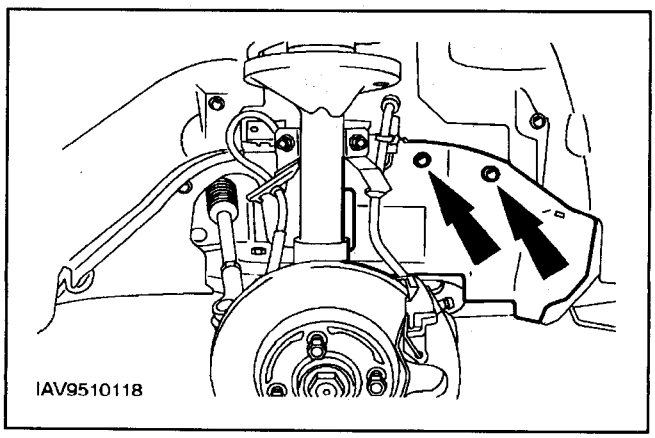
    Install the crankshaft pulley/vibration damper.



31. **NOTE:** Note the accessory drive belt direction mark if belt is to be reused.

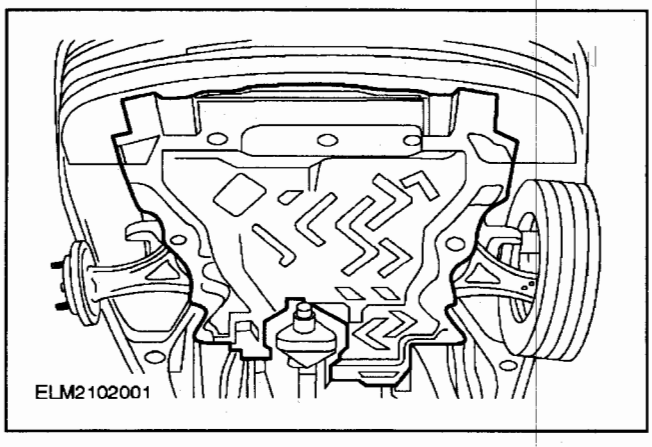
    Install the accessory drive belt.

    1 Install the belt idler pulley.
    2 Install the water pump pulley.
    3 Tension the belt tensioner clockwise and position the accessory drive belt in place.
    4 Tighten the water pump pulley bolts.



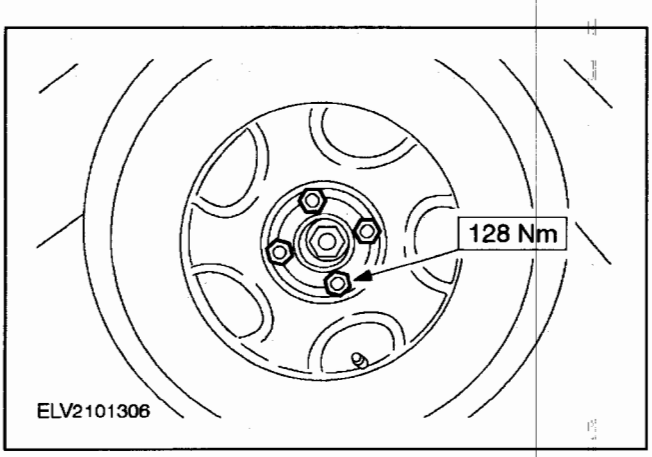
32. Install the right-hand front lower splash shield.
    - Install the right-hand front wheel.

IN-VEHICLE REPAIR (Continued)



33. Install the engine undershield (if equipped).

34. Lower the vehicle.



35. Install the right-hand front wheel.

36. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 Km (10 miles) or more to relearn the strategy.

    Connect the battery ground cable.

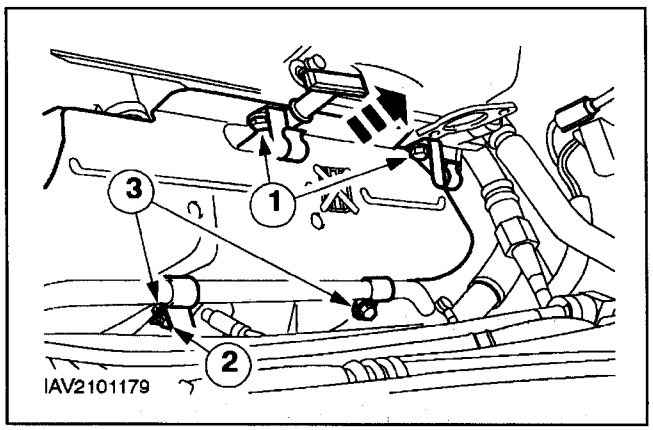
37. Check the fluid levels and correct as necessary.

38. Check the routing of the vacuum hoses and wiring and secure them with cable ties.

IN-VEHICLE REPAIR (Continued)

Exhaust Manifold

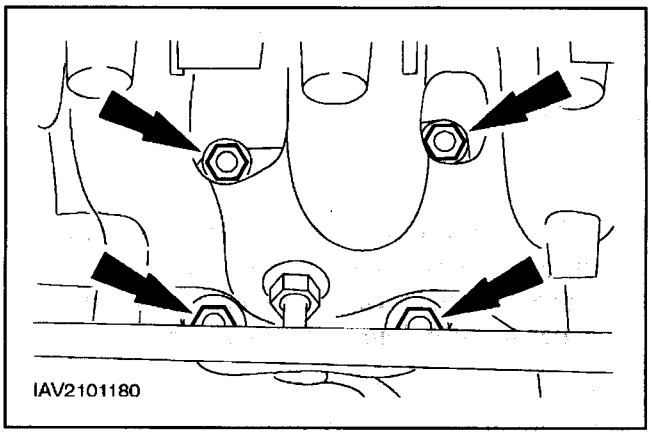
Removal



1. Remove the exhaust manifold heat shield.
   1 Remove the upper bolts.
   - Remove the coolant hose bracket and the engine lifting eye, and pull out the engine oil level indicator tube.

   2 Remove the coolant hose clamp.
   3 Remove the lower bolts.

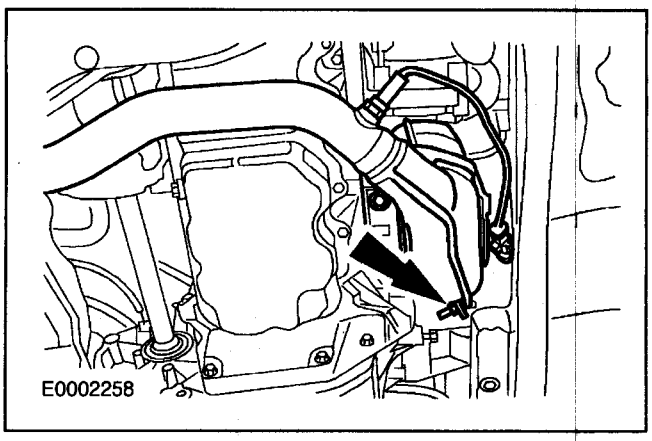
2. **CAUTION: When repairing the exhaust system or removing exhaust components, disconnect the heated oxygen sensor (HO2S) at the wiring harness to prevent damage to the sensors and the harness.**
   Disconnect the HO2S wiring electrical connector.



3. Disconnect the three way catalytic converter (TWC) from the exhaust manifold.

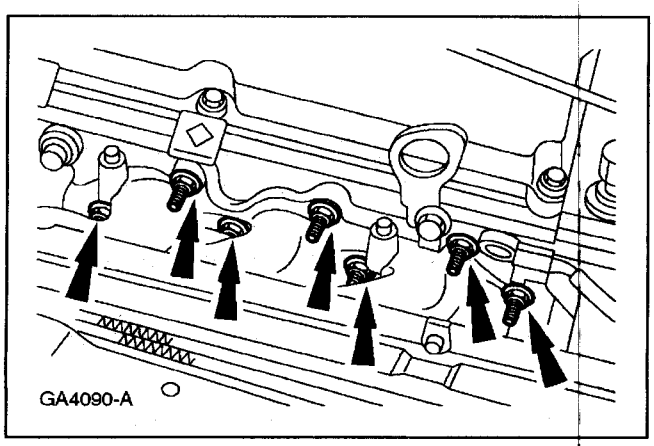
4. Raise and support the vehicle. For additional information, refer to Section 100-02.

IN-VEHICLE REPAIR (Continued)



5. Loosen the TWC bracket bolt and lower the TWC so the studs clear the exhaust manifold.

6. Lower the vehicle.

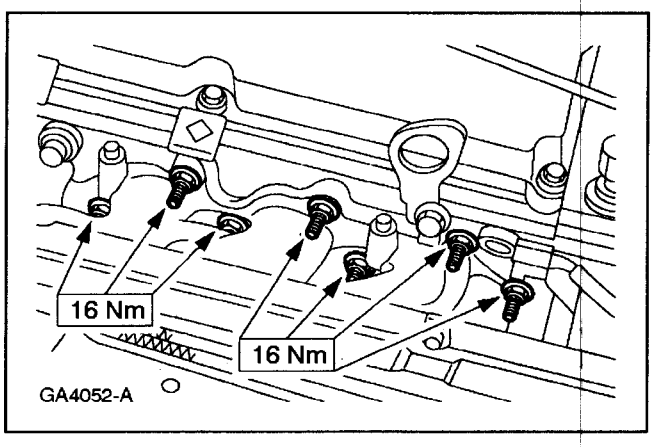


7. **CAUTION: Do not work on the aluminum engine components until the engine is cold.**

   Remove the exhaust manifold.

   - Remove the four nuts.
   - Discard the exhaust manifold gasket.

Installation

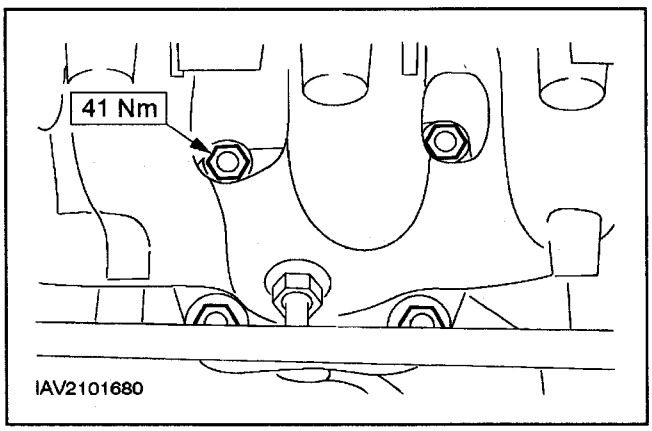


1. **CAUTION: Do not use abrasive grinding discs to remove gasket material; use only plastic manual scrapers. Do not scratch or gouge the aluminum sealing surfaces.**

   Install the exhaust manifold.

   - Install a new exhaust manifold gasket.

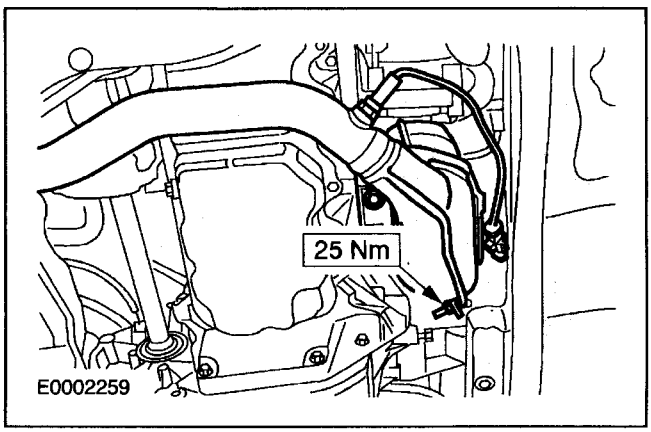
IN-VEHICLE REPAIR (Continued)



2. Connect the TWC to the exhaust manifold.

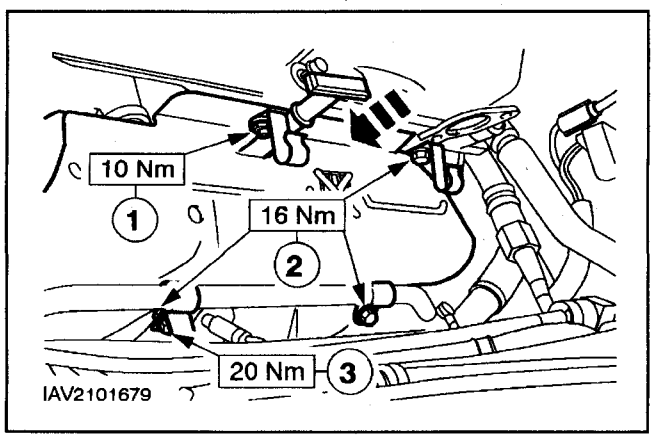
3. Connect the H02S electrical connector.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.



5. Tighten the TWC bracket bolt.

6. Lower the vehicle.



7. Install the heat shield.
   - Insert the oil level indicator tube into the cylinder block and position the coolant hose bracket and the engine lifting eye in position.
   1 Install in the upper bolts.
   2 Install the lower bolts.
   3 Install the to the coolant hose bracket.

IN-VEHICLE REPAIR (Continued)

Cylinder Head

Special Tool(s)

 21008a01	Installer, Oil Seal, Timing Cover 303-160 (T81P-6292-A)

General Equipment

Spatula
Transmission jack
Wooden blocks
Workshop hoist

Materials

Item	Specification
Cable ties	
Super Premium SAE 5W30 Motor Oil XO-5W30-QSP	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Gasket Maker F8AZ-19B508-AB	WSK-M2G348-A5

Removal

1. **CAUTION: The maximum amount by which the engine management system will adjust the camshaft timing (VCT control unit) is limited to two degrees. As a result of this an extremely high degree of accuracy is required for any work which affects the valve timing.**

   NOTE: The locations of engine mountings and engine support insulators are described looking from the transaxle to the engine.

   NOTE: Operation steps which only apply to certain model variants and therefore do not apply to all vehicles are clearly marked.

   Disconnect the battery ground cable.

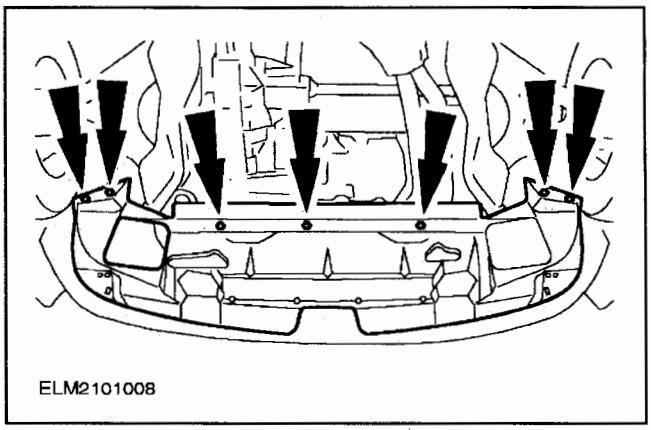
2. **WARNING: When releasing the system pressure, cover the coolant expansion tank cup with a thick cloth to prevent the possibility of scalding. Failure to follow these instruction will result in personal injury.**

   Release the coolant expansion tank cap.

3. Loosen the RH front wheel nuts.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.
   - Remove the right-hand front wheel.

IN-VEHICLE REPAIR (Continued)

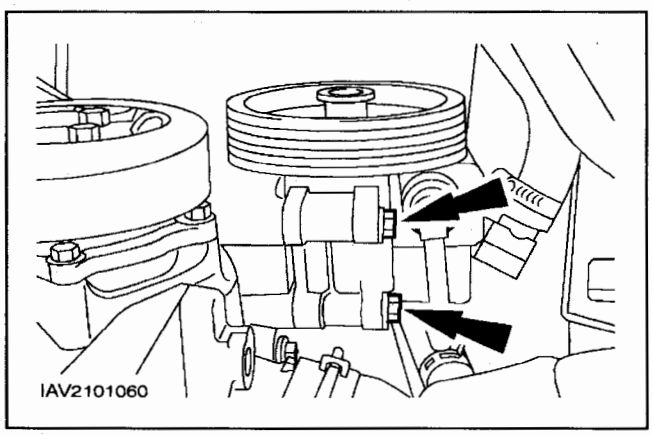


5. ⚠ **WARNING: When the engine is hot there is a risk of scalding.**

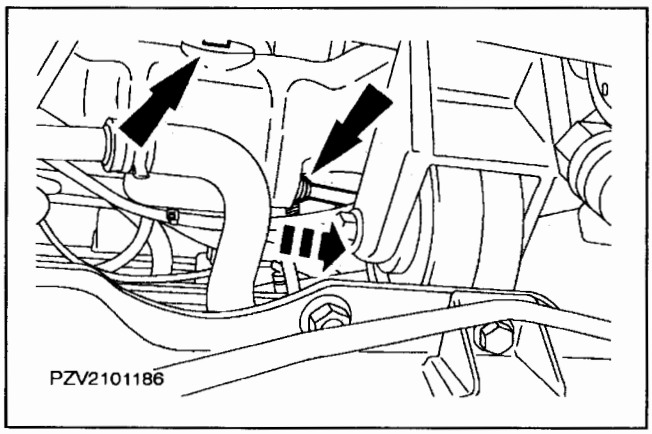
   Remove the radiator splash shield and drain the coolant.

   1 Remove the six bolts.

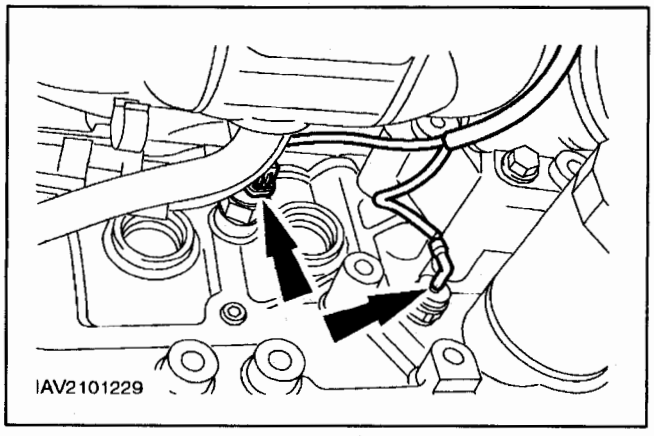
   2 Unscrew the radiator drain plug.



6. Remove the power steering pump lower bolts.



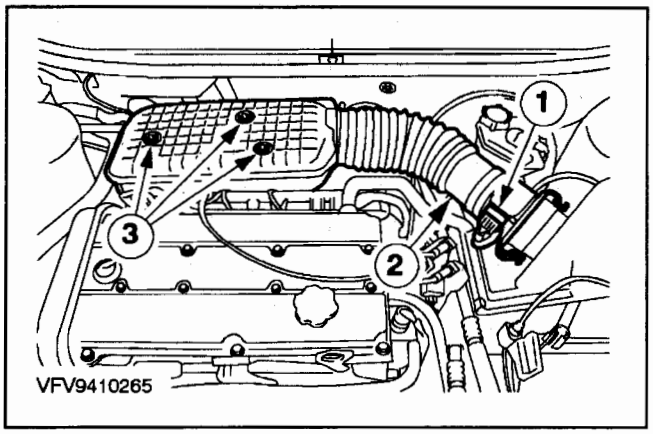
7. Disconnect the brake booster line and the crankcase ventilation hose from the intake manifold.



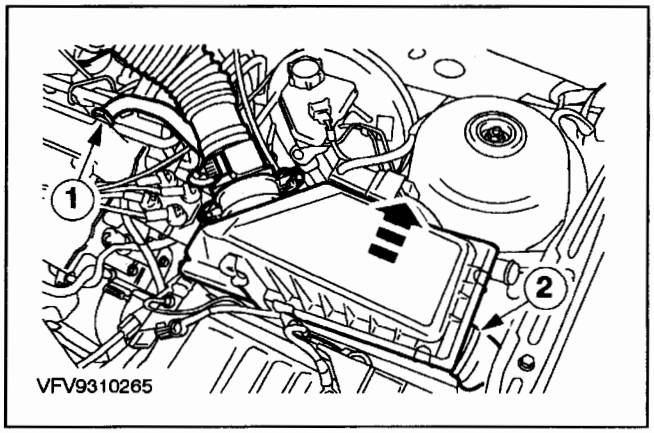
8. Disconnect the oil pressure switch and the knock sensor (KS) electrical connector

9. Lower the vehicle.

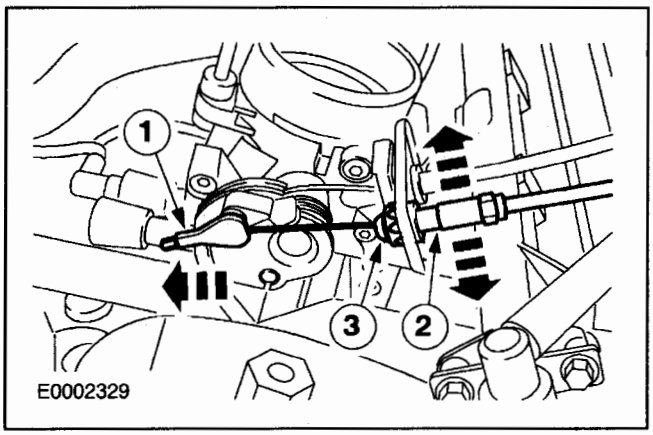
IN-VEHICLE REPAIR (Continued)



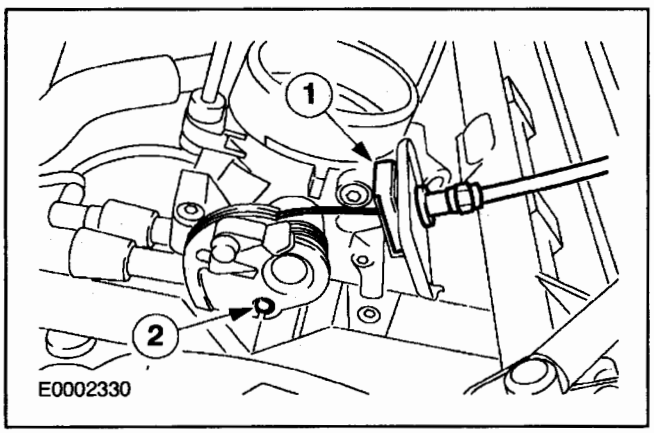
10. Remove the intake pipe.
    1 Disconnect the mass air flow (MAF) sensor electrical connector.
    2 Disconnect the intake air temperature (IAT) sensor electrical connector.
    3 Remove the bolt and the two nuts.



11. Remove the air cleaner (ACL).
    1 Disconnect the crankcase ventilation hose.
    2 Disconnect the intake hose.

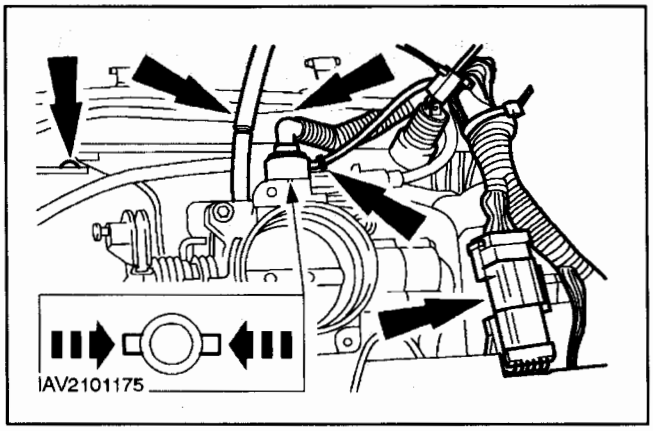


12. Disconnect the speed control cable.
    1 Disconnect the cable from throttle valve.
    2 Move the cable up and down and pull it out of the retaining bushing.
    3 Press the retaining bushing out of the bracket.

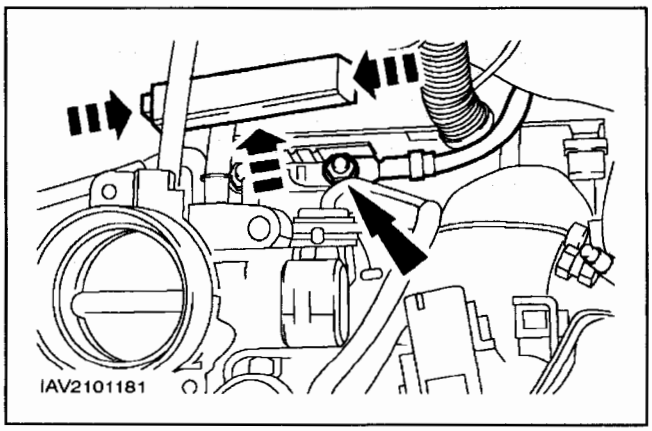


13. Disconnect the throttle cable.
    1 Remove the plastic clip and position the throttle cable to one side.
    2 Unhook the cable.

IN-VEHICLE REPAIR (Continued)

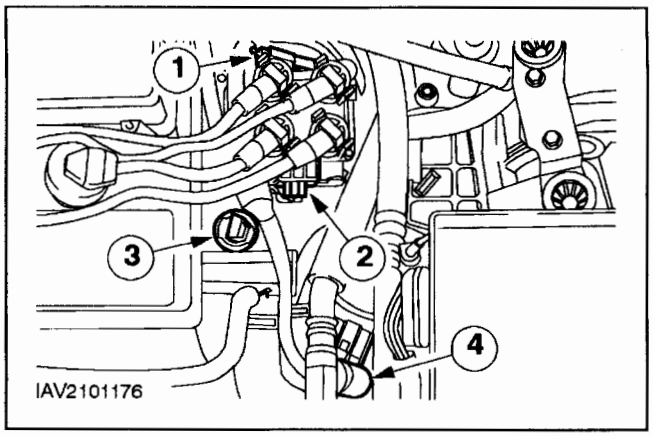


14. Disconnect the wiring harness rail and the vacuum hoses.
    - Disconnect the cylinder head wiring harness electrical connector.
    - Disconnect the vacuum hoses.
    - Unscrew the upper wiring harness rail bolts on the intake manifold.

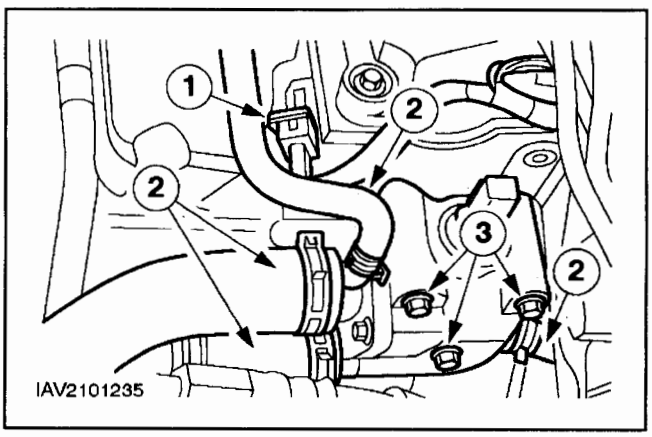


15. Disconnect the starter motor positive lead.
    - Remove the undershield.
    - ⚠ **CAUTION: Do not bend the fusible element when undoing the nut as there is a risk of it breaking.**

      Unscrew the nut.

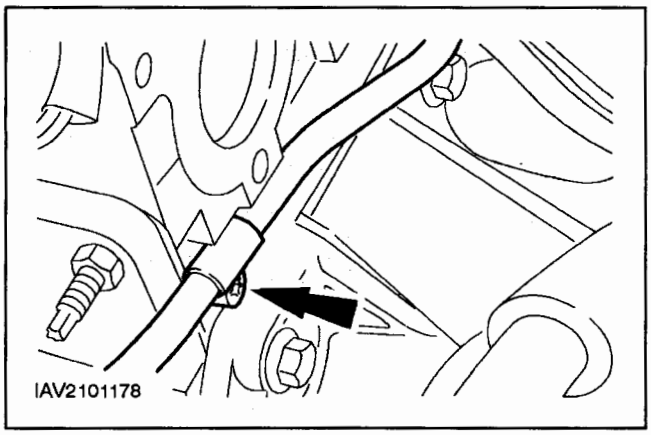


16. Disconnect the electrical connectors.
    1 Radio interference suppressor.
    2 Ignition coil.
    3 Engine coolant temperature (ECT) sensor.
    4 Power steering pressure (PSP) switch.
    - Position the wiring to one side.

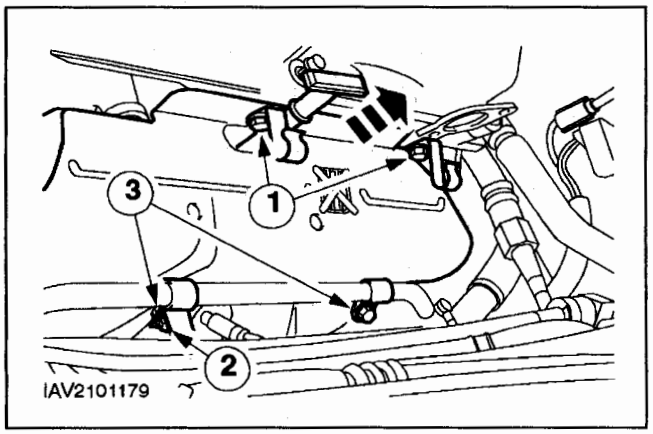


17. Remove the thermostat housing.
    1 Disconnect the camshaft position (CMP) sensor electrical connector.
    2 Disconnect the coolant hoses and position to one side.
    3 Unscrew the bolts.

IN-VEHICLE REPAIR (Continued)

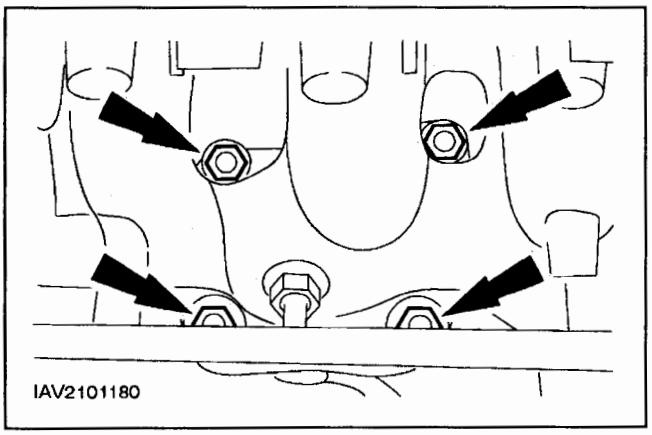


18. Detach the positive crankcase ventilation (PCV) line.

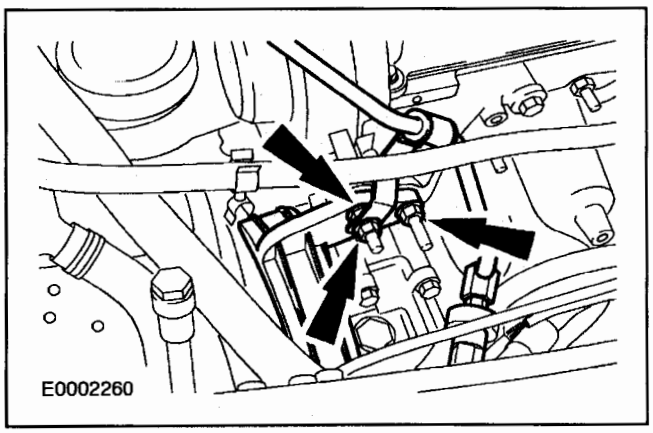


19. Remove the exhaust manifold heat shield.
    1 Unscrew the upper bolts.
    - Remove the coolant hose bracket and the engine lifting eye, and pull out the engine oil level indicator tube.

    2 Remove the coolant hose bracket clamp.
    3 Remove the lower bolts.

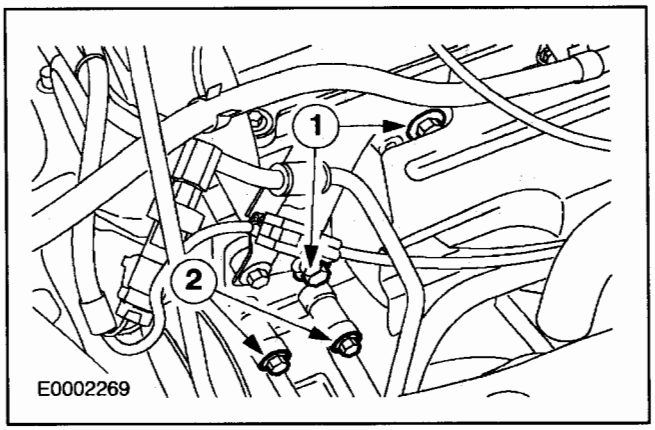


20. Disconnect the three-way catalytic converter (TWC) from the exhaust manifold.
    - Disconnect the heated oxygen sensor (HO2S) electrical connector.

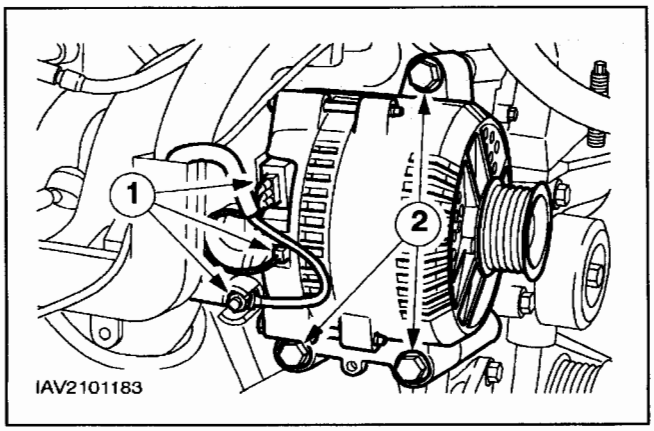


21. Remove the pulley cover.

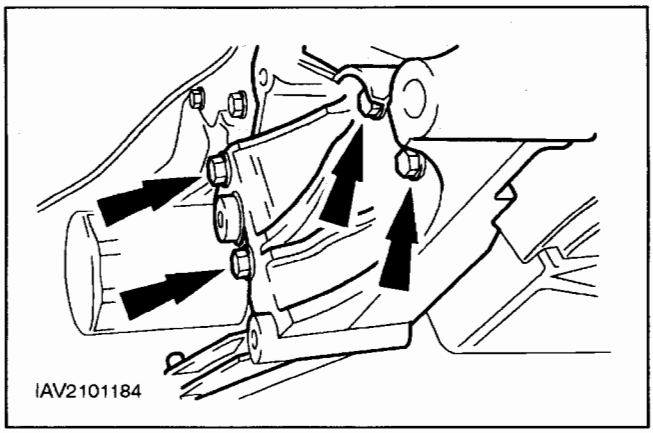
IN-VEHICLE REPAIR (Continued)



22. Detach the power steering pump.
    1 Remove the power steering pump bracket from the cylinder head.
    2 Remove the upper power steering pump bolts.



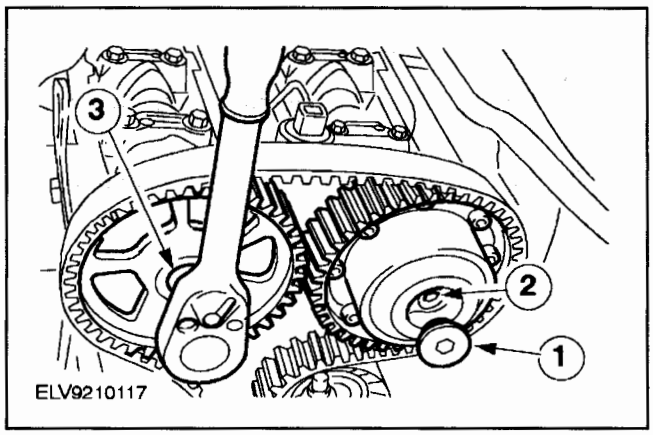
23. Remove the generator.
    1 Disconnect the generator electrical connectors.
    2 Remove the bolts.



24. Remove the generator bracket.

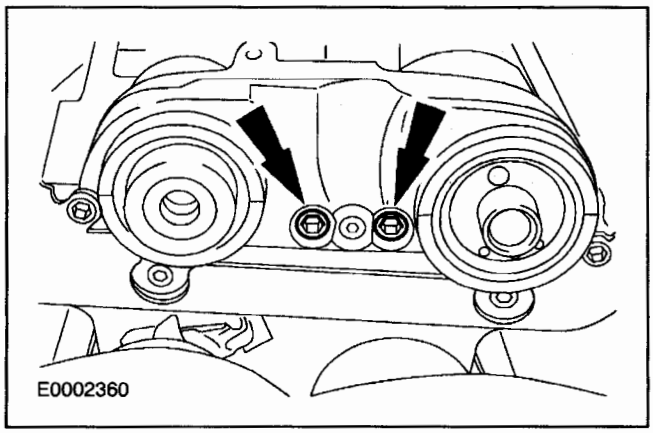
25. Remove the timing belt. For additional information, Timing Belt in this section.

IN-VEHICLE REPAIR (Continued)

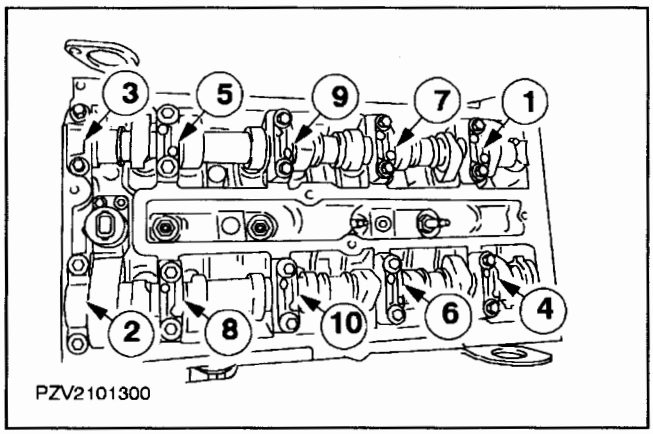


26. Remove the camshaft pulleys.
    - Remove the timing belt.
    1. Remove the blanking plug from the exhaust camshaft pulley.
    2. **NOTE:** Hold the camshaft by the hexagon with an open-ended wrench to stop it from turning.

       Remove the exhaust camshaft pulley.
    3. Remove the intake camshaft pulley.

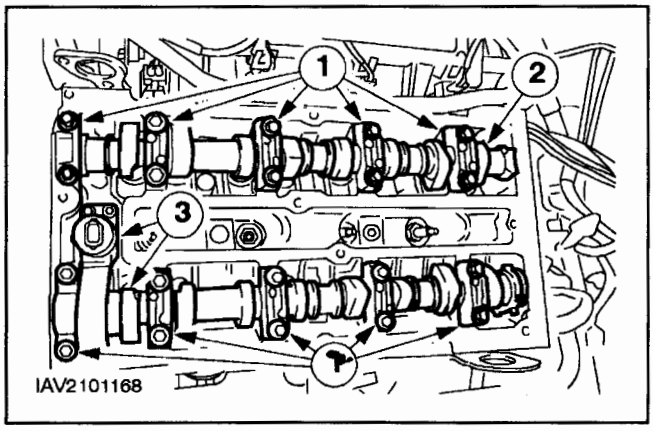


27. Remove the bolts from the variable camshaft timing (VCT) oil feed flange and the upper part of the engine front cover.



28. **NOTE:** Working evenly in several stages, unscrew each bolt two turns at a time.

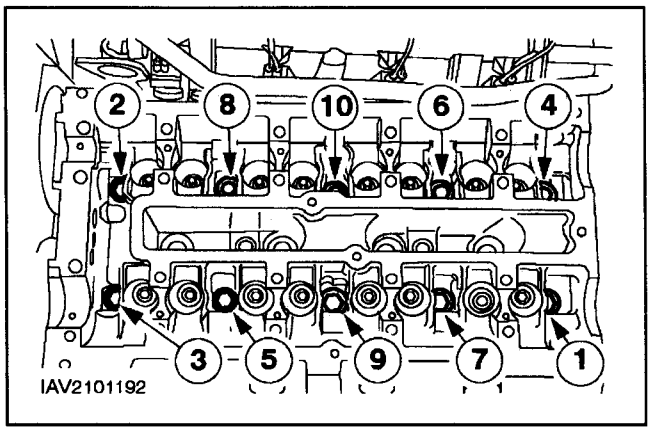
    Loosening sequence of the camshaft bearing caps.



29. **NOTE:** Loosening sequence

    Remove the camshafts.
    1. Remove the camshaft bearing caps.
    2. Remove the intake camshaft.
    3. Remove the exhaust camshaft with the VCT control unit.
    - Remove the valve tappets.

IN-VEHICLE REPAIR (Continued)



30. ⚠ **WARNING: Wait until the cylinder head has cooled down to ambient temperature. Failure to follow this instruction may result in personal injury.**

    NOTE: Loosening sequence

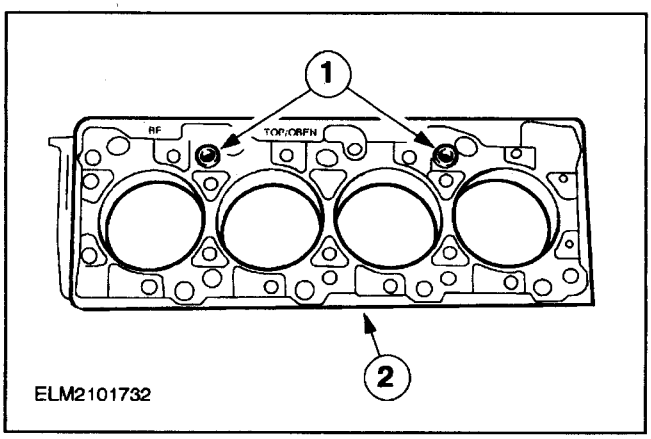
    Remove the cylinder head bolts.

31. Remove the cylinder head.
    - Using the Workshop hoist hook it into the engine lifting eyes; lift off the cylinder head and place it on clean Wooden blocks.
    - Discard the cylinder head gasket.

Installation

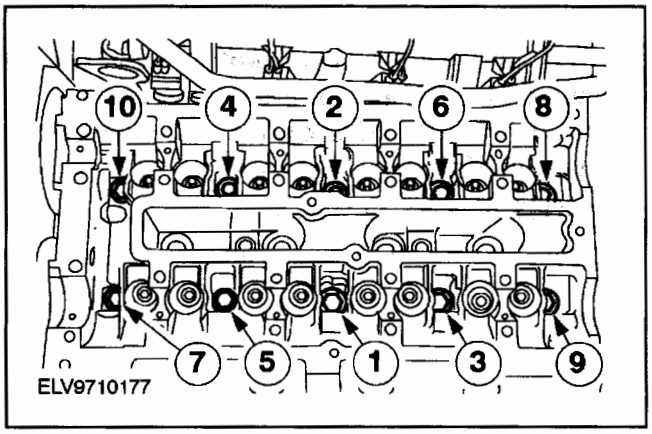
1. Preparatory operations
    - ⚠ **CAUTION: Do not damage the cylinder liners. Remove the ring of carbon from the upper edge of the cylinder.**

      Remove any gasket residues with Gasket Maker F8AZ-19B508-AB meeting Ford specification WSK-M2G348-A5 and a Spatula.
    - Thoroughly clean the threaded bores for the cylinder head bolts.
    - Check the cylinder head distortion. For additional information, refer to Section 303-00.



2. Install the cylinder head.
    1 Make sure the upright seat of the guide sleeves.
    2 Position a new cylinder head gasket onto the cylinder block.
    - Attach the cylinder head into the workshop hoist by the lifting eyes and position it on the cylinder block.

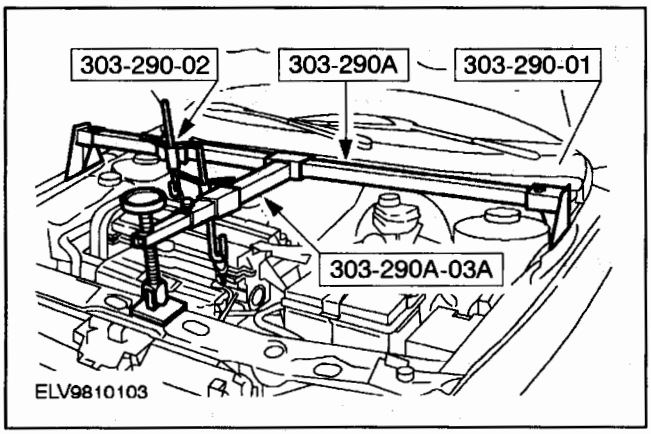
IN-VEHICLE REPAIR (Continued)



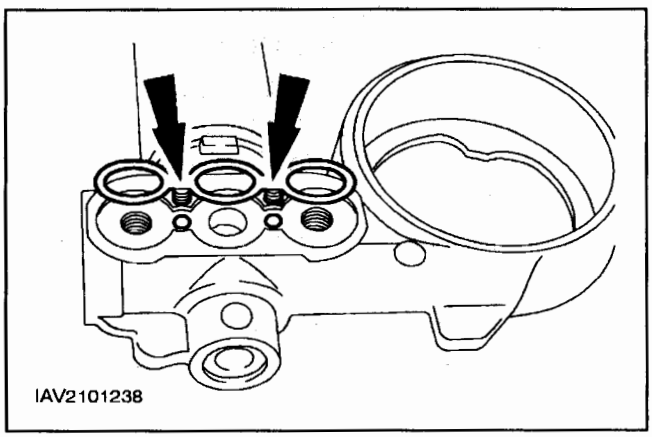
3. ⚠ **CAUTION: The cylinder head bolts must not be tightened more than once.**

   Install the bolts in the sequence shown in three stages:

   - Stage 1: Tighten bolt 1 through 10 to 20 Nm.
   - Stage 2: Tighten bolt 1 through 10 to 40 Nm.
   - Stage 3: Tighten bolt 1 through 10 to 90 degrees.

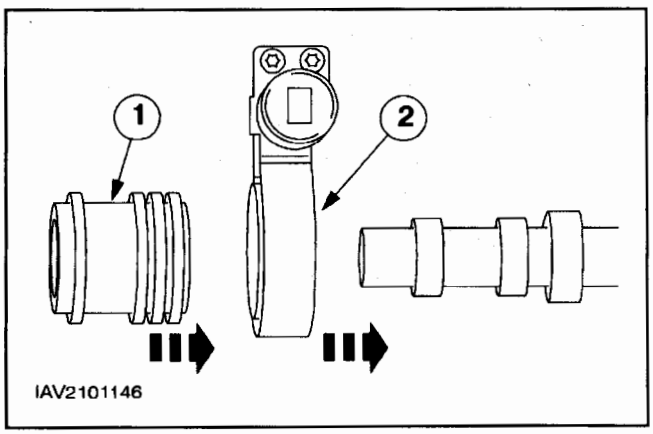


4. Install the special tools.



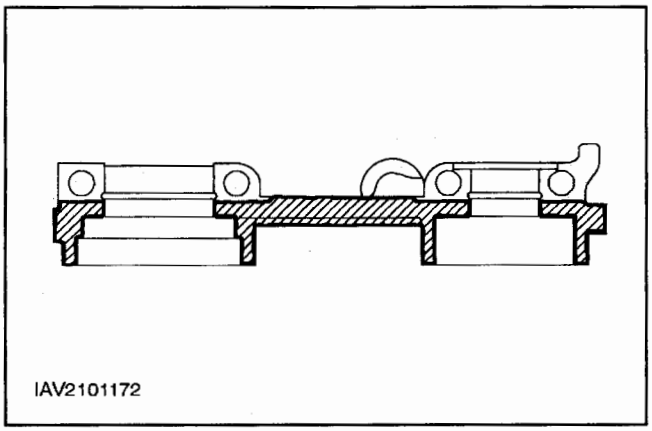
5. **NOTE:** Use a thumb to press the locating pins of the gasket into the holes.

   Press a new gasket into the oil feed flange.

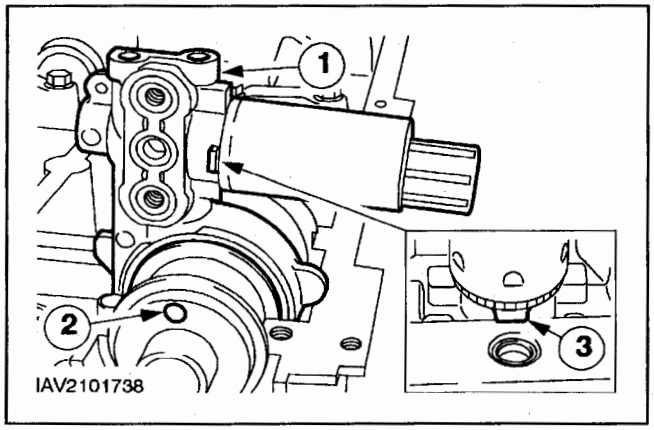


6. Prepare the exhaust camshaft for installation.
   1 Insert the oil feed ring into the oil feed flange.
   2 Slide both components together onto the exhaust camshaft.

IN-VEHICLE REPAIR (Continued)


IAV2101172

7. Thinly coat camshaft bearing cap No. 5 with Silicone Gasket and Sealant F7AZ-19554-EA meeting Ford specification WSE-M4G323-A4.



IAV2101738

8. Insert the camshafts.
   - Lubricate the valve tappets with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H and insert them.
   - Lubricate the camshaft bearings with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H.
   - Insert the intake camshaft.

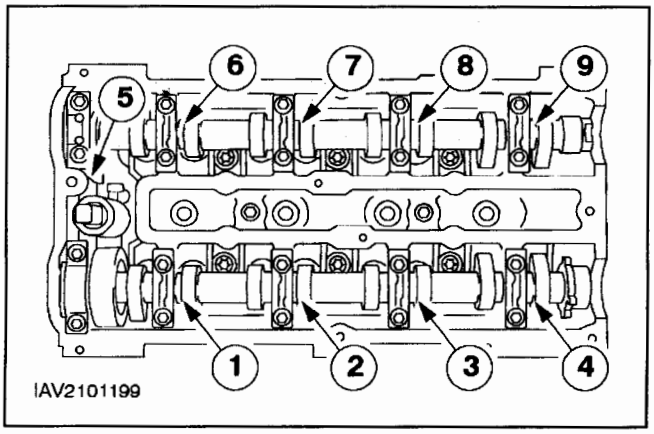
   1 Hold the oil feed flange upwards during installation of the exhaust camshaft.

   2 Position the oil feed ring hole right to the top.

   3 **NOTE:** Keep the oil feed flange away from the cylinder head when turning the flange to avoid damaging the gasket.

   Turn the oil feed flange till the locating lug is in installation position on the cylinder head.

9. Insert new exhaust camshaft oil seal.

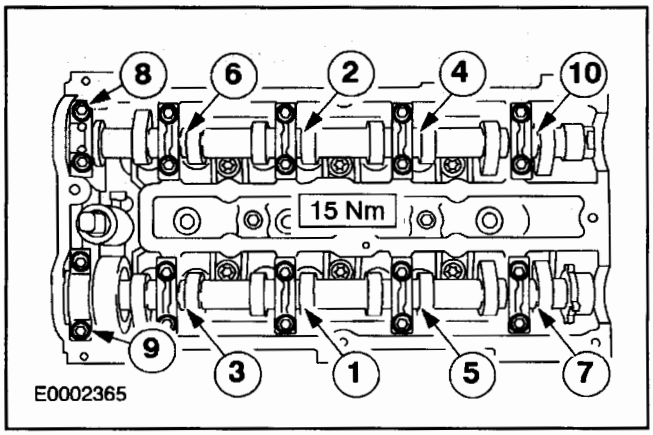


IAV2101199

10. **NOTE:** The numbering is on the outside of the camshaft bearing caps.

    Insert the camshaft bearing caps.

IN-VEHICLE REPAIR (Continued)

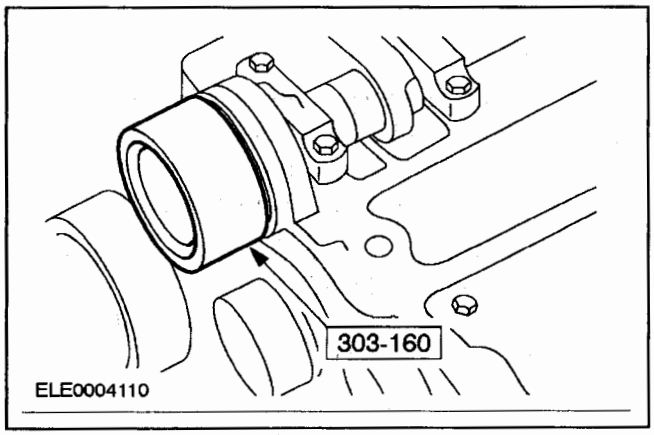


11. **NOTE:** Make sure the upright seat of the exhaust camshaft oil seal during tightening process of camshaft bearing caps.

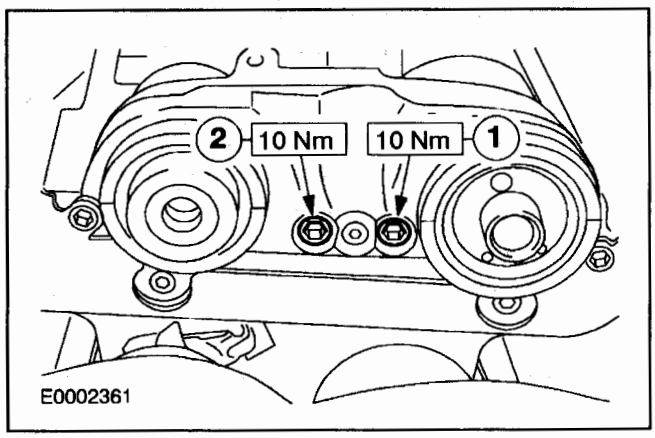
    NOTE: Working evenly in several stages, screw in each bolt two turns at a time.

    NOTE: Tighten the caps in the indicated sequence.

    Tighten the camshaft bearing bolts.



12. Using the special tool, press in the intake camshaft oil seal.



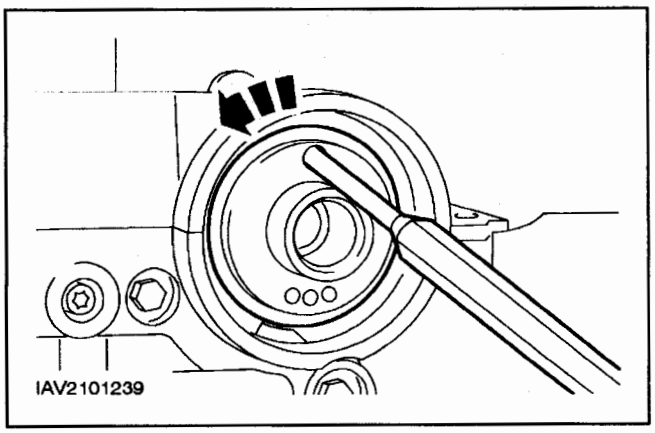
13. **NOTE:** Location lug of the oil feed flange is in installation position on the cylinder head during installation.

    Screw in the oil feed flange bolts and the upper timing case bolts.

    - Finger-tighten the right-hand bolt.
    - Finger-tighten the left-hand bolt.

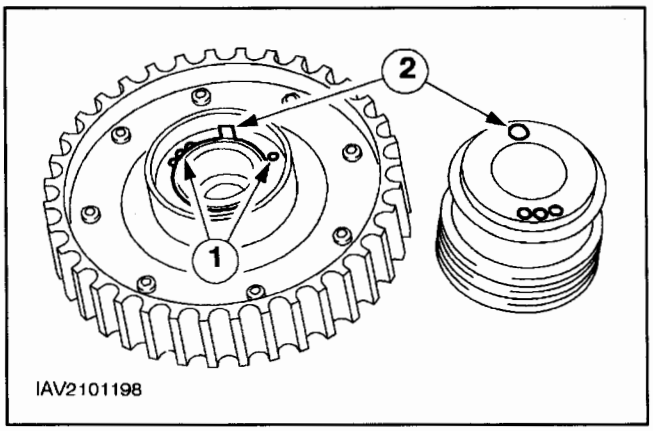
    1 Tighten the right-hand bolt.

    2 Tighten the left-hand bolt.



14. Check that the oil feed ring moves freely.
    - If it is difficult to turn the oil feed ring, loosen the bolts on the oil feed flange and tighten them again as described in step

IN-VEHICLE REPAIR (Continued)

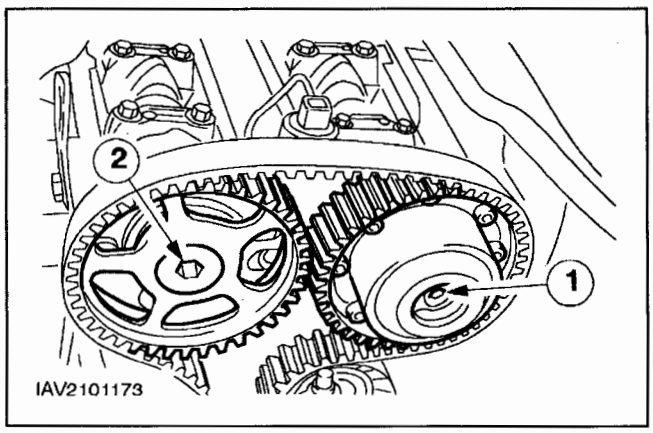


15. **NOTE:** If the lug is bent not centered between the oil bores and the mark, install a new exhaust camshaft pulley.

    Installation position of the exhaust camshaft pulley.

    1 The lug is centered between the oil bores and the mark.

    2 The lug must locate in the hole.



16. ⚠ **CAUTION: Do not rotate the crankshaft. Check that it is still resting against the special tool 303-574.**

    NOTE: Install the bolts but do not tighten at this stage.

    NOTE: New O-ring seal for the exhaust camshaft pulley.

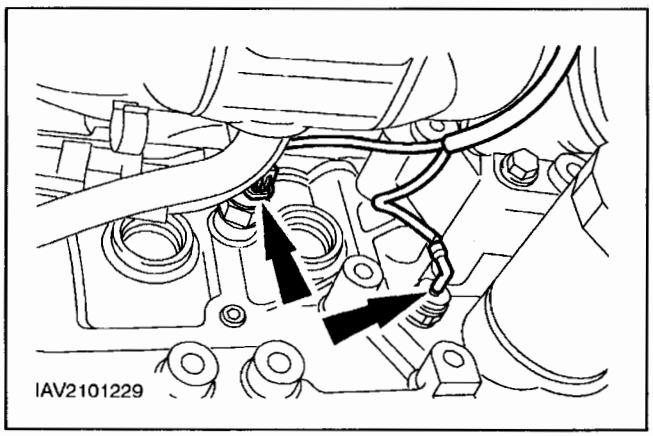
    Slide the camshaft pulleys onto the camshafts, screw in the bolts and position the new timing belt, working counterclockwise.

    1 Install the VCT unit bolt finger tight.

    2 Install the camshaft pulley bolt finger tight.

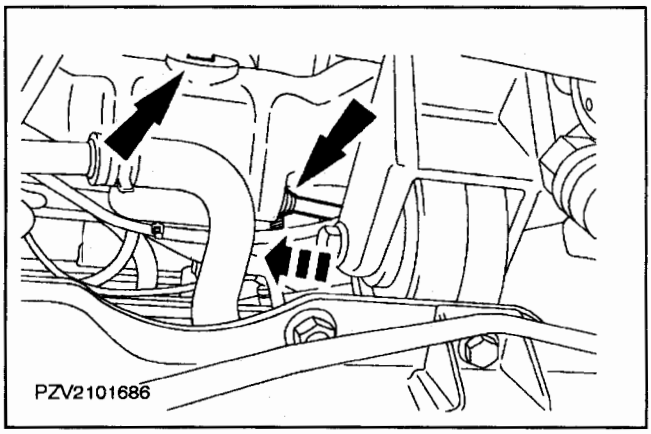
17. Install the timing belt. For additional information, Timing Belt in this section.

18. Raise and support the vehicle. For additional information, refer to Section 100-02.

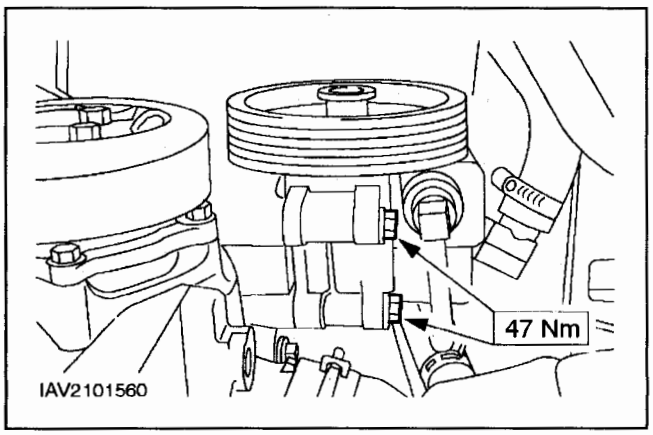


19. Connect the oil pressure switch and the knock sensor electrical connector.

IN-VEHICLE REPAIR (Continued)

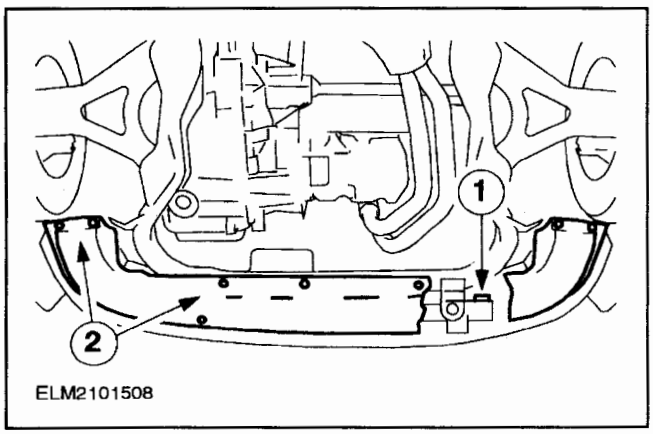


20. Install the brake booster line and the crankcase ventilation hose to the intake manifold.



21. Screw in the lower power steering pump bolts.

22. Position the right-hand front wheel.

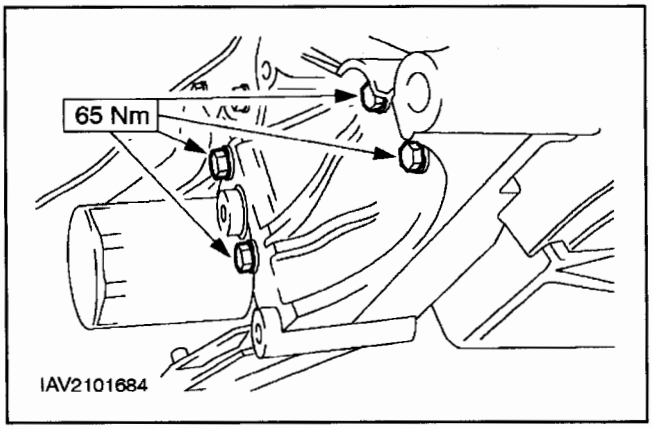


23. Install the lower radiator splash shield.
    1 Tighten the coolant drain plug.
    2 Install the seven bolts.

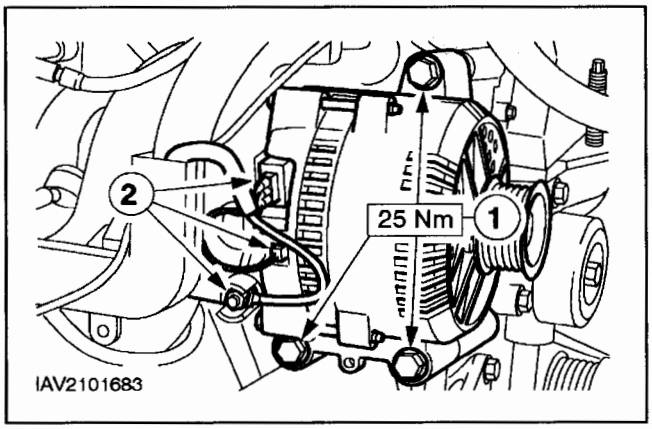
24. Lower the vehicle.

25. Secure the right-hand front wheel.

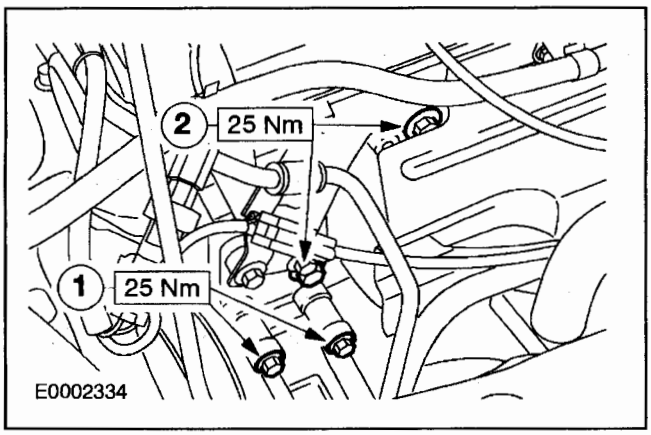
IN-VEHICLE REPAIR (Continued)



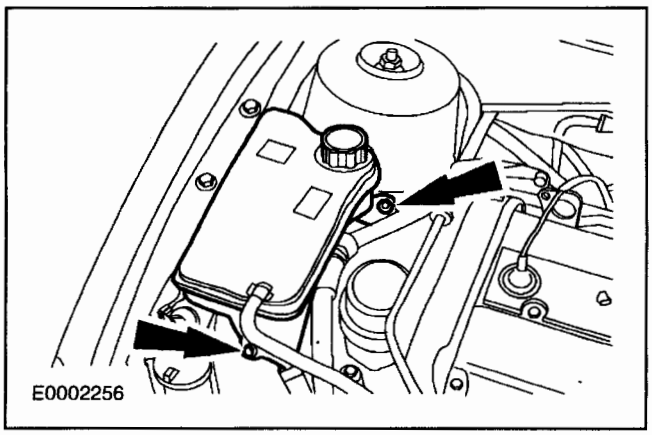
26. Install the generator bracket.



27. Install the generator.
    1 Install the bolts.
    2 Connect the generator electrical connectors.

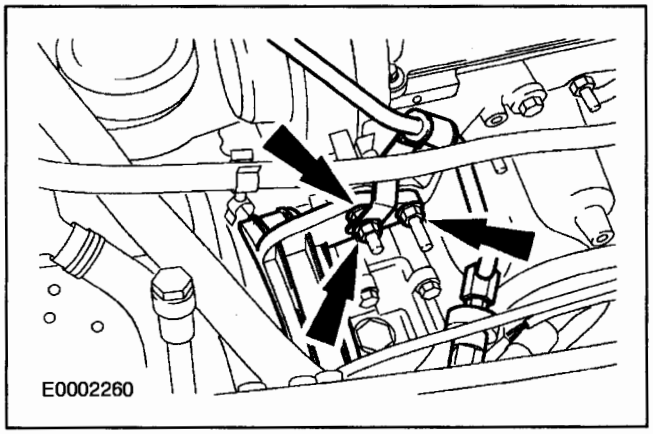


28. Install the power steering pump.
    1 Install the upper power steering pump bolts.
    2 Attach the power steering pump bracket to the cylinder head.

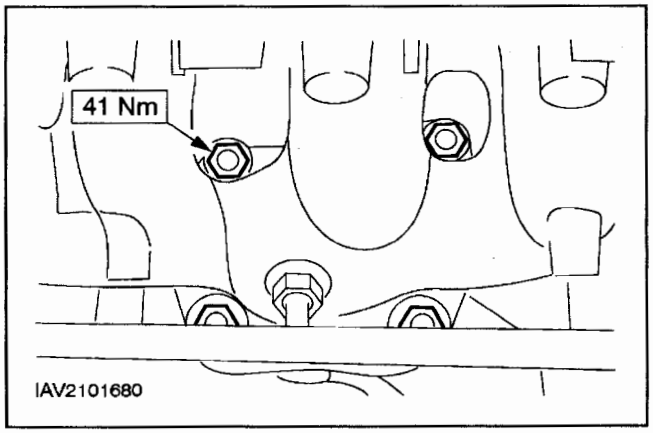


29. Install the coolant expansion tank.
    - Attach the speed control cable (if equipped) to the coolant expansion tank.

IN-VEHICLE REPAIR (Continued)

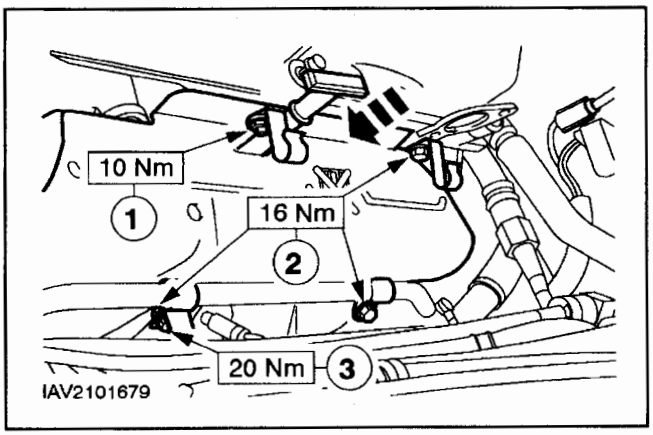


30. Install the pulley cover.

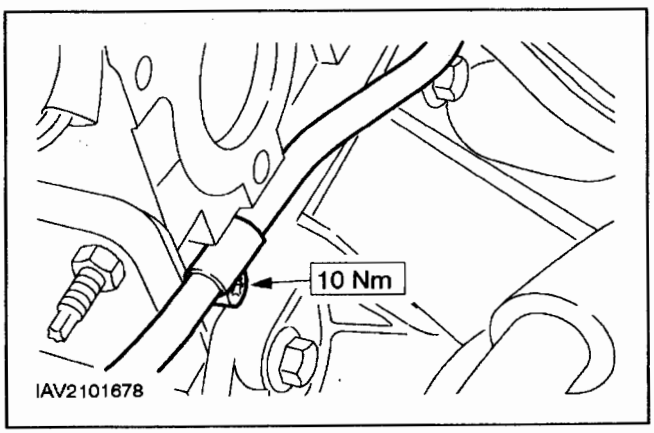


31. Connect the TWC to the exhaust manifold.

32. Connect the HO2S electrical connector.

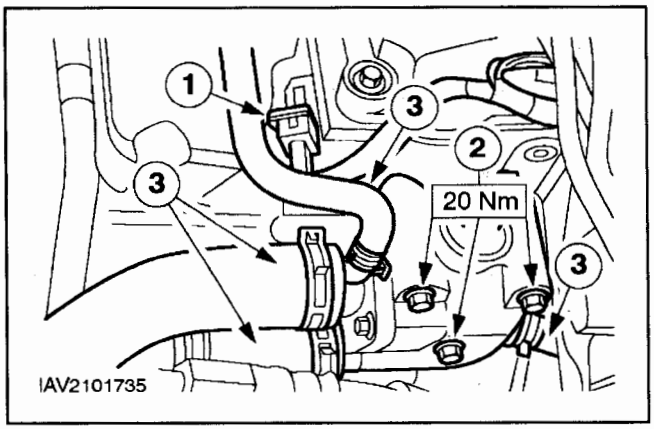


33. Install the exhaust manifold heat shield.
    - Insert the oil level indicator tube, and position the coolant hose bracket and the engine lifting eye.
    1 Install in the upper bolts.
    2 Install the bracket for the tube/hose (A/C).
    3 Install the lower bolts.

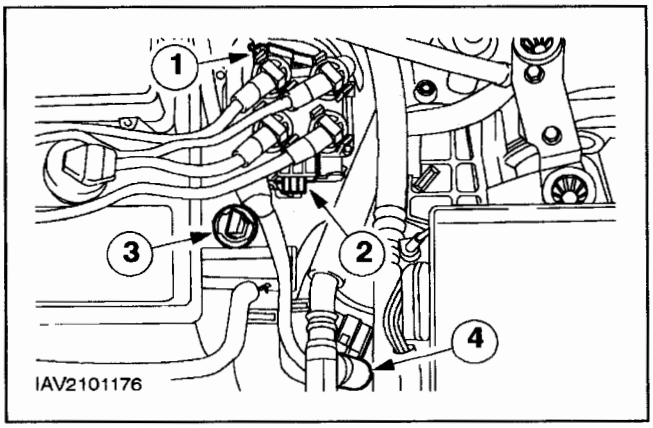


34. Install the positive crankcase ventilation line clamp.

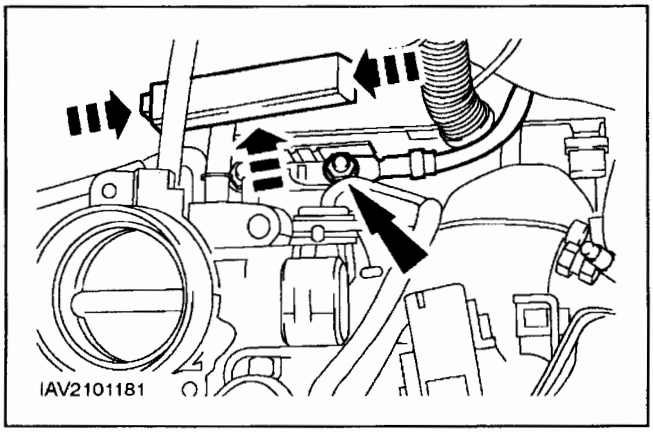
IN-VEHICLE REPAIR (Continued)



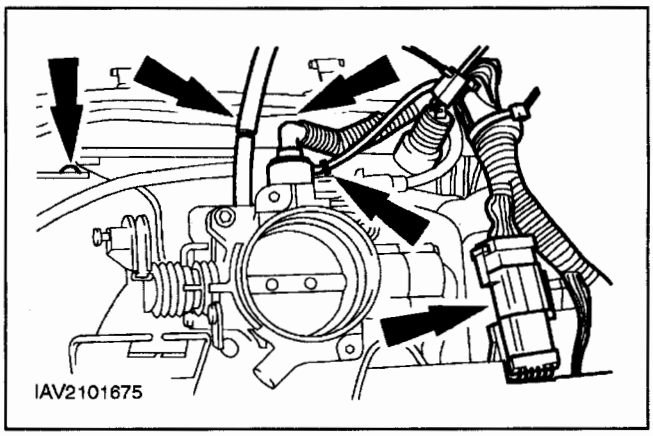
35. Install the thermostat housing with a new O-ring seal.
    1 Connect the CMP sensor electrical connector.
    2 Install in the bolts.
    3 Connect the coolant hoses.



36. Connect the electrical connectors:
    1 Radio interference suppressor.
    2 Ignition coil.
    3 Engine coolant temperature (ECT) sensor.
    4 Power steering pressure (PSP) switch.

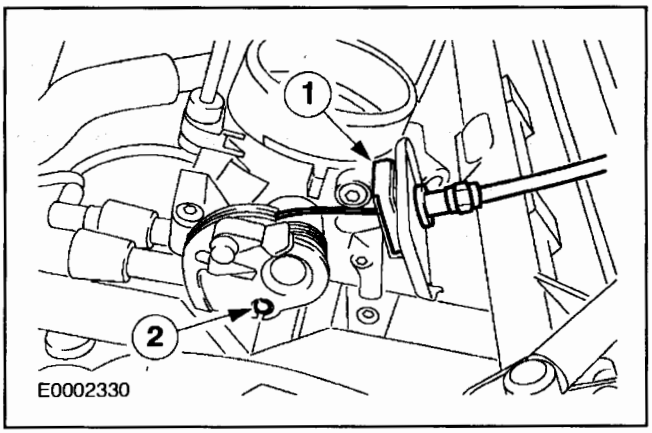


37. Connect the positive lead of the starter motor.
    - ⚠ **CAUTION: Do not bend the fusible element when tightening the nut as there is a risk of breaking it.**
      Install the nut.
    - Install the cover.

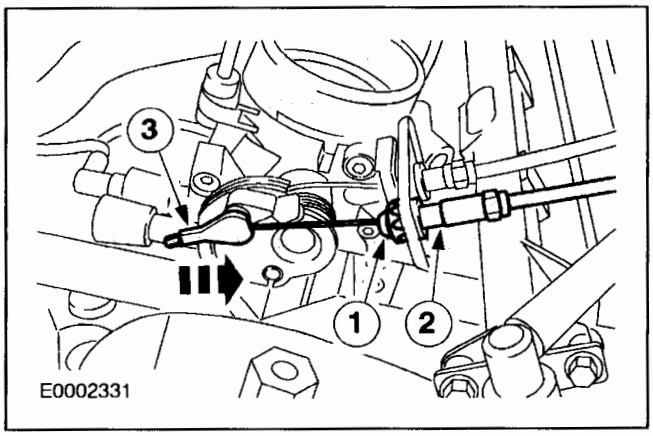


38. Install the wiring harness rail and connect the vacuum hoses.
    - Screw in the upper wiring harness rail bolts.
    - Connect the vacuum hoses.
    - Connect the cylinder head wiring harness electrical connector.

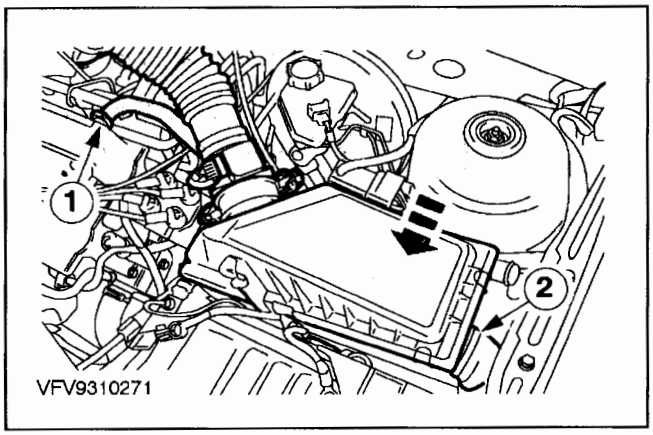
IN-VEHICLE REPAIR (Continued)



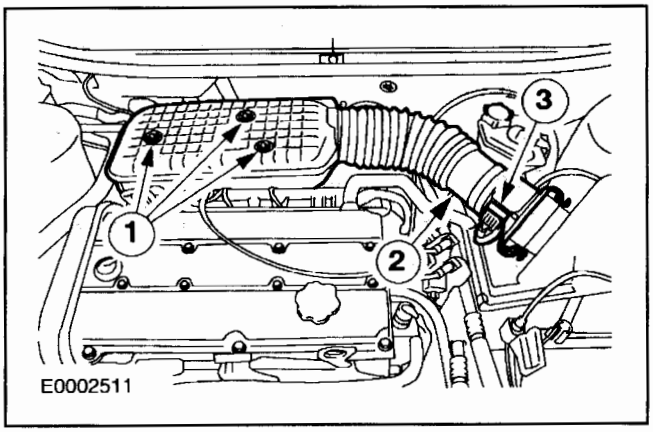
39. Connect the throttle cable.
    - Install the cable in the bracket and slide on the plastic clip.
    - Hook the cable in place.



40. Attach the speed control cable.
    1 Press the retaining bush into the bracket.
    2 **NOTE:** An audible click indicates that it has snapped into place.
    Slide the cable into the retaining bush.
    3 Connect the cable to the throttle valve.

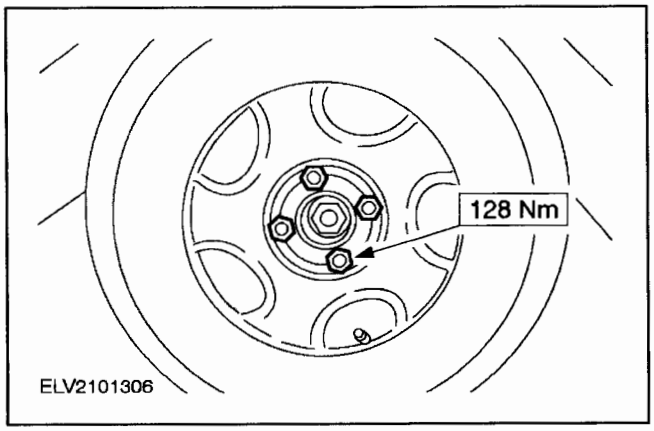


41. Install the air cleaner (ACL).
    - Press the ACL into the rubber mountings.
    1 Connect the crankcase ventilation hose.
    2 Connect the intake hose.



42. Install the intake pipe.
    1 Install the bolt and the two nuts.
    2 Connect the plug of the MAF sensor electrical connector.
    3 Connect the IAT sensor electrical connector.

IN-VEHICLE REPAIR (Continued)



43. Fill the cooling system. For additional information, refer to Section 303-03.

44. Tighten the right-hand front wheel.

45. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 Km (10 miles) or more to relearn the strategy.

    Connect the battery ground cable.

46. Check the fluid levels and correct as necessary.

47. Check the routing of the vacuum hoses and wiring and secure them with Cable ties.

48. **NOTE:** The engine oil temperature must be at least 80°C.

    Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H and oil Filter-change. For additional information, refer to Specifications.

49. Check the fluid level again and correct as necessary.

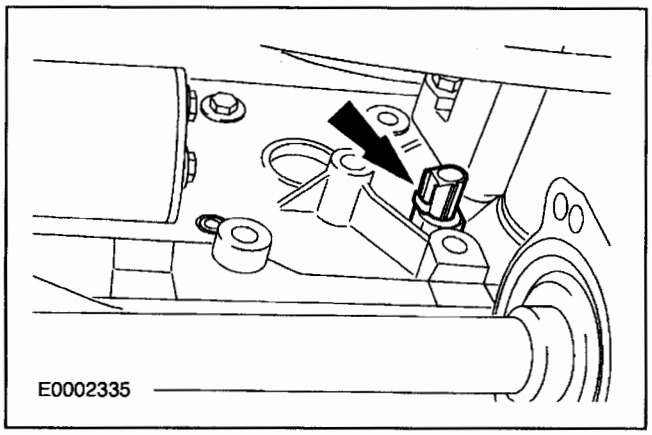
Oil Pressure Switch

Removal

1. Disconnect the battery ground cable.

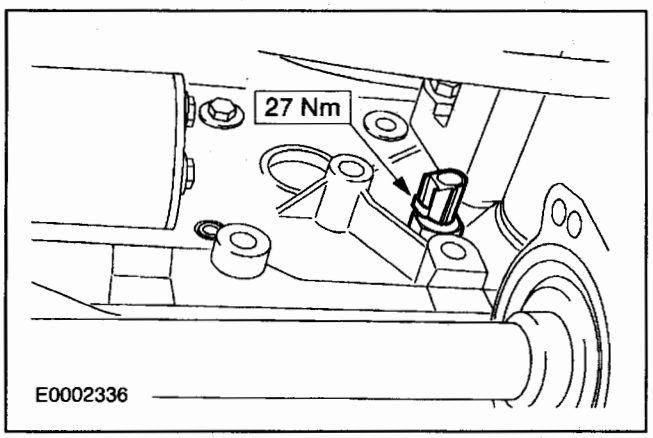
2. Raise and support the vehicle. For additional information, refer to Section 100-02.

IN-VEHICLE REPAIR (Continued)



3. Disconnect the electrical connector at the oil pressure switch.
4. Remove the oil pressure switch.

Installation



1. To install, reverse removal procedure.

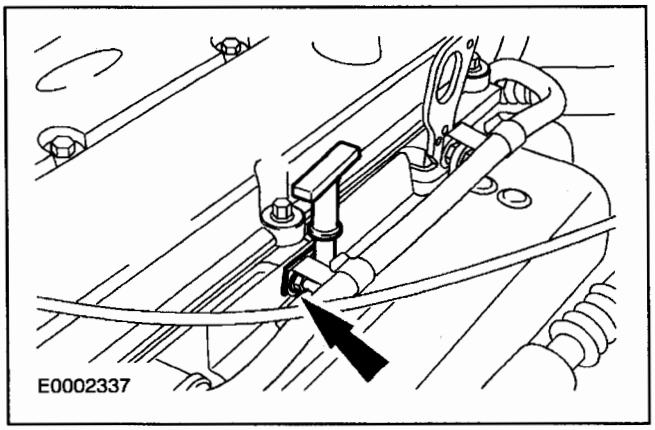
Oil Level Indicator and Tube

Materials

Item	Specification
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

IN-VEHICLE REPAIR (Continued)

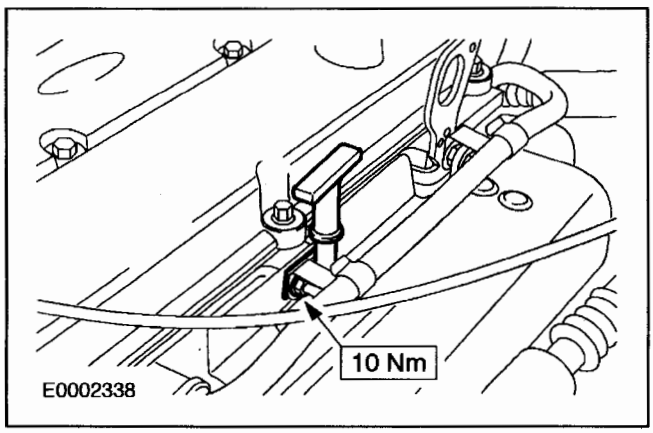
Removal



1. Remove the nut.

2. Remove the oil level indicator tube by pulling upwards.

Installation



1. Apply Threadlock 262 or equivalent meeting Ford specification WSK-M2G351-A6 to the end of the oil level indicator tube. Install the nut.

Oil Pan

General Equipment

Studs, M6 x 20
Rubber hammer
Sharp spatula

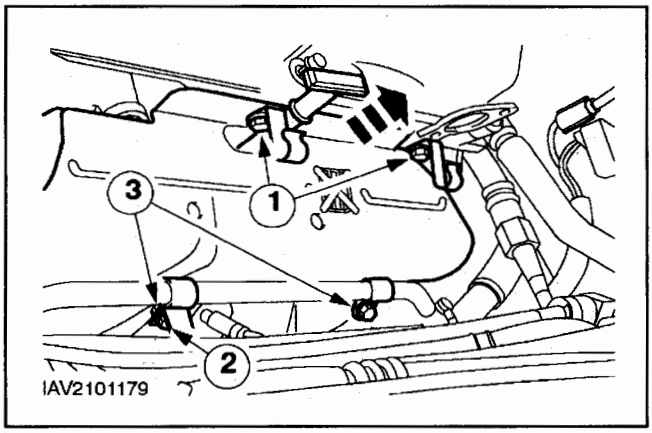
Materials

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Solvent —	WSE-M5B392-A
Cable ties	

Removal

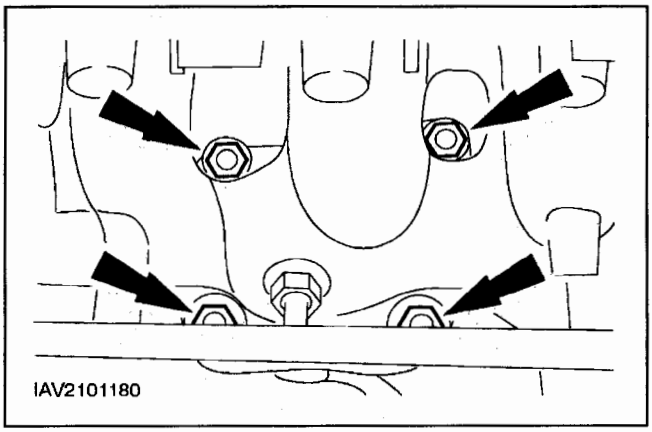
1. Disconnect the battery ground cable.

IN-VEHICLE REPAIR (Continued)



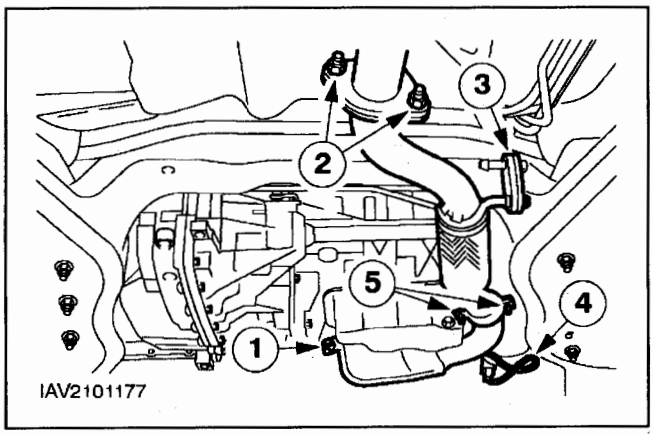
2. Remove the heat shield.
   1 Undo the upper bolt/nut.
   - Remove the coolant hose bracket and the engine lifting eye, and pull out the engine oil dipstick tube.

   2 Remove the bracket for the tube/hose (A/C).
   3 Remove the lower bolts.



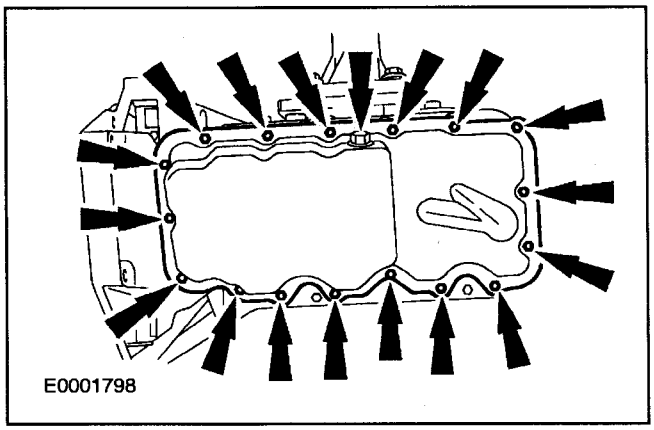
3. Disconnect the three way catalytic converter (TWC) from the exhaust manifold.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.

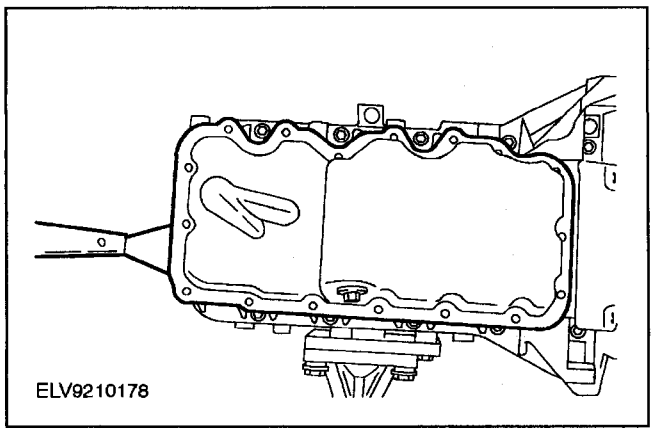


5. Remove the TWC.
   1 Remove the bolt and the retaining clip for the TWC.
   2 Disconnect the TWC from the exhaust system.
   3 Unhook the TWC from the rubber mountings.
   4 Disconnect the heated oxygen sensor (HO2S) electrical connector.
   5 Remove the TWC from the bracket.

IN-VEHICLE REPAIR (Continued)



6. Drain the engine oil at the drain plug and remove the oil pan bolts (shown with engine removed).



7. ⚠ **CAUTION: Do not damage the mating faces.**

   Remove the oil pan (shown at removed engine).

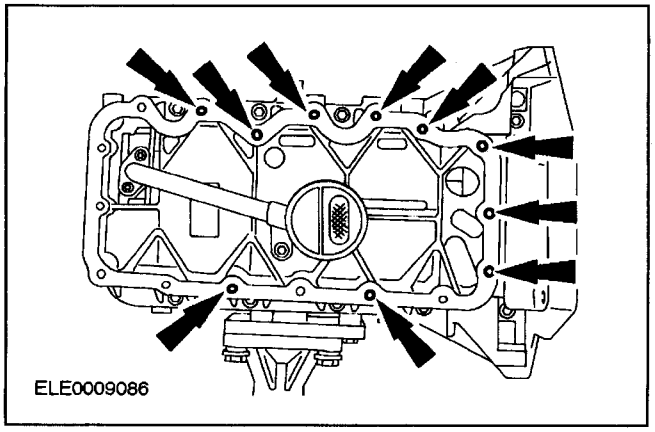
   - Separate the oil pan from the lower crankcase using a sharp Spatula. Release the oil pan from the lower crankcase by tapping slightly against the tightened drain plug with a Rubber hammer.

Installation

1. Preparatory operations
   - **NOTE:** Do not damage the mating faces.

     Clean the mating faces from old sealer.
   - **NOTE:** The mating faces must be free of oil and gasket residue.

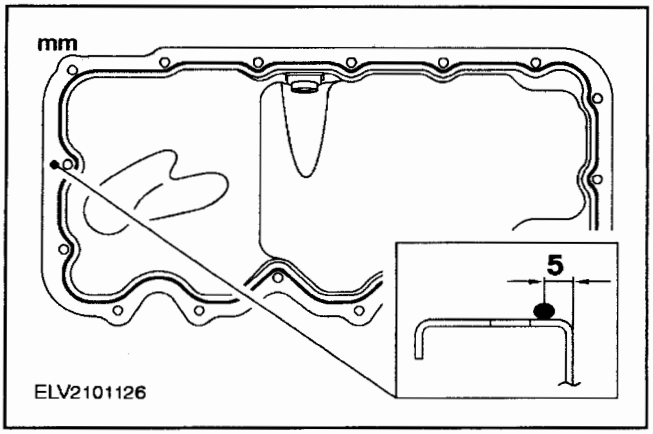
     Clean the oil pan using solvent to remove any oil residue or sludge.



2. ⚠ **CAUTION: Use studs. Sealer in the dead end bores can cause damage to the ladder frame.**

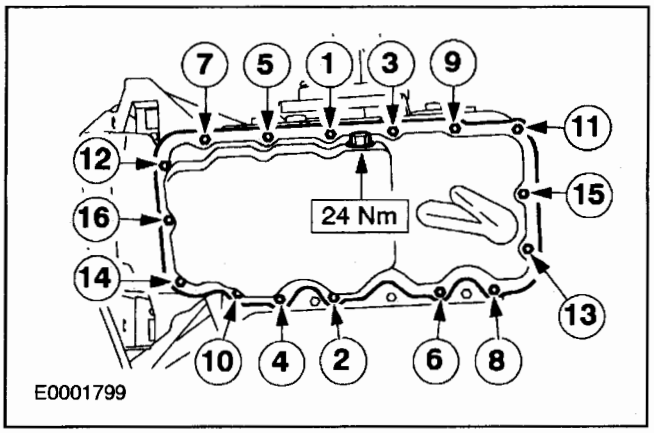
   Install 10 Studs (M6 x 20) in the shown dead end bores.

IN-VEHICLE REPAIR (Continued)



3. **NOTE:** Install the oil pan within 10 minutes after applying the sealer.

   Apply a 3 mm bead of silicone gasket and sealant to the mating face of the oil pan.

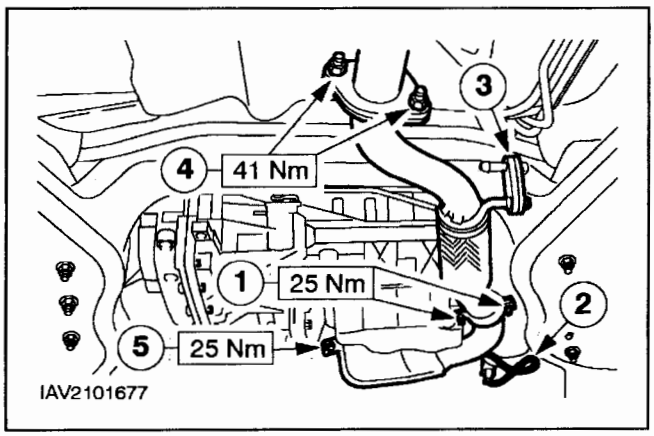


4. **NOTE:** Do not remove the oil pan, after the first contact with the ladder frame.

   NOTE: Tightening sequence.

   Install the oil pan and screw in the drain plug with a new oil seal (shown at removed engine).

   - Tighten the bolts in indicated sequence shown in two stages:
   - Stage 1: 6 Nm
   - Stage 2: 10 Nm

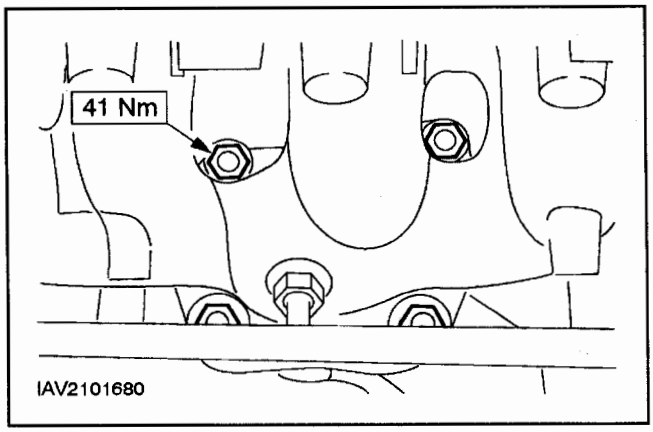


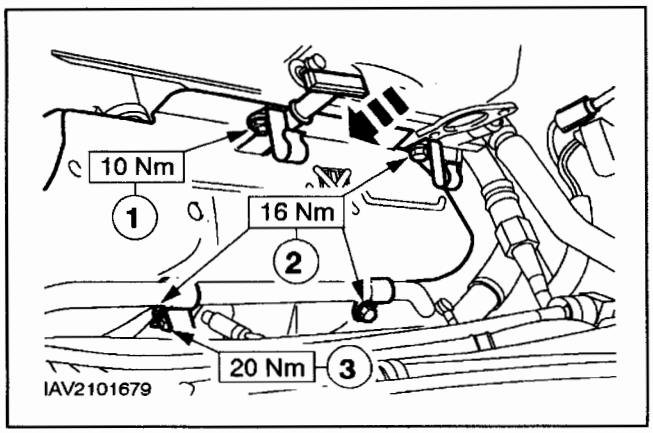
5. Install the three way catalytic converter (TWC).
   - Guide the TWC onto the exhaust manifold studs and into the exhaust.
   1. Attach the TWC to the bracket.
   2. Connect the HO2S electrical connector.
   3. Hook the TWC into the rubber mounting.
   4. Connect the TWC to the exhaust.
   5. **NOTE:** The TWC must be up against the exhaust manifold.

      Secure the retaining clip for the TWC and install in the bolt.

6. Lower the vehicle.

IN-VEHICLE REPAIR (Continued)





7. Attach the TWC to the exhaust manifold.

8. Install the heat shield.
   - Insert the oil level indicator tube into the cylinder block and position the coolant hose bracket and the engine lifting eye in installation position.
   1 Screw in the upper bolt/nut.
   2 Install the lower bolts.
   3 Install the bracket to the air conditioning (A/C) line.

9. Fill with engine oil.
   - Refer to Specifications for fill quantity and required type of oil.

10. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.
    Connect the battery ground cable.

11. Check the fluid levels and correct as necessary.

12. Check the routing of the vacuum hoses and wiring and secure them with Cable ties.

Oil Pump

General Equipment

Feeler Gauge
Straight Edge

Materials

Item	Specification
Silicone gasket and sealant F6AZ-19562-AA	WSE-M4G323-A6

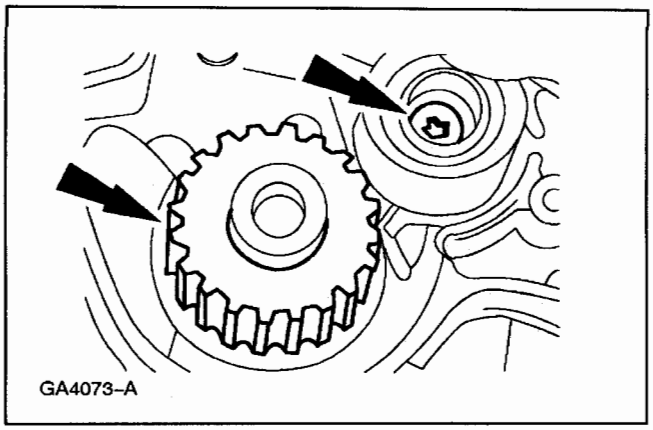
IN-VEHICLE REPAIR (Continued)

Removal

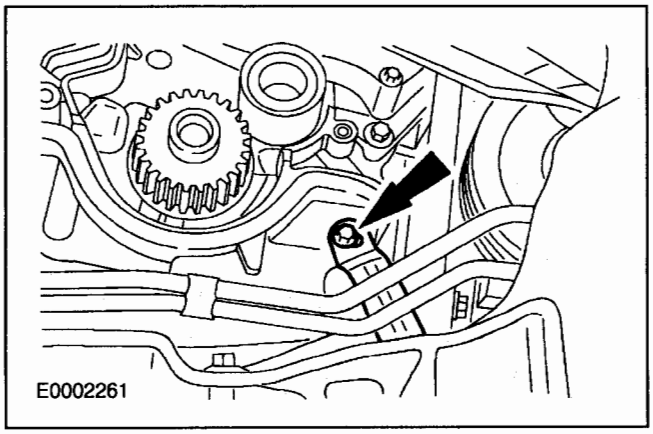
All vehicles

1. Remove the timing belt, For additional information, Timing Belt in this section.

2. Remove the oil pump screen cover and tube, refer to Oil Pump Screen and Pickup Tube in this section.

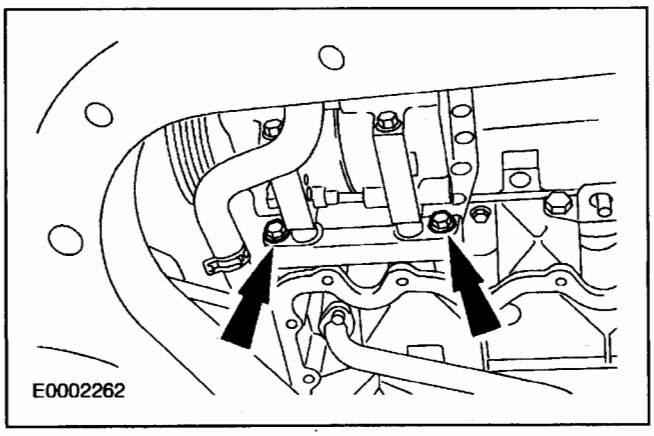


3. Remove the crankshaft timing pulley and idler pulley and spacer.



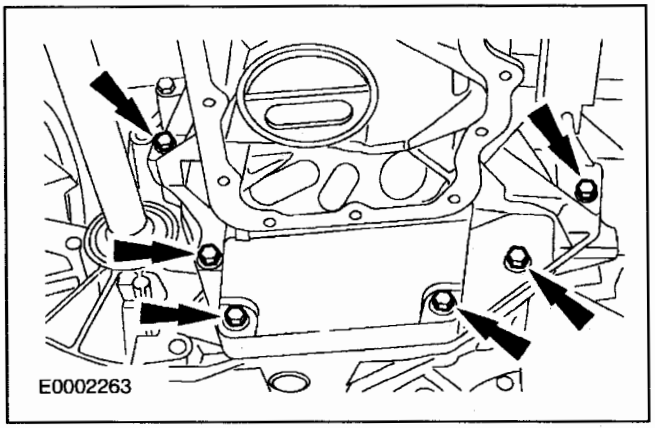
4. Remove the coolant line bracket bolt.

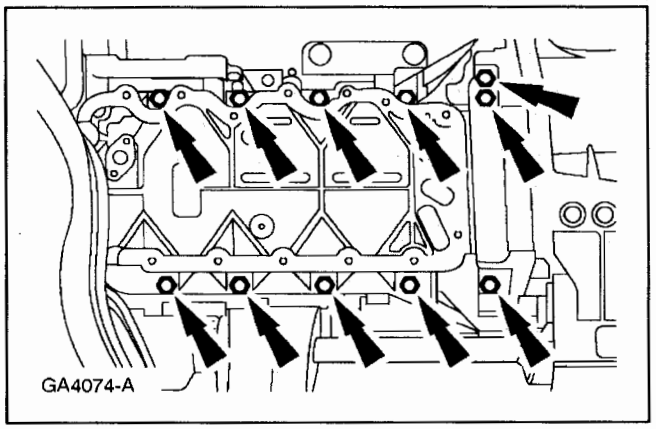
Vehicles with air conditioning

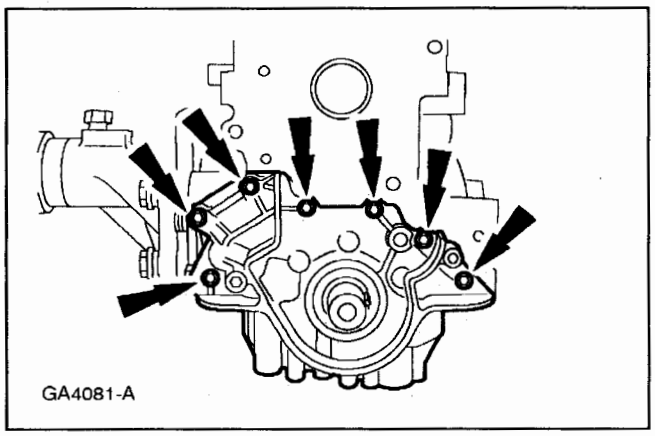


5. Remove the lower A/C bracket bolts.

IN-VEHICLE REPAIR (Continued)







All vehicles

6. Remove the lower crankcase to transmission bolts.

7. Remove the lower crankcase to upper crankcase bolts and remove the lower crankcase.

8. Remove the oil pump bolts and remove the oil pump.

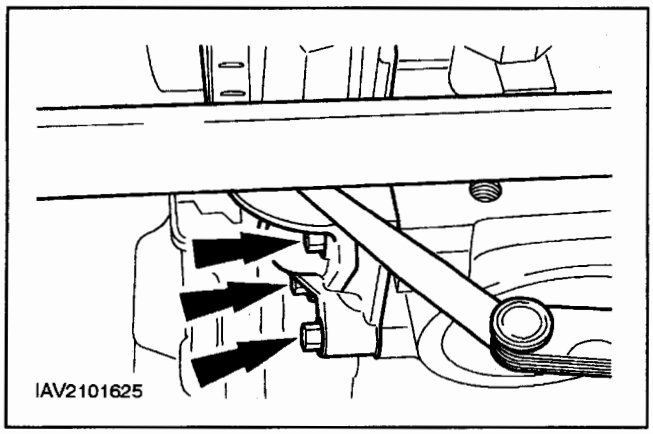
Installation

All vehicles

1. **CAUTION: Do not use abrasive grinding discs to remove gasket material; use only manual scrapers. Do not scratch or gouge aluminum sealing surfaces. Leakage may occur.**

   Clean and inspect the mounting faces of both the oil pump and the cylinder block. Both surfaces must be flat and clean.

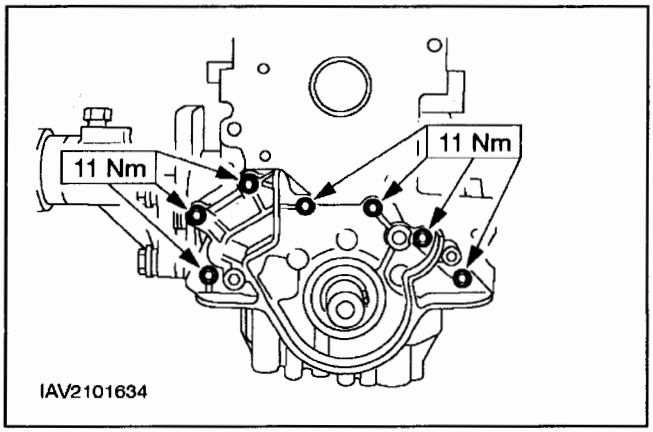
IN-VEHICLE REPAIR (Continued)



2. **NOTE:** Install a new gasket on the oil pump prior to oil pump positioning.

   Position the oil pump.

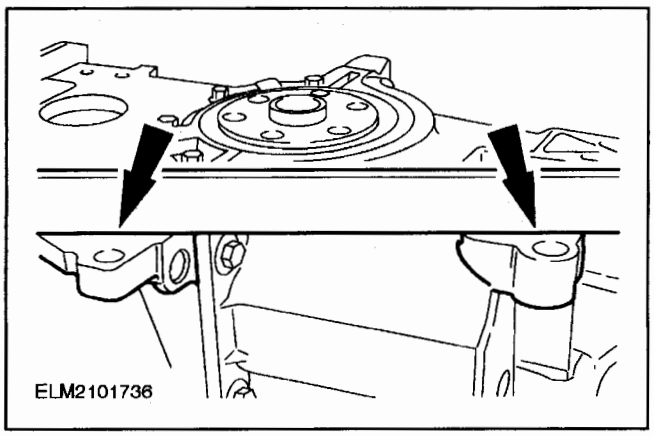
   - Position the oil pump and install the bolts finger tight.
   - Using a Feeler Gauge , align the oil pump on both sides so that the mating face is between 0.3 mm and 0.8 mm below the cylinder block.



3. Install the oil pump bolts.

   - Tighten the bolts and check the alignment using Feeler Gauge so that the mating face is between 0.3 mm and 0.8 mm below the cylinder block; correct as necessary.

4. Install a new crankshaft front oil seal.

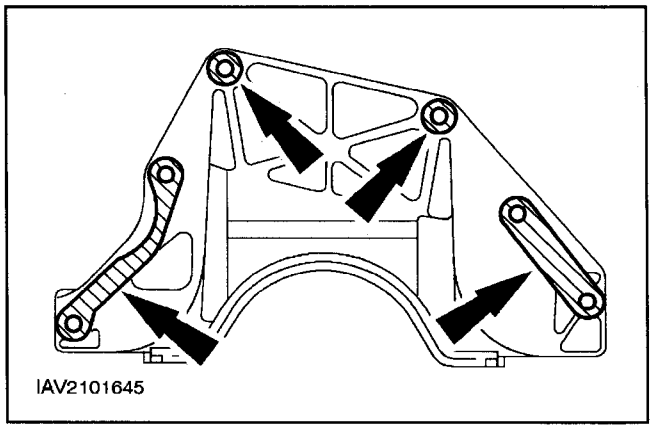


5. **NOTE:** Use a new gasket during lower crankcase installation.

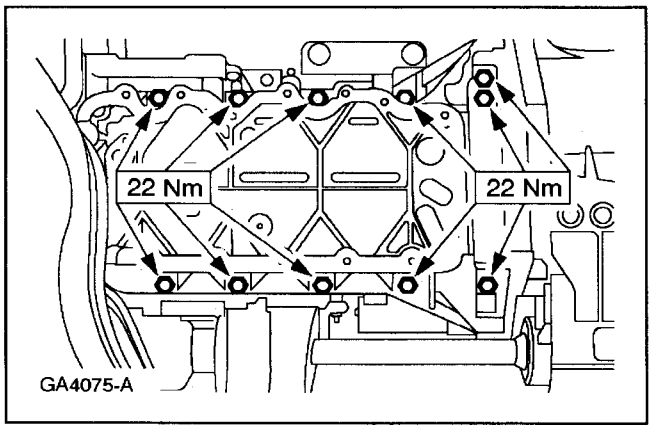
   Align the lower crankcase.

   - Coat the joints between the cylinder block and the oil pump with Silicone gasket and sealant.
   - Position the lower crankcase and gasket and install the bolts finger tight.
   - Align the lower crankcase using a Straight Edge so that the cylinder block and the lower crankcase are flush or do not exceed the following tolerances:
     - Manual transaxle: 0.10 mm overlap to 0.25 mm gap.
     - Automatic transaxle: 0.00 mm overlap to 0.25 mm gap.

IN-VEHICLE REPAIR (Continued)

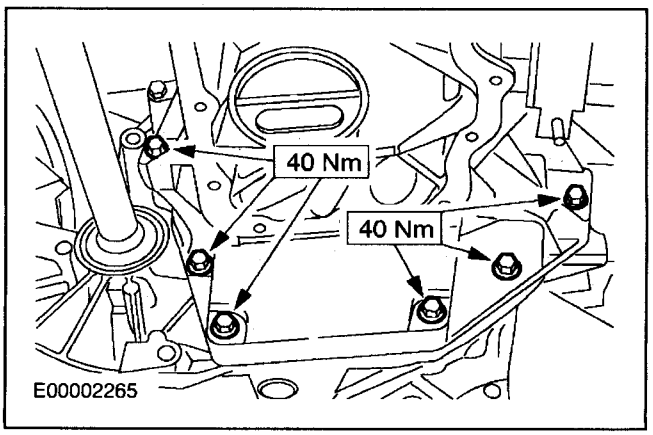

IAV2101645

6. Install lower crankcase spacer shims as required.
   - 0.26 to 0.50 mm gap, use 0.25 mm (yellow) spacer shims
   - 0.51 to 0.75 mm gap, use 0.50 mm (black) spacer shims



GA4075-A

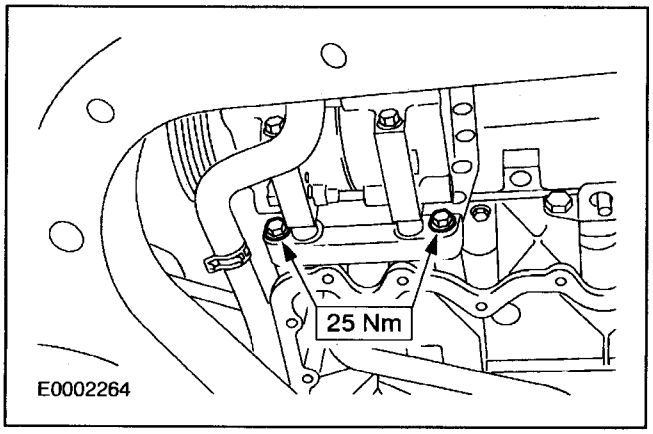
7. Install the lower crankcase and install the lower crankcase to upper crankcase bolts.



E00002265

8. Install the lower crankcase to transmission bolts.

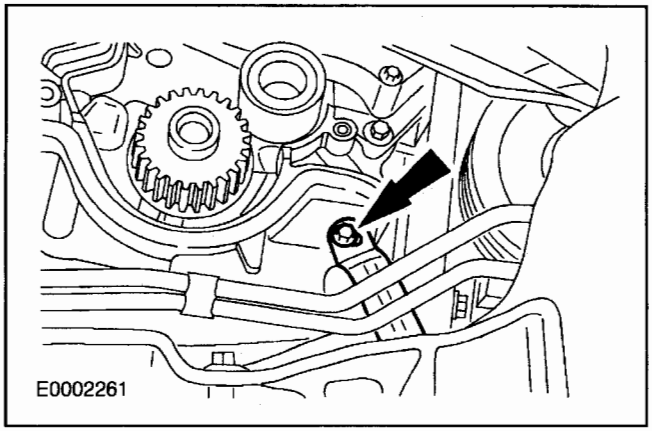
Vehicles with air conditioning



E0002264

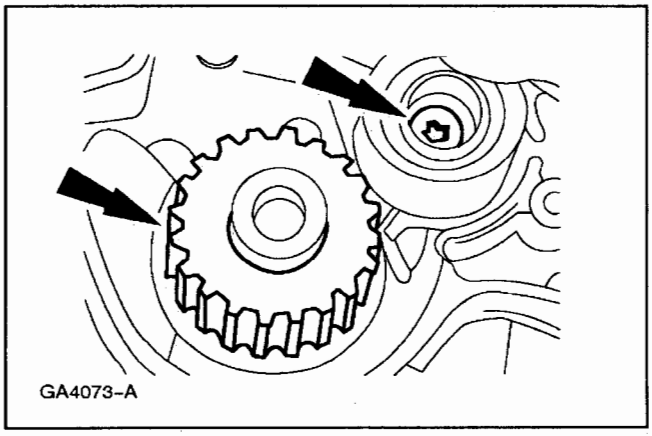
9. Install the lower A/C bracket bolts.

IN-VEHICLE REPAIR (Continued)



All vehicles

10. Install the coolant line bracket bolt.



11. Install the crankshaft timing pulley and timing belt idler pulley and spacer.

12. Install the oil pump screen cover and tube. For additional information, refer to Oil Pump Screen and Pickup Tube in this section.

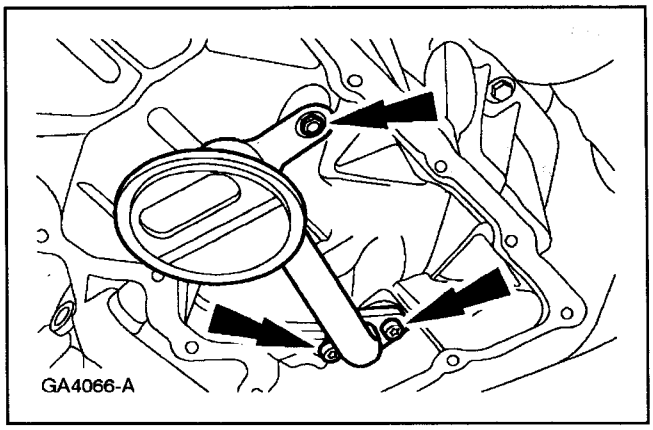
13. Install the timing belt. For additional information, Timing Belt in this section.

Oil Pump Screen and Pickup Tube

Removal

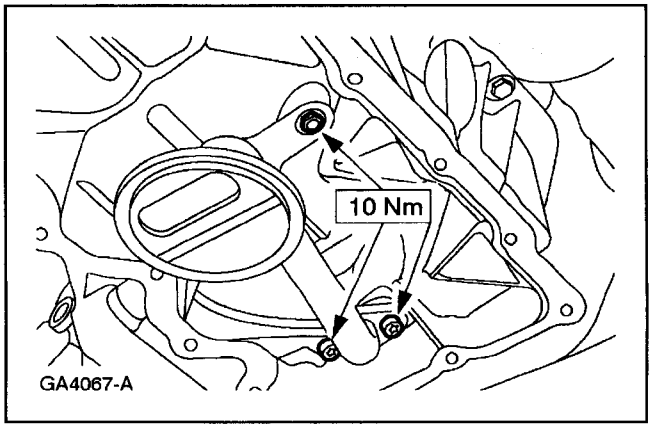
1. Remove the oil pan. For additional information, refer to Oil Pan in this section.

IN-VEHICLE REPAIR (Continued)



2. Remove the oil pump screen cover and tube.
   - Remove the bolts.
   - Remove the oil pump screen and cover and tube.

Installation

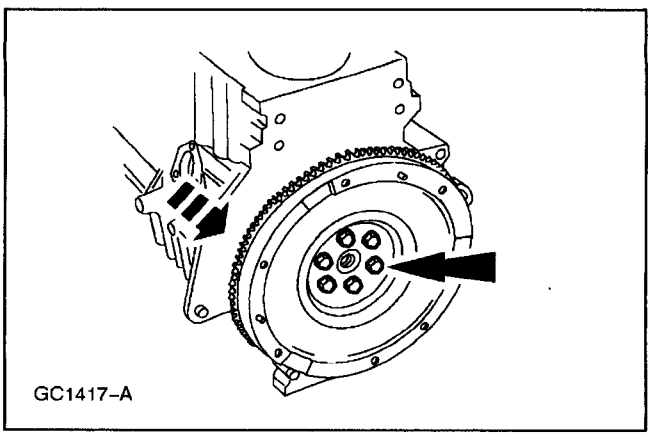


1. To install, reverse removal procedure.

Flywheel — Vehicles with Manual Transaxle

Removal

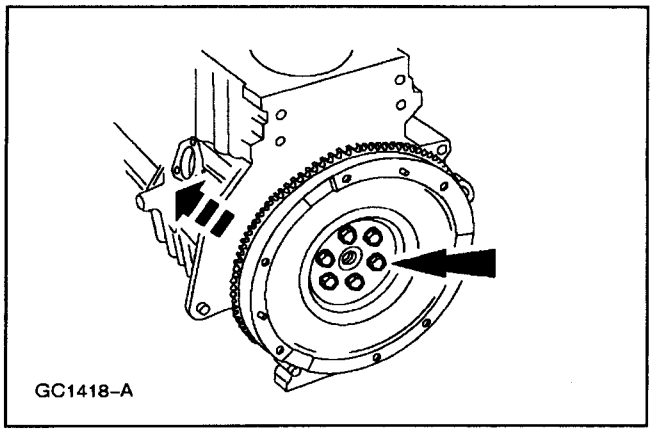
1. Remove the clutch disc and pressure plate. For additional information, refer to Section 308-01.



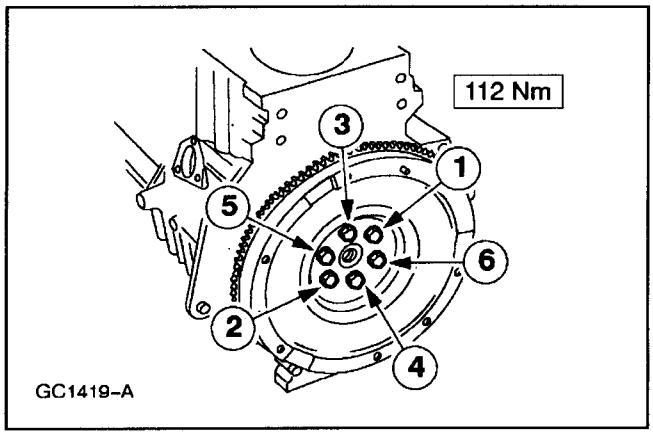
2. Remove the flywheel.

IN-VEHICLE REPAIR (Continued)

Installation


GC1418-A

1. Position the flywheel and loosely install the flywheel bolts.



GC1419-A

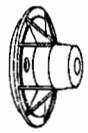
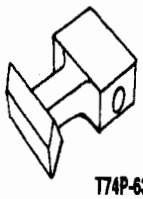
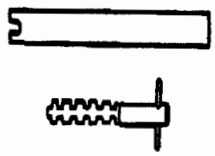
2. Tighten the bolts in the indicated sequence.

3. Install the clutch disc and pressure plate. For additional information, refer to Section 308-01.

IN-VEHICLE REPAIR (Continued)

Crankshaft Rear Oil Seal

Special Tool(s)

 T88P-6701-B1	Installer, Oil Seal (Rear), Crankshaft 303-328 (T88P-6701B-1)
 T74P-6375-A	Locking Tool, Flywheel 303-103 (T74P-6375-A)
 T92C-6700-CH	Remover, Oil Seal, Crankshaft 303-409 (T92C-6700-CH)

Materials

Item	Specification
High temperature grease —	ESD-M1C220-A

Removal

Vehicles with manual transaxle

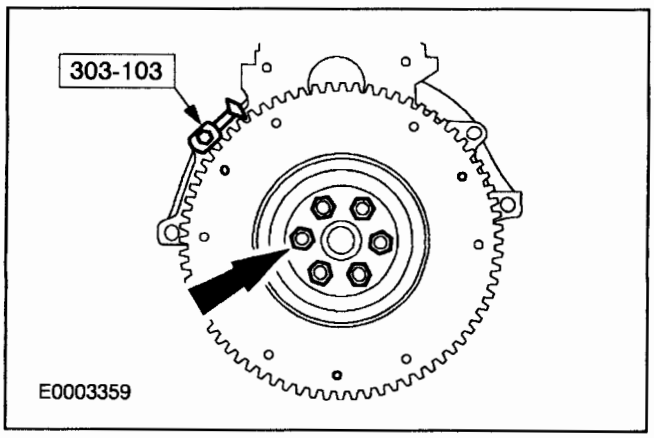
1. Remove the clutch. For additional information, refer to Section 308-01.

Vehicles with automatic transaxle

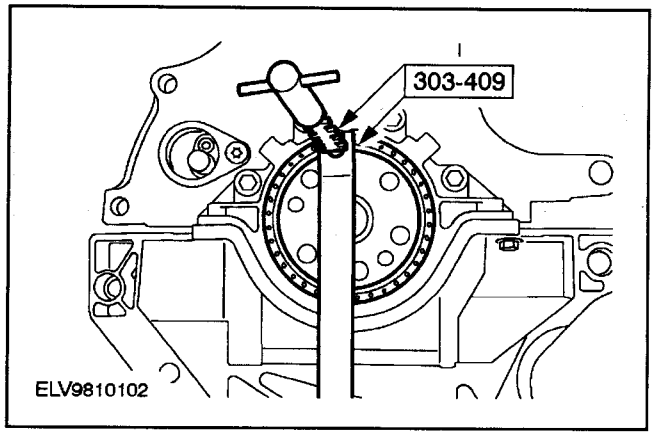
2. Remove the automatic transaxle. For additional information, refer to Section 307-01.

All vehicles

3. Using the special tool, remove the flywheel/drive plate.



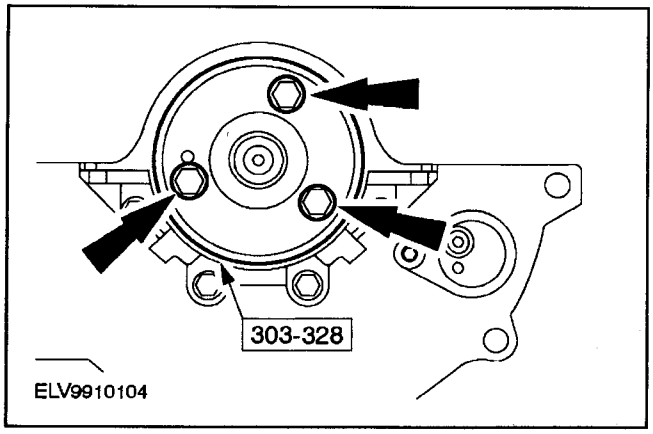
IN-VEHICLE REPAIR (Continued)



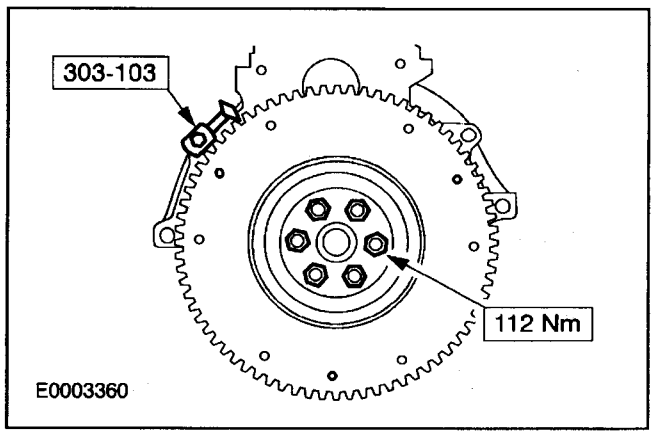
4. Using the special tool, remove the oil seal.

Installation

All vehicles



1. Using the special tool, install the oil seal.
   - Install three flywheel bolts.



2. **NOTE:** Remove any traces of thread-locking compound from the threaded bores on the crankshaft.

   Using the special tool, install the flywheel/drive plate.

Vehicles with manual transaxle

3. Install the clutch. For additional information, refer to Section 308-01.

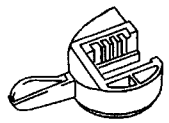
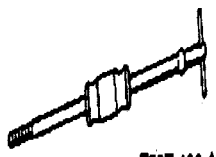
Vehicles with automatic transaxle

4. Install the automatic transaxle. For additional information, refer to Section 307-01.

REMOVAL

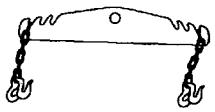
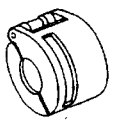
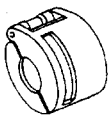
Engine — Vehicles with Manual Transaxle

Special Tool(s)

 16088	Gear Lever Aligner 308-273 (T97P-7025-A)
 T50T-100-A	Slide hammer 100-001 (T50T-100-A)
 ST1582-A	Remover, Halfshaft 205-241 (T86P-3514-A)
 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)

(Continued)

Special Tool(s)

 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)
 ST1146-A	Disconnect Tool 310-D004 (D87L-9280-A) or equivalent
 ST1147-A	Disconnect Tool 310-D005 (D87L-9280-B) or equivalent

General Equipment

Auxiliary plugs
Retaining straps
Powertrain Lift, or equivalent 014-00765
Suitable floor crane

Materials

Item	Specification
Plugs	

Removal

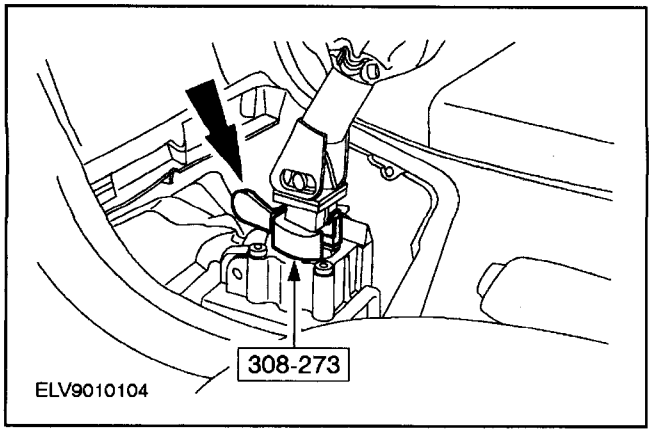
All vehicles

1. **NOTE:** The locations of engine mountings and engine support insulators are given looking from the transaxle to the engine.

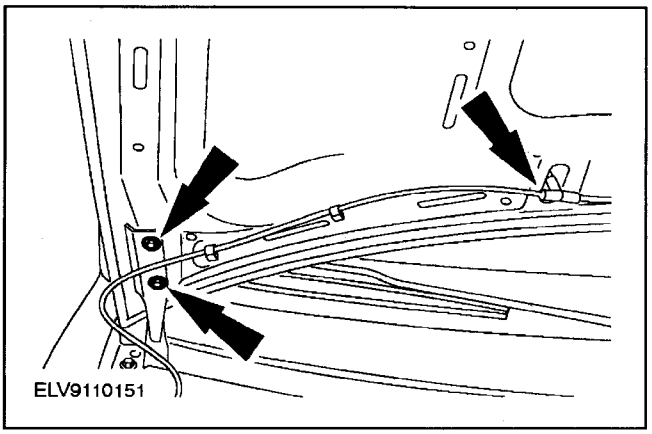
   Disconnect the battery ground cable.

2. Put the gearshift lever into neutral.

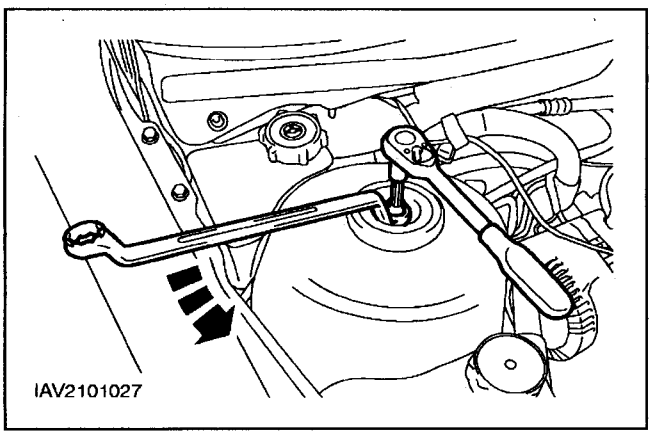
REMOVAL (Continued)



3. Using the special tool, lock the gearshift lever in neutral.
   - Unclip the boot from the gearshift lever and insert the special tool.



4. Remove the hood.
   - Disconnect the hose and remove the bolts (right hand side shown).



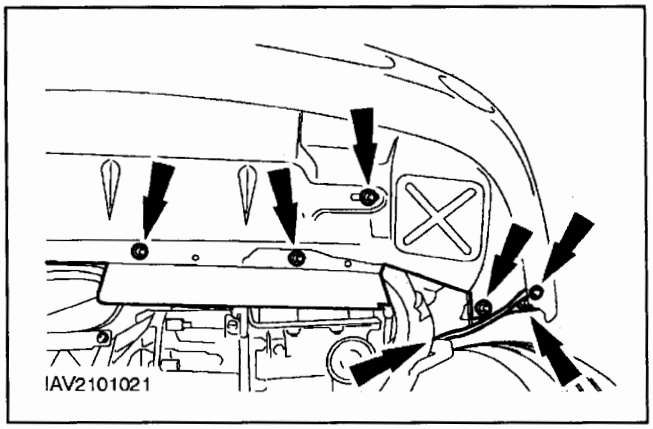
5. **NOTE:** The nuts do not need to be removed.
   Loosen the suspension strut nut five turns on both sides (right hand side shown).

6. ⚠ **WARNING: When releasing the system pressure, cover the expansion tank cap with a thick cloth to prevent the possibility of coolant scalding. Failure to follow these instructions will result in personal injury.**
   Relieve the cooling system pressure.
   - Unscrew the cap slowly.

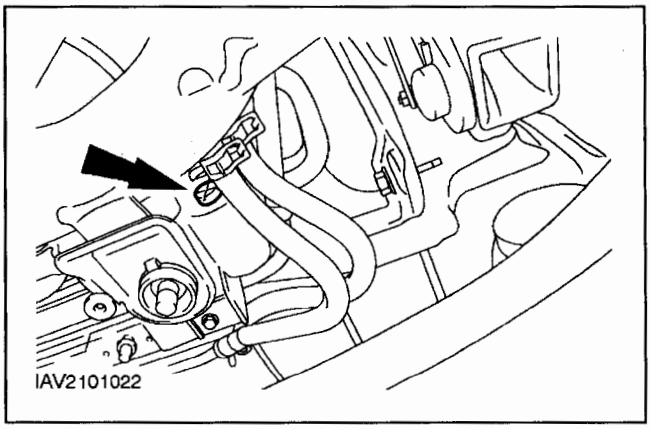
7. Raise and support the vehicle For additional information, refer to Section 100-02.

8. Remove the both front wheels.

REMOVAL (Continued)



9. Remove the radiator splash shield (nine bolts) and remove the brackets on both sides (left-hand side shown).

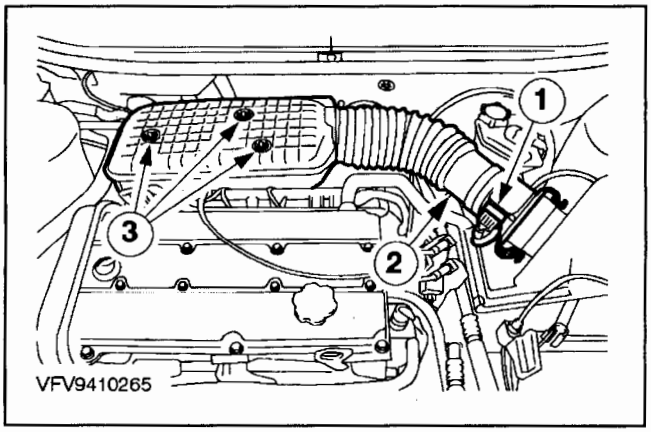


10. ⚠ **WARNING: When the engine is hot there is a risk of scalding. Failure to follow these instructions may result in personal injury.**

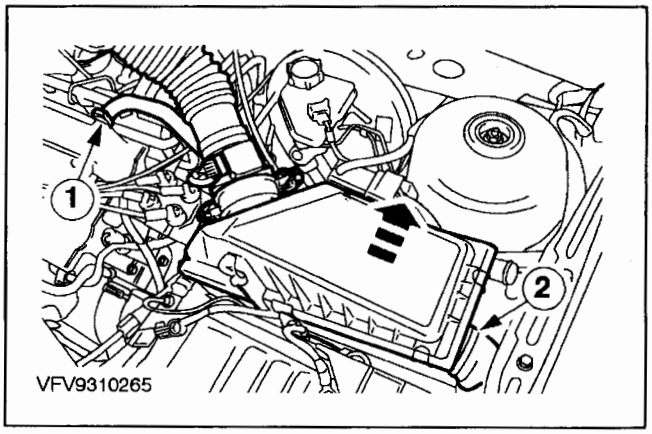
    Drain the coolant.

    - Tighten the drain plug back up again.

11. Lower the vehicle.



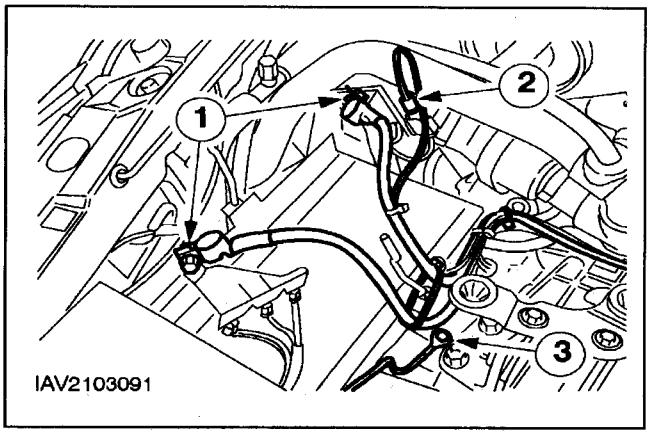
12. Remove the intake pipe with air cleaner (ACL) housing.
    1 Disconnect the mass air flow (MAF) sensor electrical connector.
    2 Disconnect the intake air temperature (IAT) sensor electrical connector.
    3 Remove the bolt and the two nuts.



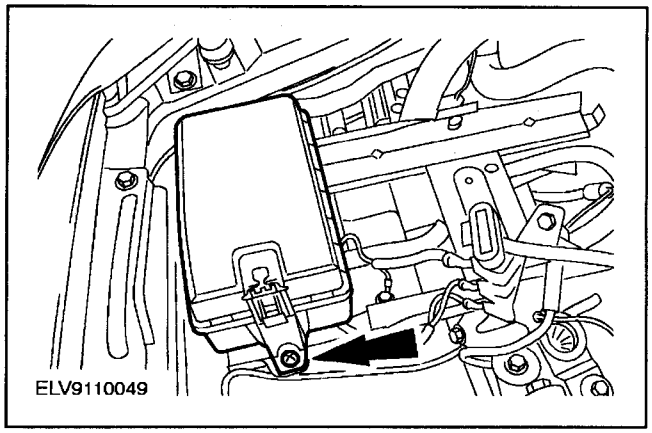
13. Remove the intake pipe with air cleaner (ACL) housing (cont.).
    1 Disconnect the crankcase ventilation hose.
    2 Disconnect the intake hose.

REMOVAL (Continued)

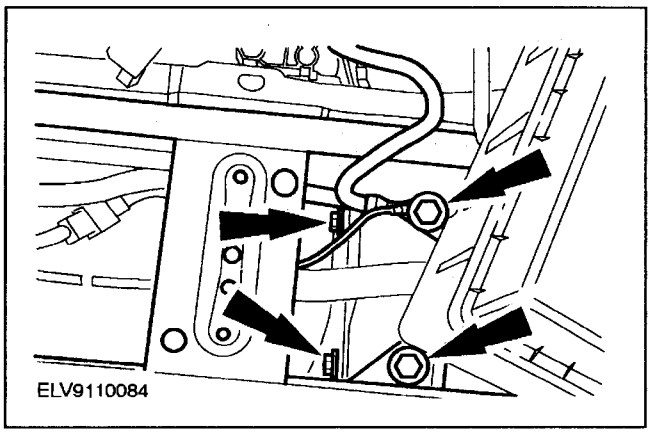
14. Remove the battery. For additional information, refer to Section 414-01.



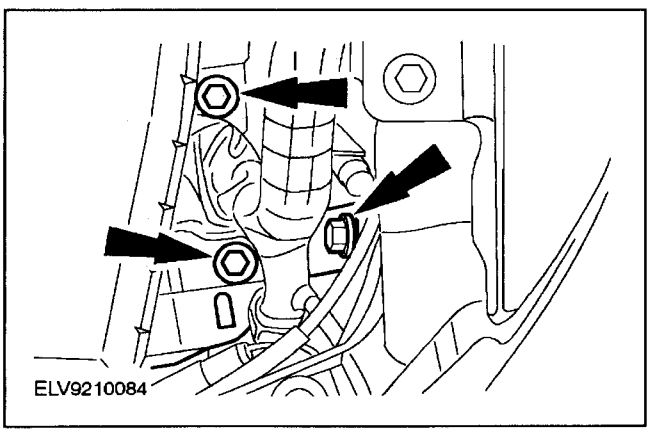
15. Disconnect the cables and the electrical connector.
    1 Battery cable
    2 Electrical connector
    3 Ground cable



16. Loosen the central junction box (CJB) and position it to one side.

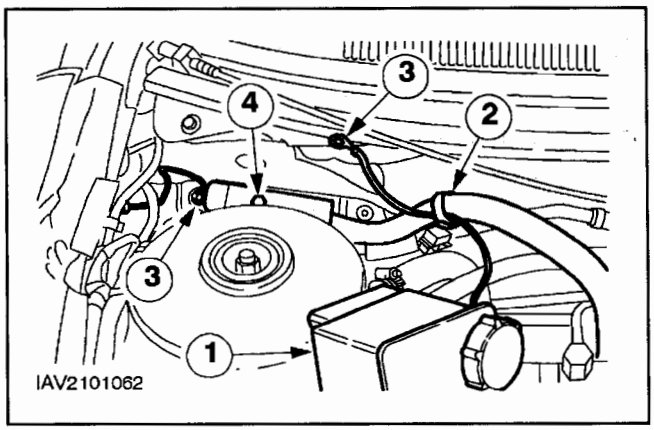


17. Remove the four battery bracket bolts and remove the two ground cables.

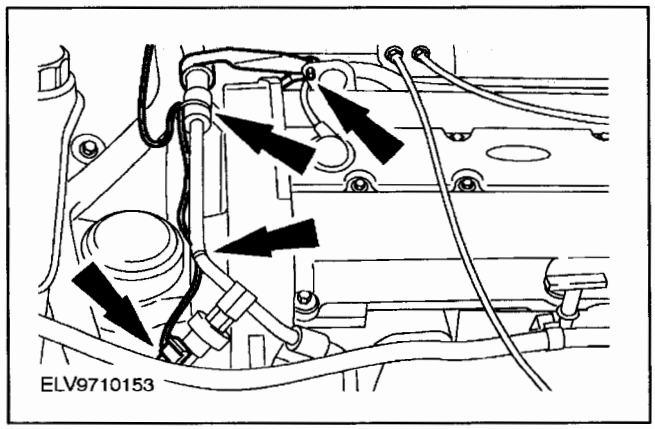


18. Remove the battery bracket.

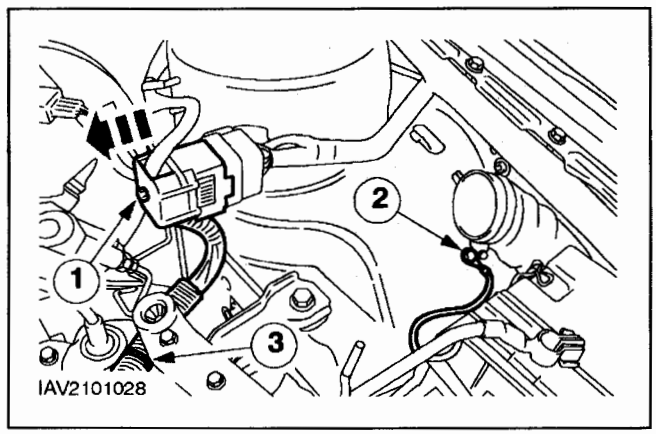
REMOVAL (Continued)



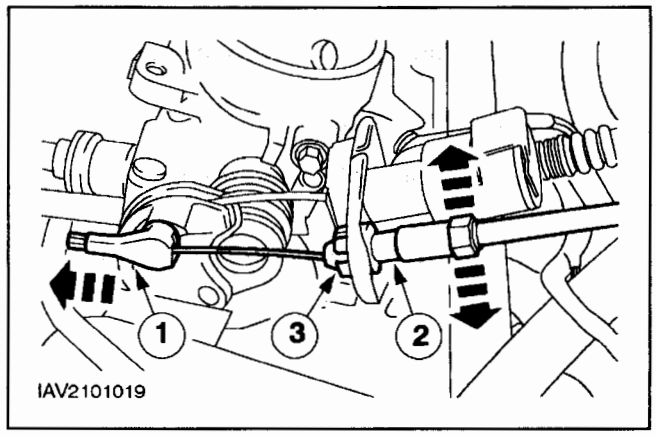
19. Disconnect the main wiring harness from the powertrain control module (PCM).
    1 Take out the power steering reservoir (push fit) and position it to one side.
    2 Open the wiring bracket.
    3 Disconnect the two ground cables.
    4 Disconnect the main wiring harness electrical connector from the PCM.



20. Remove the ground cable from the engine lifting eye and disconnect the power steering pressure (PSP) switch.

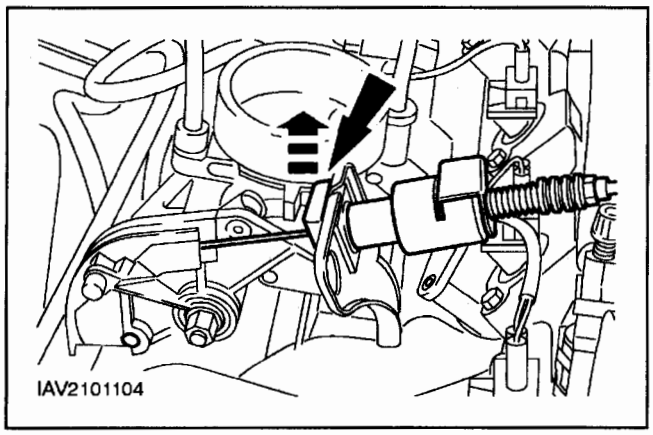


21. Disconnect the wiring.
    1 Engine wiring harness electrical connector
    2 Transaxle ground cable
    3 Remove the cable tie.

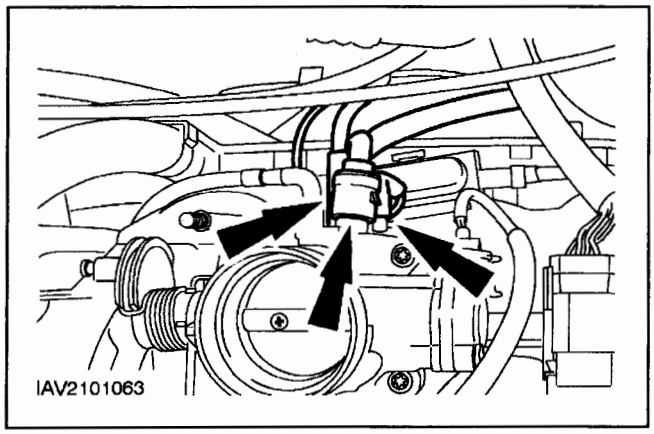


22. Disconnect the speed control cable.
    1 Disconnect the cable from throttle valve.
    2 Gently move the cable up and down and pull it out off the retaining bush.
    3 Press the retaining bush out of the bracket.

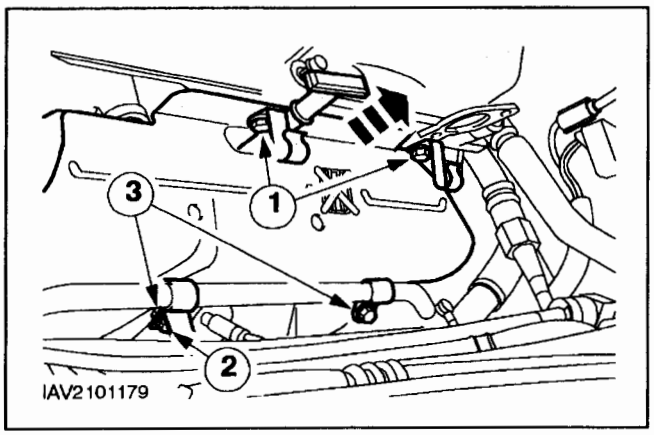
REMOVAL (Continued)



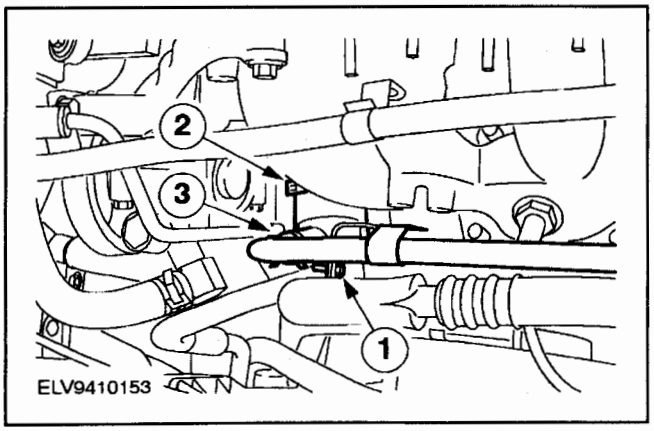
23. Disconnect the throttle cable.
    - Unhook the cable.
    - Pull off the plastic clip and lay the throttle cable to one side.



24. Disconnect the vacuum hoses from the intake manifold.

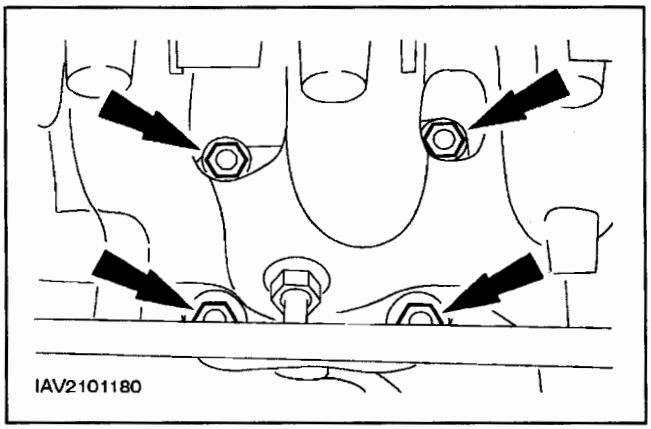


25. Remove the heat shield.
    1 Remove the upper bolts.
    - Remove the coolant hose brackets, and pull out the engine oil level indicator tube.
    2 Remove the bolt.
    3 Remove the bracket for the coolant tube.



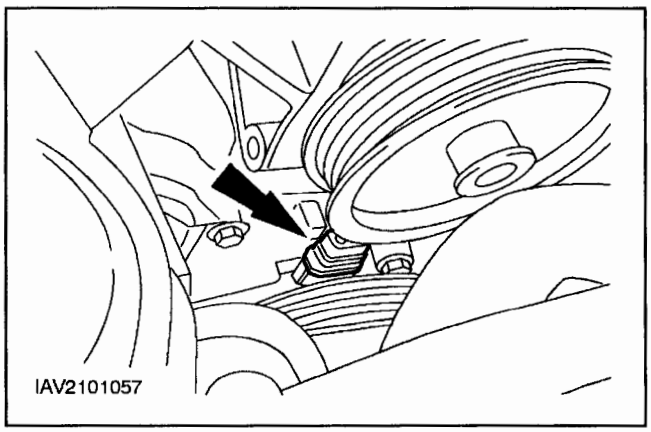
26. Disconnect the coolant hoses and remove the coolant pipe.
    1 Remove the coolant pipe.
    2 Remove the coolant hose from the coolant pipe.
    3 Remove the coolant hose from the water pump.

REMOVAL (Continued)



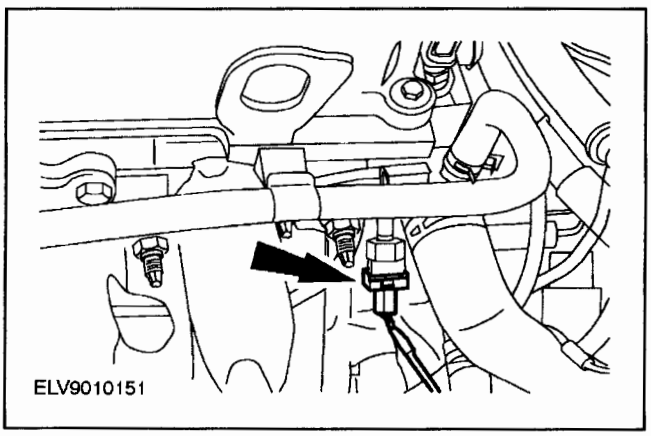
27. Remove the three-way catalytic converter (TWC) from the exhaust manifold.

Vehicles with air conditioning



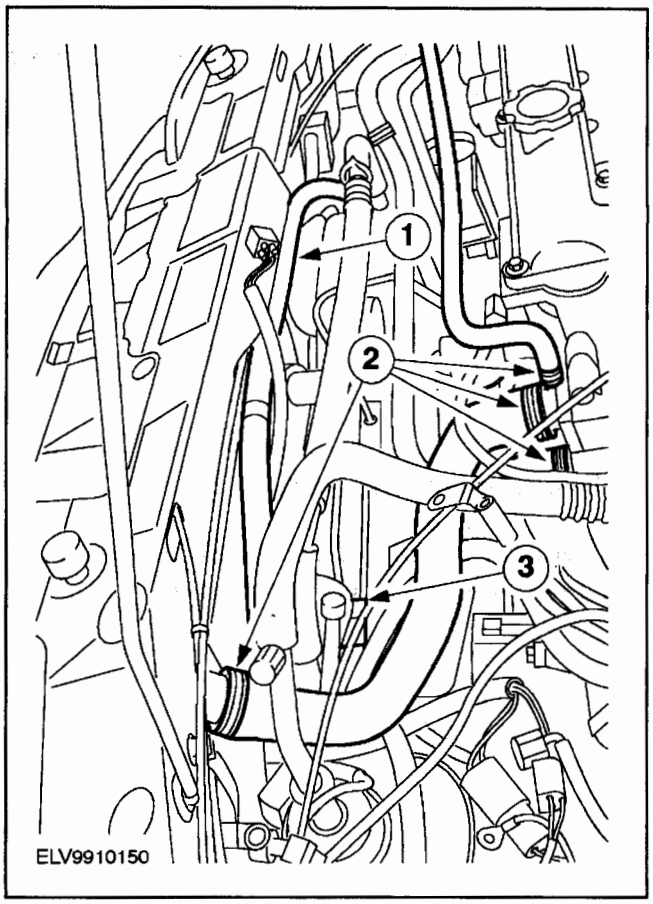
28. Disconnect the compressor electrical connector (without accessory drive belt shown).

All vehicles

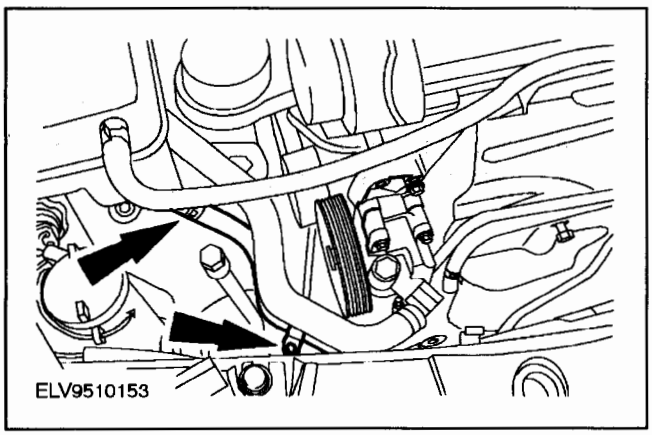


29. Disconnect the engine coolant temperature (ECT) sensor electrical connector.

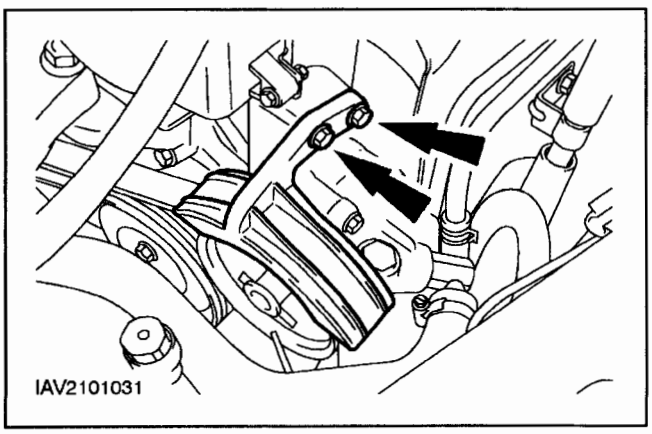
REMOVAL (Continued)



30. Disconnect the electrical connector and the upper coolant hoses.
    1 Unclip the wiring harnesses.
    2 Disconnect the coolant hoses.
    3 Disconnect fan motor electrical connector.

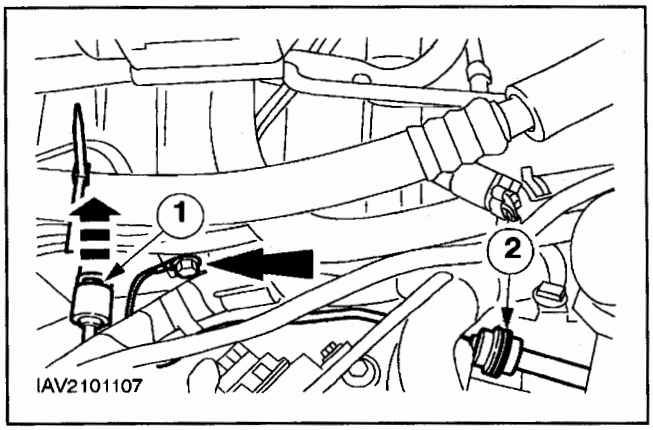


31. Remove the clamp from the fender apron panel and remove the coolant hoses.



32. Remove the upper accessory drive belt cover.

REMOVAL (Continued)



33. ⚠ **WARNING: Brake fluid may leak out. Observe the safety procedures for handling brake fluid. Failure to follow these instructions may result in personal injury.**

    ⚠ **CAUTION: Block off the hose connections to prevent fluid loss or dirt contamination.**

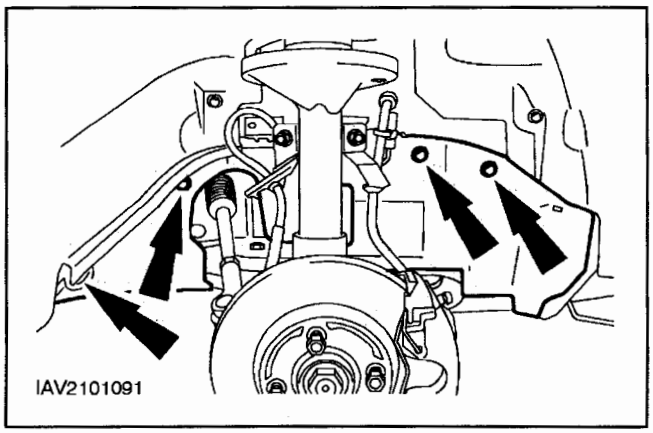
    Disconnect the clutch slave cylinder.

    1 Pull out the clip and pull off the pipe.

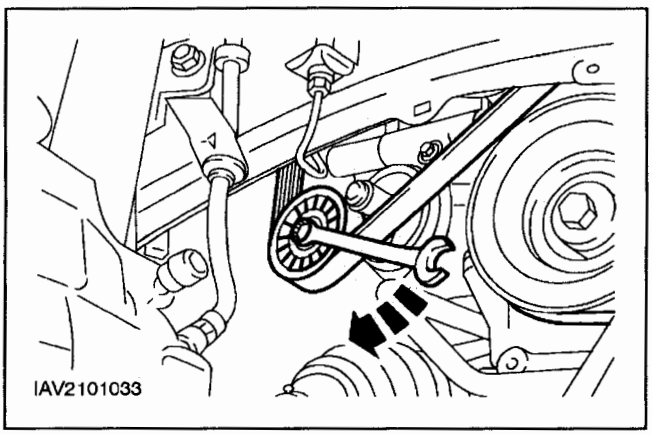
    2 Disconnect the slave cylinder pipe from the transaxle and tie it up.

    - Disconnect the ground cable from the transaxle.

34. Raise and support the vehicle. For additional information, refer to Section 100-02.

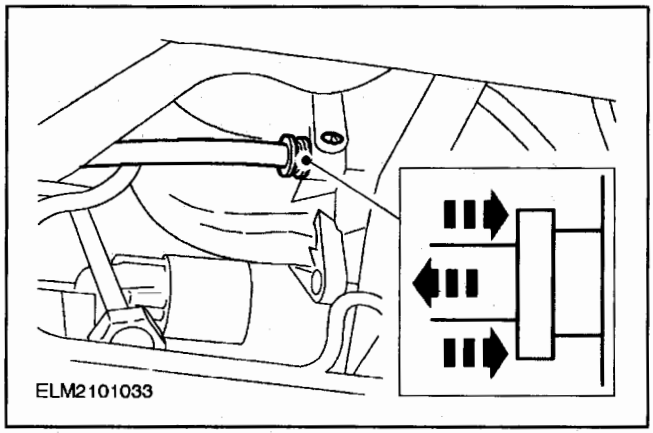


35. Remove the fender splash shields (right-hand side shown).

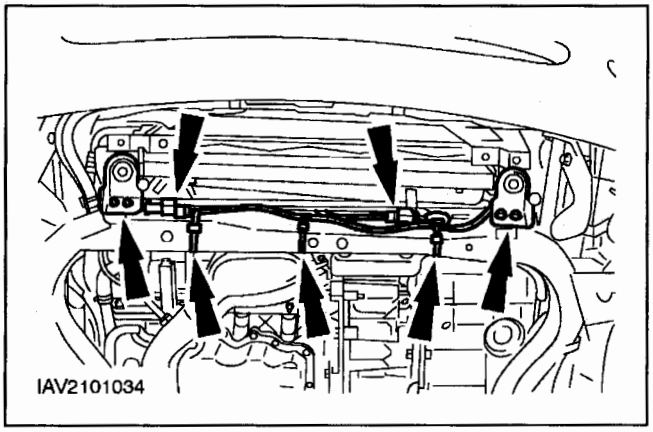


36. Loosen and remove the accessory drive belt.

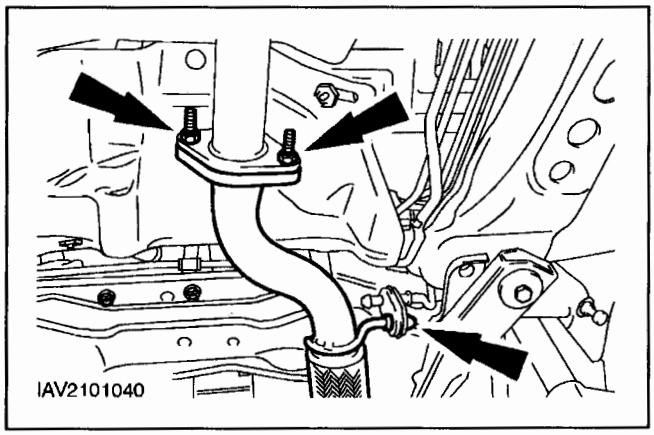
REMOVAL (Continued)



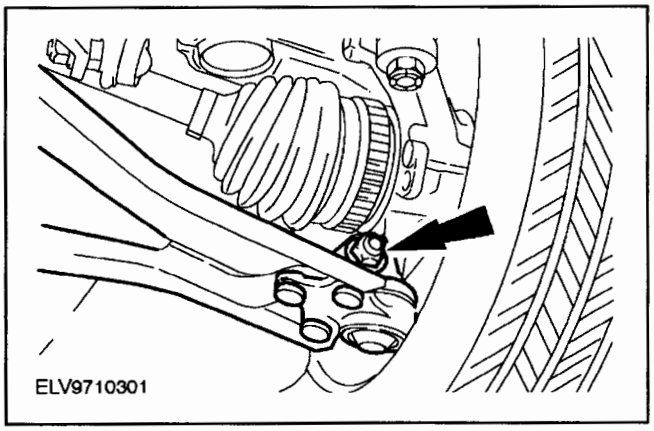
37. Disconnect the brake booster vacuum line from the intake manifold.
    - Disconnect the quick-release coupling and pull out the line.



38. Remove the radiator brackets and disconnect both heated oxygen sensor (HO2S) electrical connectors.
    - Cut the cable ties.



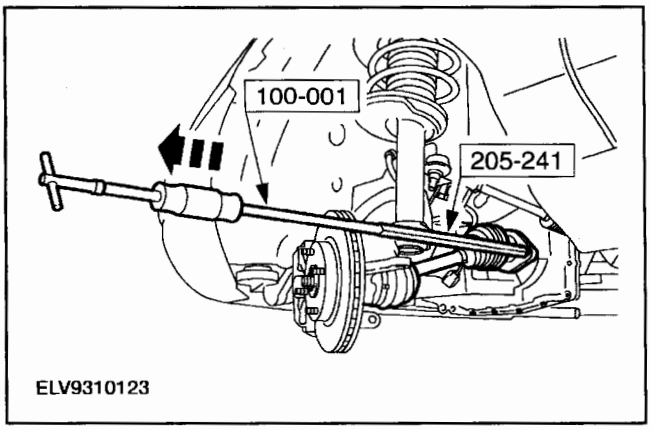
39. Disconnect the front exhaust tube and unhook it.
    - Discard the gasket.



40. ⚠ **CAUTION: Do not damage the boot and the ABS sensor ring.**

    Disconnect the right-hand lower suspension arm (left-hand side shown).
    - Remove the lower suspension arm ball joint from the spindle carrier.

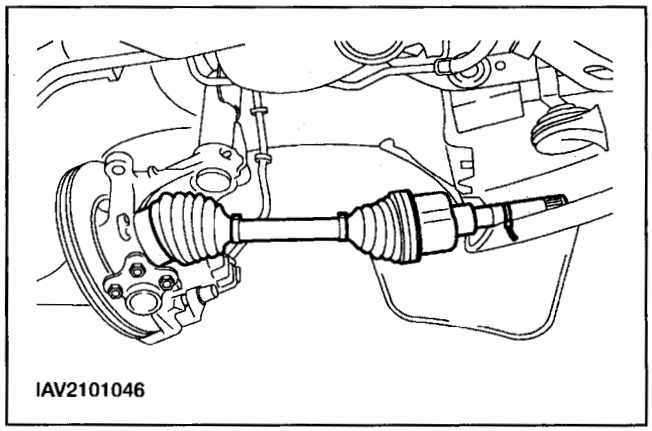
REMOVAL (Continued)



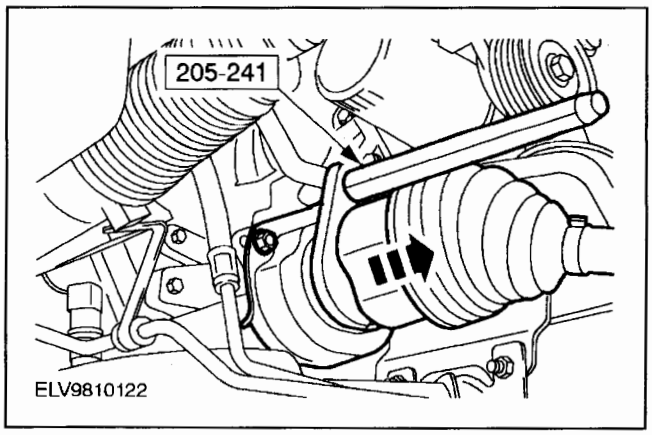
41. ⚠ **CAUTION: To avoid to damage the halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by not more than 45 degrees.**

    NOTE: Collect escaping oil. Close off the transaxle opening with plug.

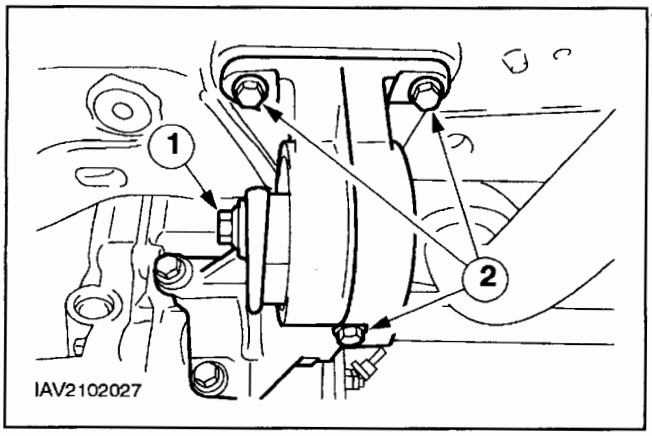
    Using the special tools, release the left-hand drive halfshaft.



42. Withdraw the drive halfshaft and tie it up.

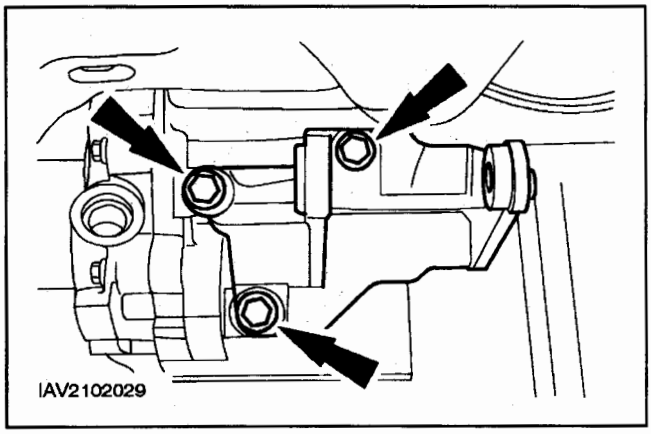


43. Using the special tool, remove the right-hand halfshaft.
    - Secure the right-hand halfshaft out of the way with mechanics wire.

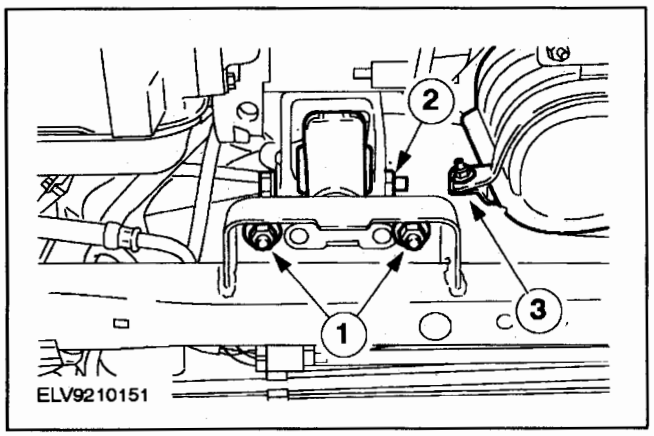


44. Remove the right-hand engine support insulator.
    1 Remove the center bolt.
    2 Remove the bracket bolts.

REMOVAL (Continued)



45. Remove the bracket for the right-hand engine support insulator from the transaxle.



46. **NOTE:** If necessary raise the transaxle slightly with a transmission jack.

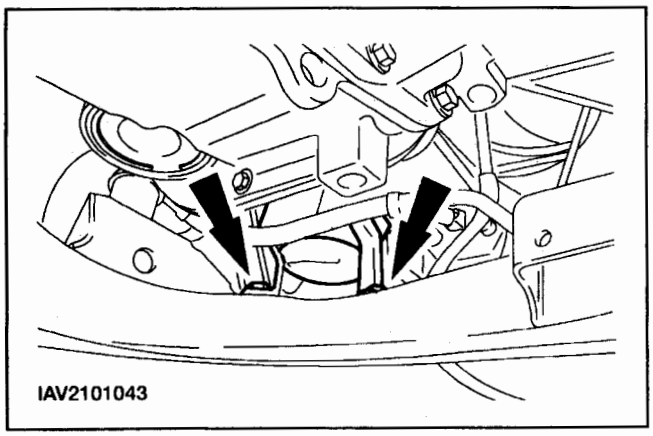
    Remove the left-hand engine support insulator and the three way catalytic converter (TWC)

    1 Remove the nuts.

    2 Remove the center bolt.

    3 Loosen the TWC bracket.

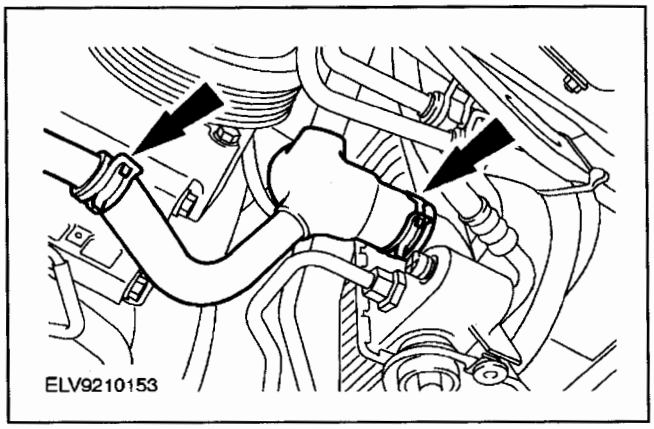
    • Remove the TWC.



Vehicles with air conditioning

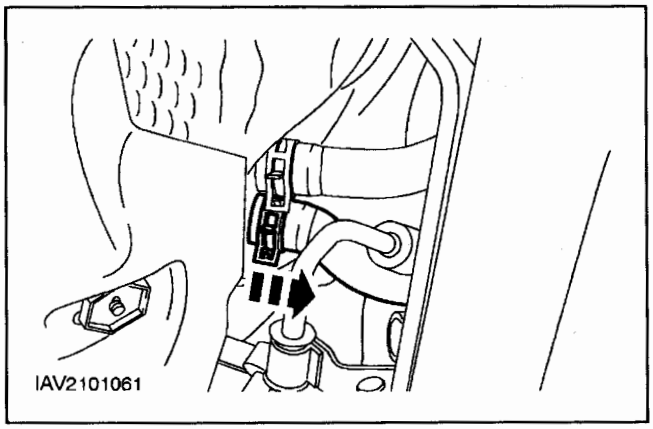
47. Remove the suction accumulator bracket bolts.

REMOVAL (Continued)



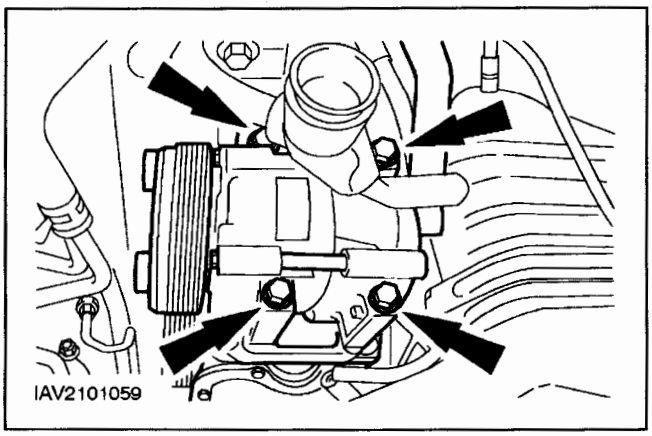
All vehicles

48. Disconnect the lower coolant hose.



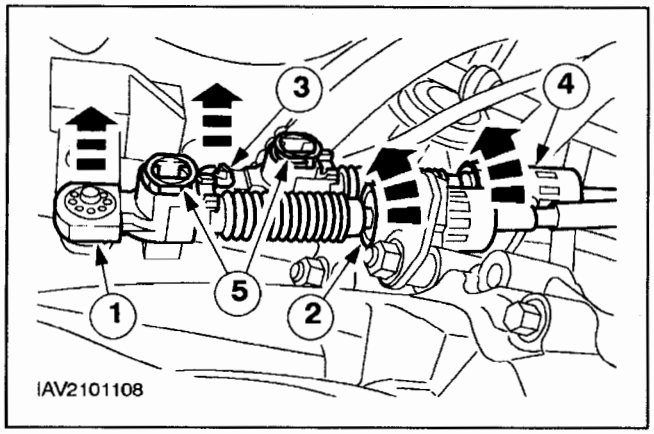
49. Disconnect the heater coolant hoses.

Vehicles with air conditioning



50. Remove the compressor bolts and position the compressor with mechanics wire to one side.

REMOVAL (Continued)



All vehicles

51. **NOTE:** Press the adjustment mechanism in until it clicks in place.

    Disconnect the shift cables from the transaxle.

    1 Disconnect the shift cable from the gear shift lever.

    2 Release the abutment bracket by turning it counter-clockwise and remove the cable from the bracket.

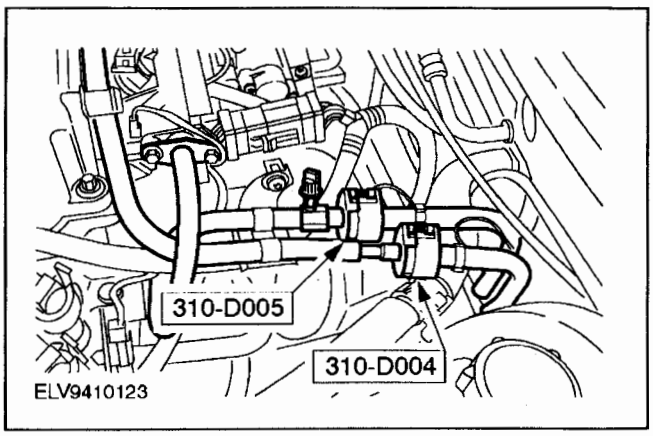
    3 Disconnect the shift cable from the gear selector lever.

    4 Release the abutment bracket by turning it counter-clockwise and remove the cable from the bracket.

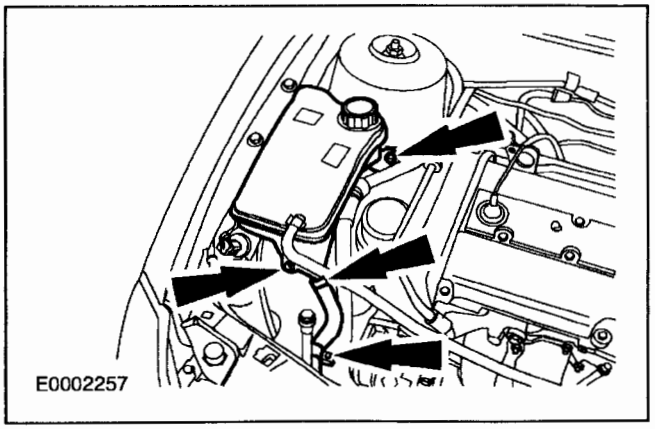
    5 Release the adjustment mechanism by pressing it in.

52. Lower the vehicle.

53. Relieve the fuel pressure. For additional information, refer to Section 310-00.

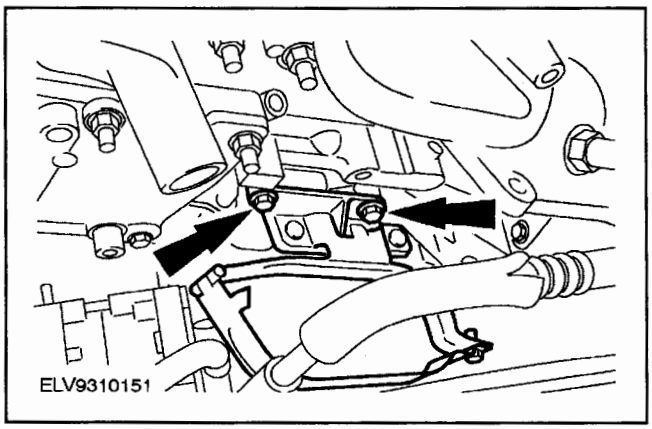


54. Using the special tools, disconnect the fuel lines.
    - Take off the retaining clips.



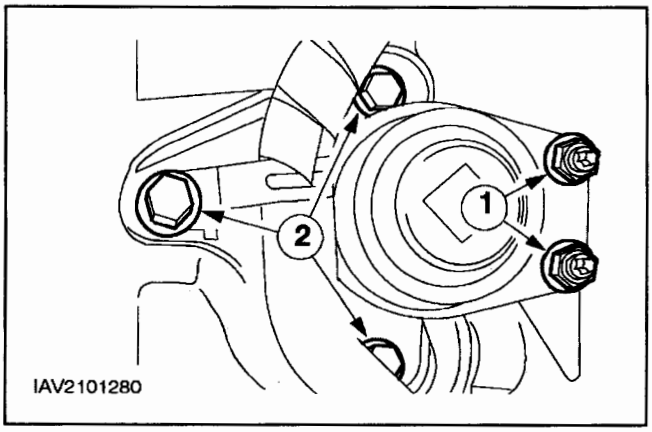
55. Remove the coolant expansion tank.
    - Disconnect the speed control cable (if equipped) from the coolant expansion tank.

REMOVAL (Continued)

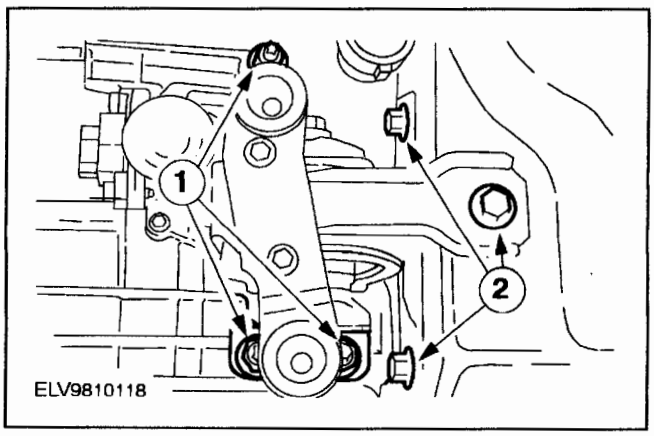


56. Remove the TWC bracket.

57. Install the special tools 303-050 and 303-D089. Using the special tools, engine lifting eyes and a Suitable Floor Crane , raise the engine/transaxle assembly slightly to remove the pressure from the support insulator.

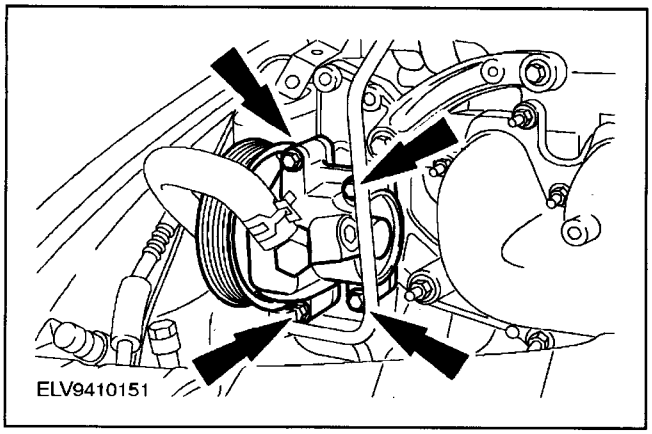


58. Remove the front engine support insulator.
    1 Remove the nuts.
    2 Loosen the bolts two turns.



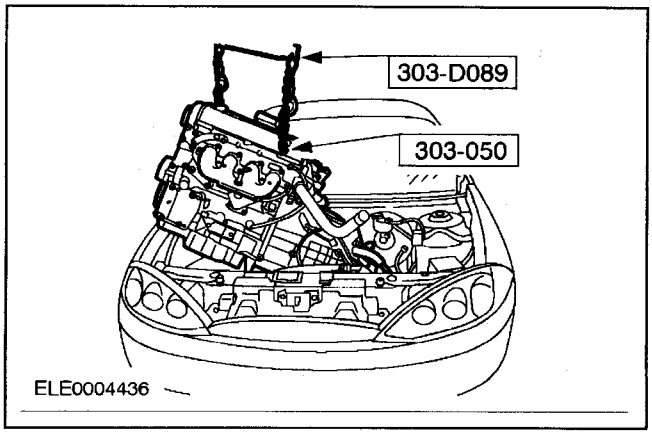
59. **NOTE:** Mark up the position.
    Remove the rear transaxle support insulator.
    1 Remove the nuts.
    2 Remove the bolts.

REMOVAL (Continued)



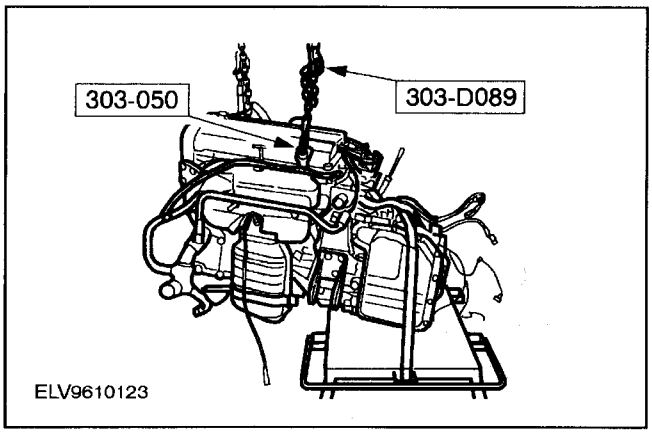
60. ⚠ **CAUTION: Make sure, that the pipes and hoses are not in stress.**

Raise the engine/transaxle assembly, until the power steering pump is accessible. Remove the power steering pump bolts and position the pump with mechanics wire to one side.

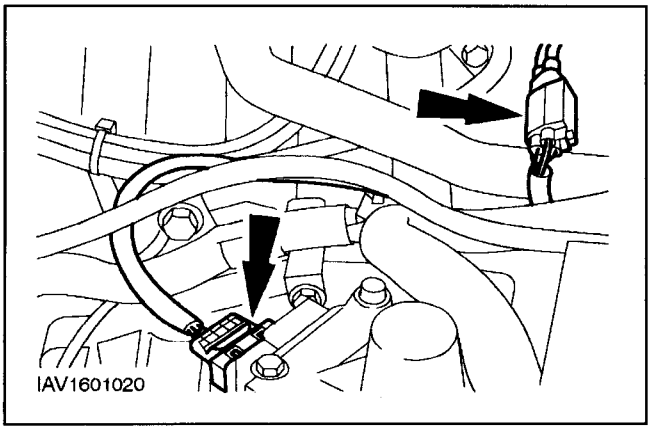


61. ⚠ **CAUTION: The engine/transaxle assembly has to be in a diagonal position to pull it out below the tube/hose A/C. Make sure, that the tube/hose (A/C) is not in stress.**

Remove the engine/transaxle assembly.

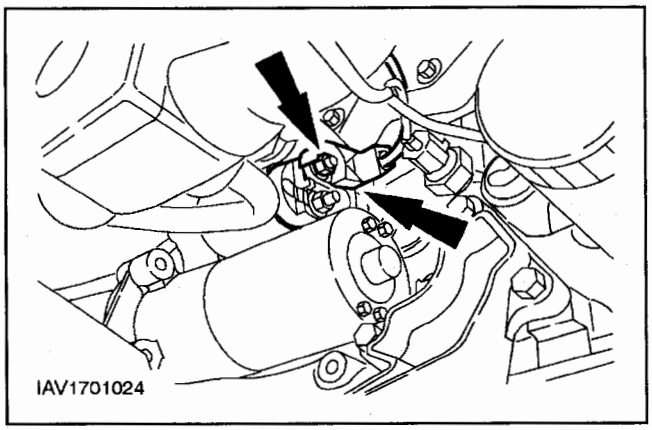


62. Using the special tools and a Suitable Floor Crane, move the engine/transaxle assembly and secure the transaxle with Securing Straps to the powertrain lift (automatic transaxle shown).

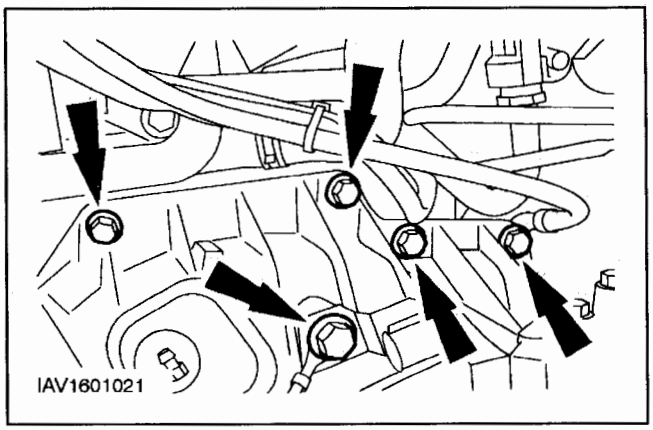


63. Disconnect the reversing lamp switch and the vehicle speed sensor (VSS) electrical connector.

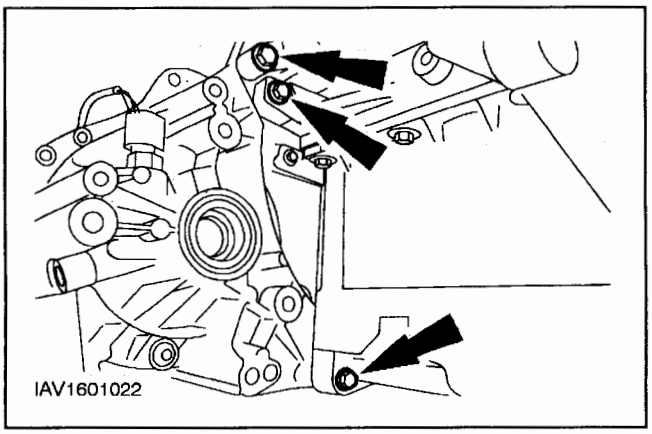
REMOVAL (Continued)



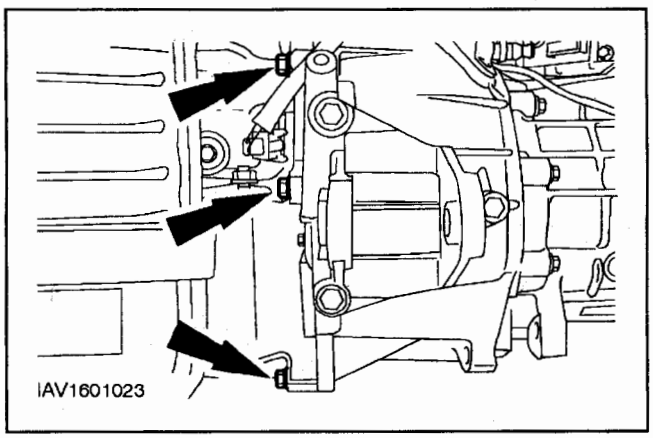
64. Disconnect the starter motor electrical connections.



65. Remove the upper transaxle flange bolts.
    - Remove the upper starter motor bolts.
    - Remove two flange bolts.
    - Disconnect the ground cable from the transaxle.



66. Remove the transaxle flange bolts on the right-hand side of the transaxle and the lower starter motor bolt.
    - Take out the starter motor and the wiring harness.



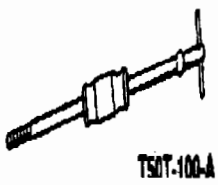
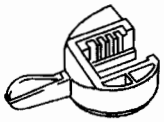
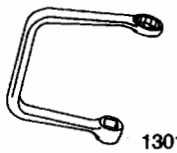
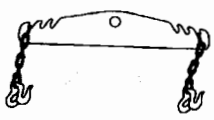
67. Remove the transaxle flange bolts on the left-hand side of the transaxle.

68. Separate the transaxle from the engine.

REMOVAL (Continued)

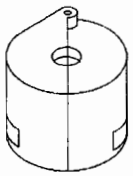
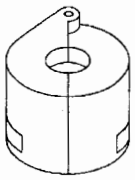
Engine — Vehicles with Automatic Transaxle

Special Tool(s)

 T50T-100-A	Slide Hammer 100-001 (T50T-100-A)
 16088	Aligner, Gearshift Lever 308-273 (T97P-7025-A)
 13013	Wrench, Steering Gear 211-202 (T97P-3504-A)
 ST1582-A	Remover, Halfshaft 205-241 (T86P-3514-A)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

(Continued)

Special Tool(s)

 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)
 D87L-9280-A	Disconnect Tool 310-D004 (D87L-9280-A)
 D87L-9280-B	Disconnect Tool 310-D005(D87L-9280-B)

General Equipment

Auxiliary plugs
Plugs
Retaining straps
Securing straps
Suitable floor crane

Removal

NOTE: The locations of engine mountings and engine support insulators are given looking from the automatic transaxle to the engine.

All vehicles

1. Disconnect the battery ground cable.

REMOVAL (Continued)

2. Move the selector lever to ''D''.

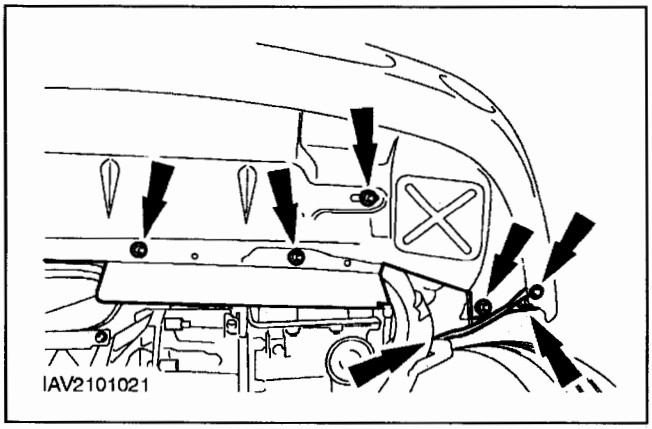
3. **⚠ WARNING: When releasing the system pressure, cover the expansion tank cap with a thick cloth to prevent the possibility of coolant scalding. Failure to follow these instructions may result in personal injury.**

   Release the cooling system pressure.

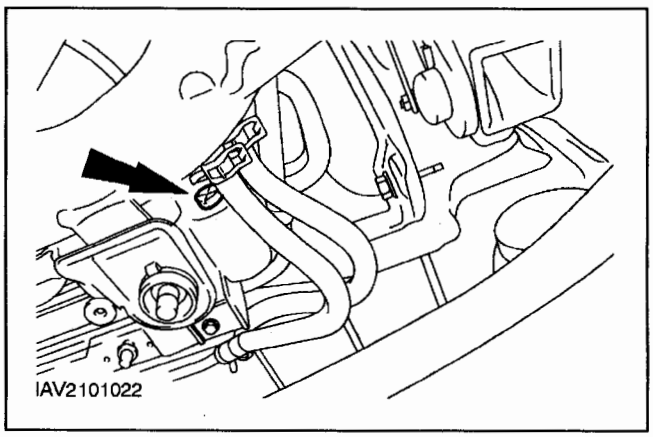
   - Unscrew the cap slowly.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.

5. Remove the front wheels.


IAV2101021

6. Remove the radiator splash shield (nine bolts) and remove the brace on both sides (left-hand side shown).


IAV2101022

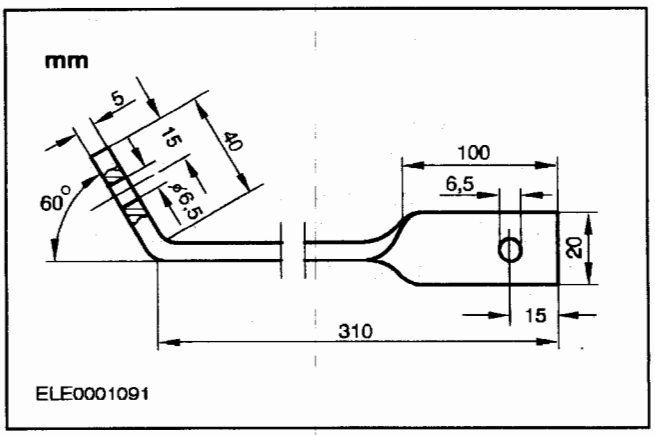
7. **⚠ WARNING: Risk of scalding when the engine is at operating temperature. Failure to follow these instructions may result in personal injury.**

   Drain the coolant.

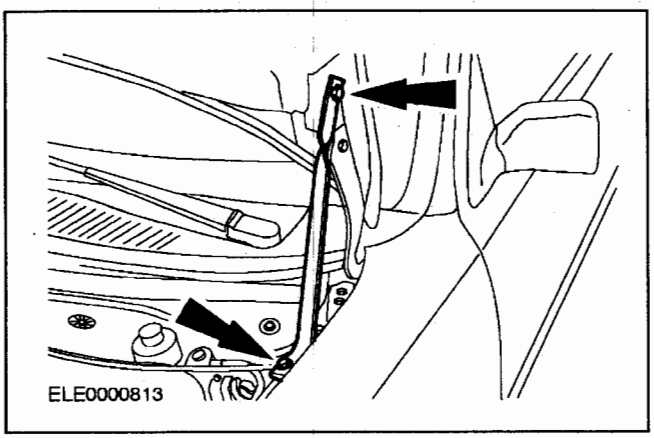
   - Tighten the drain plug back up again.

8. Lower the vehicle.

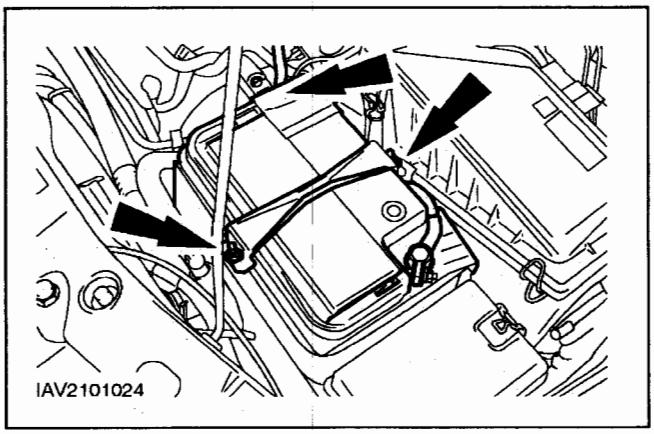
REMOVAL (Continued)



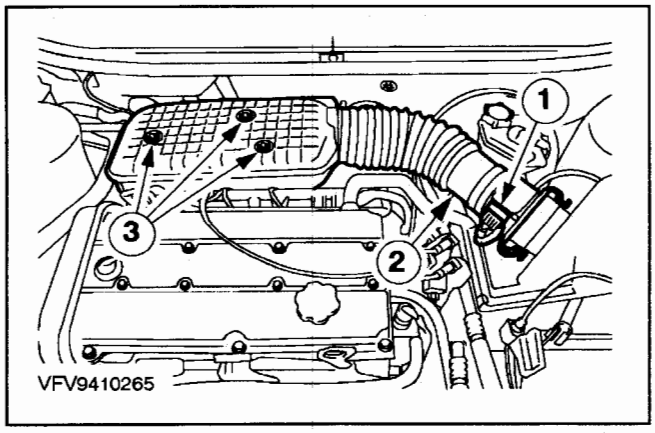
9. Make an auxiliary tool for fixing the hood in a wide-opened position.



10. Open the hood and install the auxiliary tool to the hood.

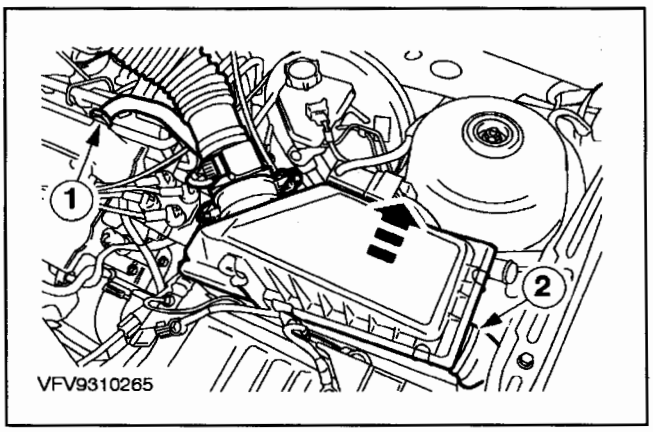


11. Remove the battery. For additional information, refer to Section 414-01.



12. Remove the intake pipe with air cleaner (ACL) housing.
    1. Disconnect the mass air flow (MAF) sensor electrical connector.
    2. Disconnect the intake air temperature (IAT) sensor electrical connector.
    3. Remove the bolt and the two nuts.

REMOVAL (Continued)

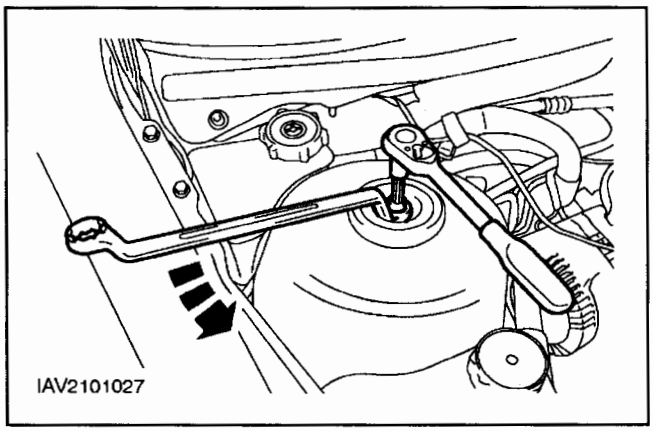


13. Remove the intake pipe with air cleaner (ACL) housing (cont.).
    1 Disconnect the crankcase ventilation hose.
    2 Disconnect the intake hose.

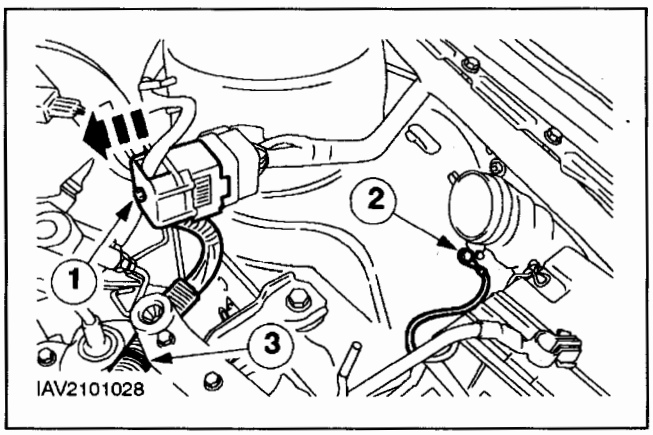
Vehicles with air conditioning

14. Use mechanics wire to secure the condenser core on the hood lock panel.

All vehicles

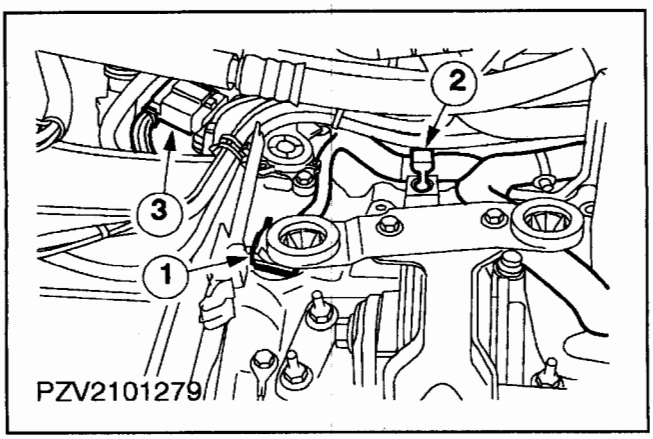


15. **NOTE:** The nuts do not need to be removed.
    Loosen the suspension strut nuts five turns on both sides (right-hand side shown).

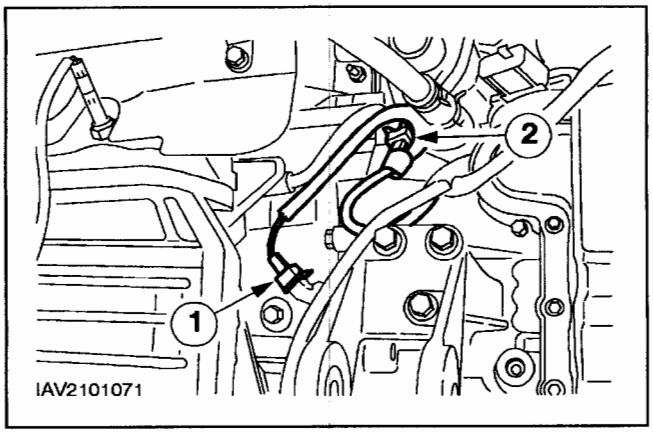


16. Disconnect the wiring.
    1 Disconnect the engine wiring harness electrical connector.
    2 Disconnect the automatic transaxle ground cable.
    3 Remove the cable tie.

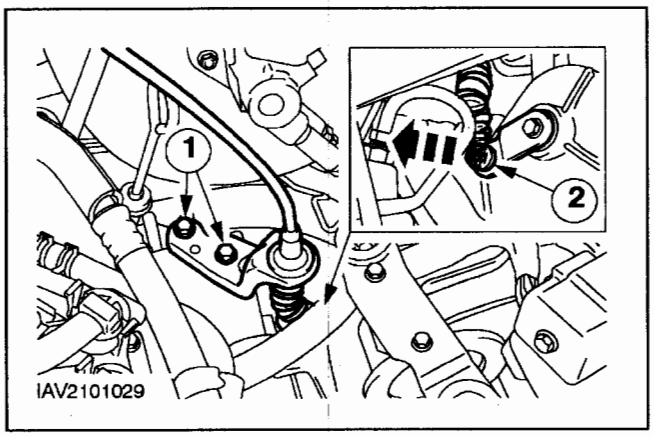
REMOVAL (Continued)



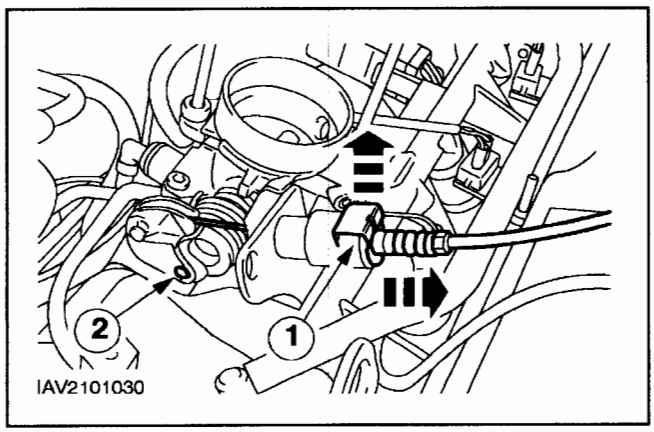
17. Disconnect the electrical connectors.
    1 Disconnect the automatic transaxle control electrical connector.
    2 Unclip the wiring harness.
    3 Disconnect the transaxle range switch (TR switch) electrical connector.



18. Disconnect the electrical connectors (continued).
    1 Crankshaft position (CKP) sensor electrical connector
    2 Engine coolant temperature (ECT) sensor electrical connector

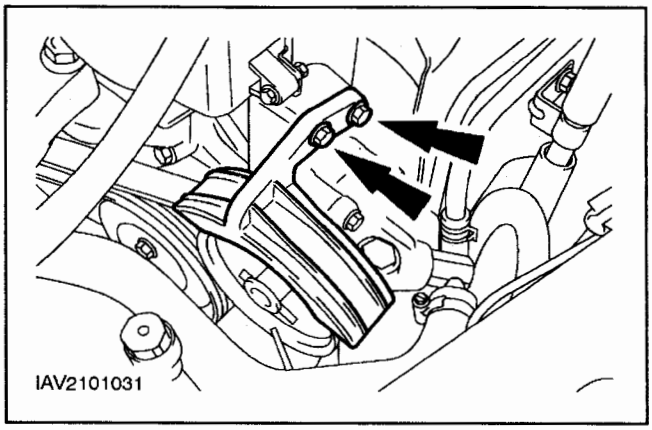


19. Disconnect the selector cable.
    1 Remove the selector cable abutment bracket.
    2 Unclip the selector cable from the selector lever.



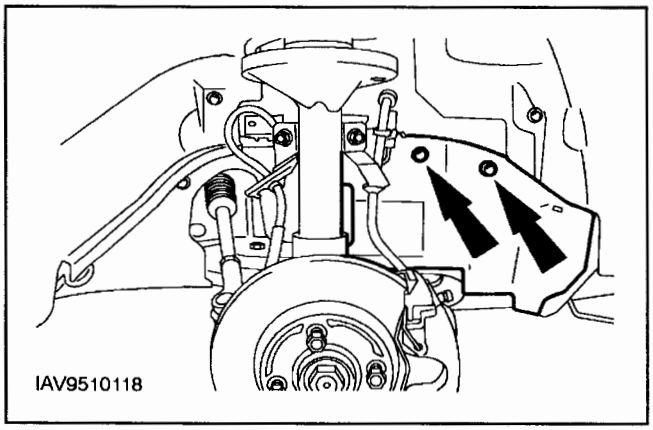
20. Disconnect the throttle cable.
    1 Pull out the clip.
    2 Unhook the cable.

REMOVAL (Continued)

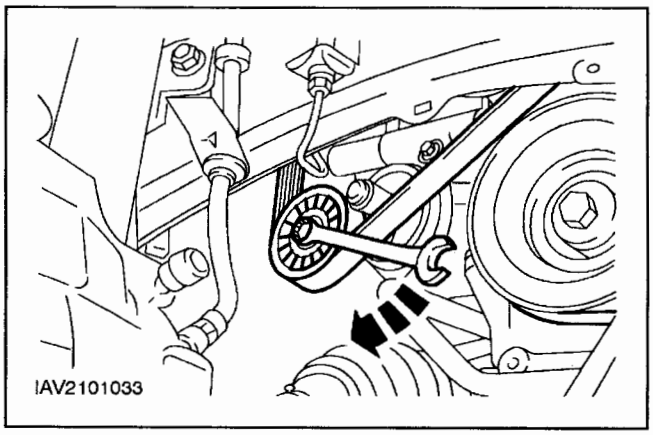


21. Remove the upper accessory drive belt cover.

22. Raise and support the vehicle. For additional information, refer to Section 100-02.

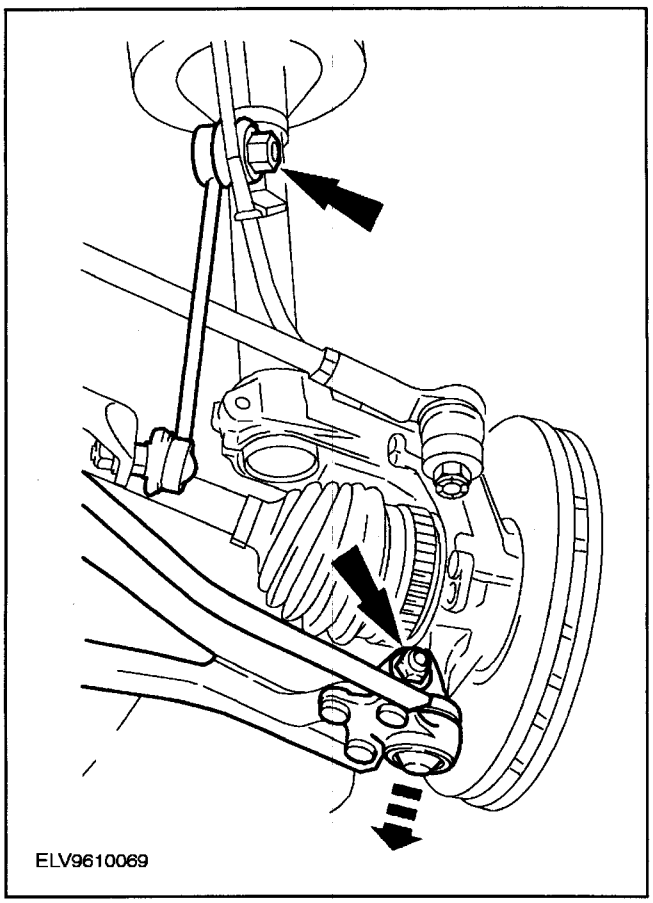


23. Remove the splash shield (right-hand side shown).



24. Loosen and remove the accessory drive belt.

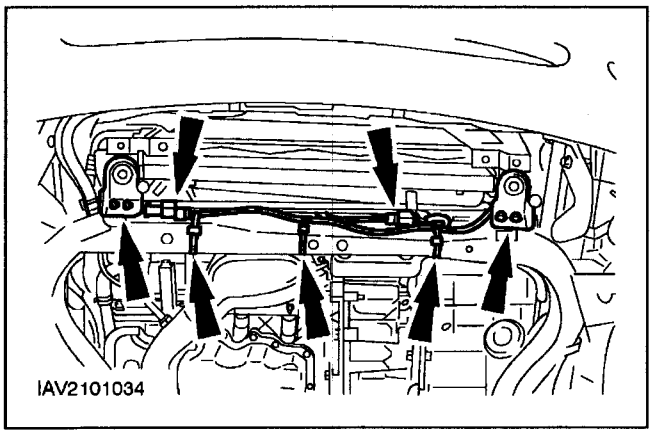
REMOVAL (Continued)



25. ⚠ **CAUTION: Do not damage boot and ABS sensor ring**

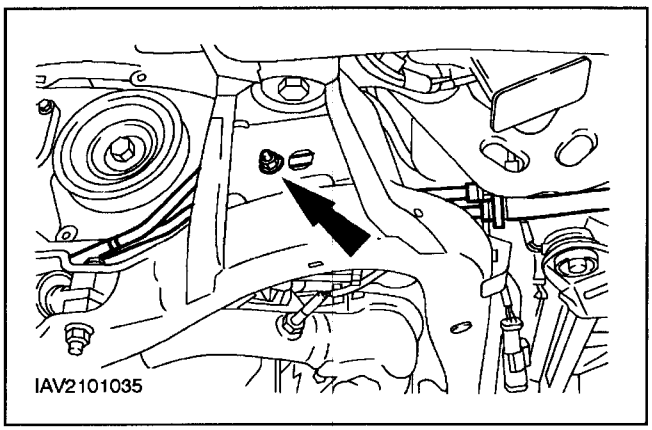
    Disconnect the lower suspension arm ball joints and the stabilizer link rods (right-hand side shown).

    - Disconnect the ABS wiring harness bracket from the suspension strut.



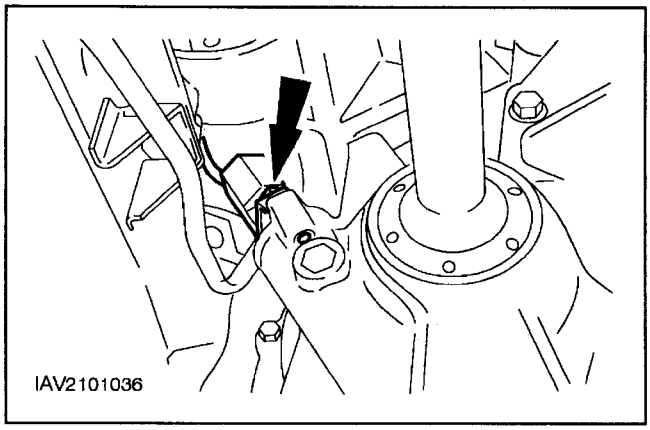
26. Disconnect the radiator at the bottom and disconnect both heated oxygen sensor (HO2S) electrical connectors.

    - Cut the cable ties.

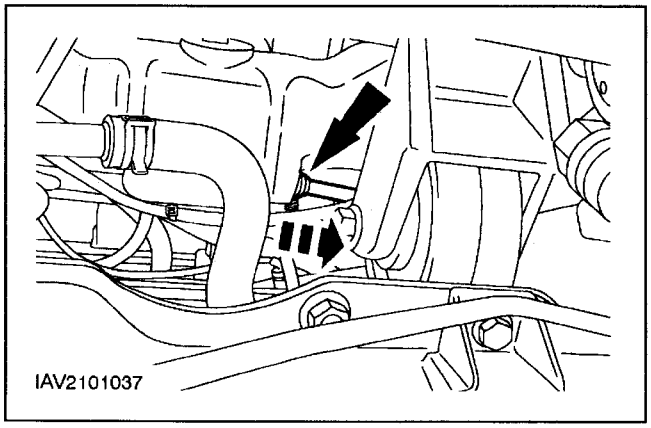


27. Disconnect the power steering hoses from the subframe.

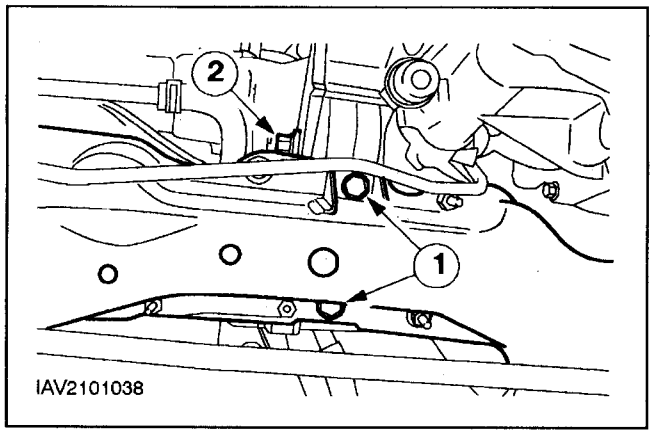
REMOVAL (Continued)



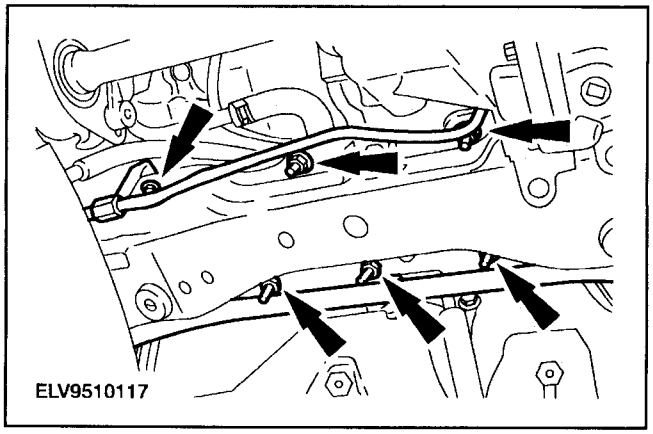
28. Remove the vehicle speed sensor (VSS).
    - Remove the retaining clip (one bolt).
    - Close off the opening.



29. Disconnect the brake booster vacuum line from of the intake manifold.
    - Disconnect the quick release coupling and pull out the line.

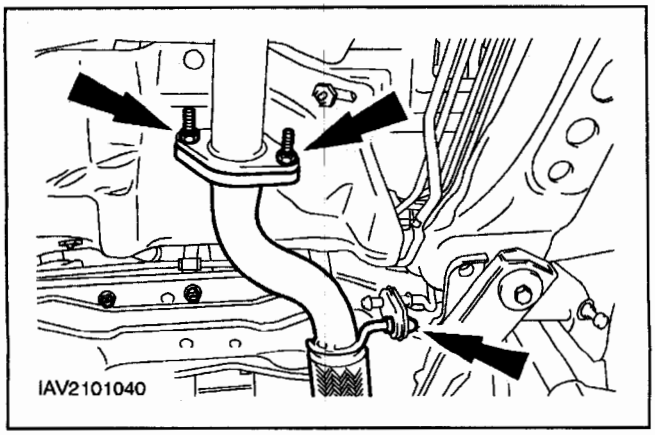


30. Remove the right-hand engine support insulator.
    1 Remove the bolts.
    2 Remove the center bolt.

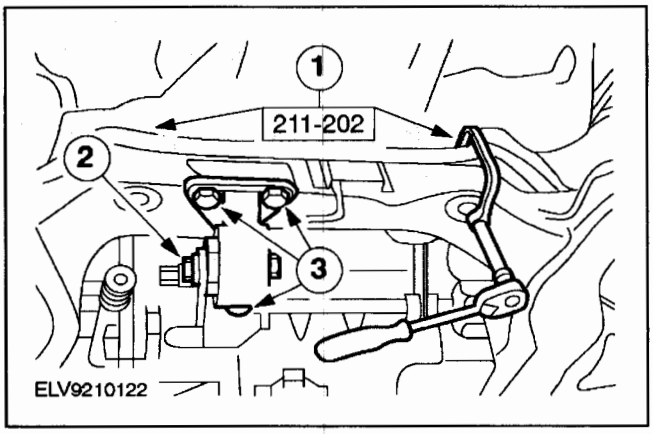


31. Remove the steering gear heat shield.
    - Remove the power steering line bracket and the coolant line bracket.

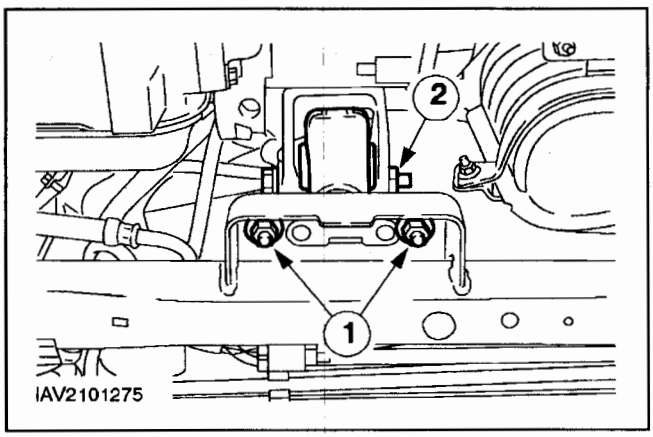
REMOVAL (Continued)



32. Disconnect the front exhaust tube and unhook it.
    - Discard the gasket.



33. Using the special tool, disconnect the steering gear (two bolts) and secure it with mechanic's wire out of the way (left-hand side shown).



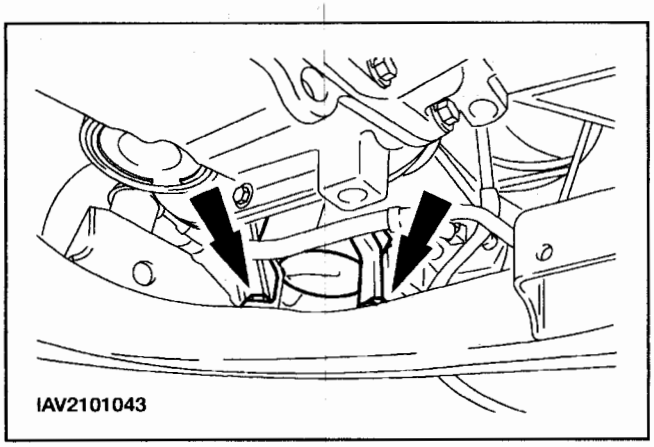
34. **NOTE:** If necessary raise the automatic transaxle slightly with a transmission jack.

    Remove the left-hand engine support insulator.

    1 Remove the nuts.

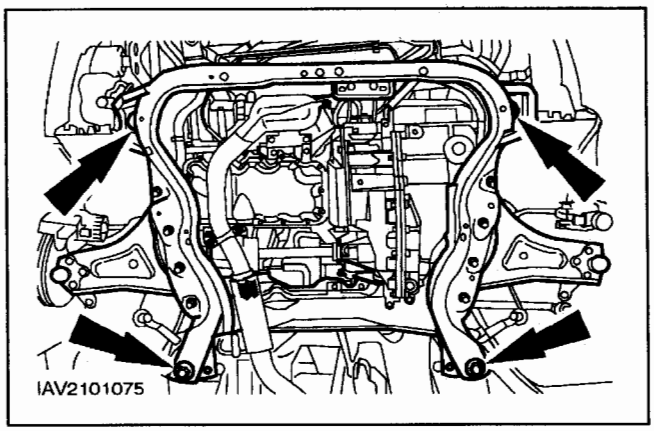
    2 Remove the center bolt.

Vehicles with air conditioning



35. Remove the suction accumulator bolts.

REMOVAL (Continued)

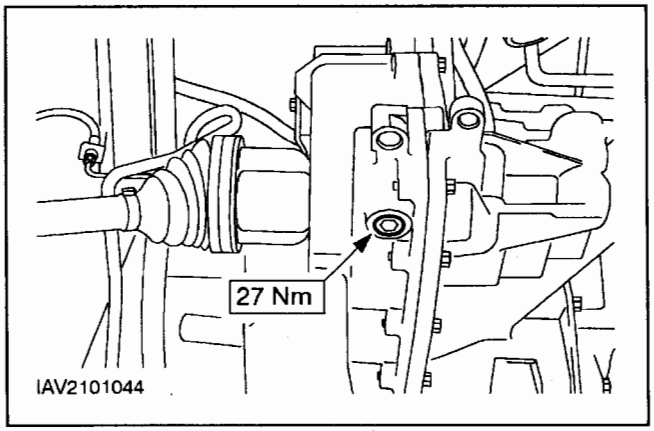

IAV2101075

All vehicles

36. ⚠ **WARNING: Support the subframe using the powertrain lift. Failure to follow these instructions may result in personal injury.**

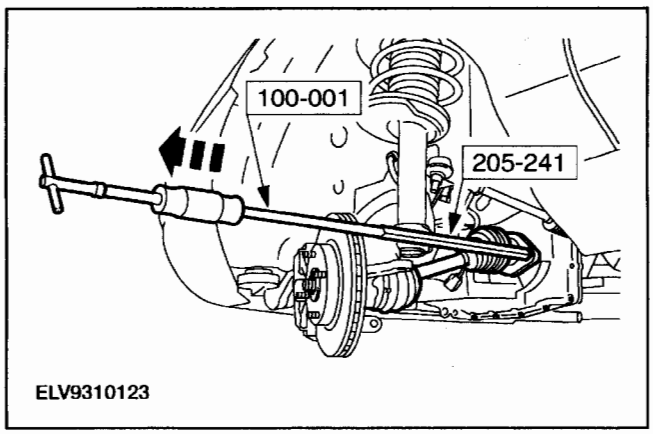
    Remove the subframe.

    - Take out the rubber guides from the lower radiator supports.



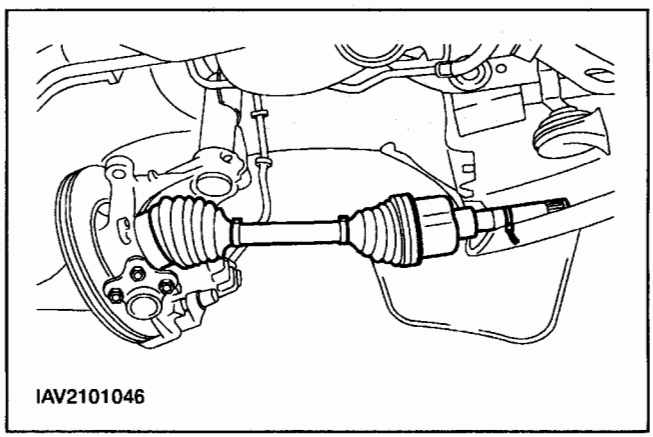
IAV2101044

37. Drain the automatic transmission fluid.
    - Install the drain plug.



ELV9310123

38. Using the special tools, release the left-hand halfshaft.

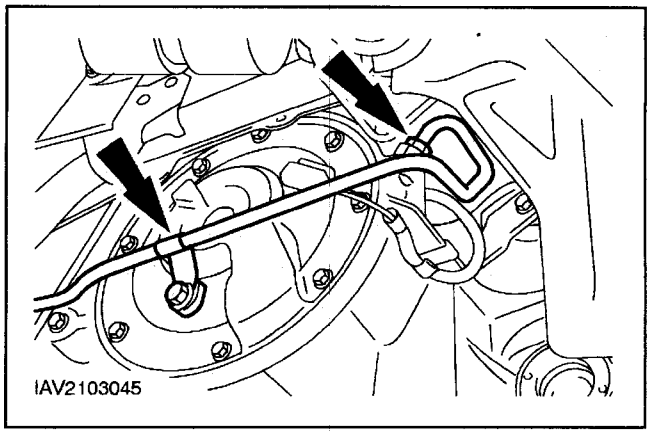

IAV2101046

39. ⚠ **CAUTION: To avoid to damage halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by not more than 45 degrees.**

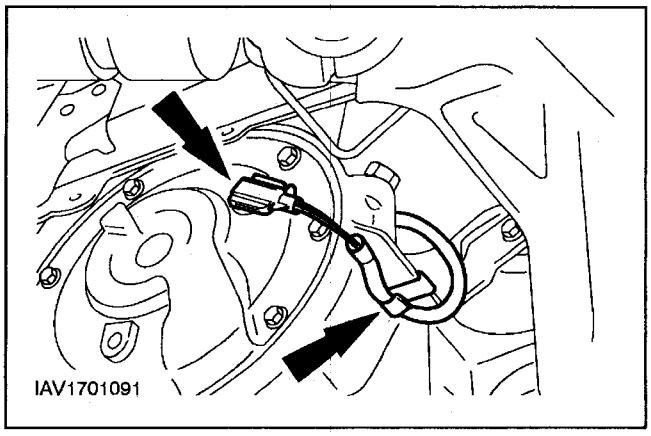
    NOTE: Collect escaping oil. Close off the transaxle opening with a plug.

    Withdraw the left-hand drive halfshaft and tie it up.

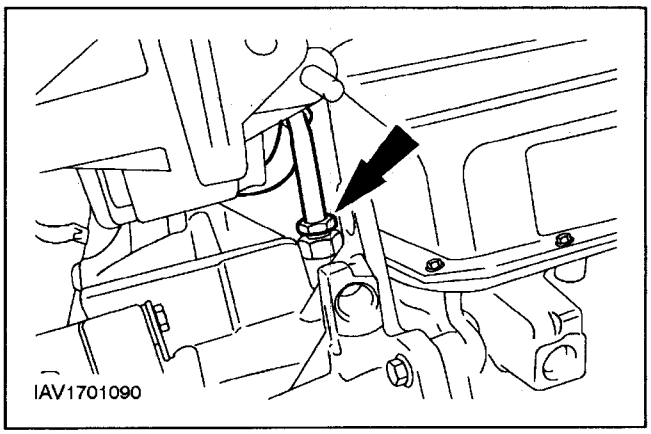
REMOVAL (Continued)



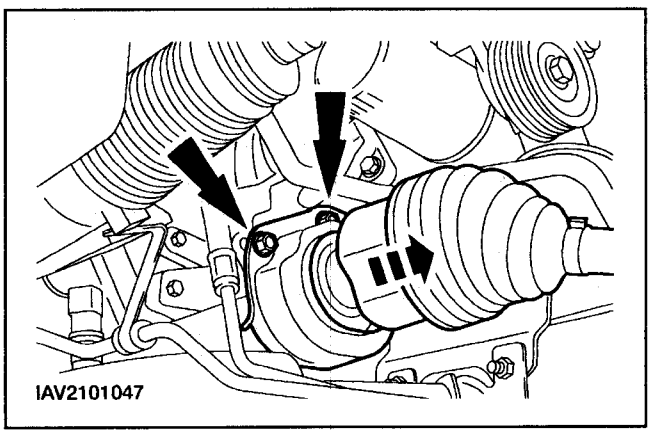
40. Disconnect the fluid tube.
    - Close off the openings with suitable plugs.



41. Disconnect the turbine shaft speed (TSS) sensor electrical connector.
    - Unclip the wiring.

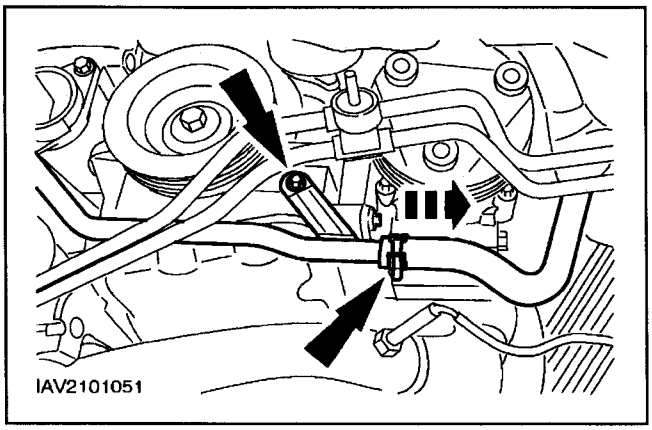


42. Disconnect the fluid cooler tube from the transaxle.

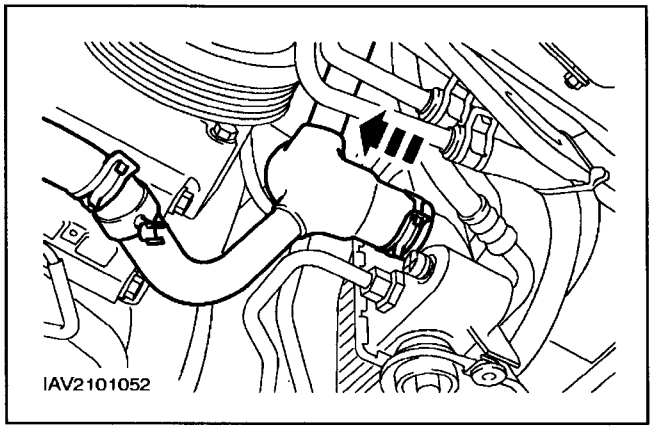


43. Remove the right-hand drive halfshaft and intermediate shaft.
    - Secure the right-hand drive halfshaft out of the way with mechanics wire.

REMOVAL (Continued)

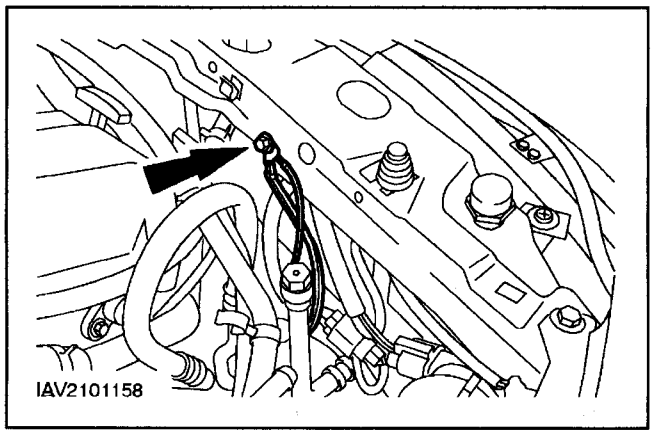


44. Disconnect the coolant hose from the heater coolant tube and remove the bracket.

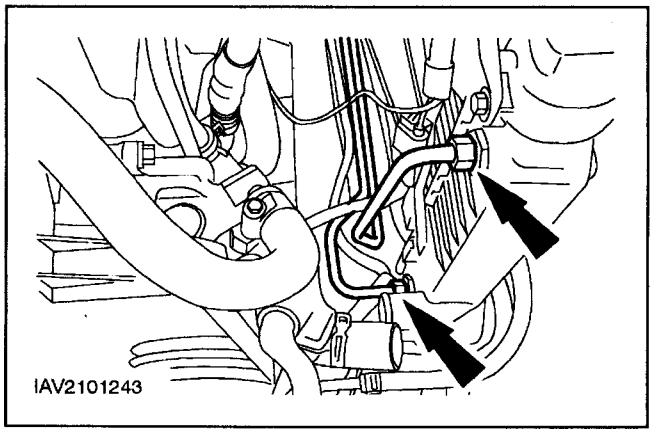


45. Disconnect the lower coolant hose.

46. Lower the vehicle.

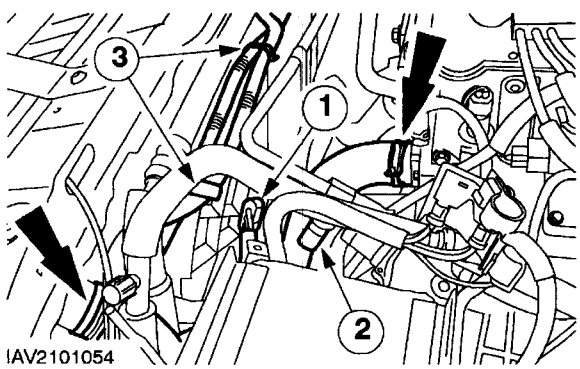


47. Disconnect the two ground cables.



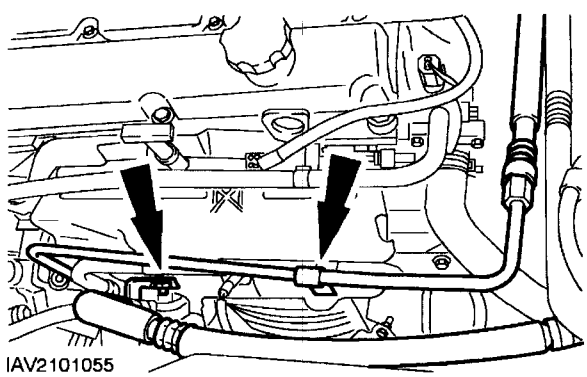
48. Disconnect the hoses from the oil cooler.

REMOVAL (Continued)

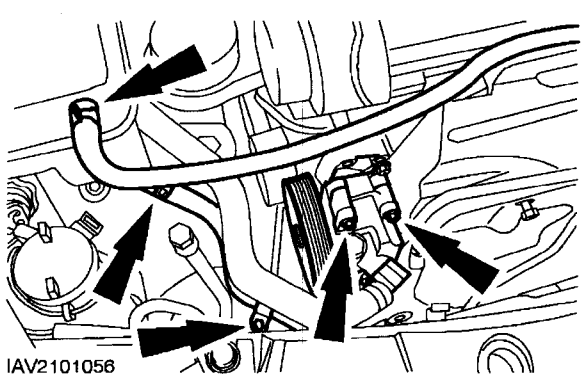


IAV2101054

49. Disconnect the electrical connectors and the upper coolant hose.
    1 Disconnect the fan motor electrical connector.
    2 Disconnect the power steering pressure (PSP) switch electrical connector.
    3 Unclip the wiring harnesses.


IAV2101055

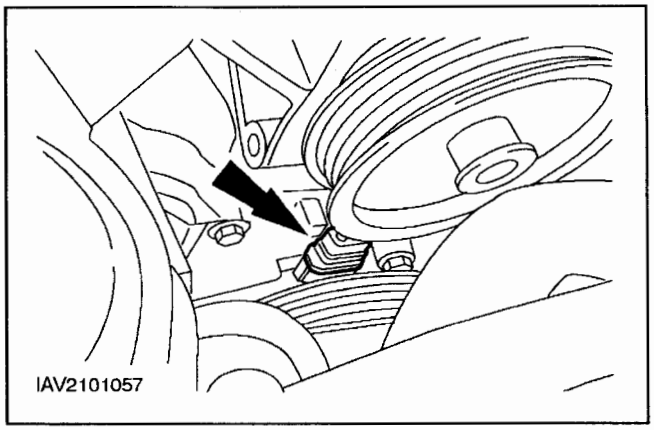
50. Remove the tube/hose (A/C) bracket and the power steering line.


IAV2101056

51. Remove the upper bolts from the power steering pump, remove the wiring clamp from the fender apron panel and remove the coolant hoses.

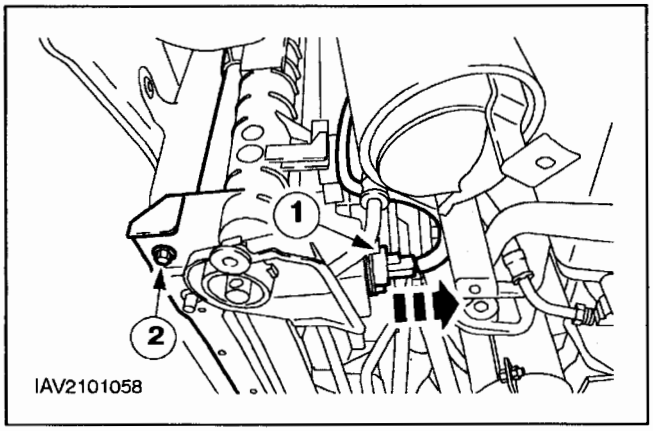
52. Raise and support the vehicle. Refer to Section 100-02.

REMOVAL (Continued)


IAV2101057

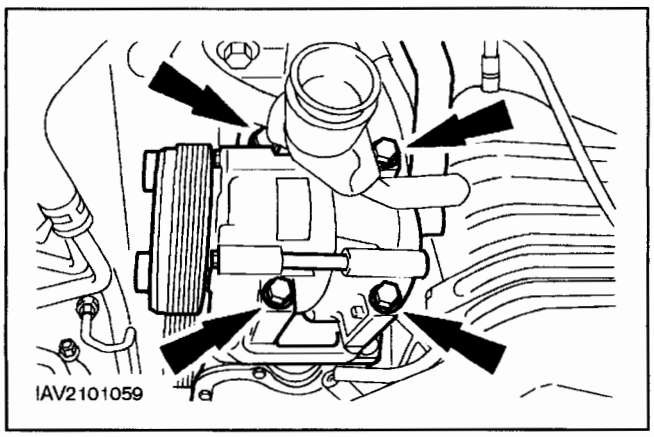
Vehicles with air conditioning

53. Disconnect the compressor electrical connector.



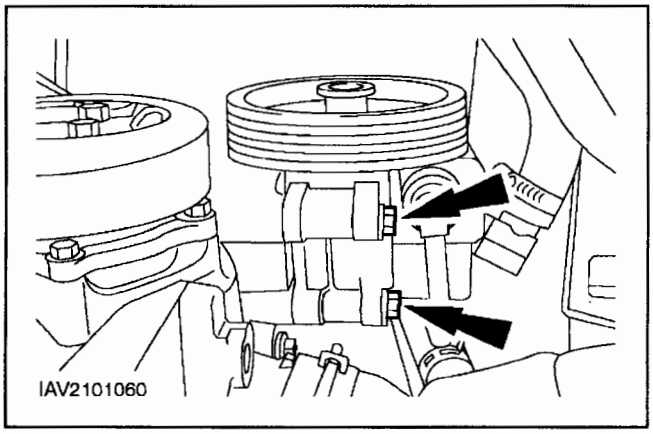
IAV2101058

54. Separate the radiator from the condenser core.
    1 Disconnect the fan motor ballast resistor electrical connector.
    2 Remove one bolt on each side (left-hand side shown).
    - Lower the radiator.


IAV2101059

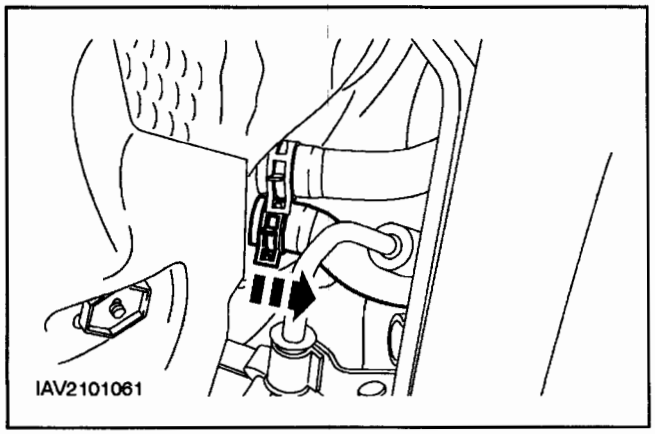
55. Remove the compressor bolts. Secure the compressor with mechanics wire and position it to one side.

All vehicles


IAV2101060

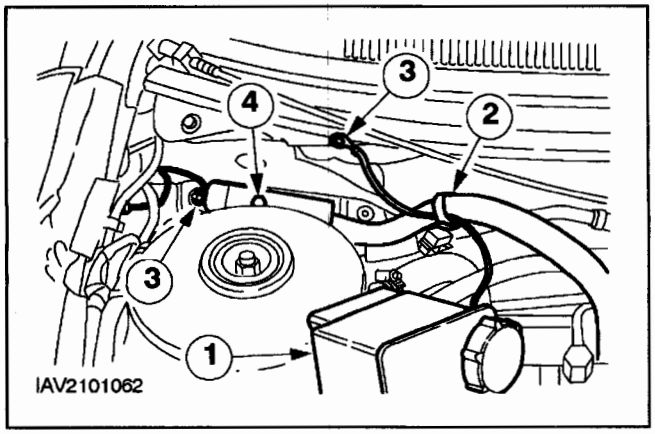
56. Disconnect the power steering pump with mechanics wire and position it to one side.

REMOVAL (Continued)

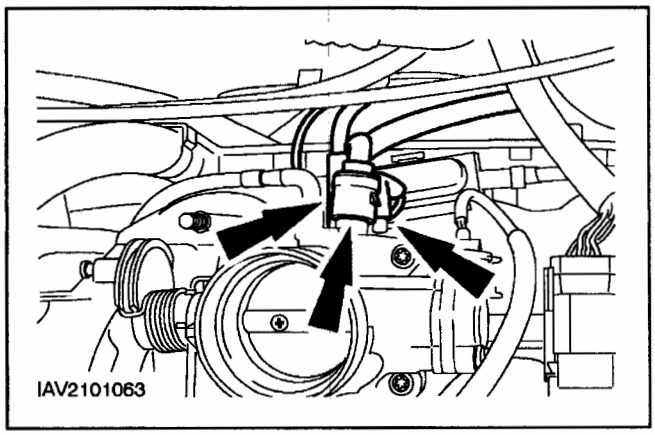


57. Disconnect the heater coolant hose.

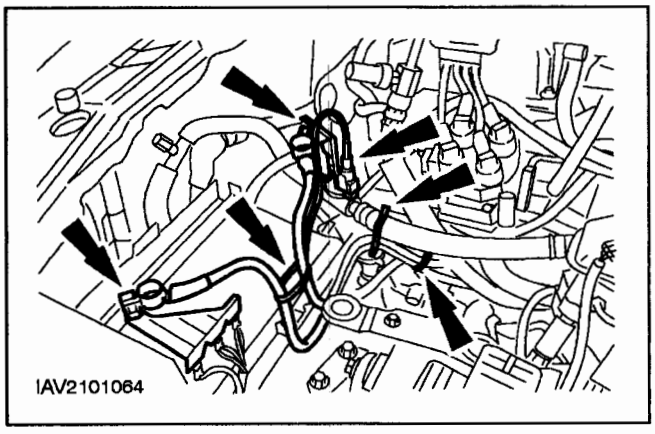
58. Lower the vehicle.



59. Disconnect the main wiring harness from the powertrain control module (PCM).
    1 Take out the power steering reservoir (push fit) and lay it to one side.
    2 Disconnect the wiring bracket.
    3 Disconnect the two ground cables.
    4 Disconnect the main wiring harness electrical connector from the PCM.



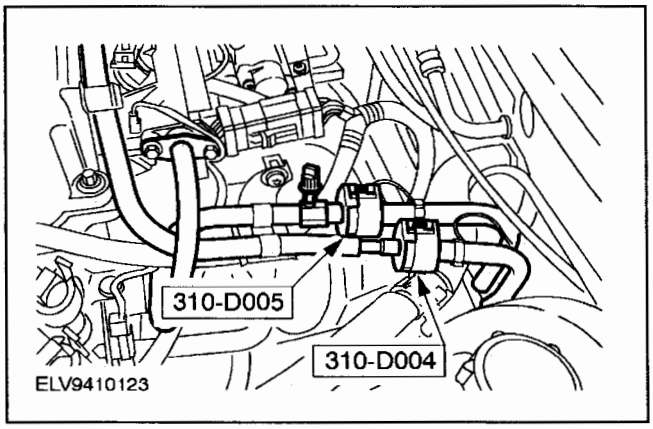
60. Disconnect the vacuum hoses from the intake manifold.



61. Disconnect the battery cables and electrical connectors, and cut the cable ties.

REMOVAL (Continued)

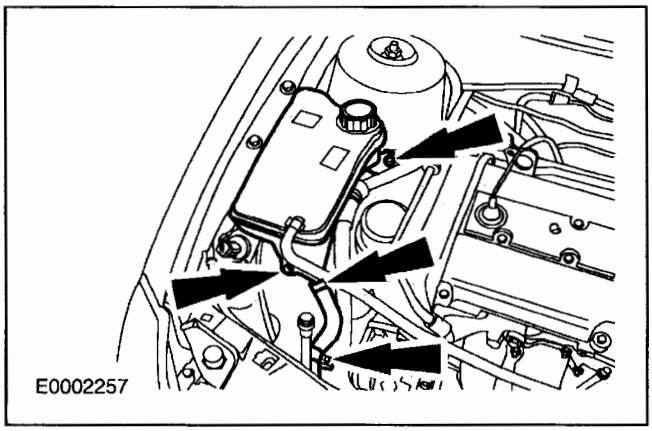
62. Relieve the fuel pressure. For additional information, refer to Section 310-00.



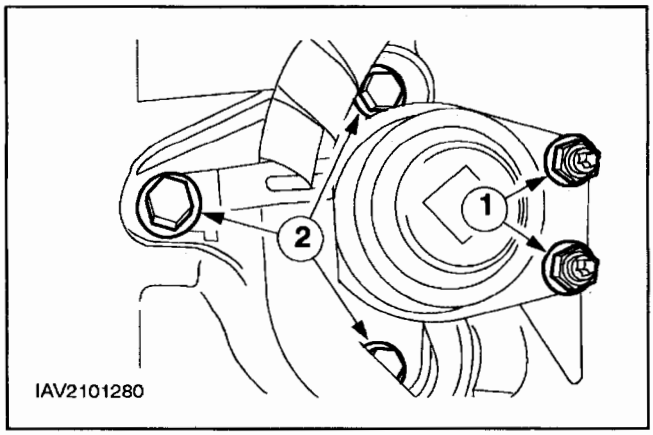
63. Using the special tools, disconnect the fuel lines.
    - Take off the retaining clips.

64. Raise and support the vehicle. For additional information, refer to Section 100-02.

65. Carefully lower the vehicle and place the engine/transaxle assembly on powertrain lift and secure it with Retaining straps.

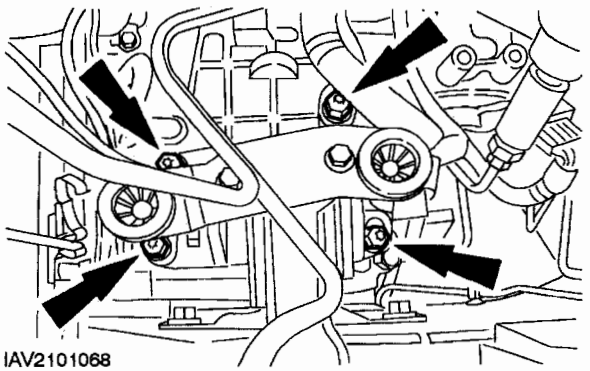


66. Remove the coolant expansion tank.

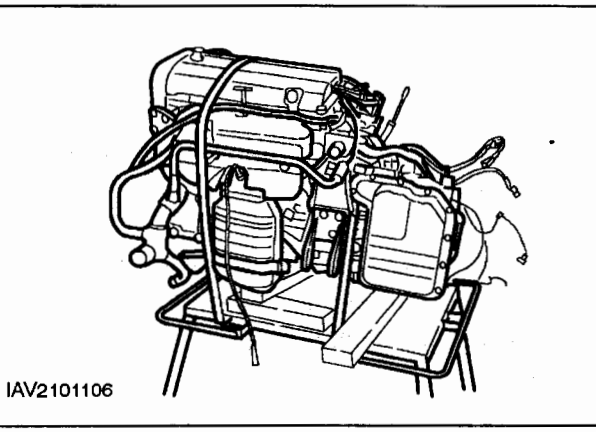


67. Remove the front engine mounting bracket.
    1 Remove the nuts.
    2 Loosen the bolts two turns.

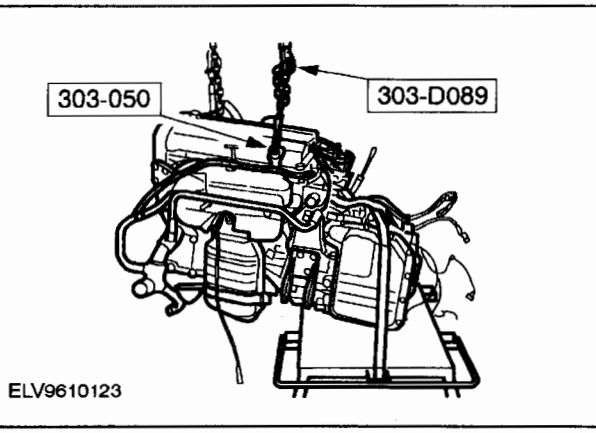
REMOVAL (Continued)


IAV2101068

68. Remove the rear engine mounting bracket.

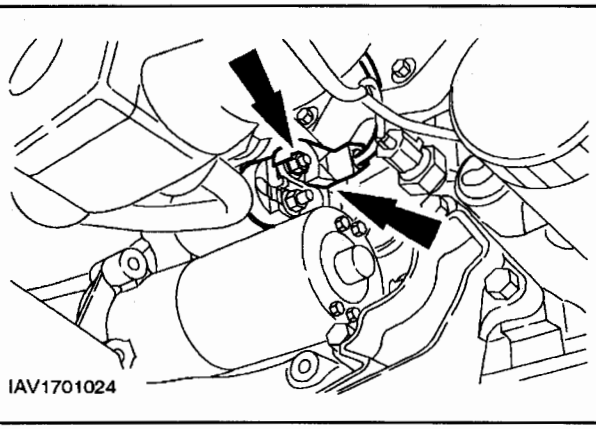

IAV2101106

69. Raise the vehicle and pull out powertrain lift with the engine/automatic transaxle assembly from underneath the vehicle.



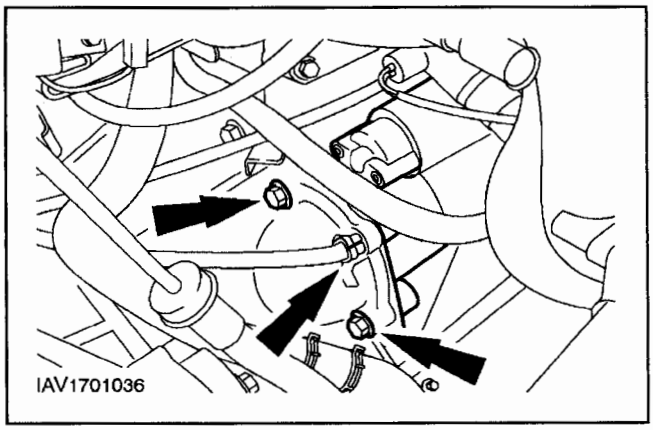
ELV9610123

70. Using special tools and a Suitable floor crane , move the engine/automatic transaxle assembly and secure the automatic transaxle with Securing straps to the powertrain lift.

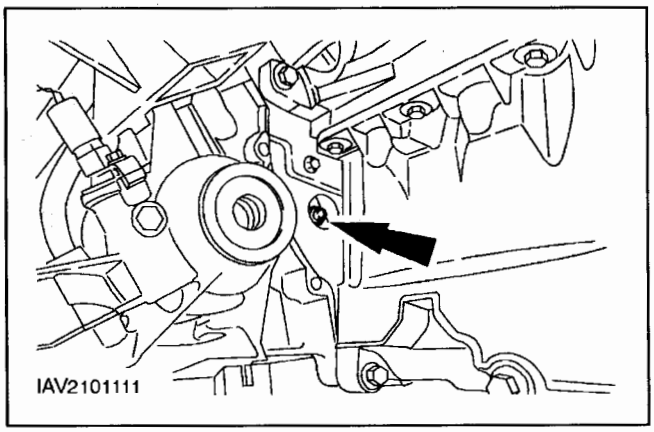

IAV1701024

71. Disconnect the starter motor electrical connections.

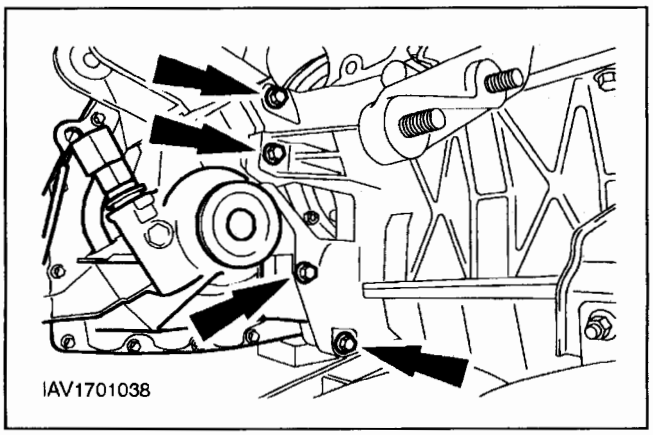
REMOVAL (Continued)



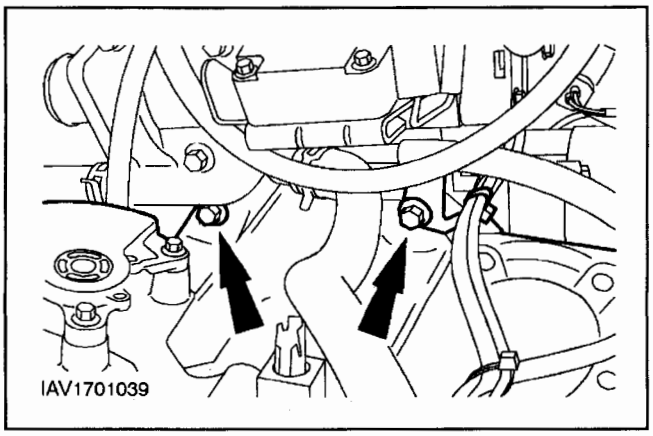
72. Remove the starter motor.



73. Remove the plastic cover and disconnect the torque converter from the engine drive plate (four nuts).

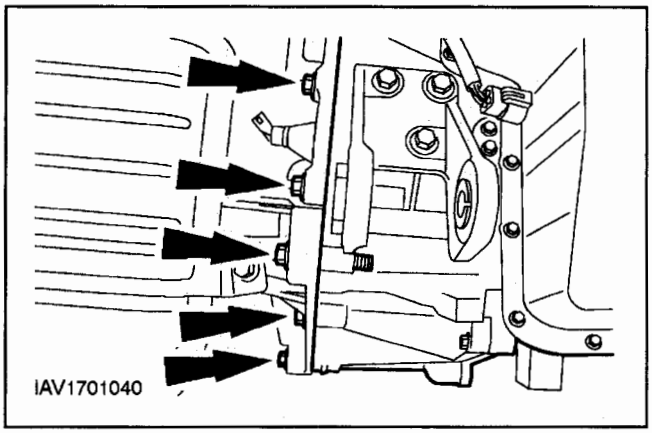


74. Remove the transaxle flange bolts on the right-hand side.



75. Remove the upper transaxle flange bolts.

REMOVAL (Continued)



76. Remove the transaxle flange bolts on the left-hand side.

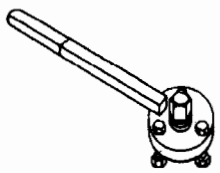
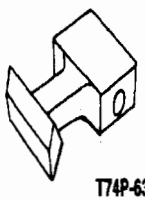
77. ⚠ **WARNING: Do not let the torque converter drop out of the transaxle. Failure to follow these instructions may result in personal injury.**

    Separate the automatic transaxle from the engine.

DISASSEMBLY

Engine

Special Tool(s)

 T74P-6256-B	Holding Tool, Timing Belt Pulley 303-098 (T74P-6256-B)
 T74P-6375-A	Locking Tool, Flywheel 303-103 (T74P-6375-A)

General Equipment

Assemble stand
Securing straps
Wooden blocks.
Rubber hammer
Sharp spatula
Workshop hoist

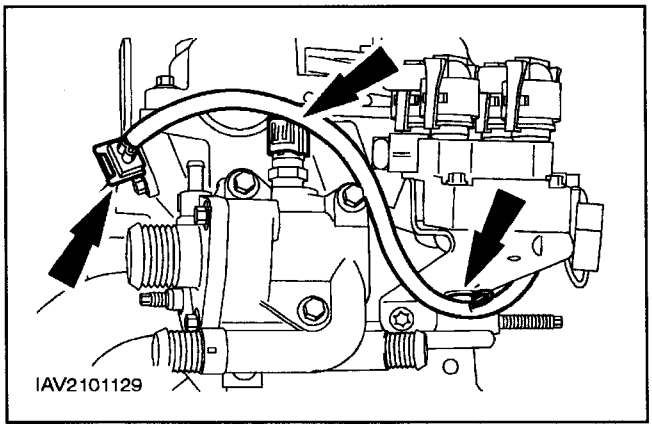
Disassembly

1. **NOTE:** The engine should stay hooked into the workshop hoist until it can be attached to the assembly stand.

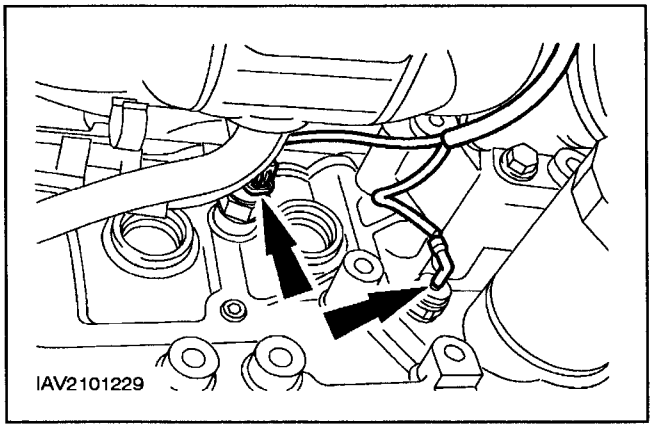
   Hook the workshop hoist into the engine lifting eyes and place the engine on the Assemble stand.

   - When it is on the assembly stand the engine has to be temporarily unhooked from the workshop hoist, secure it with Securing straps.

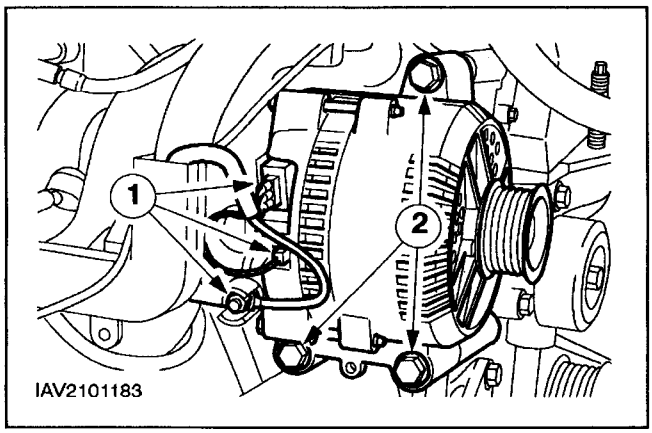
DISASSEMBLY (Continued)



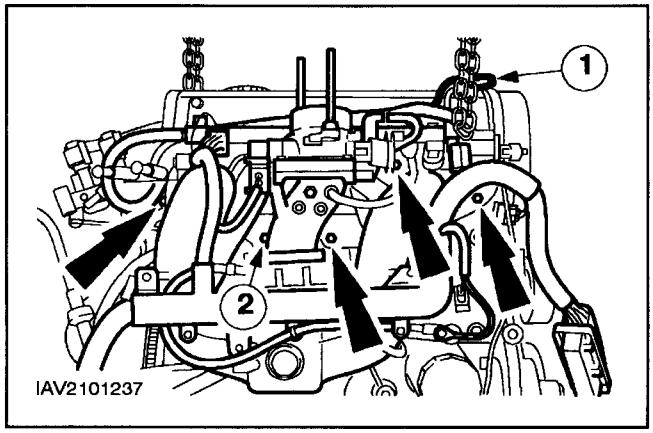
2. Disconnect the camshaft position (CMP) sensor and the engine coolant temperature (ECT) sensor.
   - Unclip the wiring from the electronic ignition (EI) coil.



3. Disconnect the oil pressure switch and knock sensor (KS) electrical connectors.

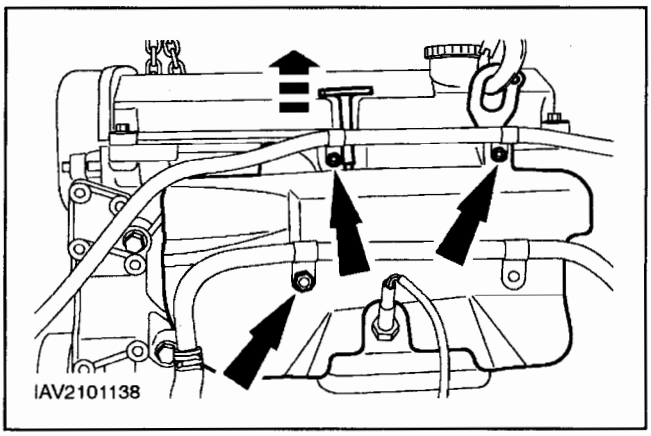


4. Remove the generator.
   1 Disconnect the generator electrical connectors.
   2 Unscrew the bolts.

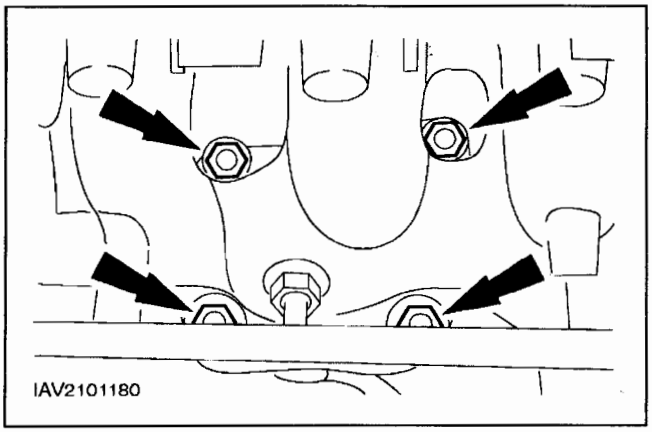


5. Remove the intake manifold.
   1 Disconnect the solenoid connector.
   2 Remove seven bolts and two nuts.

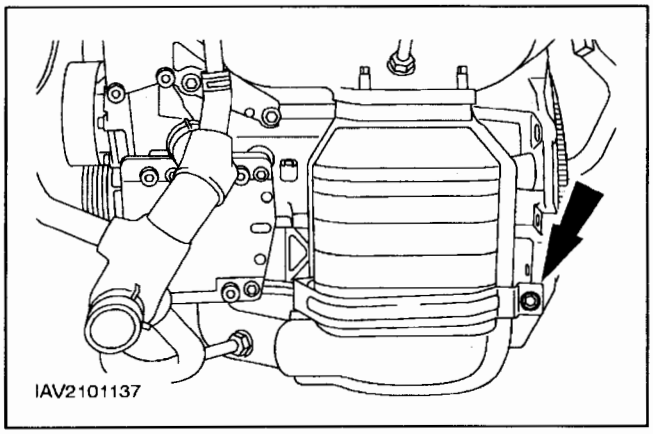
DISASSEMBLY (Continued)


IAV2101138

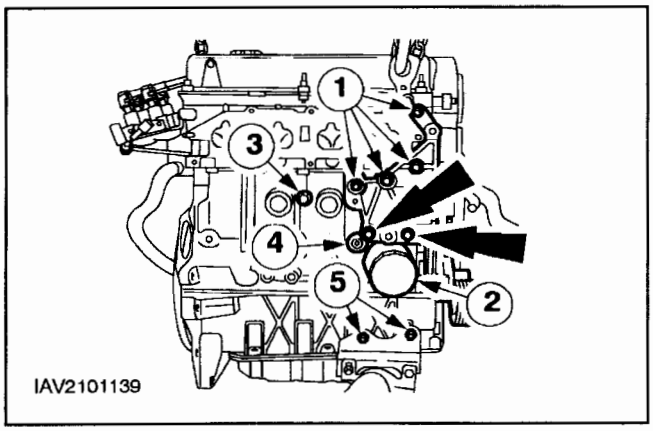
6. Remove the heat shield.
   - Remove two bolts and one nut.
   - Withdraw the engine oil level indicator.
   - Attach the engine lifting eye again and hook it into the workshop hoist.


IAV2101180

7. Disconnect the three-way catalytic converter (TWC) from the exhaust manifold.


IAV2101137

8. Remove the bolt from the TWC bracket.

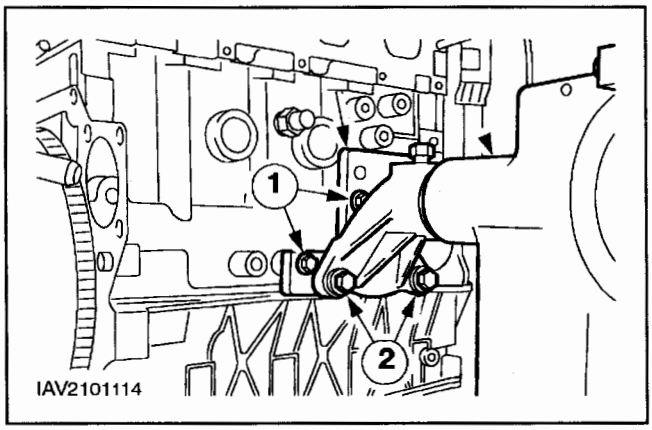


IAV2101139

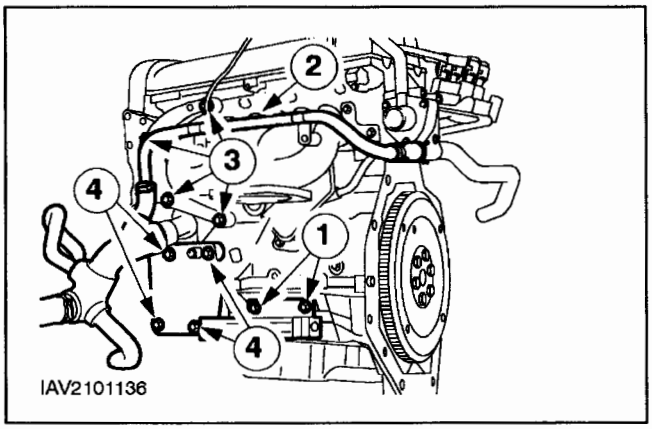
9. Remove the ancillary components on the intake side of the engine.
   - Drain off engine oil and reinstall and tighten the drain plug.

   1 Generator bracket.
   2 Oil filter.
   3 Knock sensor (KS).
   4 Oil pressure switch.
   5 Remove the exhaust tube bracket and take out the exhaust tube.

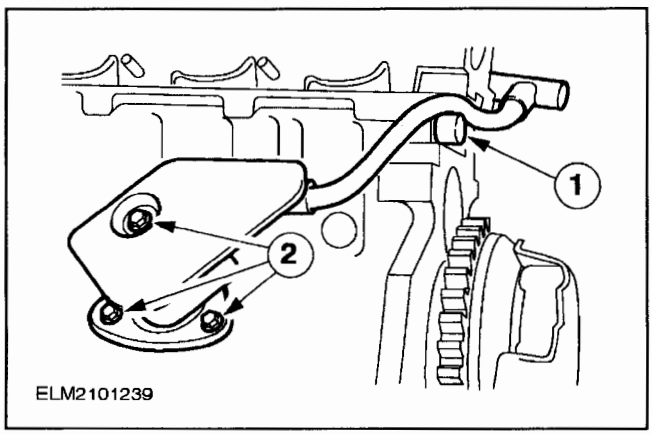
DISASSEMBLY (Continued)



10. Attach the engine to the assembly stand.
    1 Install the mounting plate.
    2 Install the mounting bracket.

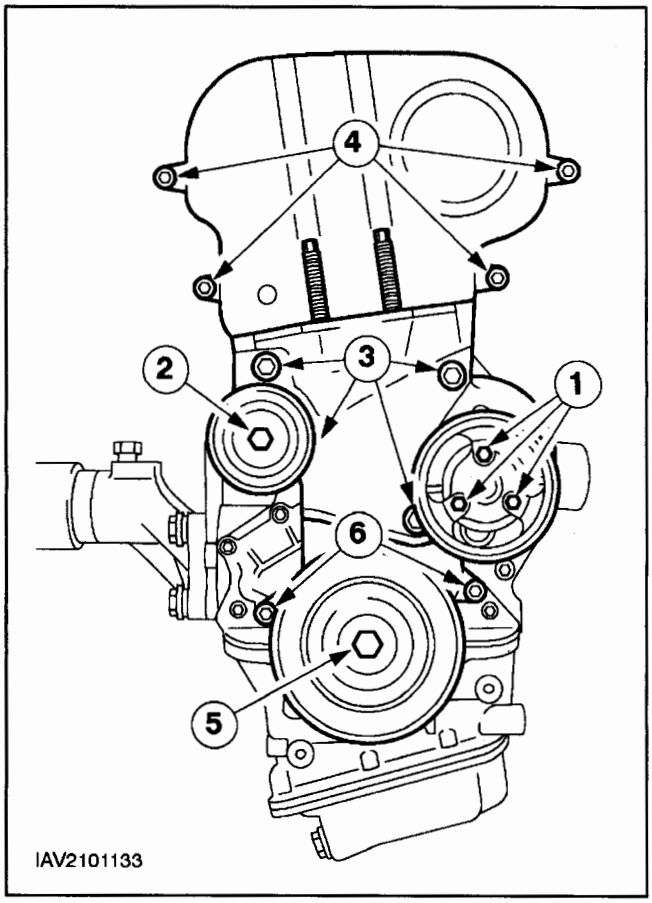


11. Remove the ancillary components on the exhaust side of the engine.
    1 TWC bracket.
    2 Coolant hose from water pump and thermostat housing.
    3 Power steering pump bracket.
    4 Air conditioning (A/C) compressor bracket.



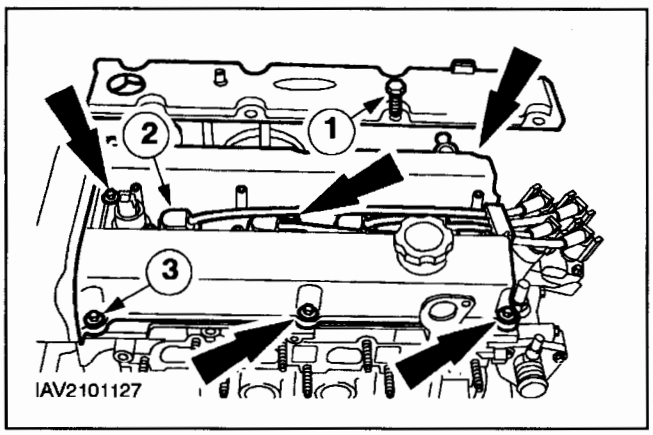
12. Remove the crankcase ventilation.
    1 Disconnect the crankcase ventilation tube.
    2 Remove the three bolts.

DISASSEMBLY (Continued)

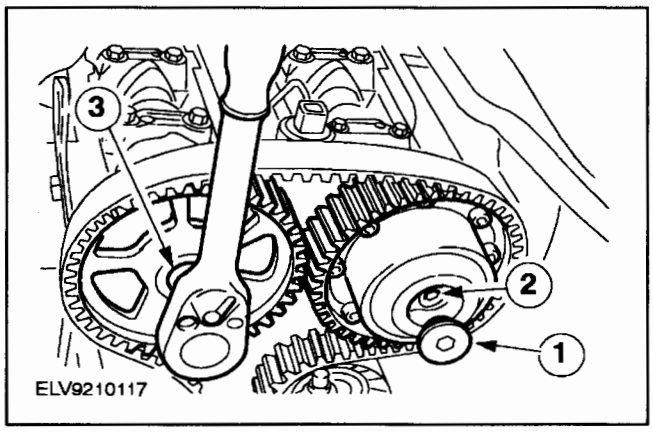


13. Remove the engine front cover.
    1 Remove the water pump pulley.
    2 Remove the idler pulley.
    3 Remove the center part of the engine front cover/front engine mounting bracket.
    4 Remove the upper part of the engine front cover.
    5 **NOTE:** Immobilize the flywheel using special tool 303-103.

      Remove the crankshaft pulley/vibration damper.
    6 Remove the lower part of the engine front cover.



14. Remove the valve cover.
    1 Remove the appearance cover.
    2 Disconnect the spark plugs HT wires.
    3 Remove the ten bolts.

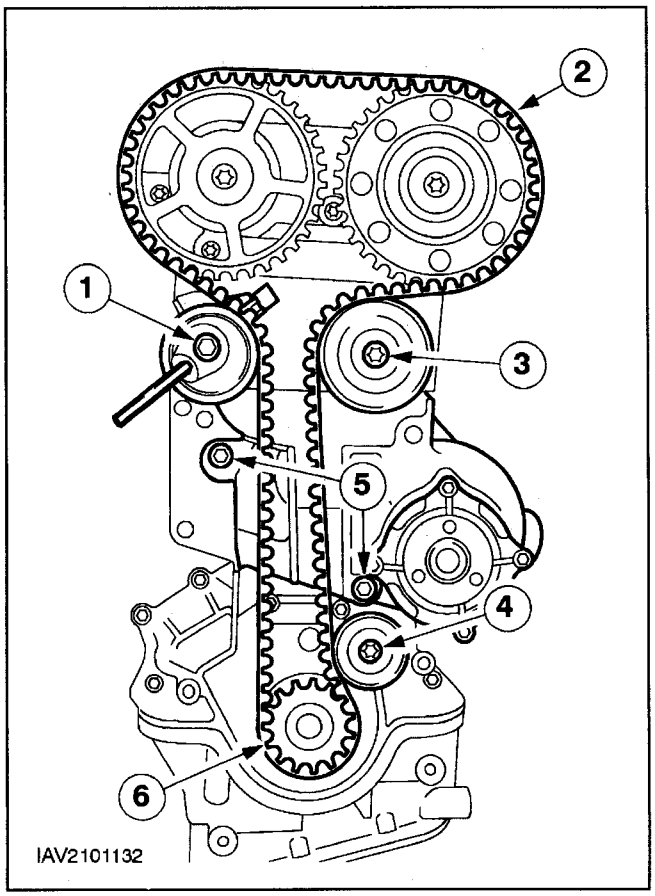


15. Loosen the camshaft timing belt pulleys.
    1 Unscrew and discard the blanking plug from the exhaust camshaft timing belt pulley.
    2 **NOTE:** Hold the camshaft by the hexagon with an open-ended wrench to stop it from turning.

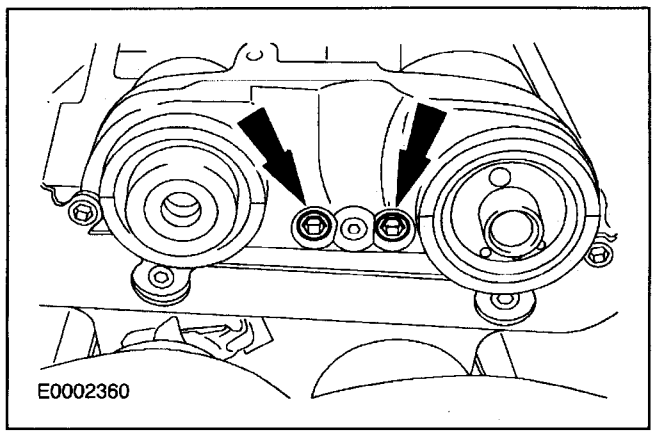
      Loosen the bolt one turn.
    3 **NOTE:** Hold the intake timing belt pulley with the special tool 303-098 to stop it from turning.

      Loosen the bolt one turn.

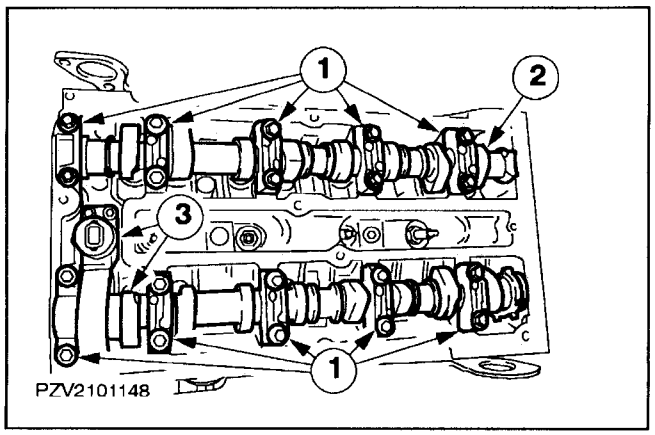
DISASSEMBLY (Continued)



16. Remove the timing belt drive and the water pump.
    1 Loosen the timing belt tensioner by turning the washer clockwise and remove it.
    2 Remove the timing belt.
    3 Remove the upper idler pulley.
    4 Remove the lower idler pulley.
    5 Remove the water pump.
    6 Remove the crankshaft timing pulley and thrust washer.
    - Remove the camshaft pulleys.



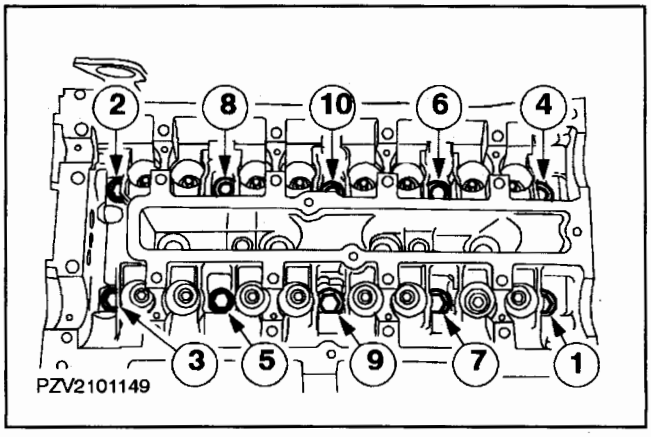
17. Remove the bolts from the oil feed flange.



18. **NOTE:** Loosening sequence: Working from the outside inwards, loosen the bolts evenly, undoing each one two turns at a time.

    Remove the camshafts.
    1 Remove the camshaft bearing caps.
    2 Take out the intake camshaft.
    3 Take out the exhaust camshaft together with the oil feed flange.
    - Remove the spark plugs.

DISASSEMBLY (Continued)

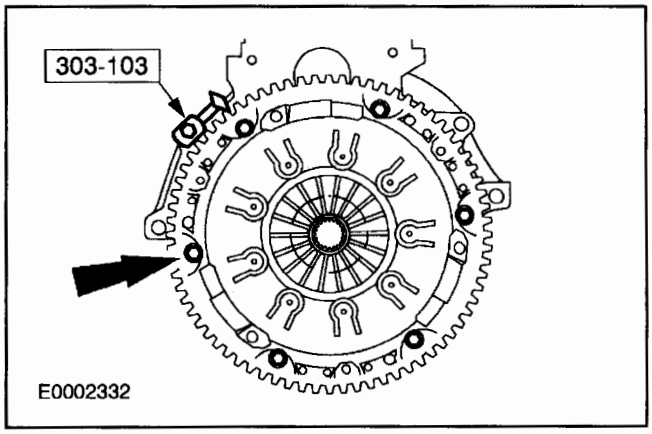


19. ⚠ **CAUTION: Wait until the cylinder head has cooled down to ambient temperature.**

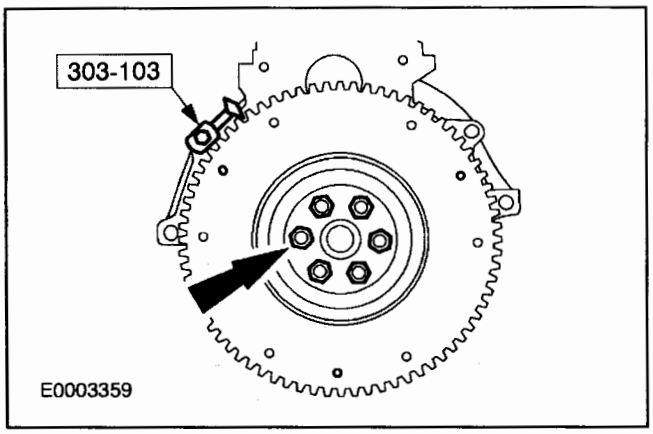
    NOTE: Loosening sequence

    Remove the bolts.

20. Lift off the cylinder head.
    - Use the Workshop hoist , hook it into the engine lifting eyes; lift off the cylinder head and place it on clean Wooden blocks.

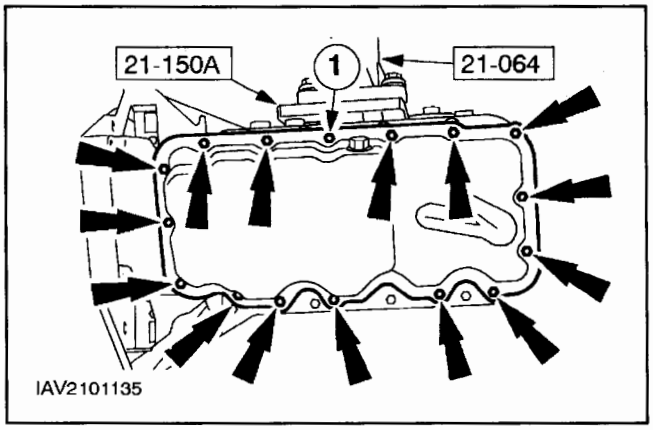


21. Using the special tool, remove the clutch pressure plate and the clutch disk, if equipped.



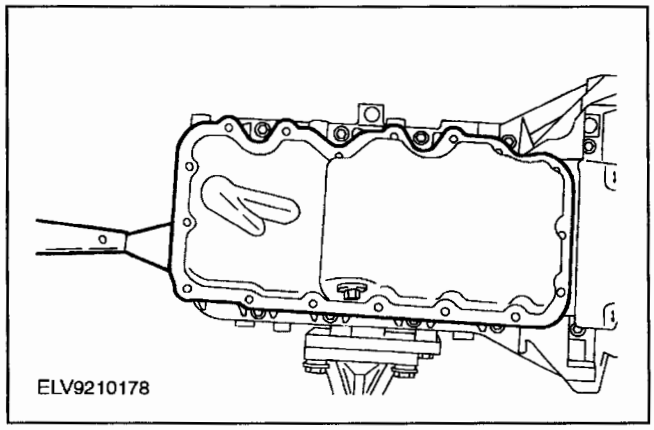
22. Using the special tool, remove the flywheel/drive plate.

DISASSEMBLY (Continued)



23. ⚠ **CAUTION: Remove the oil pan downwards. It is vital that no oil sludge or abraded particles enter the engine.**

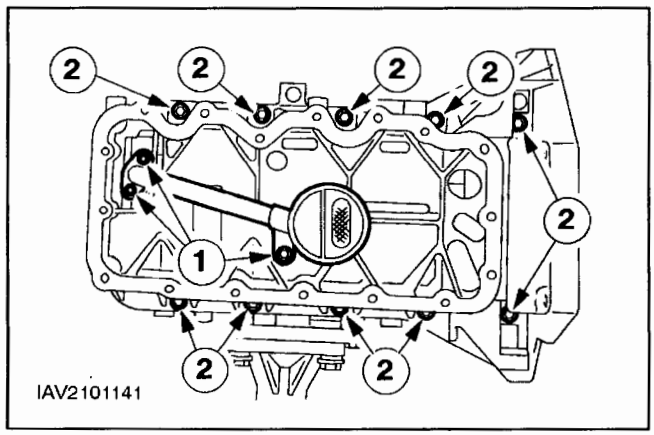
    Remove the oil pan bolts.



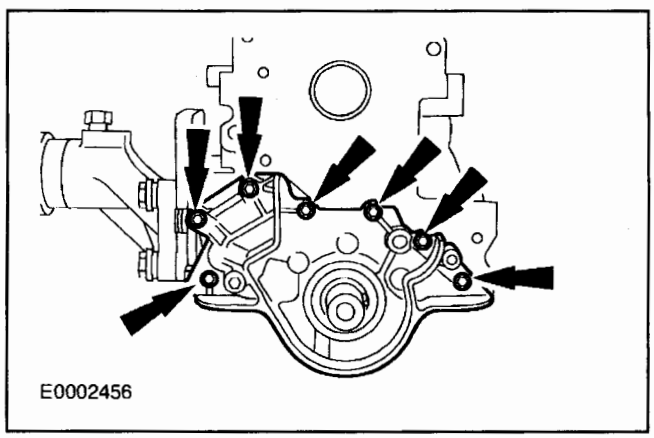
24. ⚠ **CAUTION: Do not damage the mating faces.**

    Remove the oil pan (shown at removed engine).

    - Separate the oil pan from the lower crankcase using a sharp Spatula. Release the oil pan from the lower crankcase by tapping slightly against the tightened drain plug with a Rubber hammer.

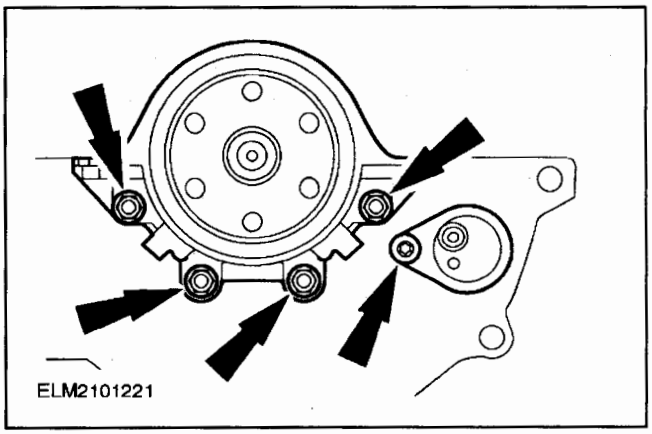


25. Remove the oil intake tube and the lower crankcase.
    1 Remove the oil intake tube.
    2 Remove the lower crankcase.

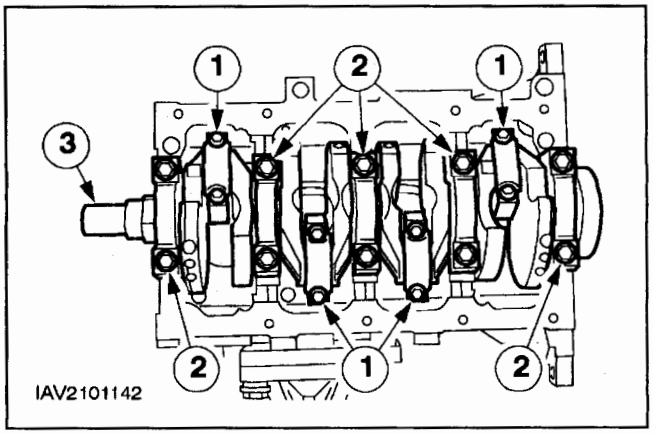


26. Remove the oil pump.

DISASSEMBLY (Continued)



27. Remove the crankshaft rear oil seal carrier and the crankshaft position (CKP) sensor with its bracket.
    1 Remove the CKP bolt.
    2 Remove the four bolts.

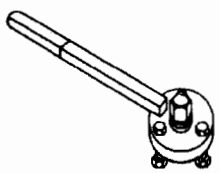
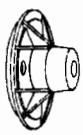


28. **NOTE:** Put all parts in order to one side.
    Remove the crankshaft and pistons.
    1 Remove the connecting rod bearing caps.
    2 Remove the main bearing caps.
    3 Remove the crankshaft and press out the pistons with the connecting rods.

ASSEMBLY

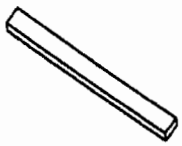
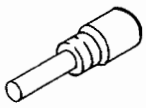
Engine

Special Tool(s)

 T74P-6256-B	Holding Tool, Timing belt pulley 303-098 (T74P-6256-B)
 T88P-6701-B1	Installer, Oil Seal (Rear), Crankshaft 303-328 (T88P-6701-B1)

(Continued)

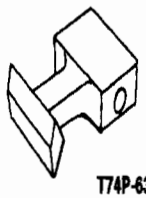
Special Tool(s)

 T94P-6256-CH	Camshaft Aligning Tool 303-465 (T94P-6256-CH)
 T97P6000A	Timing Pin, Cylinder No. 1 TDC 303-574 (T97P-6000-A)

(Continued)

ASSEMBLY (Continued)

Special Tool(s)

 21008a01	Installer, Oil Seal, Timing Cover 303-160 (T81P-6292-A)
 T74P-6375-A	Locking Tool, Flywheel 303-103 (T74P-6375-A)

General Equipment

Piston ring compressor
Spatula
Straight Edge

(Continued)

General Equipment

Engine lifting bracket
Feeler Gauge
Rubber hammer
10 studs, M6 x 20

Materials

Item	Specification
Super Premium SAE 5W30 Motor Oil XO-5W30-QSP	WSS-M2C153-H
High-Temperature Grease —	ESD-M1C220-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Gasket Maker F8AZ-19B508-AB	WSK-M2G348-A5
Solvent —	WSE-M5B392-A

Assembly

1. Remove the ring of carbon from the upper edge of the cylinder.

2. Clean all reusable parts with a spatula and gasket maker F8AZ-19B508-AB meeting Ford specification WSK-M2G348-A5, and check them for damage.

3. Thoroughly clean all threaded bores.

4. Available main bearing shell sizes.
   - **NOTE:** The main bearing shells are color coded.

     Size A: 2.145-2.152 mm (green)
   - Size B: 2.140-2.147 mm (brown)
   - Size C: 2.135-2.142 mm (yellow)
   - Size D: 2.130-2.137 mm (blue)

ASSEMBLY (Continued)

5. **NOTE:** Use size ''B'' or ''C'' main bearing shells (see previous step).

   Measure the crankshaft radial clearance For additional information, refer to Section 303-00.

   - Select the bearing shell according to previous step to obtain a bearing clearance of 0.020-0.040 mm.

6. Measure the crankshaft end float. For additional information, refer to Section 303-00.

7. Measure the camshaft radial clearance. For additional information, refer to Section 303-00.

8. Measure the camshaft end float. For additional information, refer to Section 303-00.

9. Measure the crankshaft. For additional information, refer to Section 303-00.

10. Measure the camshafts. For additional information, refer to Section 303-00.

11. Measure the cylinder bores. For additional information, refer to Section 303-00.

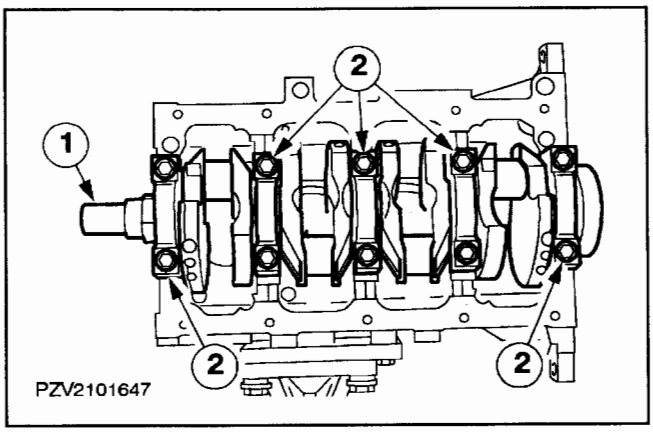
12. Measure the pistons. For additional information, refer to Section 303-00.

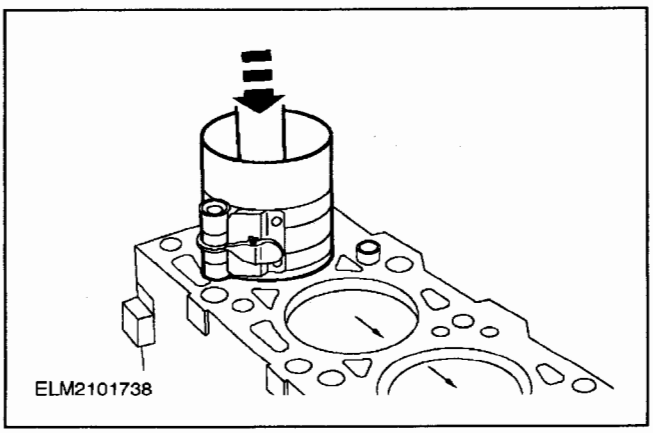
13. Measure the piston ring gaps. For additional information, refer to Section 303-00.

14. Measure the piston ring axial clearance. For additional information, refer to Section 303-00.

15. Check the cylinder head distortion. For additional information, refer to Section 303-00.

ASSEMBLY (Continued)





16. Install the crankshaft.
    - Lay the main bearing shells clean and free of oil into the cylinder block and into the bearing caps.
    - Coat the inner side of the bearing shells with engine oil.

    1 Lay the crankshaft in place.

    2 **NOTE:** Do not tighten the main bearing cap bolts yet.

    Attach the main bearing caps.

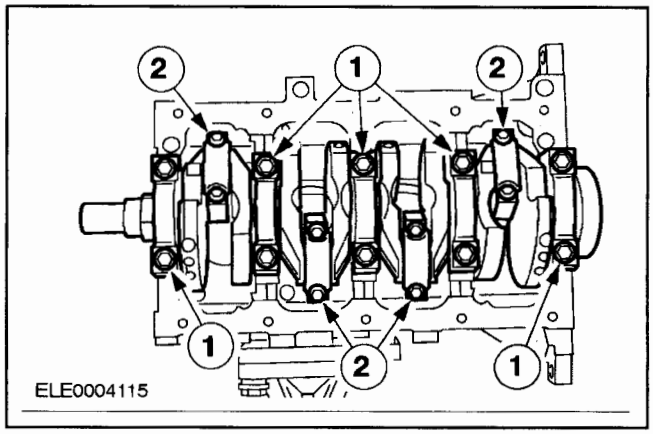
17. **NOTE:** The connecting rods are numbered starting at the timing belt end. The joined valve recesses on the piston crown face the intake side.

    Install the pistons.
    - Coat the pistons and cylinder liners with engine oil.
    - Distribute the piston ring gaps and the elements of the oil scraper ring evenly around the circumference (120 degrees).
    - Compress the piston rings using a piston ring compressor.
    - Press pistons 1 and 4 with the handle of a hammer into the cylinders. The connecting rod bearing journals for cylinders 1 and 4 must be at BDC.
    - Lay the corresponding bearing shells clean and free of oil into the connecting rod and the connecting rod bearing cap.
    - Coat the inner side of the bearing shells with engine oil.
    - **NOTE:** Use new connecting rod bearing cap bolts.

      NOTE: Do not tighten the connecting rod bearing cap bolts yet.

      Attach the bearing caps.
    - Rotate the crankshaft through 180 degrees and insert pistons 2 and 3.
    - Lay the corresponding bearing shells clean and free of oil into the connecting rod and the connecting rod bearing cap.
    - Coat the inner side of the bearing shells with engine oil.

ASSEMBLY (Continued)

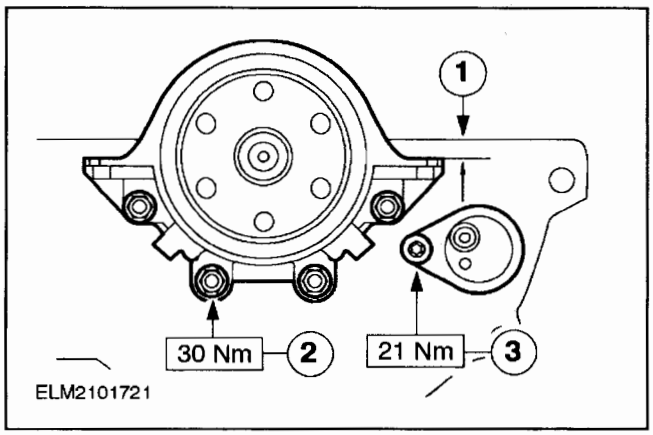


18. **NOTE:** The crankshaft must rotate freely; if necessary check and adjust the bearing clearances.

    Install the main bearings and connecting rod bearings.

    1 Tighten the main bearing bolts in two stages.
    - Stage 1: 25 Nm.
    - Stage 2: 60 degrees.

    2 Tighten the connecting rod bearing bolts in two stages.
    - Stage 1: 25 Nm.
    - Stage 2: 90 degrees.

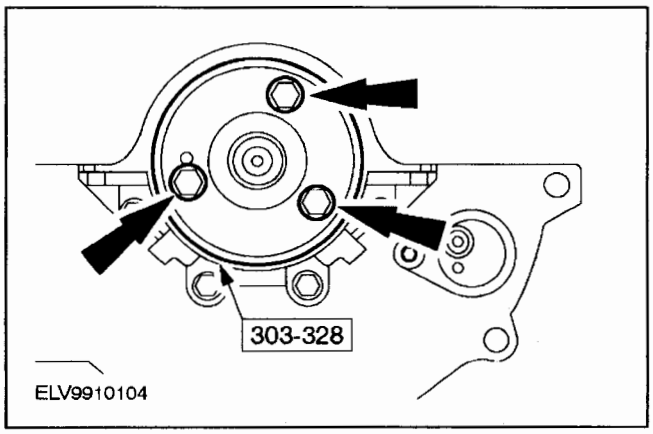


19. Install the rear oil seal carrier and the crankshaft (CKP) position sensor with its bracket.
    - Position a new oil seal carrier with a new seal in installation position and tighten the bolts finger tight.

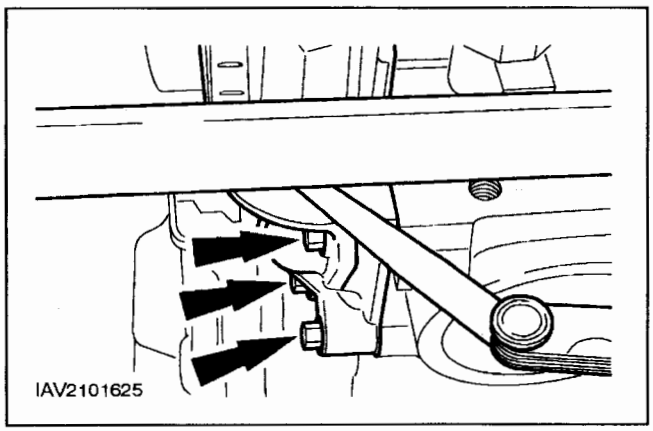
    1 Align the oil seal carrier so that the mating face of the oil seal carrier is between 0.3 mm and 0.8 mm below the cylinder block.

    2 Tighten the four bolts.

    3 Install the CKP sensor bracket.

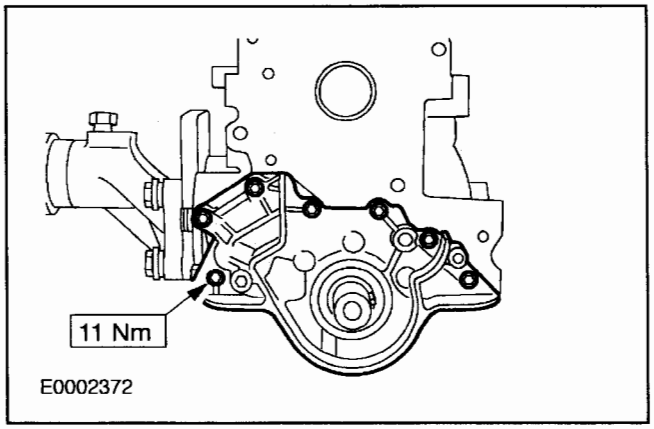


20. Using special tool, draw in the oil seal.
    - Install three flywheel bolts.

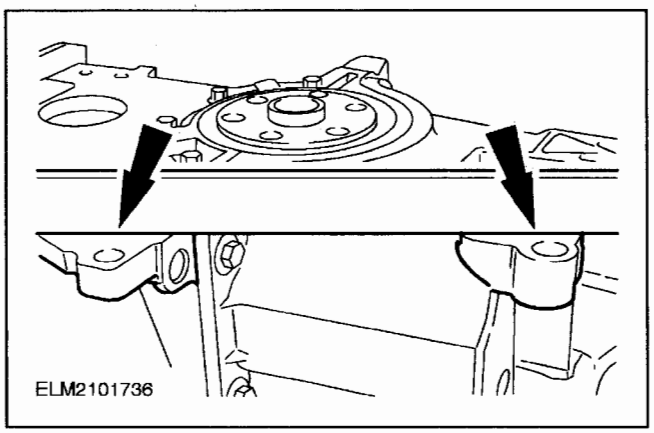


21. Position the oil pump.
    - Position the oil pump with a new gasket and tighten the bolts finger tight.
    - Using a Feeler Gauge, align the oil pump on both sides so that the mating face is between 0.3 mm and 0.8 mm below the cylinder block.

ASSEMBLY (Continued)

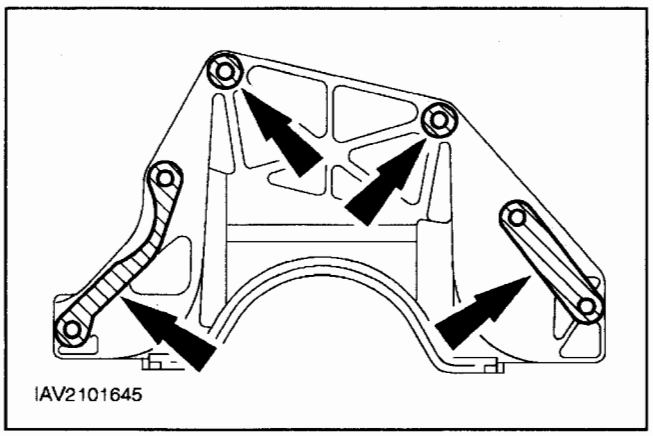


22. Install the oil pump with a new crankshaft front oil seal.
    - Tighten the bolts and check the alignment as described in the next step. Correct as necessary.



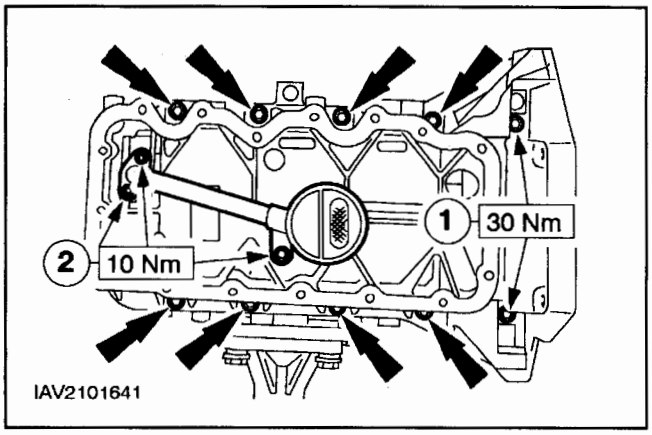
23. Align the lower crankcase.
    - Coat the joints between the cylinder block and the oil pump/oil seal carrier with Silicone Gasket and Sealant F7AZ-19554-EA meeting Ford specification WSE-M4G323-A4.
    - Position the lower crankcase in installation position with a new gasket and tighten the bolts finger tight.
    - **NOTE:** If the permissible overlaps or gaps are exceeded, use spacer shims as described in the next step.

      Align the lower crankcase using a straight edge so that the cylinder block and the lower crankcase are flush or do not exceed the following tolerances:
      - Manual transaxle: 0.10 mm overlap to 0.25 mm gap.
      - Automatic transaxle: 0.00 mm overlap to 0.25 mm gap.



24. Install lower crankcase spacer shims as required.
    - 0.26 to 0.50 mm gap, use 0.25 mm (yellow) spacer shims
    - 0.51 to 0.75 mm gap, use 0.50 mm (black) spacer shims

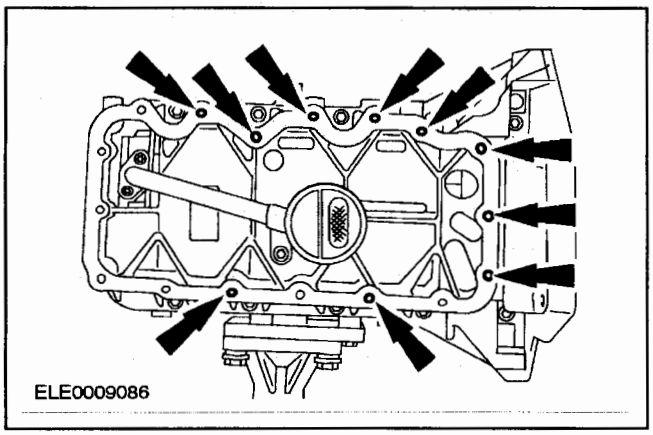
ASSEMBLY (Continued)



25. Install the lower crankcase with a new gasket.
    1 Tighten the bolts and check the alignment of the lower crankcase as described before. Correct as necessary.
    2 Install the oil intake tube with a new gasket. Tighten the oil pump bolts first and then the bolt to the lower crankcase.

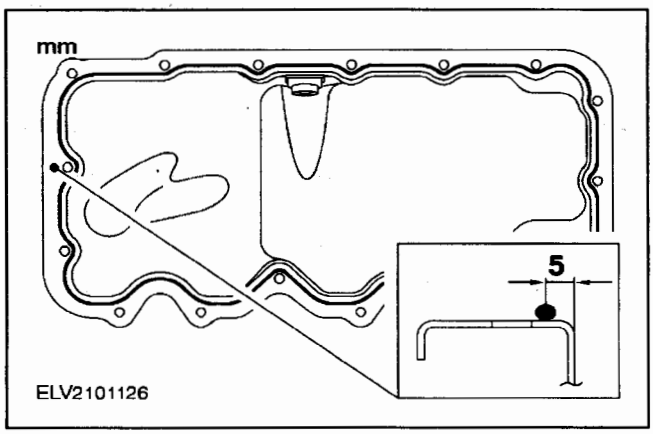
26. Preparatory operations for the installation of the oil pan.
    - **NOTE:** The mating faces must be free of oil and gasket residue.

      Clean the oil pan using Solvent to remove any oil residue or sludge.



27. ⚠ **CAUTION: Use studs. Sealer in the dead end bores can cause damage to the ladder frame.**

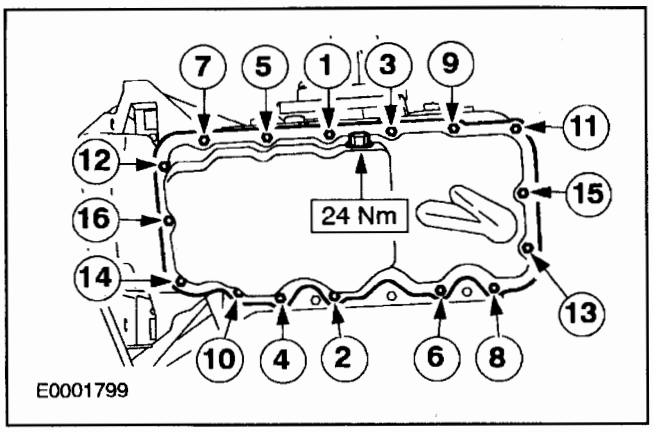
    Install 10 Studs (M6 x 20) in the shown dead end bores.



28. **NOTE:** Install the oil pan within 10 minutes after applying the sealer.

    Apply a 3 mm bead of Gasket Maker to the mating face of the oil pan.

ASSEMBLY (Continued)

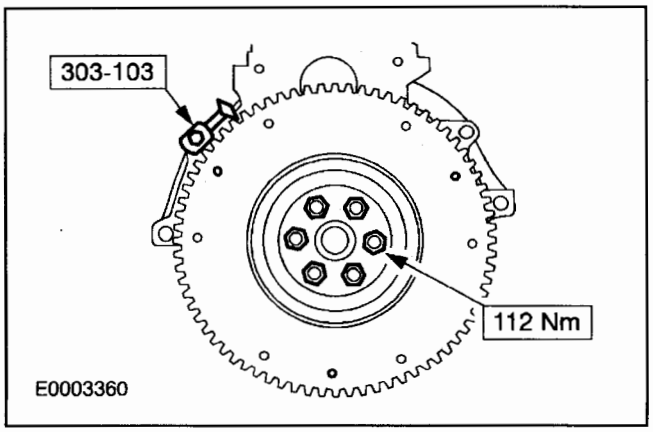


29. **NOTE:** Do not remove the oil pan, after the first contact with the ladder frame.

    NOTE: Tightening sequence.

    Install the oil pan and screw in the drain plug with a new oil seal.

    - Tighten the bolts in indicated sequence shown in two stages:
    - Stage 1: 6 Nm
    - Stage 2: 10 Nm



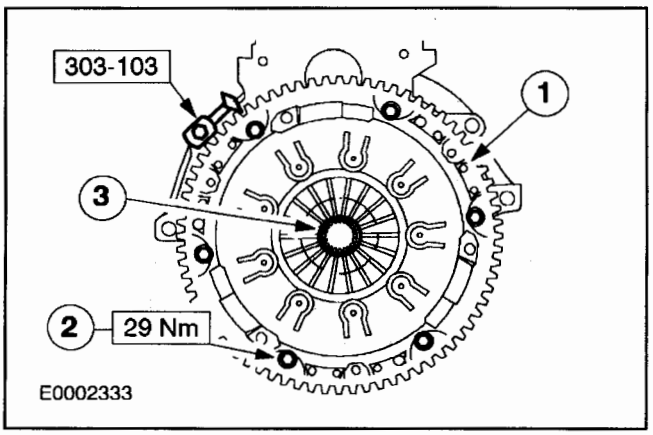
30. **NOTE:** Remove any traces of thread-locking compound from the threaded bores on the crankshaft.

    NOTE: Use new bolts.

    Using the special tool, install the flywheel.

31. **NOTE:** Apply the High temperature grease thinly enough so that when the clutch disk is fitted onto the transmission input shaft, no grease is squeezed out from the splines.

    Coat the drive splines of the clutch disk evenly with High temperature grease.



32. **NOTE:** Center the clutch disk on the pressure plate.

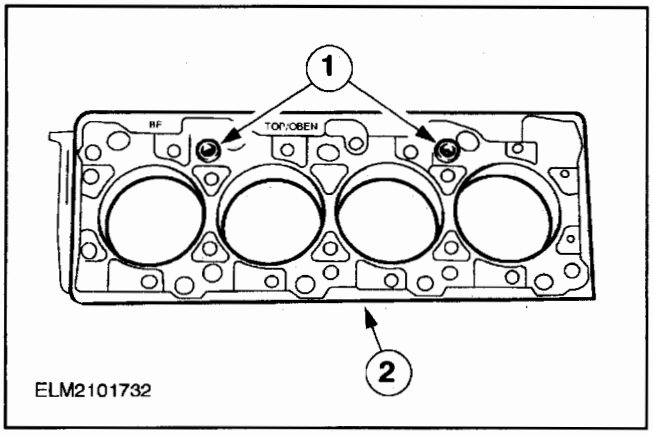
    Using the special tool, install the clutch pressure plate and the clutch disk (if equipped).

    1 Locate the clutch pressure plate in position with the centered clutch disk.

    2 Tighten the bolts in several stages, a turn at a time, working diagonally.

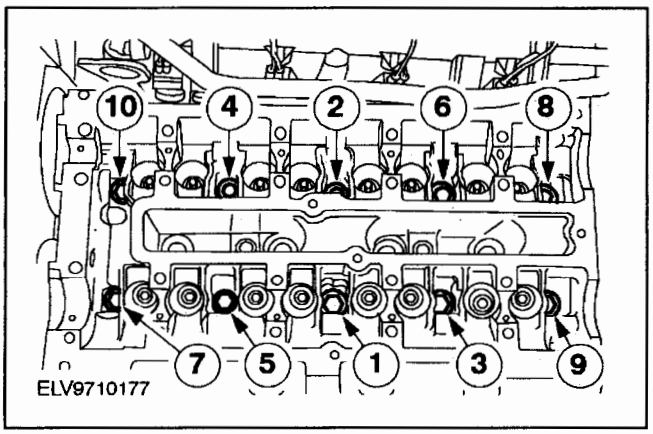
    3 Check the centering and correct as necessary.

ASSEMBLY (Continued)



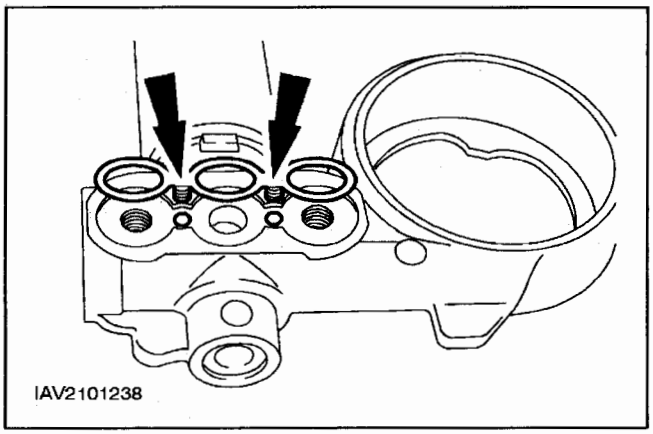
ELM2101732

33. Install the cylinder head.
    1 Make sure the upright seat of the guide sleeves.
    2 Position a new cylinder head gasket onto the cylinder block.
    - Attach the cylinder head into the workshop hoist by the lifting eyes and move it into installation position on the cylinder block.

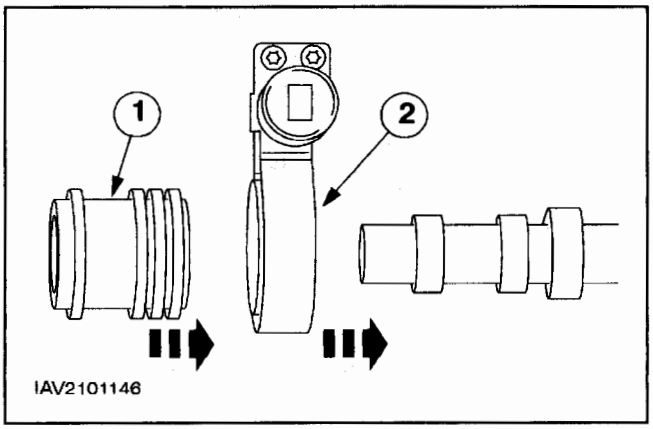


ELV9710177

34. ⚠ **CAUTION: The cylinder head bolts must not be tightened more than once.**
    NOTE: New un-oiled bolts must be installed.
    NOTE: Tighten the bolts in the indicated sequence shown in three stages.
    Install the cylinder head bolts.
    - Stage 1: 25 Nm
    - Stage 2: 45 Nm
    - Stage 3: 105 degrees


IAV2101238

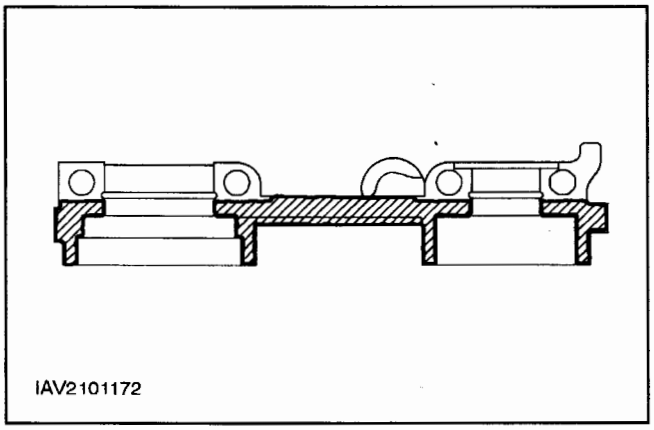
35. **NOTE:** Use your thumb to press the locating pins on the gasket into the holes.
    Press a new gasket into the oil feed flange.



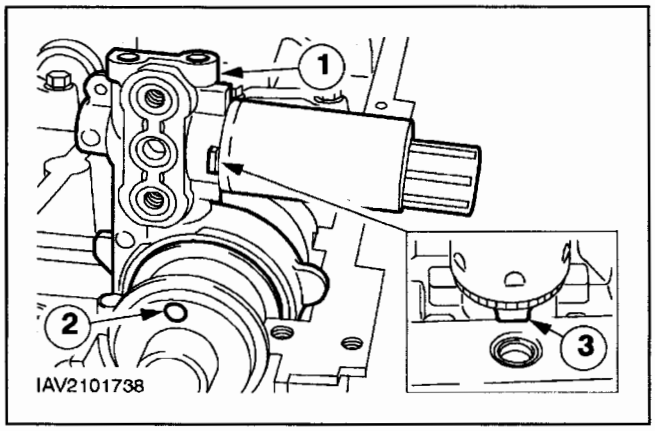
IAV2101146

36. Assemble the exhaust camshaft for installation.
    1 Insert the oil feed ring into the oil feed flange.
    2 Slide both components together onto the exhaust camshaft.

ASSEMBLY (Continued)


IAV2101172

37. Thinly coat camshaft bearing cap no. 5 with Gasket Maker F8AZ-19B508-AB meeting Ford specification WSK-M2G348-A5.



IAV2101738

38. Insert the camshafts.
    - Lubricate the valve tappets with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H and insert them.
    - Lubricate the camshaft bearings with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H.
    - Insert the intake camshaft.

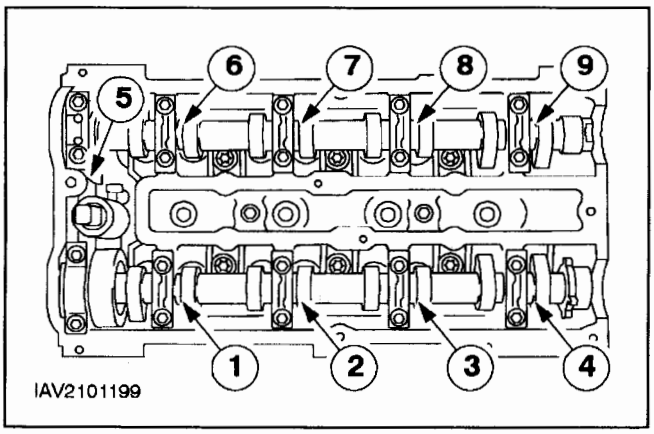
    1 Hold the oil feed flange upwards during installation of the exhaust camshaft.

    2 Position the oil feed ring hole right to the top.

    3 **NOTE:** Keep the oil feed flange away from the cylinder head when turning the flange to avoid damaging the gasket.

    Turn the oil feed flange till the locating lug is in installation position on the cylinder head.

39. Insert new exhaust camshaft oil seal.

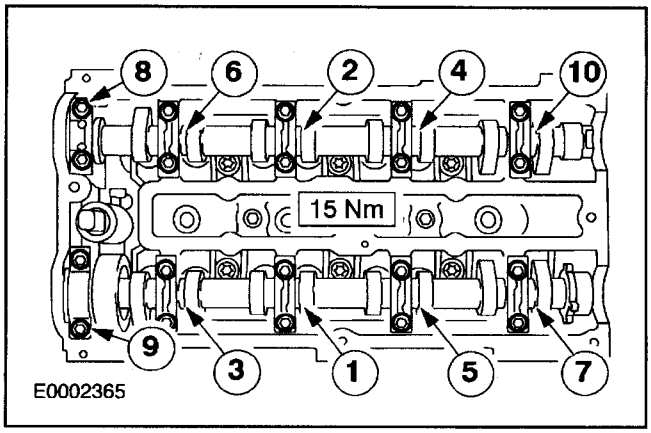


IAV2101199

40. **NOTE:** The numbering is on the outside of the camshaft bearing caps.

    Insert the camshaft bearing caps.

ASSEMBLY (Continued)

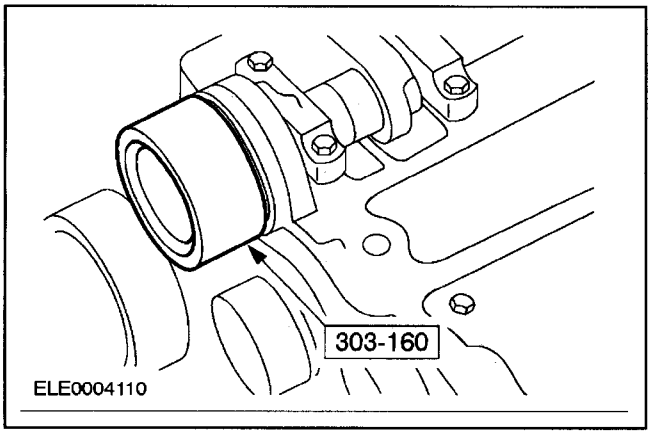


41. **NOTE:** Make sure the upright seat of the exhaust camshaft oil seal during tightening process of camshaft bearing cabs.

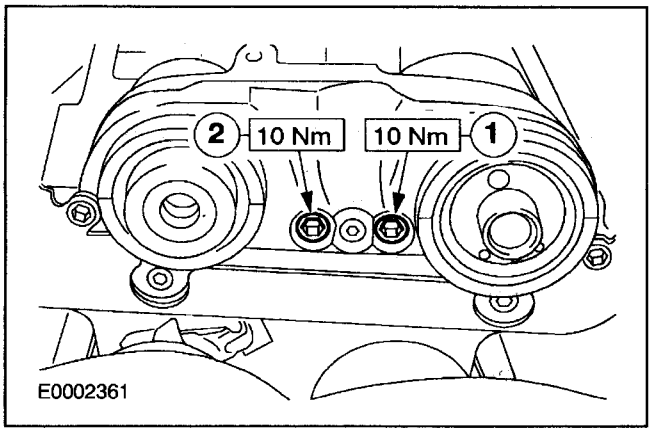
    NOTE: Working evenly in several stages, screw in each bolt two turns at a time.

    NOTE: Tightening sequence.

    Tighten the camshaft bearing cap bolts.



42. Using the special tool, press in the intake camshaft oil seals.



43. **NOTE:** Make sure the location lug of the oil feed flange is in installation position on the cylinder head during installation.

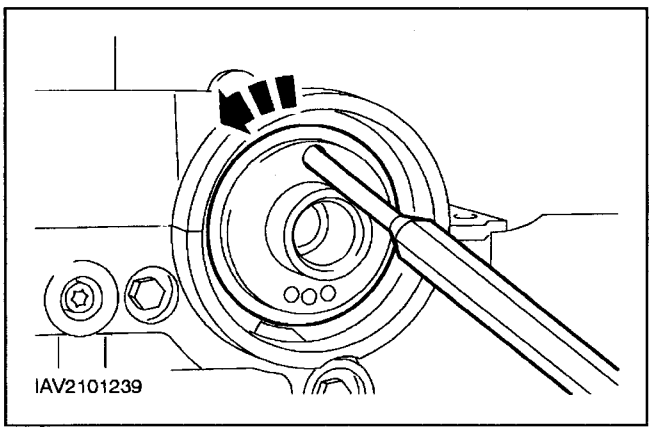
    Screw in the oil feed flange bolts.

    - Finger-tighten the right-hand bolt.
    - Finger-tighten the left-hand bolt.

    1 Tighten the right-hand bolt.

    2 Tighten the left-hand bolt.

44. Insert new camshaft oil seals.

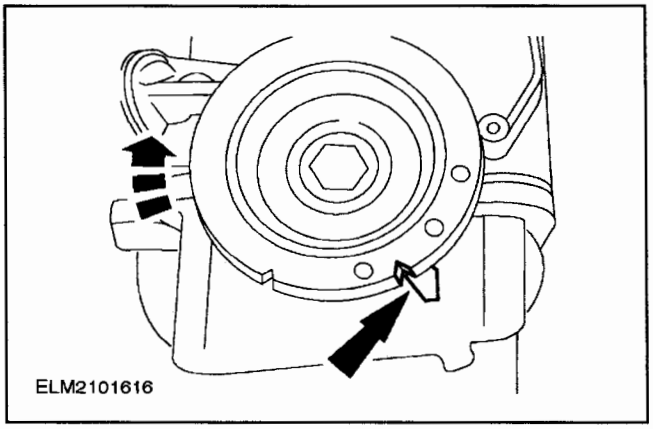


45. **NOTE:** After carrying out the check turn the hole right up to the top.

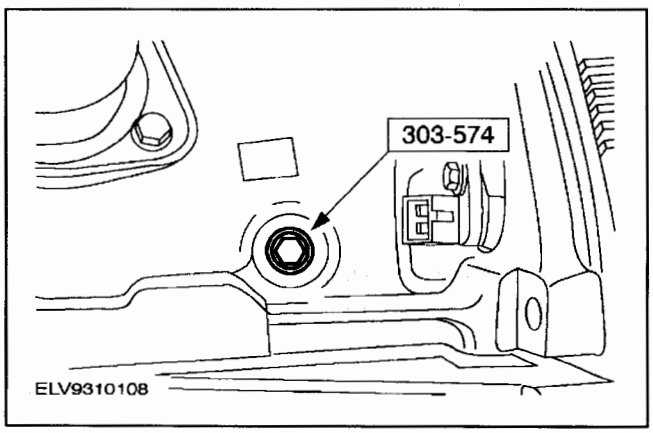
    Check that the oil feed ring moves freely.

    - If it is difficult to turn the oil feed ring, loosen the bolts on the oil feed flange and tighten them again as described in the previous step.

ASSEMBLY (Continued)

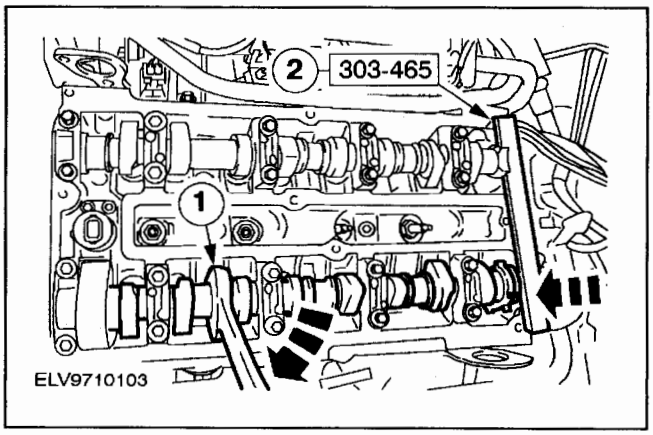


46. Set the crankshaft to TDC on cylinder No. 1.

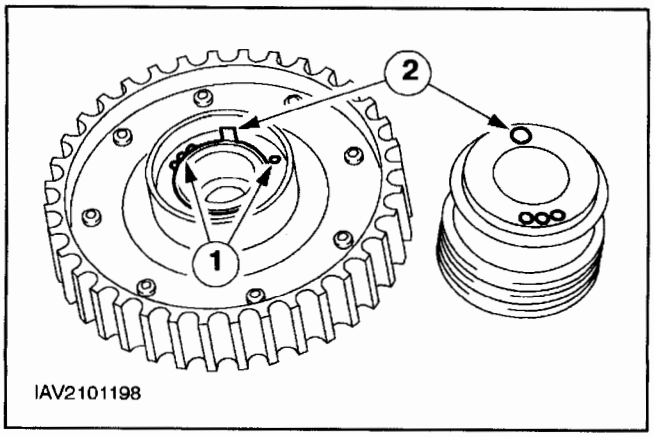


47. **NOTE:** Cylinders No. 1 and No. 4 are at TDC when the Woodruff key points straight up.

    Remove the blanking plug. Using the special tool, set the crankshaft to TDC.



48. Set cylinder No. 4 to valves rocking' and install the special tool.
    1. Using an open-ended wrench, turn the camshafts by the hexagon in the normal direction of rotation.
    2. Slide the special tool onto the ends of both camshafts.



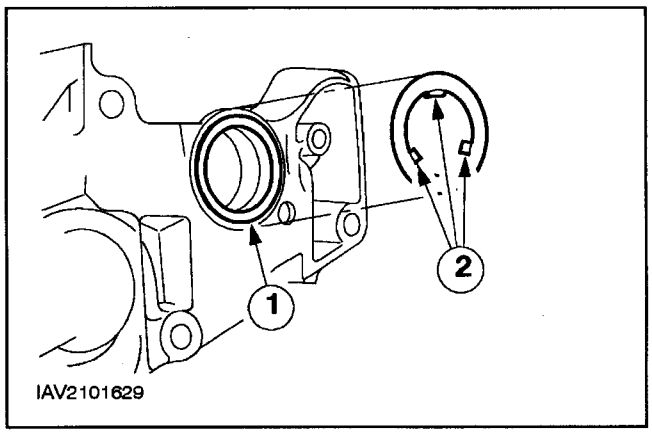
49. **NOTE:** If the lug is not bended or centered between the oil bores and the mark, install a new exhaust camshaft pulley.

    Installation position of the exhaust camshaft pulley.
    1. The lug is centered between the oil bores and the mark.
    2. The lug must locate in the hole.

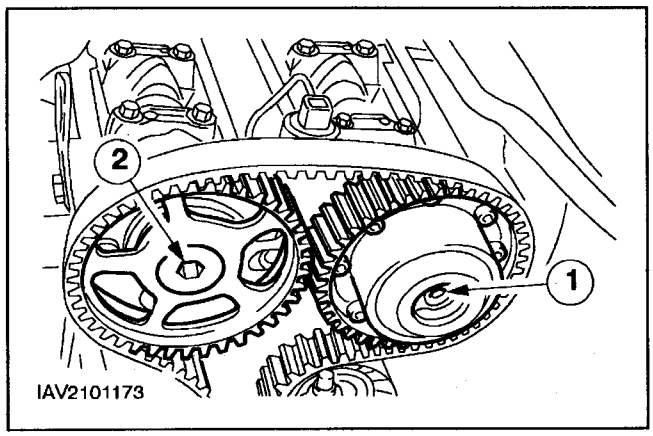
ASSEMBLY (Continued)

50. **NOTE:** Install the bolts in place but do not tighten them. It must be possible to turn the camshaft pulleys on the camshafts.

    Slide the camshaft pulleys onto the camshafts and insert the bolts.



51. Install a new gasket in the water pump.
    1 Position the gasket in the water pump.
    2 Secure the gasket by bending the tabs over.

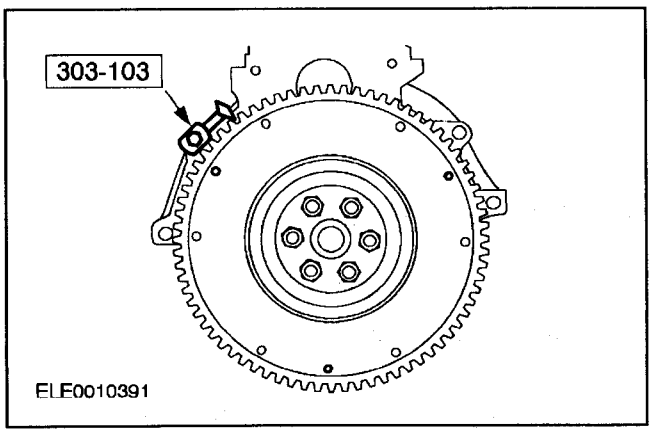


52. ⚠ **CAUTION: Do not rotate the crankshaft. Check that it is still resting against the special tool 303-574.**

    NOTE: Install the bolts in place but do not tighten them.

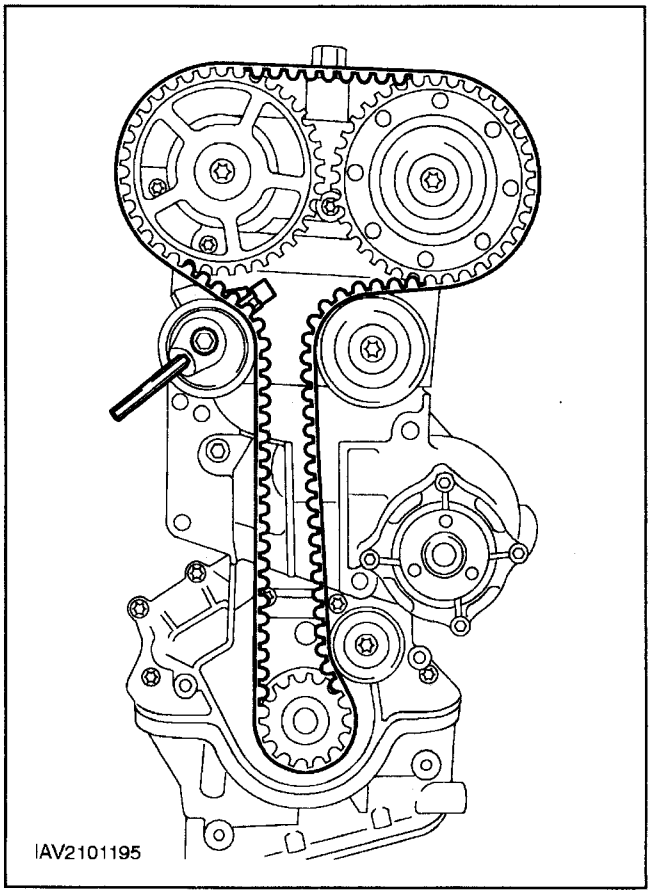
    NOTE: New O-ring seal for the exhaust camshaft pulley.

    Slide the camshaft pulleys onto the camshafts, screw in the bolts and position the new timing belt.
    1 Install the VCT unit bolt finger tight.
    2 Install the camshaft pulley bolt finger tight.



53. Using the special tool, immobilize the flywheel.

ASSEMBLY (Continued)



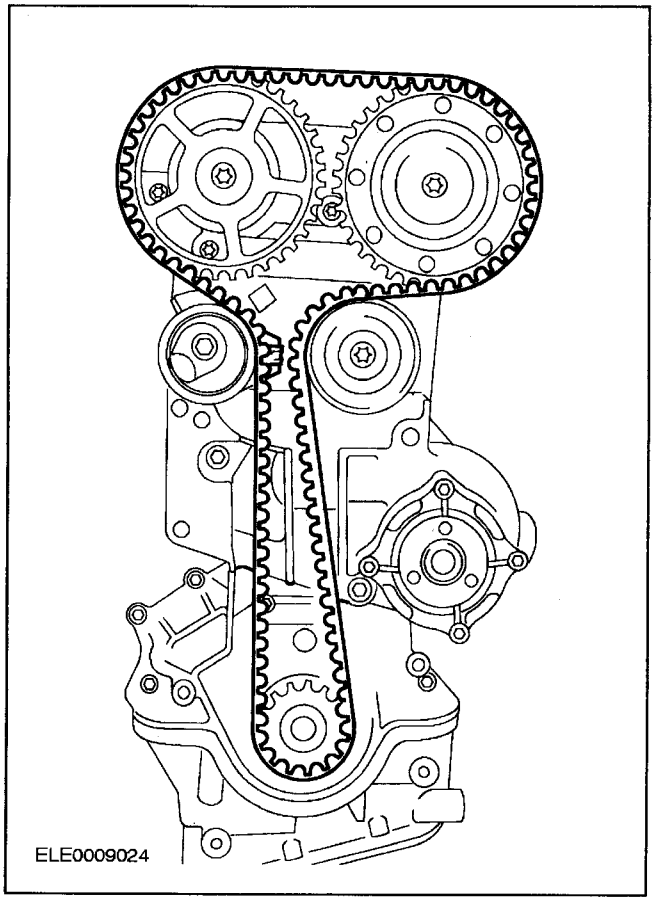
54. **⚠ CAUTION: Do not kink the timing belt (do not bend the timing belt less than a diameter of 35 mm).**

⚠ CAUTION: Do not rotate the crankshaft. Check that it is still resting against the special tool 303-574.

NOTE: The lug of the belt tensioner should not be hooked in the sheet metal cover during timing belt installation.

Position a new timing belt in place.

- Starting from the crankshaft timing belt pulley and working counterclockwise, position the timing belt in place while keeping it under tension.



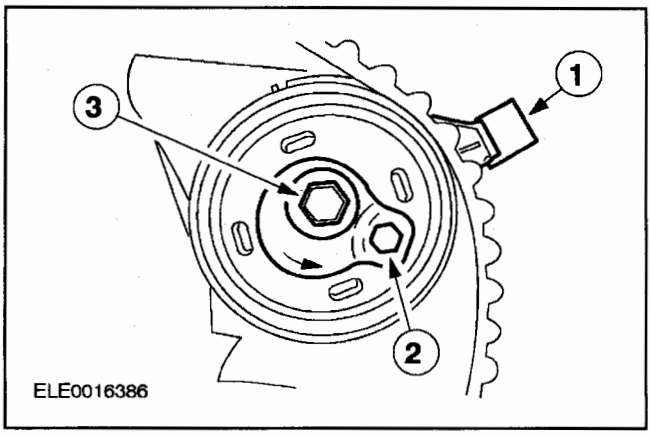
55. **⚠ CAUTION: Do not rotate the crankshaft. Check that it is still resting against the special tool 303-574.**

NOTE: The lug of the belt tensioner should not be hooked in the sheet metal cover during timing belt installation.

Position a new timing belt in place.

- Starting from the crankshaft timing belt pulley and working counterclockwise, position the timing belt in place while keeping it under tension.

ASSEMBLY (Continued)



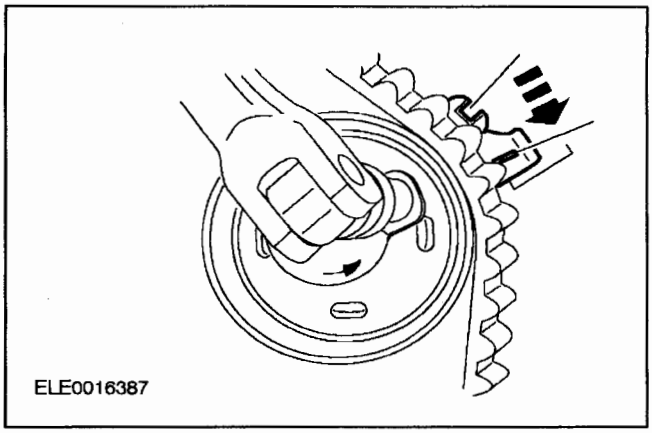
56. **NOTE:** Incorrect timing belt tension will cause incorrect valve timing.

    Pre tension the timing belt.

    1 Rotate the tensioner locating tab counterclockwise and insert the locating tab into the slot in the rear timing cover.

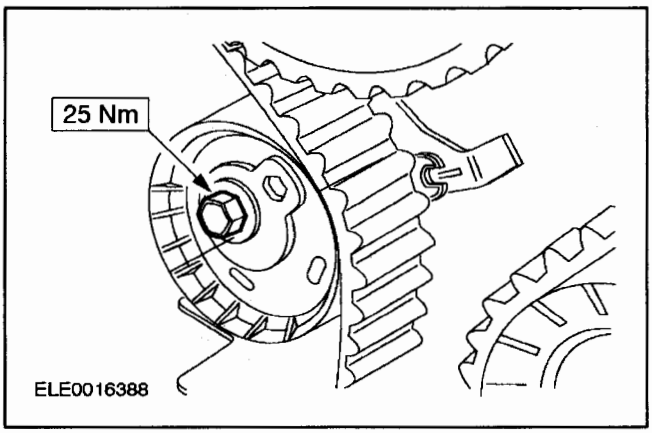
    2 Position the hex key slot in the tensioner adjusting washer to the 4 o'clock position.

    3 Tighten the attaching bold enough to seat the tensioner firmly against the rear timing cover, but still allow the tensioner adjusting washer to be rotated using a 6mm hex key.

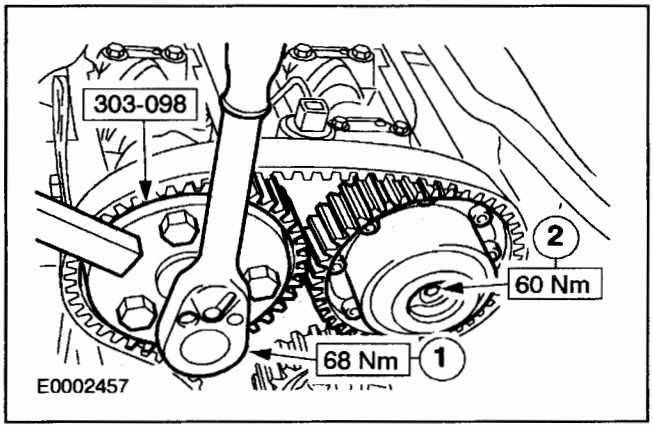


57. **⚠ CAUTION: Tension the timing belt, working counterclockwise.**

    Using the hex key, rotate the adjusting washer counterclockwise until the notch in the pointer is centered over the index line on the locating tab (the pointer will move clockwise during adjustment).



58. While holding the adjusting washer in position, tighten the bolt.



59. **NOTE:** Hold the camshaft pulley with the special tool to stop it from turning.

    Tighten the camshaft pulleys.

    1 Tighten the intake camshaft pulley bolt.

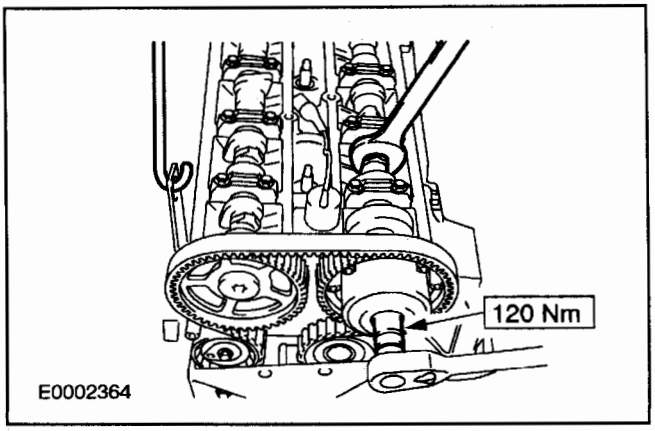
    2 **NOTE:** Hold the exhaust camshaft by the hexagon with an open-ended wrench to stop it from turning.

    Tighten the exhaust camshaft pulley bolt to tightening torque.

ASSEMBLY (Continued)

60. Remove the special tool 303-574.

61. Remove the special tool 303-465 from the camshafts.



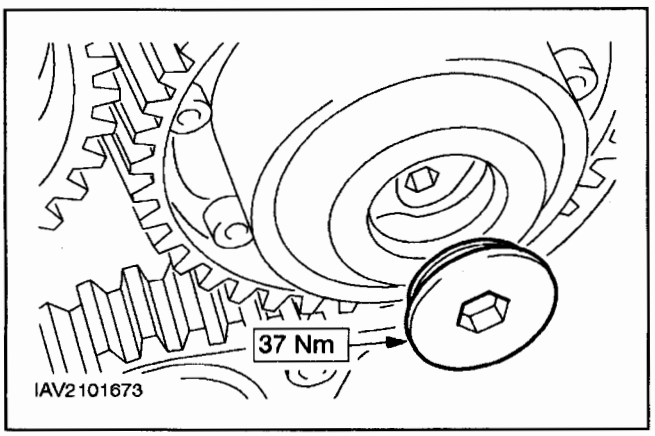
62. **NOTE:** Hold the camshaft by the hexagon with an open-ended wrench to stop it from turning.

    Tighten the exhaust camshaft pulley bolt to tightening torque.

63. **NOTE:** As necessary, only turn engine in direction of engine rotation by the crankshaft.

    Check camshaft timing.

    - Set the crankshaft to TDC on cylinder No. 1 as described before.
    - If special tool 303-465 does not install into both camshaft slots, loosen the tensioner, the intake and exhaust camshaft pulley bolts and tension the timing belt as described in the steps before.



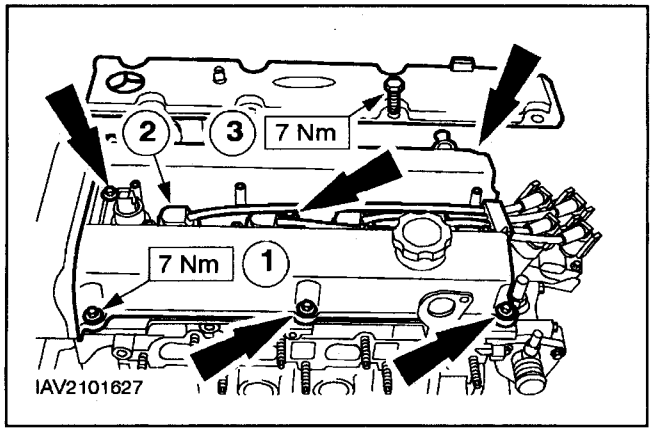
64. **NOTE:** Install a new blanking plug.

    Screw in the new blanking plug on the exhaust camshaft pulley.

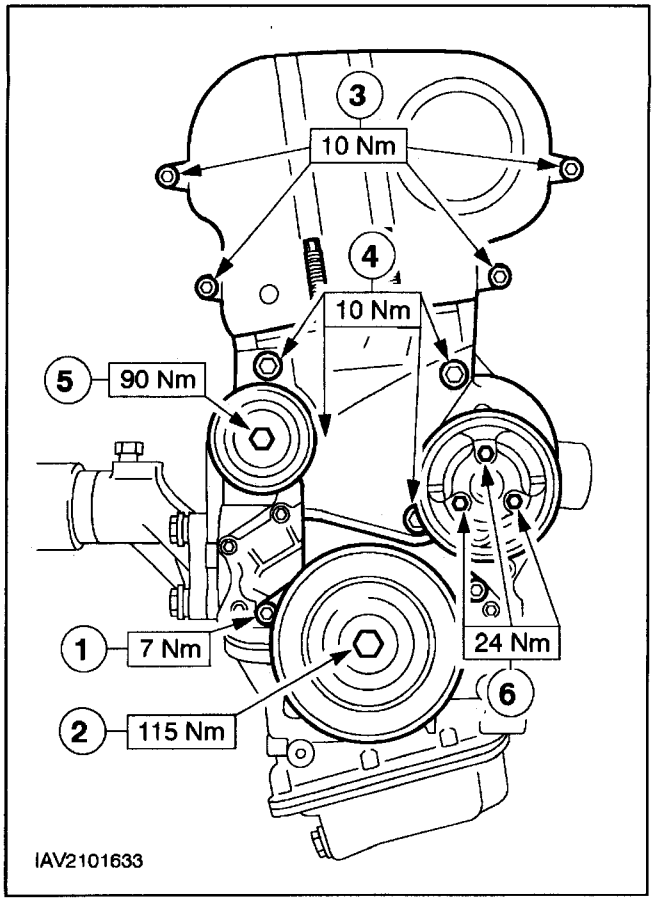
65. Install the spark plugs.

    - Tighten the spark plugs to 15 Nm.

ASSEMBLY (Continued)



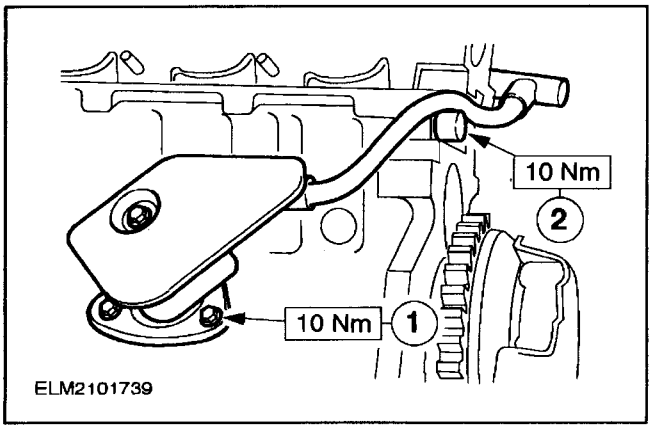
66. Install the valve cover with a new gasket and a new solenoid valve oil seal.
    1 Screw in the ten bolts.
    2 Connect the spark plugs wires.
    3 Install the cylinder head appearance cover.



67. **NOTE:** Hold the flywheel with special tool 303-103.

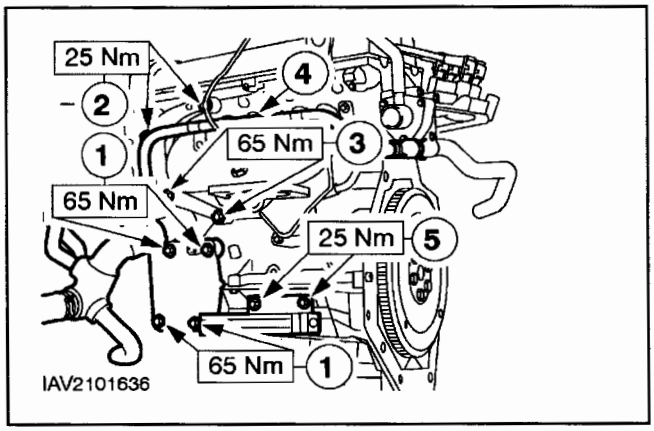
    Install the engine front cover.
    1 Install the lower part of the engine front cover.
    2 Install the crankshaft pulley/vibration damper.
    3 **NOTE:** Check the seating of the gasket and adjust it as necessary.

    Install the upper part of the engine front cover.
    4 Install the center part of the engine front cover.
    5 Install the drive belt idler pulley.
    6 Install the water pump pulley.



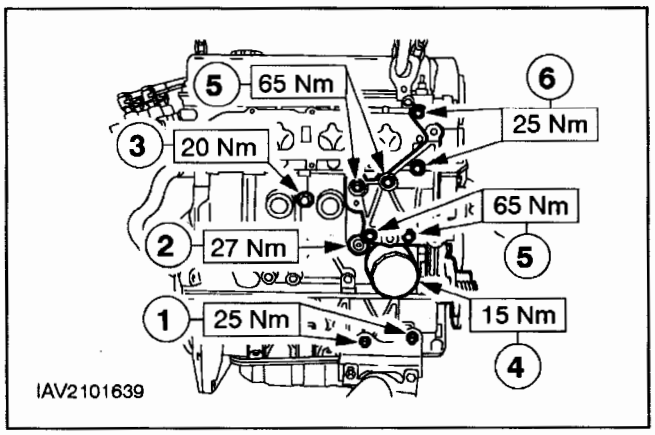
68. Install the crankcase ventilation tube.
    - Use a new gasket.
    1 Install in the three bolts.
    2 Connect the crankcase ventilation tube.

ASSEMBLY (Continued)

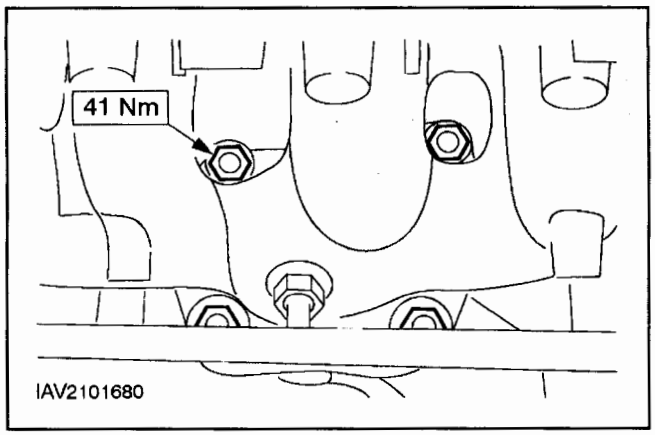


69. Install the ancillary components on the exhaust side of the engine.
    1 Air conditioning (A/C) compressor bracket.
    2 Power steering pump bracket to cylinder head.
    3 Power steering pump bracket to cylinder block.
    4 Coolant hose to thermostat housing and water pump.
    5 Three-way catalytic converter (TWC) bracket.

70. Attach the engine to engine lifting bracket by the engine lifting eyes and remove it from the assembly stand.
    - Leave the engine attached to the workshop hoist and rest the engine on the assembly stand.

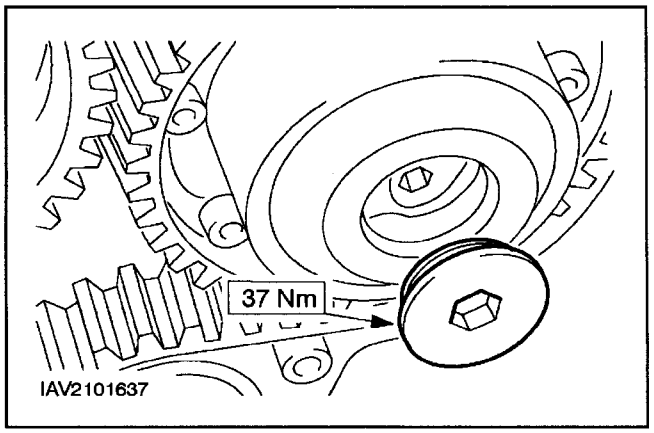


71. Install the ancillary components on the intake side of the engine:
    1 Position the TWC into the exhaust manifold and install the exhaust manifold bracket.
    2 Install in the oil pressure switch.
    3 Install in the knock sensor (KS).
    4 Install a new oil filter. Coat the oil filter seal with Super Premium SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-H before assembly.
    5 Install the generator bracket.
    6 Install the generator bracket.

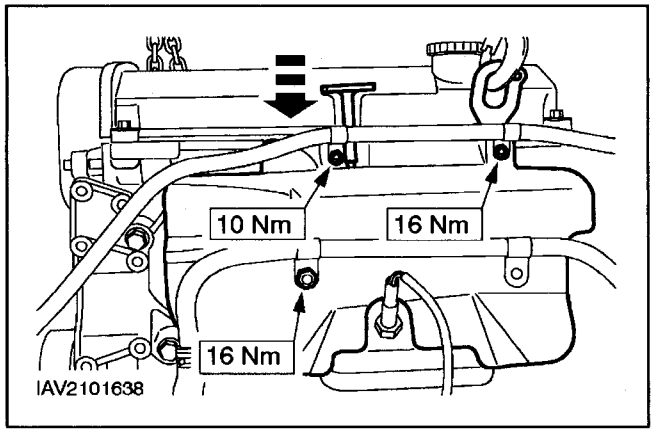


72. Install the TWC to exhaust manifold.

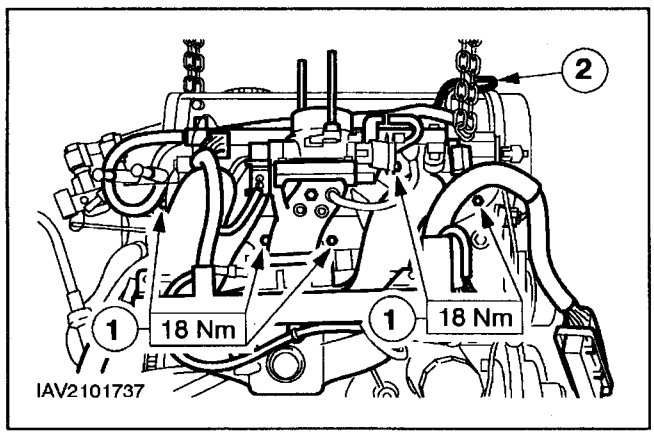
ASSEMBLY (Continued)



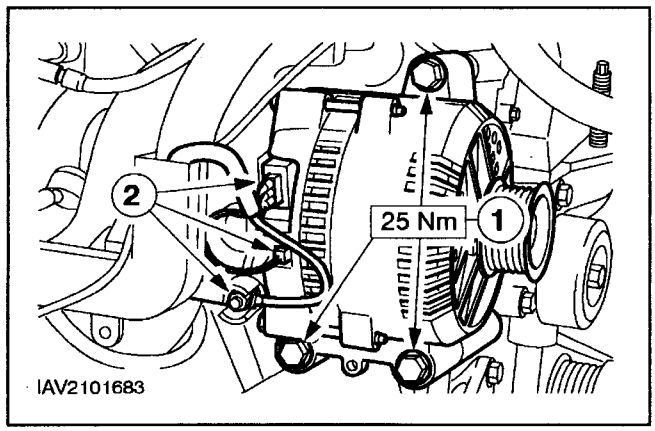
73. Install the TWC bracket bolt.



74. Install the heat shield.
    - Unhook the engine lifting eye from the engine lifting bracket and remove it.
    - Install the heat shield together with the engine oil level indicator tube and the lifting eye.
    - Hook the lifting eye back into the engine lifting bracket.

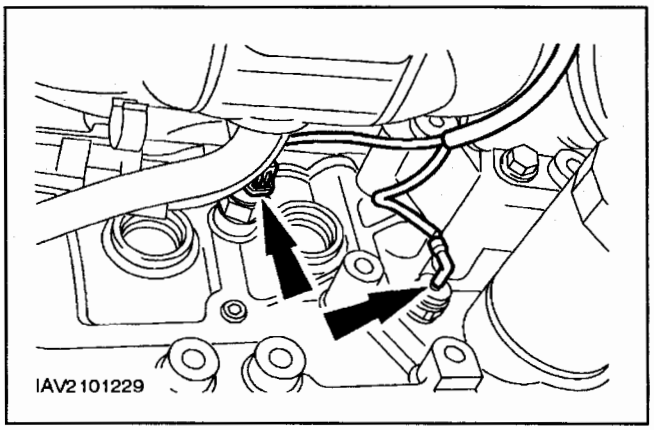


75. Install the intake manifold.
    1 Install the seven bolts and two nuts.
    2 Connect the solenoid valve electrical connector and press in the rubber seal.

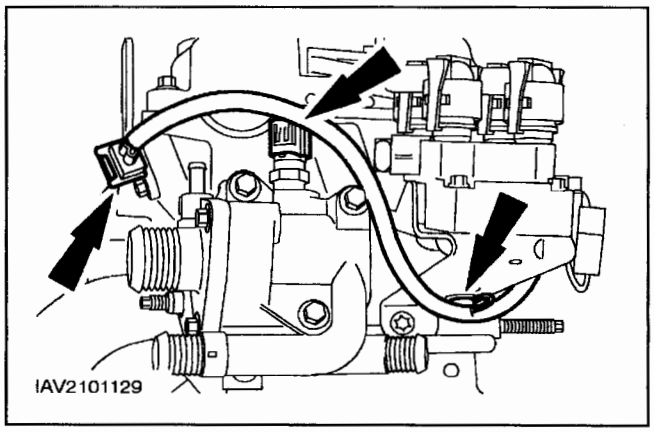


76. Install the generator.
    1 Install the bolts.
    2 Connect the generator electrical connectors.

ASSEMBLY (Continued)



77. Connect the oil pressure switch and the KS electrical connectors.

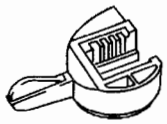
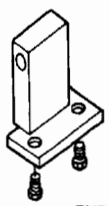


78. Connect the CMP sensor and the ECT sensor electrical connectors.
    - Connect the wiring to the EI coil.

INSTALLATION

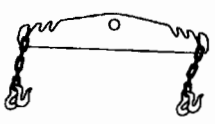
Engine — Vehicles with Manual Transaxle

Special Tool(s)

 16088	Aligner Gearshift Lever 308-273 (T97P-7025-A)
 T94P-6000-AH	Gauge, Powertrain Alignment 502-003 (T94P-6000-AH)

(Continued)

Special Tool(s)

 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

INSTALLATION (Continued)

General Equipment

Assembly stand GV2166
Securing straps
Workshop hoist
Suitable floor crane

Materials

Item	Specification
High-temperature grease —	ESD-M1C220-A
High Performance DOT3 Motor Vehicle Brake Fluid C6AZ-19542-AB	ESA-M6C25-A
High performance brake fluid DOT 4 —	ESA-M6C25-A
Manual Transmission Fluid —	WSD-M2C200-C

Installation

All vehicles

1. **NOTE:** Install new snap rings, cotter pins and self-locking nuts.

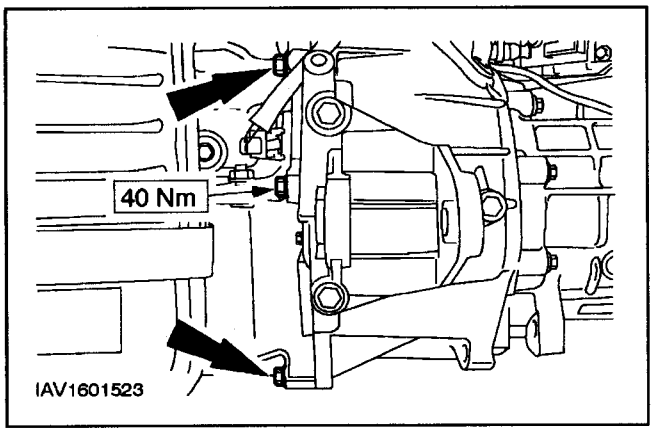
   NOTE: The locations of the engine mountings and engine support insulators are described looking from the transaxle to the engine.

   NOTE: Apply the spline grease thinly enough so that when the clutch disk is fitted onto the transaxle input shaft, no grease is squeezed out from the splines.

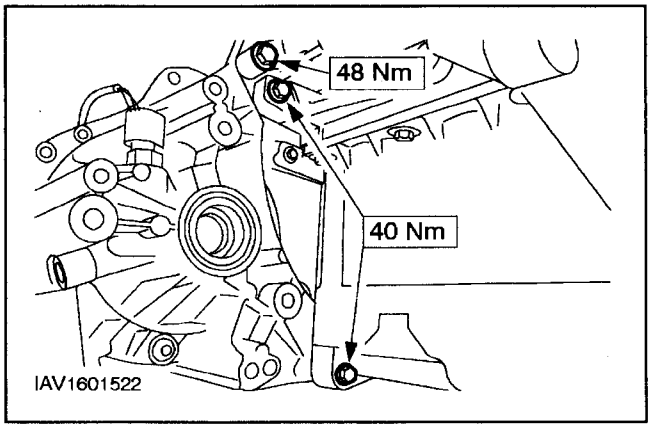
   Coat the drive splines of the clutch disk evenly with High-temperature grease.

2. Position the transaxle on the engine.

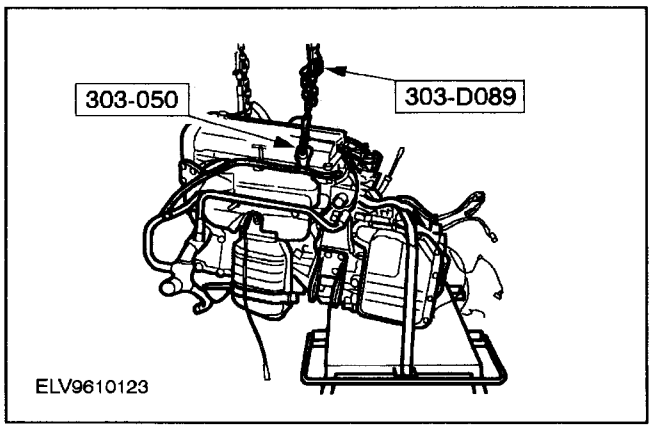
3. Install the transaxle flange bolts on the left-hand side of the transaxle.



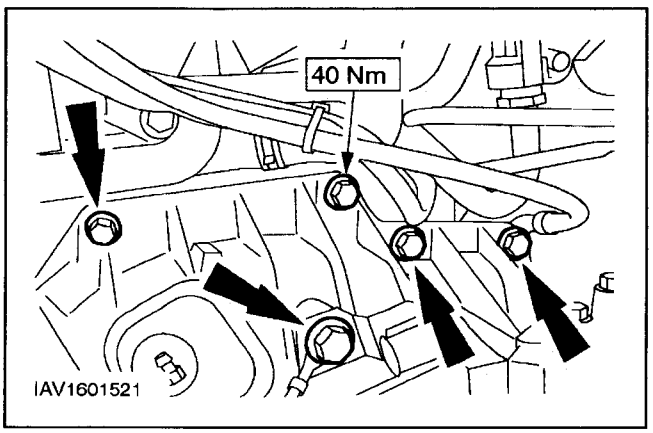
INSTALLATION (Continued)



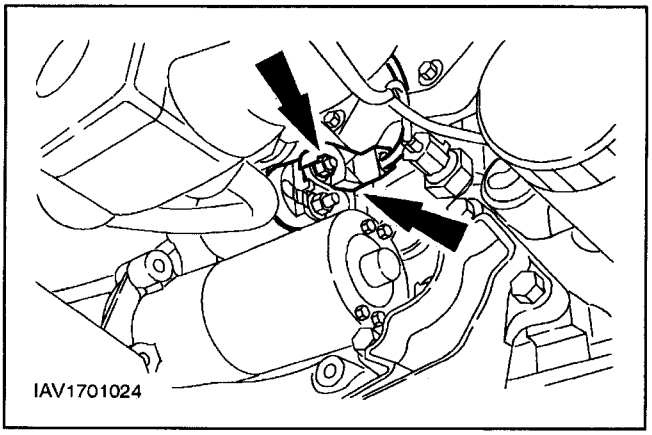
4. Install the transaxle flange bolts on the right-hand side of the transaxle and the lower starter motor bolt.



5. Using the special tools and a Suitable Floor Crane, raise the engine/transaxle assembly to remove the pressure from the powertrain lift. Take the retaining straps off the engine/transaxle assembly. Remove the powertrain lift.

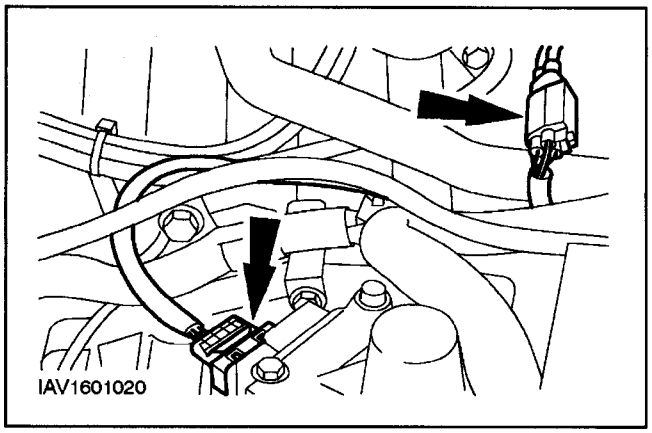


6. Install the upper transaxle flange bolts.
   - Install the upper starter motor bolts.
   - Install the two flange bolts.
   - Attach the ground lead to the transaxle.

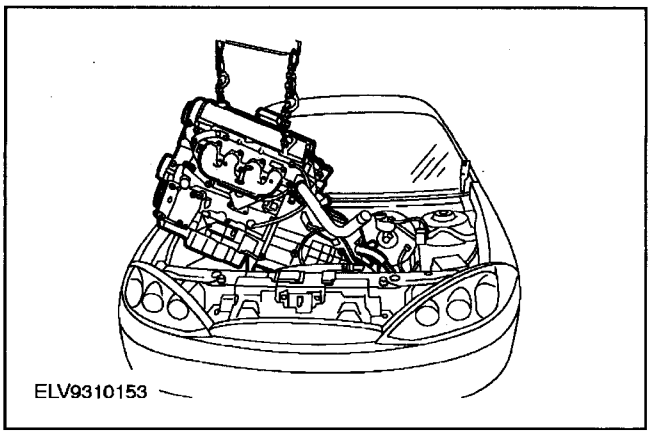


7. Install the starter motor electrical connections.

INSTALLATION (Continued)



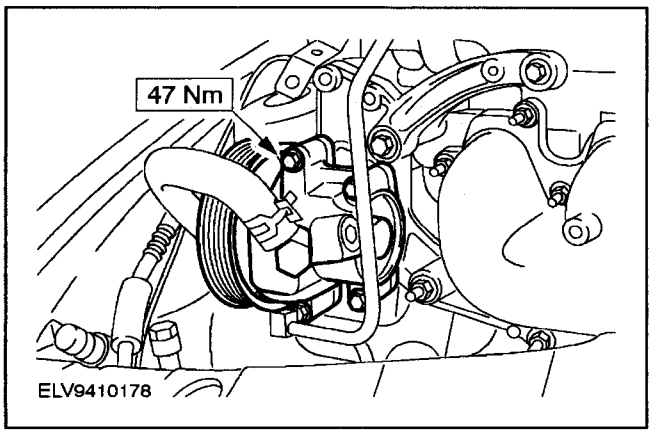
8. Connect the reversing light switch and the vehicle speed sensor (VSS) electrical connector.



9. ⚠ **CAUTION: The engine/transaxle assembly has to be in a diagonal position to pull it out below the tube/hose A/C. Make sure, that the tube/hose (A/C) is not in stress.**

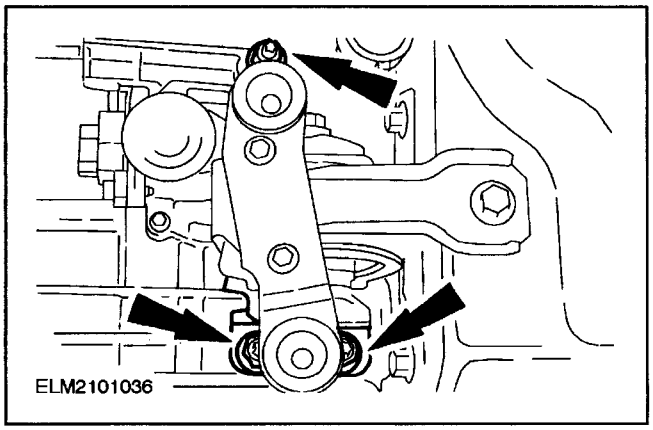
   NOTE: Install the power steering pump before the engine/transaxle assembly is in place.

   Install the engine/transaxle assembly.



10. ⚠ **CAUTION: Make sure, that the pipes and hoses are not in stress.**

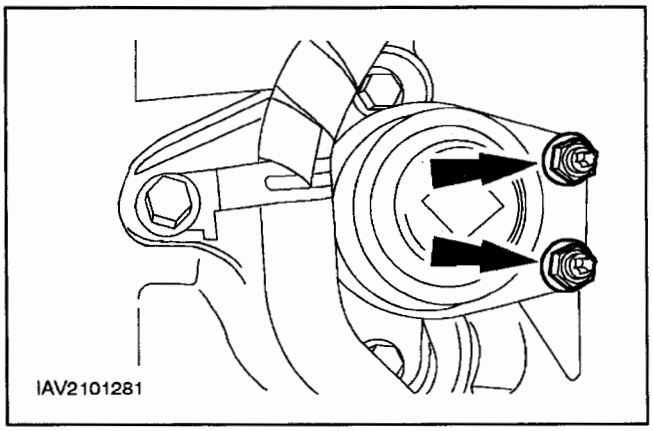
    Install the power steering pump bolts.



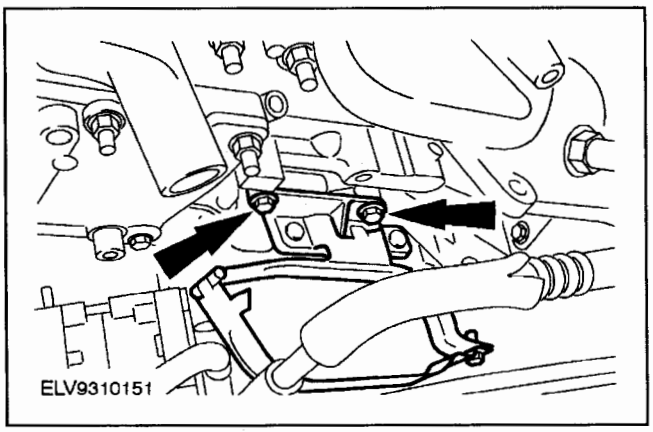
11. **NOTE:** Do not tighten the nuts.

    Install the rear transaxle support insulators.

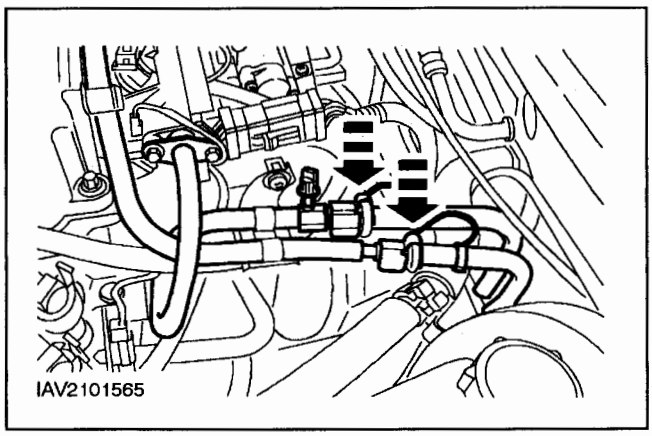
INSTALLATION (Continued)



12. **NOTE:** Do not tighten the nuts and bolts.
    Install the front engine support insulators.



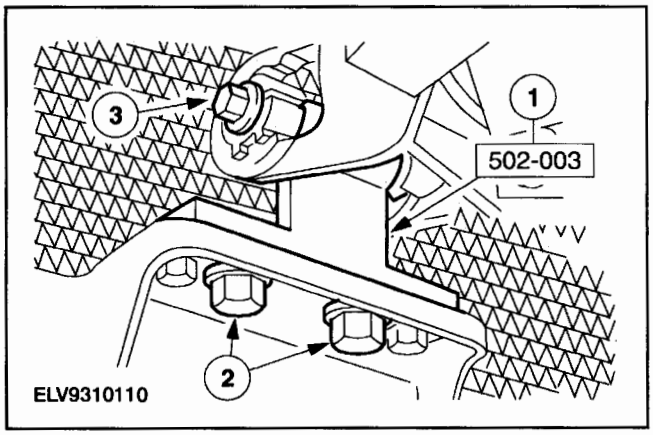
13. Install the three-way catalytic converter (TWC) bracket.



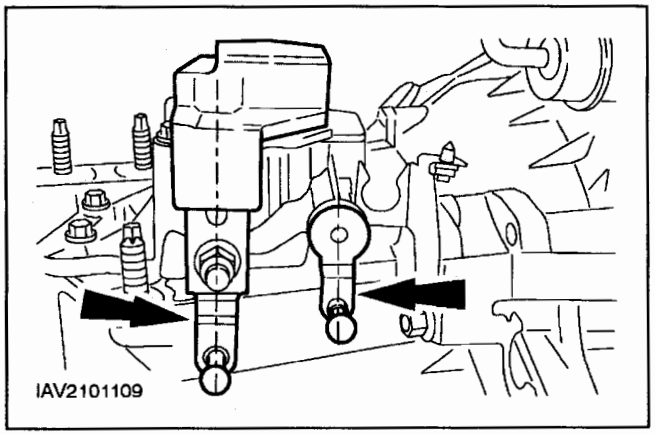
14. Connect and secure the fuel lines.

15. Raise and support the vehicle. For additional information, refer to Section 100-02.

INSTALLATION (Continued)

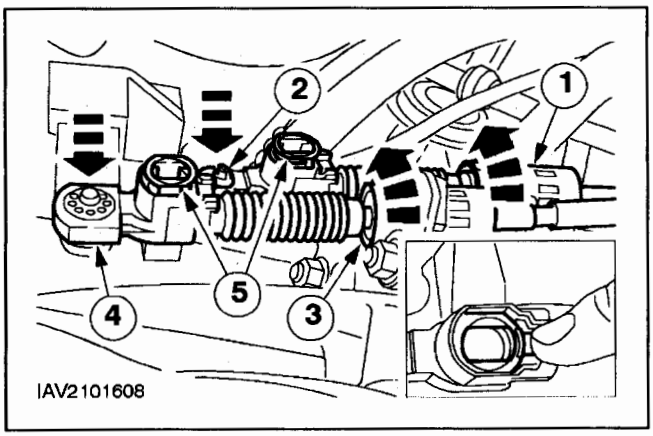


16. Install the special tool.
    1 Install the special tool.
    2 Install the bolts.
    3 Install the center bolt.



17. **NOTE:** The transaxle is in neutral when both levers are vertical.

    Set the gearshift lever and selector lever to the ''Neutral'' position.

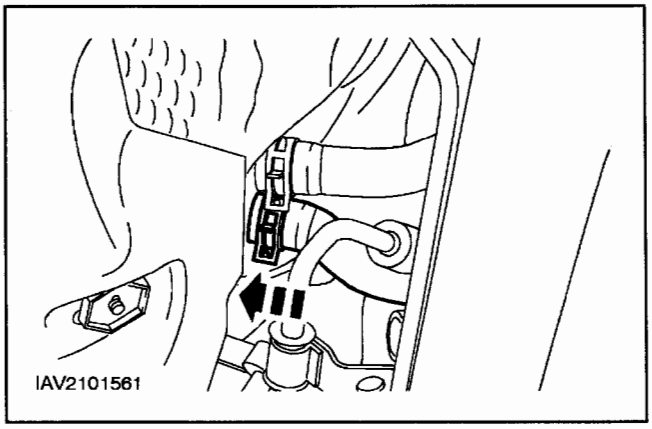


18. **NOTE:** The adjusting mechanisms must be released by pressing them in.

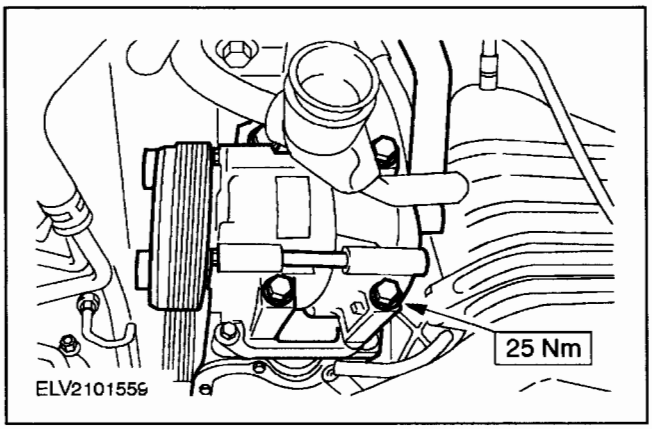
    NOTE: The abutment brackets are tensioned automatically once they have been released.

    Connect the cables to the transaxle and adjust them.
    1 Release the abutment bracket by turning it counterclockwise and install the cable in the bracket.
    2 Connect the shift cable from the gear selector lever.
    3 Release the abutment bracket by turning it counterclockwise and install the cable in the bracket.
    4 Connect the shift cable to the gearshift lever.
    5 Lock the adjusting mechanism by pressing down the clips.

INSTALLATION (Continued)

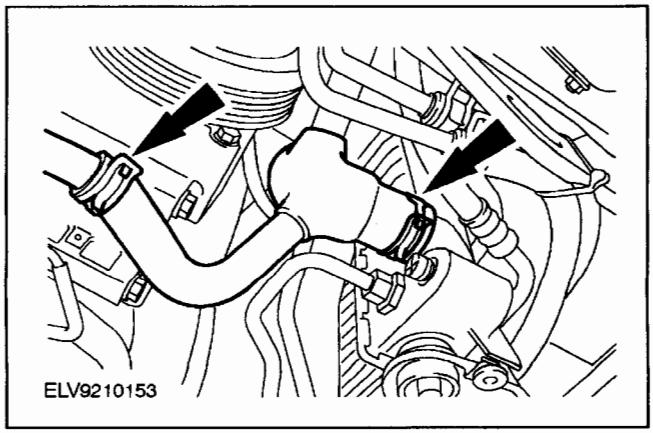


19. Connect the heater coolant hoses.



Vehicles with air conditioning

20. Install the compressor bolts.

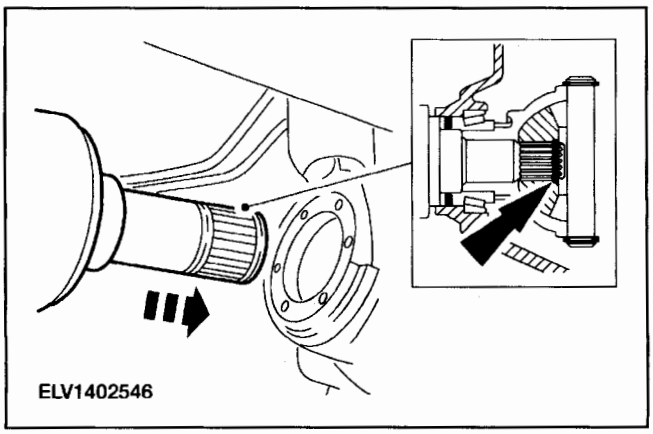


All vehicles

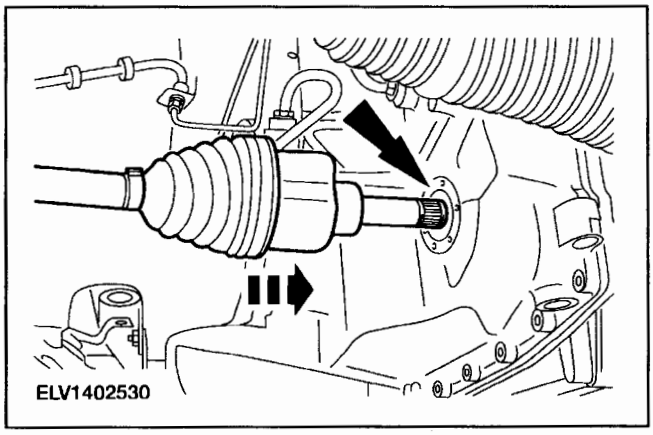
21. Connect the coolant hose.

INSTALLATION (Continued)

⚠ **CAUTION: To avoid to damage the halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by not more than 45 degrees.**

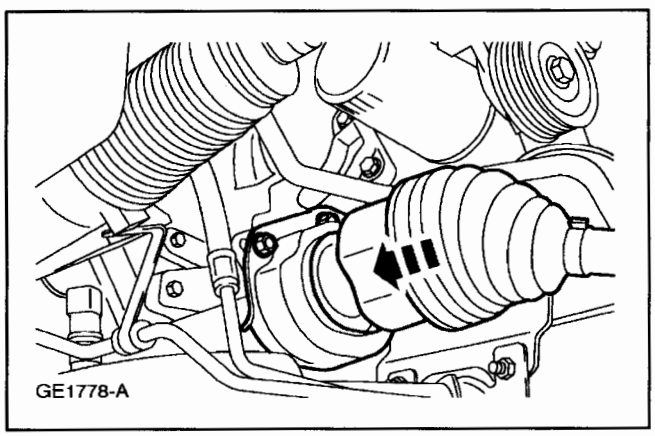


22. Install a new snap ring.



23. **NOTE:** Do not damage the oil seal. Check that the snap ring engages correctly.

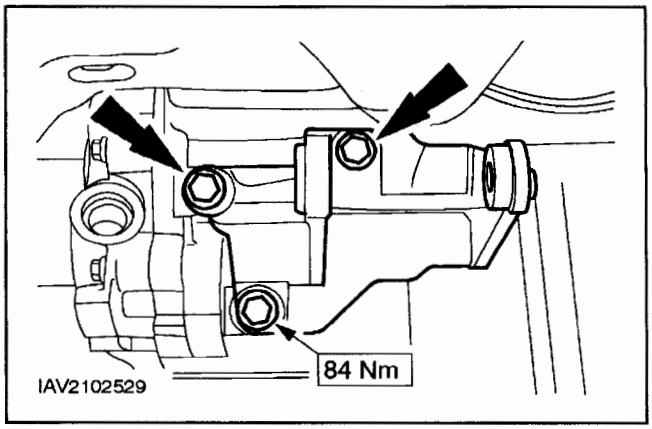
    Install the left-hand halfshaft.



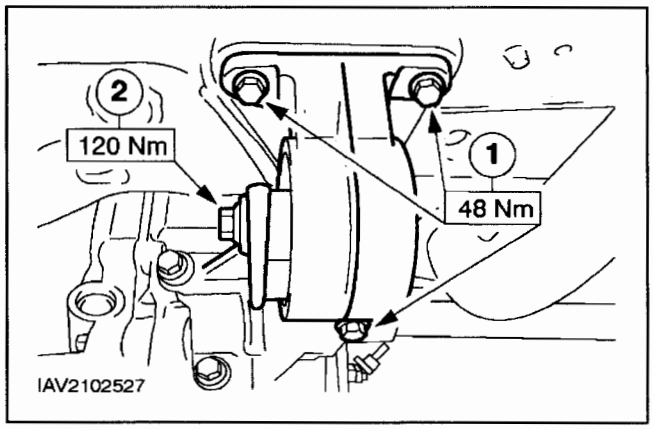
24. **NOTE:** Install a new snap ring. Do not damage the oil seal. Check that the snap ring engages correctly.

    Install the right-hand halfshaft.

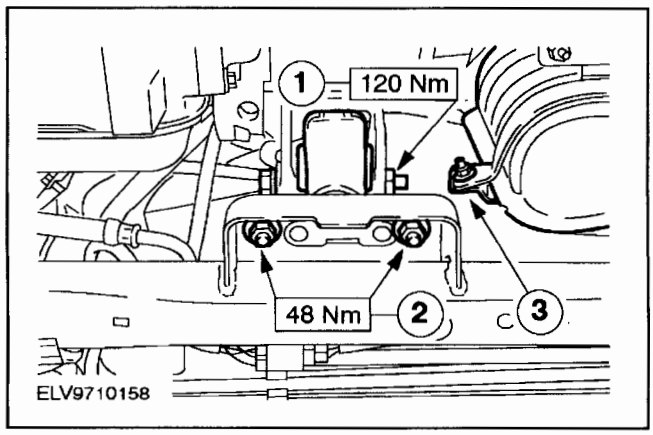
INSTALLATION (Continued)



25. Install the bracket for the right-hand engine support insulator to the transaxle.

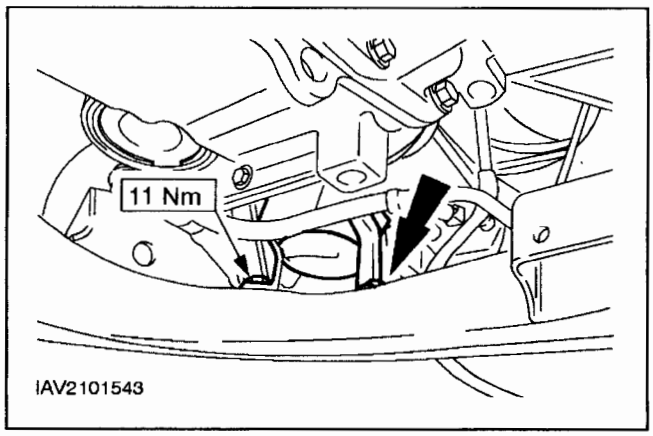


26. Install the right-hand engine support insulator.
    1 Install the bracket bolts.
    2 Install the center bolt.



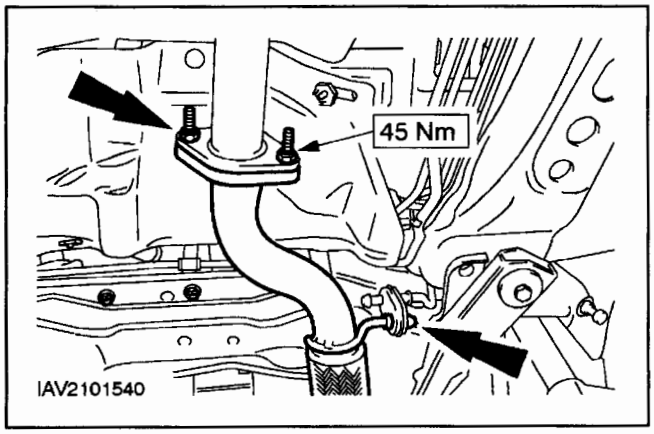
27. Remove the special tool, install the engine support insulator and the three way catalytic converter (TWC).
    1 Install the center bolt.
    2 Install the nuts.
    - Install the TWC.
    3 Tighten the TWC bolt.

Vehicles with air conditioning



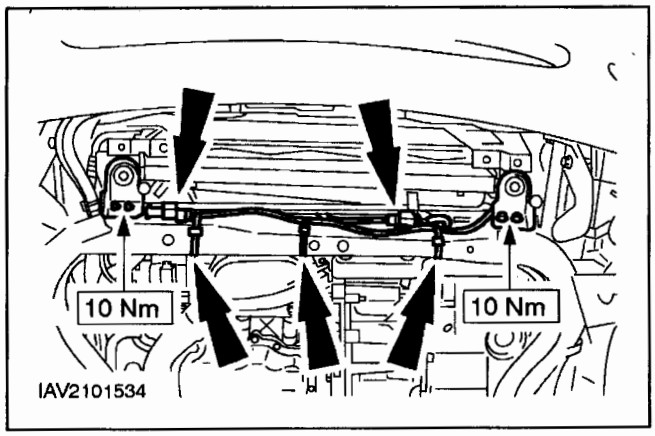
28. Install the suction accumulator bracket bolts.

INSTALLATION (Continued)

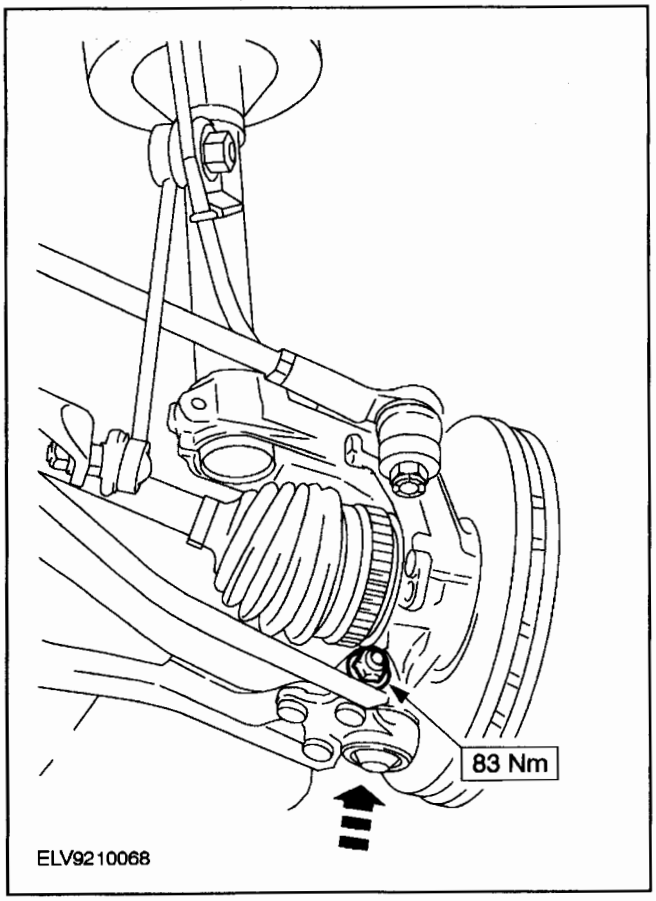


All vehicles

29. Install the front exhaust tube with a new gasket and hook it in place.
    - Install a new gasket.



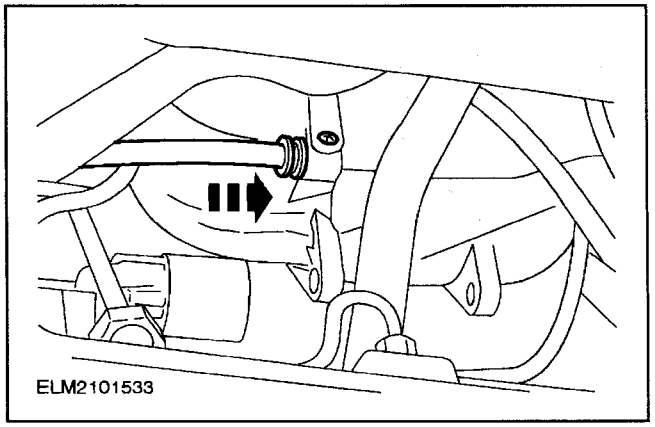
30. Install the radiator brackets and connect both heated oxygen sensor (HO2S) electrical connectors.
    - Secure the wiring harness with cable ties.



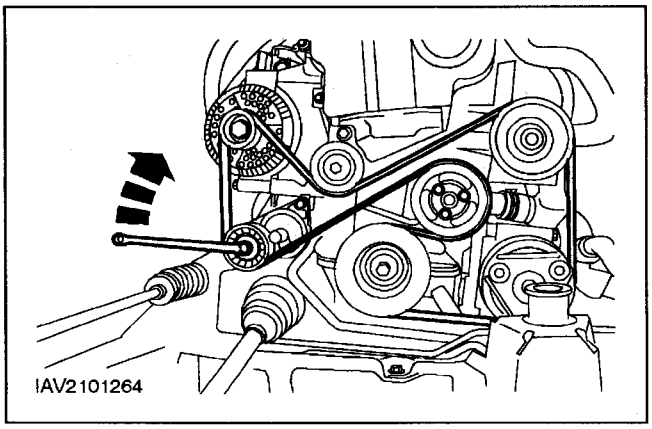
31. ⚠ **CAUTION: Do not damage boot and ABS sensor ring**

    Connect the lower suspension arm ball joints.
    - Attach the ABS wiring harness bracket to the suspension strut.

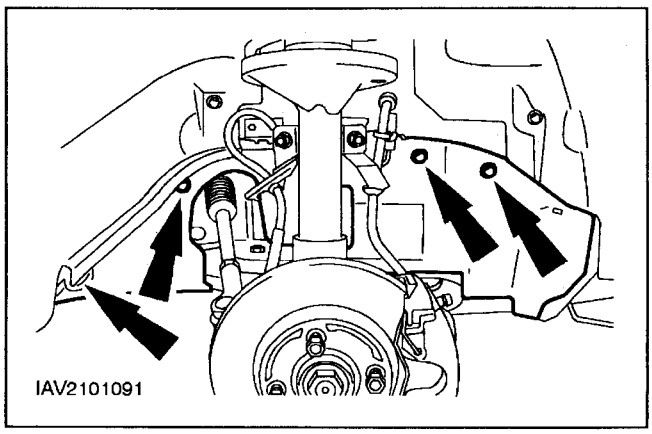
INSTALLATION (Continued)



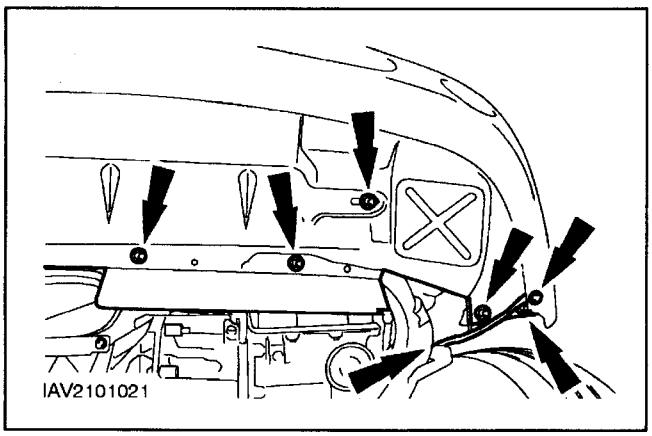
32. Insert the brake booster vacuum hose into the intake manifold.



33. Position the accessory drive belt in place and tension it (removed engine shown).



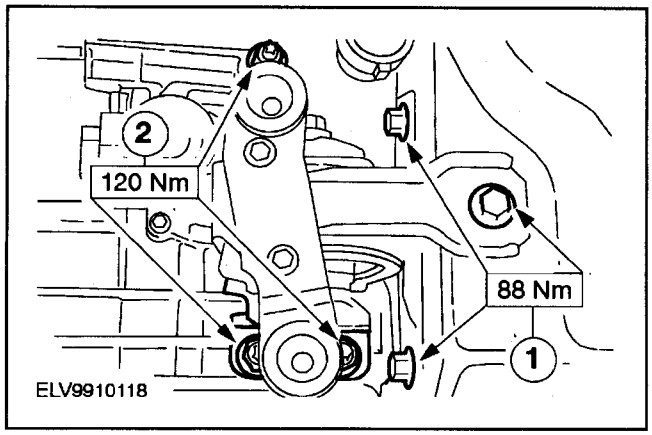
34. Install the fender splash shields (right-hand side shown).



35. Install the radiator splash shield (nine bolts) and install the brackets on both sides (left-hand side shown).

36. Lower the vehicle.

INSTALLATION (Continued)



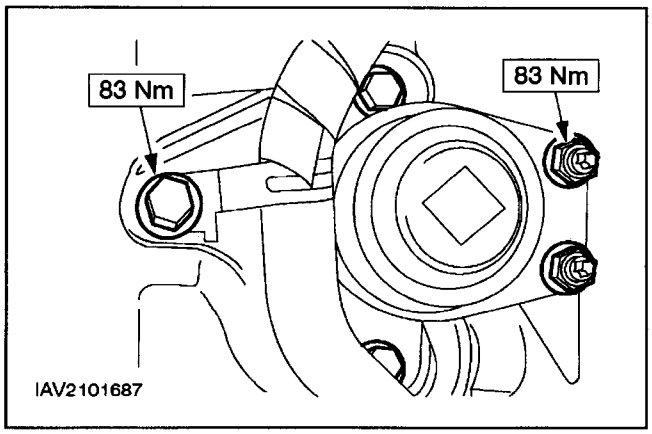
37. ⚠ **CAUTION: Do not twist or strain the rear engine support insulators.**

NOTE: Install new self-locking nuts.

Install the rear transaxle support insulator.

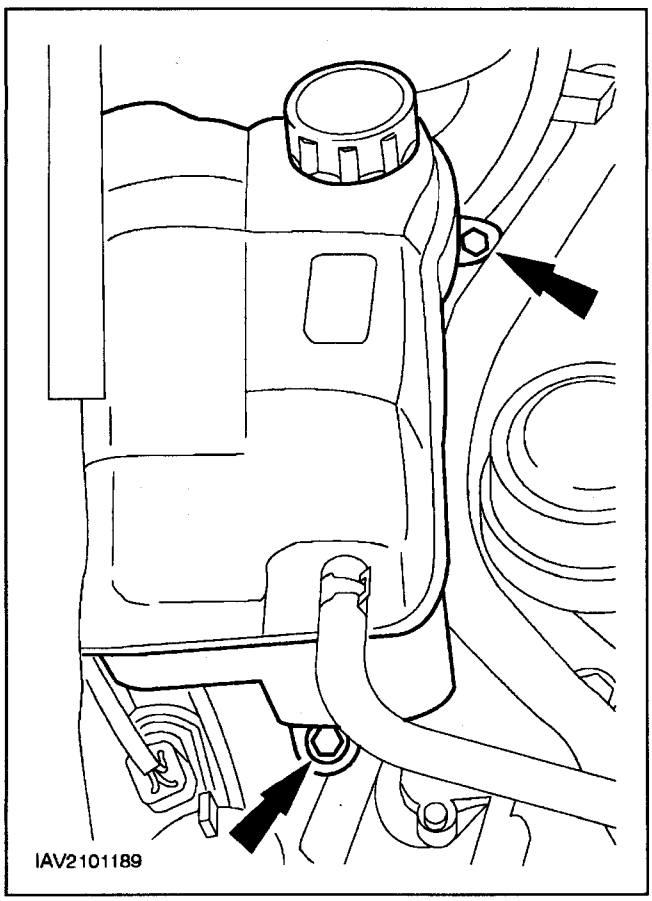
1 Install the bolts.

2 Install the nuts.



38. ⚠ **CAUTION: Do not twist or strain the front engine support insulators.**

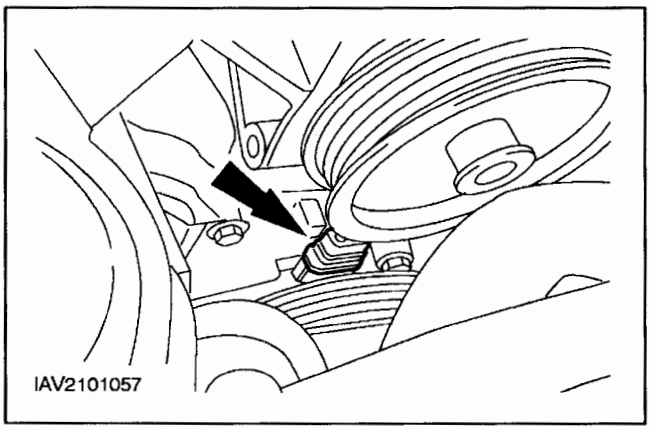
Align the front engine support insulators and tighten the nuts.



39. Install the coolant expansion tank.

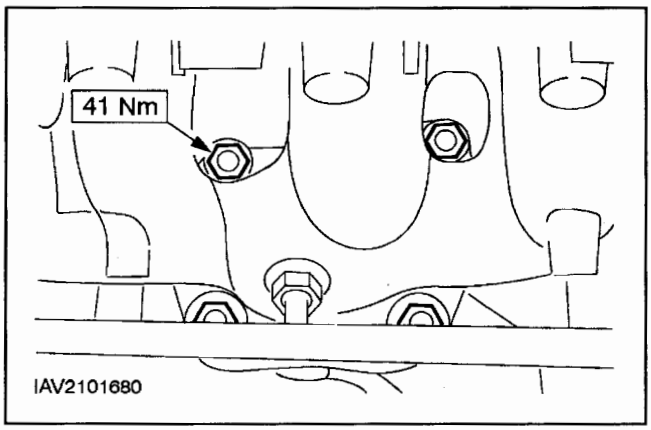
- Attach the speed control cable (if equipped) to the coolant expansion tank.

INSTALLATION (Continued)



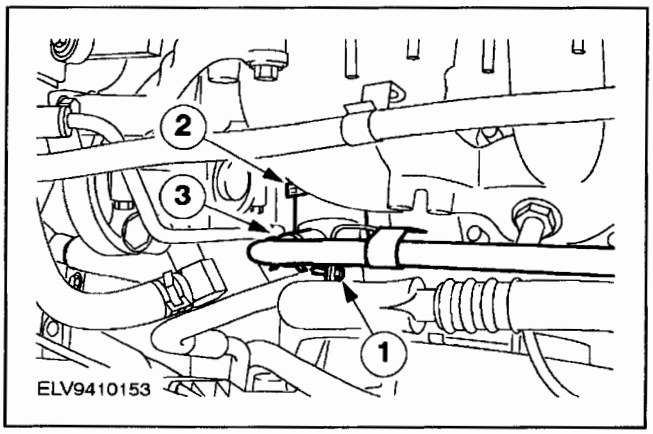
Vehicles with air conditioning

40. Connect the compressor electrical connector (without accessory belt drive shown).

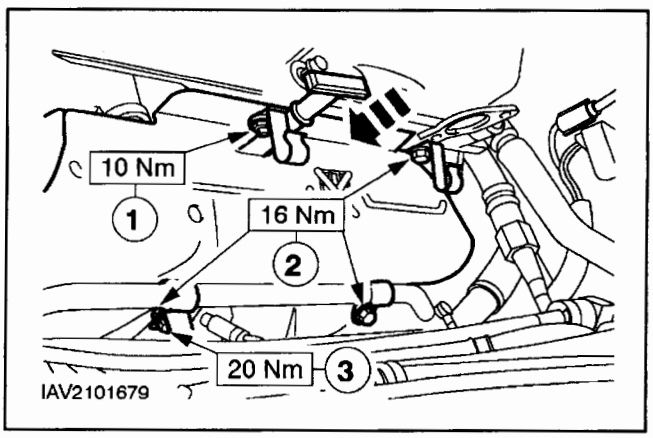


All vehicles

41. Install the TWC to the exhaust manifold.



42. Connect the coolant hoses and install the coolant pipe.
    1 Install the coolant pipe.
    2 Install the coolant hose to the coolant pipe.
    3 Install the coolant hose to the water pump.

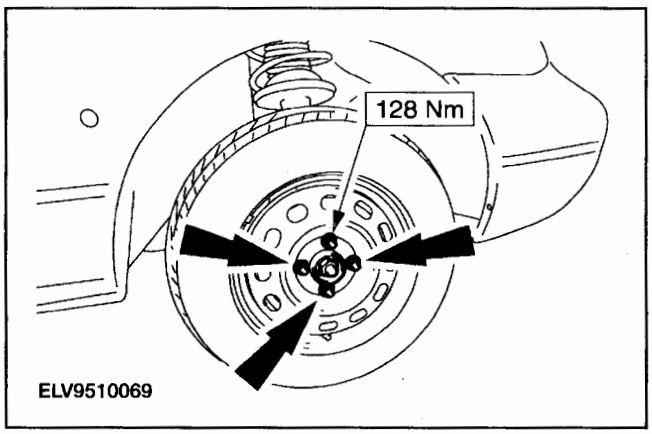


43. Install the heat shield.
    1 Install the coolant hose brackets, and the engine oil level indicator tube.
    - Install the upper bolt.
    2 Install the brackets for the coolant hose.
    3 Install the bolts.

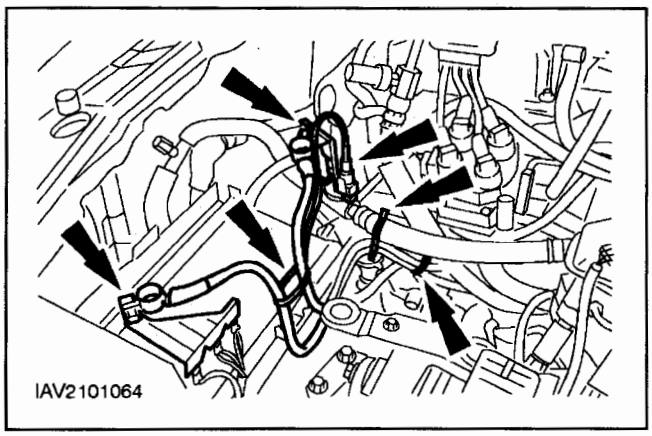
INSTALLATION (Continued)

44. Install the front wheels.

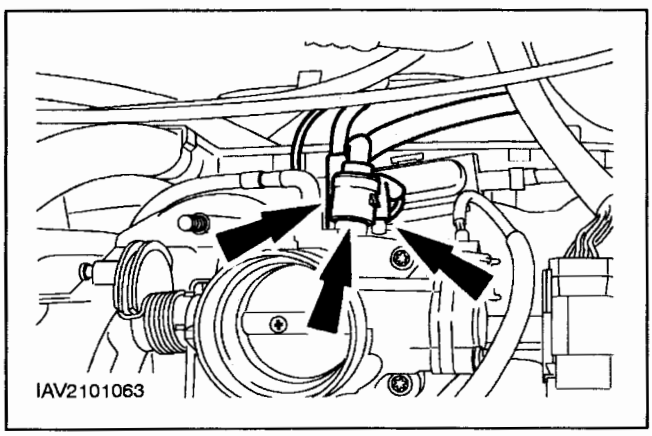
45. Lower the vehicle.



46. Tighten the front wheel nuts.

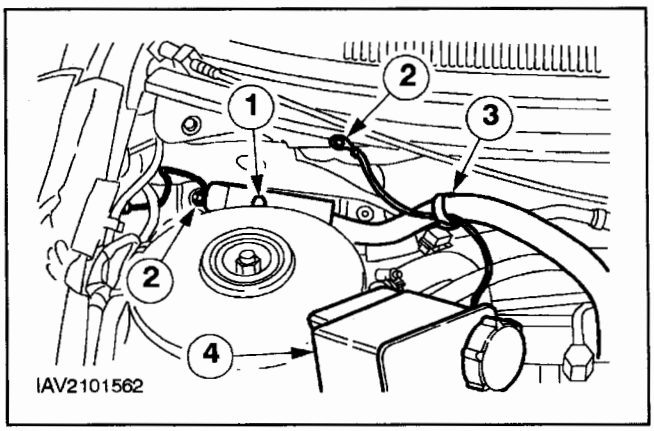


47. Connect the battery cables and electrical connectors and secure the wiring harness with cable ties.

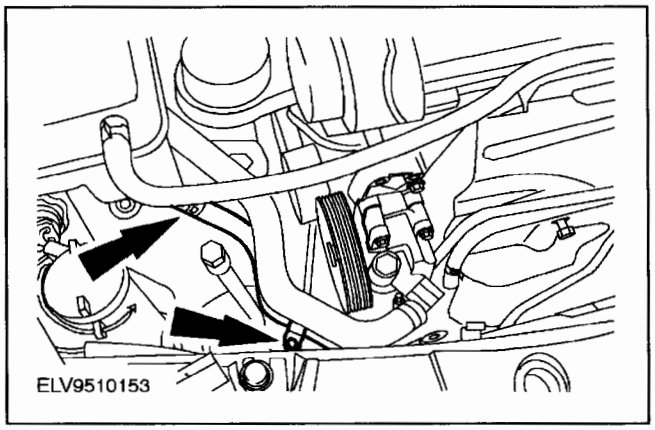


48. Connect the vacuum hoses to the intake manifold.

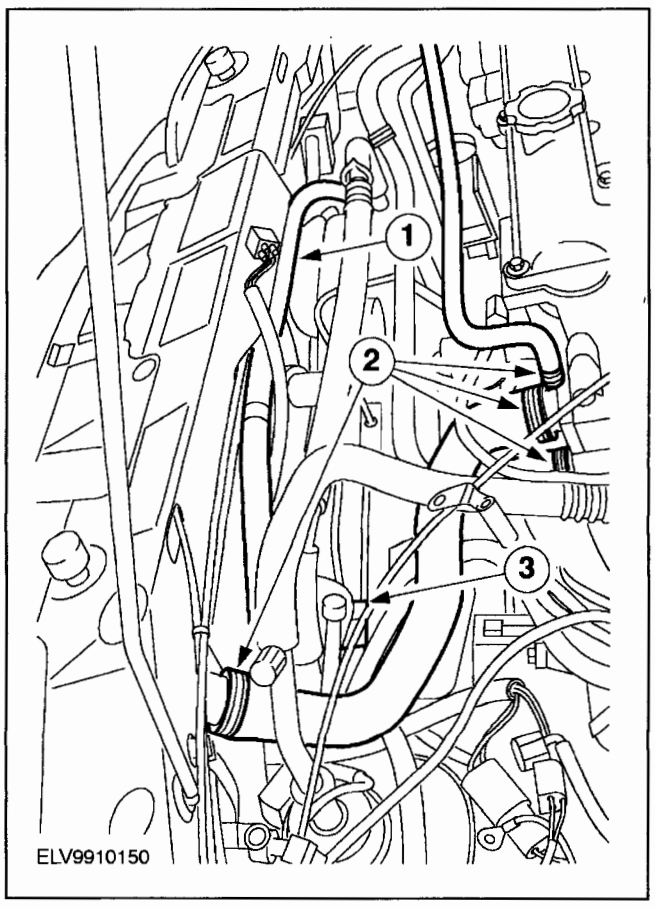
INSTALLATION (Continued)



49. Connect the main wiring harness to the powertrain control module (PCM).
    1 Connect the main wiring harness electrical connector.
    2 Connect the two ground cables.
    3 Close the wiring bracket.
    4 Install the power steering reservoir.

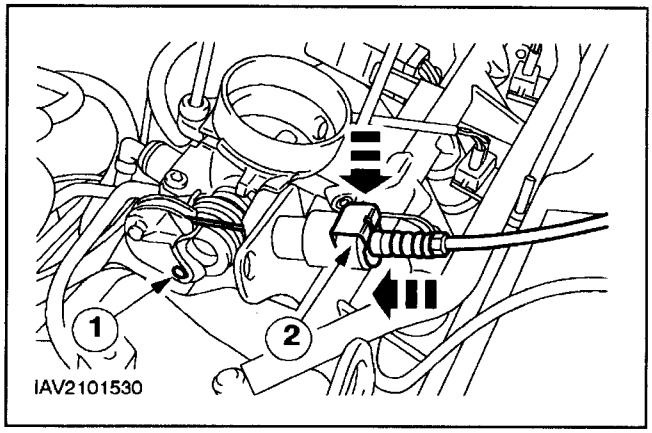


50. Install the clamp to the fender apron panel and install the coolant hoses.



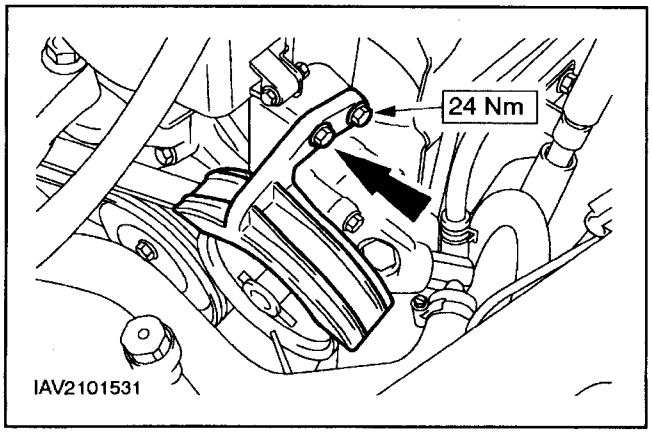
51. Disconnect the electrical connector and the upper coolant hoses.
    1 Clip the wiring harnesses in place.
    2 Connect the coolant hoses.
    3 Connect fan motor electrical connector.

INSTALLATION (Continued)

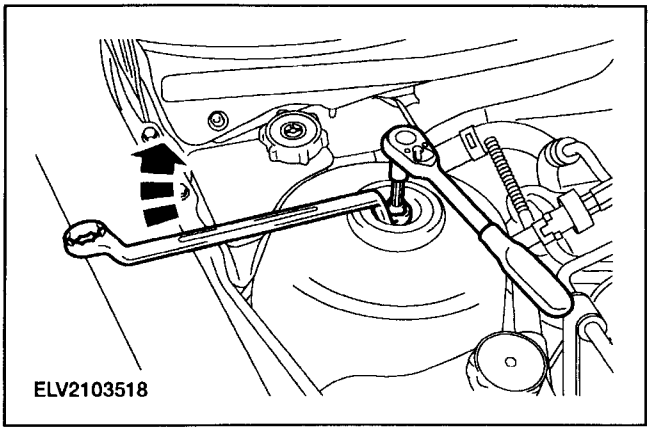


52. Install the throttle cable and adjust it.
    1 Guide the cable into the abutment bracket and push on the plastic clip.
    - Hook the cable in place.

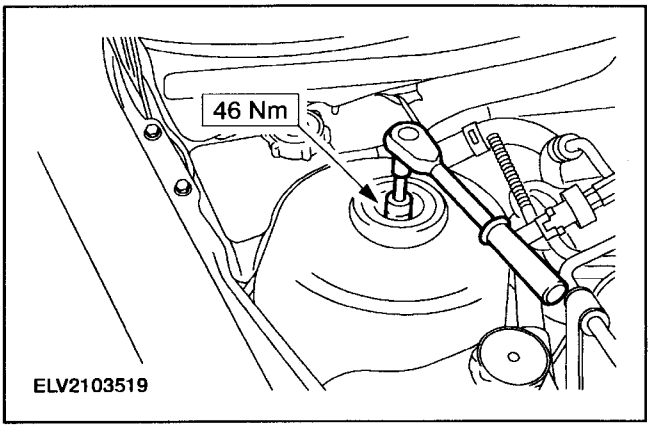
    2 Install the clip.
    - Pull the cable out a few notches.
    - Fully depress the accelerator pedal once and slide the clip back on.
    - Check whether the throttle valve opens fully when the accelerator pedal is fully depressed-repeat adjustment if necessary.



53. Install the upper accessory drive belt cover.

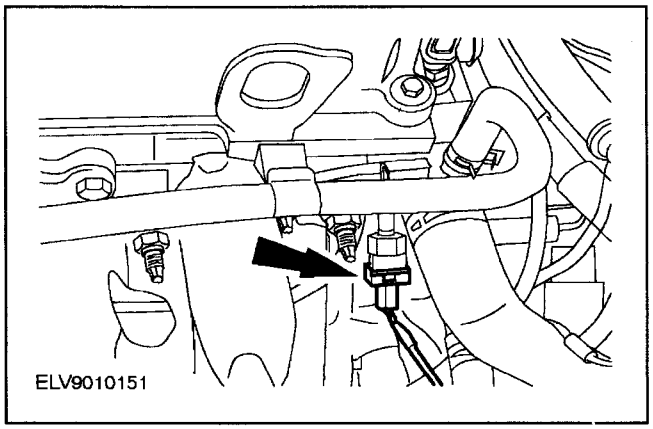


54. **NOTE:** Use an Allen wrench to stop the piston rod from turning.
    Tighten the suspension strut nut on both sides (right-hand side shown).

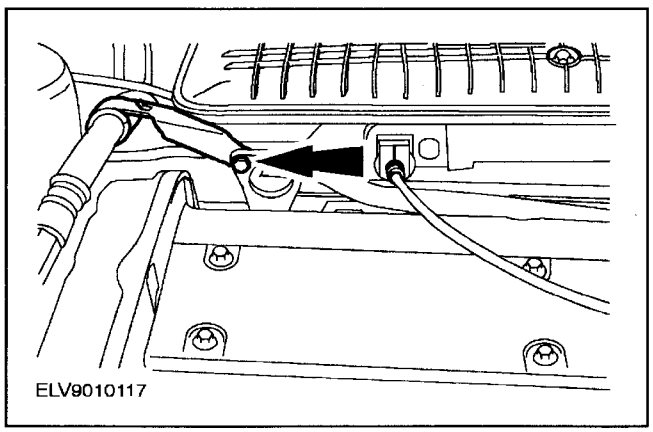


55. Tighten the suspension strut nut (right side shown).

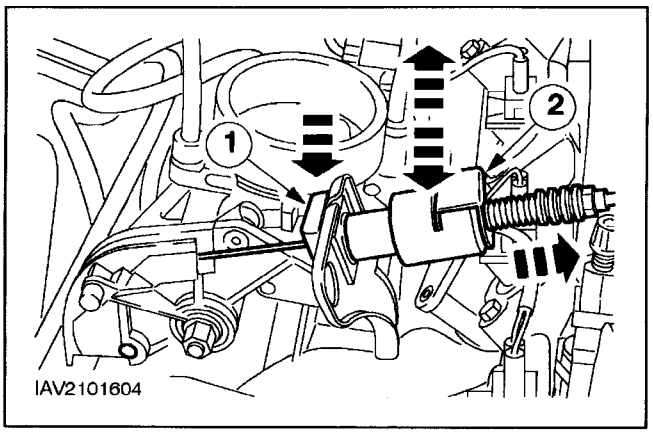
INSTALLATION (Continued)



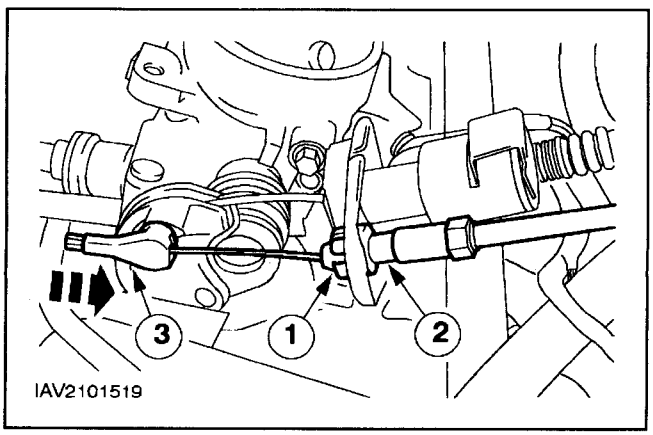
56. Connect the engine coolant temperature (ECT) sensor electrical connector.



57. Install the ground cable and the power steering line bracket to the engine lifting eye.

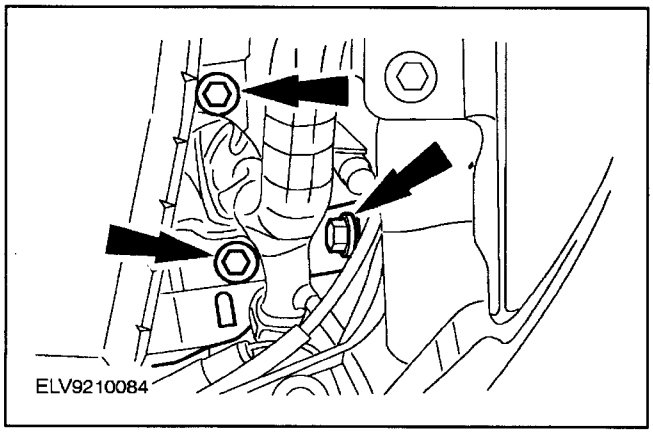


58. Connect the throttle cable.
    1 Install the plastic clip.
    2 Install the cable.

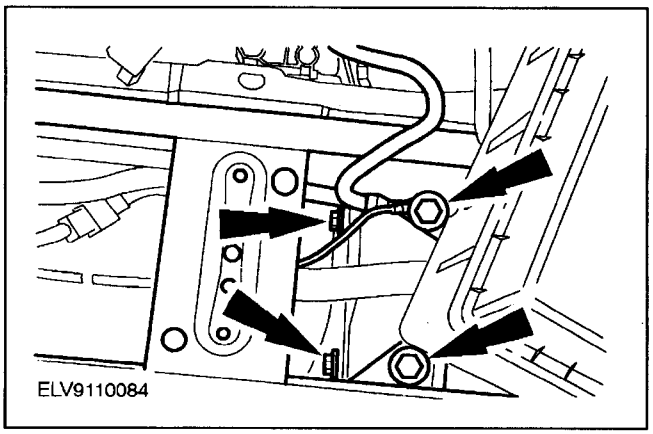


59. Connect the speed control cable.
    1 Press the retaining bush in the bracket.
    2 Pull the cable in the retaining bush.
    3 Connect the cable to throttle valve.

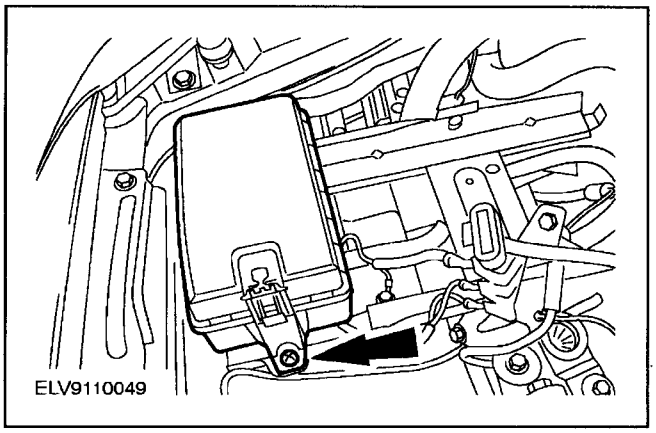
INSTALLATION (Continued)



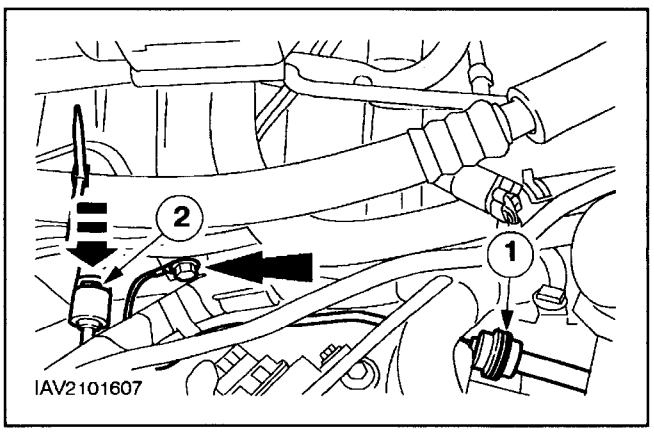
60. Install the battery bracket.



61. **NOTE:** Two ground cables.
    Install the battery bracket.

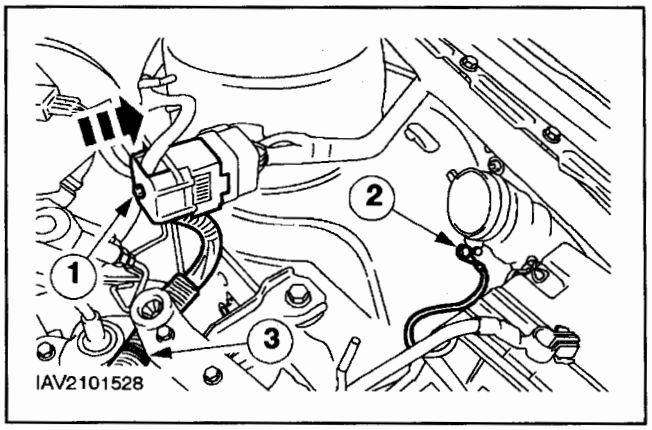


62. Install the central junction box (CJB).

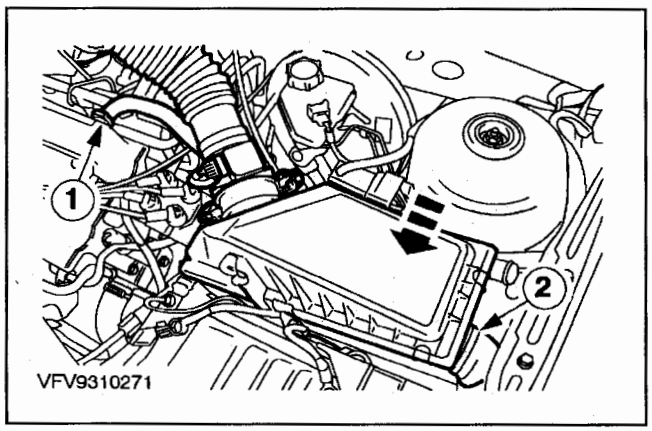


63. **NOTE:** There is an audible click when it engages.
    Connect the clutch slave cylinder.
    - Attach the ground lead to the transaxle.
    1 Install the slave cylinder pipe in the bracket.
    2 Connect the slave cylinder pipe to the transaxle and slide on the clip.

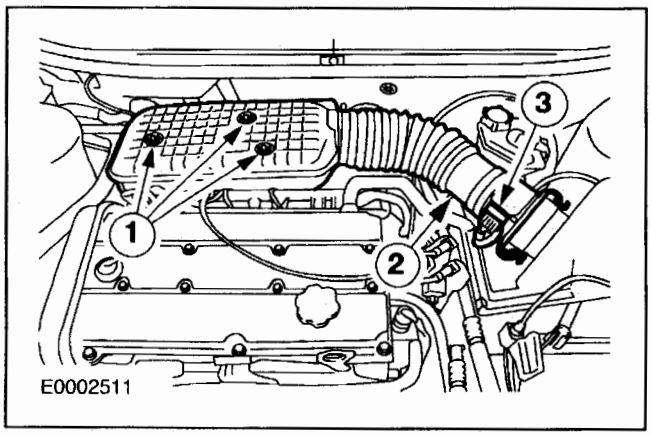
INSTALLATION (Continued)



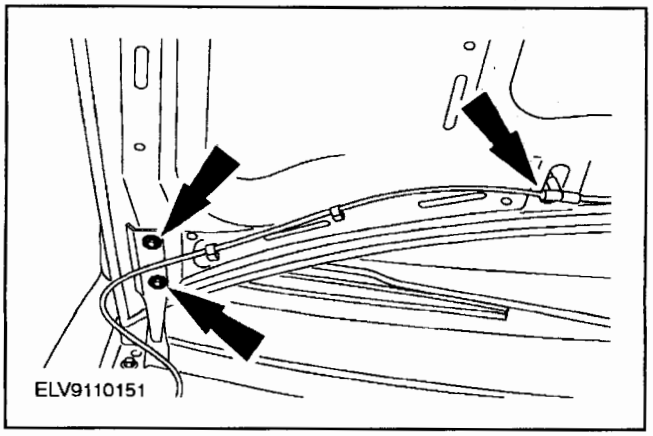
64. Connect the wiring.
    1 Engine wiring harness connector
    2 Transaxle ground cable
    3 Secure the wiring harness using cable ties.



65. Install the air cleaner housing.
    - Insert the air cleaner housing (push fit).
    1 Install the crankcase ventilation hose.
    2 Install the air hose.

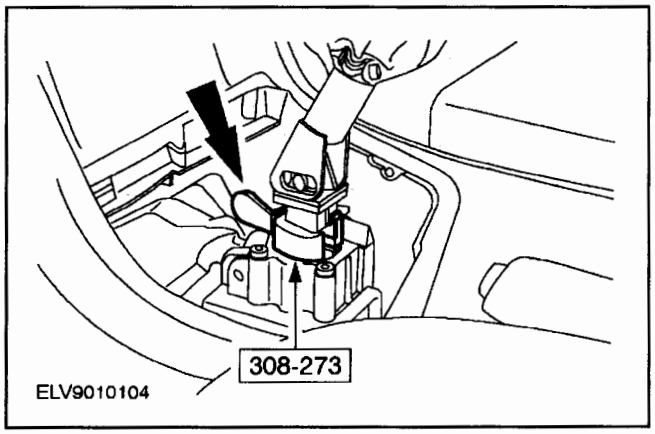


66. Install the air intake tube.
    1 Install one bolt and two nuts.
    2 Connect the IAT sensor electrical connector.
    3 Connect the MAF sensor electrical connector.



67. Install the hood.
    - Connect the hose and install the bolts (right hand side shown.

INSTALLATION (Continued)



68. Remove the special tool from the gearshift lever and press in the boot.

69. Bleed the hydraulic clutch system. For additional information, refer to Section 308-00.

70. **CAUTION: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.**

    Install and connect the battery. For additional information, refer to Section 414-01.

71. Fill the cooling system. For additional information, refer to Section 303-00.

72. Fill in Manual Transmission Fluid. For additional information, refer to Section 308-00.

73. Check the routing of the vacuum hoses and wiring and secure them with cable ties.

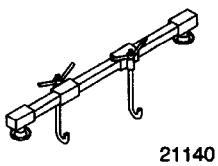
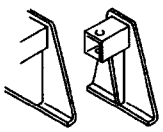
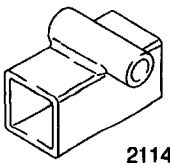
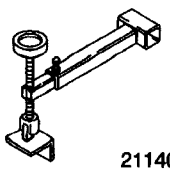
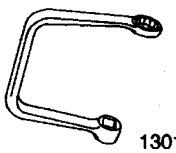
74. Check the fluid levels after the road test and correct as necessary.

75. Check the engine and cooling system for leaks (visual inspection).

INSTALLATION (Continued)

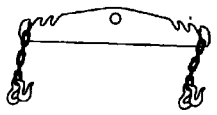
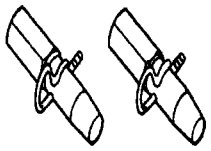
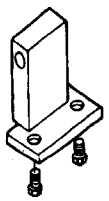
Engine — Vehicles with Automatic Transaxle

Special Tool(s)

 21140	Support Bar, Engine 303-290A (21-140)
 2114001	Adaptor for 303-290A (21-140) 303-290-01 (21-140-01)
 2114002	Adaptor for 303-290 (21-140) 303-290-02 (21-140-02)
 2114003	Adaptor for 303-290A (21-140) 303-290-03 (21-140-03)
 13013	Socket wrench, steering rack 211-202 (T97P-3504-A)
 T70P-6000	Lifting Bracket, Engine 303-050 (T70P6000)

(Continued)

Special Tool(s)

 ST1602-A	Spreader Bar 303-D089 (D93P6001A3)
 T94P-2100-AH	Subframe Alignment Pins 502-002 (T94P-2100-AH)
 T94P-6000-AH	Powertrain Alignment Tool 502-003 (T94P-6000-AH)

General Equipment

Transmission jack
Assembly stand GV2166
Retaining straps
Securing straps
suitable floor crane
Workshop hoist
Straight Edge

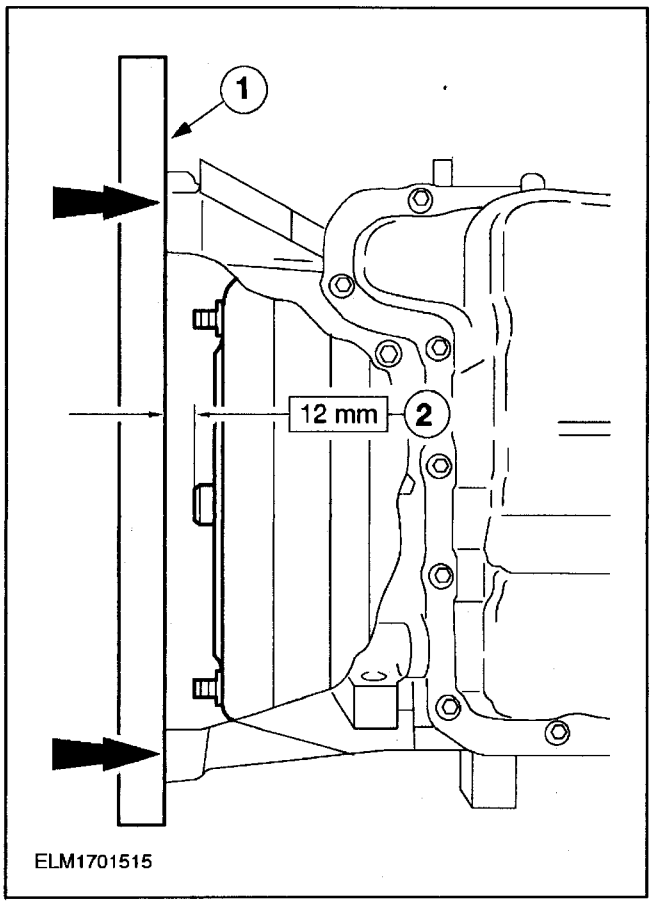
Materials

Item	Specification
High-temperature grease —	ESD-M1C220-A
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

INSTALLATION (Continued)

Installation

All vehicles



1. **NOTE:** The locations of engine mountings and engine support insulators are given looking from the automatic transaxle to the engine.

   NOTE: Install new snap rings, cotter pins and self-locking nuts.

   NOTE: The torque converter hub must fully engage with the oil pump drive gear.

   Check the installation depth of the torque converter.

   1 Lay a Straight edge on the transaxle flange.

   2 Check the depth between transaxle flange and the torque converter centering spigot for the correct clearance.

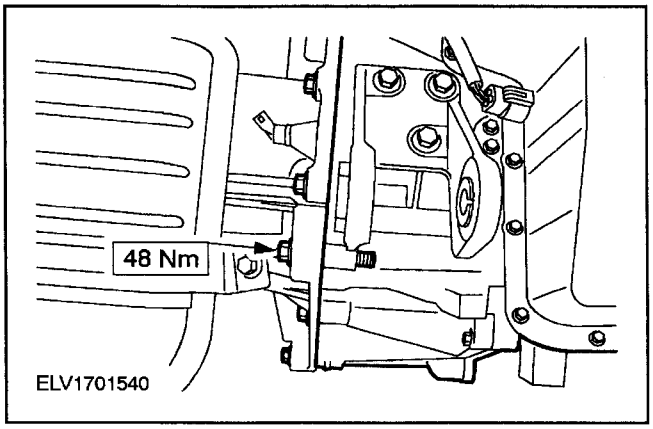
2. Apply a thin layer of High-temperature grease to the centering spigot bore on the torque converter.

3. ⚠ **CAUTION: The torque converter must remain at the correct installation depth throughout the entire installation procedure. Check that the adapter plate is in the correct position.**

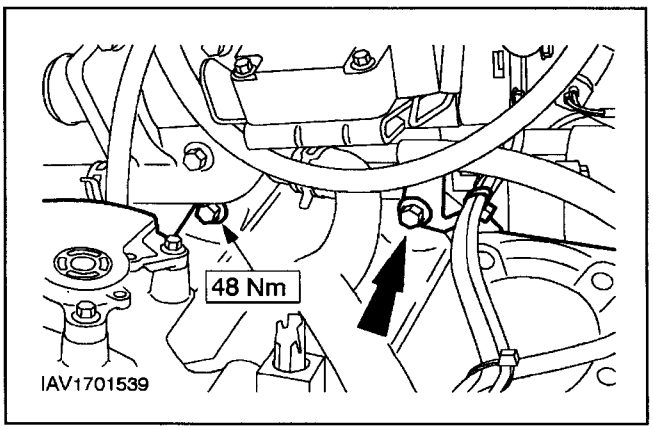
   Position the transaxle in installation position next to the engine and guide the torque converter stud into the drive plate.

4. Screw in all the flange bolts.

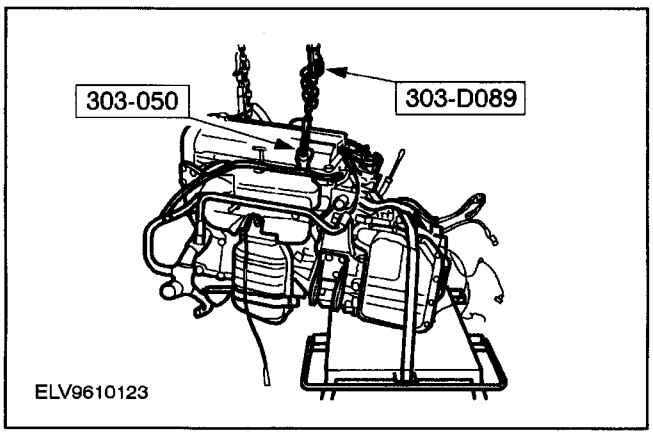
INSTALLATION (Continued)



5. Tighten the flange bolts on the left-hand side.

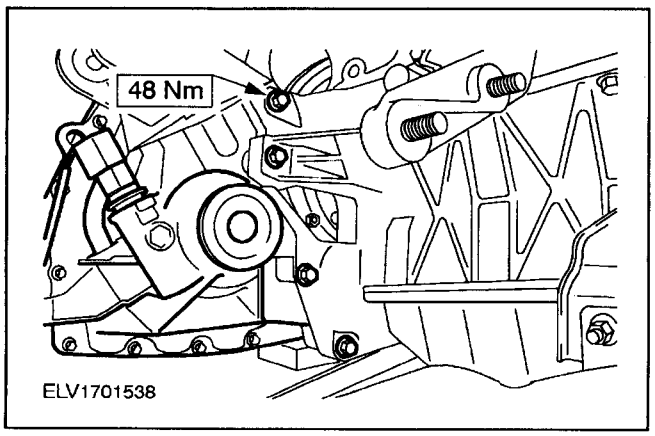


6. Tighten the upper flange bolts.
   - Install the starter motor cable bracket.



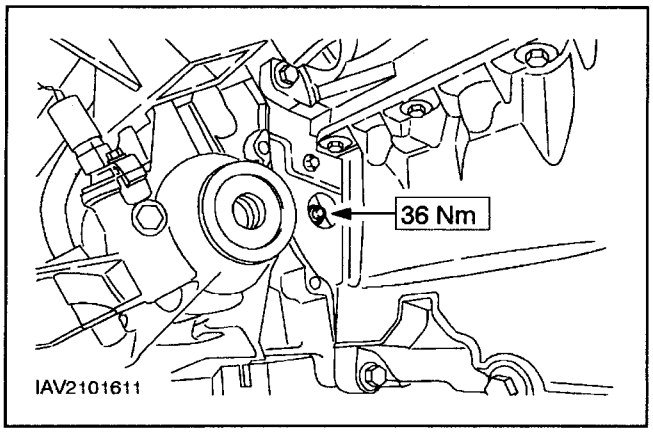
7. Using the special tools and a suitable Floor Crane , move the engine/transaxle assembly and secure it with Securing straps on powertrain lift.

8. Remove the special tools.

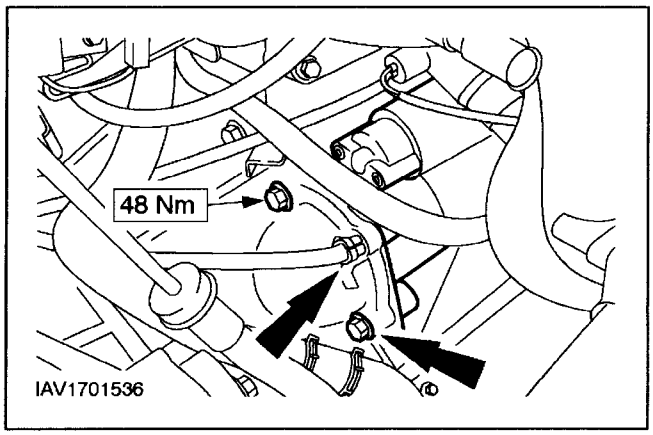


9. Tighten the flange bolts on the right-hand side.

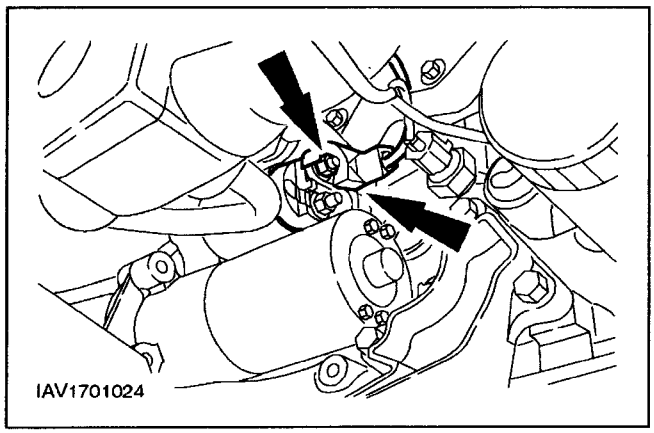
INSTALLATION (Continued)



10. Connect the torque converter to the engine drive plate (four nuts) and install the rubber cover.



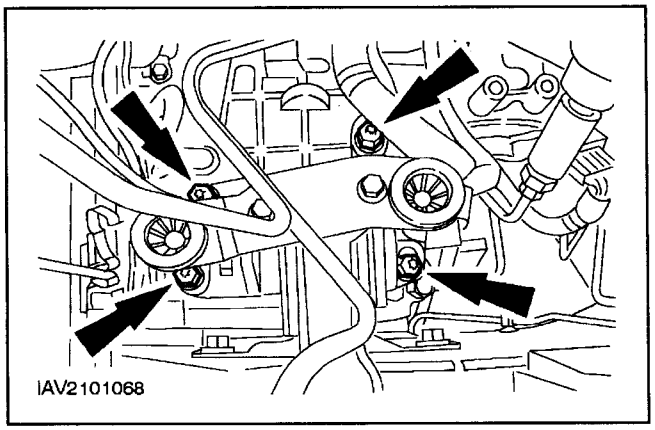
11. Install the starter motor.
    - Install the ground cable.



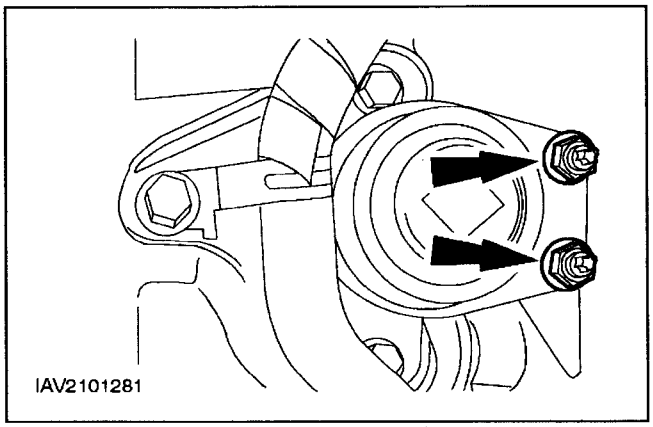
12. Install the starter motor electrical connections.

13. Move the engine and transaxle assembly on Powertrain Lift underneath the vehicle into installation position and carefully lower the vehicle.

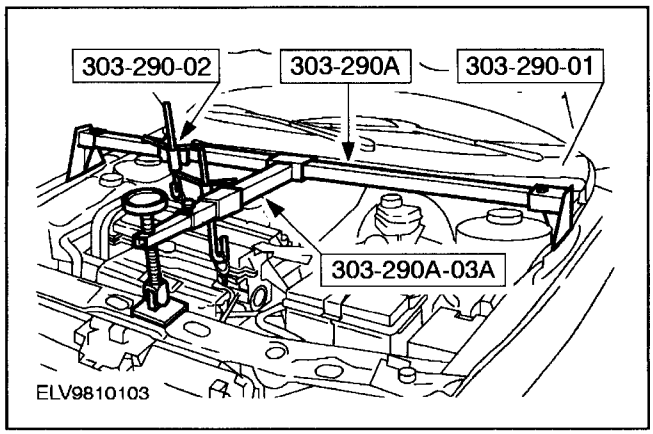
INSTALLATION (Continued)



14. **NOTE:** Do not tighten the nuts.
    Install the rear engine mounting bracket nuts.



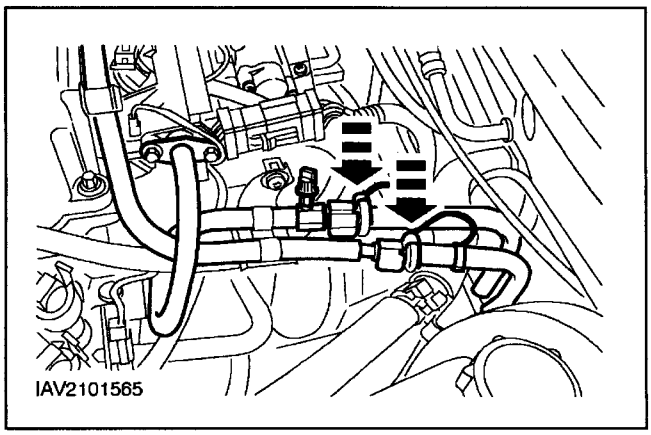
15. **NOTE:** Do not tighten the nuts and bolts.
    Install the front engine mounting bracket nuts.



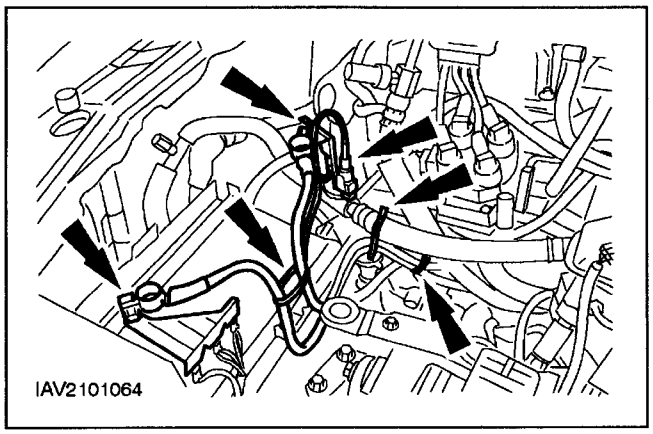
16. Install the special tools.

17. Remove the retaining straps from the engine and the transaxle. Remove the Powertrain Lift.

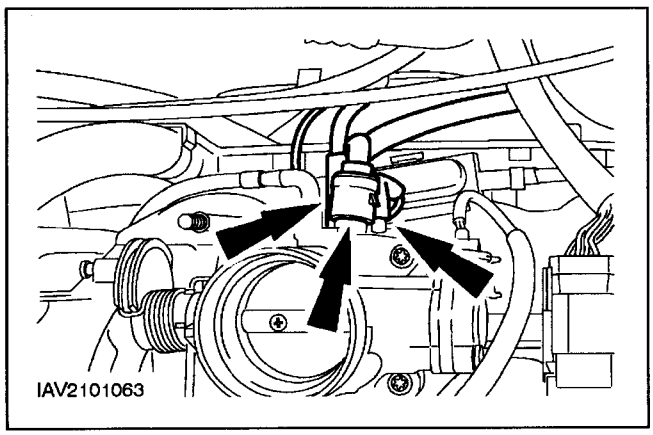
INSTALLATION (Continued)


IAV2101565

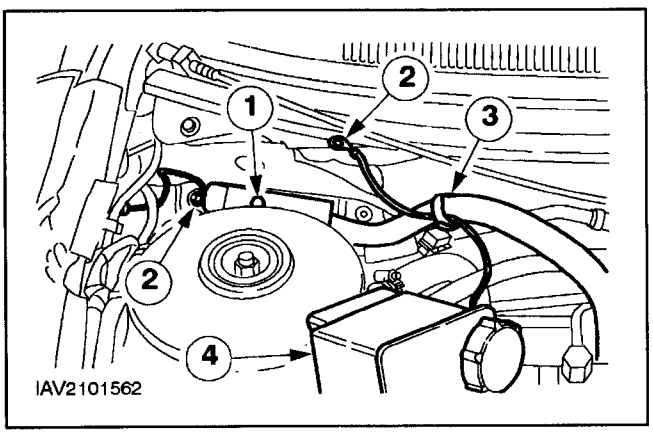
18. Connect and secure the fuel lines.
    - Push on the retaining clips.


IAV2101064

19. Connect the battery cables and electrical connectors and secure the wiring harness with cable ties.


IAV2101063

20. Connect the vacuum hoses to the intake manifold.

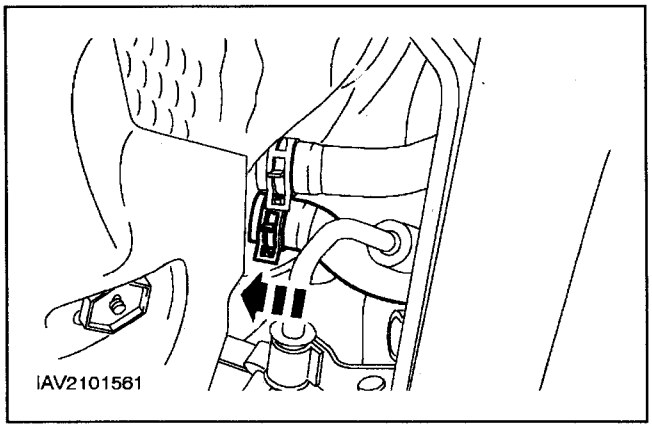


IAV2101562

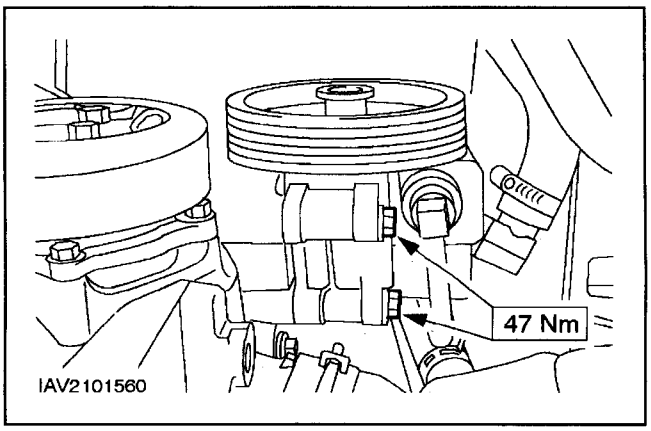
21. Connect the main wiring harness to the powertrain control module (PCM).
    1 Connect the main wiring harness electrical connector.
    2 Connect the two ground cables.
    3 Install the wiring bracket.
    4 Install the power steering reservoir.

INSTALLATION (Continued)

22. Raise and support the vehicle. For additional information, refer to Section 100-02.

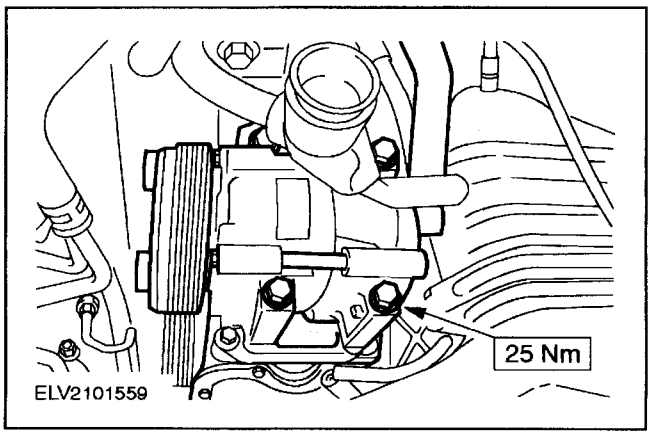


23. Connect the heater coolant hose.



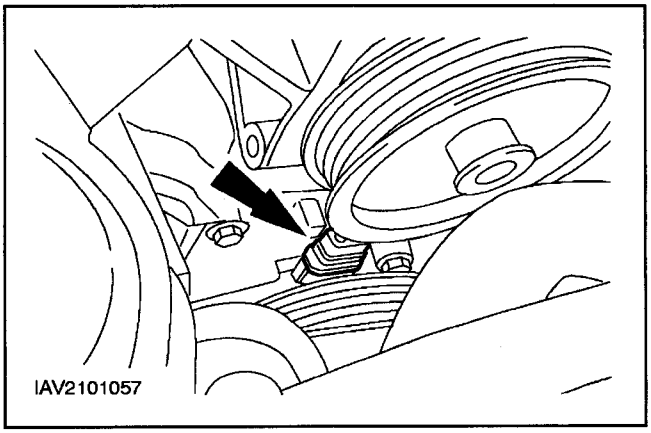
24. Install the power steering pump bolts.

Vehicles with air conditioning



25. Install the compressor bolts.

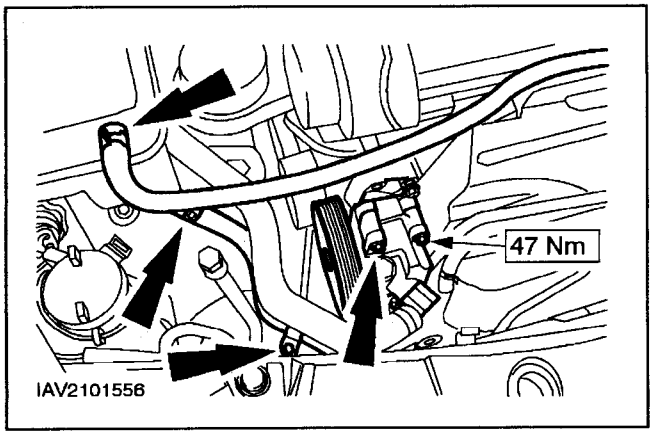
INSTALLATION (Continued)



26. Connect the compressor electrical connector.

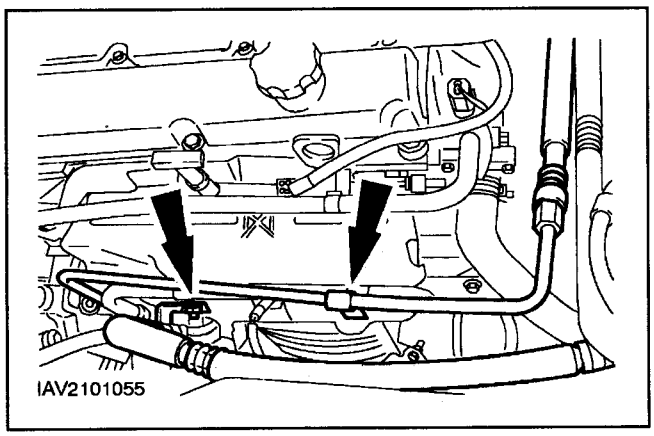
All vehicles

27. Lower the vehicle.



28. Screw in the upper bolts on the power steering pump, attach the wiring clamp to the fender apron panel and install the coolant hose.

Vehicles with air conditioning

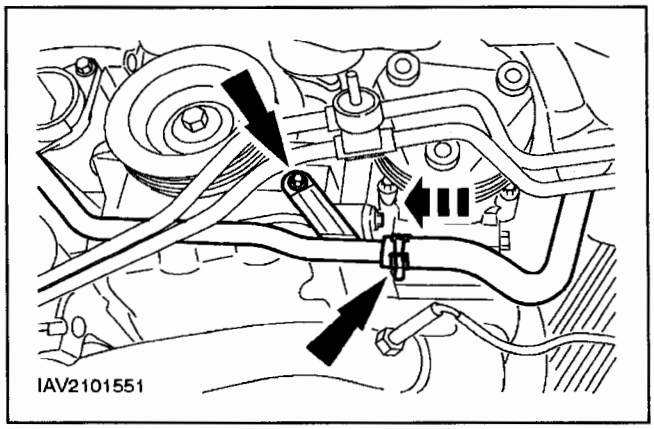


29. Install the tube/hose (A/C) bracket and the power steering line.

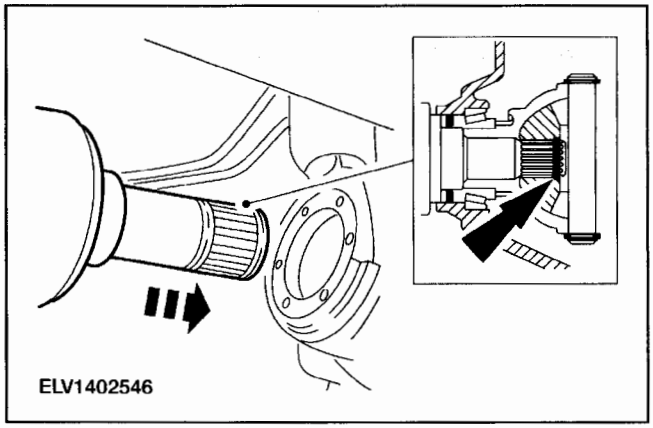
All vehicles

30. Raise and support the vehicle. For additional information, refer to Section 100-02.

INSTALLATION (Continued)

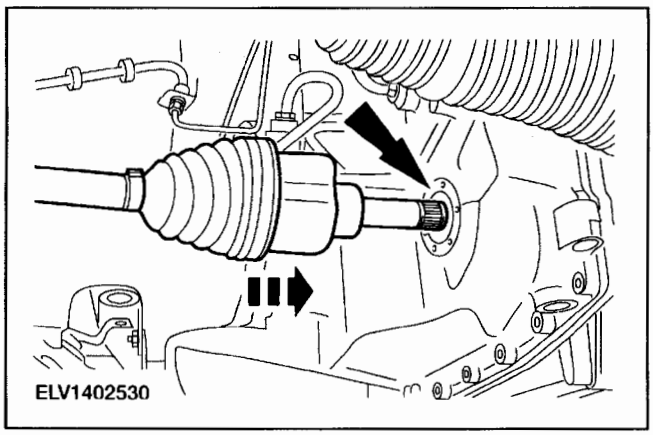


31. Connect the coolant hose to the heater coolant tube and install the bracket.



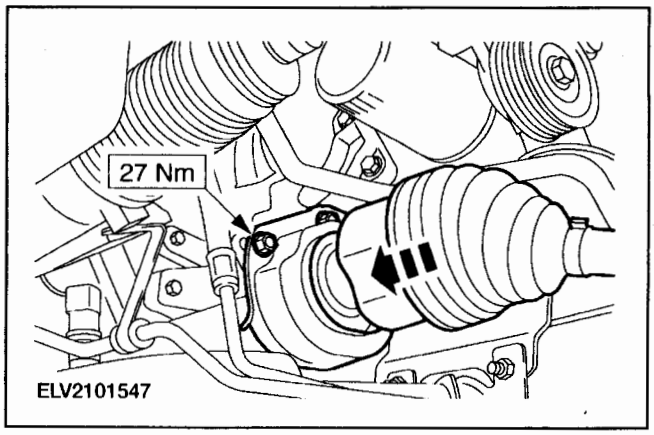
32. ⚠ **CAUTION: To avoid to damage the halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by not more than 45 degrees.**

    Install a new snap ring.



33. **NOTE:** Do not damage the oil seal. Check that the snap ring engages correctly.

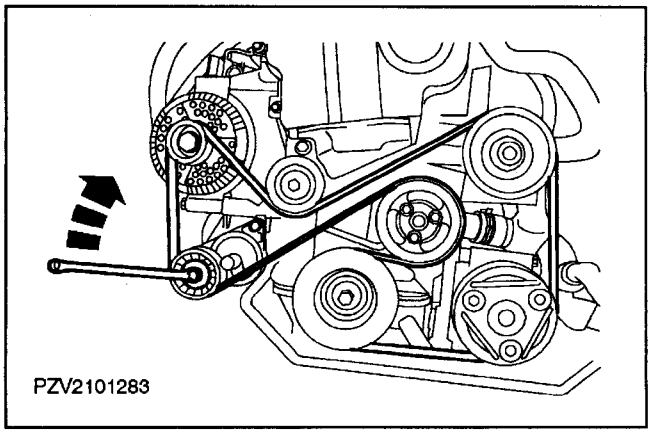
    Install the left-hand halfshaft.



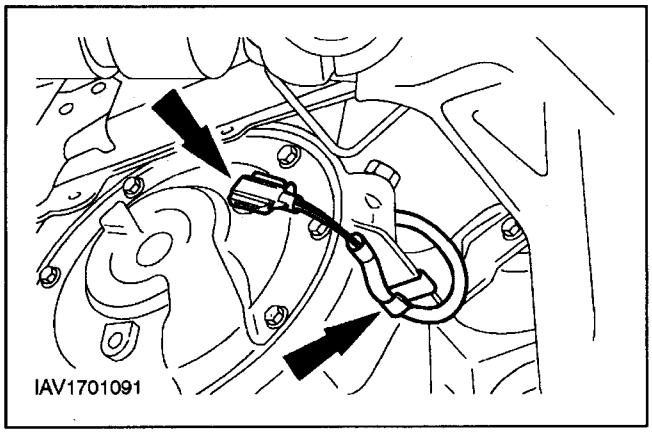
34. **NOTE:** Do not damage the oil seal.

    Install the right-hand halfshaft and intermediate shaft.

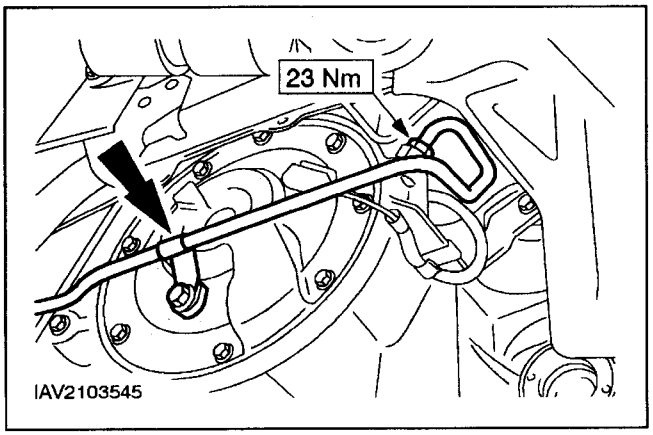
INSTALLATION (Continued)


PZV2101283

35. Position the drive belt in place and tension it.
    - Turn the drive belt tensioner clockwise to relieve belt tension.


IAV1701091

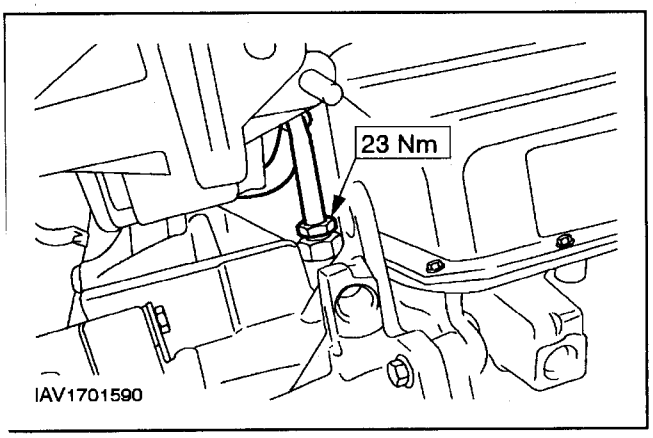
36. Connect the to the turbine shaft speed (TSS) sensor.
    - Clip the wiring in place.



IAV2103545

37. **NOTE:** Remove the plug prior to installation of the tube.

    Connect the fluid tube.

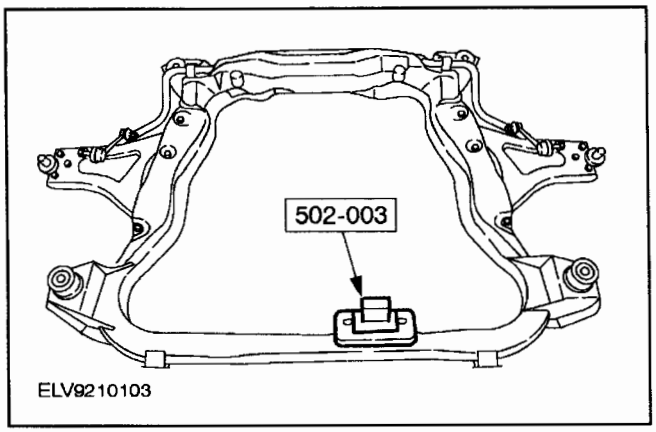


IAV1701590

38. **NOTE:** Remove the plug prior to installation of the tube.

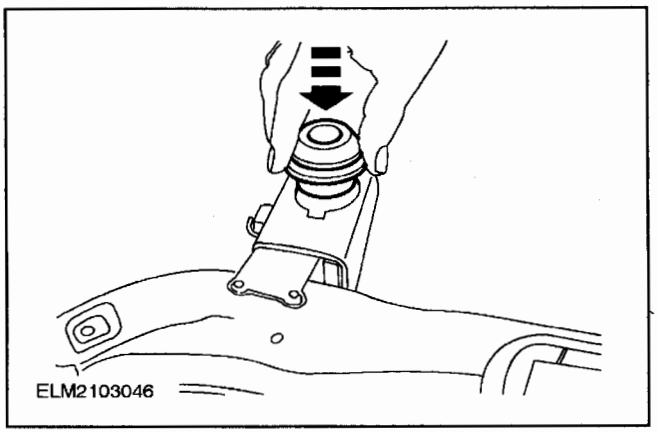
    Connect the fluid cooler tube to the transaxle.

INSTALLATION (Continued)

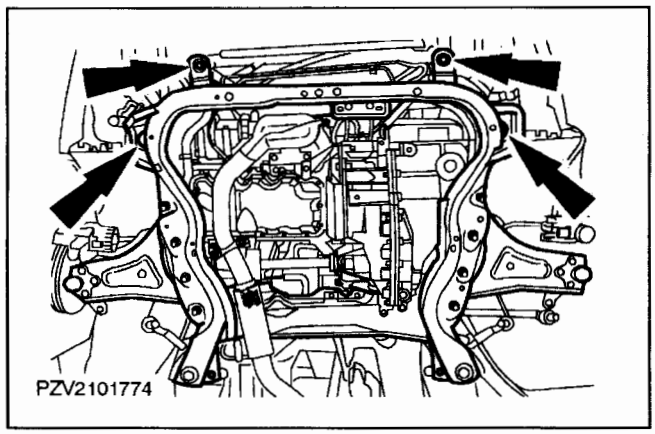


39. **NOTE:** The gauge is marked with an arrow and ''Front''.

    Install the special tool.



40. Insert the rubber guides of the lower radiator supports into the subframe.

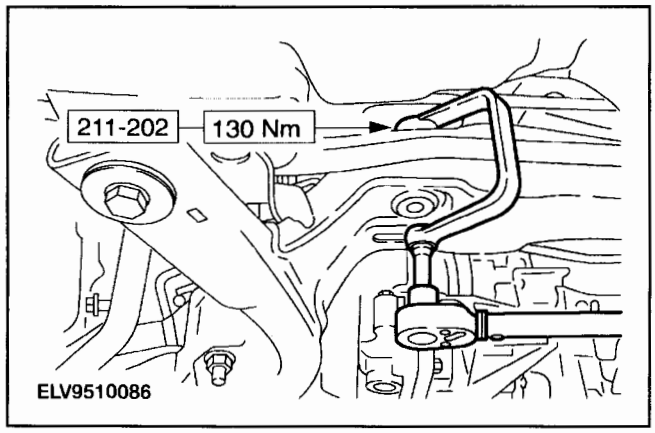


41. **NOTE:** Do not tighten the bolts.

    NOTE: Align the steering gear and the fluid line bracket.

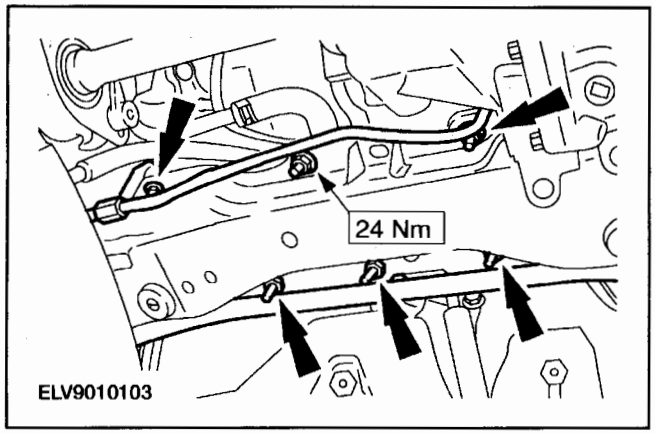
    Move the subframe into installation position using a Powertrain Lift and attach it at the front.

    - Insert the radiator into the subframe.



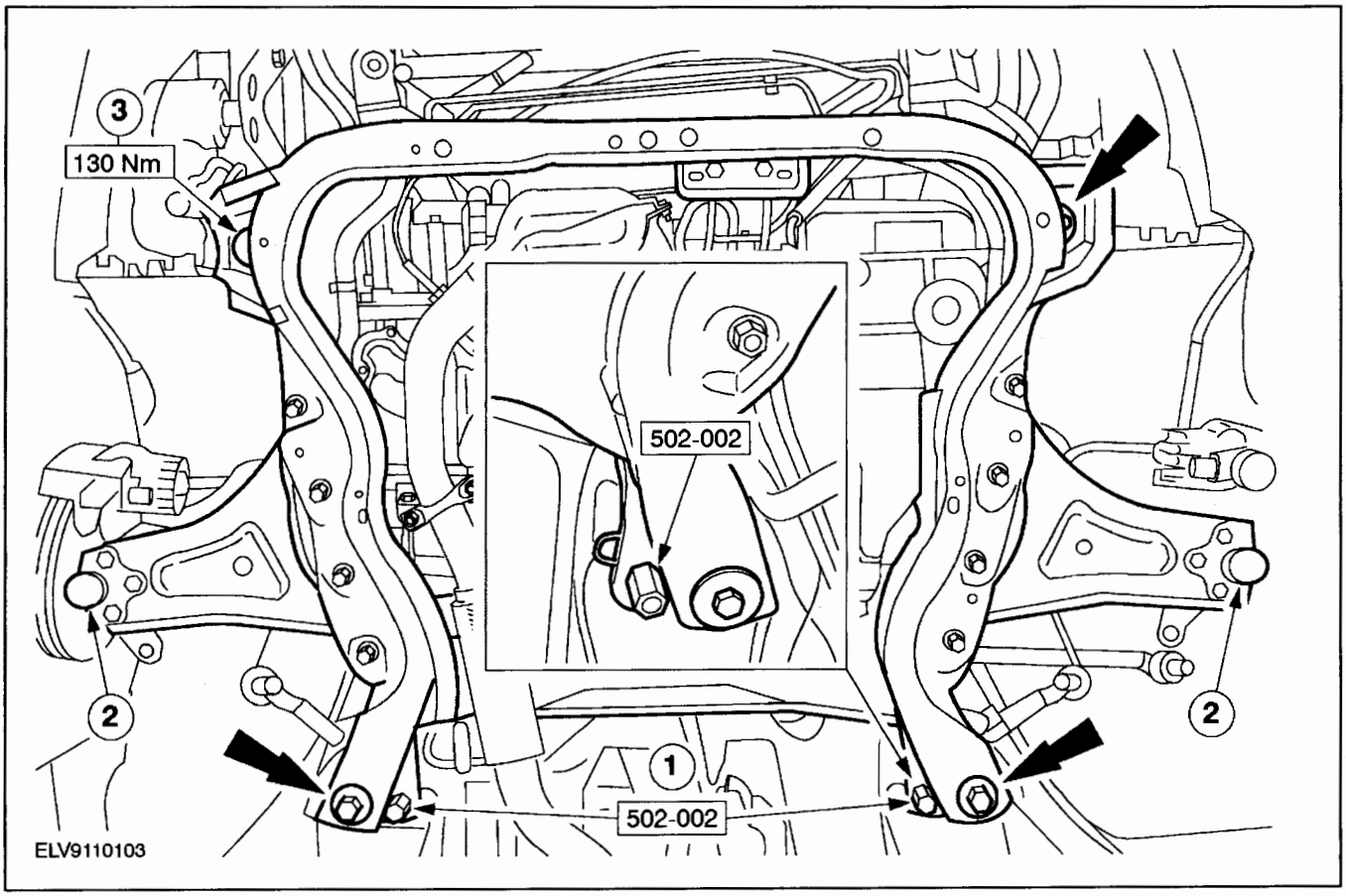
42. Using the special tool, attach the steering gear (two bolts; left-hand side shown).

INSTALLATION (Continued)



43. **NOTE:** Install the power steering line bracket and the coolant line bracket.

    Install the heat shield for the steering gear.



44. **NOTE:** The subframe must not move when tightening the bolts.

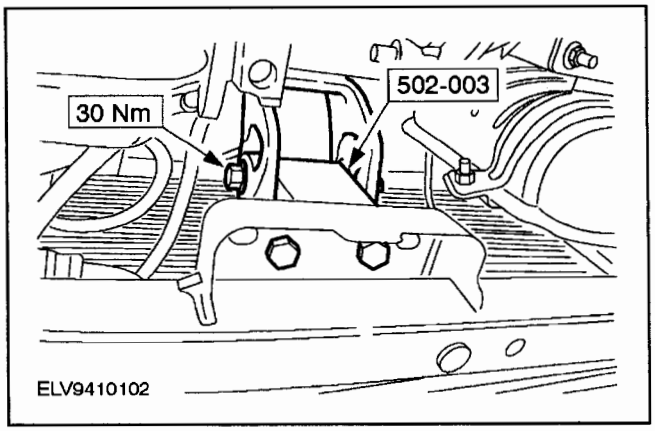
    Using the special tool, align the subframe and tighten the bolts.

    1 Insert the special tools.

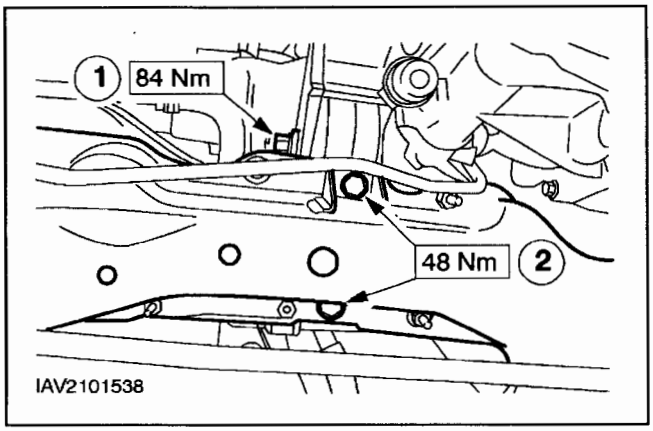
    2 Insert the suspension arm into the spindle.

    3 Tighten the bolts working diagonally.

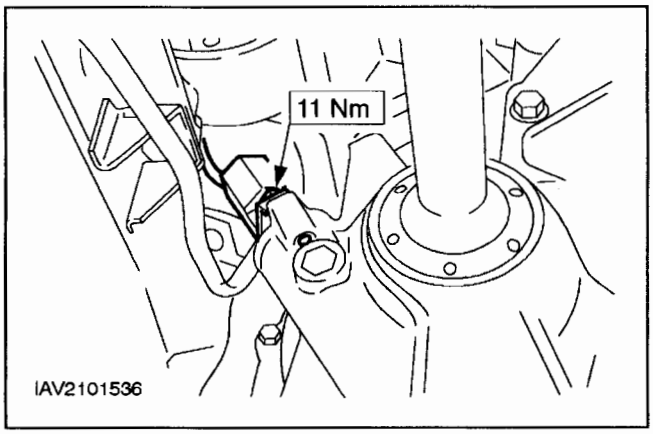
INSTALLATION (Continued)



45. Align the engine and transaxle assembly.
    - Screw the center bolt into the special tool and tighten it.

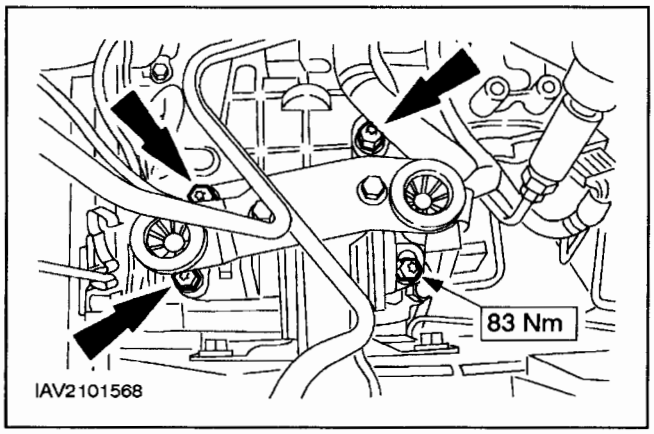


46. Install the right-hand engine support insulator.
    1 Install the center through bolt.
    2 Install the bolts.



47. Install the vehicle speed sensor (VSS).
    - Attach the retaining clip (one bolt).

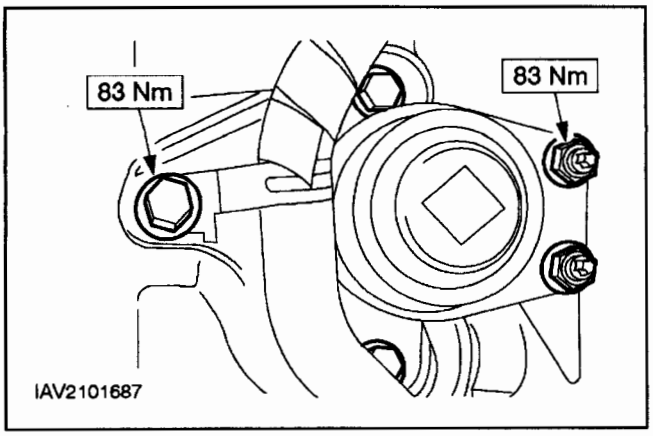
48. Lower the vehicle.



49. ⚠ **CAUTION: Do not twist or strain the rear engine mounting brackets.**

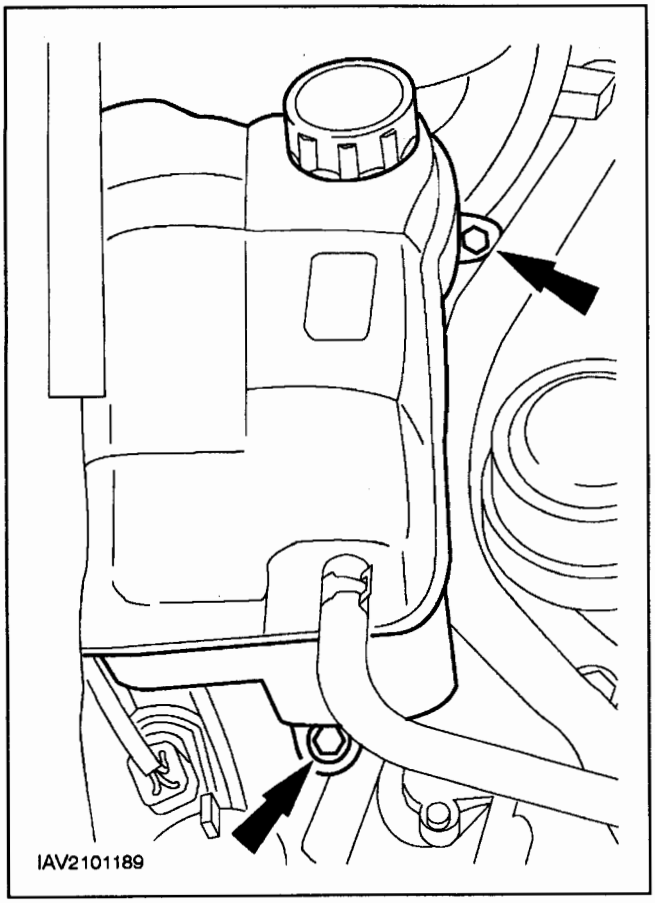
    Tighten the nuts on the rear engine mounting brackets.

INSTALLATION (Continued)



50. ⚠ **CAUTION: Do not twist or strain the front engine mounting brackets.**

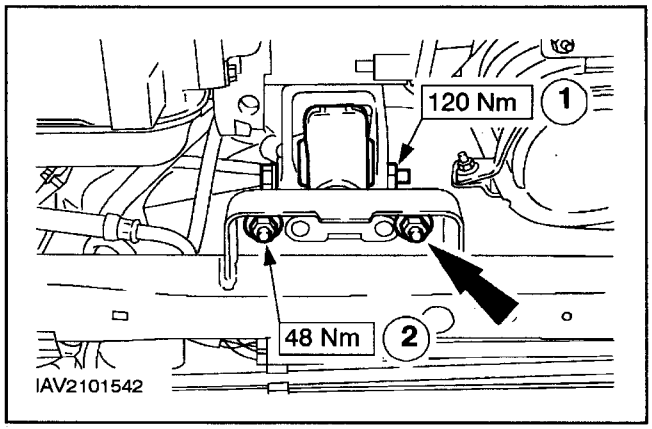
    Align and tighten the front engine mounting brackets.



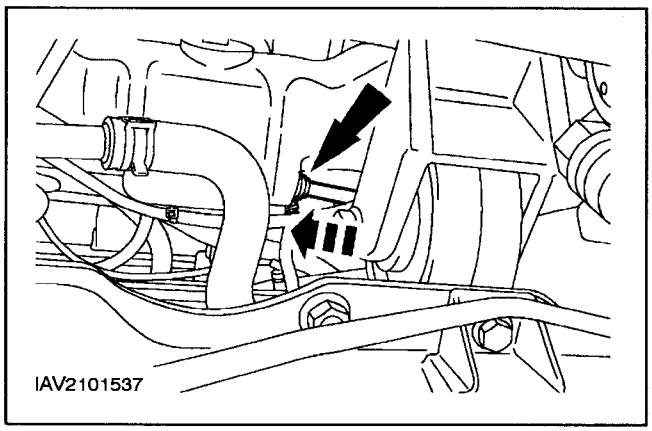
51. Install the coolant expansion tank.
    - Connect the speed control cable (if equipped) to the coolant expansion tank.

52. Raise and support the vehicle. For additional information, refer to Section 100-02.

INSTALLATION (Continued)

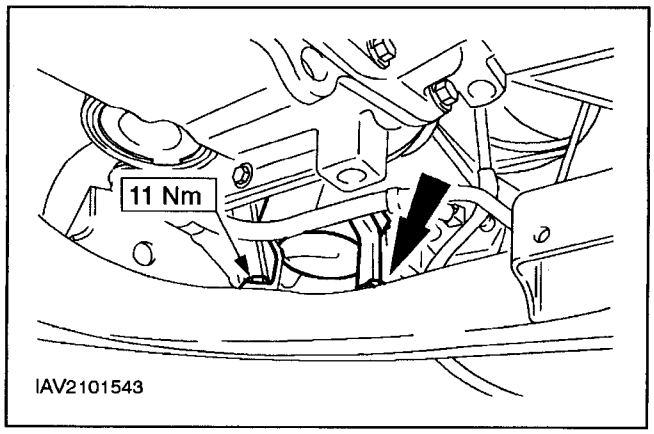


53. Remove the special tool and install the engine support insulator.
    1 Install the center bolt.
    2 Install the nuts.



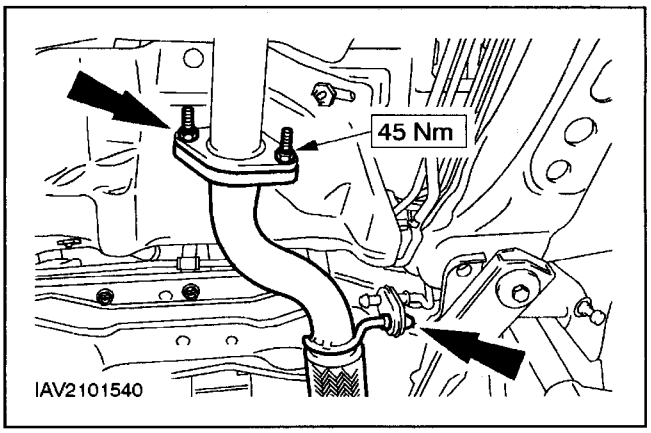
54. Insert the brake booster vacuum hose into the intake manifold.

Vehicles with air conditioning



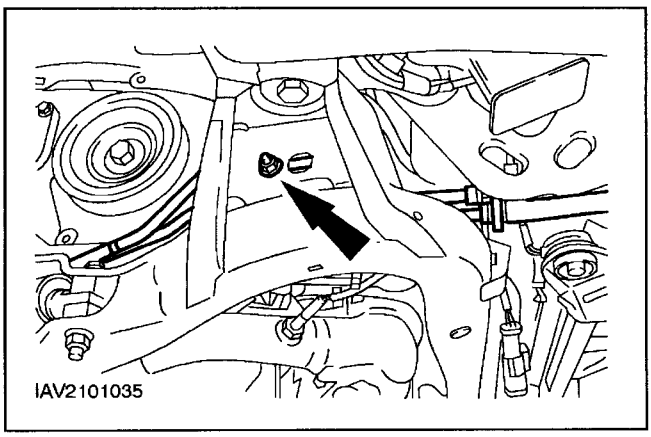
55. Install the suction accumulator bracket bolts.

INSTALLATION (Continued)

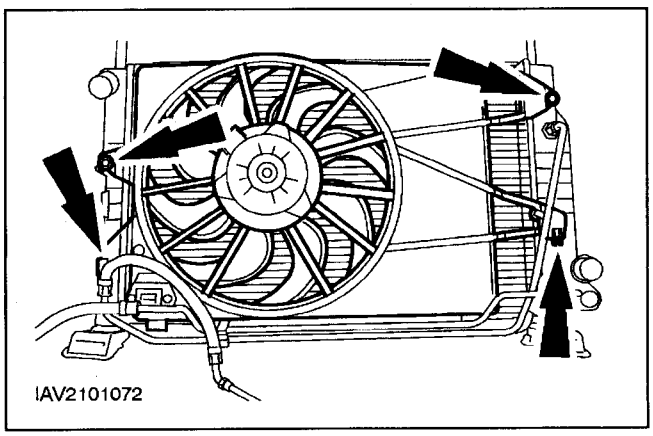


All vehicles

56. Attach the front exhaust tube with a new gasket and hook it in place.



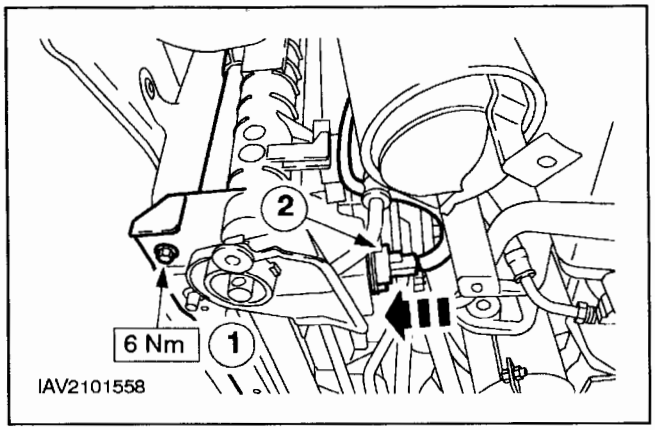
57. Attach the power steering lines to the subframe.



58. Remove the fan motor and the radiator shroud from the radiator.

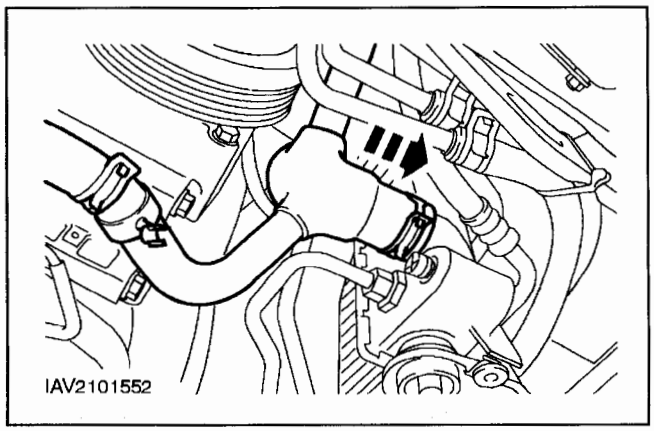
59. Working from below, loosely hook the fan motor and radiator shroud into the vehicle.

INSTALLATION (Continued)



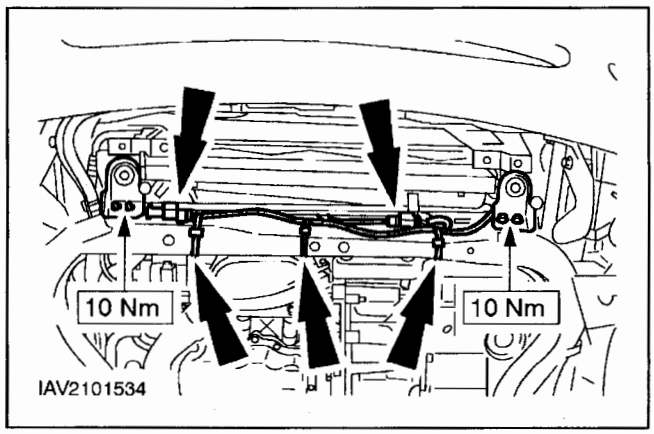
Vehicles with air conditioning

60. Attach the radiator to the condenser core.
    - Working from below, move the radiator into installation position (push fit at the top).
    1 Screw in one bolt on each side (left-hand side shown).
    2 Connect the connector to the fan motor ballast resistor.



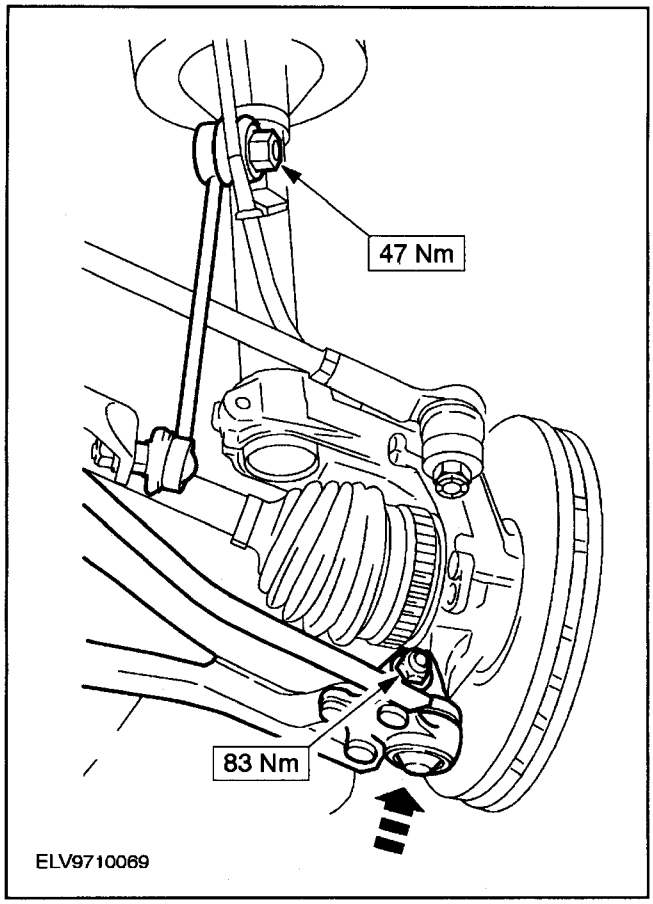
All vehicles

61. Connect the lower coolant hose.



62. Attach the radiator at the bottom and connect both HO2S electrical connectors.
    - Secure the wiring harness with cable ties.

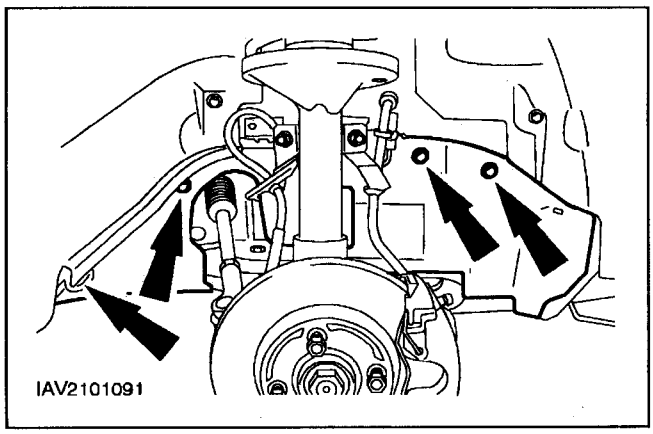
INSTALLATION (Continued)



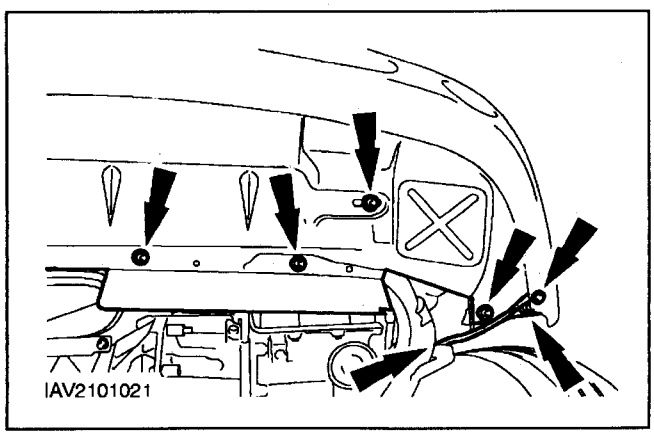
63. ⚠ **CAUTION: Do not damage boot and ABS sensor ring**

    Connect the lower suspension arm ball joints and the stabilizer link rod.

    - Attach the ABS wiring harness bracket to the suspension strut.



64. Install the fender splash shields (right-hand side show).

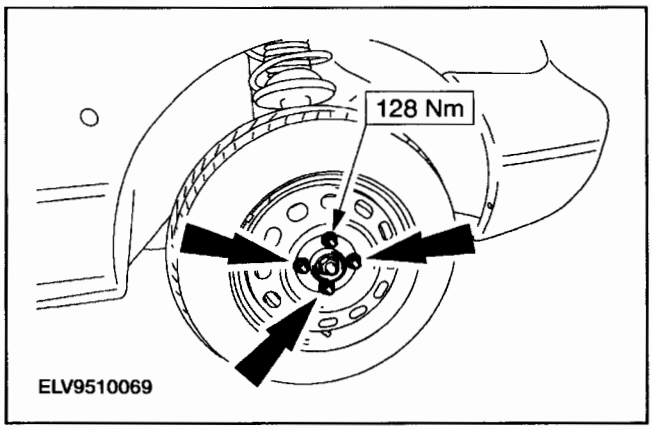


65. Install the radiator splash shield (nine bolts) and attach the bracket on each side (left-hand side shown).

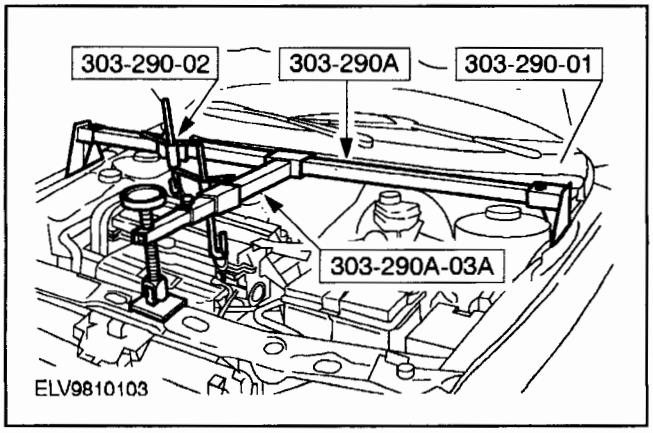
INSTALLATION (Continued)

66. Install the left-hand front wheel.

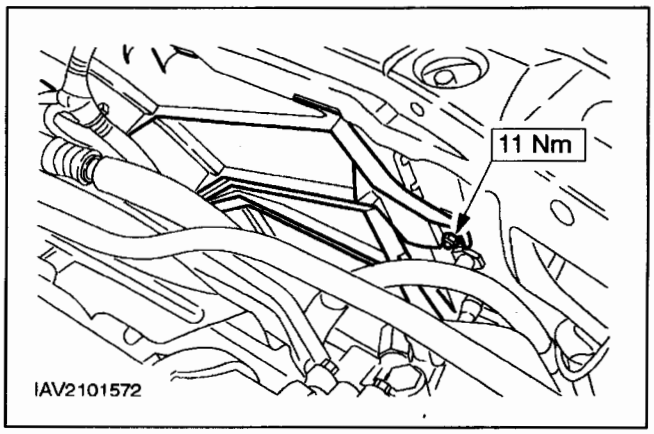
67. Lower the vehicle.



68. Tighten the front wheels (right hand side shown).

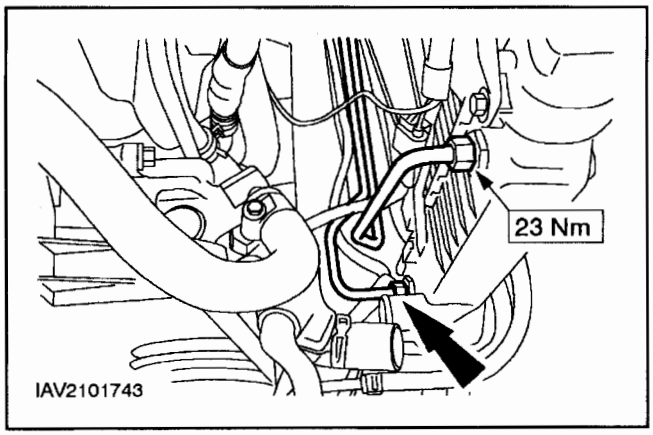


69. Remove the special tools.

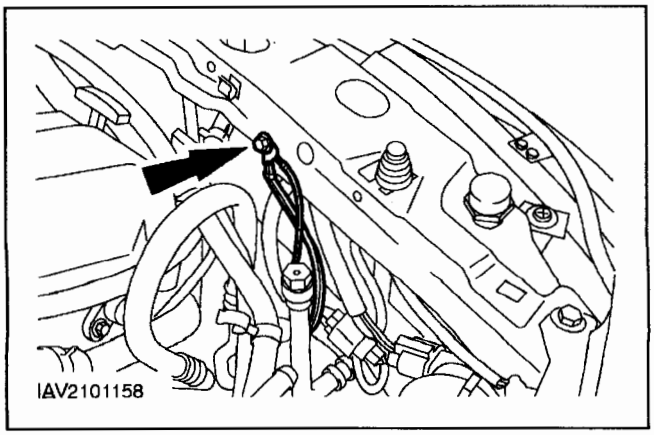


70. Attach the fan motor and the radiator shroud to the radiator (one nut on each side, right-hand side shown).

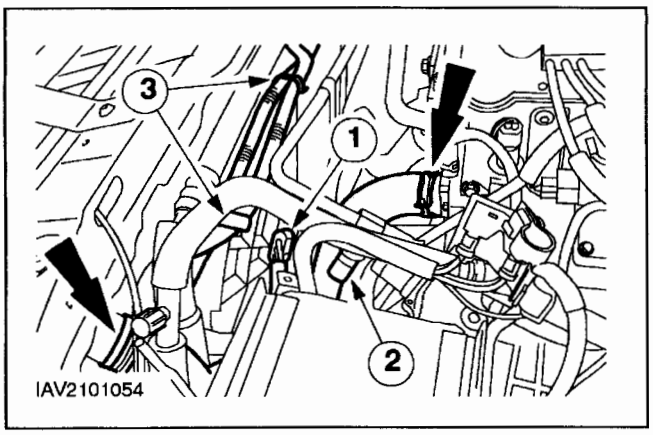
INSTALLATION (Continued)



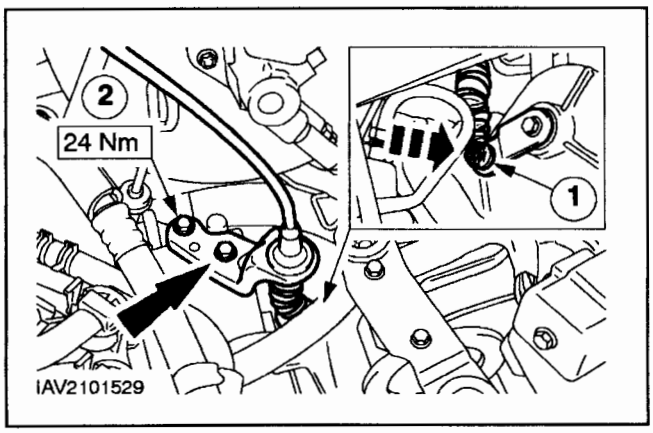
71. Connect the hoses to the transaxle oil cooler.



72. Connect the two ground cables.



73. Connect the connectors and the upper coolant hose.
    1 Connect the fan motor electrical connector.
    2 Connect the power steering pressure (PSP) switch electrical connector.
    3 Clip the wiring harnesses in place.

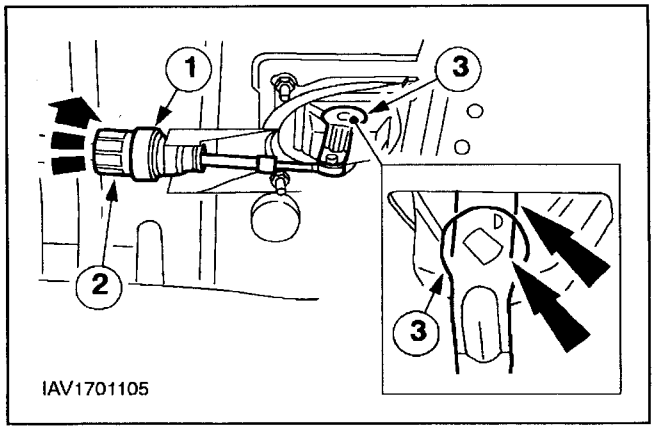


74. Attach the selector cable.
    1 Press the selector cable into the selector lever and clip it in place.
    2 Install the selector cable abutment bracket.

INSTALLATION (Continued)

75. Raise and support the vehicle. For additional information, refer to Section 100-02.

76. Remove the heat shield for the rear exhaust system.



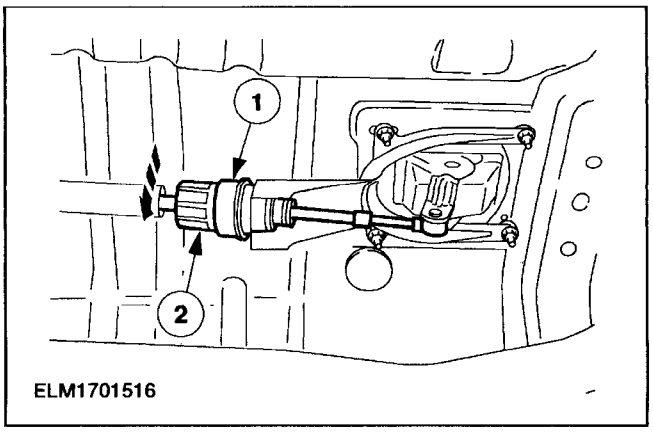
77. **NOTE:** The selector lever has its own engagement system.

    Move the selector lever to ''D'' and check the selector cable adjustment.

    1 Hold the adjusting mechanism still.

    2 Release the selector cable locking mechanism.

    3 The markings on the selector lever must line up.

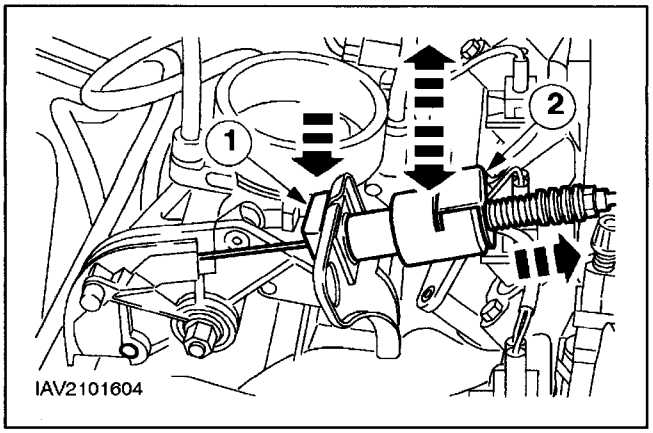


78. Lock the selector cable in place.

    1 Hold the adjusting mechanism still.

    2 Secure the selector cable locking mechanism.

79. Install the heat shield for the rear exhaust system.



80. Connect the throttle cable and adjust it.

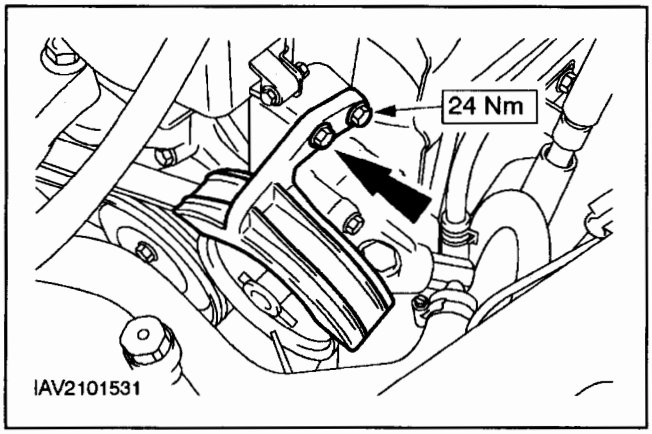
    1 Guide the cable into the abutment bracket and push on the plastic clip.

    - Hook the cable in place.

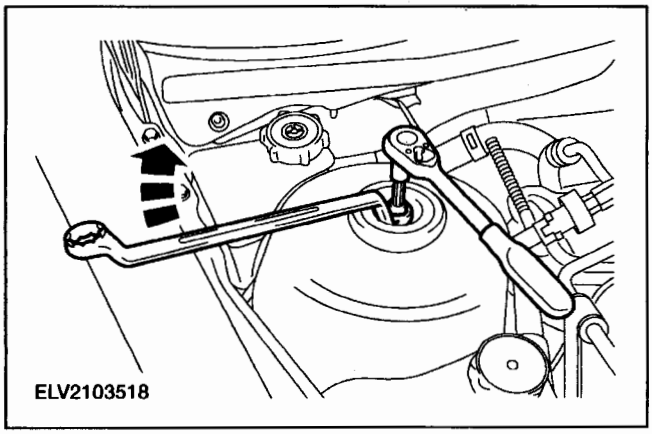
    2 Pull the clip off the throttle cable.

    - Pull the cable out a few notches.
    - Fully depress the accelerator pedal once and slide the clip back on.
    - Check whether the throttle valve opens fully when the accelerator pedal is fully depressed-repeat adjustment if necessary.

INSTALLATION (Continued)

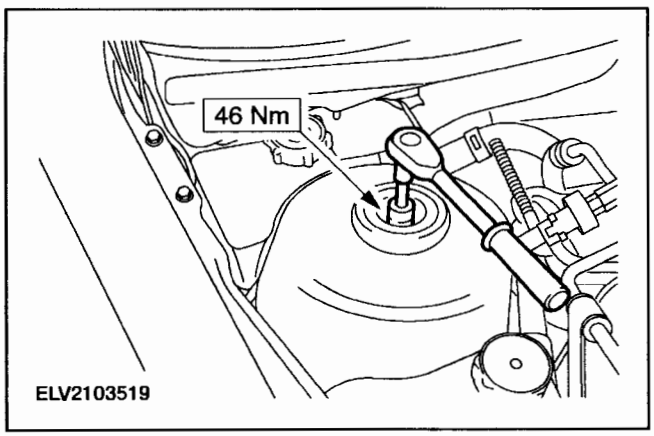


81. Install the upper drive belt cover.

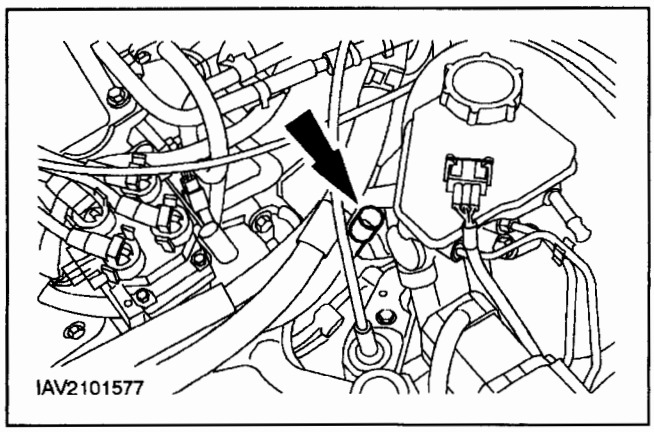


82. **NOTE:** Use an Allen Key to stop the piston rod from turning.

    Tighten the suspension strut locknuts (right-hand side shown).

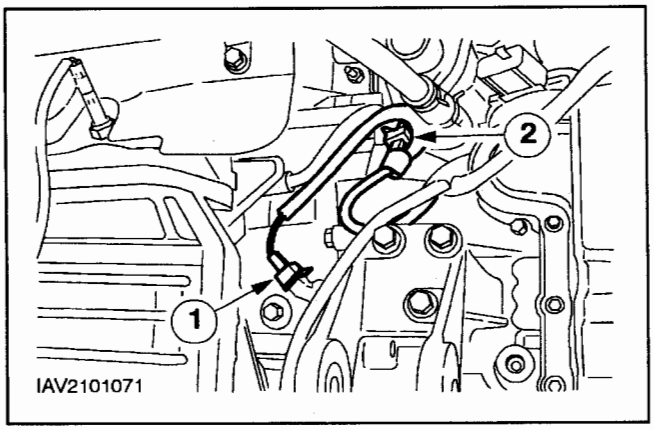


83. Tighten the suspension strut locknut with a torque wrench (right side shown).

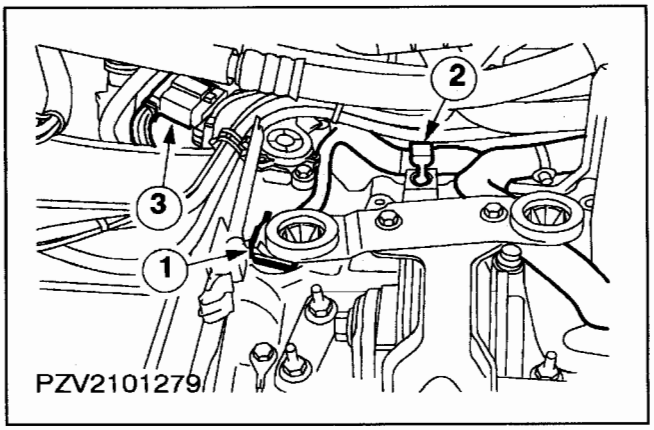


84. Fill the transaxle with the same amount of MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX meeting MERCON® specification that was drained.
    - Insert the oil level indicator.

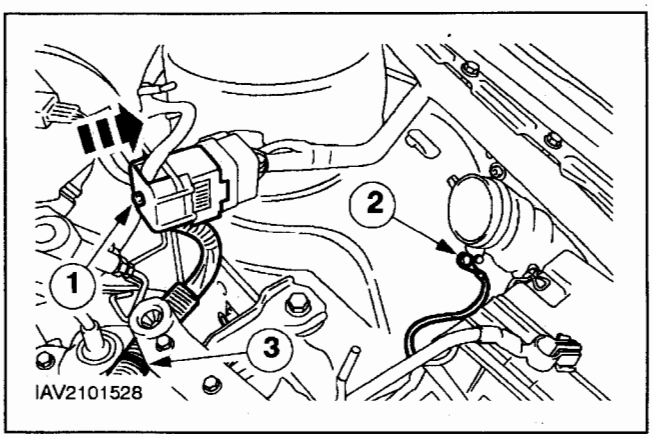
INSTALLATION (Continued)



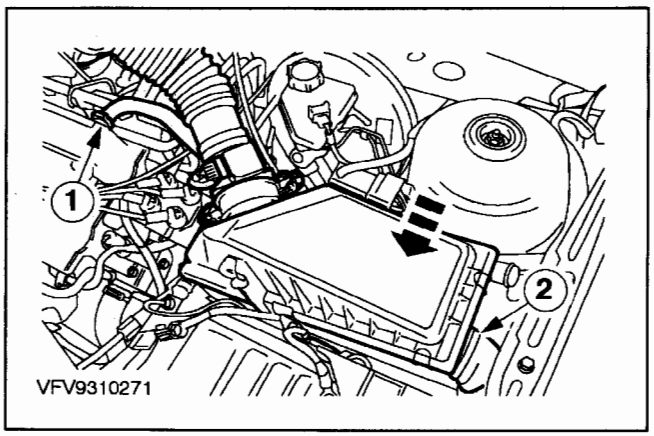
85. Connect the electrical connectors.
    1 CKP sensor
    2 ECT sensor



86. Connect the electrical connectors.
    1 Automatic transaxle control
    2 Clip the wiring harness in position.
    3 TR switch

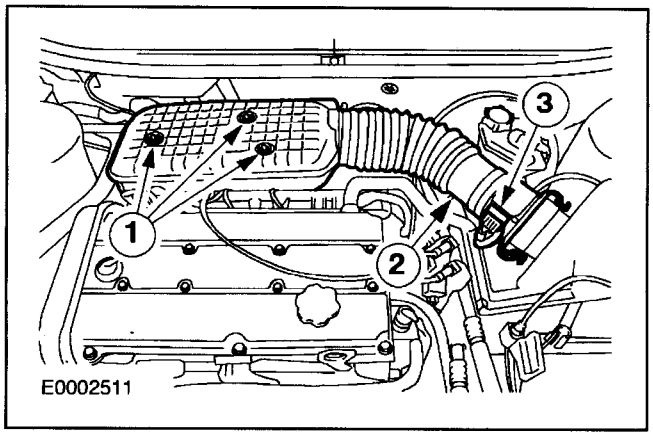


87. Connect the wiring.
    1 Main wiring harness electrical connector
    2 Automatic transaxle ground cable
    3 Secure the wiring harness using cable ties.

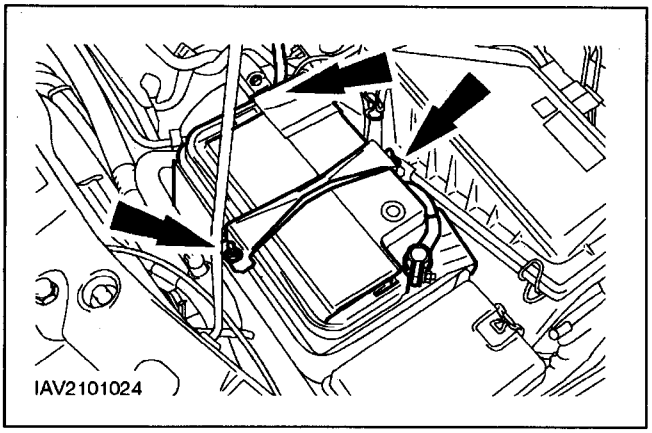


88. Install the air cleaner housing.
    • Insert the air cleaner housing (push fit).
    1 Install the crankcase ventilation hose.
    2 Install the air hose.

INSTALLATION (Continued)



89. Install the air intake tube.
    1 Install one bolt and two nuts.
    2 Connect the IAT sensor electrical connector.
    3 Connect the MAF sensor electrical connector.



90. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.
    Install the battery. For additional information, refer to Section 414-01.

91. Fill the cooling system. For additional information, refer to Section 303-00.

92. Check the routing of the vacuum hoses and wiring and secure them with cable ties.

93. Check the fluid levels after the road test and correct as necessary.

94. Automatic transaxle: check the fluid levels. For additional information, refer to Section 307-01.

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SPECIFICATIONS

Engine Data

Description	2.5L	2.5L SVT
Firing order	1-4-2-5-3-6	1-4-2-5-3-6
Bore mm	81.66	81.66
Stroke	79.5	79.5
Cubic capacity cm ^{3}	2499	2499
Compression ratio	9.7:1	10.25:1
Power output kW /PS	125/ 170	151/ 205
at rpm	6250	6700
Torque	220	229
at rpm	4250	5500
Idle speed (manual transaxle) rpm	725±50	725±50
Max. permissible engine speed, continuous rpm	6700	6700
Max. permissible engine speed, intermittent rpm	6925	6925

General Specifications

Item	Specification
Lubricants	
Super Premium SAE 5W20 Motor Oil XO-5W20-QSP	WSS-M2C153-H
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®
Coolant fluid	Refer to Section 303-03.

(Continued)

General Specifications

Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Gasket Maker F8AZ-19B508-AB	WSK-M2G348-A5
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
High Temperature Grease	ESD-M1C220-A
Capacities	
Engine oil, inclusive filter change	5.5
Engine oil, exclusive filter change	5.0
Coolant (manual transaxle)	9.5
Coolant (automatic transaxle)	9.7
Transmission fluid (CD4E with oil cooler), total capacity	10.0 [a]
Transmission fluid level (CD4E with oil cooler)	Mark on dipstick
Transmission fluid (MTX 75), total capacity	2.6

a New transmissions are already pre-filled with 3.5 liters.

Main Bearing Journal/Crankshaft and Cylinder Block Code Example Chart

Corresponding main bearing journal		1	2		3	4	
Crankshaft code (11 digits)	*	70	80	*	80	72	*
Cylinder block code (11 digits)	*	08	09	*	07	10	*
Select-Fit Main Bearing Grade	—	3	2	—	2	3	—

Select-Fit Main Bearing Grade Chart 1

Crank-shaft Code	Cylinder Block Code											
	98	99	00	01	02	03	04	05	06	07	08	09
91	1	1	1	1	1	1	1	1	1	1	1	1
90	1	1	1	1	1	1	1	1	1	1	1	1
89	1	1	1	1	1	1	1	1	1	1	1	1
88	1	1	1	1	1	1	1	1	1	1	1	1
87	1	1	1	1	1	1	1	1	1	1	1	1

(Continued)

SPECIFICATIONS (Continued)

Select-Fit Main Bearing Grade Chart 1

Crankshaft Code	Cylinder Block Code											
	98	99	00	01	02	03	04	05	06	07	08	09
86	1	1	1	1	1	1	1	1	1	1	1	1
85	1	1	1	1	1	1	1	1	1	1	1	2
84	1	1	1	1	1	1	1	1	1	1	2	2
83	1	1	1	1	1	1	1	1	1	2	2	2
82	1	1	1	1	1	1	1	1	2	2	2	2
81	1	1	1	1	1	1	1	2	2	2	2	2
80	1	1	1	1	1	1	2	2	2	2	2	2
79	1	1	1	1	1	2	2	2	2	2	2	2
78	1	1	1	1	2	2	2	2	2	2	2	2
77	1	1	1	2	2	2	2	2	2	2	2	2
76	1	1	2	2	2	2	2	2	2	2	2	2
75	1	2	2	2	2	2	2	2	2	2	2	2
74	2	2	2	2	2	2	2	2	2	2	2	2
73	2	2	2	2	2	2	2	2	2	2	2	2
72	2	2	2	2	2	2	2	2	2	2	2	3
71	2	2	2	2	2	2	2	2	2	2	3	3
70	2	2	2	2	2	2	2	2	2	3	3	3
69	2	2	2	2	2	2	2	2	3	3	3	3
68	2	2	2	2	2	2	2	3	3	3	3	3

Select-Fit Main Bearing Grade Chart 2

Crankshaft Code	Cylinder Block Code											
	10	11	12	13	14	15	16	17	18	19	20	21
91	1	1	1	1	1	2	2	2	2	2	2	2
90	1	1	1	1	2	2	2	2	2	2	2	2
89	1	1	1	2	2	2	2	2	2	2	2	2
88	1	1	2	2	2	2	2	2	2	2	2	2
87	1	2	2	2	2	2	2	2	2	2	2	2
86	2	2	2	2	2	2	2	2	2	2	2	2
85	2	2	2	2	2	2	2	2	2	2	2	2
84	2	2	2	2	2	2	2	2	2	2	2	3
83	2	2	2	2	2	2	2	2	2	2	3	3
82	2	2	2	2	2	2	2	2	2	3	3	3
81	2	2	2	2	2	2	2	2	3	3	3	3
80	2	2	2	2	2	2	2	3	3	3	3	3
79	2	2	2	2	2	2	3	3	3	3	3	3
78	2	2	2	2	2	3	3	3	3	3	3	3
77	2	2	2	2	3	3	3	3	3	3	3	3

(Continued)

SPECIFICATIONS (Continued)

Select-Fit Main Bearing Grade Chart 2

Crankshaft Code	Cylinder Block Code											
	10	11	12	13	14	15	16	17	18	19	20	21
76	2	2	2	3	3	3	3	3	3	3	3	3
75	2	2	3	3	3	3	3	3	3	3	3	3
74	2	3	3	3	3	3	3	3	3	3	3	3
73	3	3	3	3	3	3	3	3	3	3	3	3
72	3	3	3	3	3	3	3	3	3	3	3	3
71	3	3	3	3	3	3	3	3	3	3	3	3
70	3	3	3	3	3	3	3	3	3	3	3	3
69	3	3	3	3	3	3	3	3	3	3	3	3
68	3	3	3	3	3	3	3	3	3	3	3	3

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
A/C compressor bolts	25	18	—
Accelerator cable bracket to throttle body nuts	3.5	—	30
Accelerator cable bracket to throttle body bolts	25	18	—
Air cleaner bracket	25	18	—
Battery ground cable to engine nut	25	18	—
Battery positive cable bolt	10	—	89
Bulkhead to cylinder block (Stage 1, bolts 1-8)	25	18	—
Bulkhead to cylinder block (Stage 2, bolts 9-16)	40	30	—
Bulkhead to cylinder block (Stage 3, bolts 1-16)[c]	—	—	—
Bulkhead to cylinder block (Stage 4, bolts 17-22)	25	18	—
Brake caliper bolts	28	21	—
Camshaft cap bolts	40	30	—
Camshaft position sensor nuts	10	—	89
Camshaft rear oil seal retainer bolts	10	—	89
Connecting rod bolts [a]	—	—	—
Connecting shaft bracket to cylinder block	47	35	—
Condenser core to radiator bolt	11	8	—

(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Coolant crossover tube to cylinder head nuts	10	—	89
CMP-Sensor	10	—	89
CKP-Sensor	10	—	89
Crankcase ventilation tube nut	6	—	53
Crankshaft pulley bolt (Stage 1)	120	89	—
Crankshaft pulley bolt (Stage 2) [b]	—	—	—
Crankshaft pulley bolt (Stage 3)	50	37	—
Crankshaft pulley bolt (Stage 4) [c]	—	—	—
Crankcase ventilation tube nut	10	—	89
Crankcase ventilation tube nut[a]	—	—	—
Cylinder head (Stage 1)	40	30	—
Cylinder head (Stage 2)[c]	—	—	—
Cylinder head (Stage 3) [d]	—	—	—
Cylinder head (Stage 4)	40	30	—
Cylinder head (Stage 5)[c]	—	—	—
Cylinder head (Stage 6)[c]	—	—	—
Dual converter y-pipe to cylinder block front	40	30	—
Dual converter Y-pipe to cylinder block back	35	26	—
Exhaust pipe to three way catalytic converter (TWC)	40	30	—

(Continued)

SPECIFICATIONS (Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
EGR back pressure transducer mounting bracket bolt and stud	10	—	89
EGR back pressure transducer mounting bracket bolt and stud	25	18	—
EGR back pressure transducer mounting bracket bolt and stud	40	30	—
EGR back pressure transducer mounting bracket bolt and stud	a	—	—
EGR valve	25	18	—
Engine bulkhead housing to cylinder block[a]	—	—	—
Engine front cover bolts and studs	25	18	—
Engine lifting eyes bolt and stud	112	83	—
Engine to transaxle	40	30	—
Exhaust manifold retaining nuts	20	15	—
Flywheel to crankshaft	80	59	—
Front axle drive halfshaft outer bearing bracket	25	18	—
Front engine support insulator	83	61	—
Front engine support bracket nuts[a]	—	—	—
Front stabilizer bar link to front stabilizer bar nut	48	35	—
Front sub-frame to body bolts	130	96	—
Front wheel knuckles to front suspension lower arm bolt	54	40	—
Generator bolt	47	35	—
Generator brace bolts	25	18	—
Generator mounting bracket bolts	25	18	—
Halfshaft bearing bracket bolts	27	20	—
Halfshaft hub nut	290	214	—
Heated oxygen sensors(HO2S) to exhaust manifolds	41	30	—
Ground cable bolt	25	18	—
Idle air control (IAC) valve bolts	6	—	53

(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Ignition coil bolts	6	—	53
Ignition coil ground cable nut	6	—	53
Intake manifold runner control (IMRC) box to valve cover bolts	10	—	89
Intermediate shaft nuts	27	20	—
Intermediate shaft bearing bracket	47	35	—
IMRC actuator bolts	10	—	89
Lifting eye bolt	112	83	—
LH engine support insulator through bolt	120	89	—
LH engine support insulator to front sub-frame bolts[a]	—	—	—
Lower ball joint bolts	83	61	—
Lower intake manifold bolts	10	—	89
Lower radiator hose tube retaining nuts	6	—	53
Oil bypass filter[a]	—	—	—
Oil cooler fitting	57	42	—
Oil filter mounting insert to cylinder block	34	25	—
Oil level indicator tube bolt	10	—	89
Oil pan to transaxle housing bolts	40	30	—
Oil pan baffle bolts (Stage 1)	5	—	44
Oil pan baffle bolts (Stage 2) [e]	—	—	—
Oil pan drain plug	26	19	—
Oil pan retaining bolts	25	18	—
Oil pressure sensor	14	10	—
Oil pressure sensor adapter	25	18	—
Oil pump screen cover and tube bolts (Stage 1)	5	—	44
Oil pump screen cover and tube bolts (Stage 2)[e]	—	—	—
Oil pump bracket nut (Stage 1)	5	—	44
Oil pump bracket nut (Stage 2)[c]	—	—	—

(Continued)

SPECIFICATIONS (Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Oil pump to cylinder block bolts	10	—	89
Oil separator bolts	10	—	89
Power steering bracket bolts	47	35	—
Power steering pump bolts	25	18	—
Power steering pump pulley bolts	25	18	—
Power steering pump stud nuts	10	—	89
Powertrain alignment gauge to front sub-frame and engine	27	20	—
Radiator support to front sub-frame bolts	9	—	80
Radiator coolant expansion tank bolts	10	—	89
RH engine support insulator through bolt	120	89	—
RH engine support insulator to front sub-frame bolts	48	35	—
Selector cable bracket bolt	24	18	—
Shift cable and bracket to transaxle bolts	23	17	—
Shift rod to transaxle bolt	23	17	—
Spark plugs	15	11	—
Stabilizer bar to transaxle nut	55	41	—
Starter motor upper electrical connector	12	9	—
Starter motor lower electrical connector	5	—	44
Starter motor bracket bolts	25	18	—

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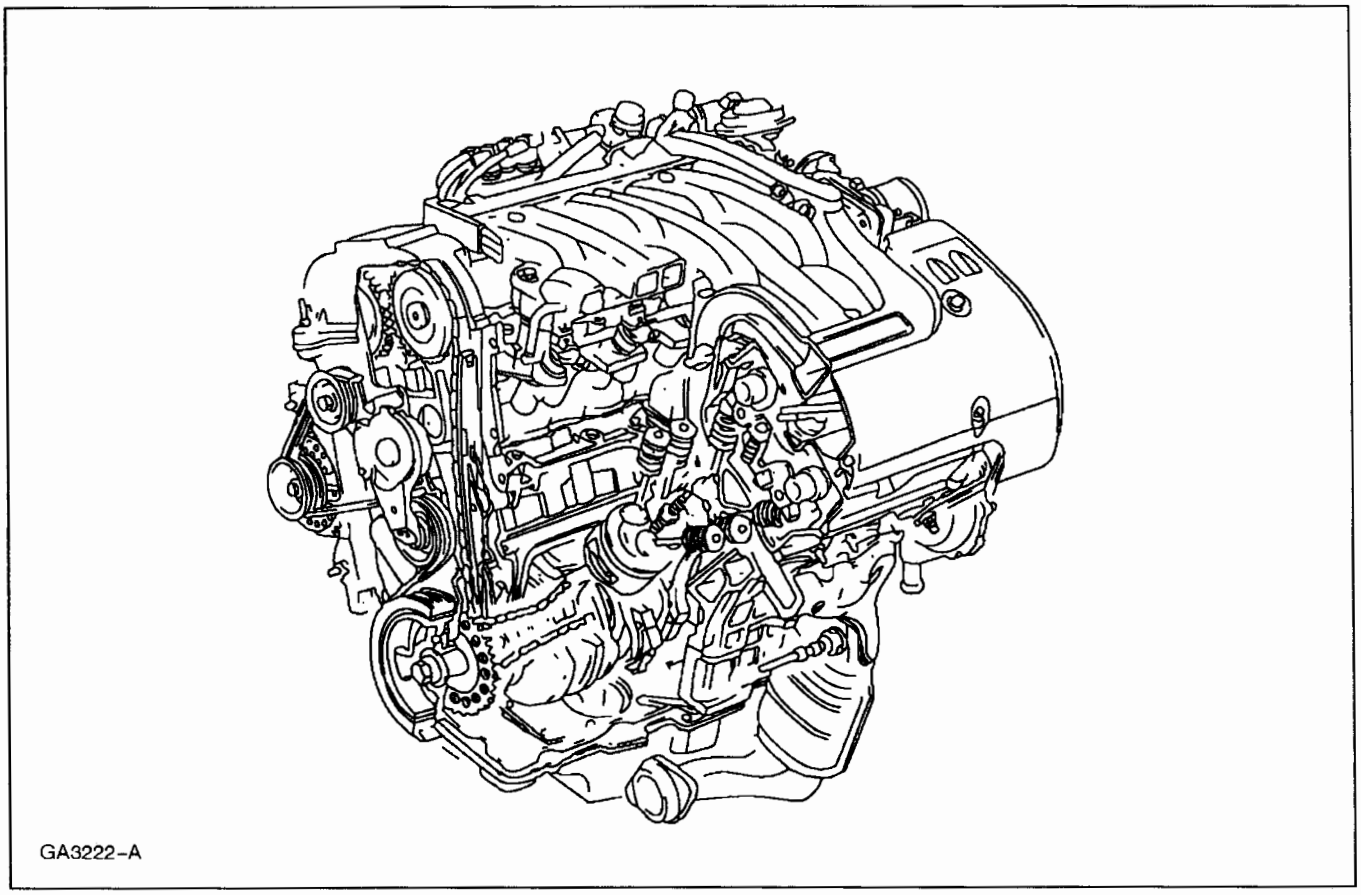
Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Steering gear to sub-frame bolts	130	96	—
Steering shaft and joint bolt	24	18	—
Throttle body bolts and studs	6	—	53
Tie-rod end stud nuts	26	19	—
Timing chain guide bolts	25	18	—
Timing chain tensioner bolts	25	18	—
Torque converter to flywheel nuts	36	27	—
Transmission oil cooler line nuts	23	17	—
Transmission flange bolts	48	35	—
Upper intake manifold bolts	10	—	89
Valve cover bolts and studs	10	—	89
Water bypass tube bolt and stud	10	—	89
Water pump bolts (Stage 1)	10	—	89
Water pump bolts (Stage 2)[c]	—	—	—
Water pump to housing bolts	24	18	—
Wheel nuts	128	94	—
Wiring harness shield	6	—	53

a Refer to the procedure in this section
b Back off the bolt one full turn
c 90 degrees
d Loosen 360 degrees (one full turn) in reverse order
e 45 degrees

DESCRIPTION AND OPERATION

Engine



The 2.5L Duratec engine is of all aluminium construction with a two piece cylinder block made by a special casting process.

The 2.5 liter 24 valve V6 engine has an electrically controlled lower intake manifold switching system to optimize torque and power output.

The four overhead camshafts are driven by two timing chains. The engine incorporates the latest engineering: electronic engine management with Distributorless Ignition (EI) System, sequential multiport electronic returnless fuel injection, electronically controlled exhaust gas recirculation and two catalytic converters in the exhaust manifolds.

The Cougar SVT includes the following power upgrades:

- Higher power output.
- Extruded honed primary and secondary cylinder head intake ports.
- Extruded honed upper intake manifolds.
- Larger 60 mm throttle body.
- New intake and exhaust camshafts with revised valve timing.
- Compression ratio is increased.
- Low restriction air inlet using a conical filter element.
- Large diameter low restriction exhaust system with dual outlets.
- Light weight flywheel 1.8 lbs lighter than the base flywheel.

SPECIFICATIONS (Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Oil pump to cylinder block bolts	10	—	89
Oil separator bolts	10	—	89
Power steering bracket bolts	47	35	—
Power steering pump bolts	25	18	—
Power steering pump pulley bolts	25	18	—
Power steering pump stud nuts	10	—	89
Powertrain alignment gauge to front sub-frame and engine	27	20	—
Radiator support to front sub-frame bolts	9	—	80
Radiator coolant expansion tank bolts	10	—	89
RH engine support insulator through bolt	120	89	—
RH engine support insulator to front sub-frame bolts	48	35	—
Selector cable bracket bolt	24	18	—
Shift cable and bracket to transaxle bolts	23	17	—
Shift rod to transaxle bolt	23	17	—
Spark plugs	15	11	—
Stabilizer bar to transaxle nut	55	41	—
Starter motor upper electrical connector	12	9	—
Starter motor lower electrical connector	5	—	44
Starter motor bracket bolts	25	18	—

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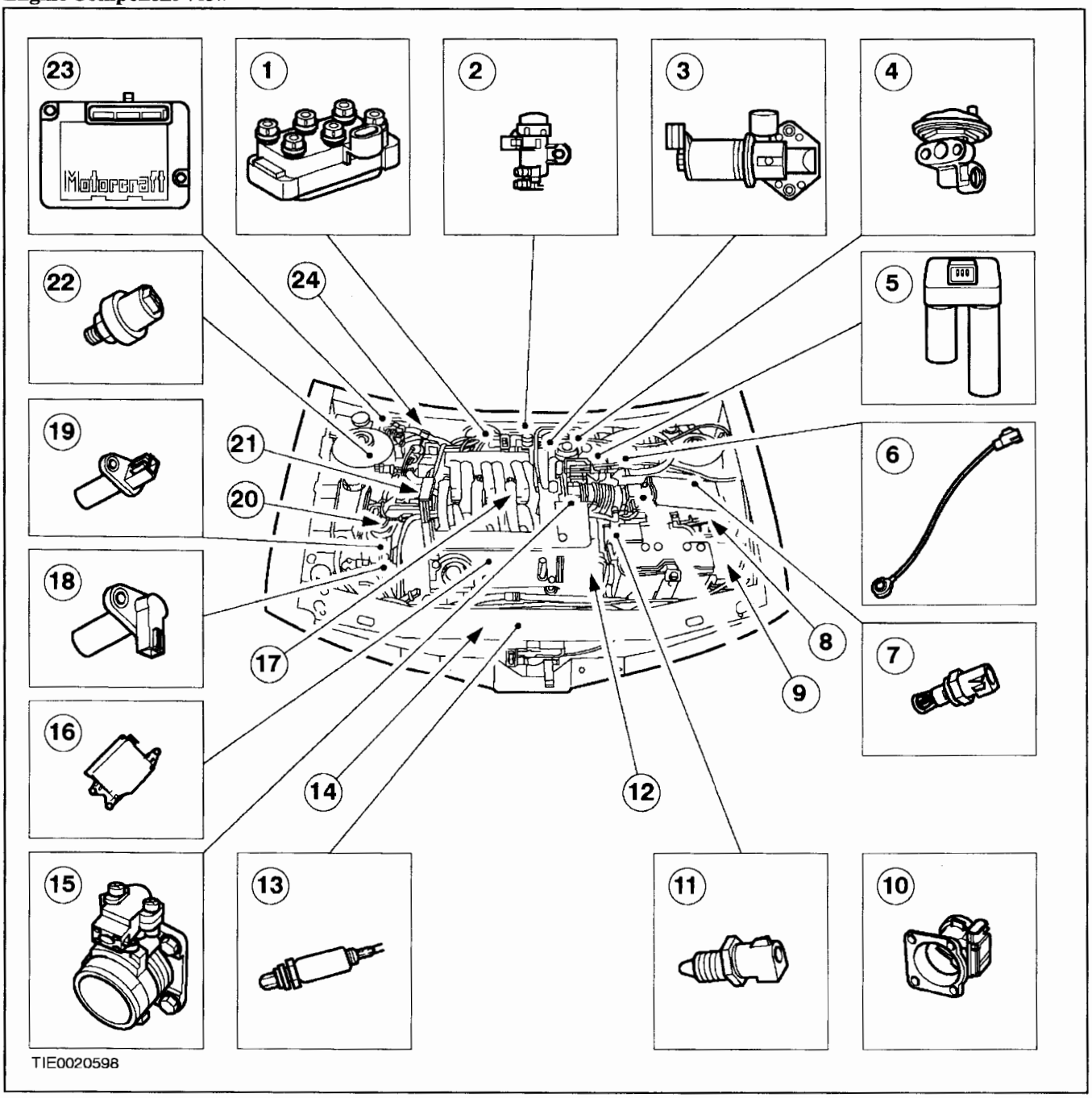
Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Steering gear to sub-frame bolts	130	96	—
Steering shaft and joint bolt	24	18	—
Throttle body bolts and studs	6	—	53
Tie-rod end stud nuts	26	19	—
Timing chain guide bolts	25	18	—
Timing chain tensioner bolts	25	18	—
Torque converter to flywheel nuts	36	27	—
Transmission oil cooler line nuts	23	17	—
Transmission flange bolts	48	35	—
Upper intake manifold bolts	10	—	89
Valve cover bolts and studs	10	—	89
Water bypass tube bolt and stud	10	—	89
Water pump bolts (Stage 1)	10	—	89
Water pump bolts (Stage 2)[e]	—	—	—
Water pump to housing bolts	24	18	—
Wheel nuts	128	94	—
Wiring harness shield	6	—	53

a Refer to the procedure in this section
b Back off the bolt one full turn
c 90 degrees
d Loosen 360 degrees (one full turn) in reverse order
e 45 degrees

DESCRIPTION AND OPERATION (Continued)

Engine Component View



TIE0020598

Item	Part Number	Description
1	—	EI system ignition coil
2	—	EGR vacuum regulator solenoid
3	—	Idle air control (IAC) valve
4	—	Exhaust gas recirculation (EGR) valve
5	—	Differential pressure feedback EGR sensor, mounted on the EGR tube

(Continued)

Item	Part Number	Description
6	—	Knock sensor
7	—	Intake air temperature (IAT) sensor
8	—	Air cleaner (ACL)
9	—	Battery junction box (BJB)
10	—	Mass air flow (MAF) sensor

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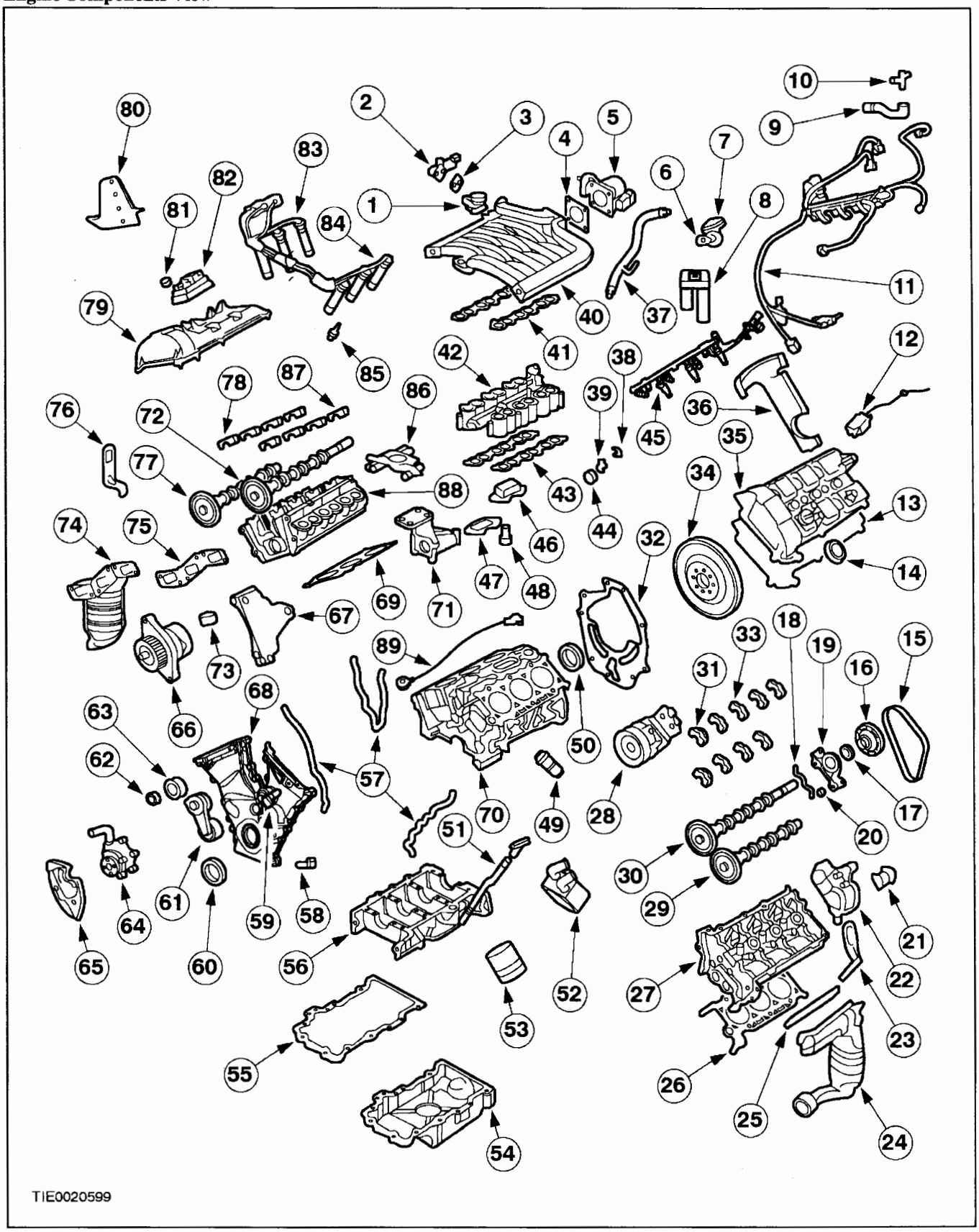
DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
11	—	Engine coolant temperature (ECT) sensor in engine coolant bypass tube between cylinder heads
12	—	Water pump pulley shield
13	—	One pre-catalyst for each cylinder bank (one unit in each exhaust manifold)
14	—	One heated oxygen sensor (HO2S) for each cylinder bank, in exhaust manifold
15	—	Throttle body and throttle position (TP) sensor
16	—	Electric intake manifold runner control (IMRC) actuator
17	—	Upper intake manifold
18	—	Camshaft position (CMP) sensor, on engine front cover (exhaust camshaft, left-hand cylinder head)
19	—	Crankshaft position (CKP) sensor, on lower engine front cover
20	—	Hydraulic engine mount
21	—	Engine mounting bracket
22	—	Power steering pressure (PSP) switch
23	—	Powertrain control module (PCM) EEC V
24	—	Service connector (octane adjust)

(Continued)

DESCRIPTION AND OPERATION (Continued)

Engine Components View



DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
1	—	EGR vacuum regulator solenoid
2	—	Idle air control (IAC) valve
3	—	Idle air control (IAC) gasket
4	—	Throttle body gasket
5	—	Throttle body
6	—	EGR valve gasket
7	—	EGR valve
8	—	Differential pressure feedback EGR (DPFE) located on the EGR tube
9	—	Positive crankcase ventilation PCV hose
10	—	Positive crankcase ventilation (PCV) valve
11	—	Fuel charging wiring
12	—	Electric IMRC actuator
13	—	Valve cover gasket (LH)
14	—	Oil filler cap
15	—	Water pump drive belt
16	—	Water pump drive pulley
17	—	Camshaft rear oil seal
18	—	Camshaft oil seal retainer gasket
19	—	Camshaft rear oil seal retainer
20	—	Alignment dowel (2 required)
21	—	Water pump drive belt tensioner
22	—	Water pump
23	—	Engine lifting eye (LH)
24	—	Exhaust manifold (LH)
25	—	Exhaust manifold gasket (LH)
26	—	Cylinder head gasket (LH)
27	—	Cylinder head (LH)
28	—	A/C compressor
29	—	Exhaust camshaft (LH)
30	—	Intake camshaft (LH)
31	—	Camshaft journal thrust cap (LH) (2 required)
32	—	Adaptor plate
33	—	Camshaft journal cap (LH) (7 required)
34	—	Flywheel
35	—	Valve cover (LH)
36	—	Water pump pulley shield

(Continued)

Item	Part Number	Description
37	—	EGR valve to exhaust manifold tube
38	—	Fuel injector retainer (6 required)
39	—	Fuel injector (6 required)
40	—	Intake manifold upper
41	—	Intake manifold upper gasket, (2 required)
42	—	Intake manifold lower
43	—	Intake manifold lower gasket, (2 required)
44	—	Fuel injector seal (6 required)
45	—	Fuel rail
46	—	Oil separator
47	—	Oil separator to cylinder block gasket
48	—	Engine coolant tube
49	—	Oil cooler insert
50	—	Crankshaft rear oil seal
51	—	Oil level indicator tube
52	—	High output applications only
53	—	Oil filter
54	—	Oil pan
55	—	Oil pan gasket
56	—	Lower cylinder block
57	—	Engine front cover gasket
58	—	Crankshaft position(CKP) sensor
59	—	Camshaft position(CMP) sensor
60	—	Crankshaft front oil seal
61	—	Accessory drive belt tensioner
62	—	Dust cover
63	—	Drive belt idler pulley
64	—	Power steering pump
65	—	Power steering pump brace
66	—	Generator
67	—	Generator mounting bracket
68	—	Engine front cover
69	—	Cylinder head gasket (RH)
70	—	Cylinder block
71	—	Engine mounting bracket
72	—	Intake camshaft (RH)
73	—	Generator brace

(Continued)

DESCRIPTION AND OPERATION (Continued)

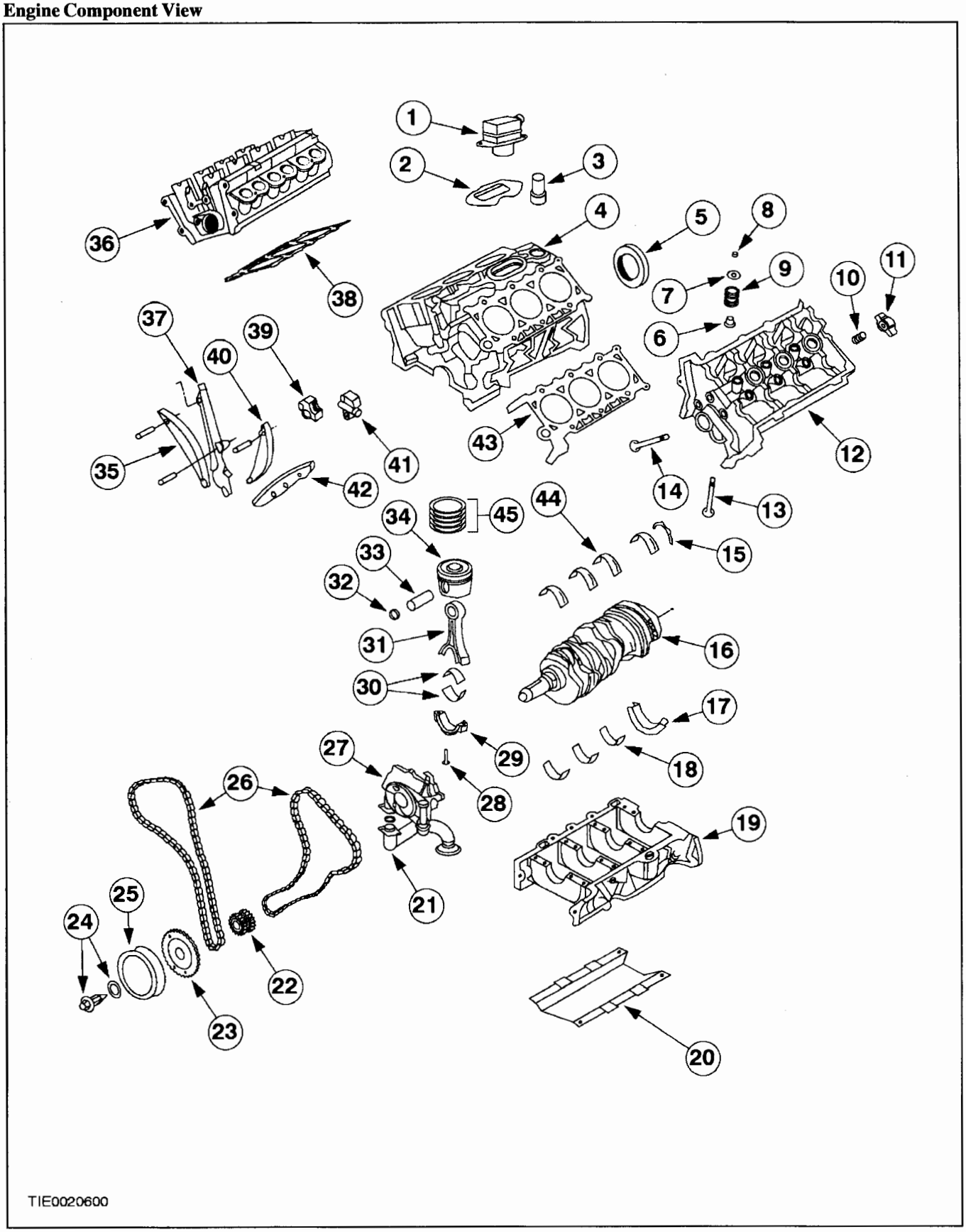
Item	Part Number	Description
74	—	Exhaust manifold (RH)
75	—	Exhaust manifold gasket (RH)
76	—	Engine lifting eye (RH)
77	—	Exhaust camshaft (RH)
78	—	Camshaft journal thrust cap (RH) (2 required)
79	—	Valve cover (RH)
80	—	Inline connector bracket
81	—	Radio ignition Interference capacitor

(Continued)

Item	Part Number	Description
82	—	Ignition coil
83	—	Ignition wire (RH)
84	—	Ignition wire (LH)
85	—	Spark plug (6 required)
86	—	Water bypass tube
87	—	Camshaft journal cap (6 required)
88	—	Cylinder head (RH)
89	—	Knock sensor

DESCRIPTION AND OPERATION (Continued)

Engine Component View



DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
1	—	Oil separator
2	—	Oil separator to cylinder block gasket
3	—	Engine coolant tube
4	—	Cylinder block
5	—	Crankshaft rear oil seal
6	—	Valve stem oil seal (12 required each side)
7	—	Valve collets (12 required each side)
8	—	Valve spring retainer key (24 required each side)
9	—	Valve spring (12 required each side)
10	—	Valve tappet (12 required each side)
11	—	Roller finger follower
12	—	Cylinder head (LH)
13	—	Exhaust valve (6 required each side)
14	—	Intake valve (6 required each side)
15	—	Crankshaft thrust washer (1 required)
16	—	Crankshaft
17	—	Lower crankshaft thrust main bearing (1 required)
18	—	Lower crankshaft main bearing (3 required)
19	—	Lower cylinder block
20	—	Oil pan baffle
21	—	Oil pump screen cover and tube
22	—	Crankshaft timing chain sprocket
23	—	Crankshaft position sensor pulse wheel
24	—	Crankshaft bolt and washer
25	—	Crankshaft pulley
26	—	Timing chain (2required)
27	—	Oil pump
28	—	Connecting rod bolt (12 required)
29	—	Connecting rod cap (6 required)
30	—	Connecting rod bearing (12 required)
31	—	Connecting rod (6 required)
32	—	Piston pin retainer (12 required)
33	—	Piston pin (6 required)
34	—	Piston (6 required)
35	—	Timing chain tensioner arm (RH)
36	—	Cylinder head (RH)
37	—	Timing chain guide (RH)
38	—	Cylinder head gasket (RH)
39	—	Timing chain tensioner (RH)
40	—	Timing chain tensioner arm (LH)
41	—	Timing chain tensioner (LH)
42	—	Timing chain guide (LH)
43	—	Cylinder head gasket (LH)
44	—	Upper crankshaft main bearing (4 required)
45	—	Piston ring set (6 required)

(Continued)

DIAGNOSIS AND TESTING

Engine

Refer to Section 303-00.

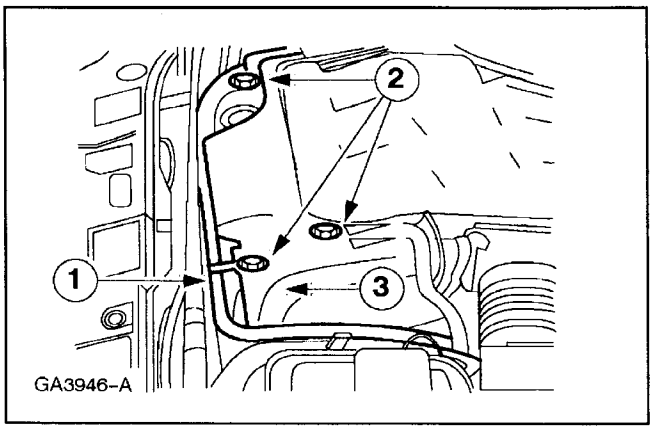
IN-VEHICLE REPAIR

Intake Manifold — Upper

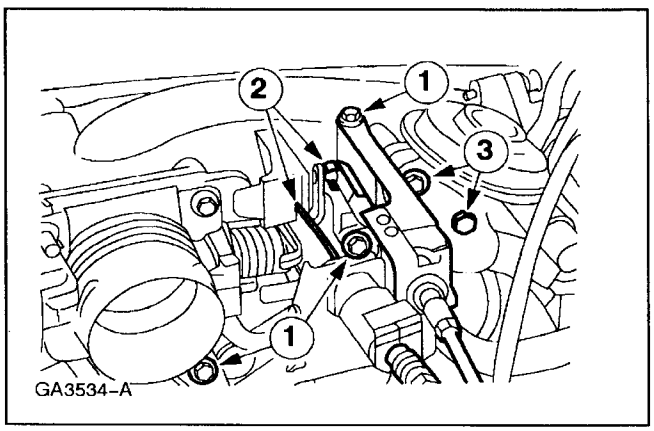
Removal

1. Remove the air cleaner (ACL). For additional information, refer to Section 303-12B.

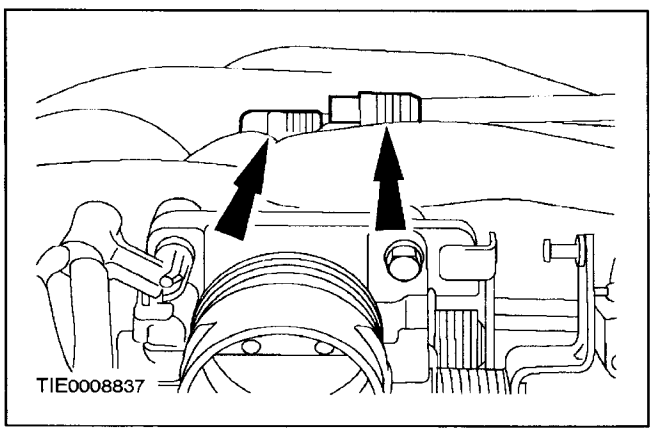
2. Disconnect the battery ground cable.



3. Remove the water pump pulley shield.
   1 Detach the coolant hose from the clip.
   2 Remove the bolts.
   3 Remove the cover.

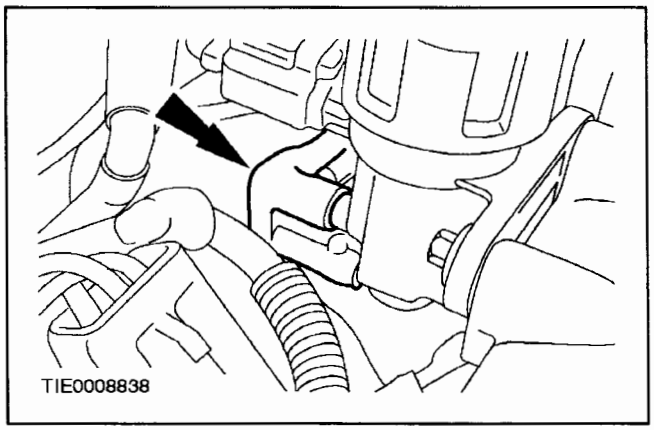


4. Remove the accelerator bracket and the exhaust gas recirculation (EGR) valve from the upper intake manifold.
   1 Remove the bolts.
   2 Disconnect accelerator and speed control cables from the throttle body and position to one side.
   3 Remove the bolts and discard the gasket.

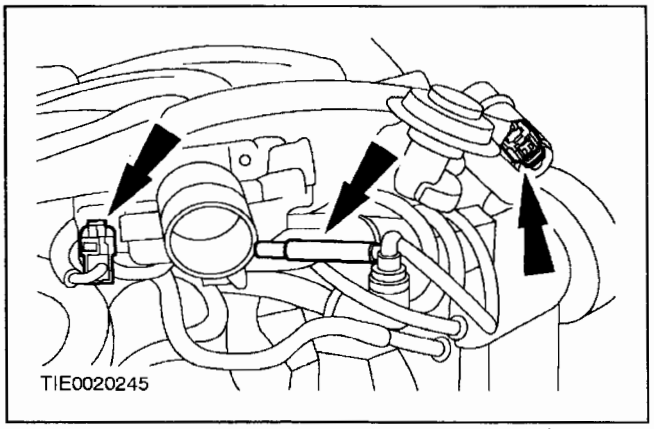


5. Depress the retainer and disconnect the two vacuum supply lines from the upper intake.

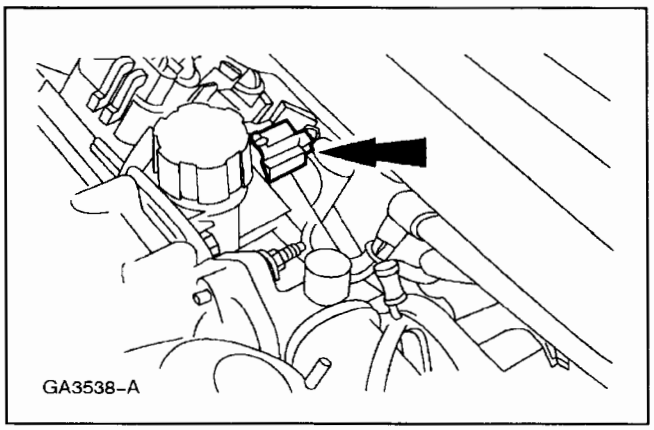
IN-VEHICLE REPAIR (Continued)



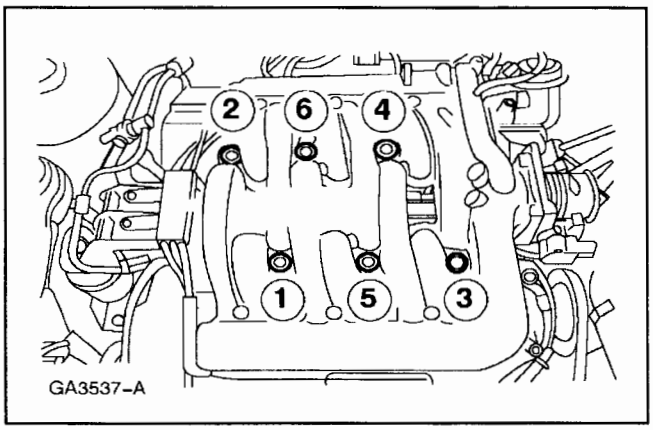
6. Disconnect the EGR vacuum regulator hoses.



7. Disconnect the positive crankcase ventilation (PCV) hose and electrical connectors.
   - Throttle position (TP) sensor electrical connector.
   - PCV hose.
   - Idle air control (IAC) valve electrical connector.



8. Disconnect the EGR vacuum regulator solenoid electrical connector.

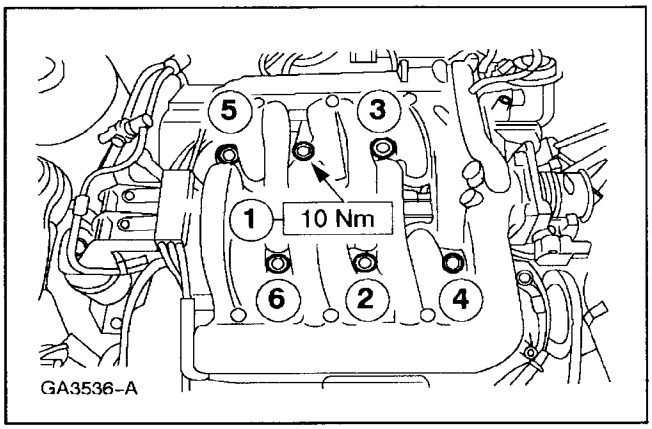


9. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the upper intake manifold and discard the gaskets.

IN-VEHICLE REPAIR (Continued)

Installation

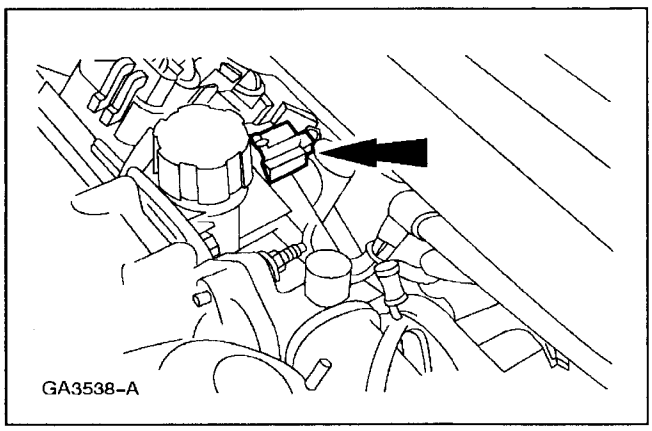


1. **NOTE:** Verify the insulating bushings are on the bolts of the upper intake manifold.

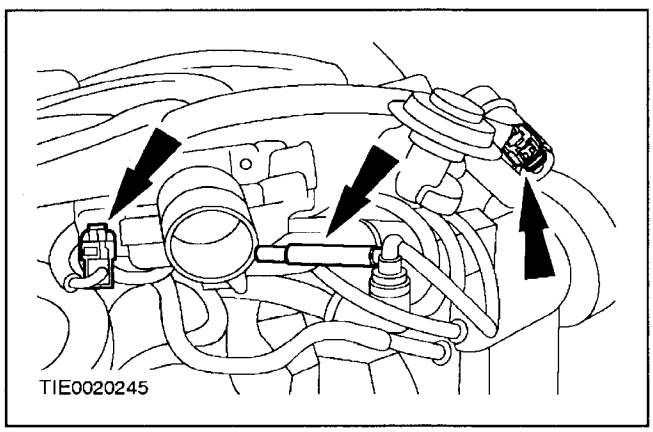
   NOTE: New gaskets must be used, position the gasket on the lower intake manifold.

   NOTE: Tighten the bolts in the indicated sequence.

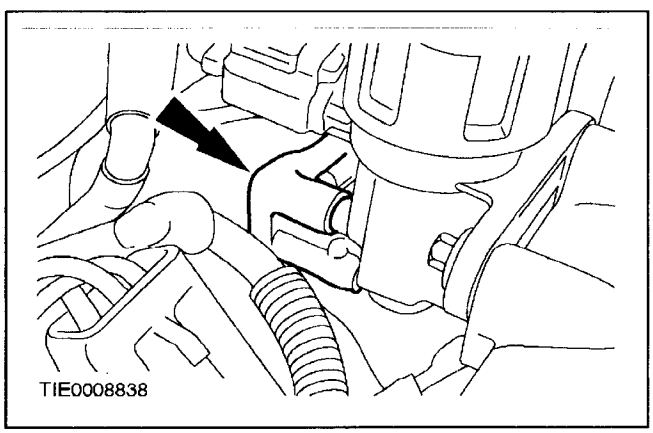
   Position the upper intake manifold and tighten the bolts.



2. Connect the EGR vacuum regulator solenoid electrical connector.

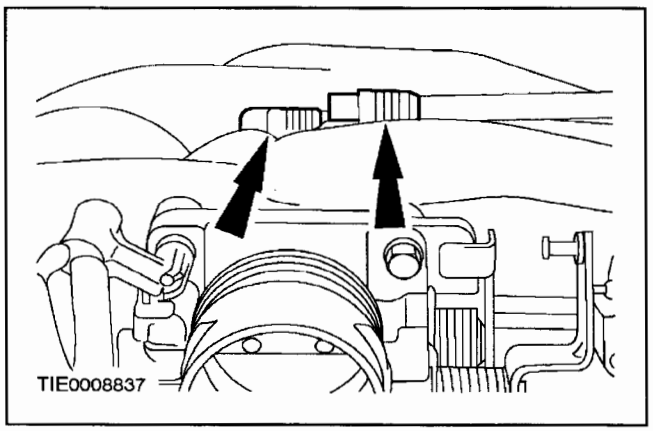


3. Connect the PCV hose and electrical connectors.
   - TP sensor electrical connector.
   - PCV hose.
   - IAC valve electrical connector.

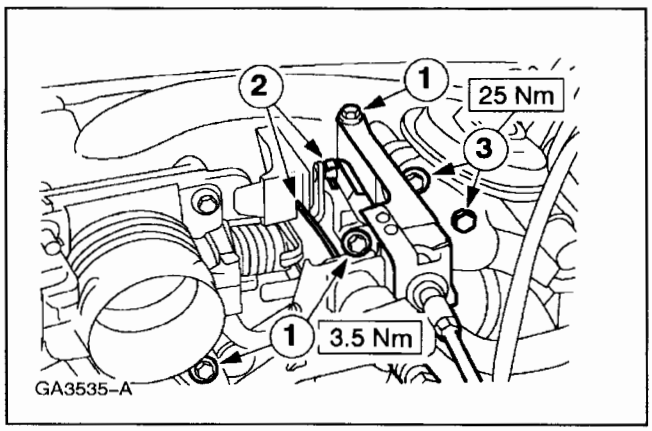


4. Connect the EGR vacuum regulator hoses.

IN-VEHICLE REPAIR (Continued)



5. Connect the two vacuum supply lines to the upper intake manifold.



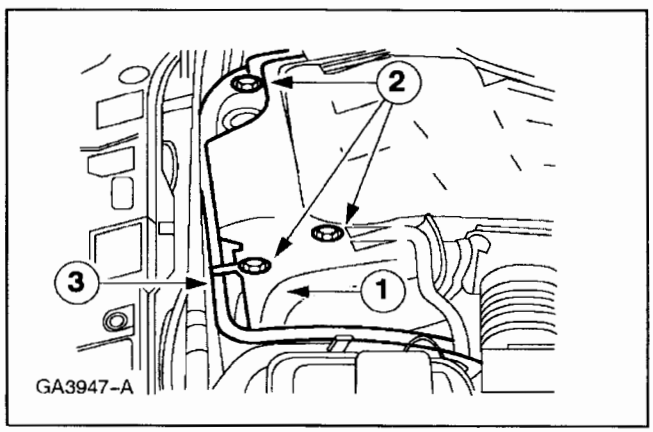
6. **NOTE:** Use a new EGR valve gasket.

   Install the accelerator bracket and EGR valve to the upper intake manifold.

   1 Position the accelerator bracket and install the bolts.

   2 Connect the accelerator and speed control cables to the throttle body.

   3 Position the EGR valve and the bolts.



7. Install the water pump pulley cover.

   1 Install the cover.

   2 Install the bolts.

   3 Attach the coolant hose to the clip.

8. Install the ACL. For additional information, refer to Section 303-12B.

9. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect battery ground cable.

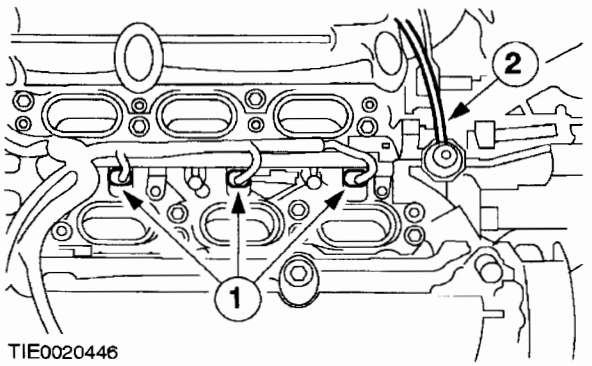
IN-VEHICLE REPAIR (Continued)

Intake Manifold — Lower

Removal

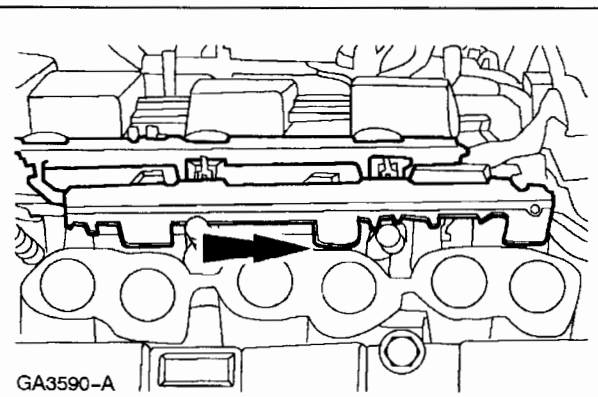
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

2. Disconnect the fuel line(s). For additional information, refer to Section 310-00.

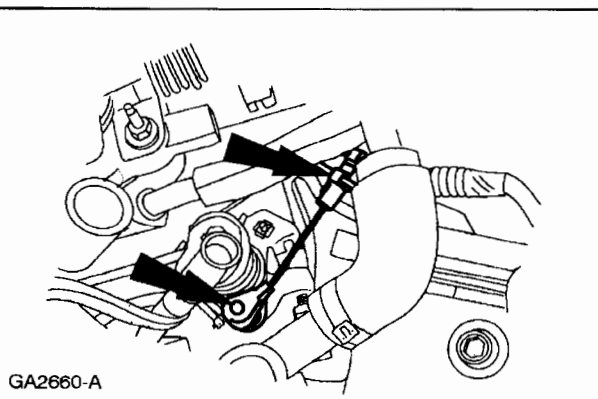


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3. Disconnect the fuel rail.
   1 Disconnect the six fuel injector electrical connectors.
   2 Disconnect the fuel pressure damper vacuum hose.


GA3590-A

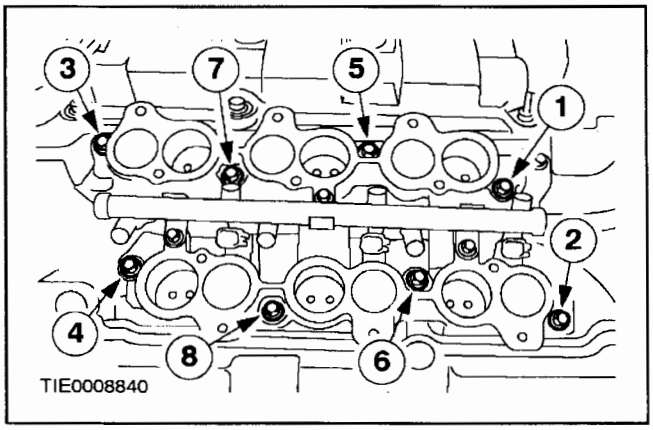
4. Disconnect the fuel injector electrical connectors and position the wiring harness aside.


GA2660-A

5. ⚠ **CAUTION: Do not loosen or bend the intake manifold runner control (IMRC) cable bracket. The bracket alignment is critical and damage to the IMRC actuator may occur.**

   Disconnect the IMRC actuator cable from the stud and bracket.

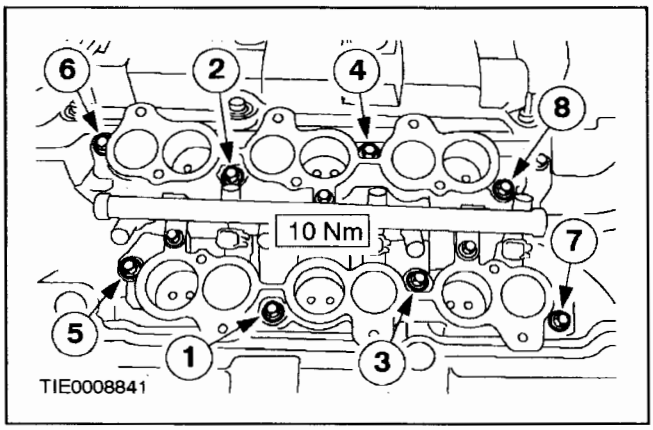
IN-VEHICLE REPAIR (Continued)



6. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the lower intake manifold and discard the gaskets.

Installation

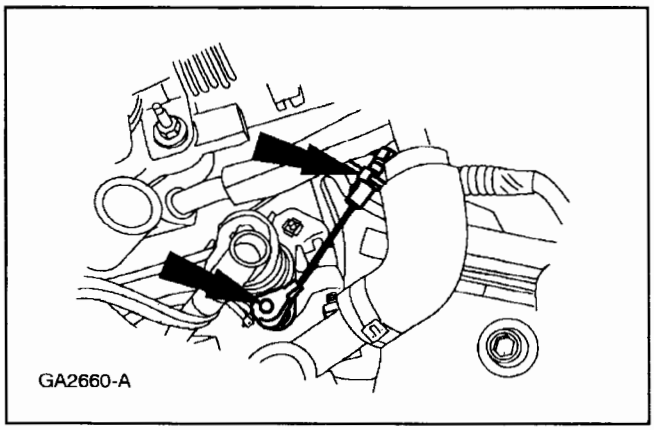


1. **NOTE:** Use new gaskets.

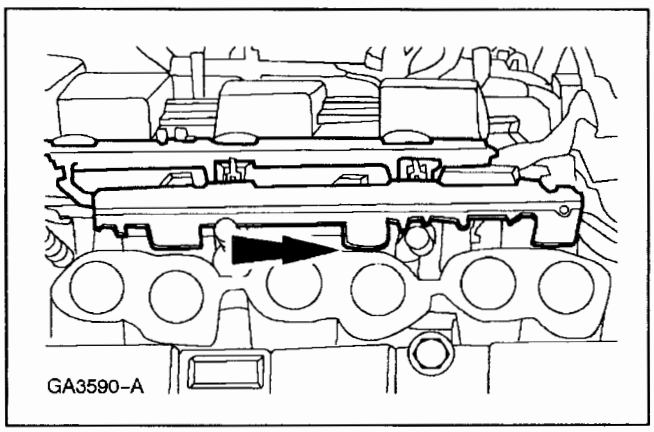
   NOTE: Tighten the bolts in the indicated sequence.

   Install the lower intake manifold.

   - Install the gaskets with the locating holes facing downwards.
   - Position the gaskets in the position holes.

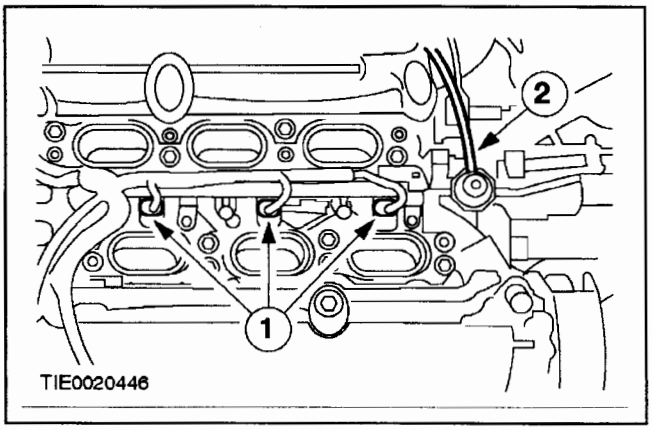


2. Connect the IMRC actuator cable to the stud and bracket.



3. Connect the fuel injector electrical connectors.

IN-VEHICLE REPAIR (Continued)



4. Connect the fuel rail.
   1 Connect the six fuel injector electrical connectors.
   2 Connect the fuel pressure damper vacuum hose.

5. Connect the fuel line(s). For additional information, refer to Section 310-00.

6. Install the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

Valve Cover — LH

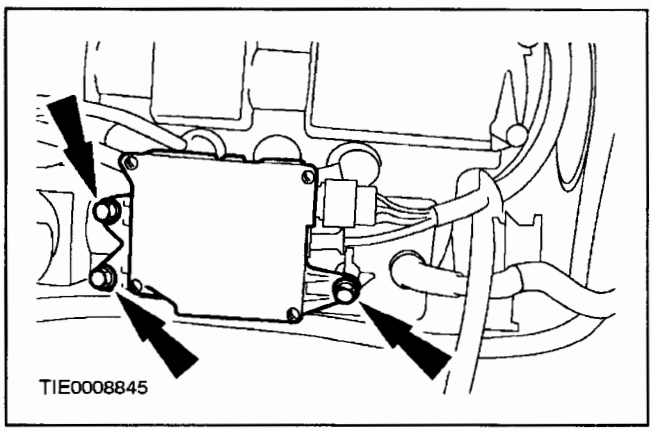
Materials

Item	Specification
Silicone Gasket and Sealant F7AZ-19562-EA	WSE-M4G323-A4
Metal Surface Cleaner F4A2-19A536-RA	WSE-M5B392-A

Removal

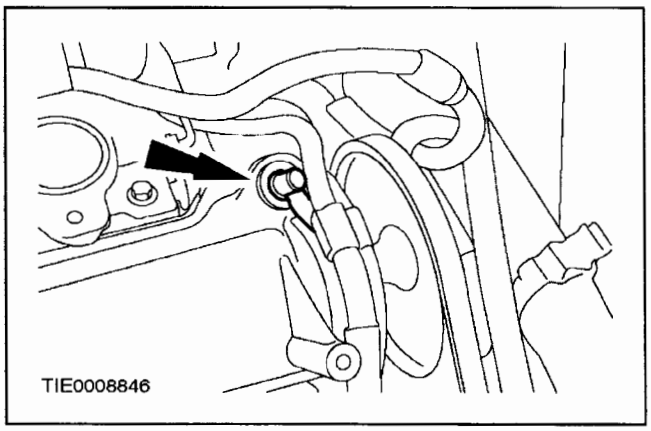
1. Disconnect the battery ground cable.

2. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

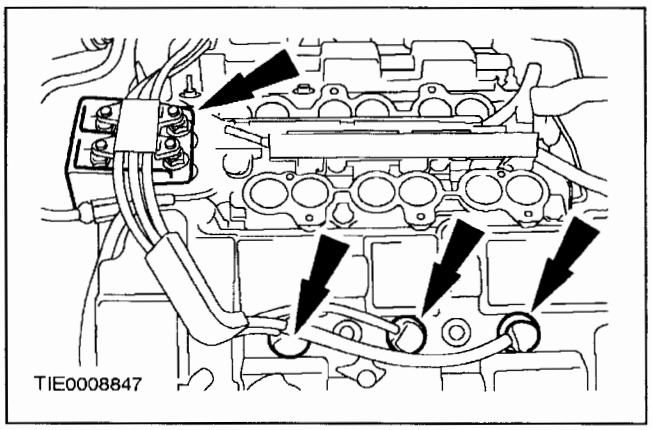


3. Remove the intake manifold runner control (IMRC) actuator bolts.

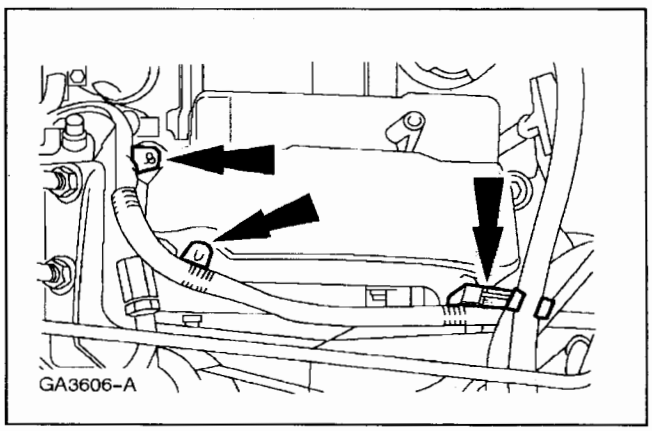
IN-VEHICLE REPAIR (Continued)



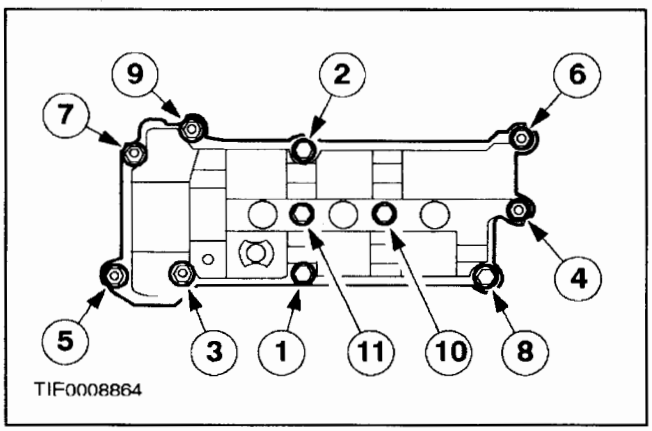
4. Detach the cable bridge and position the IMRC actuator to one side.



5. Disconnect the left-hand spark plug wires and bracket.



6. Disconnect the radiator coolant expansion tank hose and wiring harness.
   - Disconnect the coolant expansion tank breather hose bracket from the stud on the left-hand valve cover.
   - Disconnect the wiring harness from the left-hand valve cover.



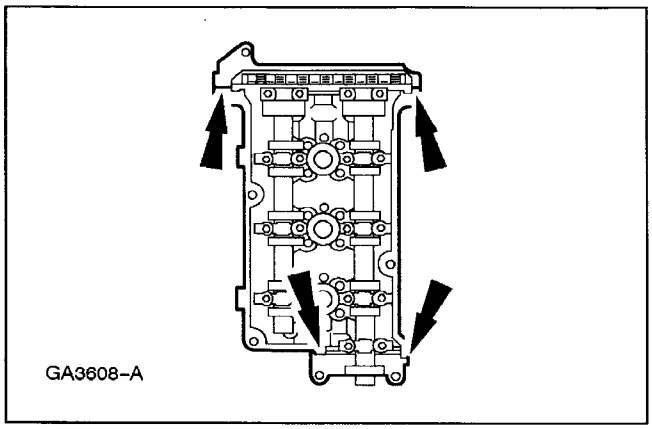
7. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the valve cover and discard the gasket.

IN-VEHICLE REPAIR (Continued)

Installation

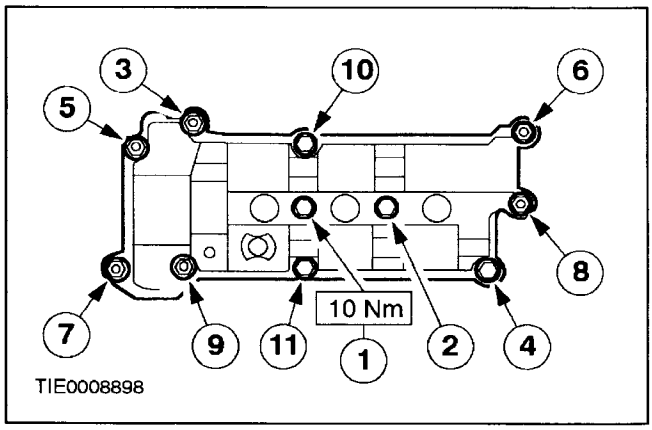
1. Prior to installation, clean the valve cover sealing surfaces using a shop towel and metal surface cleaner.



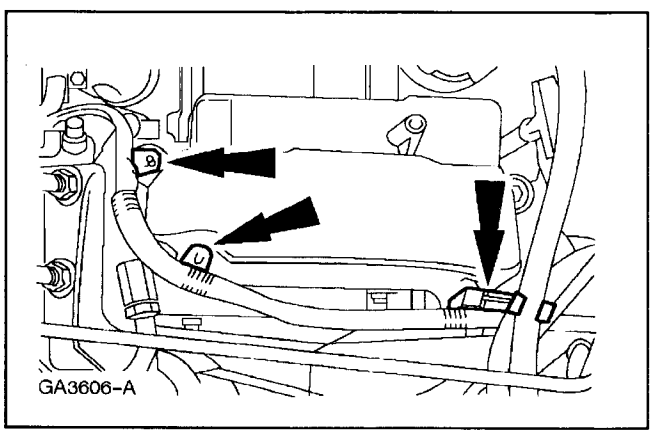
2. **NOTE:** Use a new gasket in the valve cover and install the valve cover within six minutes of applying the sealant. Before installing the valve cover, apply a drop of sealant approximately 8 mm in diameter to the joint areas shown in the diagram.

   Position a new gasket on the valve cover.

   - Apply silicon gasket and sealant where indicated.

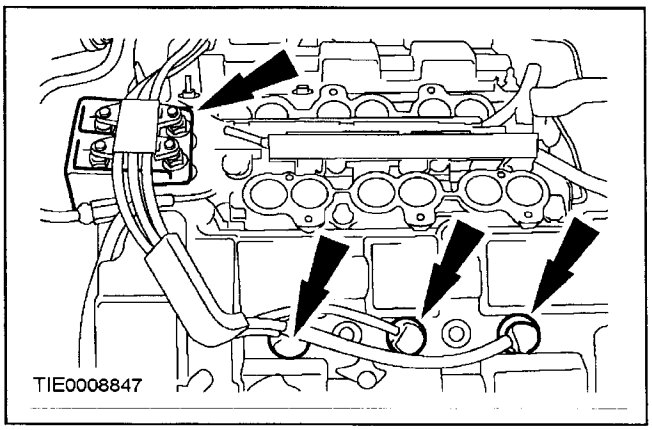


3. Tighten the valve cover bolts in the indicated sequence.

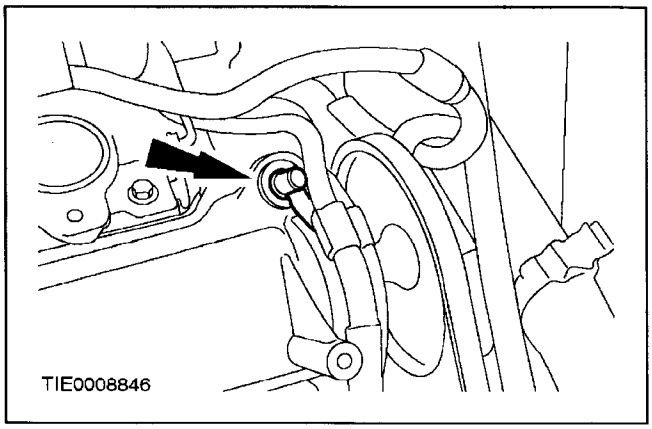


4. Install the radiator coolant expansion tank hose.
   - Install the wiring harness onto the left-hand valve cover.
   - Push the coolant expansion tank breather hose bracket onto the left-hand valve cover stud.

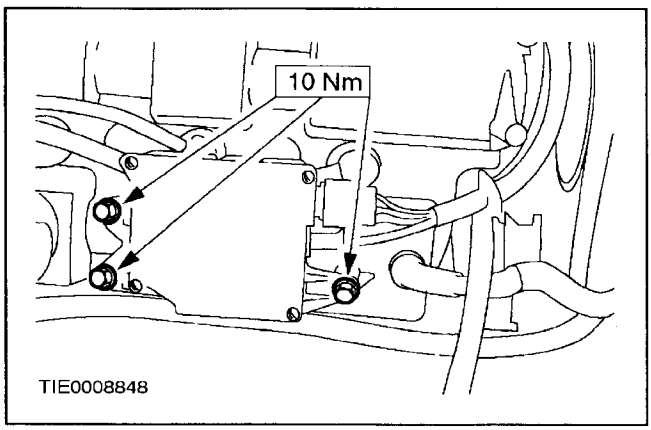
IN-VEHICLE REPAIR (Continued)



5. Connect spark plugs wires and bracket.



6. Position the IMRC actuator and install the bridge.



7. Install the IMRC actuator bolts.

8. Install the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

9. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable.

IN-VEHICLE REPAIR (Continued)

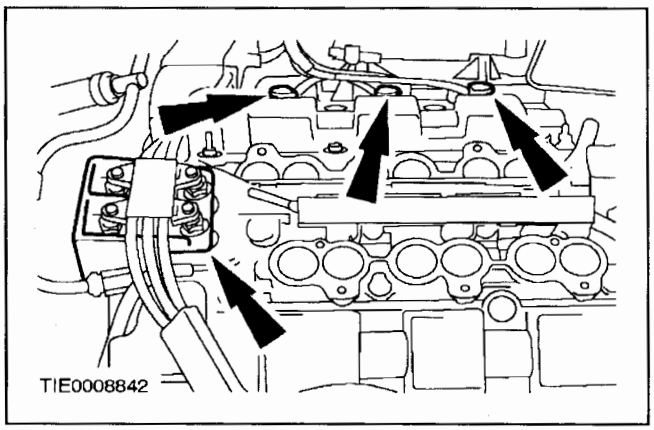
Valve Cover — RH

Materials

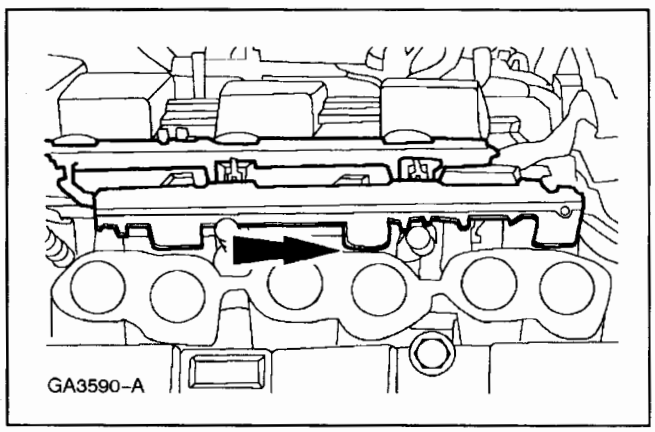
Item	Specification
Silicone Gasket and Sealant F7AZ-19562-EA	WSE-M4G323-A4
Metal Surface Cleaner F4A2-19A536-RA	WSE-M5B392-A

Removal

1. Disconnect the battery ground cable.
2. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

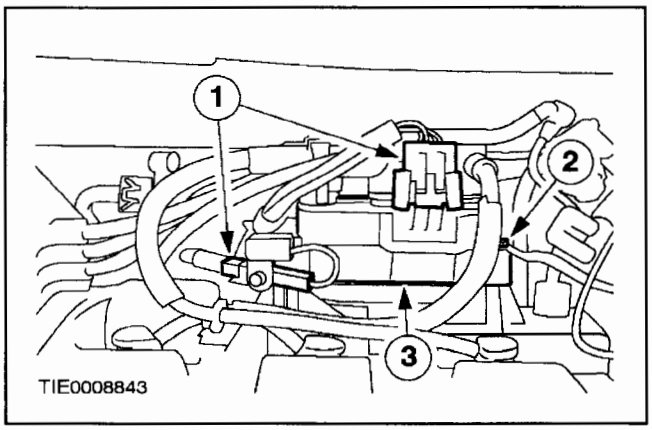


3. Disconnect the left-hand and right-hand spark plug wires and the bracket.

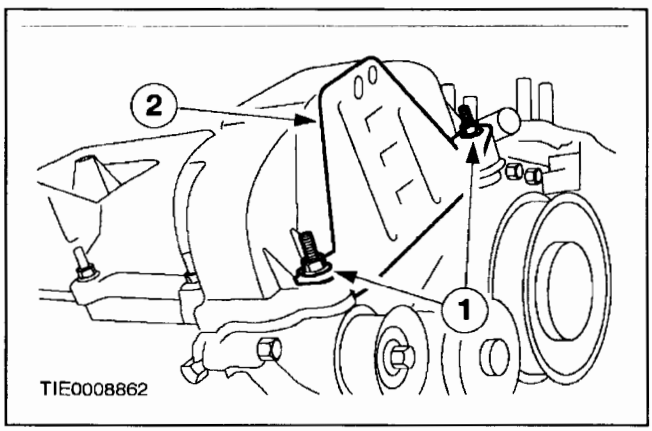


4. Remove the fuel charging wiring from the fuel injectors.

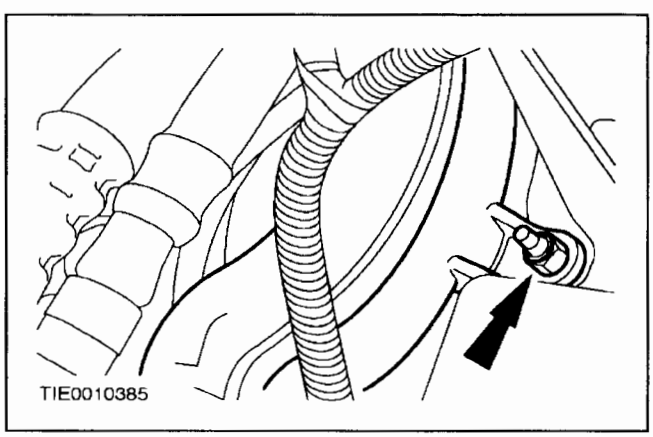
IN-VEHICLE REPAIR (Continued)



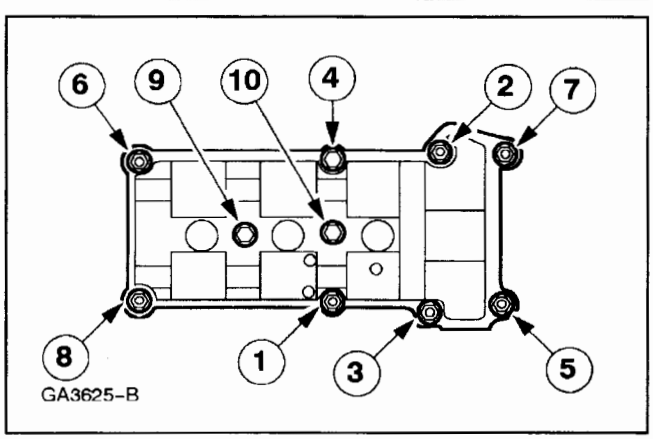
5. Remove the ignition coil.
   1 Disconnect the ignition coil electrical connectors.
   2 Remove the bolts.
   - Disconnect the ground cable and radio suppressor.
   3 Remove the ignition coil.



6. Remove the in-line connector bracket from the right-hand valve cover.
   1 Remove the nuts.
   2 Remove the bracket.



7. Remove two nuts and remove the wiring harness shield from the right-hand valve cover.

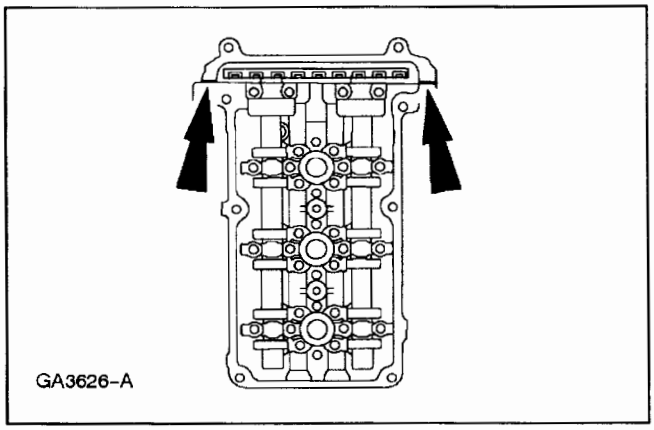


8. **NOTE:** Remove the bolts in the indicated sequence.
   Remove the valve cover and discard the gasket.

IN-VEHICLE REPAIR (Continued)

Installation

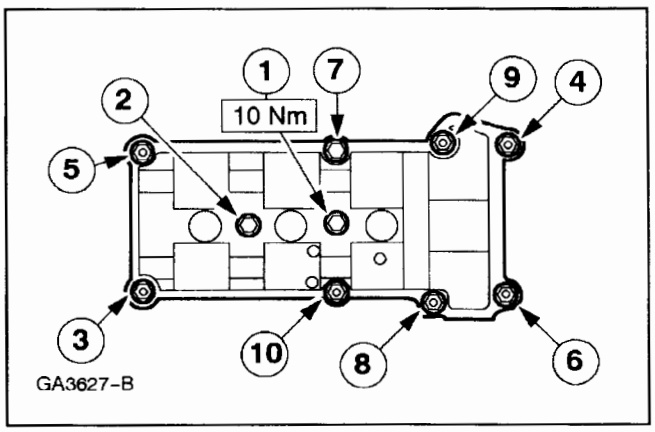
1. Prior to installation, clean the valve cover sealing surfaces using a shop towel and metal surface cleaner.



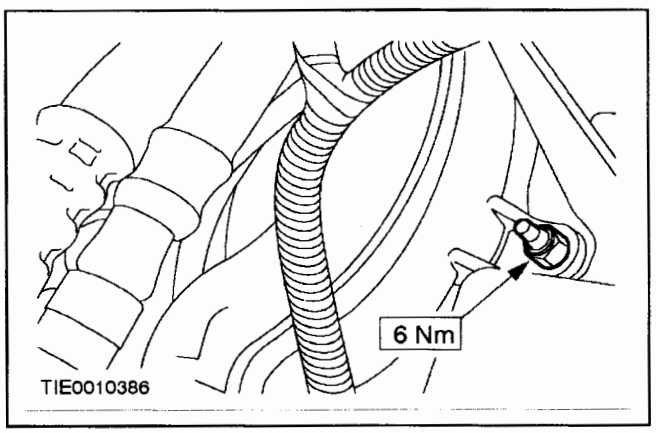
2. **NOTE:** Install a new gasket in the valve cover and install the valve cover within six minutes of applying the sealant. Before installing the valve cover, apply a drop of sealant approximately 8 mm in diameter to the joint areas shown in the diagram.

   Position a new gasket on the valve cover.

   - Apply silicone gasket and sealant where indicated.

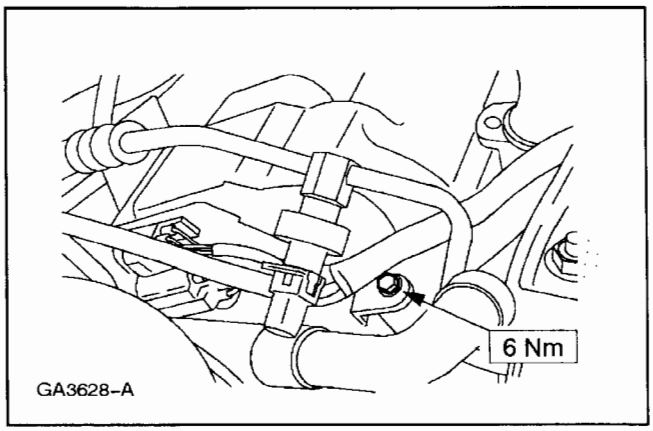


3. Tighten the valve cover bolts in the indicated sequence.

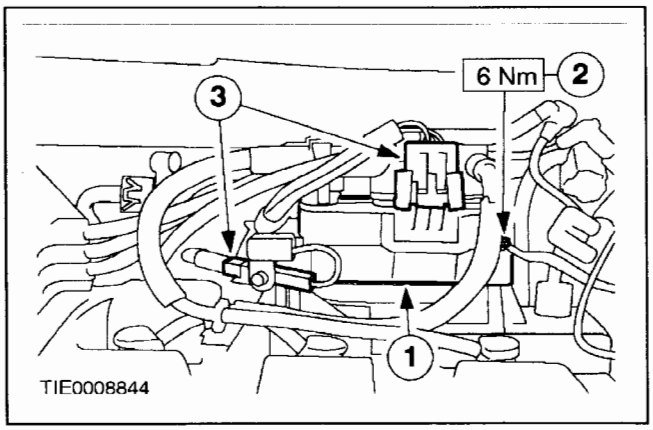


4. Install the right-hand wiring harness shield and two nuts.

IN-VEHICLE REPAIR (Continued)



5. Install the in-line connector bracket to the right-hand valve cover.



6. **NOTE:** Make sure that the ground cable is in position when installing the ignition coil.

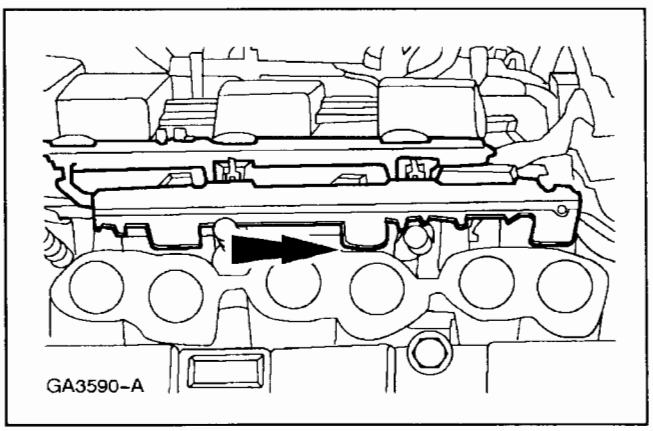
   Install the ignition coil.

   1 Position the ignition coil.

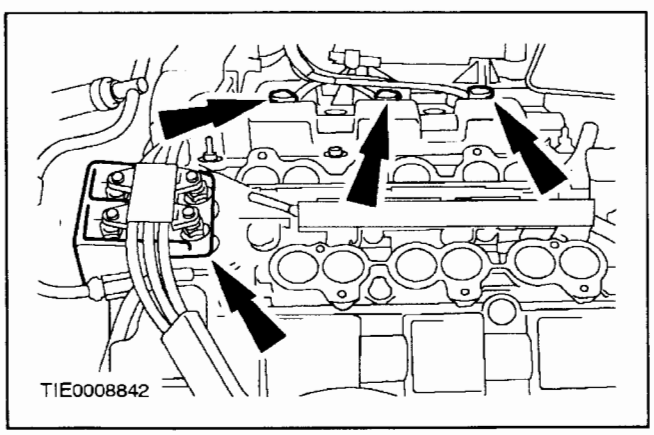
   2 Install the bolts.

   - Connect the radio suppressor and ground cable.

   3 Connect the electrical connectors.



7. Install the fuel charging wiring.
   - Begin at the front of the engine and work towards the rear of the engine.



8. Connect the spark plug wires to the spark plugs and install the bracket.

IN-VEHICLE REPAIR (Continued)

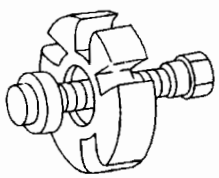
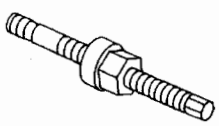
9. Install the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

10. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

    Connect the battery ground cable.

Crankshaft Pulley

Special Tool(s)

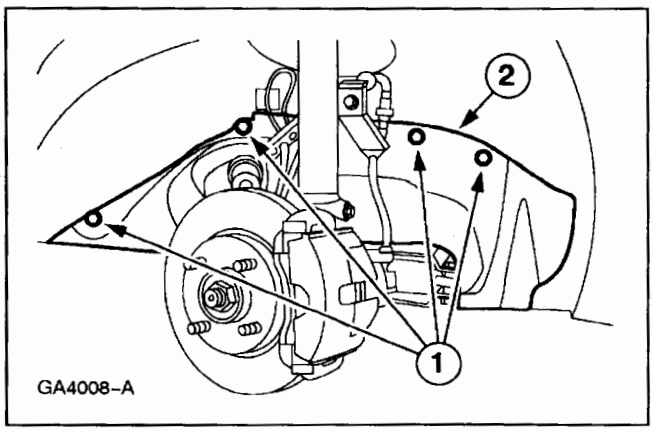
 ST1286-A	Remover, Vibration Damper, Crankshaft 303-009 (T58P-6316-D)
 ST1287-A	Installer, Vibration Damper, Crankshaft 303-102 (T74P-6316-B)

Materials

Item	Specification
Silicone Gasket and Sealant F7AZ-19562-EA	WSE-M4G323-A4
Metal Surface Cleaner F4A2-19A536-RA	WSE-M5B392-A

Removal

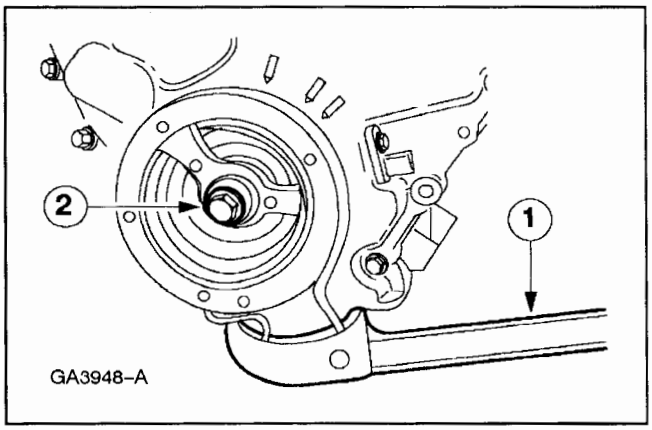
1. Remove the right-hand wheel. For additional information, refer to Section 204-04.



2. Remove the right-hand fender splash shields.
   1 Remove the bolts.
   2 Remove the shields.

3. Remove the accessory drive belt. For additional information, refer to Section 303-05.

IN-VEHICLE REPAIR (Continued)



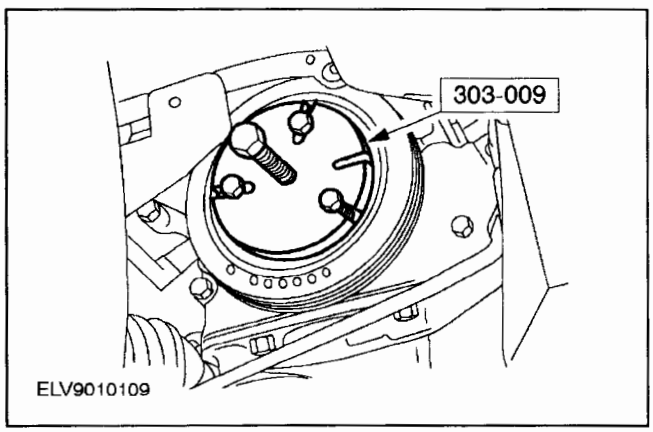
4. ⚠ **CAUTION: Prevent the crankshaft from rotating in a counterclockwise direction during the crankshaft pulley bolt removal.**

   NOTE: The crankshaft pulley bolt is torque to-yield and must not be reused.

   Remove the crankshaft pulley bolt and washer.

   1 Install a suitable strap wrench to hold the crankshaft pulley.

   2 Remove the crankshaft pulley bolt.

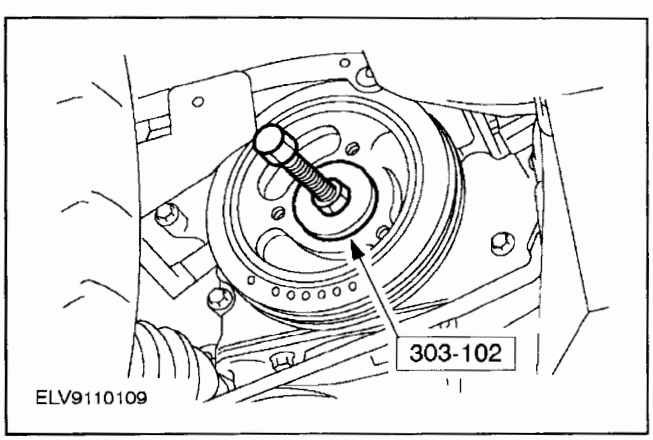


5. Using the special tool, remove the crankshaft pulley.

Installation

1. Prior to applying sealant, clean the sealing surfaces with metal surface cleaner to remove all residues that may interfere with the sealants ability to adhere.

2. Apply silicone gasket and sealant to the front of the crankshaft on the inside diameter surface of the crankshaft pulley at the keyway.

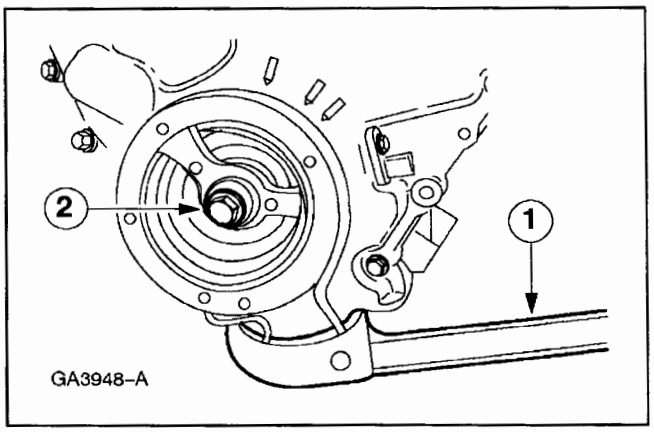


3. **NOTE:** Use the washer of the new crankshaft pulley bolt for installation.

   Using the special tool, install the crankshaft pulley.

4. Apply silicone gasket and sealant to the crankshaft pulley bolt.

IN-VEHICLE REPAIR (Continued)



5. **NOTE:** Use a suitable strap wrench to prevent the crankshaft pulley from turning.

   NOTE: Use a new crankshaft pulley bolt.

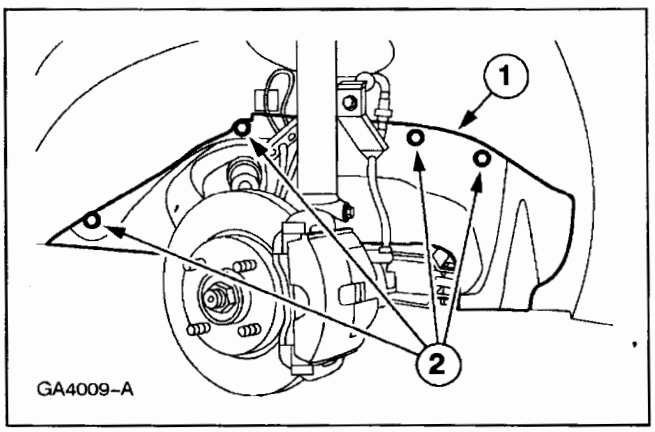
   Install the crankshaft pulley bolt.

   1 Install a suitable strap wrench to hold the crankshaft pulley.

   2 Install the crankshaft pulley bolt in four stages:

   - Stage 1: 120 Nm
   - Stage 2: Back off the bolt one full turn.
   - Stage 3: 50 Nm
   - Stage 4: 90 degrees

6. Install the accessory drive belt. For additional information, refer to Section 303-05.



7. Install the right-hand fender splash shields.

   1 Install the shields.

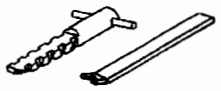
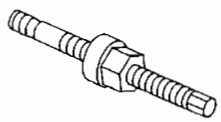
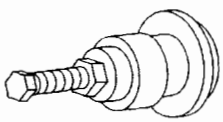
   2 Install the bolts.

8. Install the right-hand wheel. For additional information, refer to Section 204-04.

IN-VEHICLE REPAIR (Continued)

Crankshaft Front Oil Seal

Special Tool(s)

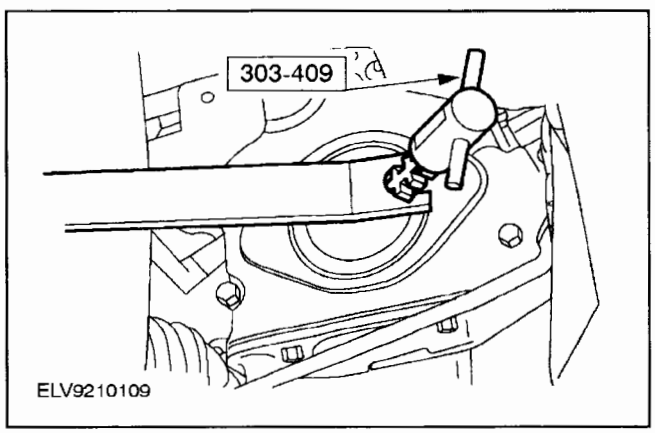
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1287-A	Installer, Vibration Damper, Crankshaft 303-102 (T74P-6316-B)
 ST1328-A	Aligner/Installer, Oil Seal, Crankshaft 303-335 (T88T-6701-A)

Materials

Item	Specification
Engine oil —	WSS-M2C153-H

Removal

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.



2. ⚠ **CAUTION: Protect the crankshaft surface when removing the oil seal.**

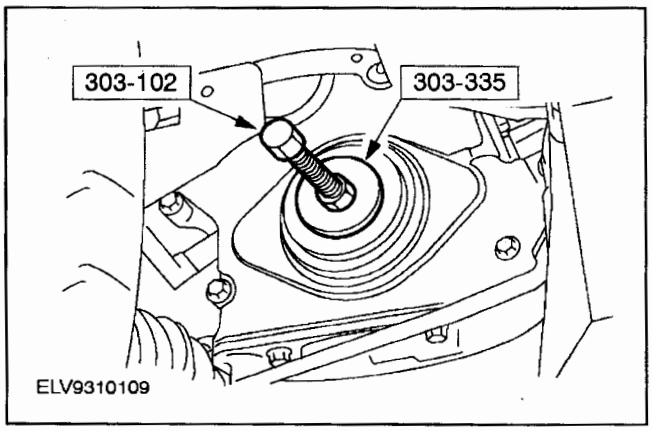
   Using the special tool, remove the crankshaft front oil seal.

   1 Install the special tool.

   2 Lever out the oil seal.

IN-VEHICLE REPAIR (Continued)

Installation



1. **NOTE:** Use the washer of the crankshaft pulley bolt for installation.

   Using the special tools, install the crankshaft front oil seal.

   - Coat the outer ring and the sealing lip of the oil seal with engine oil.

2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Engine Front Cover

Materials

Item	Specification
Engine oil —	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19562-EA	WSE-M4G323-A4
Metal Surface Cleaner F4A2-19A536-RA	WSE-M5B392-A

Removal

1. Remove the right-hand valve cover. For additional information, refer to Valve Cover—RH in this section.

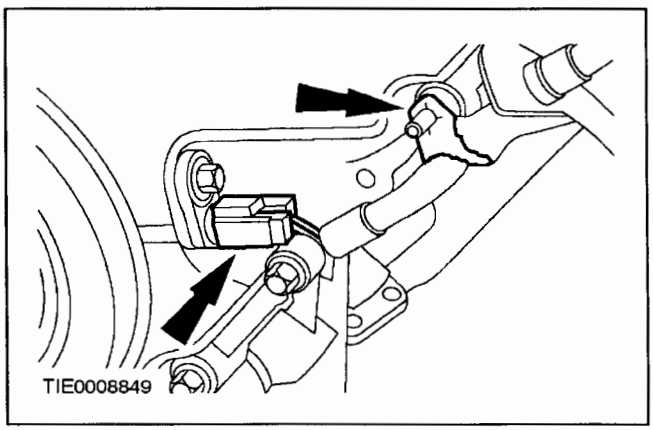
2. Remove the left-hand valve cover. For additional information, refer to Valve Cover—LH in this section.

3. Remove the oil pan. For additional information, refer to Oil Pan in this section.

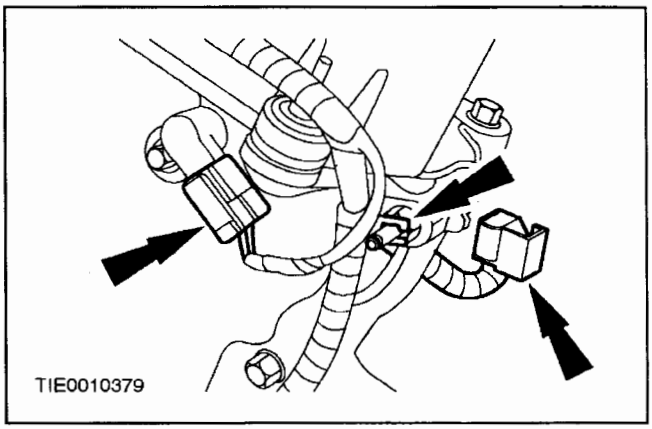
4. Remove the generator. For additional information, refer to Section 414-02.

IN-VEHICLE REPAIR (Continued)

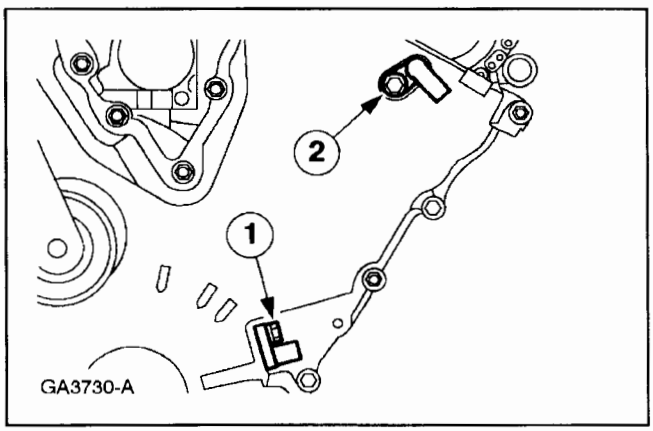
5. Remove the power steering pump. For additional information, refer to Section 211-02.



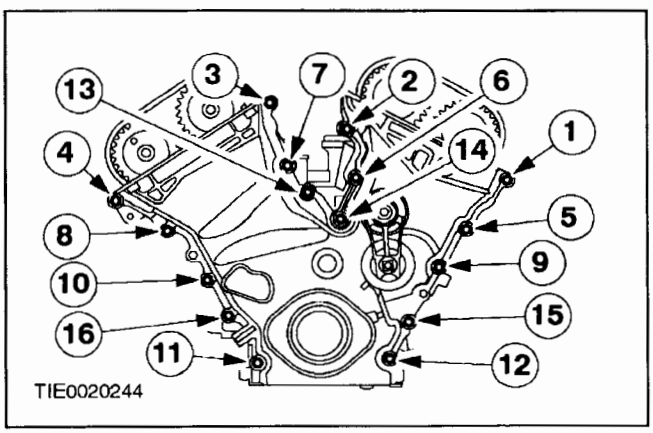
6. Disconnect the crankshaft position (CKP) sensor electrical connector.



7. Disconnect the camshaft position (CMP) sensor and the left-hand heated oxygen sensor (HO2S) electrical connectors.
   - Detach the wiring harness retainer and position the harness to one side.



8. Remove the sensors.
   1 The CKP sensor.
   2 The CMP sensor.



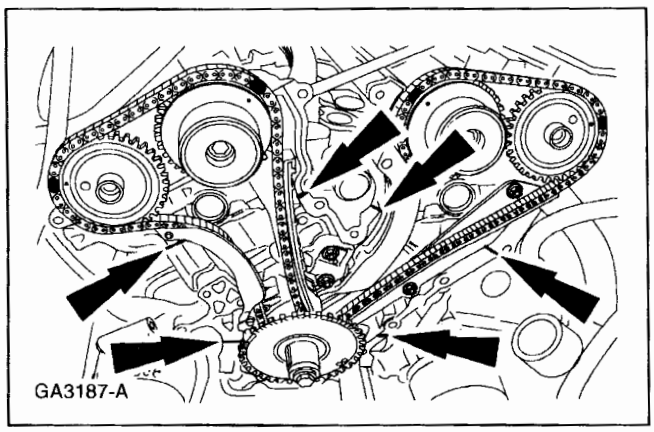
9. **NOTE:** Remove the bolts and studs in the indicated sequence.

   Remove the engine front cover and discard the gaskets.

IN-VEHICLE REPAIR (Continued)

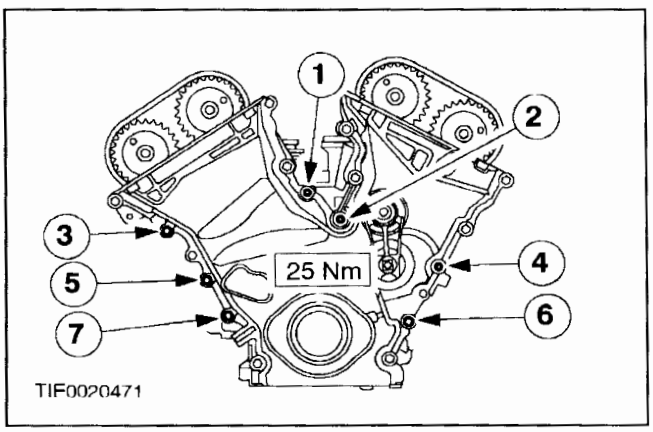
Installation

1. Prior to applying silicone gasket and sealant, clean the front cover to cylinder block and cylinder head sealing surfaces.



2. **NOTE:** Install the engine front cover within six minutes of applying silicone gasket and sealant.

   Apply a 6 mm dot of silicone gasket and sealant to the indicated locations.

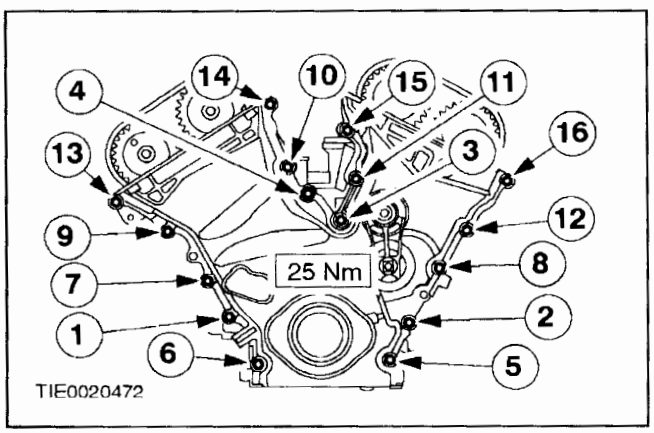


3. **NOTE:** The engine front cover must be installed in a two step sequence.

   NOTE: Locating dowels and the locations of the studs.

   Install the engine front cover.

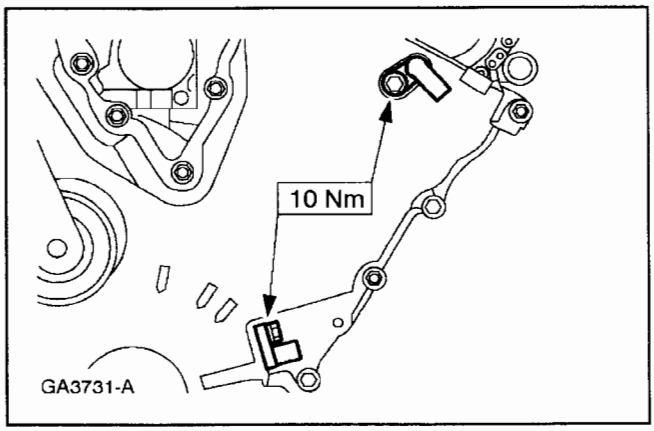
   - Use new gaskets.
   - Install the bolts and studs in the indicated sequence and tighten in two steps.
   - First tighten the seven bolts and studs one quarter turn (90 degrees) after the engine front cover contacts the cylinder block and the cylinder heads.



4. **NOTE:** Tighten the bolts and studs in the indicated sequence.

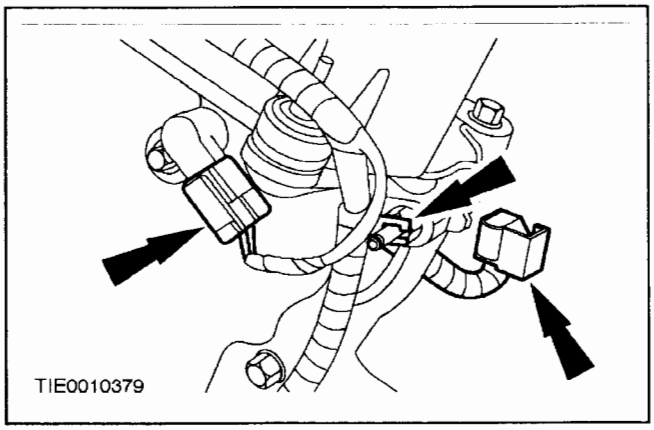
   Install the remaining bolts and studs.

IN-VEHICLE REPAIR (Continued)

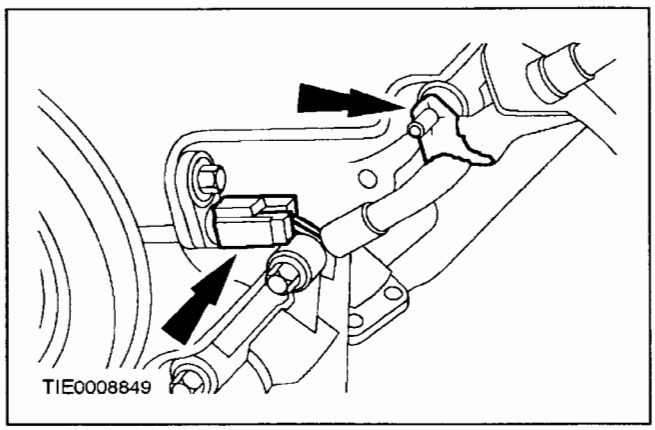


5. **NOTE:** Lightly lubricate the new O-ring seals with engine oil before installation.

   Install the CMP and CKP sensors.



6. Connect the CMP sensor and left hand HO2S electrical connectors.
   - Position the wiring harness and attach the retainer.



7. Connect the CKP sensor electrical connector and attach the retainer.

8. Install the power steering pump. For additional information, refer to Section 211-02.

9. Install the generator. For additional information, refer to Section 414-02.

10. Install the oil pan. For additional information, refer to Oil Pan in this section.

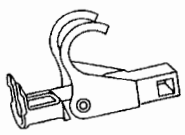
11. Install the right-hand valve cover. For additional information, refer to Valve Cover—RH in this section.

IN-VEHICLE REPAIR (Continued)

12. Install the left-hand valve cover. For additional information, refer to Valve Cover—LH in this section.

Valve Springs

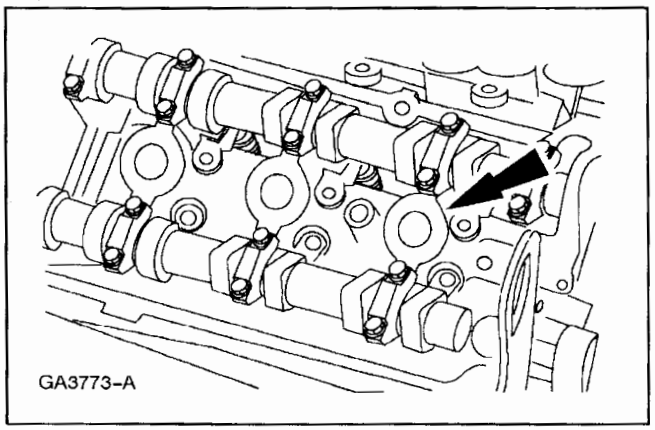
Special Tool(s)

 ST1975-A	Valve Spring Compressor 303-473 (T94P-6565-BH)

Removal

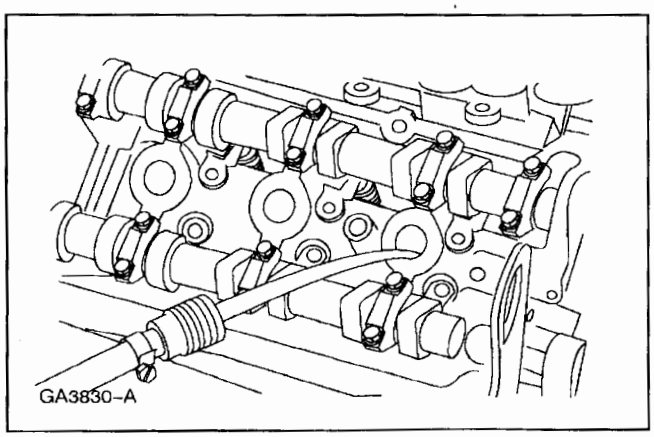
1. Remove the left-hand valve cover. For additional information, refer to Valve Cover—LH in this section.

2. Remove the right-hand valve cover. For additional information, refer to Valve Cover—RH in this section.


GA3773-A

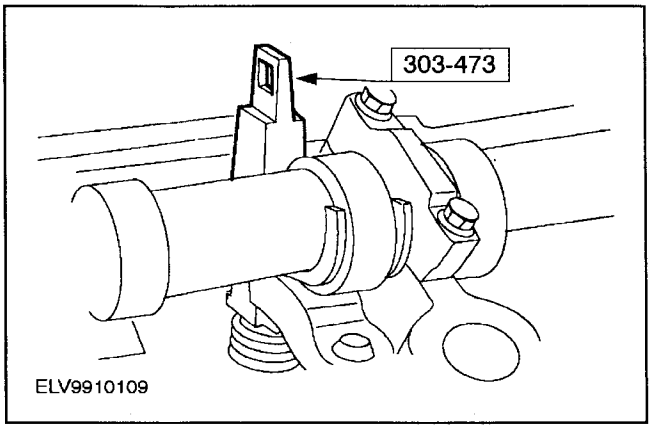
3. ⚠ **CAUTION: The piston must be at the bottom of its stroke with both valves closed. Any loss of air pressure will allow the valve to fall into the cylinder.**

   Remove the spark plug.

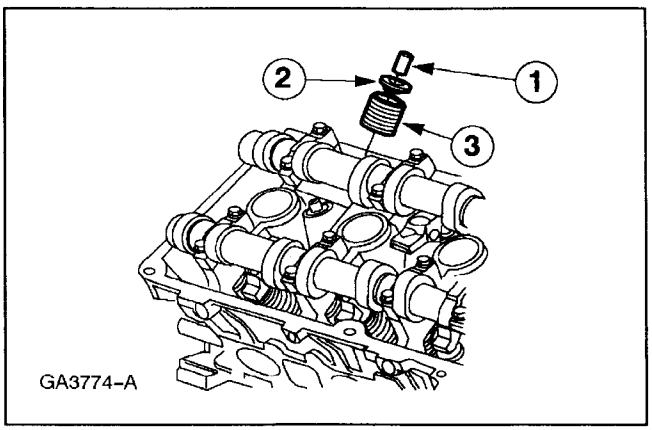

GA3830-A

4. Install the adapter into the spark plug bore and connect a compressed air supply at 102-144 psi.

IN-VEHICLE REPAIR (Continued)

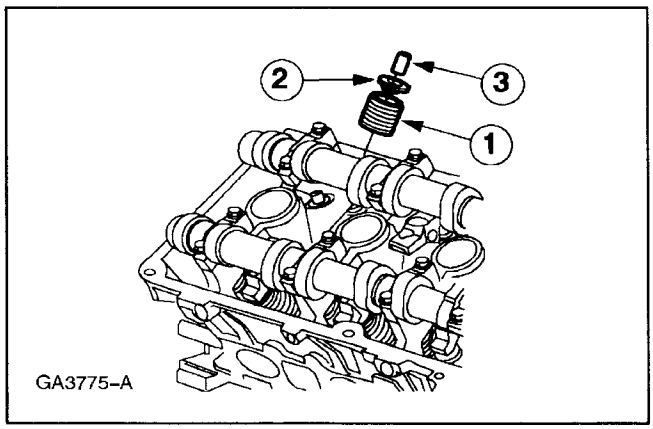


5. Using the special tool, compress the valve spring and remove the roller finger follower.

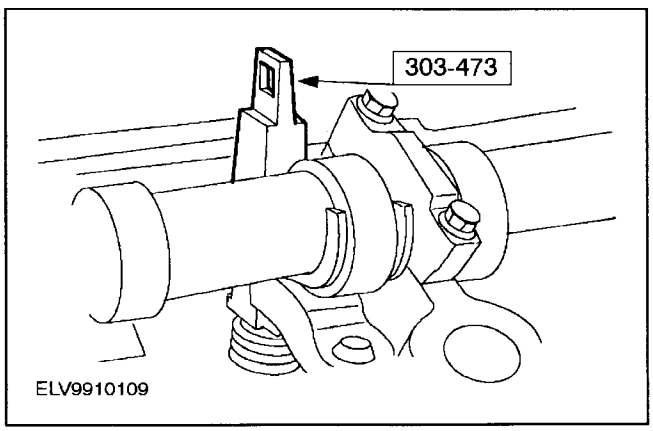


6. Using the special tool, remove the valve spring assembly.
   1 Compress the valve spring and remove the valve spring collets.
   2 Remove the valve spring retainer.
   3 Remove the valve spring.

Installation

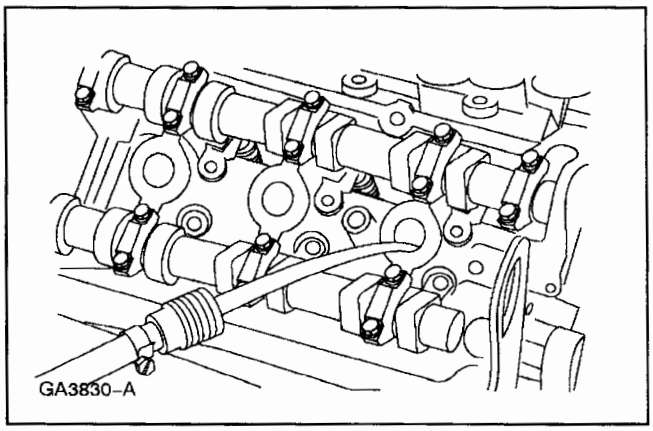


1. Using the special tool, install the valve spring.
   1 Install the valve spring.
   2 Install the valve spring retainer.
   3 Compress the valve spring and install the valve collets.

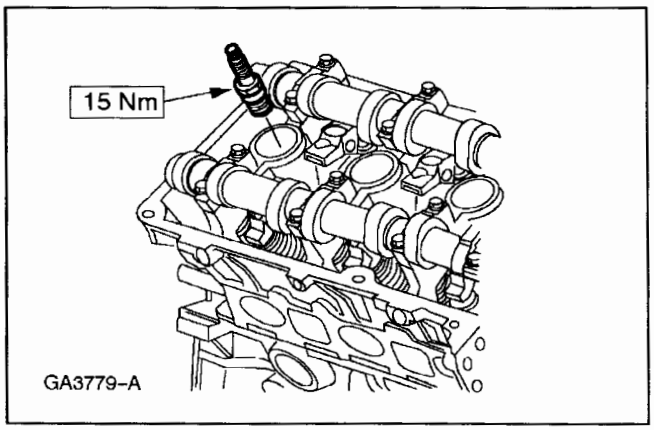


2. Using the special tool, compress the valve spring and install the roller finger follower.

IN-VEHICLE REPAIR (Continued)



3. Remove the adapter for the compressed air supply.



4. Install the spark plug.

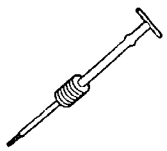
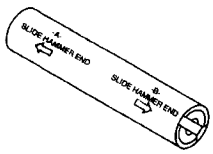
5. Install the right-hand valve cover. For additional information, refer to Valve Cover—RH in this section.

6. Install the left-hand valve cover. For additional information, refer to Valve Cover—LH in this section.

IN-VEHICLE REPAIR (Continued)

Valve Seals

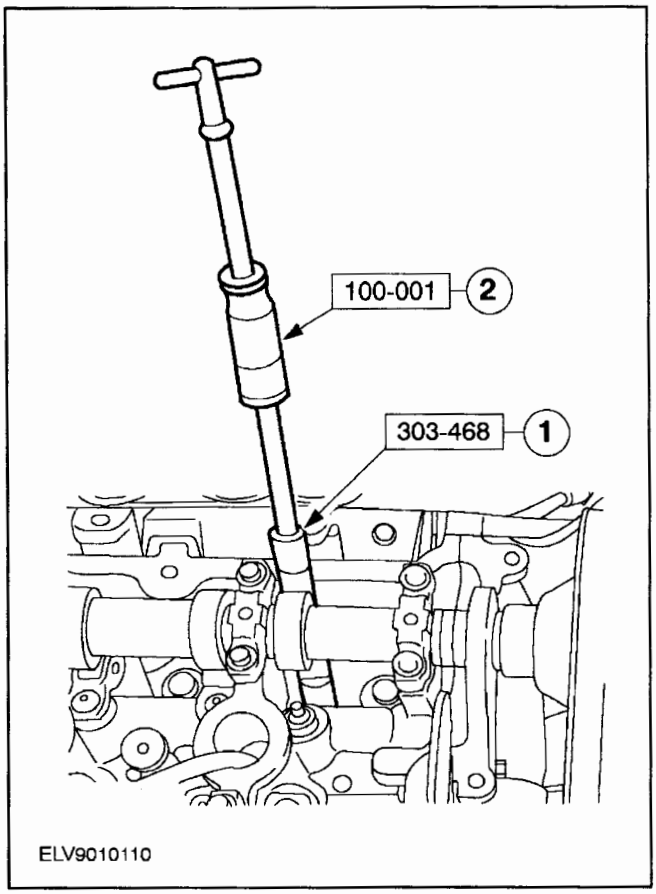
Special Tool(s)

 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1976-A	Valve Stem Seal Remover 303-468 (T94P-6510-AH)
 ST1977-A	Valve Stem Seal Replacer 303-470 (T94P-6510-CH)

Removal

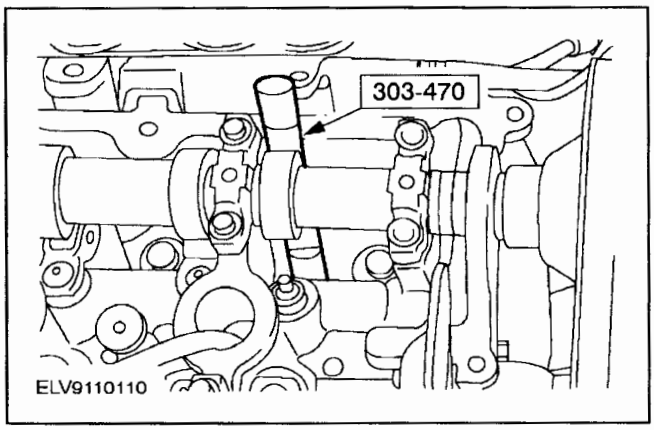
1. Remove the valve spring. For additional information, refer to Valve Springs in this section.

IN-VEHICLE REPAIR (Continued)



2. Using the special tools, remove the valve stem seal.
   1 Install the special tool.
   2 Install the special tool to remove the seal.

Installation



1. **NOTE:** Cover the valve collet groove on the valve stem with a protective sleeve.

   Using the special tool, install the new valve stem seal.
   - Remove the protective sleeve.

2. Install the valve spring. For additional information, refer to Valve Springs in this section.

IN-VEHICLE REPAIR (Continued)

Hydraulic Lash Adjusters

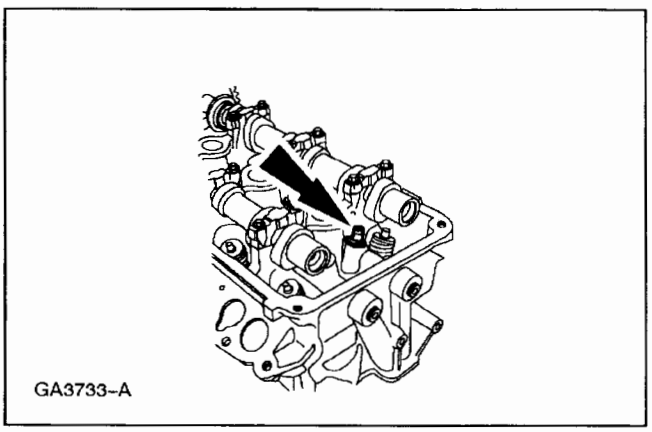
Materials

Item	Specification
Engine oil —	WSS-M2C153-H

Removal

1. ⚠ **CAUTION: Mark the position of the camshaft follower and hydraulic lash adjuster to make sure they are assembled in their original position if they are to be reused.**

   Remove the camshaft follower. For additional information, refer to Camshaft Followers in this section.



2. Remove the hydraulic lash adjuster.

Installation

1. **NOTE:** Inspect the hydraulic lash adjuster and replace if necessary.

   Install the hydraulic lash adjuster.

   - Lubricate the hydraulic lash adjuster with engine oil before installation.

2. Install the camshaft follower. For additional information, refer to Camshaft Followers in this section.

IN-VEHICLE REPAIR (Continued)

Camshaft — LH

Materials

Item	Specification
Engine oil	WSS-M2C153-H
—	

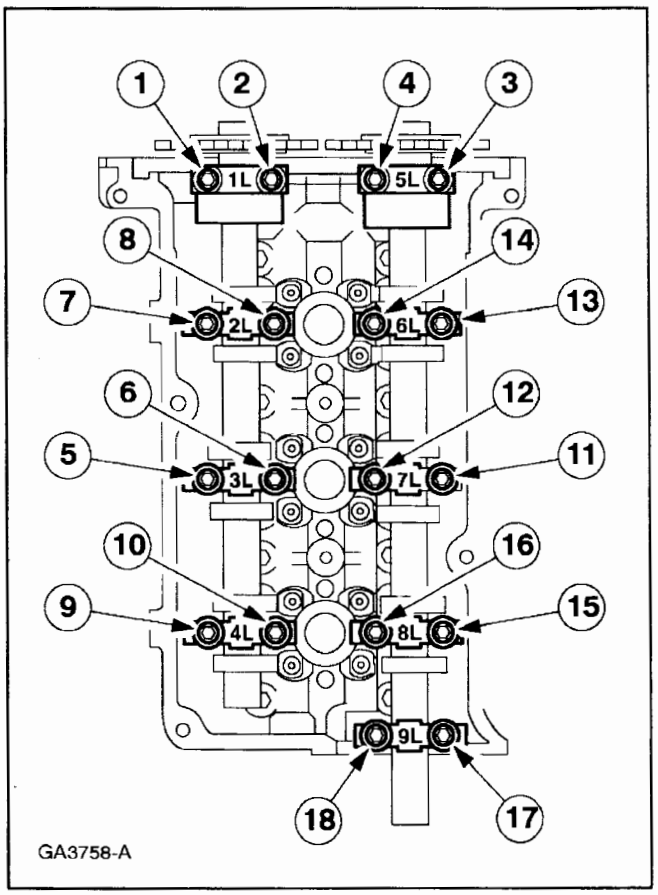
Removal

1. **CAUTION: Mark the orientation and position of the caps and camshaft followers. They must be installed in the same position and orientation, or damage may occur.**

   Remove the timing chains. For additional information, refer to Timing Chain in this section.

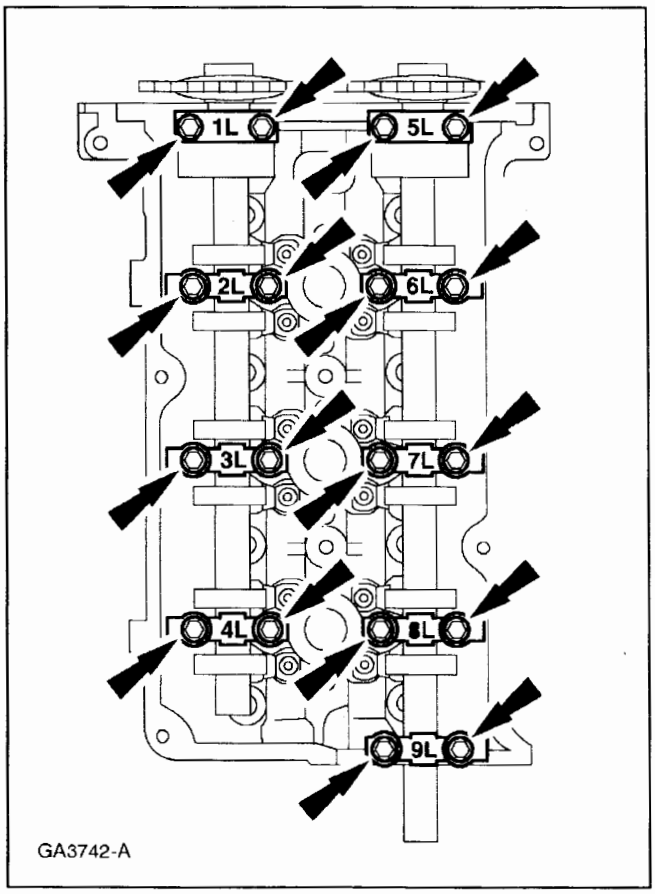
2. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the left-hand camshafts.



IN-VEHICLE REPAIR (Continued)

Installation



1. **CAUTION: Do not install the left-hand cylinder head camshaft journal thrust caps until the camshaft journal caps are installed or damage to the thrust caps can occur.**

   NOTE: Lubricate the camshafts with engine oil before installation.

   Install the left-hand camshafts.

   - Install the caps in their original positions.
   - Loosely install the bolts.

2. Install the timing chains. For additional information, refer to Timing Chain in this section.

Camshaft — RH

Materials

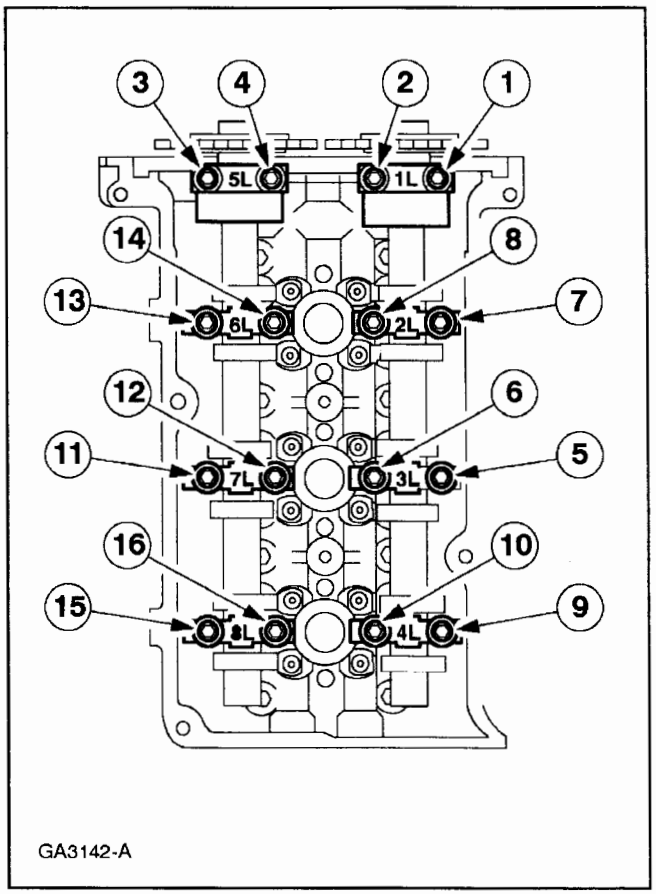
Item	Specification
Engine oil —	WSS-M2C153-H

Removal

1. **CAUTION: Mark the orientation and position of the caps and camshaft followers. They must be installed in the same position and orientation, or damage may occur.**

   Remove the timing chains. For additional information, refer to Timing Chain in this section.

IN-VEHICLE REPAIR (Continued)

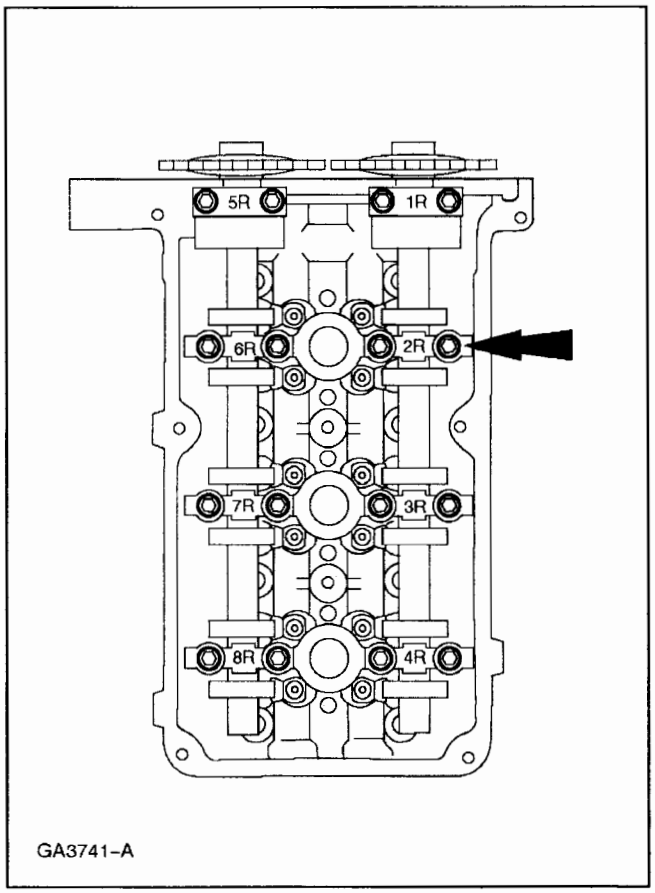


2. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the right-hand camshafts.

IN-VEHICLE REPAIR (Continued)

Installation



1. ⚠ **CAUTION: Do not install the right-hand cylinder head camshaft journal thrust caps until the camshaft journal caps are installed or damage to the thrust caps can occur.**

   NOTE: Lubricate the camshafts with engine oil before installation.

   Install the right-hand camshafts.

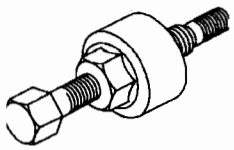
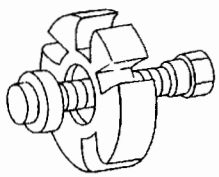
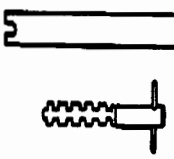
   - Install the caps in their original position.
   - Loosely install the bolts.

2. Install the timing chains. For additional information, refer to Timing Chain in this section.

IN-VEHICLE REPAIR (Continued)

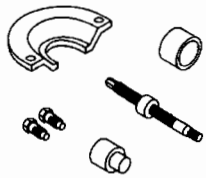
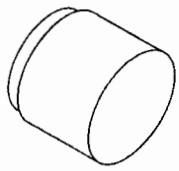
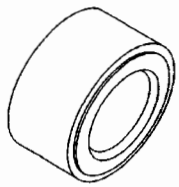
Camshaft Oil Seal

Special Tool(s)

 ST1586-A	Installer, Pulley, Power Steering Pump 211-185 (T91P-3A733-A)
 ST1286-A	Remover, Vibration Damper, Crankshaft 303-009 (T58P-6316-D)
 T92C-6700-CH	Remover, Oil Seal, Crankshaft 303-409 (T92C-6700-CH)

(Continued)

Special Tool(s)

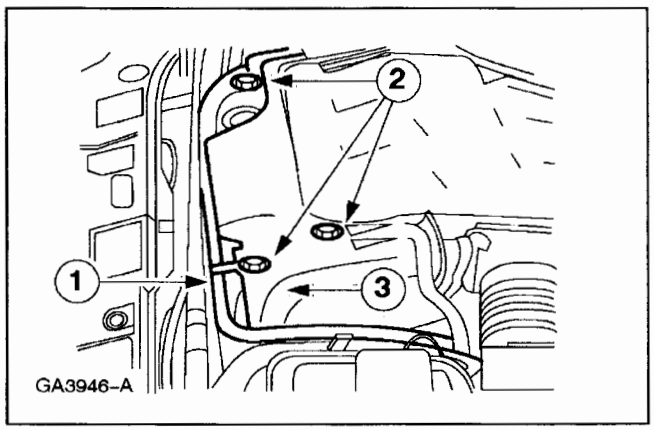
 ST1971-A	Remover/Installer, Pulley (Water Pump Drive), Camshaft 303-S455 (T94P-6312-AH)
 ST2060-A	Installer, Oil Seal, Camshaft 303-463
 ST1979-A	Installer, Oil Seal, Camshaft 303-464

Materials

Item	Specification
Engine oil	WSS-M2C153-H
—	

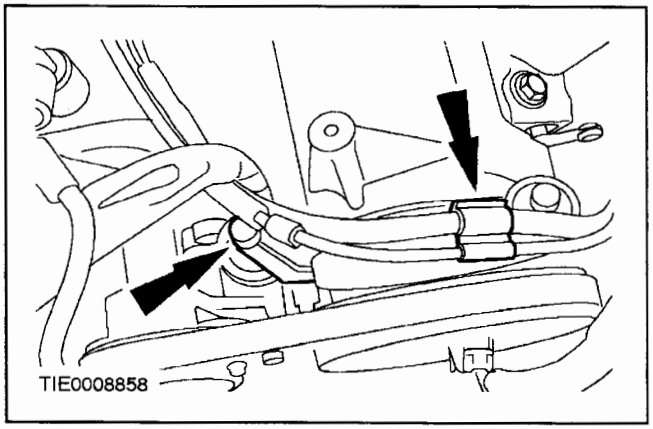
Removal

1. Disconnect the battery ground cable.

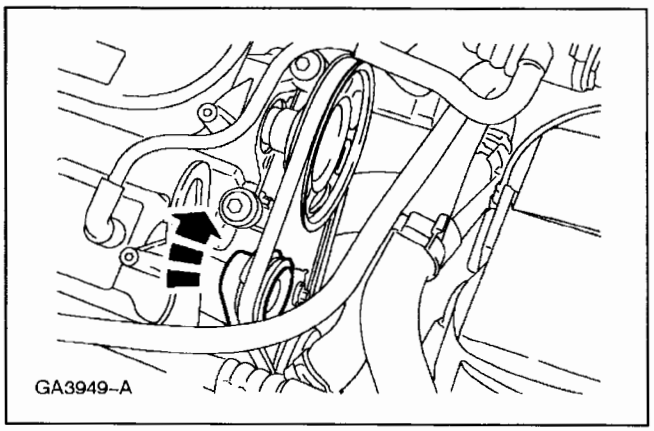


2. Remove the water pump pulley cover.
   1 Detach the coolant hose from the clip.
   2 Remove the bolts.
   3 Remove the cover.

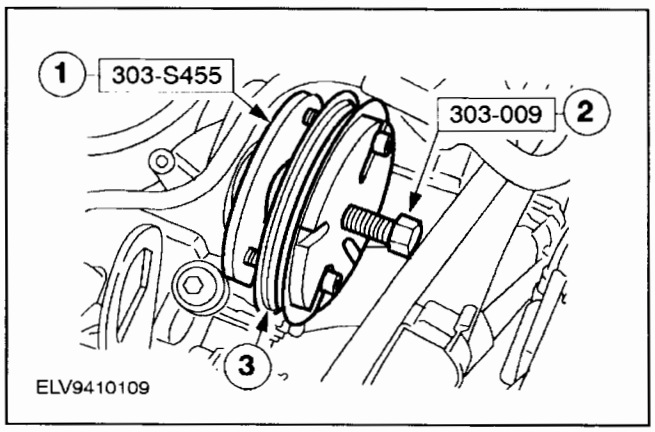
IN-VEHICLE REPAIR (Continued)



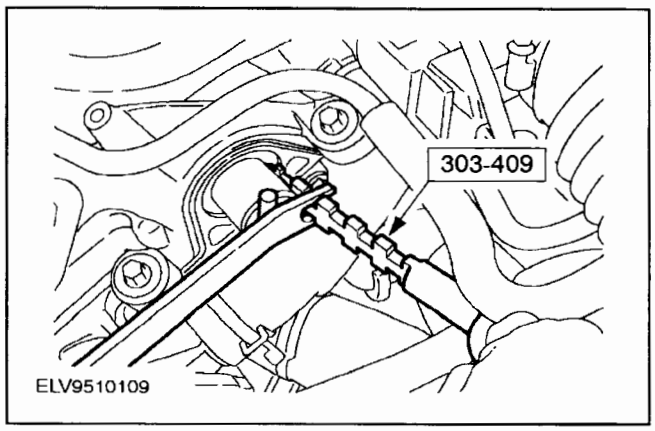
3. Unclip the wire and cable from the bridge and remove the bridge.



4. Rotate the belt tensioner clockwise, towards the camshaft drive pulley, to release the drive belt tension and remove the belt.



5. Remove the water pump drive pulley.
   1 Install special tool.
   2 Install special tool then turn the center bolt.
   3 Remove the pulley.

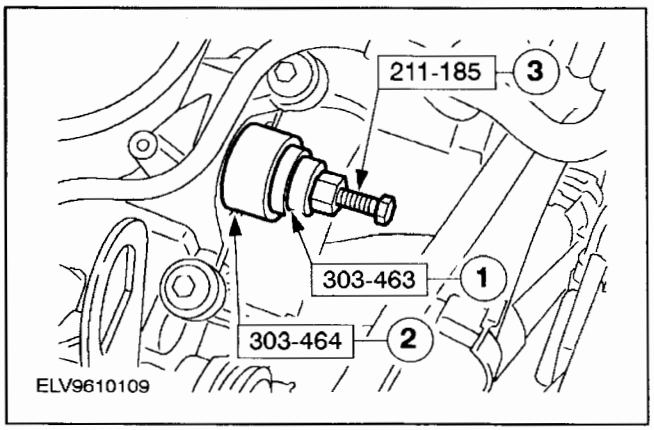


6. **NOTE:** In order to make sure correct sealing do not scratch the camshaft.

   Using the special tools, remove the camshaft oil seal.

IN-VEHICLE REPAIR (Continued)

Installation



1. **NOTE:** Do not damage the running surface of the camshaft.

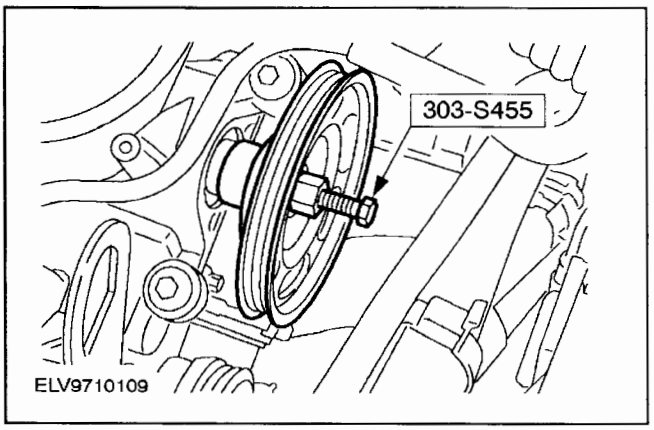
   NOTE: Lubricate the camshaft oil seal with engine oil before installation.

   Install the new camshaft oil seal.

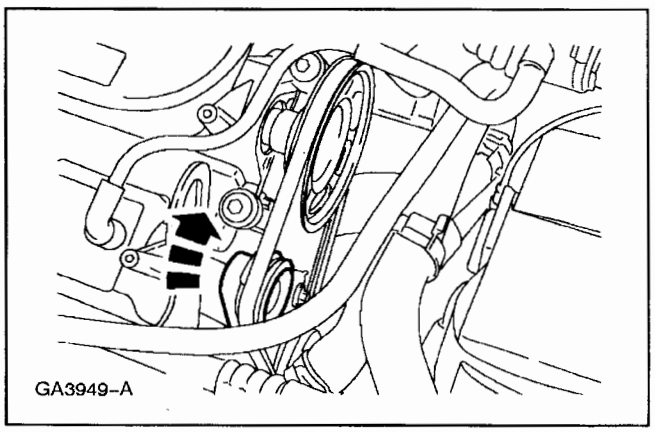
   1 Install special tool on end of camshaft.

   2 Position special tool over the new oil seal.

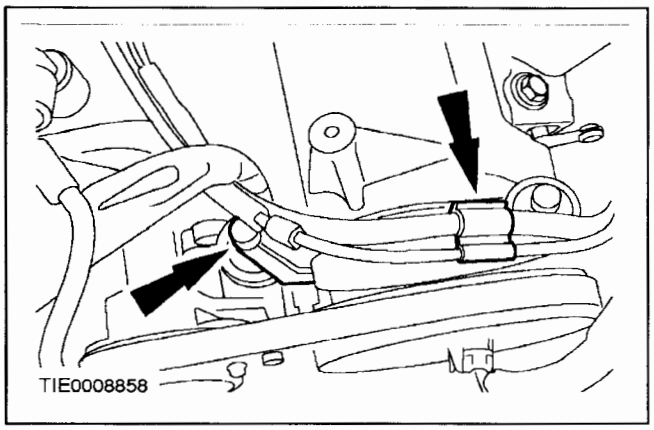
   3 Install special tool then turn to install the oil seal.



2. Using the special tool, install the water pump drive pulley.

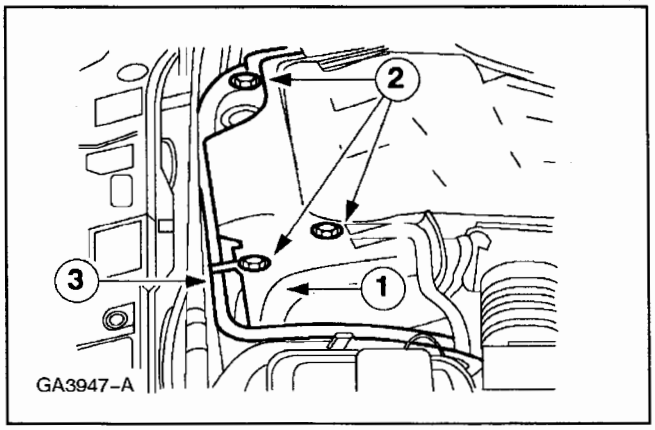


3. Rotate the belt tensioner clockwise towards the camshaft drive pulley and install the belt.



4. Install the bridge and attach the cable and wire.

IN-VEHICLE REPAIR (Continued)



5. Install the water pump pulley cover.
   1 Install the cover.
   2 Install the bolts.
   3 Attach the coolant hose to the clip.

6. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable.

Timing Chain

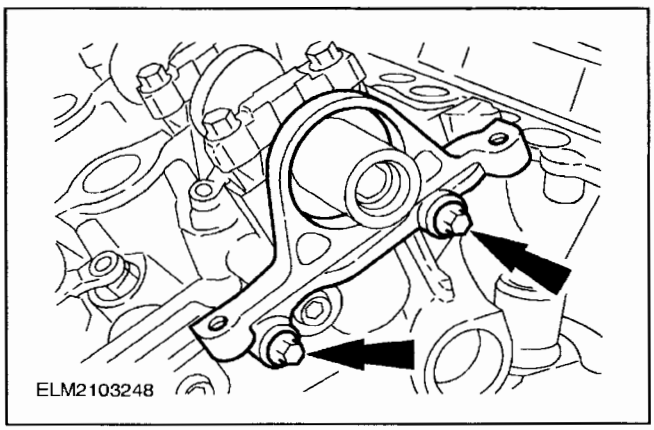
Materials

Item	Specification
Engine oil —	WSS-M2C153-H

Removal

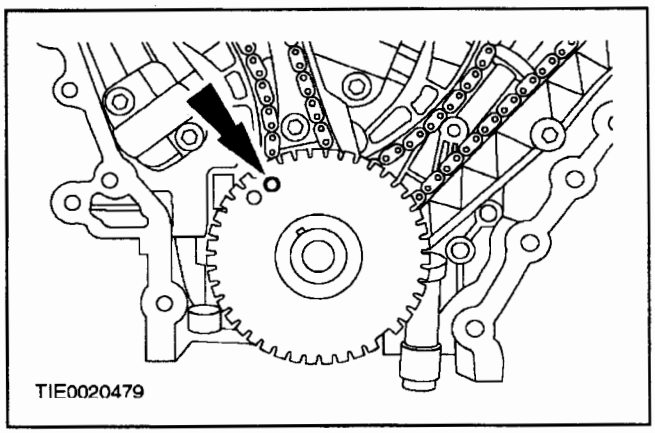
1. Remove and discard the camshaft oil seal. For additional information, refer to Camshaft Oil Seal in this section.

2. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.



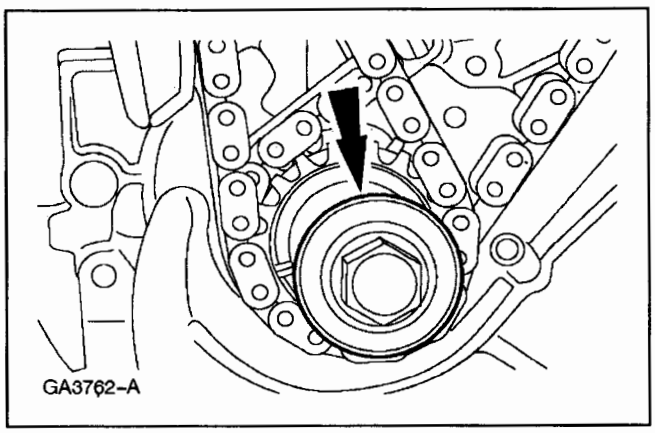
3. Remove the camshaft oil seal retainer.

IN-VEHICLE REPAIR (Continued)

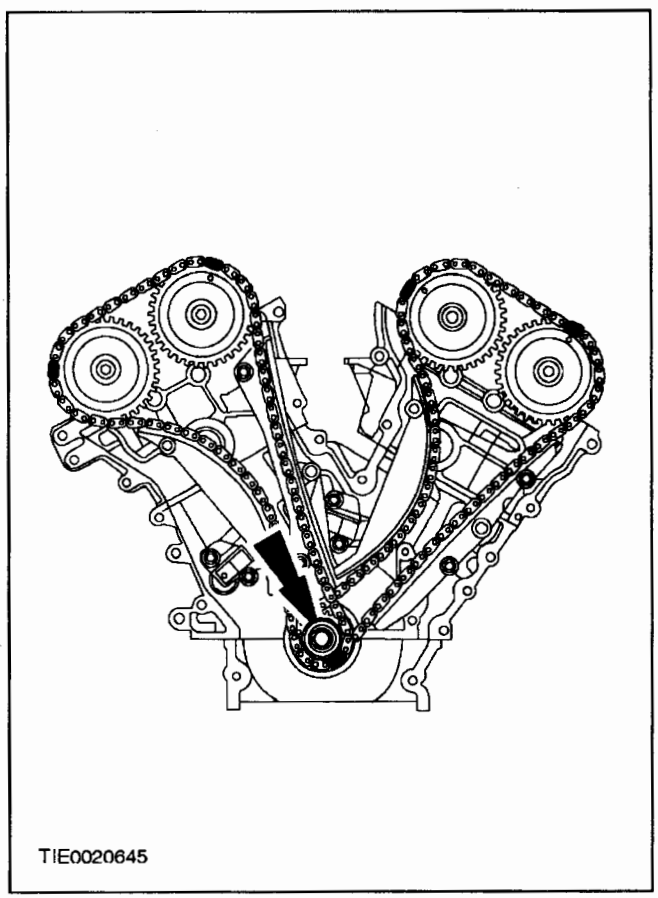

TIE0020479

4. **⚠ CAUTION: This pulse wheel has two keyway slots and is used in several different engines. Install the pulse wheel in the keyway slot stamped 25, color coded blue.**

   Remove the crankshaft position (CKP) sensor pulse wheel.


GA3762-A

5. Install the crankshaft pulley bolt and washer.


TIE0020645

6. **⚠ CAUTION: Rotate the crankshaft clockwise to position the crankshaft keyway to the 11 o'clock position and the engine to top dead center (TDC) No. 1 cylinder before the removal and installation of the camshafts and the roller finger followers or damage to the engine may occur.**

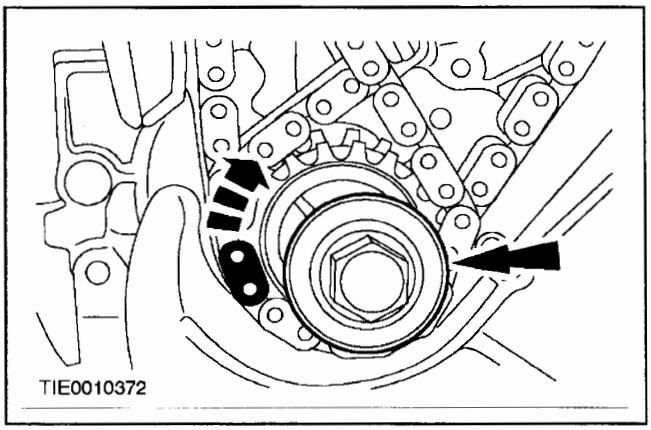
   NOTE: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

   NOTE: If the roller finger follower marks do not align, rotate the crankshaft one complete revolution.

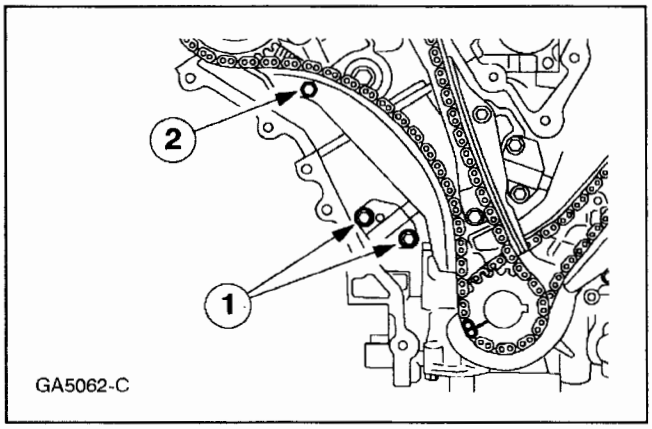
   Position the crankshaft.

   - Rotate the crankshaft keyway clockwise to the 11 o'clock position.

IN-VEHICLE REPAIR (Continued)



7. Rotate the crankshaft clockwise to position the crankshaft keyway in the 3 o'clock position.
   - The right-hand camshafts are in the neutral position.

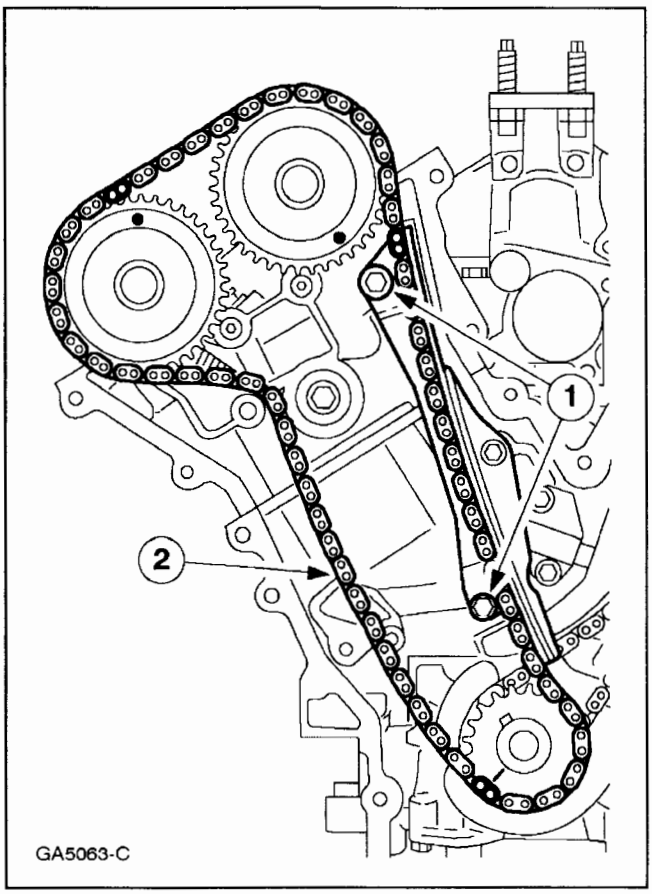


8. **NOTE:** Mark the position of all chain drive components to make sure they are assembled in their original positions.

   Remove the right-hand chain tensioner and tensioner arm.

   1 Remove the bolts, the chain tensioner and the tensioner adapter plate right-hand, (if equipped).

   2 Remove the tensioner arm.

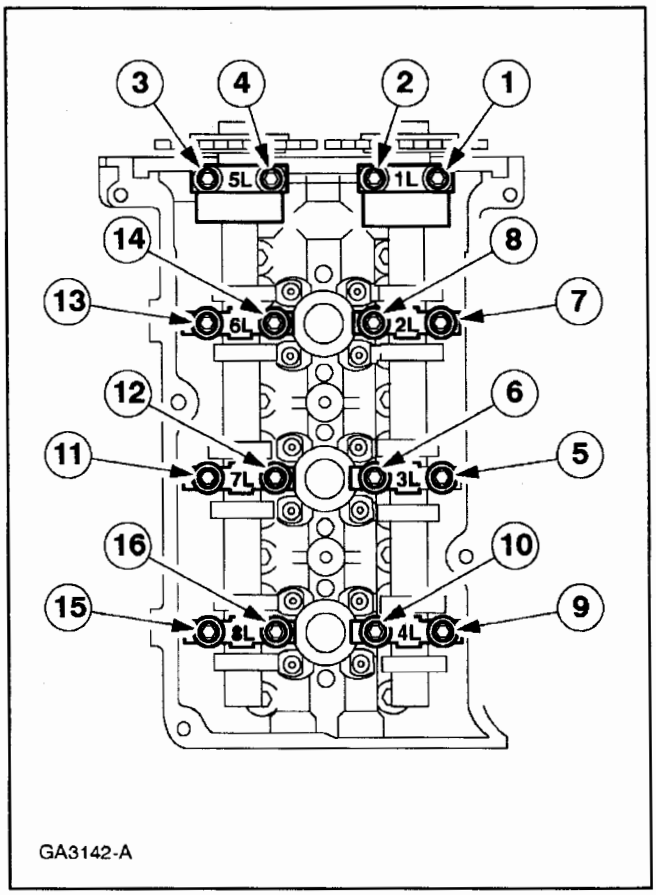


9. Remove the right-hand timing chain.

   1 Remove the timing chain guide.

   2 Remove the right-hand timing chain.

IN-VEHICLE REPAIR (Continued)



GA3142-A

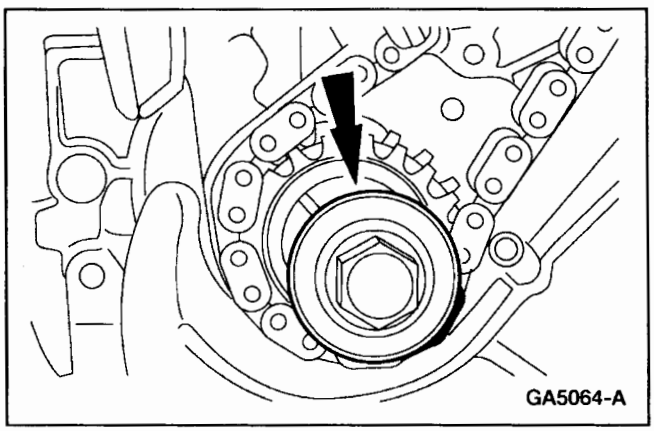
10. ⚠ **CAUTION: The cylinder head and the camshaft bearing caps are numbered to make sure they are reassembled in their original position. When removed, keep the bearing caps with the cylinder head they were removed from. Do not mix the caps.**

    NOTE: Remove the camshaft bearing thrust caps Nos. 1R and 5R first. Do not loosen any other bolts until the thrust caps are removed.

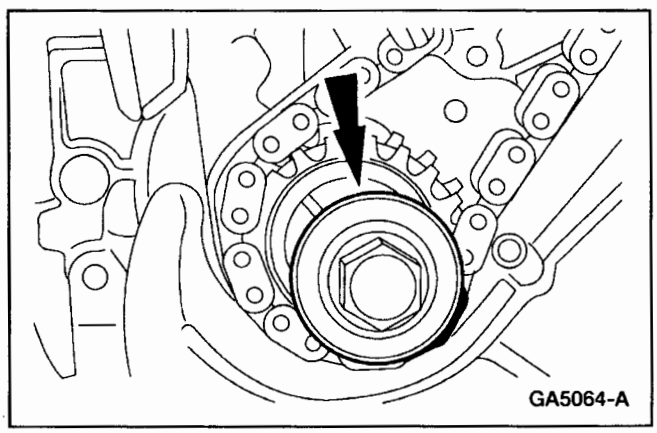
    NOTE: Camshaft bearing caps are dowelled to the cylinder head. If necessary use a plastic mallet to loosen the caps.

    Loosen the camshafts (right-hand cylinder head).

    - Loosen the remaining bolts and bearing caps in the indicated sequence in several passes to allow the camshafts to gradually raise from the cylinder head.
    - Remove the roller finger followers.

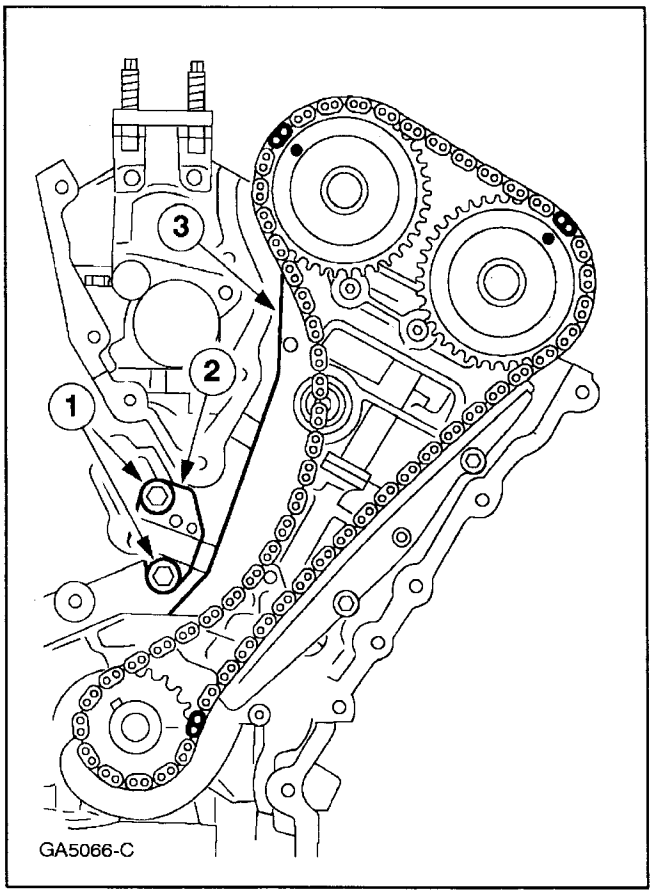

GA5064-A

11. Rotate the crankshaft clockwise 2 revolutions until the keyway is in the 11 o'clock position.

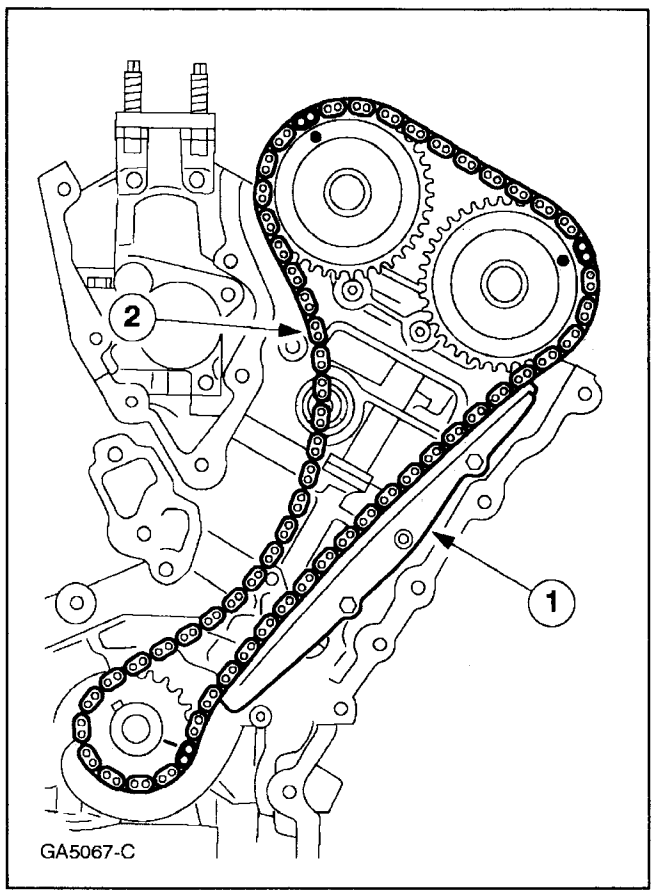

GA5064-A

12. Remove the crankshaft pulley bolt and washer.

IN-VEHICLE REPAIR (Continued)

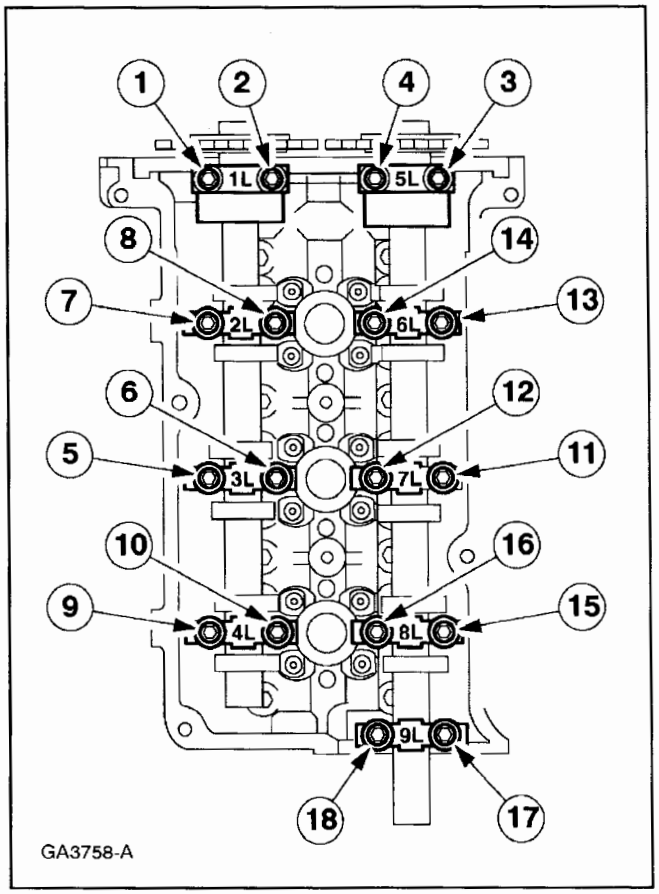


13. Remove the left-hand chain tensioner and tensioner arm.
    1 Remove the bolts.
    2 Remove the chain tensioner and the tensioner adapter plate left-hand, if equipped.
    3 Remove the tensioner arm.



14. Remove the left-hand timing chain.
    1 Remove the fixed chain guide.
    2 Remove the left-hand timing chain.

IN-VEHICLE REPAIR (Continued)



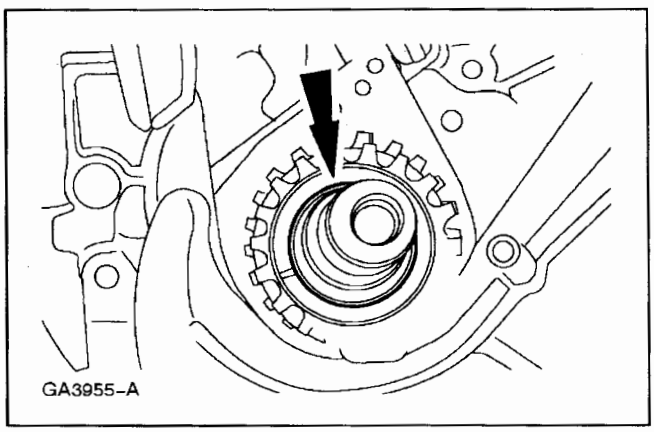
GA3758-A

15. ⚠ **CAUTION: The cylinder head and the camshaft bearing caps are numbered to make sure they are reassembled in their original position. When removed, keep the bearing caps with the cylinder head they were removed from. Do not mix the caps.**

    NOTE: Remove the camshaft bearing thrust caps Nos. 1L and 5L first. Do not loosen any other bolts until the thrust caps are removed.

    Loosen the camshafts (left-hand cylinder head).

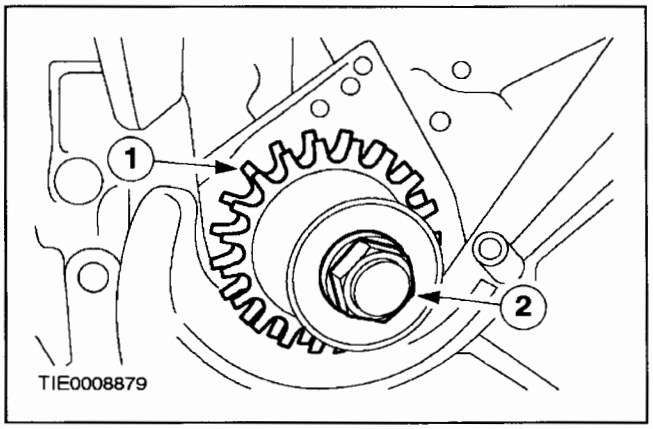
    - Loosen the remaining bolts and bearing caps in the indicated sequence in several passes to allow the camshafts to gradually raise from the cylinder head.
    - Remove the roller finger followers.


GA3955-A

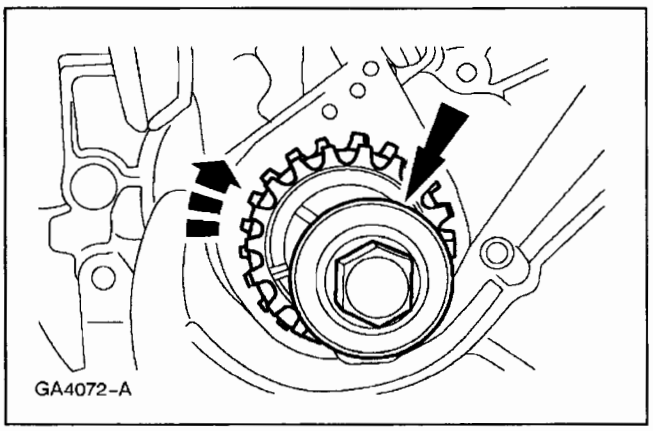
16. Remove the timing chain sprockets.

IN-VEHICLE REPAIR (Continued)

Installation



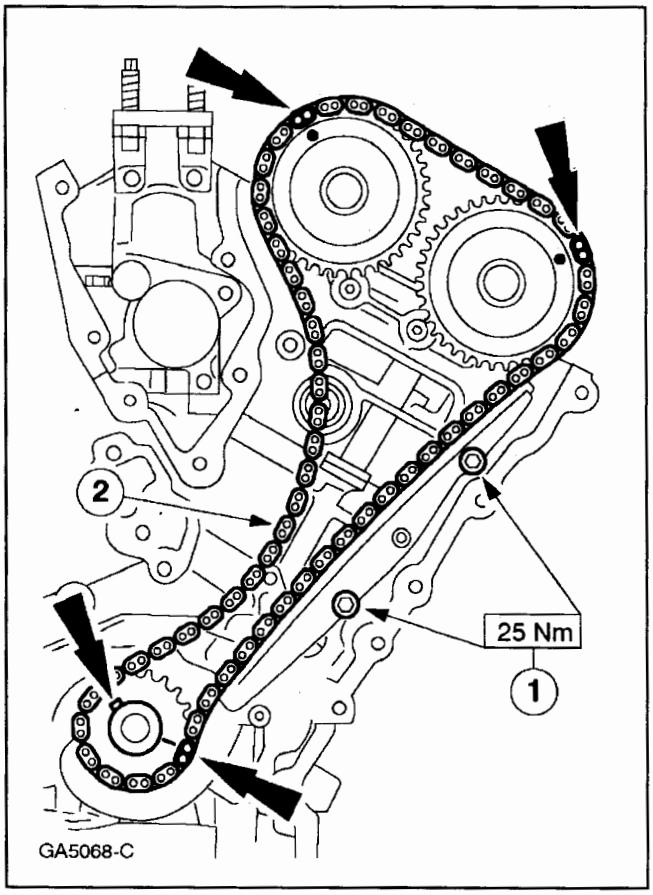
1. Install the crankshaft pulley washer and bolt.
   1 Install the timing chain sprockets.
   2 Install the washer and bolt.



2. Position the crankshaft.
   - Turn the crankshaft clockwise to position the key to the 11 o'clock position.
   - Remove the crankshaft pulley bolt and washer.

3. Lubricate the camshafts with engine oil.

IN-VEHICLE REPAIR (Continued)

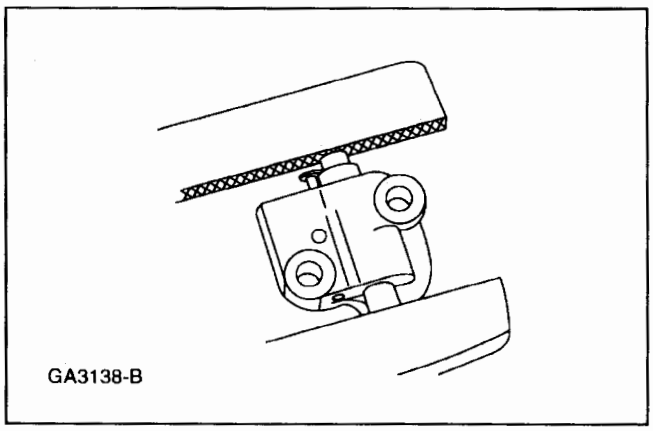


4. **NOTE:** The colored links of the timing chain and the marks on the timing sprockets must line up.

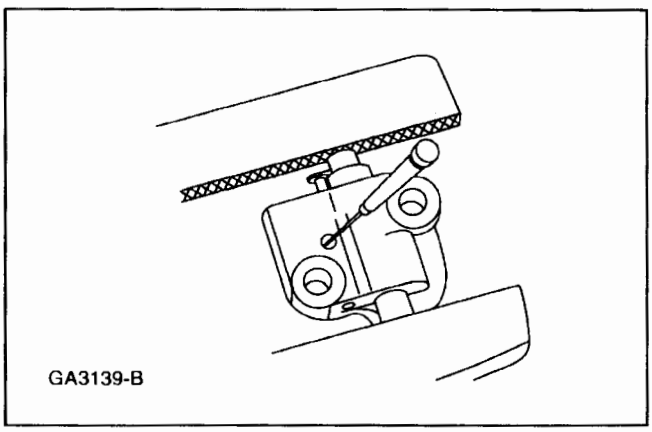
   Install the left-hand timing chain.

   1 Install the left-hand chain guide and bolts.

   2 Install the timing chain.



5. Position the left-hand timing chain tensioner in a vise with jaw protectors.



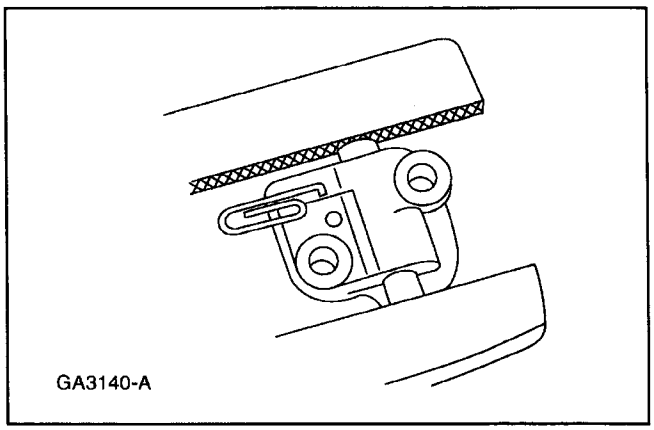
6. ⚠ **CAUTION: During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore, or damage to the ratchet stem will result.**

   Hold the left-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.

IN-VEHICLE REPAIR (Continued)

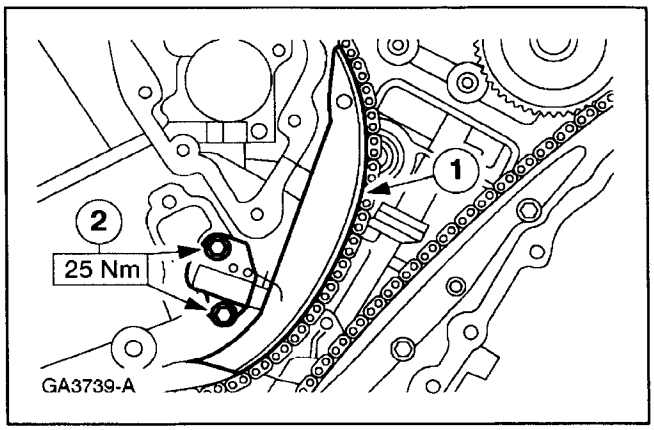
7. **NOTE:** The piston should retract with minimal force. If binding occurs, reposition the tensioner to eliminate side loading.

   Slowly compress the left-hand timing chain tensioner.



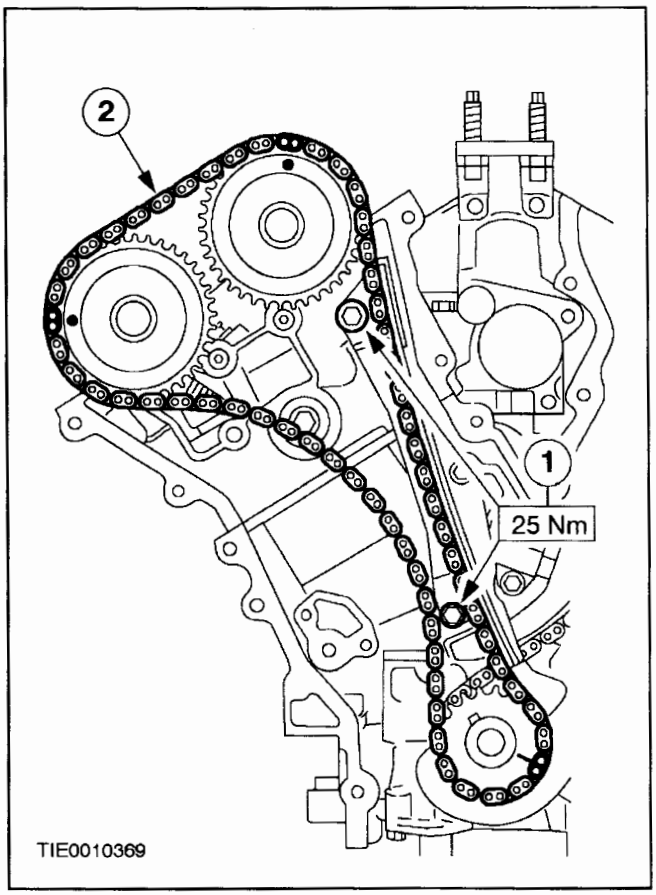
8. **NOTE:** The wire must remain in the timing chain tensioner until the tensioner is installed onto the engine with the piston bottomed in the bore.

   Retain piston with a 1.5 mm wire or paper clip.



9. Install the left-hand timing chain tensioner.
   1. Install the left-hand tensioner arm (black material).
   2. Install the left-hand tensioner adapter plate and the timing chain tensioner.

IN-VEHICLE REPAIR (Continued)

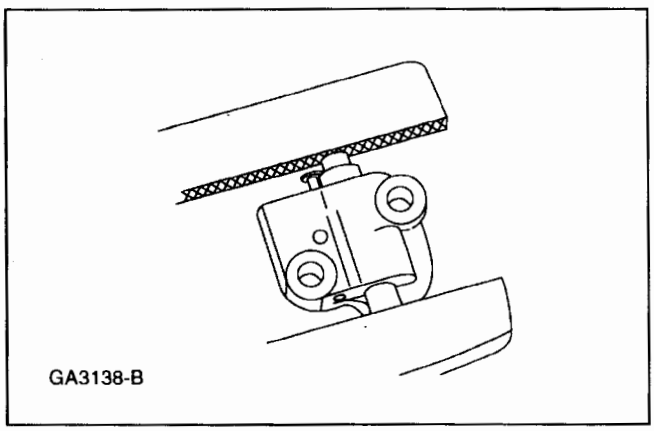


10. **NOTE:** The colored links of the timing chain and the marks on the timing sprockets must line up.

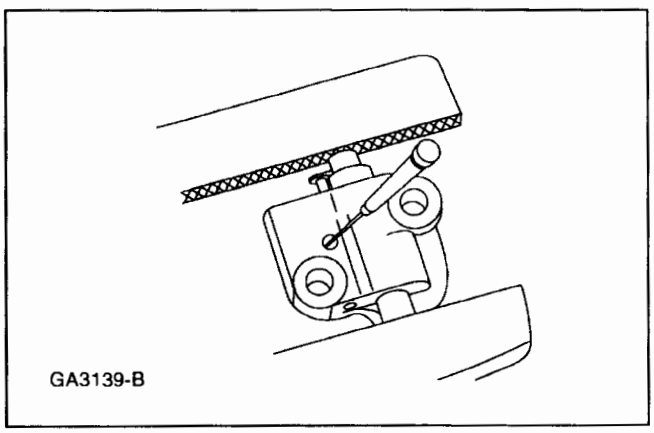
    Install the right-hand timing chain.

    1 Install the timing chain guide and bolts.

    2 Install the timing chain.



11. Position the right-hand timing chain tensioner in a vise with jaw protectors.



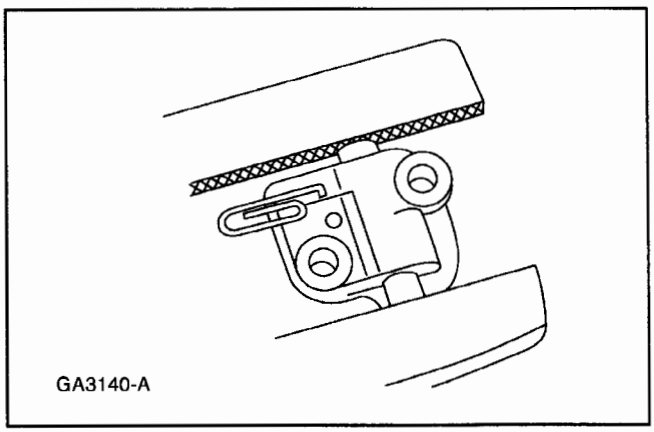
12. ⚠ **CAUTION: During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore, or damage to the ratchet stem will result.**

    Hold the right-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.

IN-VEHICLE REPAIR (Continued)

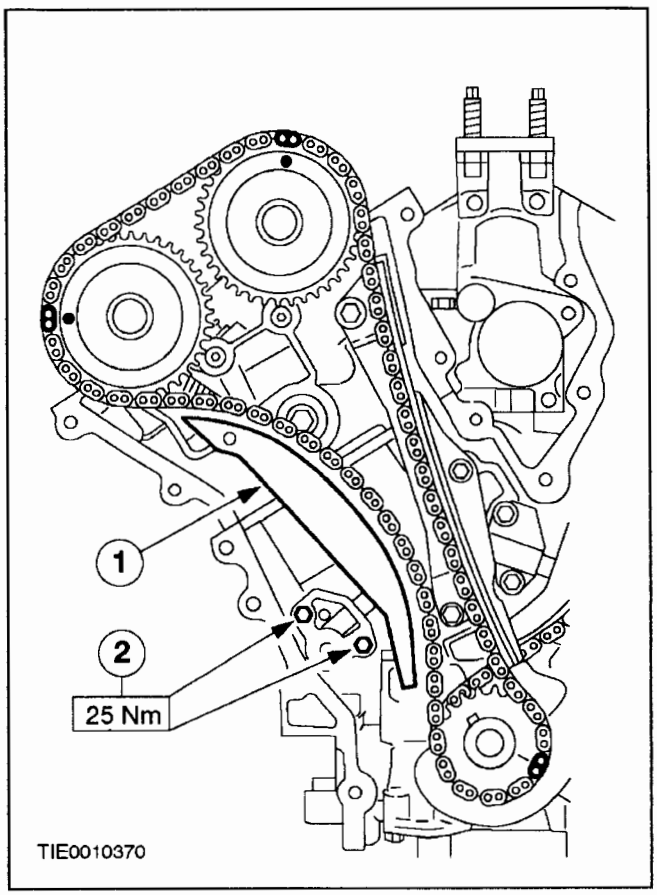
13. **NOTE:** The piston should retract with minimal force. If binding occurs, reposition the tensioner to eliminate side loading.

    Slowly compress the right-hand timing chain tensioner.



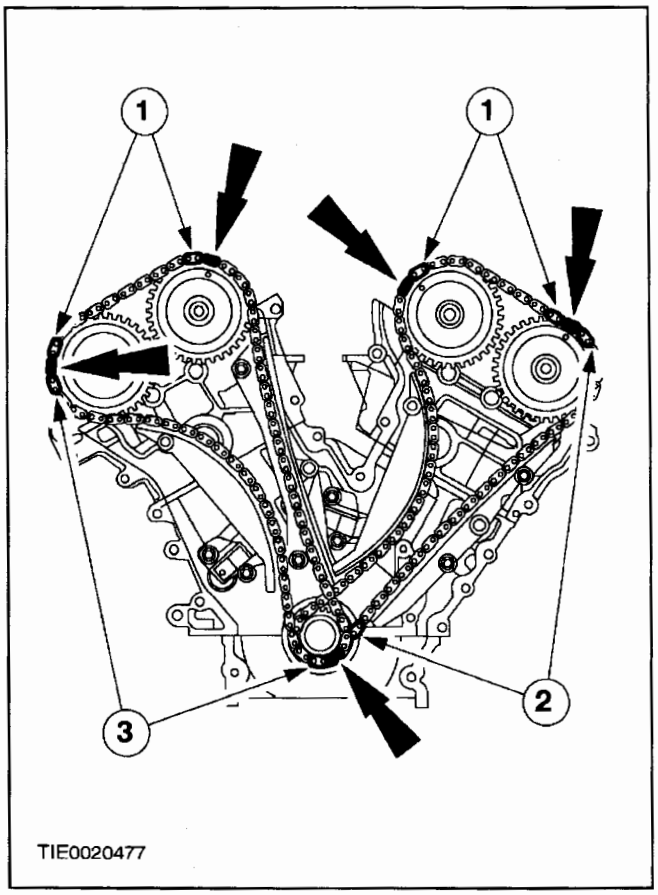
14. **NOTE:** The wire must remain in the timing chain tensioner until the tensioner is installed with the piston bottomed in the bore.

    Retain piston with a 1.5 mm wire or paper clip.



15. Install the right-hand timing chain tensioner.
    1. Install the right-hand tensioner arm (tan material).
    2. Install the right-hand tensioner adapter plate and the timing chain tensioner.

IN-VEHICLE REPAIR (Continued)



TIE0020477

16. **NOTE:** Ignore the timing flags on the rear of the camshaft sprockets.

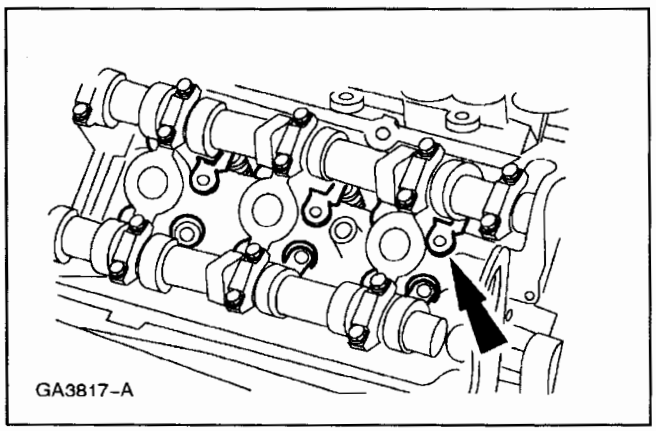
    NOTE: Check the number of timing chain links between the camshaft front timing marks and the timing marks on the crankshaft sprockets.

    Check the camshaft timing.

    1 10 links.

    2 23 Links.

    3 25 Links.


GA3817-A

17. **⚠ CAUTION: The crankshaft keyway must be in the 11 o'clock position prior to installation of the left-hand cylinder roller finger followers. Failure to do so may lead to engine damage.**

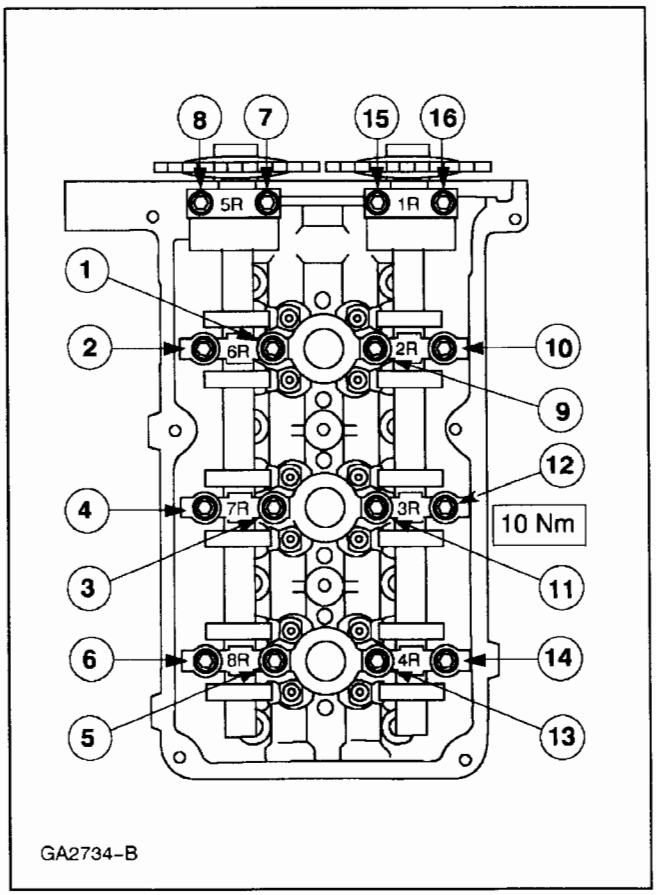
    NOTE: Verify that all timing marks are in the correct position before installing the roller finger followers.

    NOTE: Roller finger followers must be installed in their original locations.

    Install the left-hand roller finger followers.

    - Lubricate the roller finger followers with engine oil.

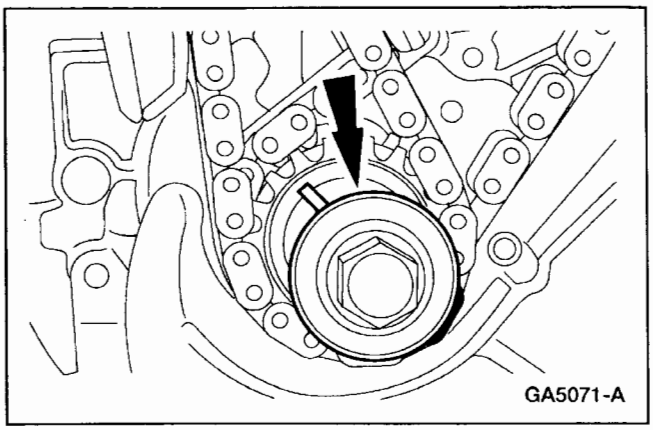
IN-VEHICLE REPAIR (Continued)



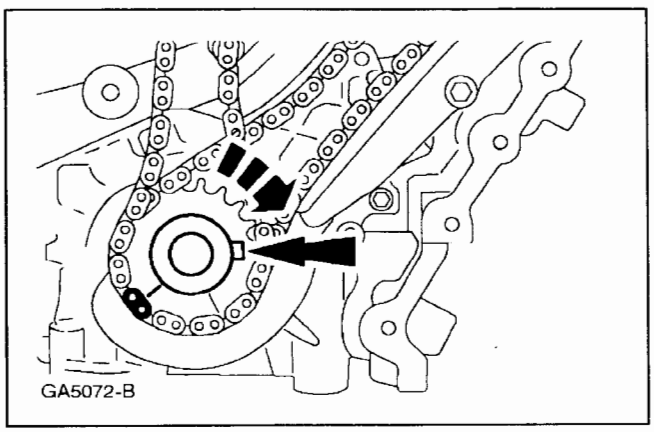
18. ⚠ **CAUTION: Do not install the left-hand cylinder head camshaft journal thrust caps until camshaft journal caps are installed or damage to the thrust caps may occur.**

    NOTE: With left-hand cylinder head roller finger followers installed, align camshaft endplay using thrust caps as a guide before tightening journal caps.

    Tighten the left-hand camshaft cap bolts in the indicated sequence in several passes.



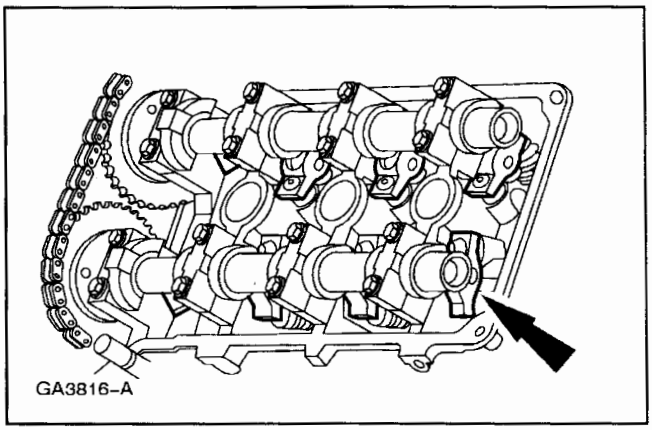
19. Install the crankshaft pulley bolt and washer.



20. ⚠ **CAUTION: Rotating the crankshaft counterclockwise may cause the timing chains to bind and may cause engine damage.**

    Rotate the engine clockwise to locate the crankshaft keyway to the 3 o'clock position.

IN-VEHICLE REPAIR (Continued)

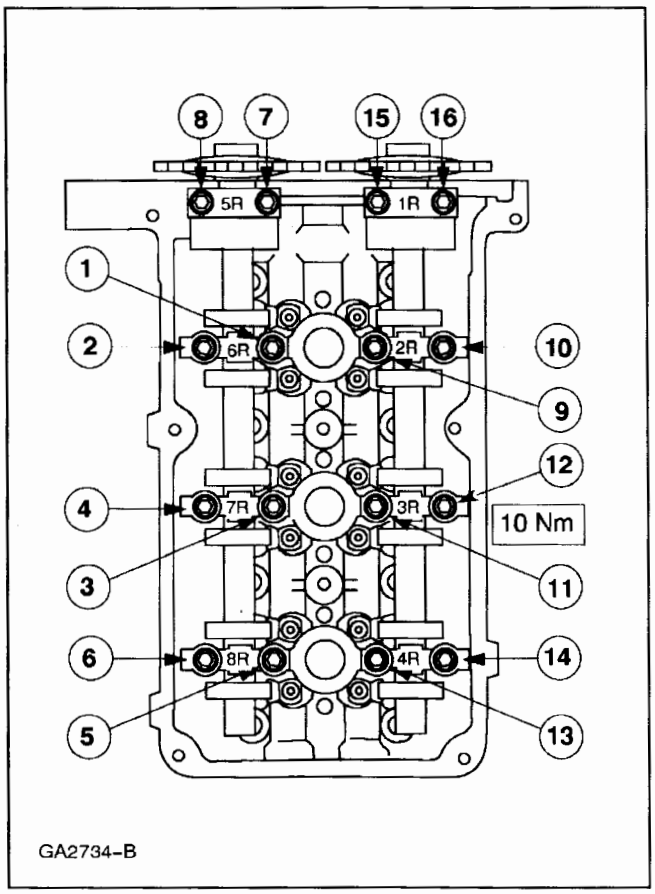


21. ⚠ **CAUTION: The crankshaft keyway must be in the 3 o'clock position before installation of the right-hand cylinder head roller finger followers. Failure to do so may lead to engine damage.**

    NOTE: Roller finger followers must be installed in their original locations.

    Install the right-hand roller finger followers.

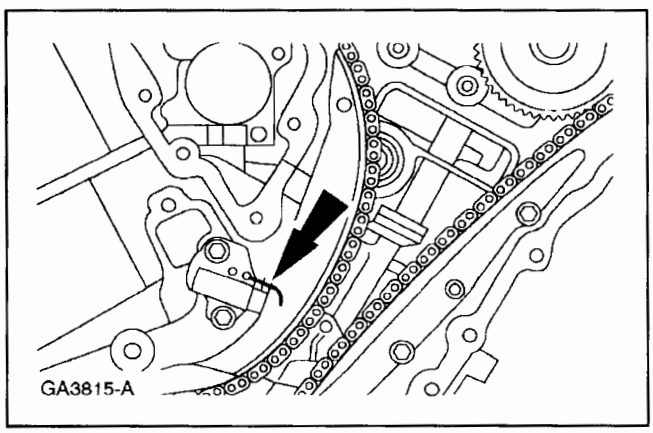
    - Lubricate the roller finger followers with engine oil.



22. ⚠ **CAUTION: Do not install the right-hand cylinder head camshaft journal thrust caps until camshaft journal caps are installed, or damage to the thrust caps may occur.**

    NOTE: With the right-hand cylinder head roller finger followers installed, align the camshaft end play using the thrust caps as a guide before tightening the journal caps.

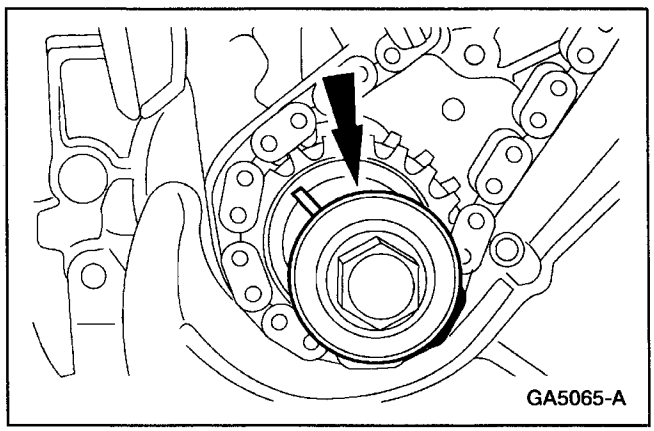
    Tighten the right-hand camshaft cap bolts in the indicated sequence in several passes.



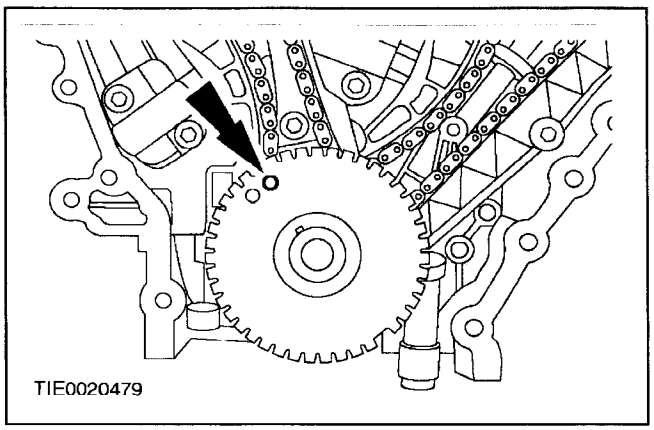
23. **NOTE:** Left-hand shown, right-hand similar.

    Remove the right-hand and left-hand chain tensioner retaining wires.

IN-VEHICLE REPAIR (Continued)

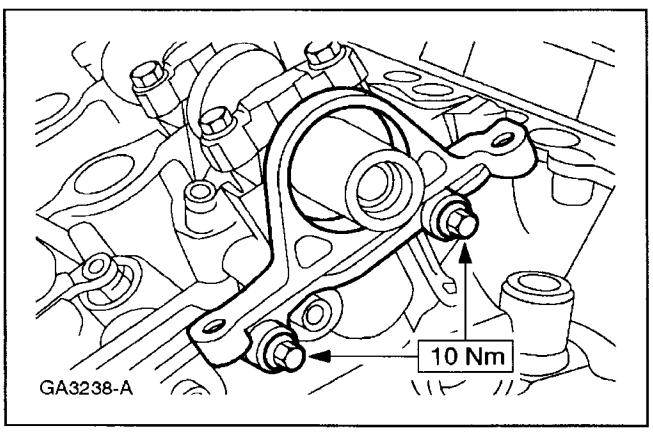


24. Remove the crankshaft pulley bolt and washer.



25. ⚠ **CAUTION: This pulse wheel has two keyway slots and is used in several different engines.**

    Install the pulse wheel with the keyway in the slot stamped 25, color coded blue.



26. Install the camshaft oil seal retainer.

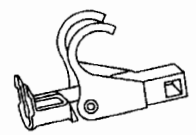
27. Install a new camshaft oil seal. For additional information, refer to Camshaft Oil Seal in this section.

28. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

IN-VEHICLE REPAIR (Continued)

Camshaft Followers

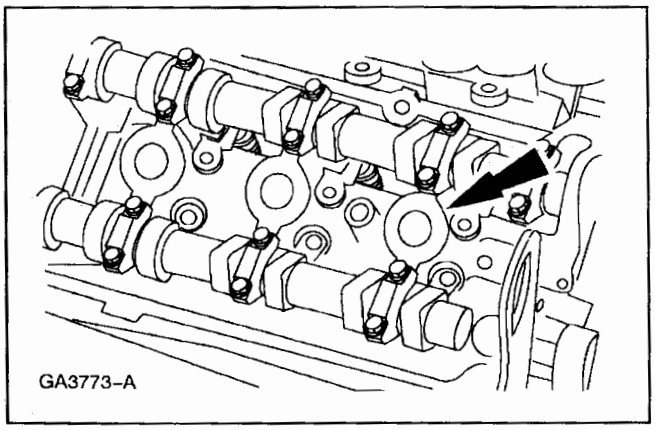
Special Tool(s)

 ST1975-A	Valve Spring Compressor 303-473 (T94P-6565-BH)

Removal

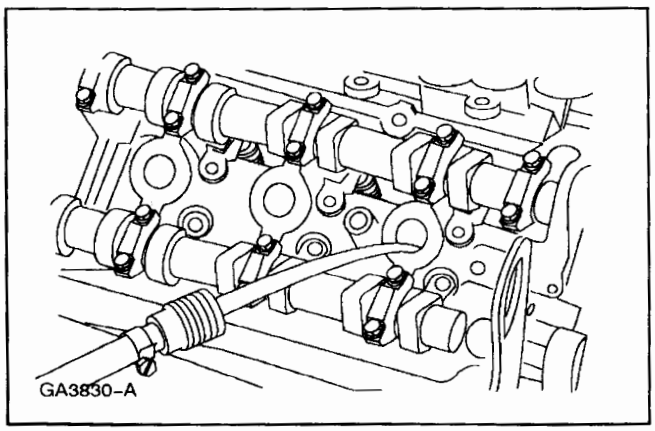
1. Remove the left-hand valve cover. For additional information, refer to Valve Cover—LH in this section.

2. Remove the right-hand valve cover. For additional information, refer to Valve Cover—RH in this section.


GA3773-A

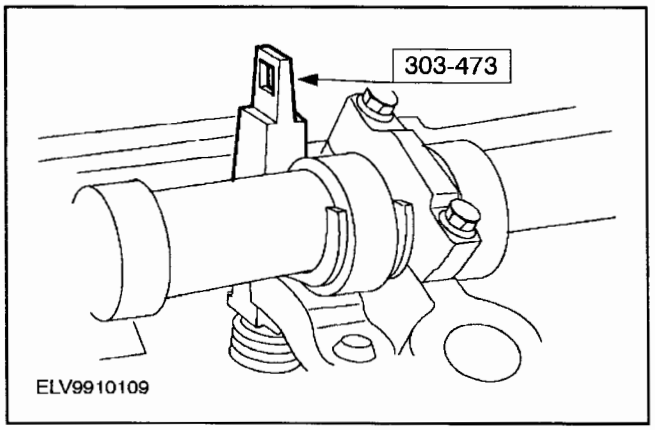
3. **CAUTION: The piston must be at the bottom of its stroke with both valves closed. Any loss of air pressure will allow the valve to fall into the cylinder.**

   Remove the spark plug.


GA3830-A

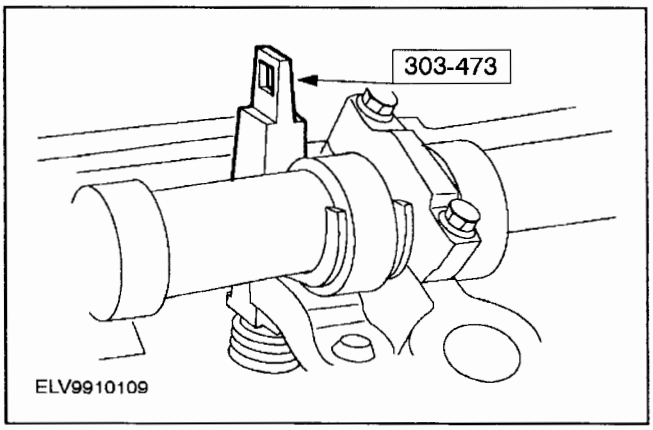
4. Install the adapter into the spark plug bore and connect a compressed air supply at 102-144 psi.

IN-VEHICLE REPAIR (Continued)

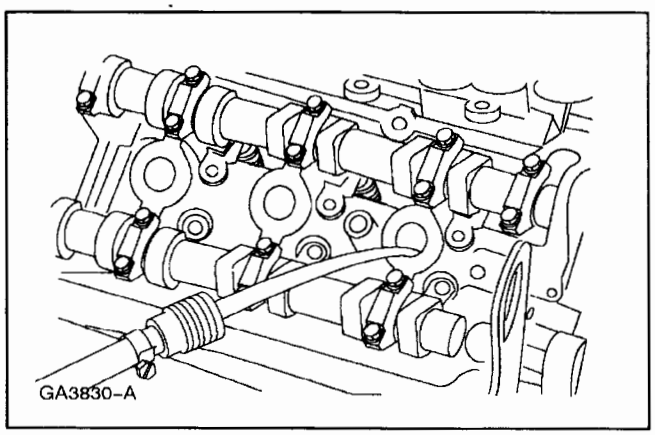


5. Using the special tool, compress the valve spring and remove the roller finger follower.

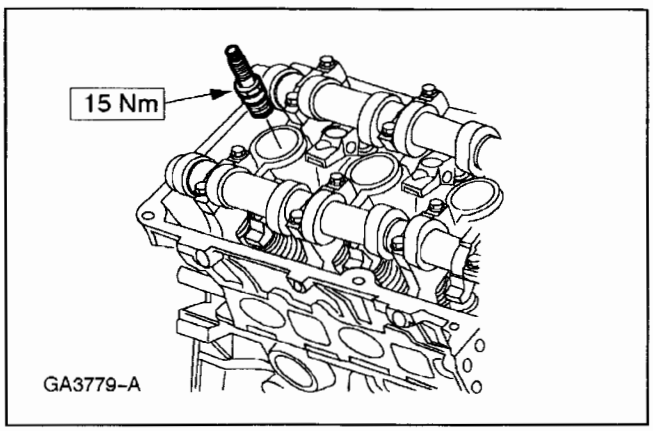
Installation



1. Using the special tool, compress the valve spring and install the roller finger follower.



2. Remove the adapter for the compressed air supply.



3. Install the spark plug.

IN-VEHICLE REPAIR (Continued)

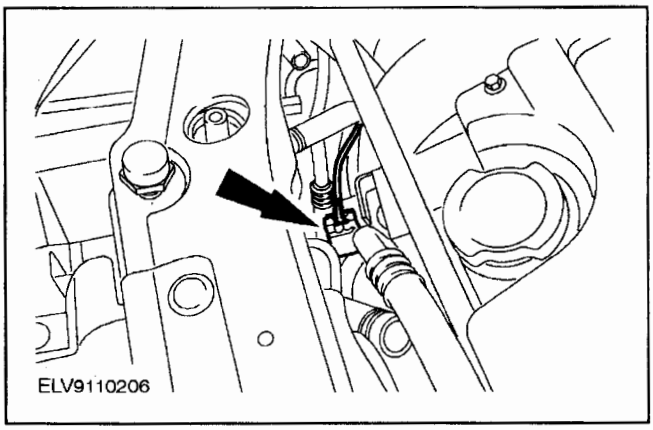
4. Install the right-hand valve cover. For additional information, refer to Valve Cover—RH in this section.

5. Install the left-hand valve cover. For additional information, refer to Valve Cover—LH in this section.

Exhaust Manifold — LH

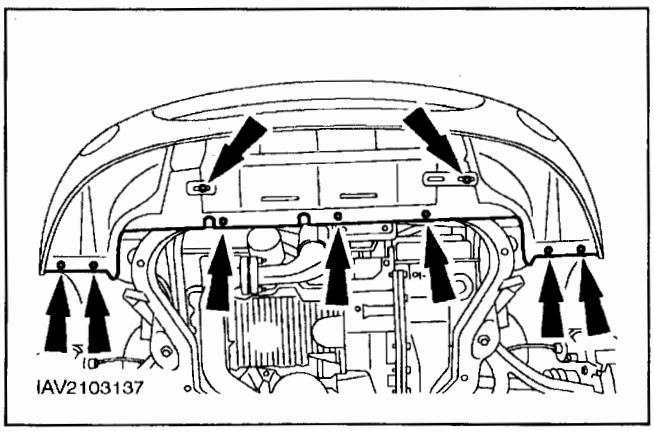
Removal

1. Disconnect the battery ground cable.



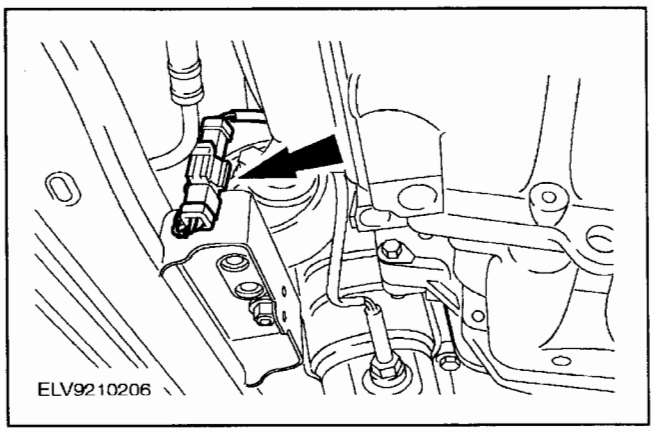
2. Disconnect the upper heated oxygen sensor (HO2S) electrical connector.

3. Raise and support the vehicle. For additional information, refer to Section 100-02.

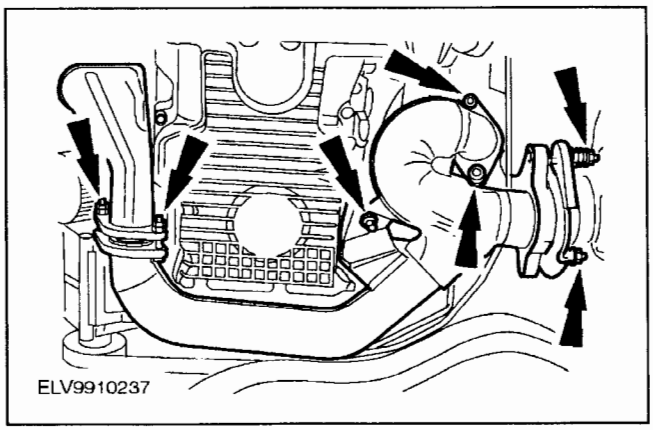


4. Remove the radiator splash shield.

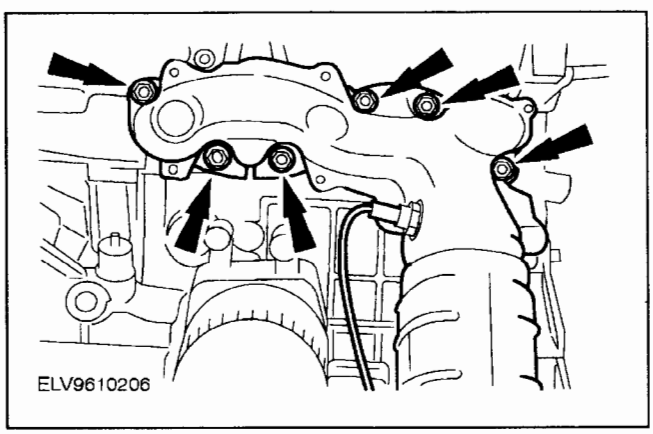
IN-VEHICLE REPAIR (Continued)



5. Disconnect the lower HO2S electrical connector.

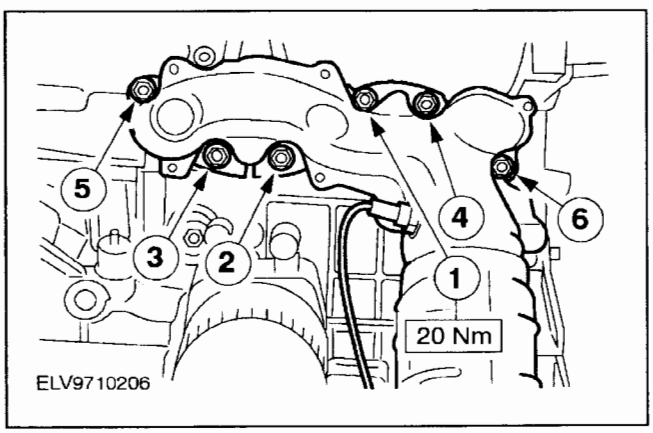


6. Remove the exhaust pipe.
   - Discard the gaskets.



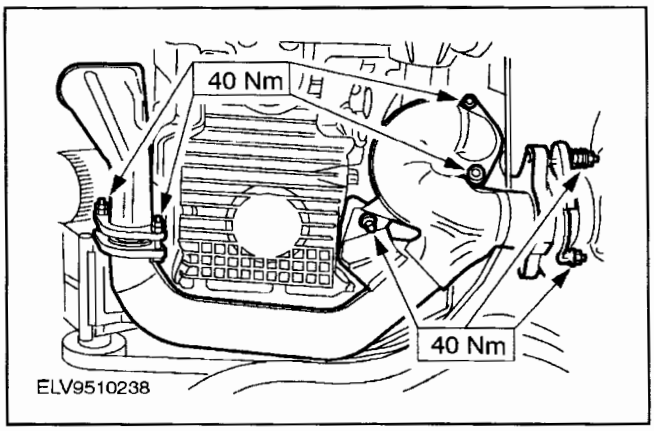
7. **NOTE:** Use a 3/8'' socket set.
   Remove the exhaust manifold.
   - Discard the gasket.

Installation

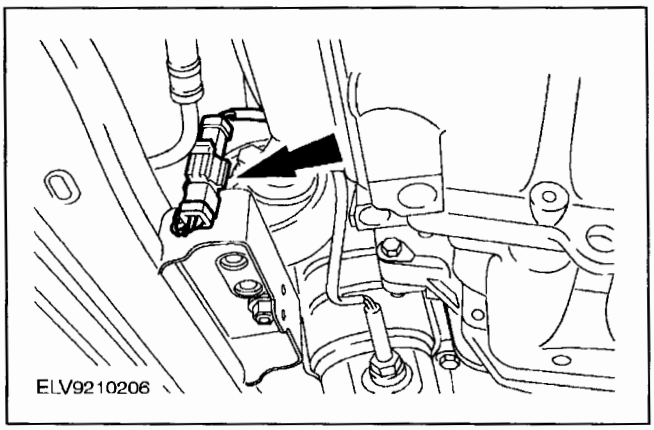


1. **NOTE:** Tighten the nuts in the sequence shown.
   Install the exhaust manifold with a new gasket.

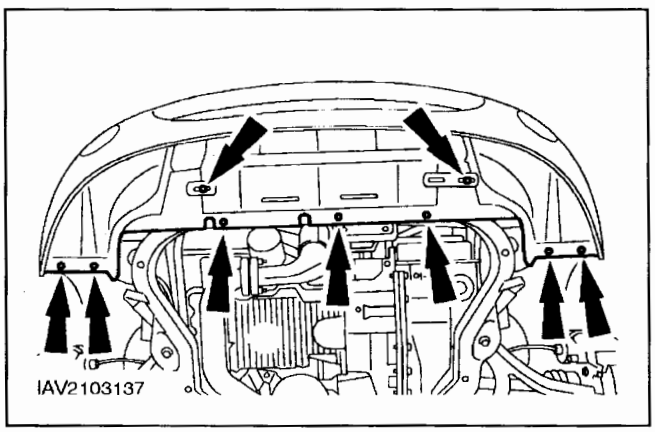
IN-VEHICLE REPAIR (Continued)



2. Install the exhaust pipe.

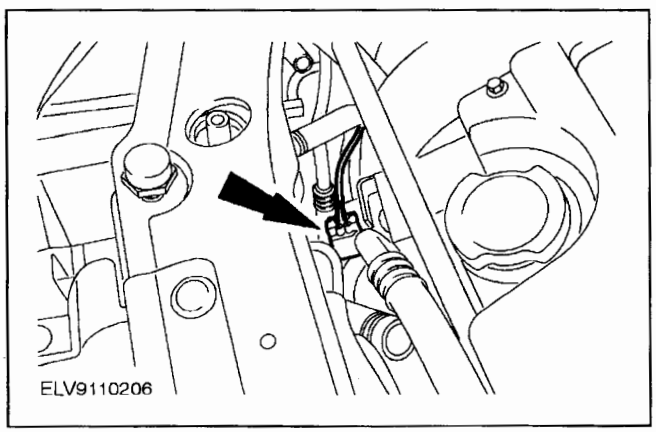


3. Connect the lower HO2S electrical connector.



4. Install the radiator splash shield.

5. Lower the vehicle.



6. Connect the upper HO2S electrical connector.

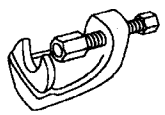
IN-VEHICLE REPAIR (Continued)

7. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Connect the battery ground cable.

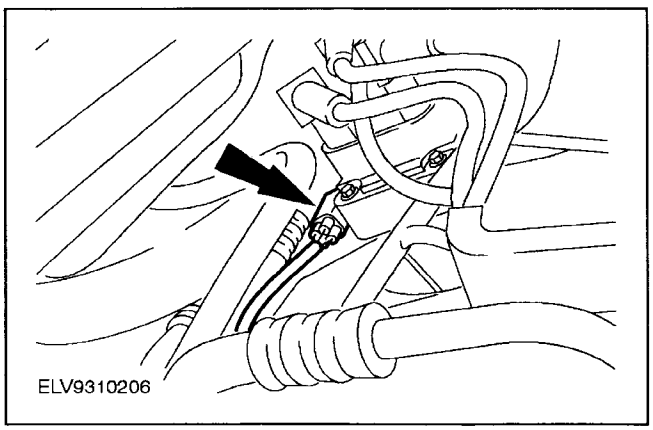
Exhaust Manifold — RH

Special Tool(s)

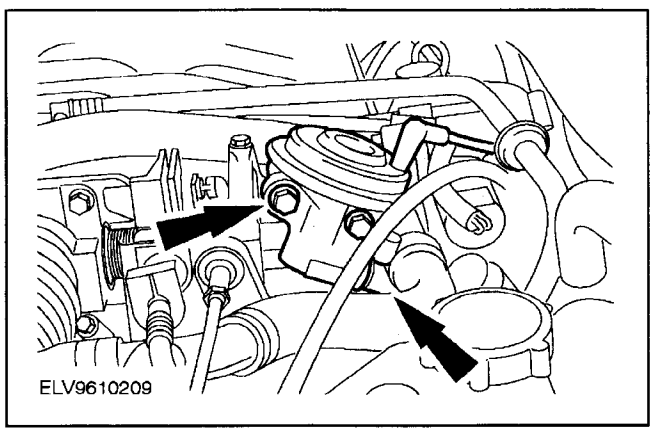
 211-001	Separator, Ball Joint 211-001 (TOOL-3290-D)

Removal

1. Disconnect the battery ground cable.



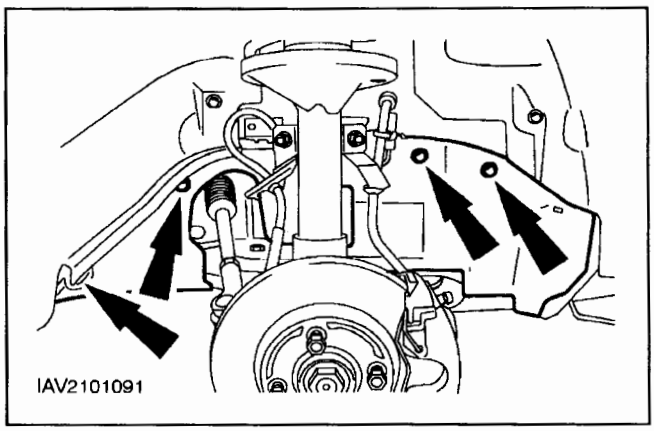
2. Disconnect the upper heated oxygen sensor (HO2S) electrical connector.



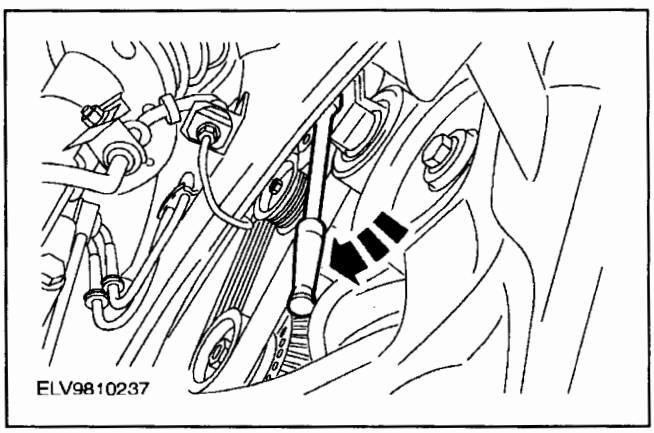
3. Remove the exhaust gas recirculation (EGR) valve from the intake manifold.
   - Loosen the EGR pipe.

IN-VEHICLE REPAIR (Continued)

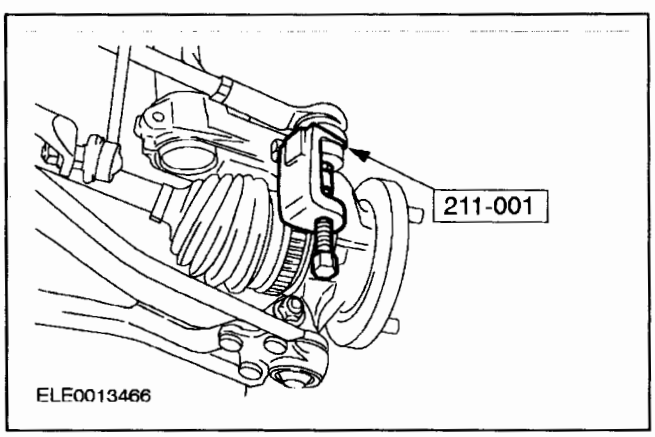
4. Remove the right-hand front wheel. For additional information, refer to Section 204-04.



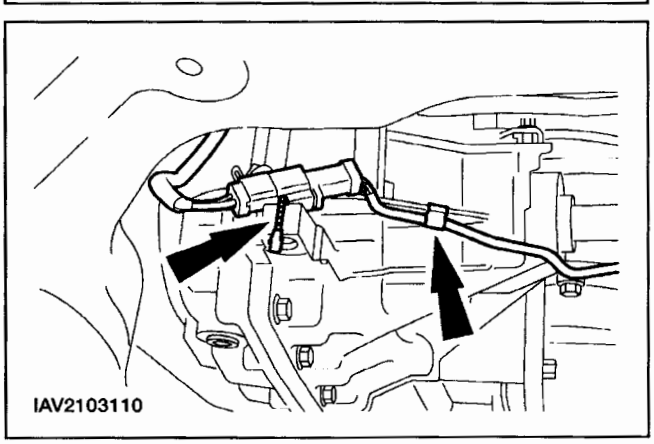
5. Remove the right-hand fender splash shields.



6. Loosen the accessory drive belt and remove the drive belt from the generator.

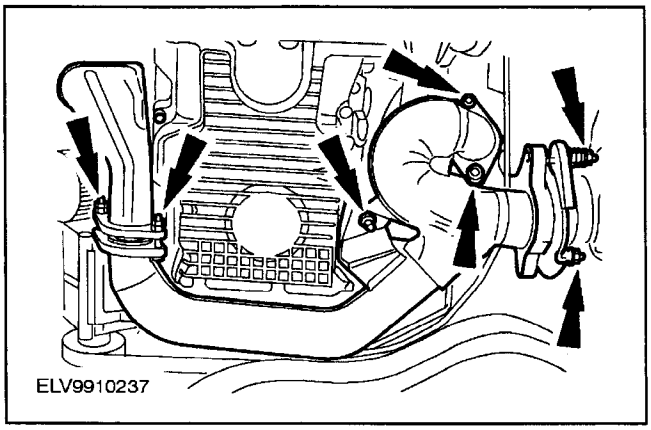


7. Using the special tool, disconnect the right-hand tie-rod end.

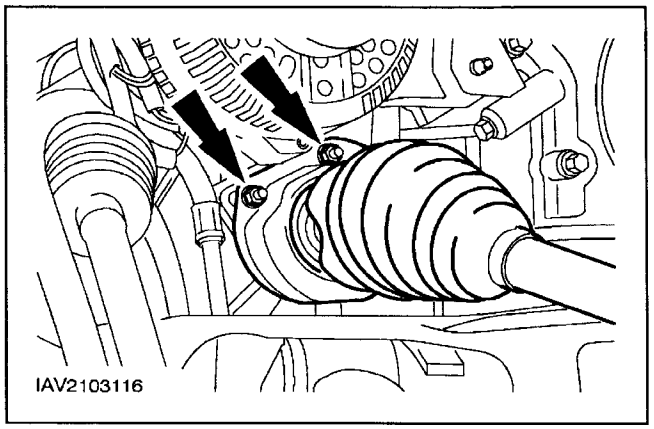


8. Disconnect the lower HO2S electrical connector.
   - Cut the cable ties.
   - Detach the cable from the clip.

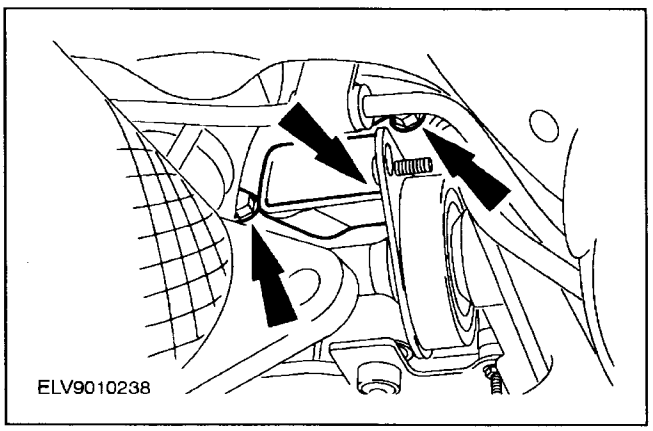
IN-VEHICLE REPAIR (Continued)



9. Remove the exhaust pipe.
   - Discard the gaskets.



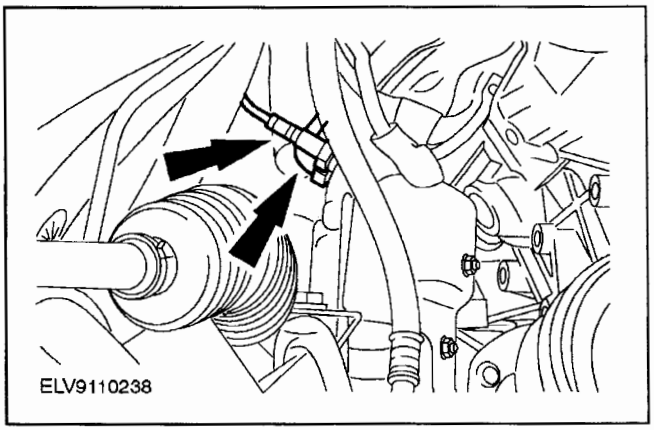
10. Remove the front axle drive halfshaft center bearing bolts and the heat shield.



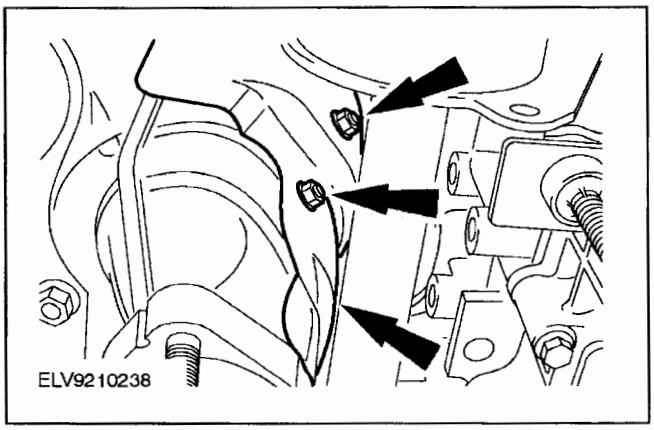
11. Remove the front axle drive halfshaft center bearing bracket.

12. Remove the generator. For additional information, refer to Section 414-02.

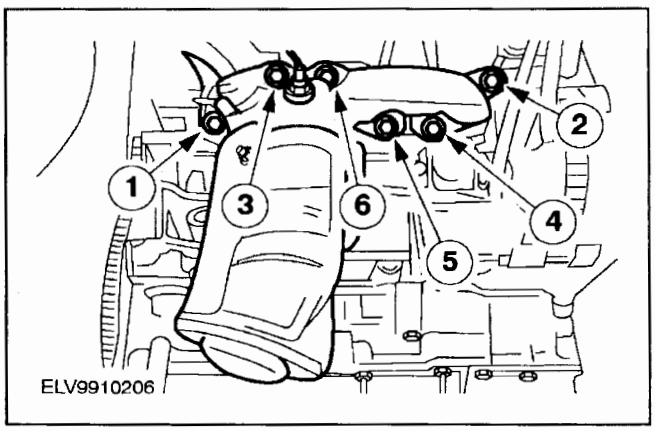
IN-VEHICLE REPAIR (Continued)



13. Remove the upper HO2S sensor and the EGR pipe.

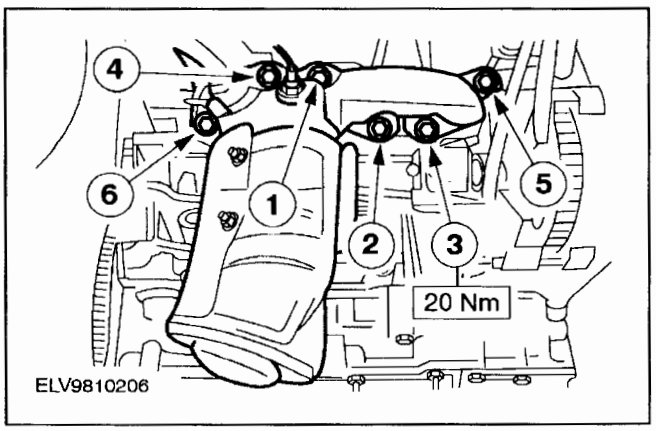


14. Remove the exhaust manifold heat shield.



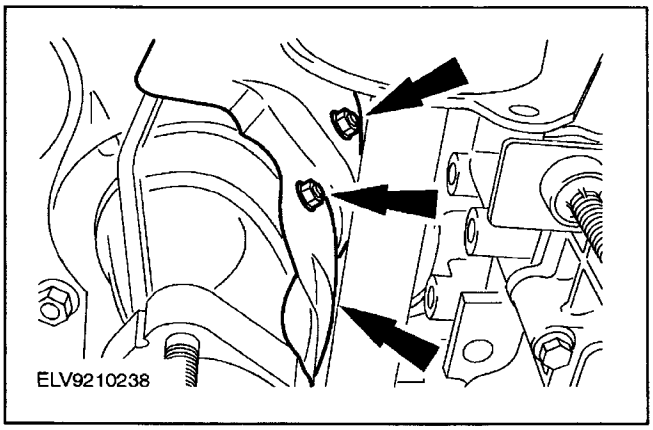
15. Remove the exhaust manifold (shown on removed engine).
    - Discard the gasket.

Installation



1. **NOTE:** Tighten the nuts in the sequence shown.
   Install the exhaust manifold with a new gasket (shown on removed engine).

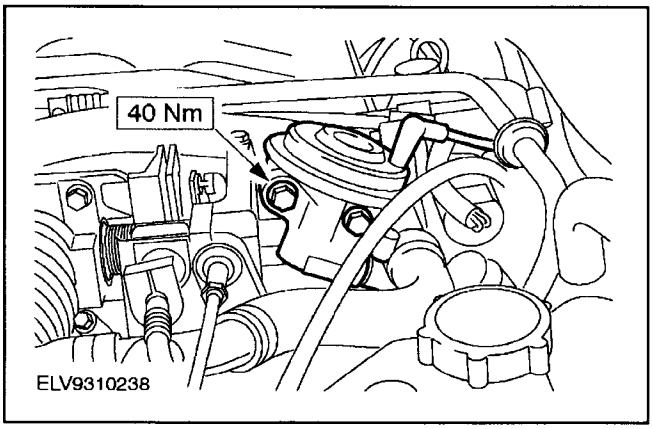
IN-VEHICLE REPAIR (Continued)



2. Install the exhaust manifold heat shield.

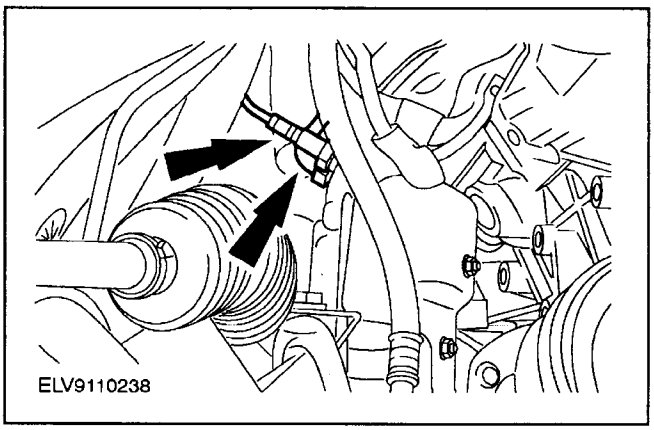
3. Position the EGR pipe to exhaust manifold.

4. Lower the vehicle.



5. Install the EGR valve to intake manifold.

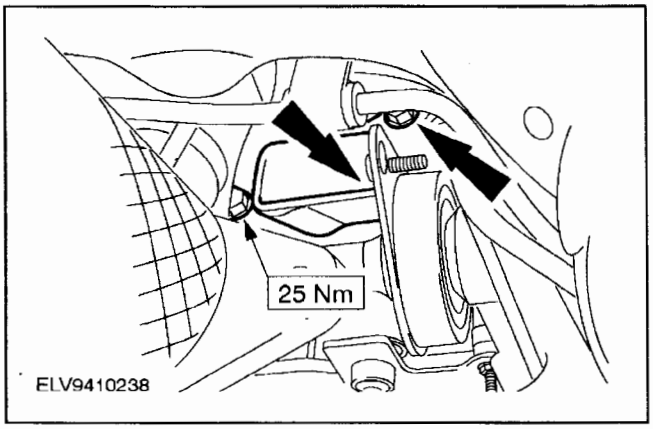
6. Raise and support the vehicle. For additional information, refer to Section 100-02.



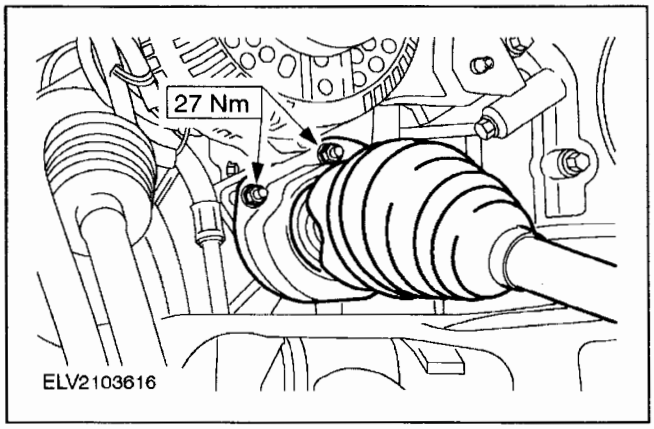
7. Install the upper HO2S and tighten the EGR pipe.

8. Install the generator. For additional information, refer to Section 414-02.

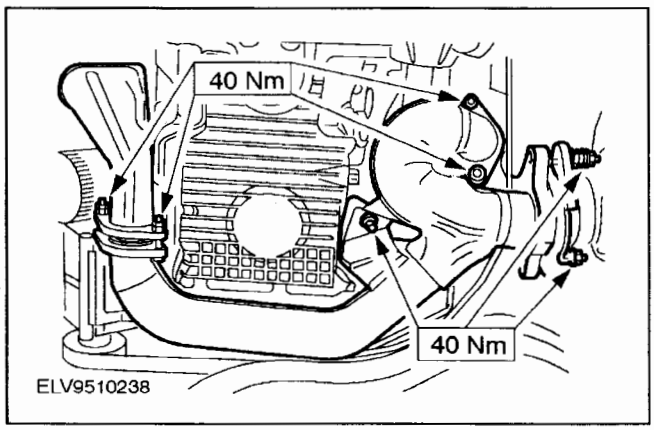
IN-VEHICLE REPAIR (Continued)



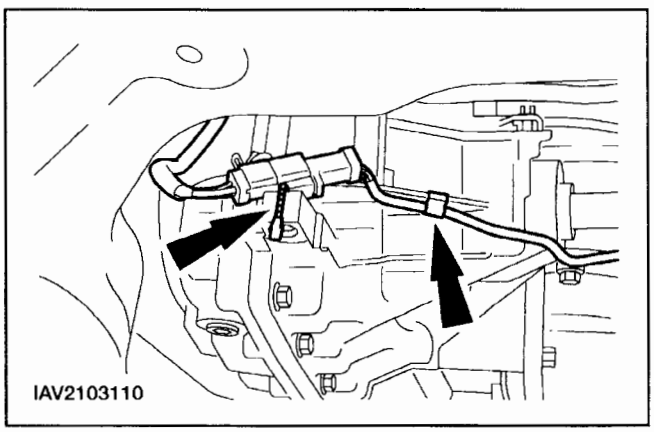
9. Install the front axle drive halfshaft center bearing bracket.



10. Install the front axle drive halfshaft center bearing bolts and the heat shield.

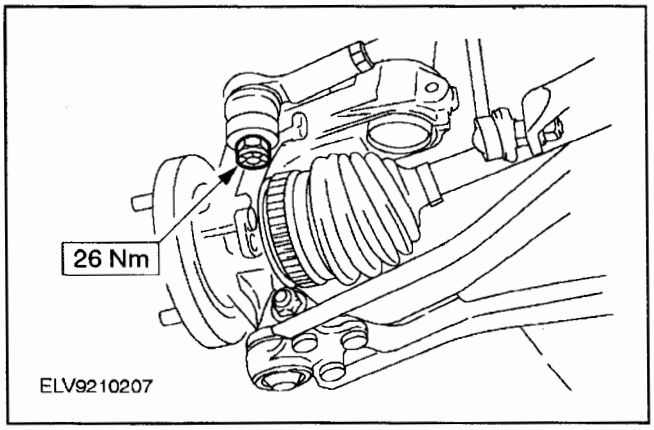


11. **NOTE:** Use new gaskets.
    Install the exhaust pipe.

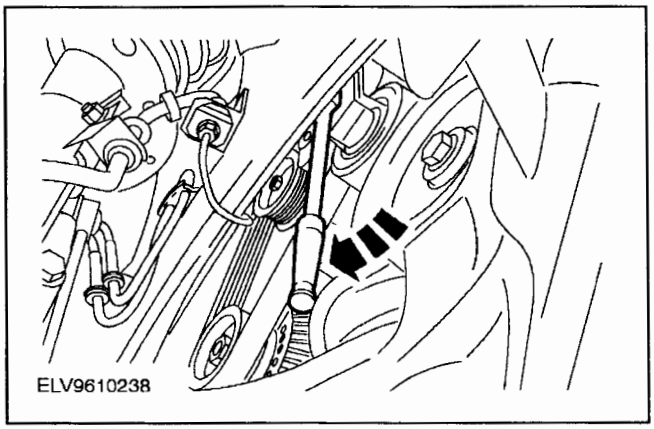


12. Connect the lower HO2S electrical connector.
    - Attach the cable to the clip.
    - Secure the cable with cable ties .

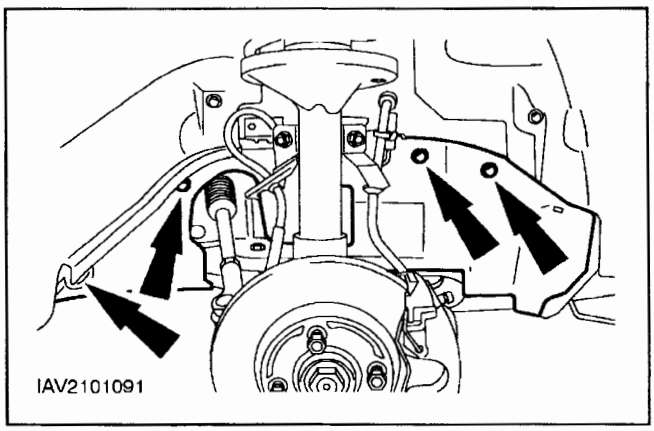
IN-VEHICLE REPAIR (Continued)



13. Install the tie-rod end (left-hand side shown).



14. Install the accessory drive belt to the generator.

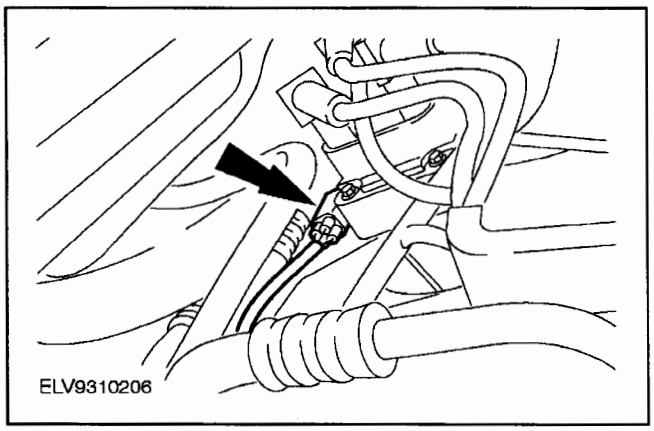


15. Install the right-hand fender splash shields.

16. Install the right-hand front wheel. For additional information, refer to Section 204-04.

17. Lower the vehicle.

IN-VEHICLE REPAIR (Continued)



18. Connect the upper HO2S electrical connector.

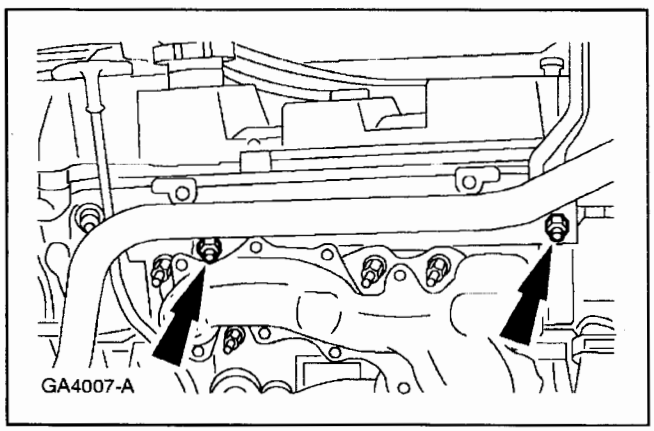
19. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

    Connect the battery ground cable.

Cylinder Head — LH

Removal

1. Remove the water pump. For additional information, refer to Section 303-03.



2. Remove the lower radiator hose tube.

3. Remove the left-hand heated oxygen (HO2S) sensor. For additional information, refer to Section 303-14B.

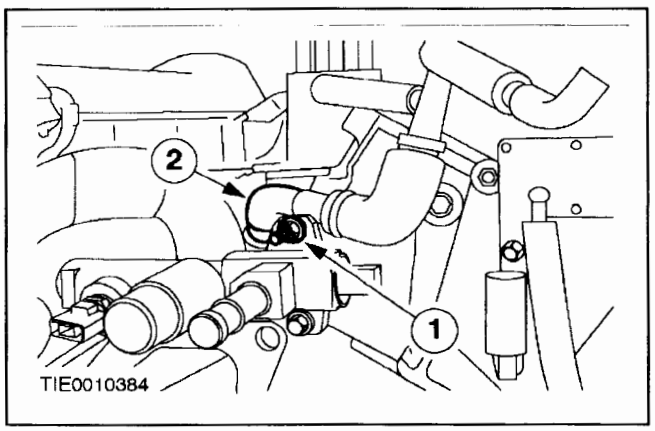
4. Remove the camshafts. For additional information, refer to Camshaft—LH in this section.

IN-VEHICLE REPAIR (Continued)

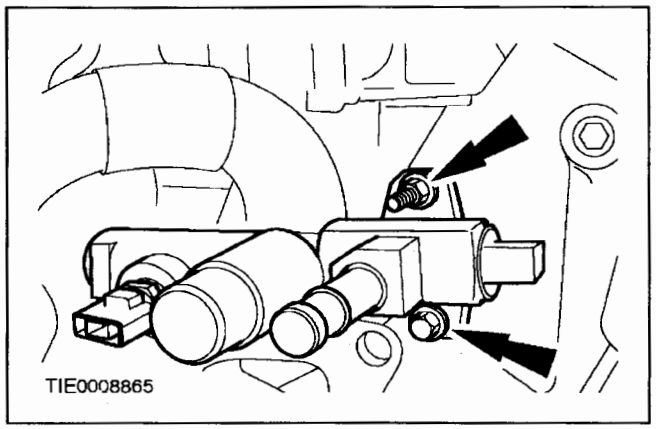
5. **NOTE:** If the camshaft followers are to be reused, mark their position to make sure they are assembled in the original location.

   Remove the roller finger followers. For additional information, refer to Camshaft Followers in this section.

6. Remove the 12 hydraulic lash adjusters. For additional information, refer to Hydraulic Lash Adjusters in this section.



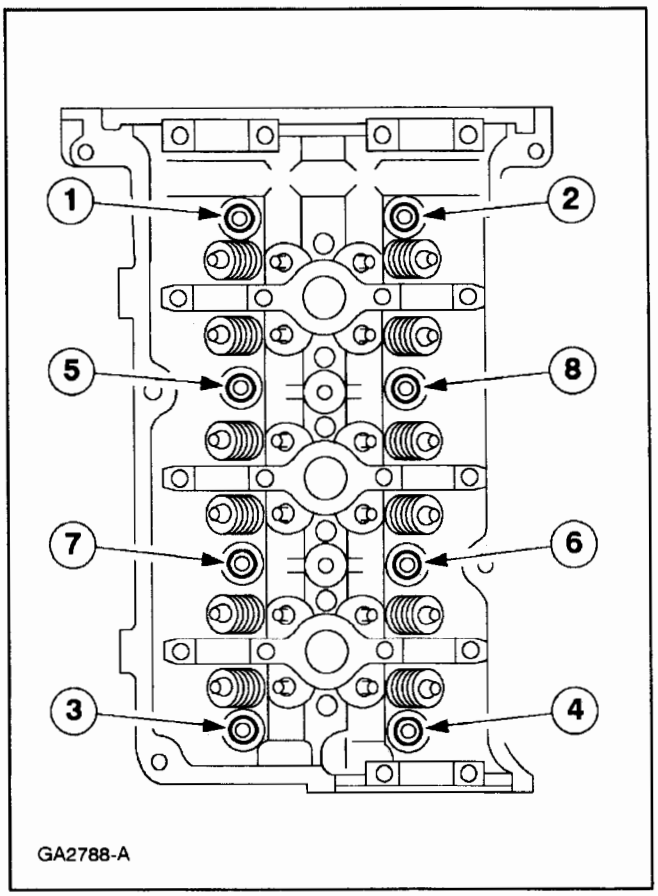
7. Remove the PCV valve tube.
   1 Remove the bracket nut.
   2 Disconnect the hose.



8. Remove the bolt and stud and position the water bypass to one side.

9. Remove the oil level indicator and tube. For additional information, refer to Oil Level Indicator and Tube in this section.

IN-VEHICLE REPAIR (Continued)

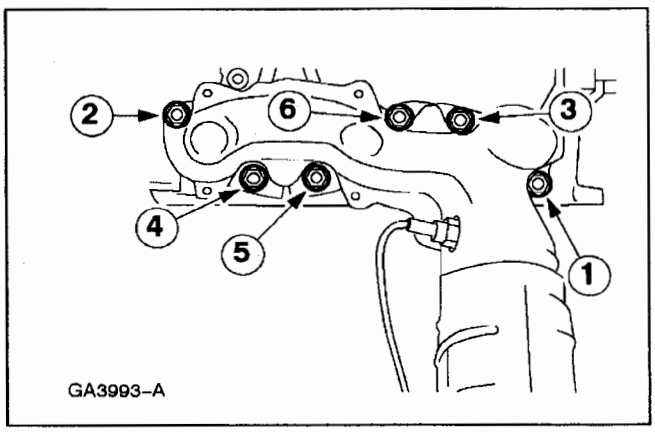


10. **NOTE:** Remove the left-hand cylinder head with the exhaust manifold.

    NOTE: Remove the bolts in the indicated sequence.

    Remove the left-hand cylinder head, with the exhaust manifold attached.

    - Discard the gasket.



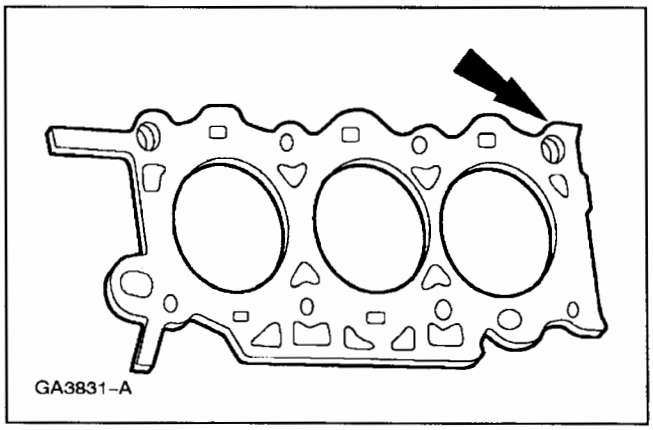
11. **NOTE:** Remove the nuts in the indicated sequence.

    Remove the exhaust manifold.

12. Clean and inspect the cylinder head and cylinder block. For additional information, refer to Section 303-00.

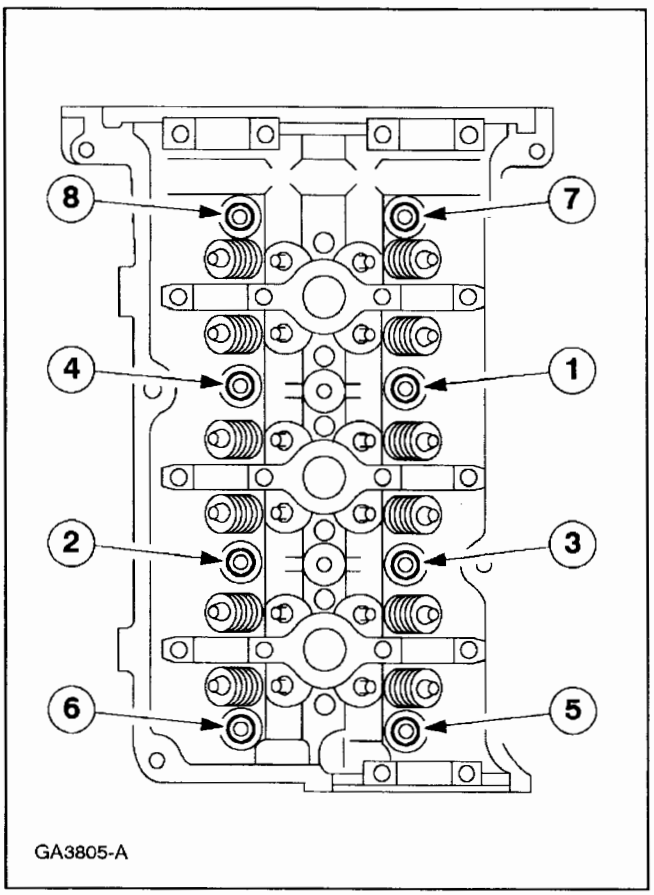
IN-VEHICLE REPAIR (Continued)

Installation



1. **NOTE:** The cylinder head gaskets must be installed over the cylinder head to block dowels.

   Use a new cylinder head gasket.



2. **CAUTION: Use care when installing the cylinder head. Damage to the cylinder block and or the cylinder head may result.**

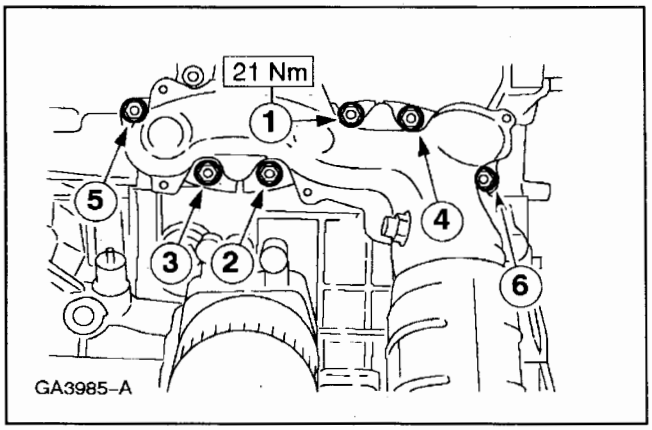
   NOTE: Make sure the cylinder head is installed in its original position.

   NOTE: Tighten the bolts in the indicated tightening sequence in six stages.

   Position the left-hand cylinder head and install new cylinder head bolts and washers.

   - Stage 1: Tighten to 40 Nm.
   - Stage 2: Tighten 90 degrees.
   - Stage 3: Loosen 360 degrees (one full turn) in reverse order.
   - Stage 4: Tighten to 40 Nm.
   - Stage 5: Tighten 90 degrees.
   - Stage 6: Tighten 90 degrees.

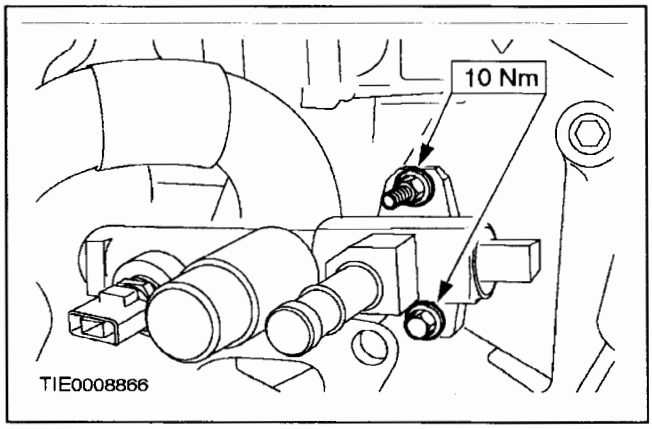
IN-VEHICLE REPAIR (Continued)



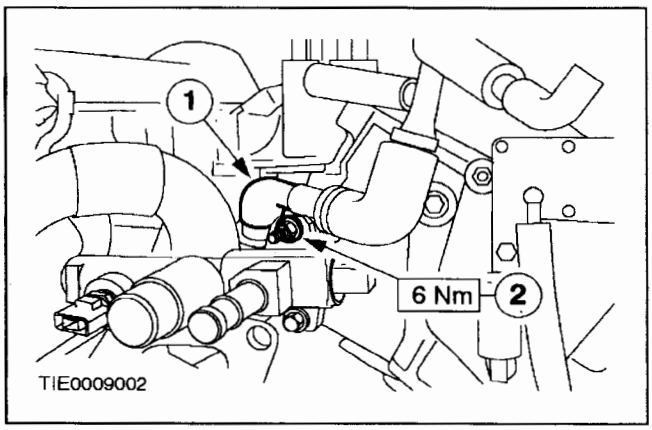
3. **NOTE:** Tighten the nuts in the indicated sequence.

   Install the exhaust manifold.

   - Use a new gasket.



4. Lubricate new O-ring seals with coolant and install the water bypass tube.



5. Install the PCV valve tube.
   1 Connect the hose.
   2 Install the bracket nut.

6. Install the oil level indicator. For additional information, refer to Oil Level Indicator and Tube in this section.

7. Install the special tool 303-290A.

8. **NOTE:** Make sure the lash adjusters are installed in their original position.

   Install the lash adjusters. For additional information, refer to Hydraulic Lash Adjusters in this section.

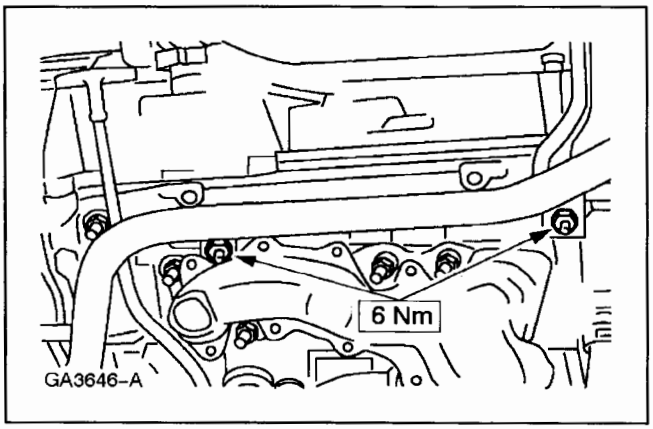
IN-VEHICLE REPAIR (Continued)

9. **NOTE:** Make sure the camshaft followers are installed in their original position.

   NOTE: Lubricate the roller finger followers with clean engine oil before installation.

   Install the roller finger followers. For additional information, refer to Camshaft Followers in this section.

10. Install the camshafts. For additional information, refer to Camshaft—LH in this section.



11. Install the lower radiator hose tube.

12. Install the water pump. For additional information, refer to Section 303-03.

13. Install the left-hand HO2S sensor. For additional information, refer to Section 303-14B.

Cylinder Head — RH

Materials

Item	Specification
Engine oil	WSS-M2C153-H
—	

Removal

1. Drain the engine coolant. For additional information, refer to Section 303-03.

2. Remove the right-hand heated oxygen (HO2S) sensor. For additional information, refer to Section 303-14B.

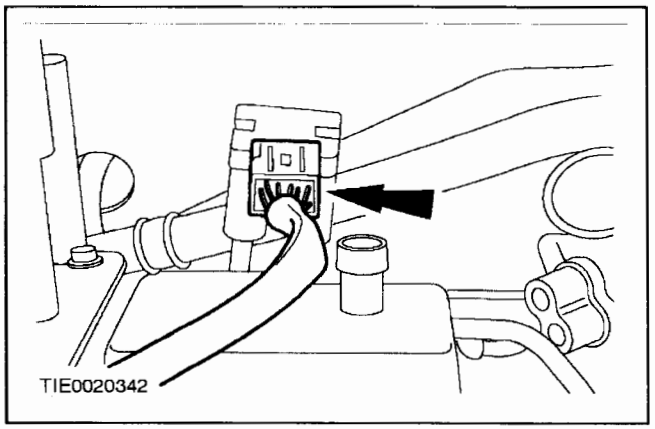
IN-VEHICLE REPAIR (Continued)

3. Remove the camshafts. For additional information, refer to Camshaft—RH in this section.

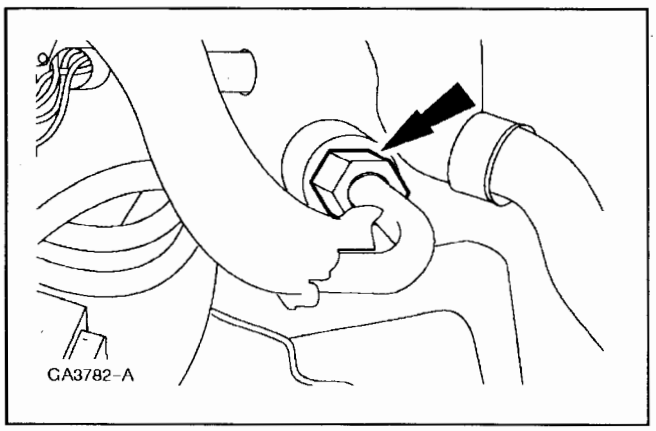
4. **NOTE:** If the camshaft followers are to be reused, mark their position to make sure they are assembled in the original location.

   Remove the roller finger followers. For additional information, refer to Camshaft Followers in this section.

5. Remove the twelve hydraulic lash adjusters. For additional information, refer to Hydraulic Lash Adjusters in this section.

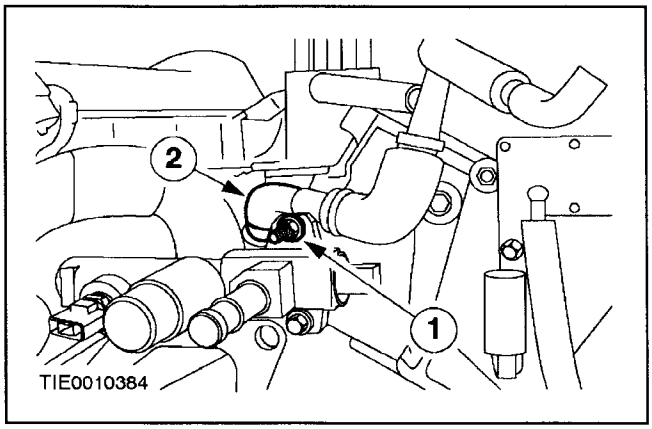


6. Disconnect the exhaust gas recirculation (EGR) backpressure transducer electrical connector.

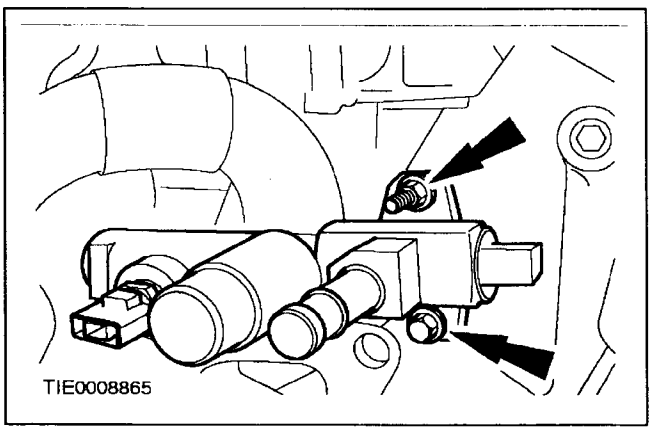


7. Remove the EGR valve to exhaust manifold tube from the exhaust manifold.

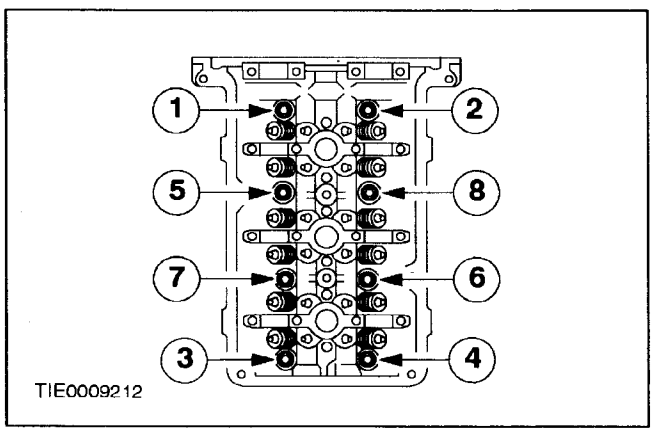
IN-VEHICLE REPAIR (Continued)



8. Remove the PCV valve tube.
   1 Remove the bracket nut.
   2 Disconnect the hose.



9. Remove the bolt and stud and position the water bypass to one side.

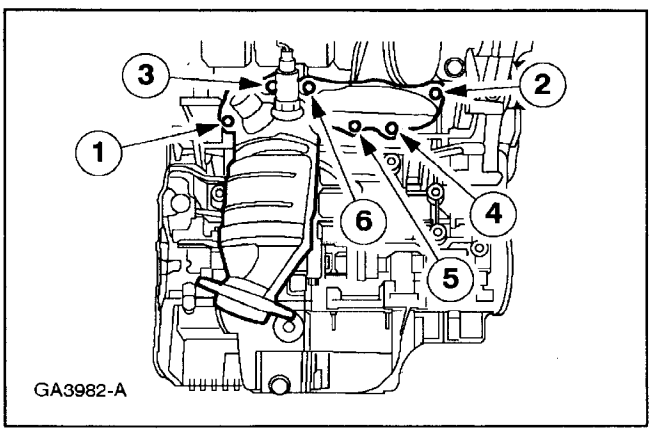


10. **NOTE:** Remove the right-hand cylinder head with the exhaust manifold and EGR backpressure transducer bracket attached.

    NOTE: Remove the bolts in the indicated sequence.

    Remove the right-hand cylinder head.

    - Discard the gasket.



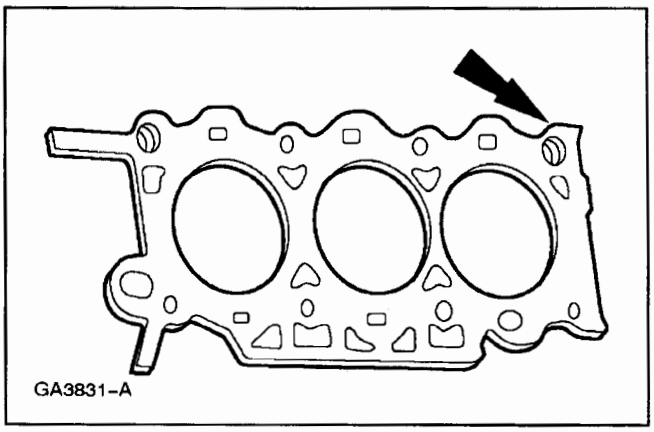
11. **NOTE:** Remove the nuts in the indicated sequence.

    Remove the exhaust manifold.

IN-VEHICLE REPAIR (Continued)

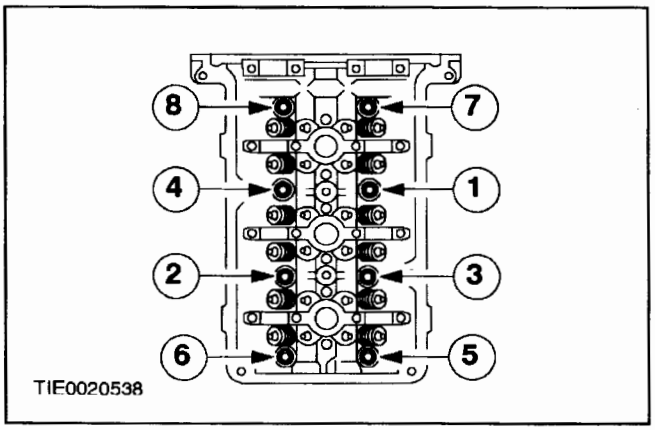
12. Clean and inspect the cylinder head and cylinder block. For additional information, refer to Section 303-00.

Installation



1. **NOTE:** The head gaskets must be installed over the cylinder head to block dowels.

   Install a new cylinder head gasket.



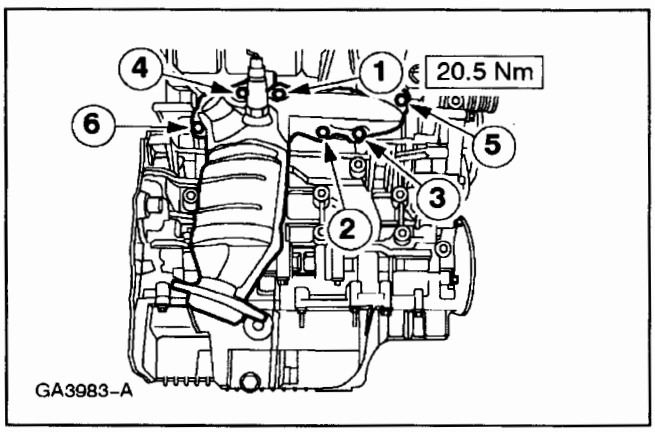
2. **CAUTION: Use care when installing the cylinder head. Damage to the cylinder block and/or the cylinder head may result.**

   NOTE: Make sure the cylinder head is installed in its original position.

   NOTE: Tighten the bolts in the indicated sequence in six stages.

   Position the right-hand cylinder head and install new cylinder head bolts with washers.

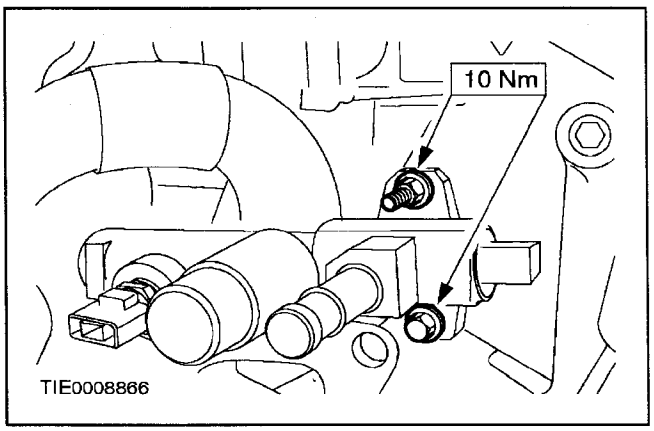
   - Stage 1: Tighten to 40 Nm.
   - Stage 2: Tighten 90 degrees.
   - Stage 3: Loosen 360 degrees in reverse sequence.
   - Stage 4: Tighten to 40 Nm.
   - Stage 5: Tighten 90 degrees.
   - Stage 6: Tighten 90 degrees.



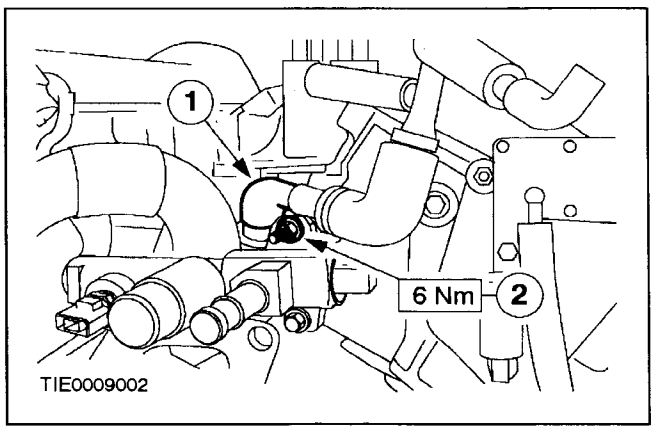
3. **NOTE:** Tighten the nuts in the indicated sequence.

   Install the right-hand exhaust manifold.

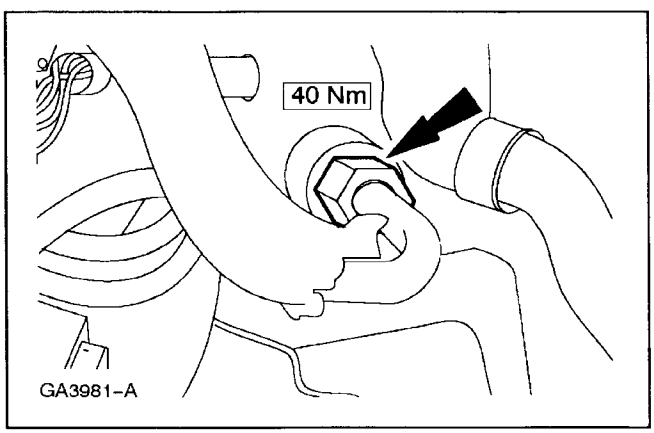
IN-VEHICLE REPAIR (Continued)



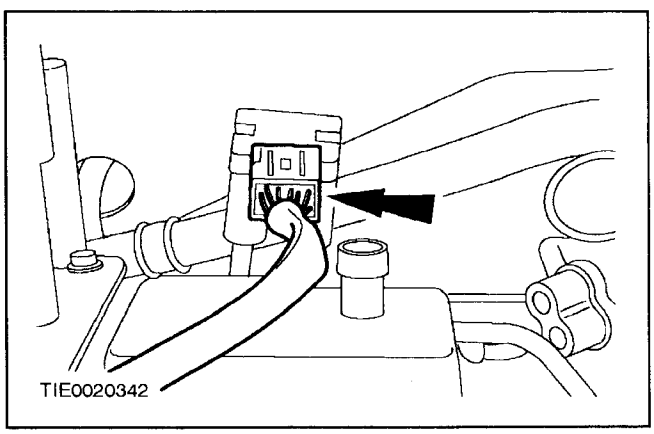
4. Lubricate new O-ring seals with coolant and install the water bypass tube.



5. Install the PCV valve tube.
   1 Connect the hose.
   2 Install the bracket nut.



6. Install the EGR valve to exhaust manifold tube to the exhaust manifold.



7. Connect the EGR backpressure transducer electrical connector.

IN-VEHICLE REPAIR (Continued)

8. **NOTE:** Make sure the lash adjusters are installed in their original position.

   Install the lash adjusters. For additional information, refer to Hydraulic Lash Adjusters in this section.

9. **NOTE:** Make sure the roller finger followers are installed in their original position.

   NOTE: Lubricate the roller finger followers with clean engine oil before installation.

   Install the roller finger followers. For additional information, refer to Camshaft Followers in this section.

10. Install the camshafts. For additional information, refer to Camshaft—RH in this section.

11. Install the right-hand HO2S sensor. For additional information, refer to Section 303-14B.

12. Fill engine cooling system. For additional information, refer to Section 303-03.

Oil Cooler

Materials

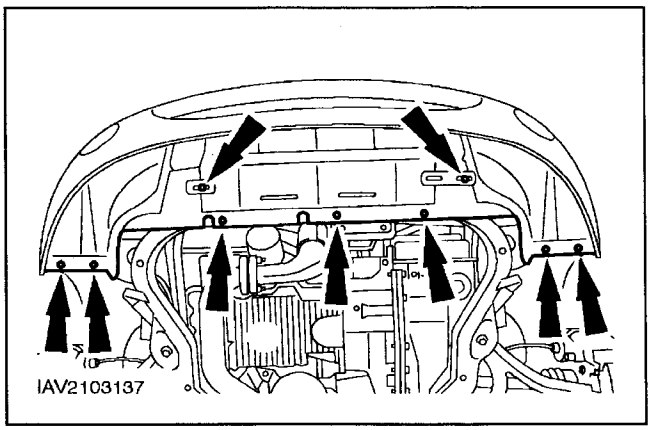
Item	Specification
Engine oil	WSS-M2C153-H
—	

Removal

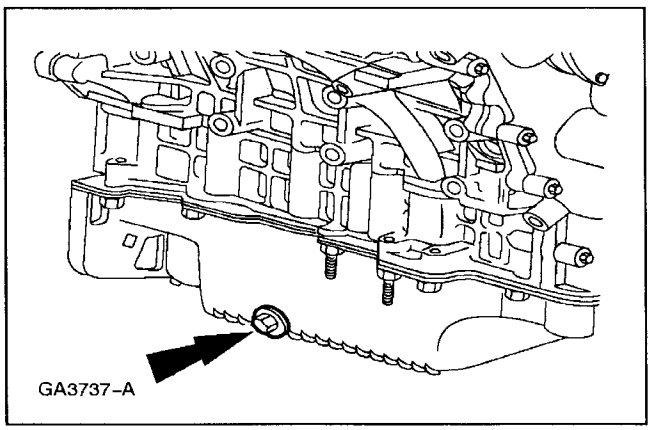
1. Drain the engine coolant. For additional information, refer to Section 303-03.

2. Raise and support the vehicle. For additional information, refer to Section 100-02.

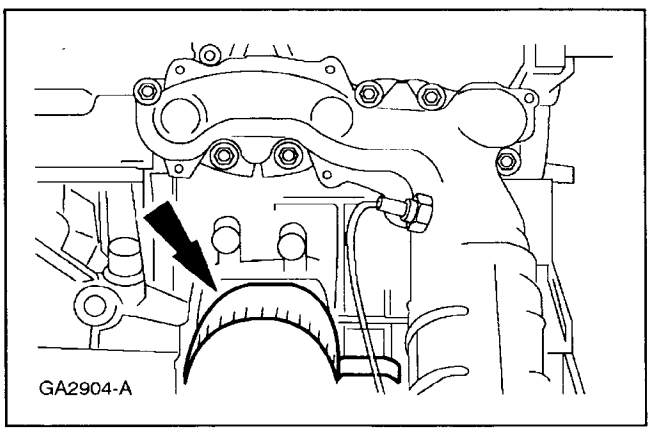
IN-VEHICLE REPAIR (Continued)



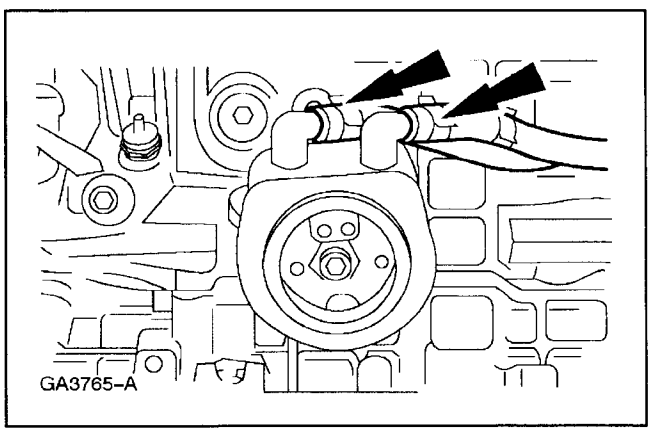
3. Remove the radiator splash shield.



4. Drain the engine oil.

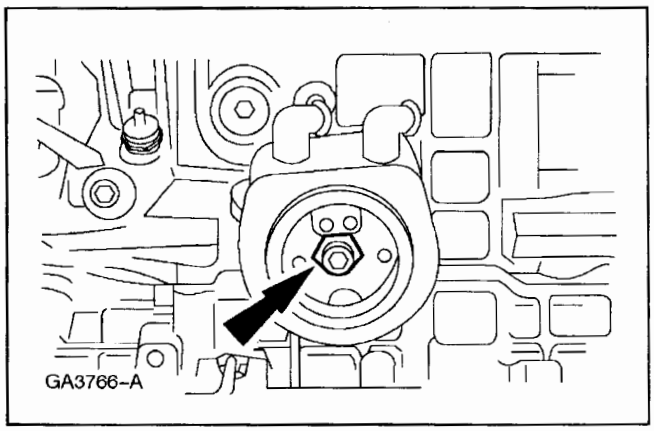


5. Remove and discard the oil filter.



6. Disconnect the oil cooler lines.

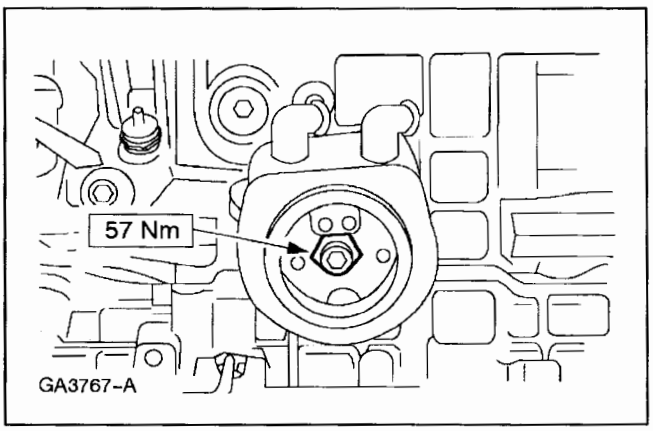
IN-VEHICLE REPAIR (Continued)



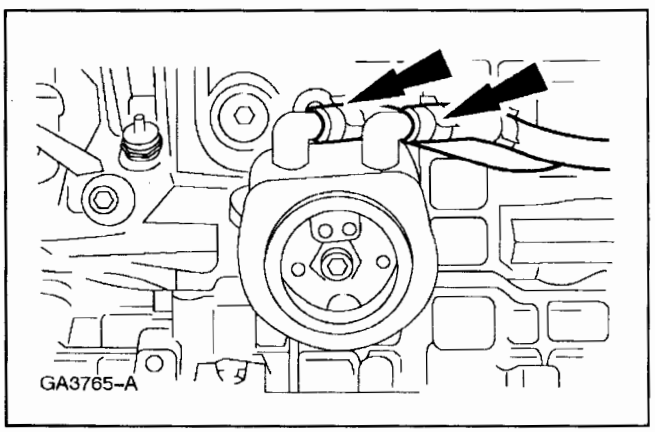
7. Remove the oil cooler insert O-ring and remove the oil cooler.

Installation

NOTE: Prior to installation, apply engine oil to the oil cooler gasket, oil cooler insert O-ring and oil filter gasket.

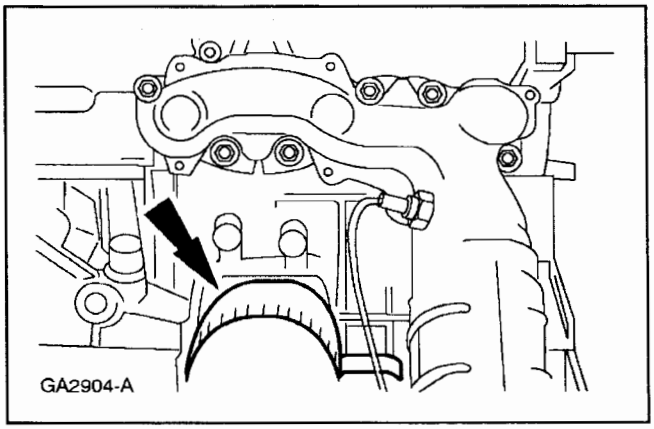


1. Install the oil cooler and the oil cooler insert O-ring.

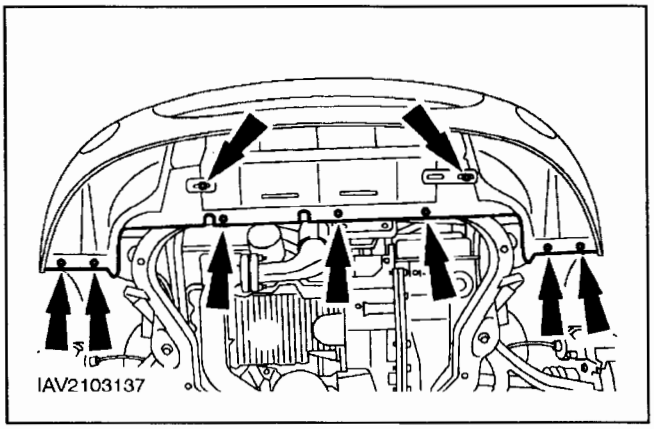


2. Connect the oil cooler lines.

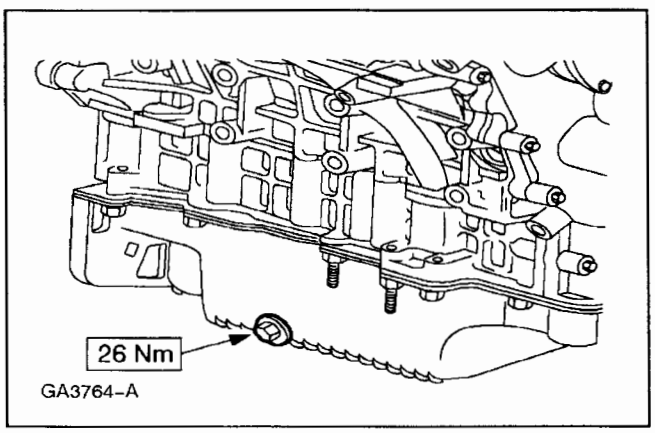
IN-VEHICLE REPAIR (Continued)



3. **NOTE:** Use a new oil filter.
   Install the oil filter.



4. Install the radiator splash shield.



5. Install the oil drain plug.

6. Lower the vehicle.

7. Fill the cooling system. For additional information, refer to Section 303-03.

8. Fill the engine with engine oil.

IN-VEHICLE REPAIR (Continued)

Oil Pressure Switch

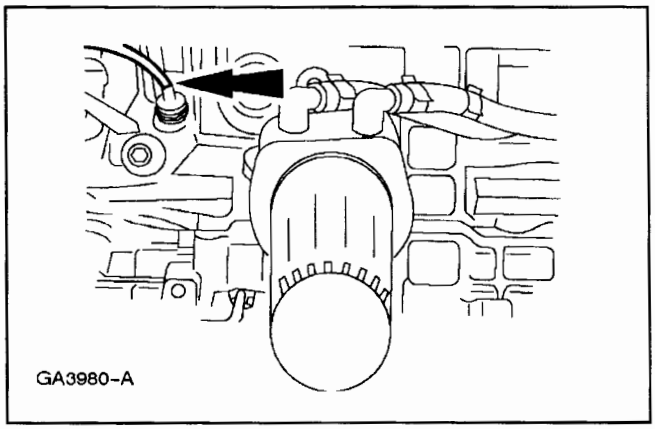
Materials

Item	Specification
Pipe Sealant with Teflon D82A-19554-A	WSK-M26350-AZ

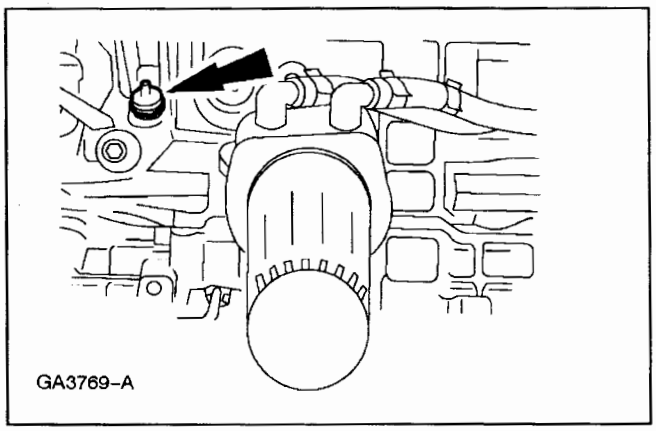
Removal

NOTE: High output engine shown, base engine not equipped with oil cooler.

1. Raise and support the vehicle. For additional information, refer to Section 100-02.



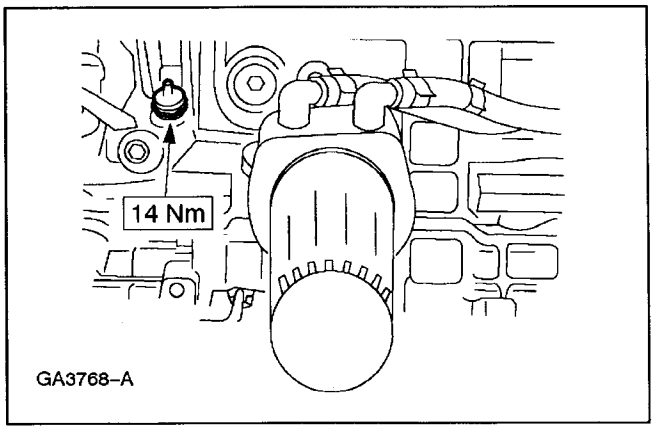
2. Disconnect the oil pressure switch electrical connector.



3. Remove the oil pressure switch.

IN-VEHICLE REPAIR (Continued)

Installation



1. To install, reverse the removal procedure.
   - Use pipe sealant with Teflon.

Oil Level Indicator and Tube

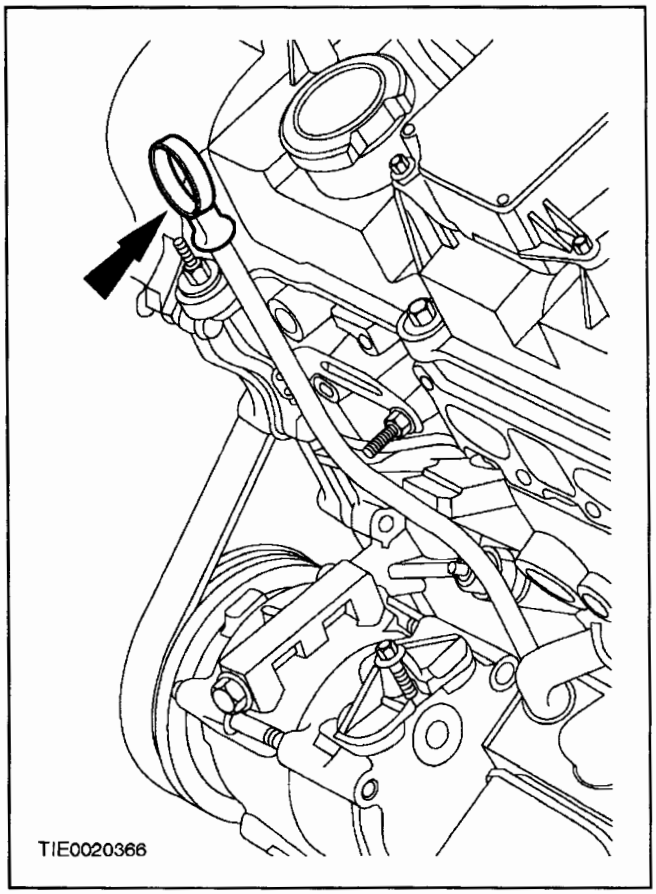
Materials

Item	Specification
Engine oil	WSS-M2C153-H
—	

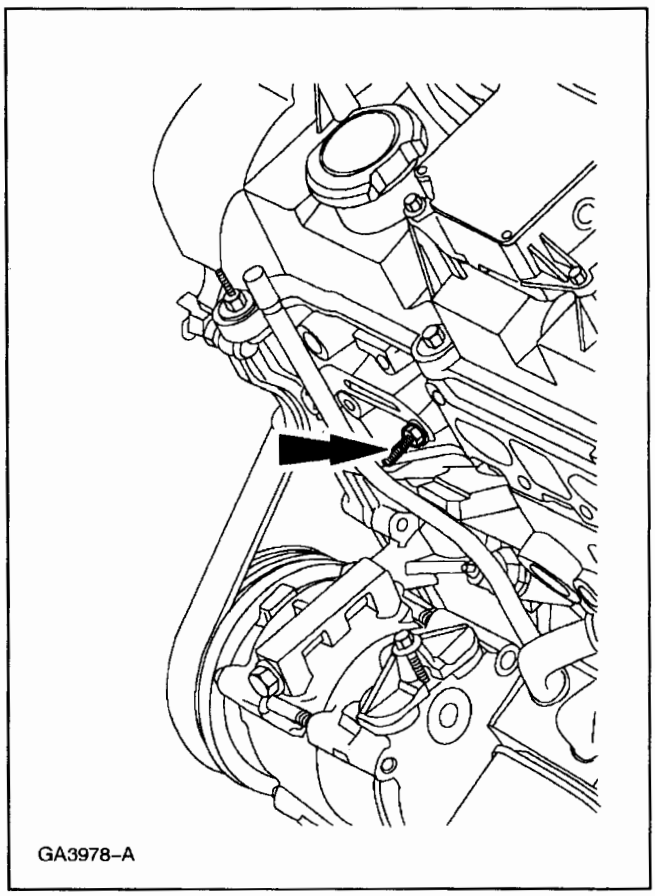
Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02.
2. Remove the radiator lower hose tube. For additional information, refer to Section 303-03.

IN-VEHICLE REPAIR (Continued)

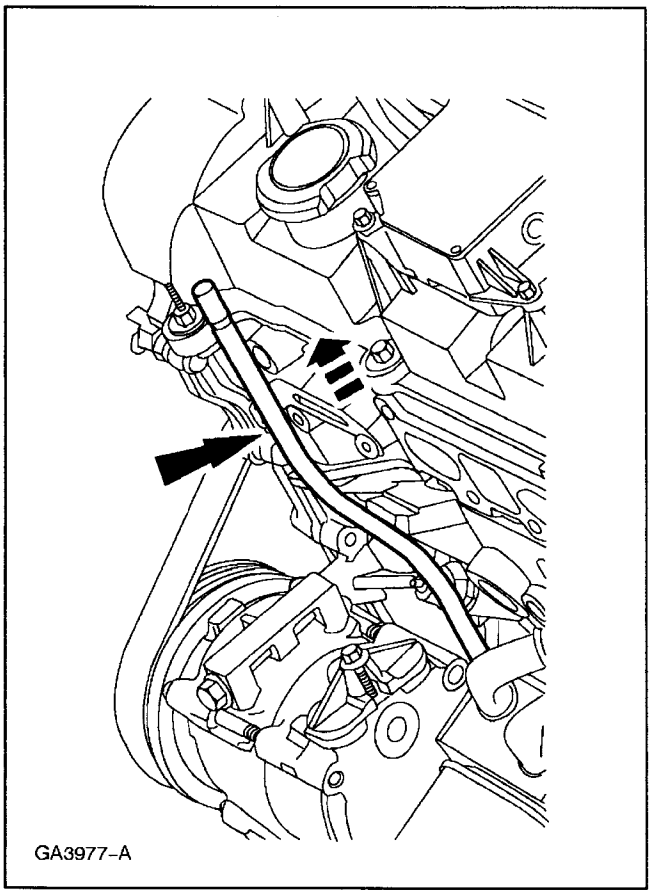


3. Remove the oil level indicator.



4. Remove the nut.

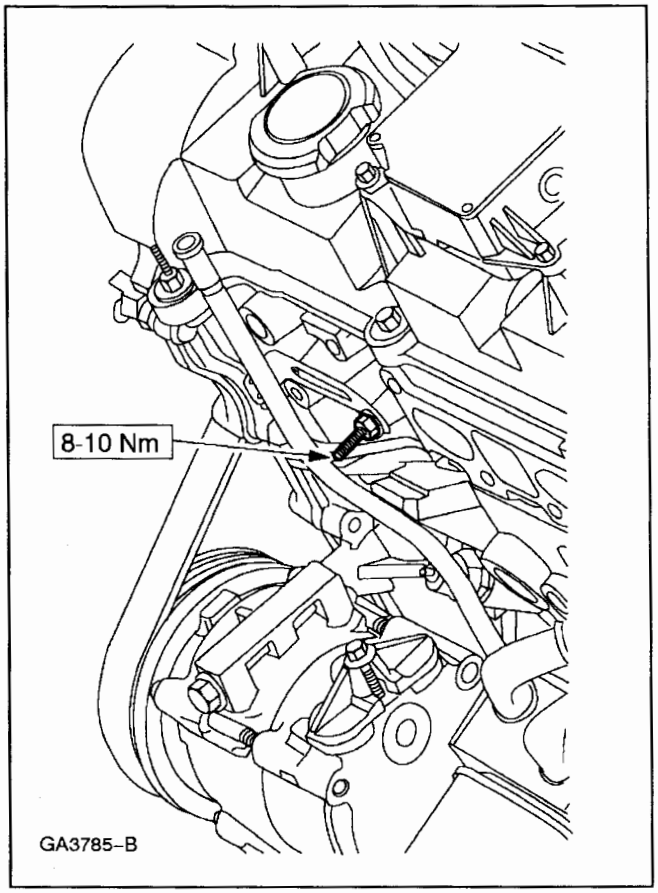
IN-VEHICLE REPAIR (Continued)



5. Remove the oil level indicator tube.
   - Use a twisting motion to remove the tube from the lower cylinder block.

IN-VEHICLE REPAIR (Continued)

Installation



1. **NOTE:** Inspect and lubricate O-ring seal with engine oil prior to installing the oil level indicator tube.

   To install, reverse the removal procedure.

Oil Pan

Materials

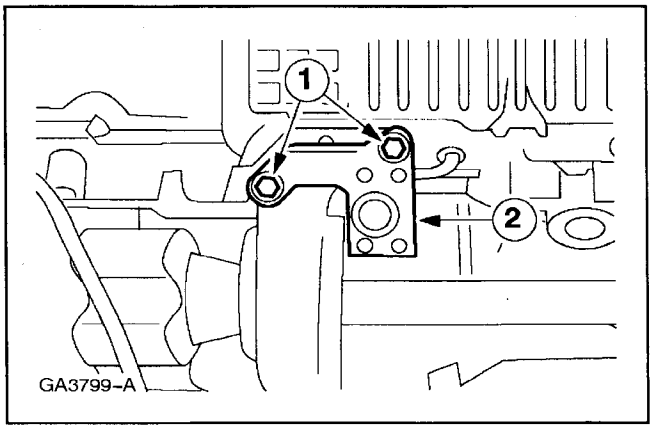
Item	Specification
Engine oil —	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19562-EA	WSE-M4G323-A4
Metal Surface Cleaner F4A2-19A536-RA	WSE-M5B392-A

Removal

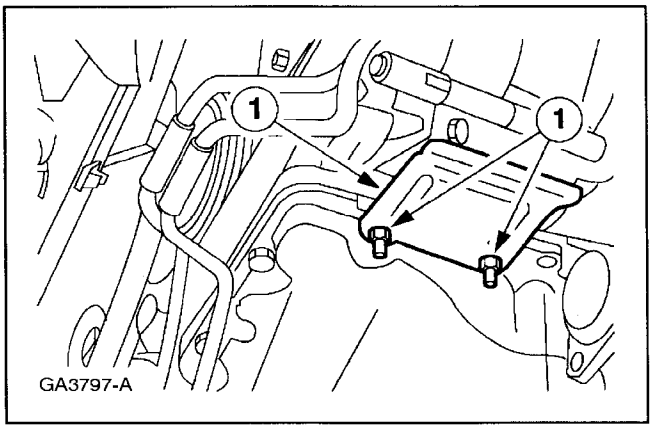
All vehicles

1. Remove the exhaust Y-pipe. For additional information, refer to Section 309-00.

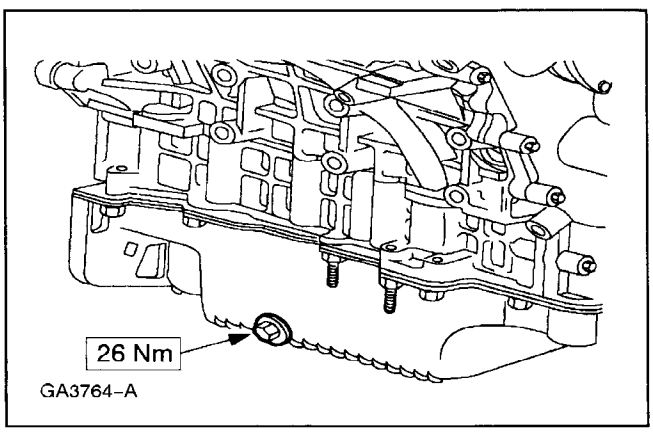
IN-VEHICLE REPAIR (Continued)



2. Remove the exhaust support bracket.
   1 Remove the bolts.
   2 Remove the bracket.

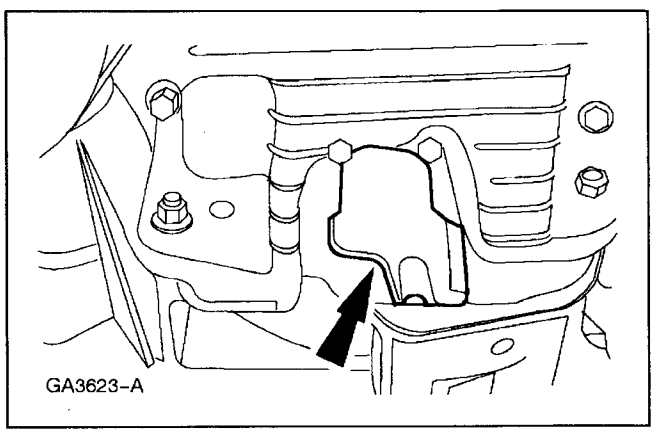


3. Remove the air conditioning (A/C) compressor heat shield.
   1 Remove the nuts.
   2 Remove the heat shield.



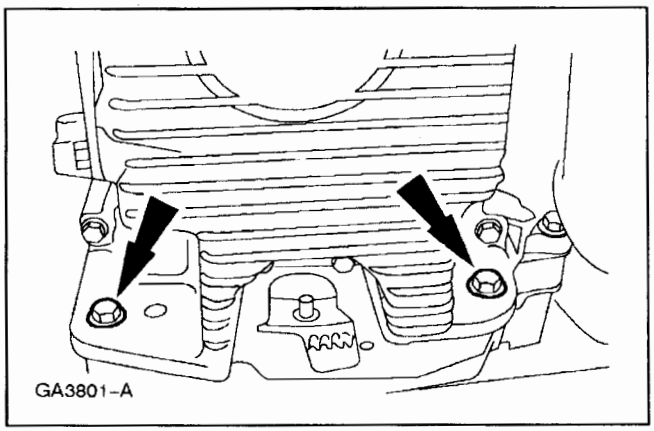
4. Drain the engine oil.
   - Remove the drain plug.
   - Install the drain plug with a new gasket.

Vehicles with automatic transmission



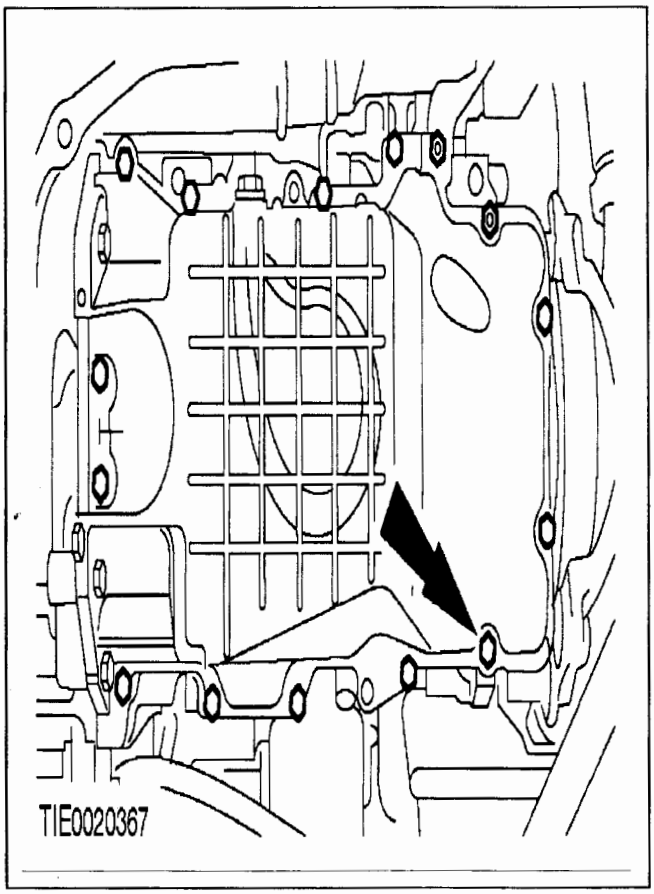
5. Remove the flywheel access cover.

IN-VEHICLE REPAIR (Continued)



All vehicles

6. Remove the oil pan bolts from the transaxle housing.

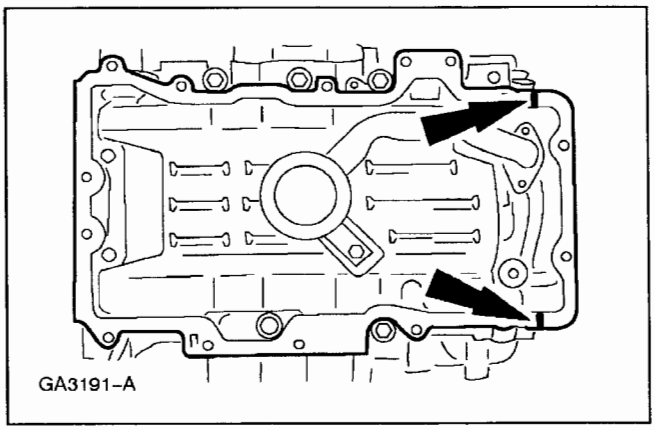


7. Remove the oil pan.
   - Discard the gasket.
   - Clean and inspect oil pan and cylinder block sealing surfaces.

IN-VEHICLE REPAIR (Continued)

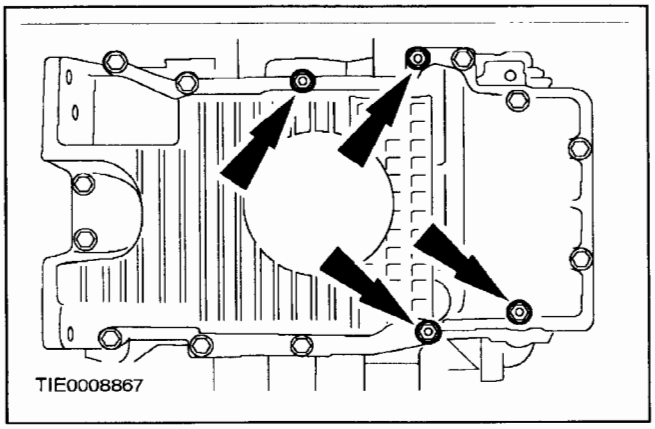
Installation

All vehicles



1. **NOTE:** Install the oil pan and tighten the bolts within six minutes of applying sealant.

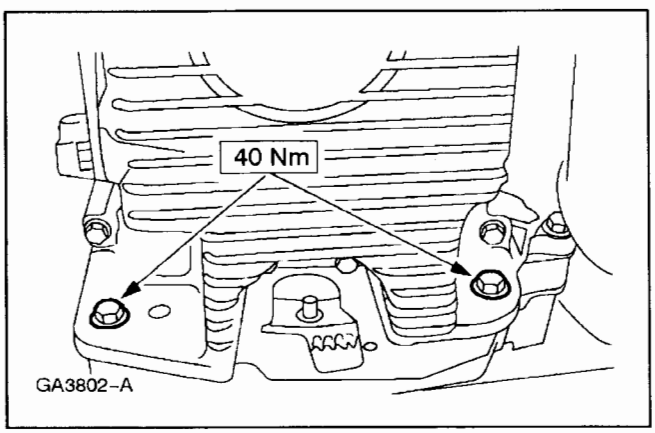
   Apply 8 mm dots of silicone gasket and sealant to the sealing surface on the cylinder block.



2. **NOTE:** Note the locations of the studs.

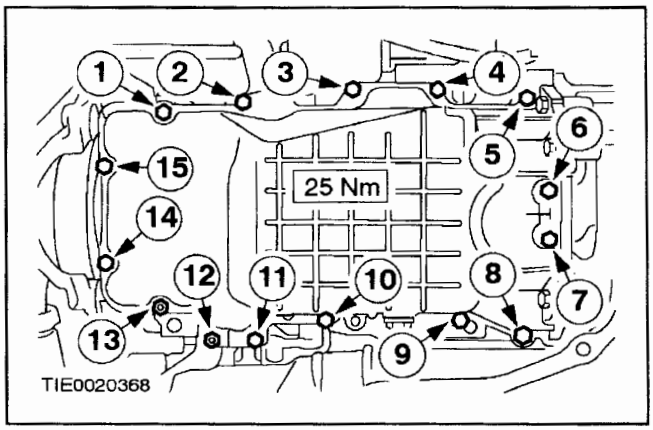
   NOTE: A new oil pan gasket must be used when the oil pan is being installed.

   Position the oil pan and loosely install the bolts and studs.



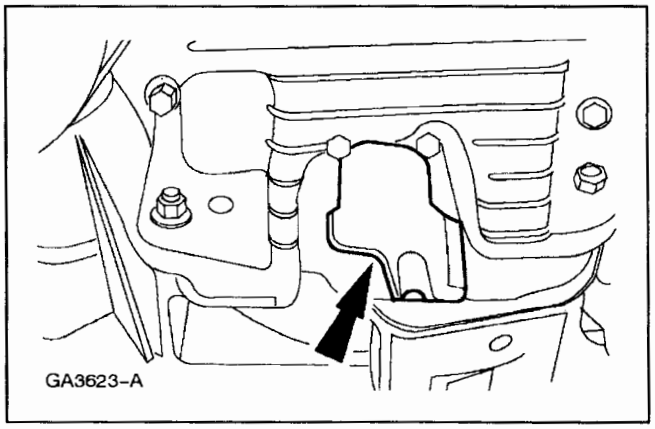
3. Install the oil pan to transaxle housing bolts.

IN-VEHICLE REPAIR (Continued)



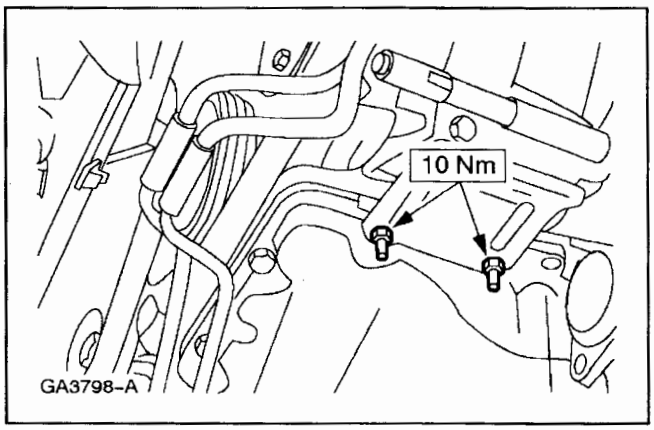
4. **NOTE:** Tighten the bolts and nuts in the indicated sequence.

   Install the oil pan.



Vehicles with automatic transmission

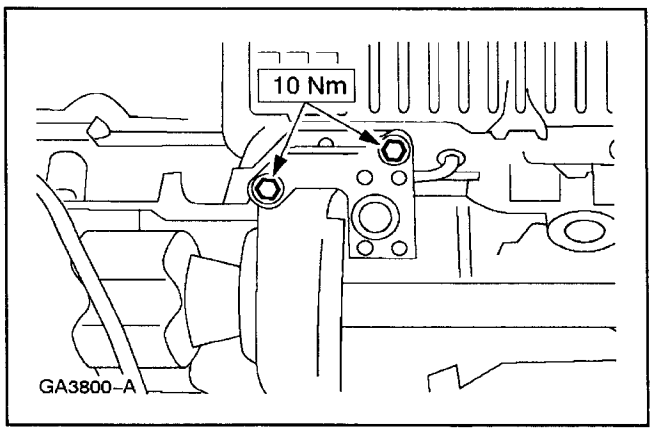
5. Install the flywheel access cover.



All vehicles

6. Install the A/C compressor heat shield.

IN-VEHICLE REPAIR (Continued)



7. Install the exhaust support bracket.

8. Install exhaust Y-pipe. For additional information, refer to Section 309-00.

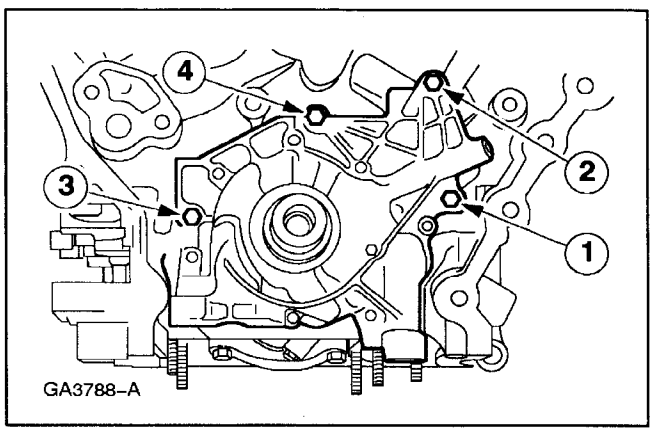
9. Fill the engine with engine oil.

Oil Pump

Removal

1. Remove the oil pump screen cover and tube. For additional information, refer to Oil Pump Screen and Pickup Tube in this section.

2. Remove the timing chains. For additional information, refer to Timing Chain in this section.

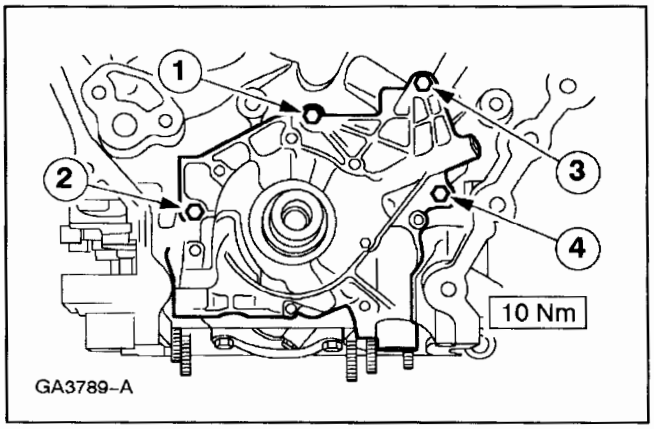


3. **NOTE:** Remove the bolts in the sequence shown.
   Remove the oil pump.

4. Inspect the oil pump for damage and wear. For additional information, refer to Section 303-00.

IN-VEHICLE REPAIR (Continued)

Installation



1. ⚠ **CAUTION: Install the oil pump flush to the cylinder block for correct sealing.**

   NOTE: Rotate the inner rotor of the oil pump to align with the flats on the crankshaft before installation.

   Install and tighten the bolts in the sequence shown.

2. Install the timing chains. For additional information, refer to Timing Chain in this section.

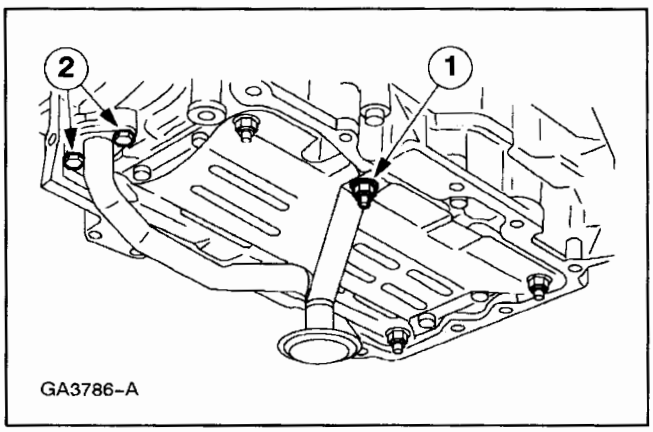
3. Install the oil pump screen cover and tube. For additional information, refer to Oil Pump Screen and Pickup Tube in this section.

4. Install a new oil filter.

Oil Pump Screen and Pickup Tube

Removal

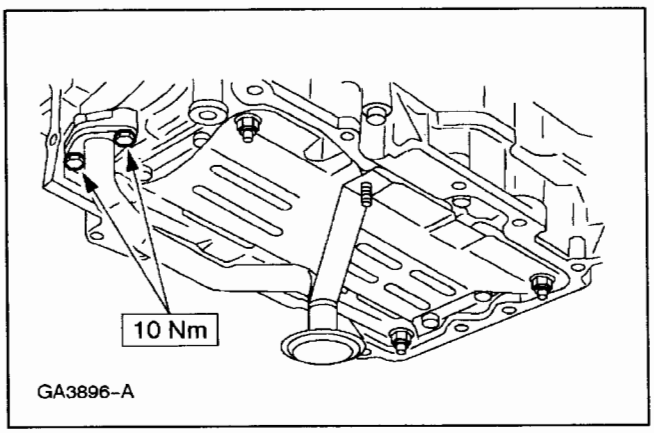
1. Remove the oil pan. For additional information, refer to Oil Pan in this section.



2. Remove the oil pump screen and cover tube.
   1 Remove the nut.
   2 Remove the bolts.

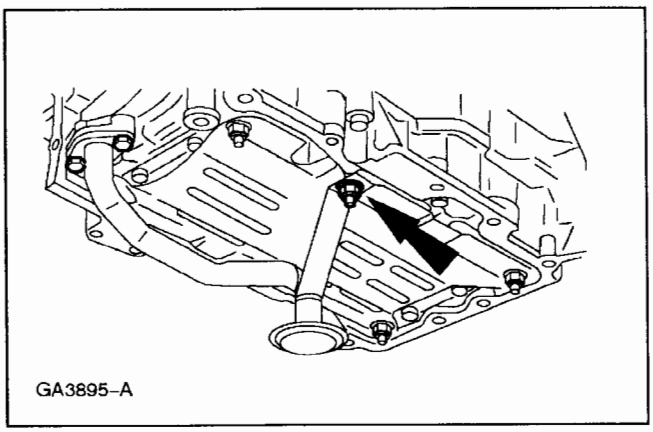
IN-VEHICLE REPAIR (Continued)

Installation



1. **NOTE:** Inspect the oil pump screen cover and tube O-ring seal and install a new one, if necessary.

   Position the oil pump screen cover and tube and install the bolts.



2. Install the bracket nut.
   - Stage 1: 5 Nm
   - Stage 2: 45 degrees

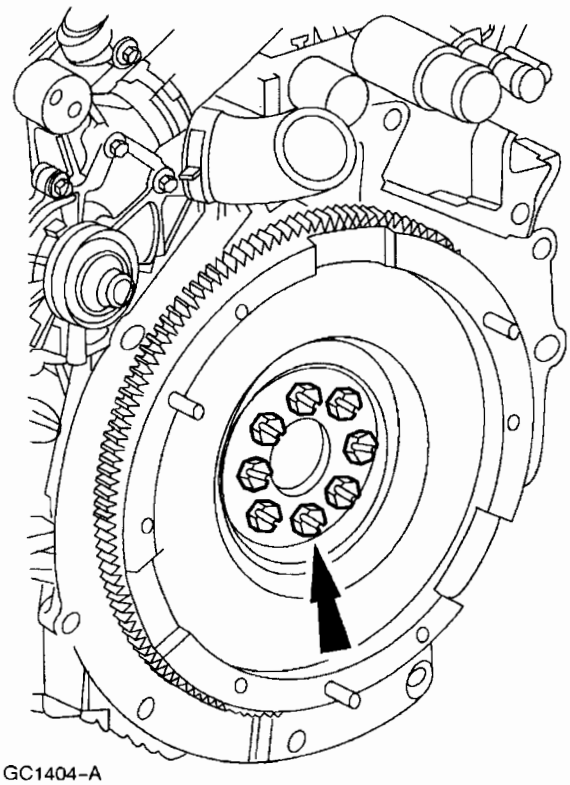
3. Install the oil pan. For additional information, refer to Oil Pan in this section.

Flywheel — Vehicles With Manual Transaxle

Removal

1. Remove the clutch disc and pressure plate. For additional information, refer to Section 308-01.

IN-VEHICLE REPAIR (Continued)

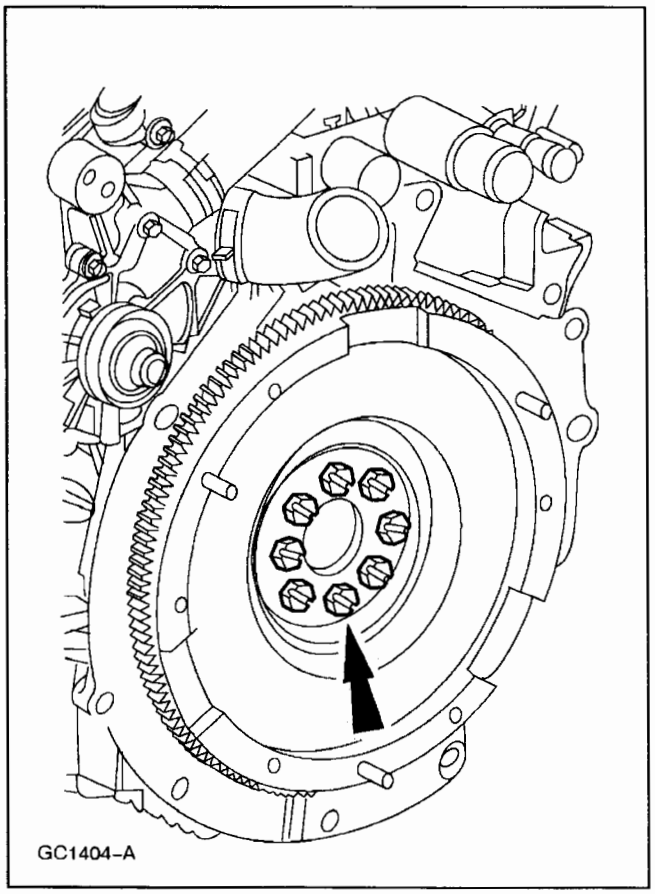

GC1404-A

2. **NOTE:** Base flywheel shown, high output has yellow color code.

   Remove the flywheel.

IN-VEHICLE REPAIR (Continued)

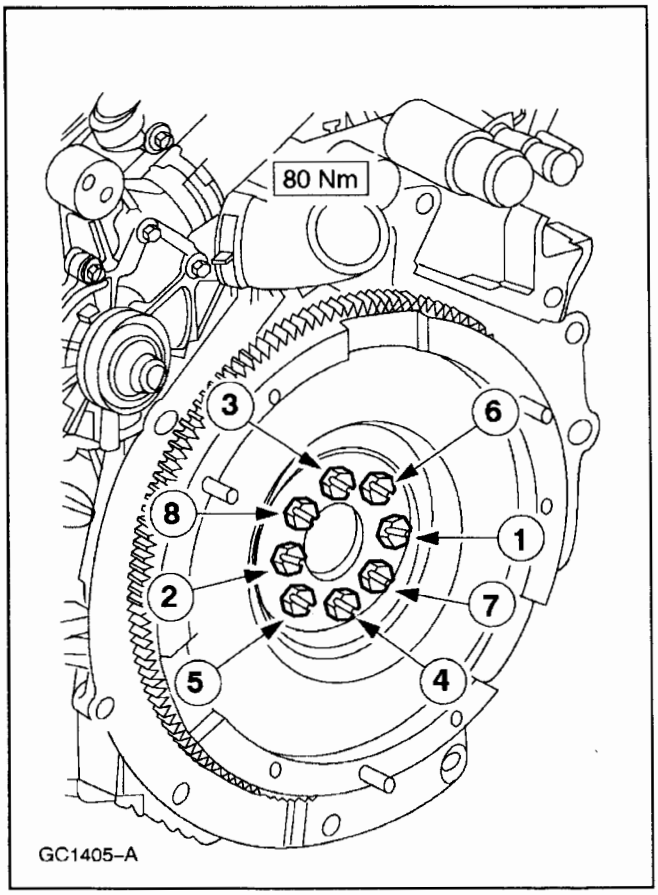
Installation



1. **NOTE:** Base flywheel shown, high output has yellow color code.

   Position the flywheel and loosely install the flywheel bolts.

IN-VEHICLE REPAIR (Continued)



2. Tighten the bolts in the indicated sequence.

3. Install the clutch disc and pressure plate. For additional information, refer to Section 308-01.

Flywheel — Vehicles With Automatic Transaxle

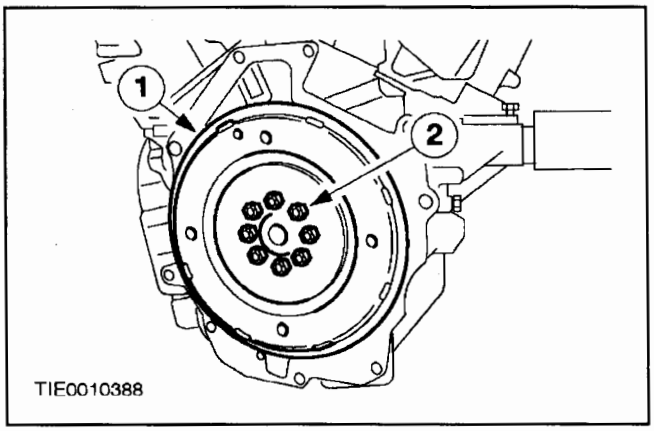
General Equipment

Suitable strap wrench

Removal

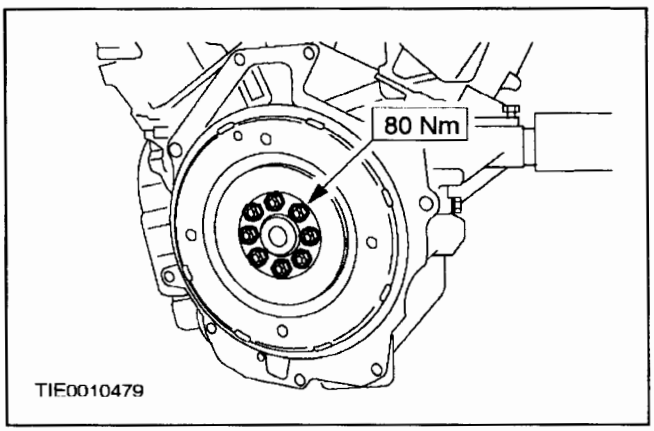
1. Remove the transaxle. For additional information, refer to Section 307-01.

IN-VEHICLE REPAIR (Continued)



2. Remove the flywheel.
   - Use a suitable strap wrench to hold the crankshaft by the crankshaft pulley.
   1 Mark the position of the flywheel and crankshaft flange.
   2 Remove the flywheel bolts and the flywheel.

Installation

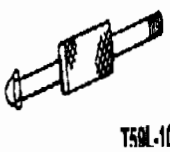


1. Install the flywheel.
   - Use a suitable strap wrench to hold the crankshaft by the crankshaft pulley.
   - Install the flywheel and tighten the bolts working diagonally.

2. Install the transaxle. For additional information, refer to Section 307-01.

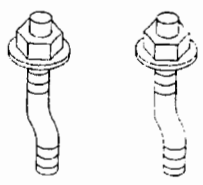
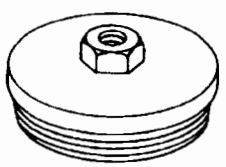
Crankshaft Rear Oil Seal

Special Tool(s)

	Impact Slide Hammer 307-005 (T59L-100-B)
 ST1327-A	Installer, Oil Seal (Rear), Crankshaft 303-178 (T82L-6701-A)

(Continued)

Special Tool(s)

 ST1333-A	Rear Main Seal Replacer Adapters 303-384 (T91P-6701-A)
 ST1382-A	Rear Crankshaft Seal Remover 303-519 (T95P-6701-EH)

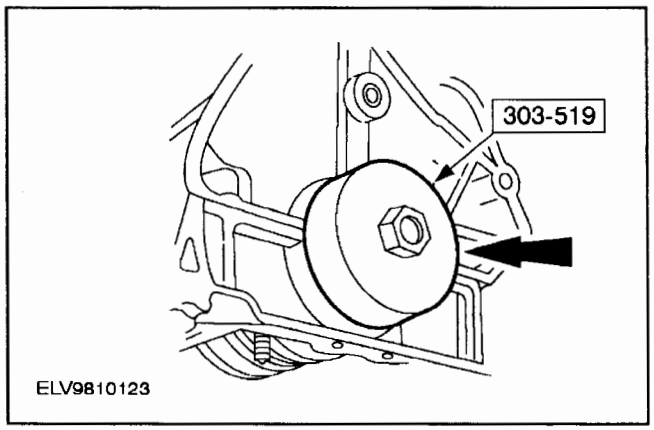
IN-VEHICLE REPAIR (Continued)

Materials

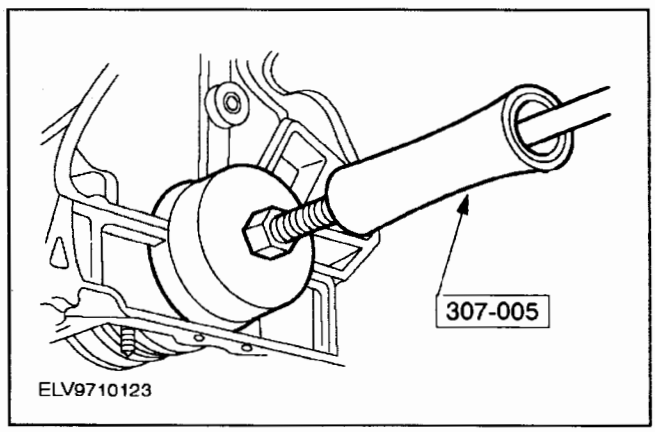
Item	Specification
Engine oil —	WSS-M2C153-H

Removal

1. Remove the flywheel. For additional information, refer to Flywheel—Vehicles With Manual Transaxle or Flywheel—Vehicles With Automatic Transaxle in this section.



2. **CAUTION: Avoid scratching or damaging the crankshaft rear oil seal sealing surfaces on the crankshaft and cylinder block.**
   Install the special tool.



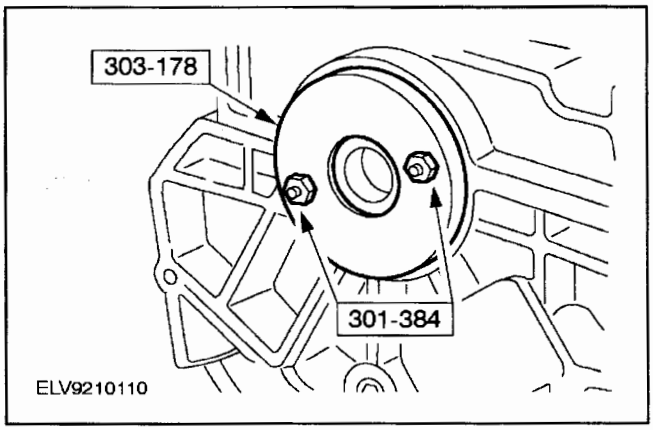
3. Using the special tool, remove the crankshaft rear oil seal.

Installation

1. Clean and inspect the crankshaft rear oil seal sealing surfaces. For additional information, refer to Section 303-00.

2. Lubricate the crankshaft flange, the crankshaft rear oil seal bore, and the oil seal lip with clean engine oil.

IN-VEHICLE REPAIR (Continued)



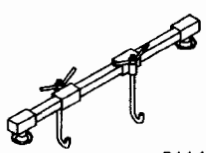
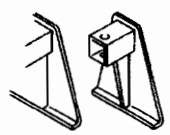
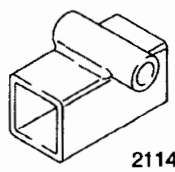
3. **NOTE:** Alternate bolt tightening to correctly seat the crankshaft rear oil seal until it is flush with the cylinder block.

   Using special tools, install the crankshaft real oil seal.

4. Install the flywheel. For additional information, refer to Flywheel—Vehicles With Manual Transaxle or Flywheel—Vehicles With Automatic Transaxle in this section..

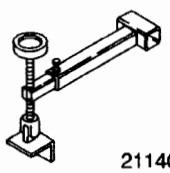
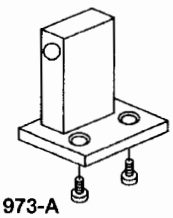
Engine Mount

Special Tool(s)

 21140	Support Bar, Engine 303-290A
 2114001	Adaptor for 303-290A 303-290-01
 2114002	Adaptor for 303-290A 303-290-02

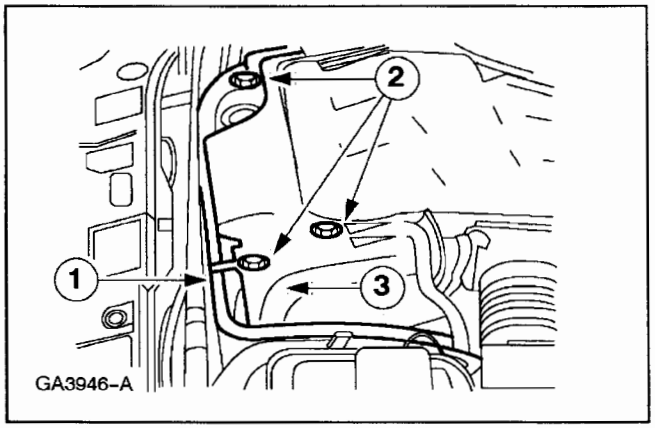
(Continued)

Special Tool(s)

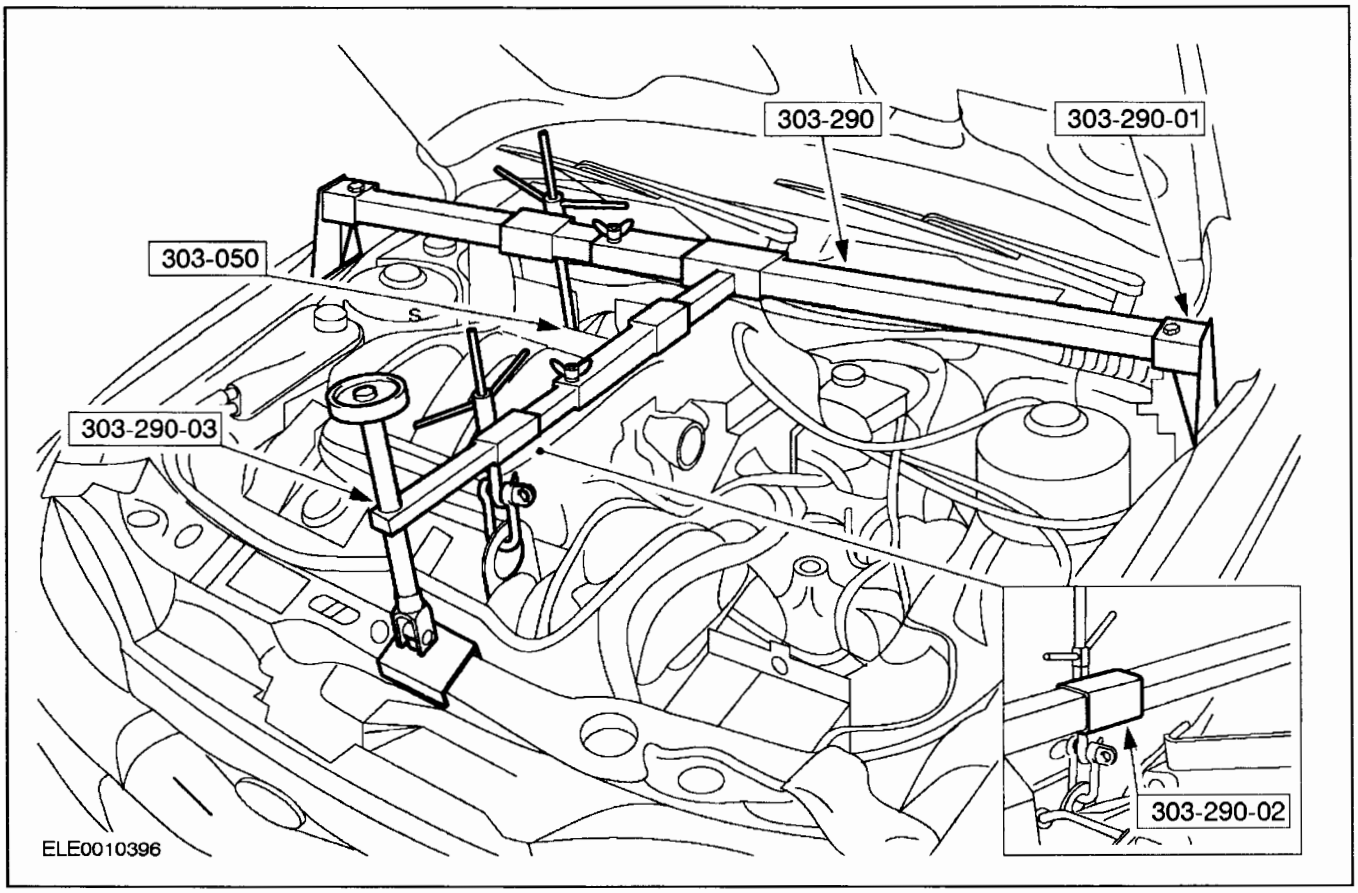
 2114003	Adaptor for 303-290A 303-290-03A
 ST1973-A	Gauge, Powertrain Alignment 502-003 (T94P-6000-AH)
 T70P-6000	Lifting Bracket, Engine 303-050

IN-VEHICLE REPAIR (Continued)

Removal

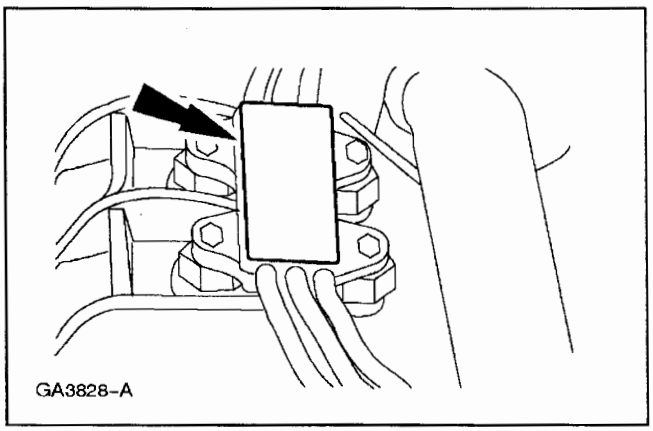


1. Remove the water pump pulley shield.
   1 Detach the coolant expansion tank hose from the clip.
   2 Remove the bolts.
   3 Remove the shield.

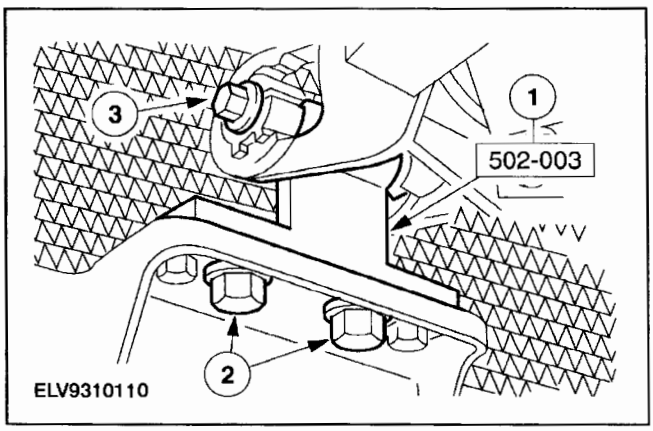


2. Install the special tools.

IN-VEHICLE REPAIR (Continued)



3. Remove the ignition wires and retainer from the upper front engine support bracket and position it to one side.



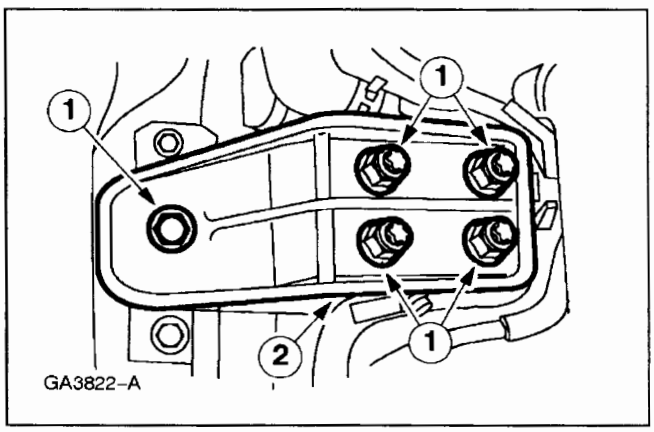
4. **⚠ CAUTION: Do not allow power steering fluid to come into contact with the drive belt. Damage to the belt may occur.**

   Disconnect the power steering pressure line from the power steering pump.

   1 Remove the power steering pressure line bracket bolt.

   2 Remove the ground strap.

   3 Disconnect the power steering pressure line and position it to one side.



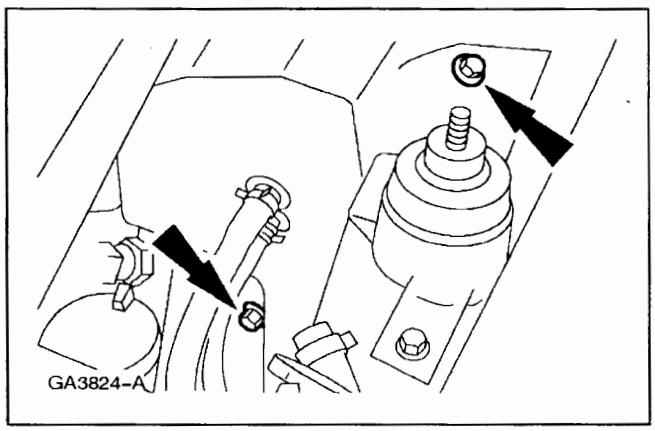
5. **NOTE:** Install new self-locking nuts.

   NOTE: Mark on the engine support bracket the position of the nuts.

   Remove the upper front engine support bracket.

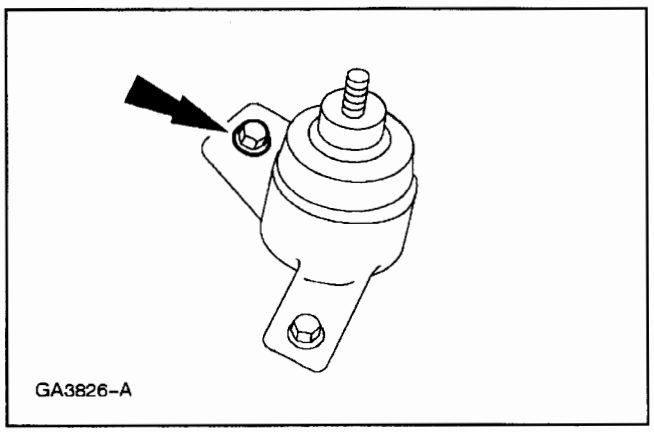
   1 Remove and discard the nuts.

   2 Remove the upper front engine support bracket.



6. Remove the bolts and position the radiator coolant expansion tank to one side.

IN-VEHICLE REPAIR (Continued)


GA3826-A

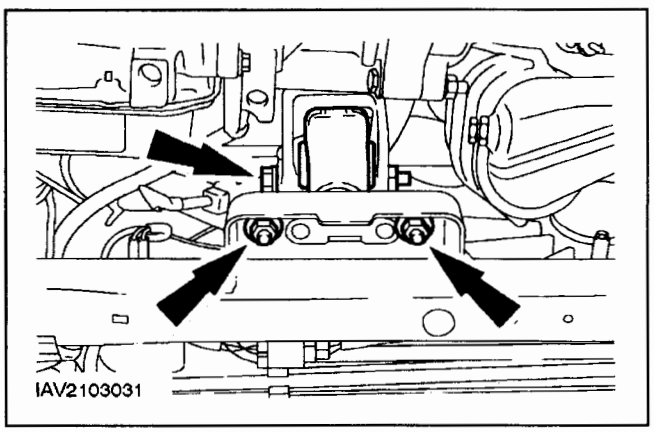
7. Remove the three bolts and remove the upper front engine support insulator.

Installation

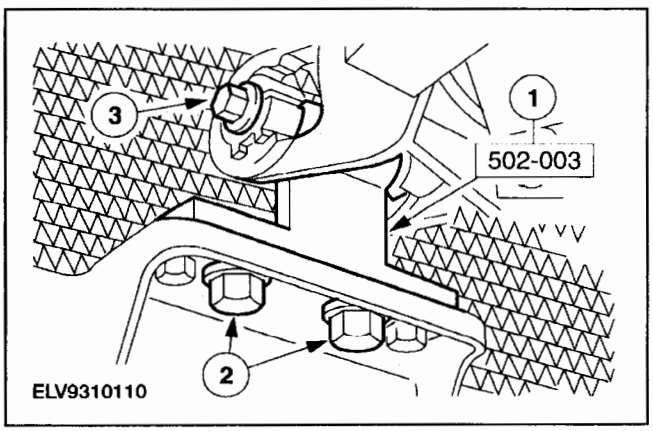
1. ⚠ **CAUTION: If the upper front engine support insulator, front subframe, or the front engine support bracket has been removed, the engine and transaxle position must be realigned to the front subframe. Failure to realign the engine and transaxle may result in excessive driveline vibration.**

   Make sure correct alignment.

2. Raise and support the vehicle. For additional information, refer to Section 100-02.


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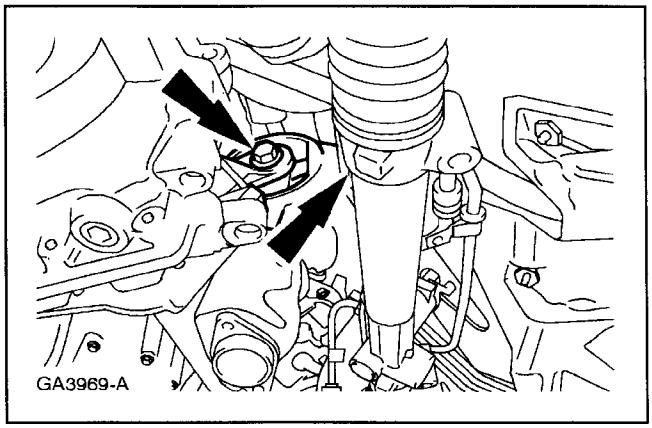
3. Remove the bolts, the through bolt and remove the left-hand front engine support insulator.



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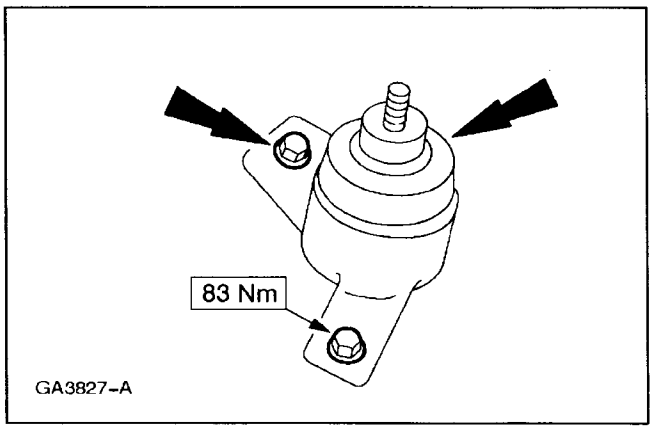
4. Replace the left-hand engine support insulator with special tool.
   1 Install the special tool.
   2 Install the bolts.
   3 Install the through bolt and finger tighten.

IN-VEHICLE REPAIR (Continued)

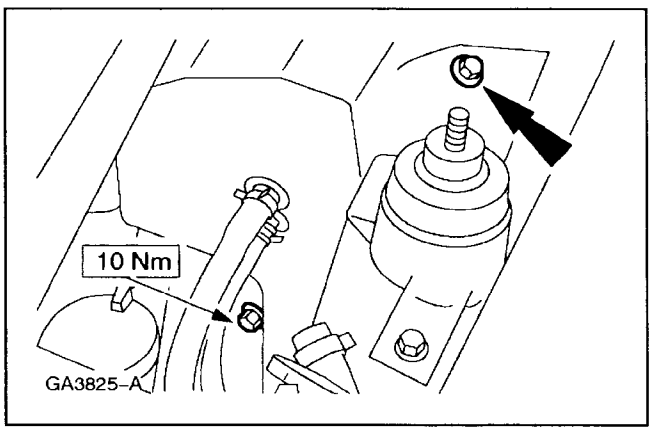


5. Remove the right-hand engine support insulator through bolt.
   - Loosen the mounting bolts, but do not remove.

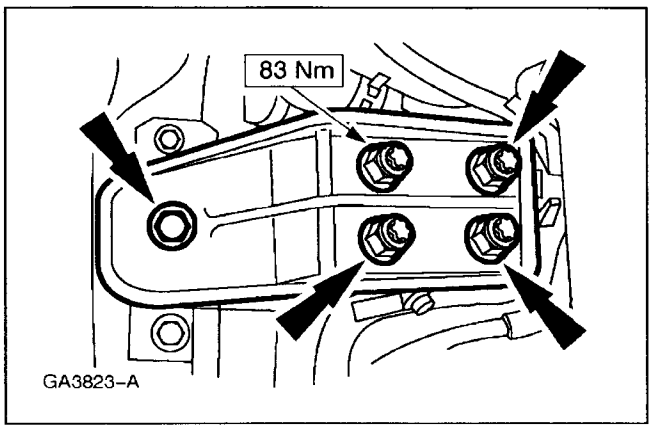
6. Lower the vehicle.



7. Install the front engine support insulator.



8. Install the radiator coolant expansion tank.



9. **NOTE:** The self-locking nuts must be replaced.

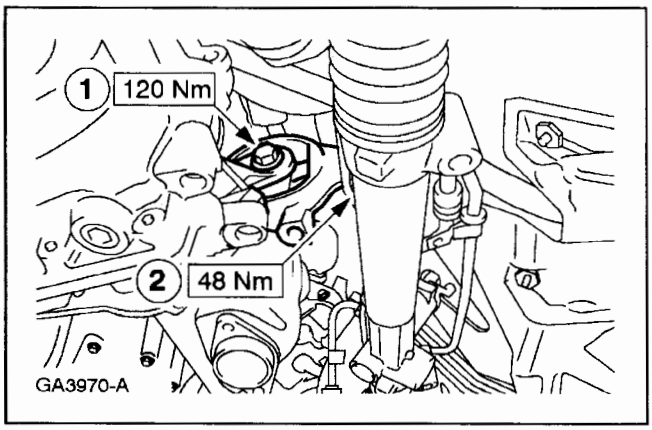
   NOTE: Make sure that the new nuts are aligned with the marks on the engine support bracket.

   Install the upper front engine support bracket.

IN-VEHICLE REPAIR (Continued)

10. Remove the three bar engine support and universal lifting eye.

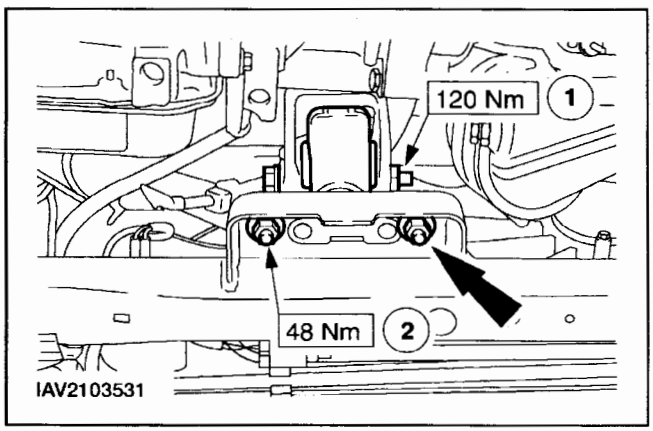
11. Raise and support the vehicle. For additional information, refer to Section 100-02.



12. **NOTE:** Verify that the right-hand engine support insulator is centered in the transaxle bracket and in perfect front-to-rear alignment before tightening the through bolt or the mounting bolts.

    Install the right-hand engine support insulator bolts.

    - Install the insulator through bolt.
    - Install the insulator mounting bolts.

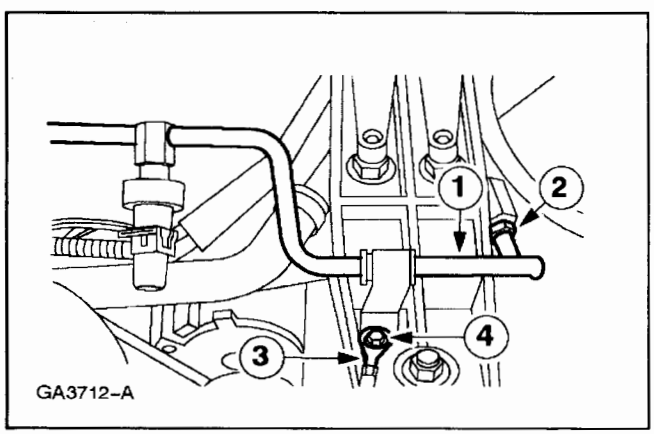


13. **NOTE:** Verify that the left-hand engine support insulator is centered in the transaxle bracket and in perfect front-to-rear alignment before tightening the through bolt.

    Replace the powertrain alignment gauge with the left-hand engine support insulator.

    1 Install the through bolt.

    2 Install the bolts.



14. Install the power steering pressure line to the power steering pump.

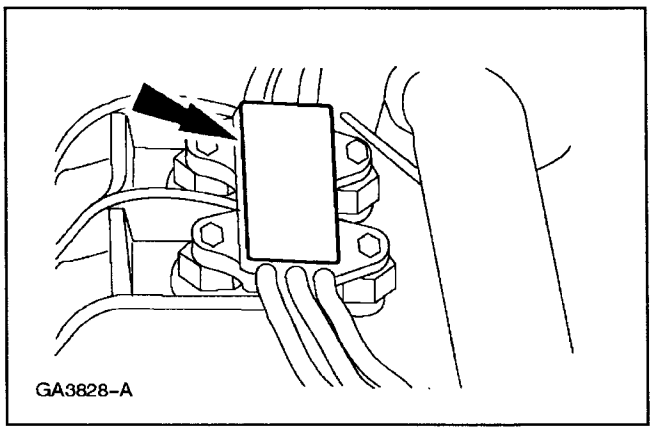
    1 Install the power steering pressure line.

    2 Install power steering pressure line union.

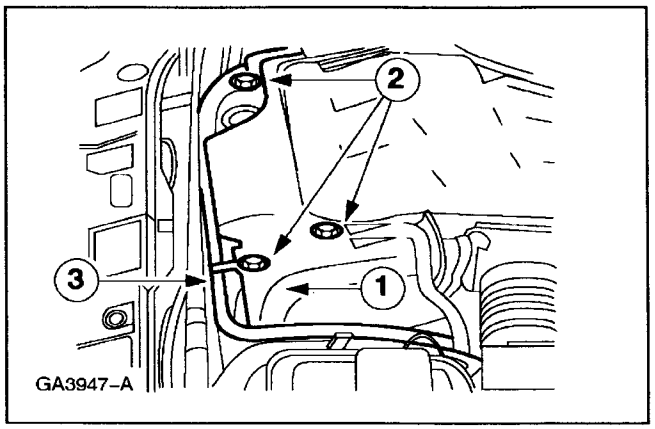
    3 Install the ground strap and bracket.

    4 Install the bolt.

IN-VEHICLE REPAIR (Continued)



15. Install the ignition wires and retainer onto the upper front engine support bracket studs.



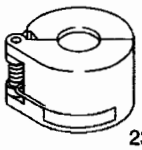
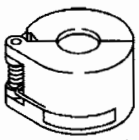
16. Install the water pump pulley shield.
    1 Install the shield.
    2 Install the bolts.
    3 Attach the coolant expansion tank hose to the bracket.

17. Fill the power steering system. For additional information, refer to Section 211-00.

REMOVAL

Engine — Vehicles with Manual Transaxle

Special Tool(s)

 23039	Remover, Fuel Pipe 3/8'' (yellow) 310-D004 (23039)
 23040	Remover, Fuel Pipe 1/2'' (green) 310-D005 (23040)
 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)

Materials

Item	Specification
Cable ties	

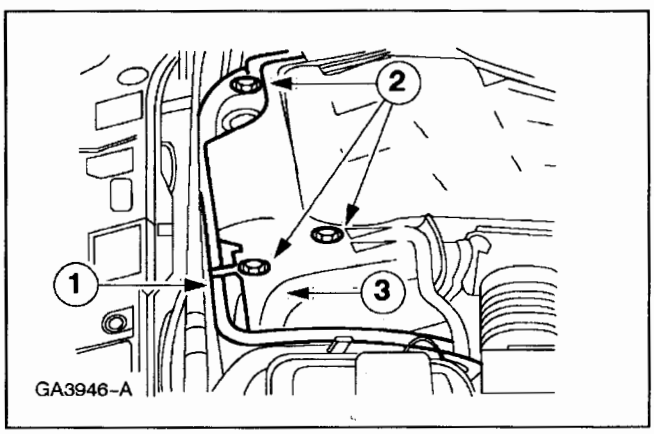
Removal

All vehicles

1. **NOTE:** The location of the engine support insulators are described looking from the transaxle to the engine.

   Remove the battery. For additional information, refer to Section 414-01.

2. Remove the hood.



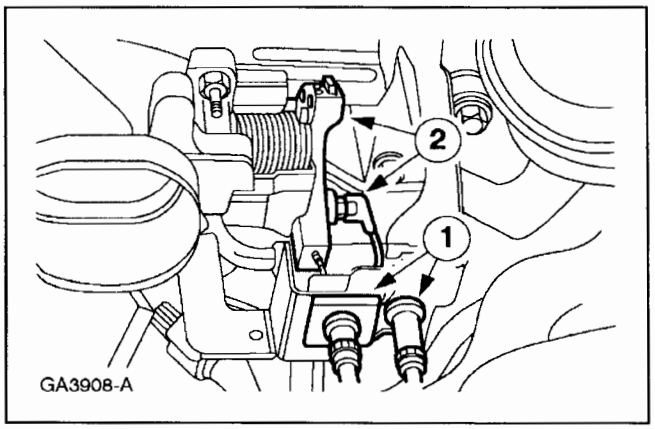
3. Remove the water pump pulley cover.
   1 Detach the coolant hose from clip.
   2 Remove the bolts.
   3 Remove the cover.

REMOVAL (Continued)

4. Remove the air cleaner (ACL). For additional information, refer to Section 303-12B.

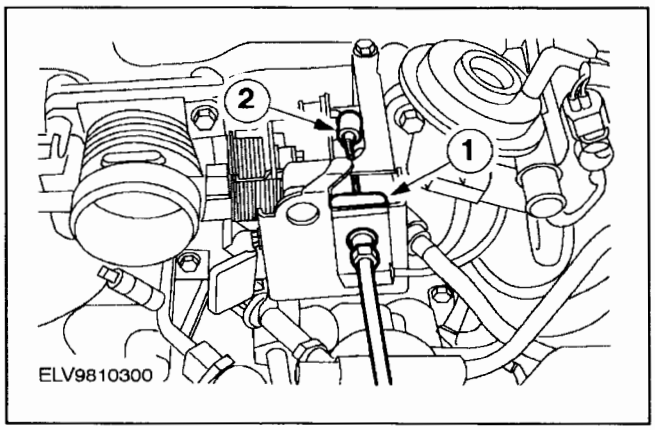
5. Drain the brake fluid. For additional information, refer to Section 206-00.

Vehicles with speed control



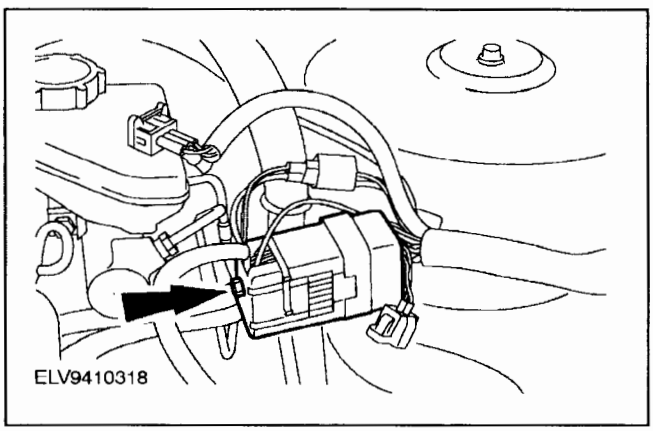
6. Disconnect the accelerator and speed control cables.
   1 Detach the cables from the bracket.
   2 Disconnect the accelerator and speed control cables.

Vehicles without speed control



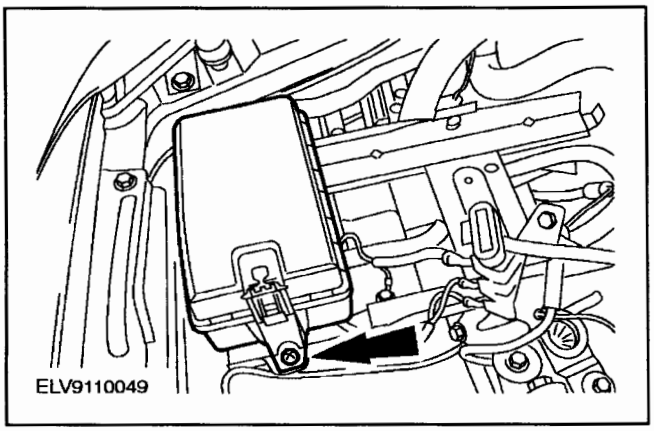
7. Disconnect the accelerator cable.
   1 Detach the cables from the bracket.
   2 Disconnect the accelerator cable.

All vehicles

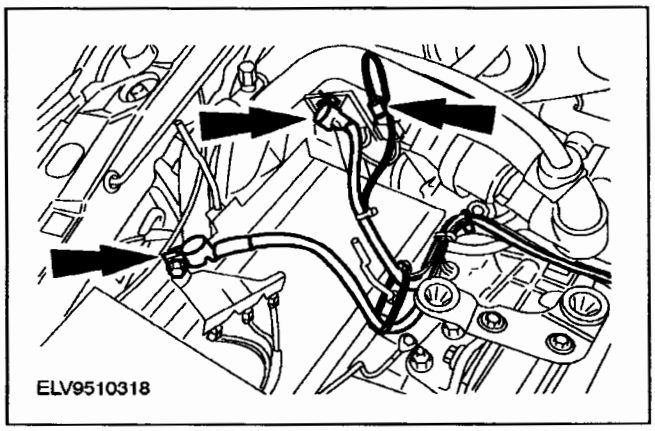


8. Disconnect the bulkhead electrical connector.

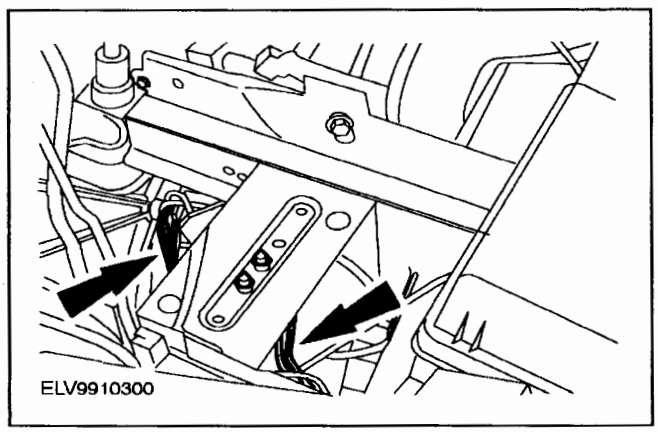
REMOVAL (Continued)



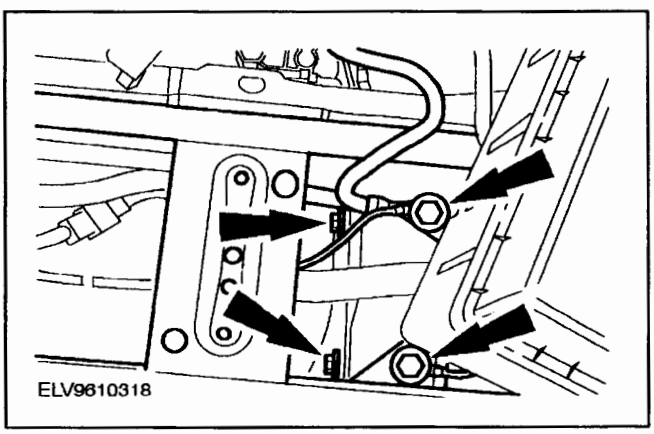
9. Loosen the central junction box (CJB) and position it to one side.



10. Disconnect the battery cables and the electrical connector.

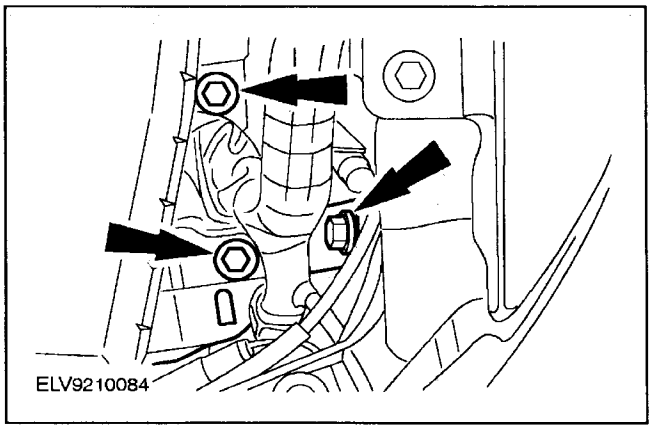


11. Remove the fan motor electrical connectors from the battery tray.



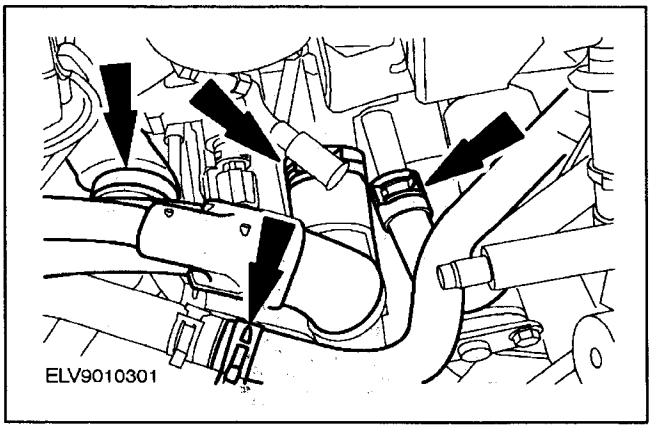
12. Remove the four battery tray bolts and remove the three ground cables.

REMOVAL (Continued)

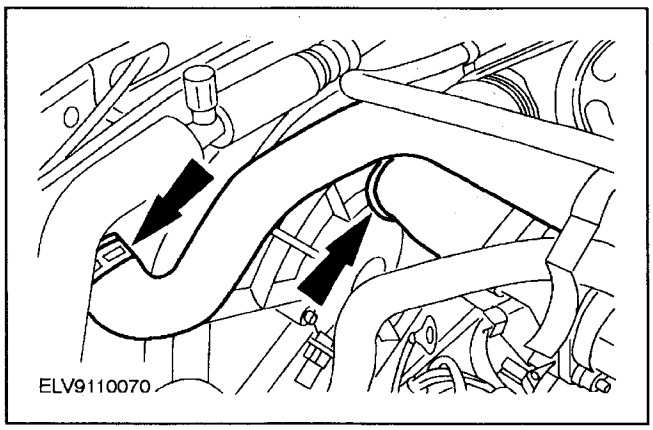


13. Remove the battery tray.

14. Disconnect the fuel lines. For additional information, refer to Section 310-00.

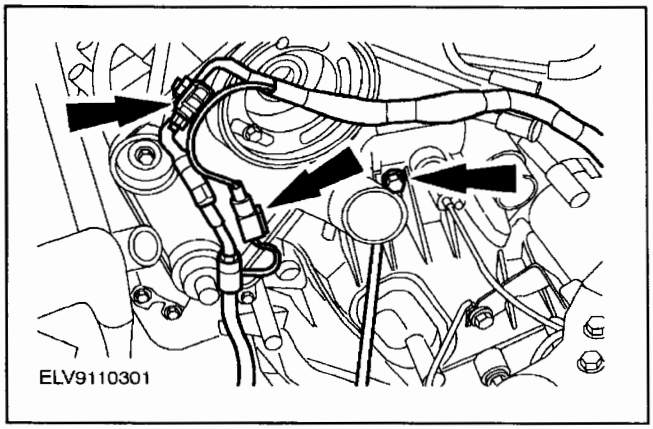


15. Disconnect the coolant hoses.

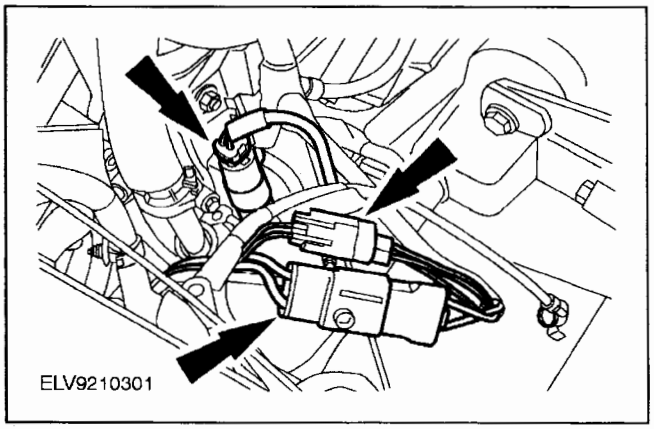


16. Disconnect the coolant hoses from the radiator and from the coolant passages.
    - Position the coolant passage to one side.

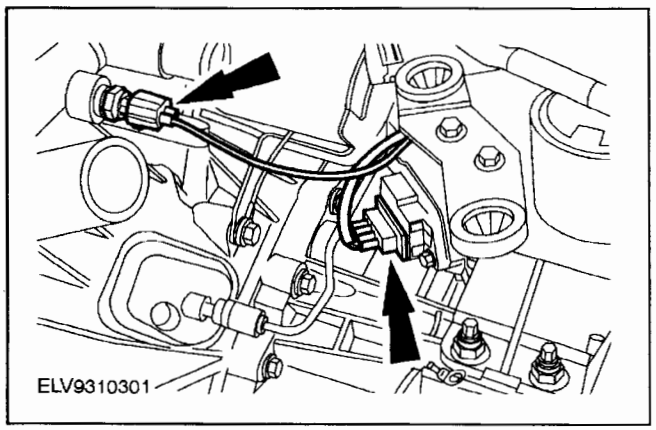
REMOVAL (Continued)



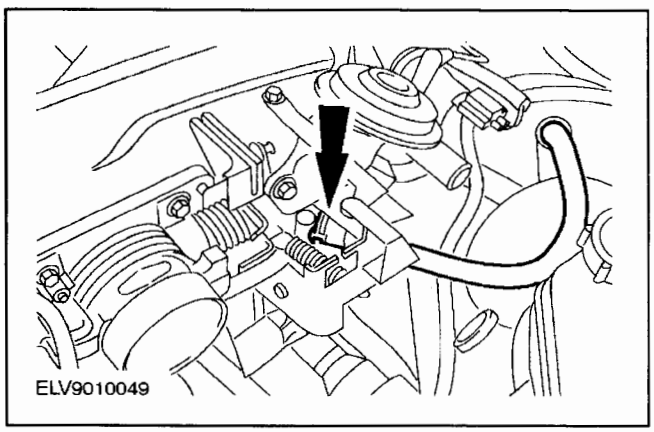
17. Disconnect the battery positive cable, the electrical connector and remove the transaxle housing bolt with the ground cable.



18. Disconnect the suction accumulator electrical connector and the two fan electrical connectors.

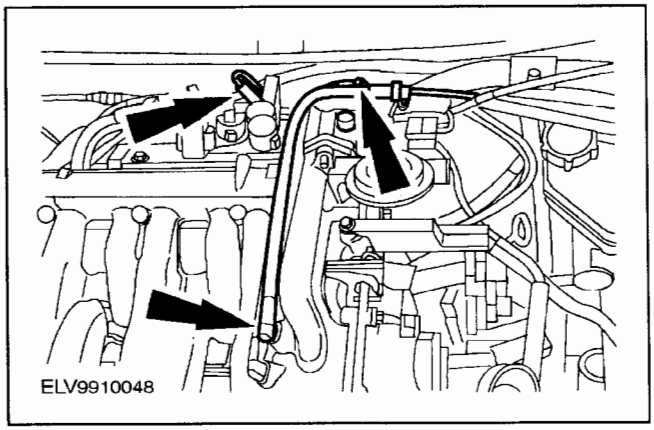


19. Disconnect the engine coolant temperature (ECT) sensor and the reverse lamp electrical connectors.

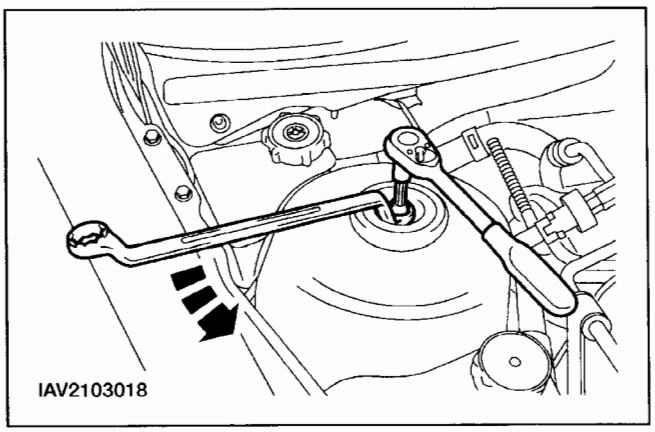


20. Disconnect the evaporative emission (EVAP) hose.

REMOVAL (Continued)

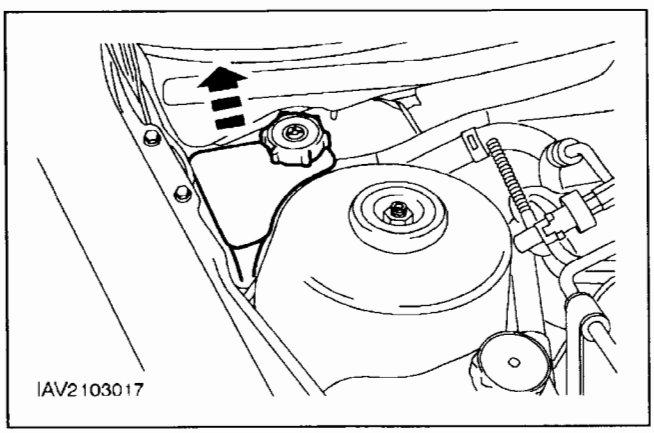


21. Disconnect the upper intake vacuum supply line and the heater control vacuum hoses.

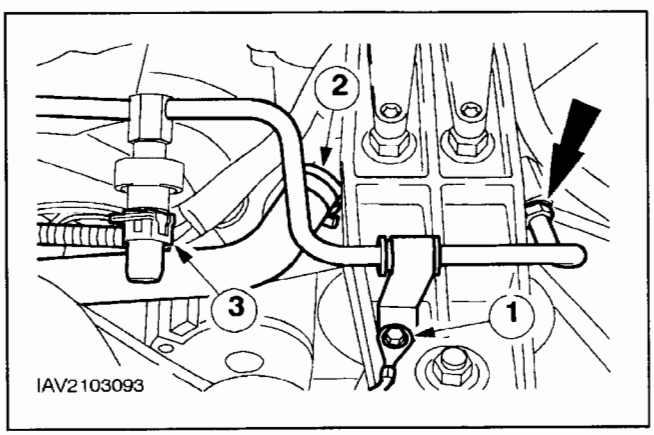


22. **NOTE:** Use an Allen Key to prevent the piston rod from turning.

    Loosen the suspension strut lock nuts five turns on both sides (right-hand side shown).

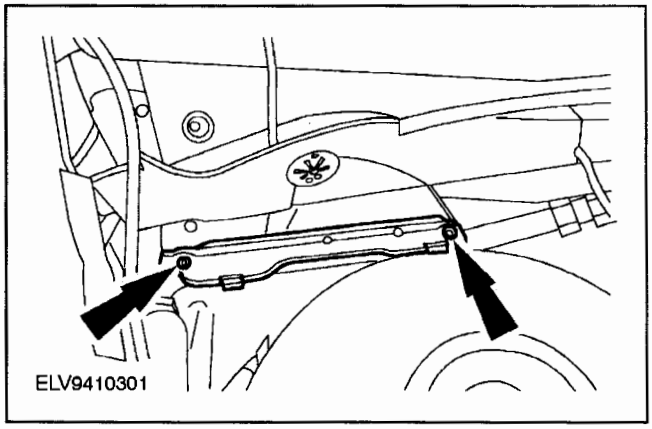


23. Drain the power steering reservoir and pull it out (push-fit) and position it to one side.



24. Disconnect the power steering lines.
    1. Remove the bolt and the ground cable.
    2. Disconnect the power steering lines and position it to one side.
    3. Disconnect the electrical connector.

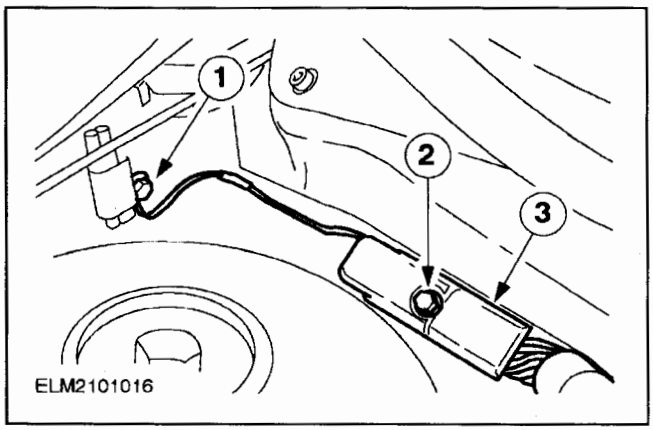
REMOVAL (Continued)



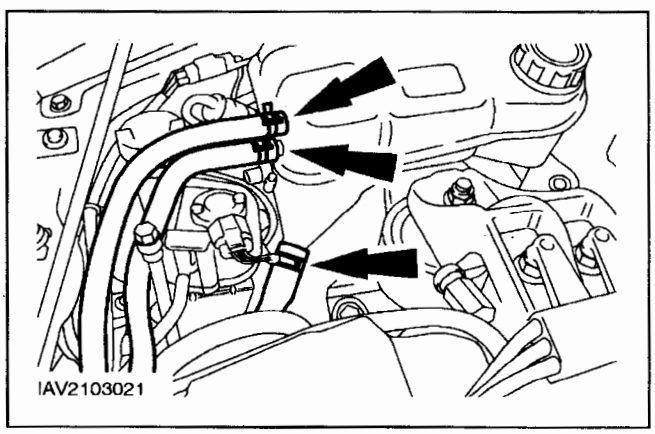
25. ⚠ **CAUTION: Do not damage the (A/C) tube/hose if equipped.**

    Remove the powertrain control module (PCM) cover plate.

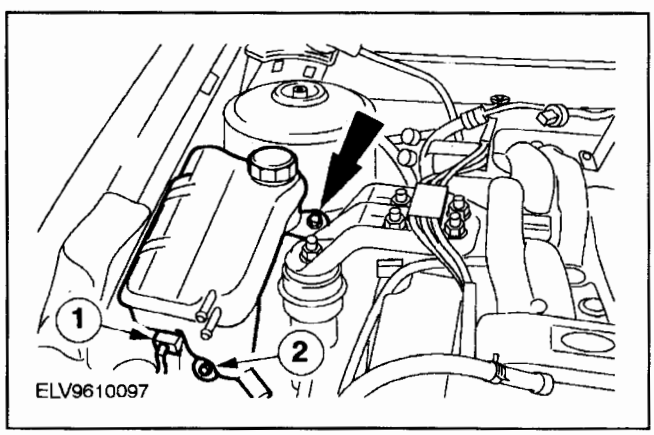
    - Drill out the rivets.



26. Disconnect the PCM electrical connector.
    1 Ground cable
    2 Bolt
    3 Connector

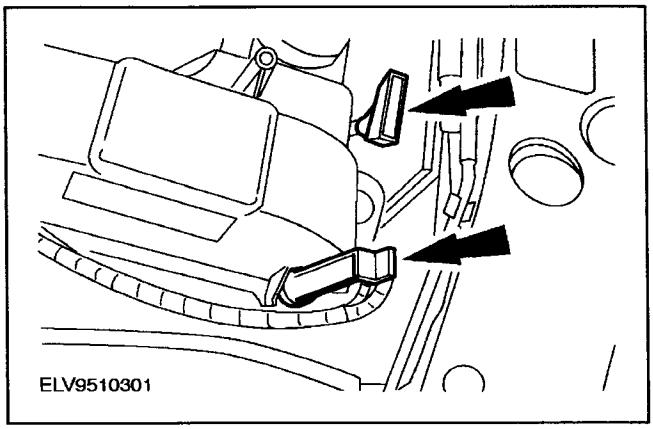


27. Disconnect the coolant expansion tank hoses.

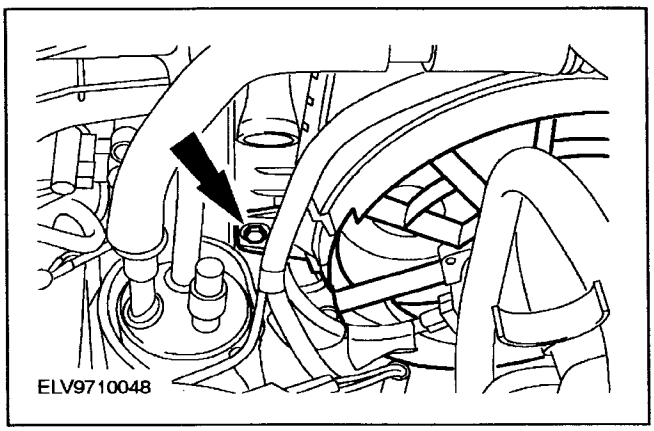


28. Remove the coolant expansion tank.
    1 Disconnect the coolant level sensor electrical connector.
    2 Remove the bolts.

REMOVAL (Continued)

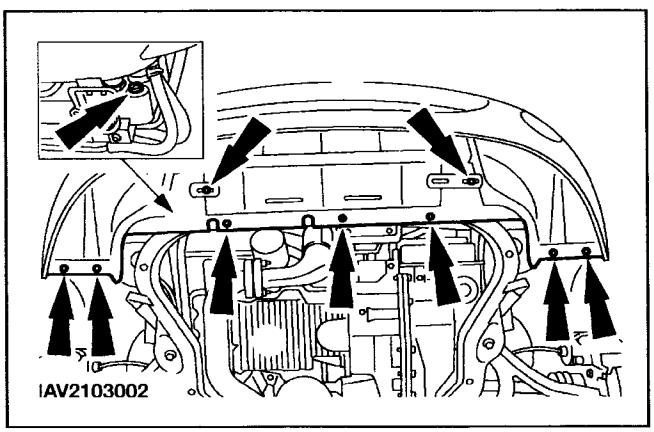


29. Remove the oil lever indicator and the heated oxygen sensor (HO2S) electrical connector bracket.



30. Loosen the fan from the radiator (one screw on each side).
    - Secure the fan to the subframe with cable ties .

31. Raise and support the vehicle. For additional information, refer to Section 100-02.

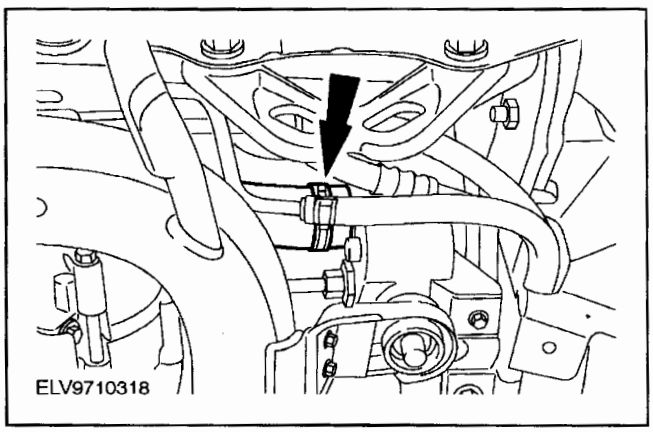


32. Remove the radiator splash shield.

33. Drain the cooling system. For additional information, refer to Section 303-03.

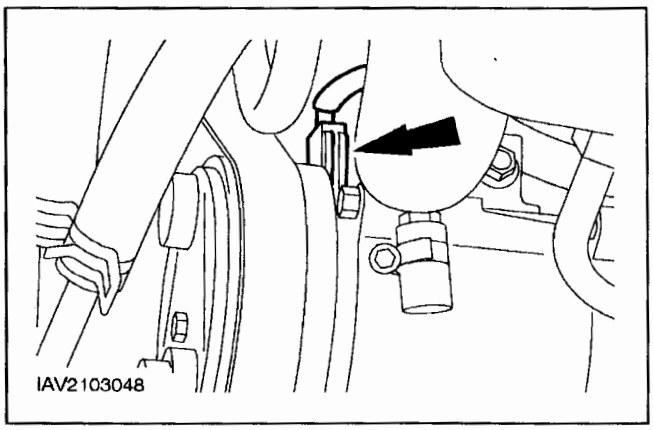
34. Drain the Transmission Fluid. For additional information, refer to Section 308-03.

REMOVAL (Continued)

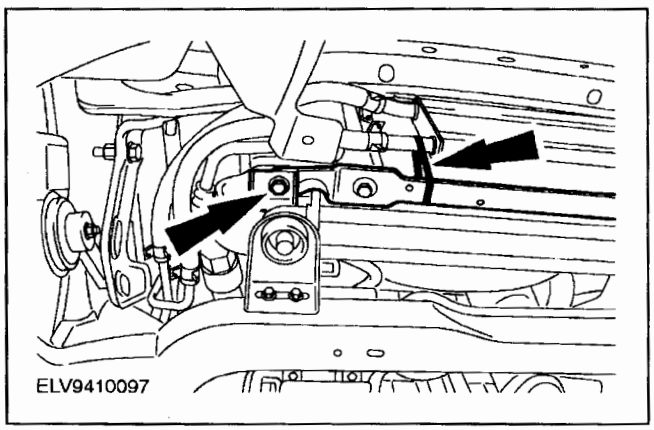


35. Remove the coolant hose from the radiator.

36. Drain the engine oil.
    - Install the drain plug on completion.

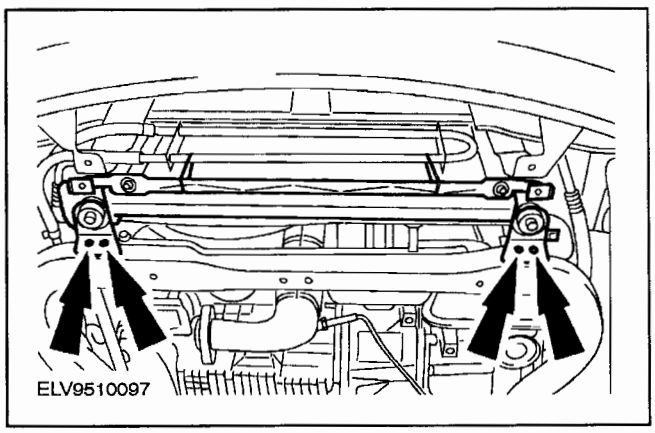


37. Disconnect the compressor electrical connector.



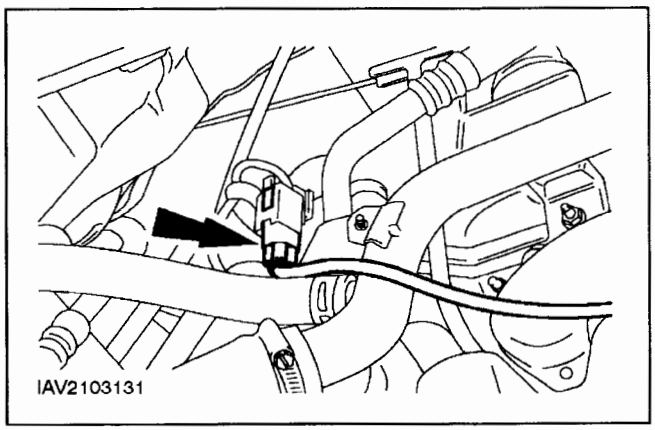
38. Remove the condenser core from the radiator.
    - Secure the condenser core to one side with cable ties.

REMOVAL (Continued)

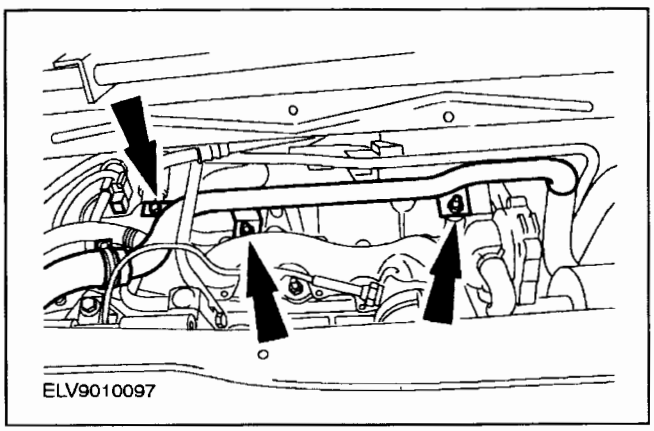


39. Remove the radiator.

40. Remove the fan.
    - Cut the cable ties.

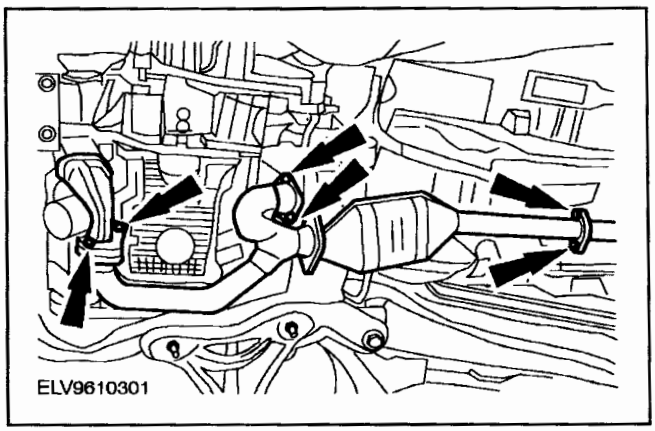


41. Disconnect the HO2S electrical connector.

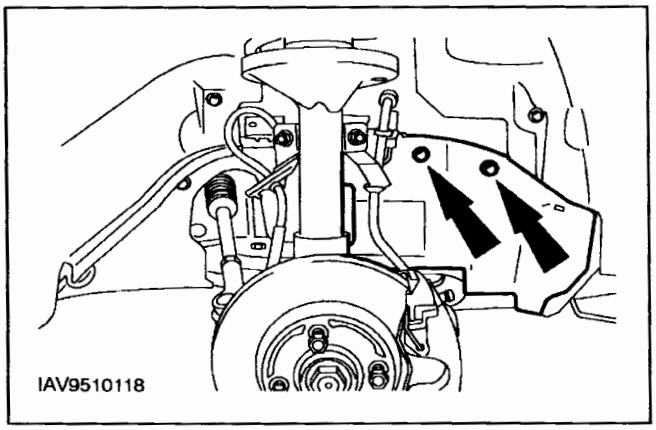


42. Remove the coolant pipe.

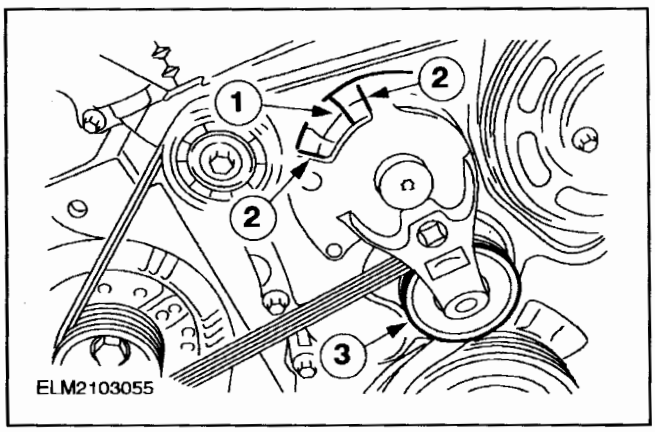
REMOVAL (Continued)



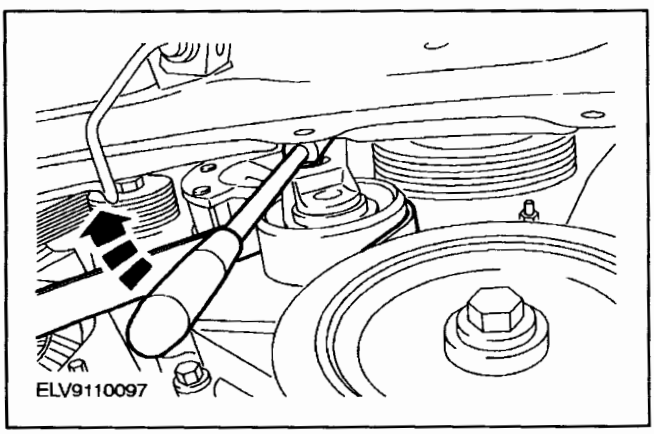
43. Remove the dual converter Y-pipe and the three-way catalytic converter (TWC).
    - Discard the gaskets.



44. Remove the right-hand front fender splash shield (shown with wheel removed).

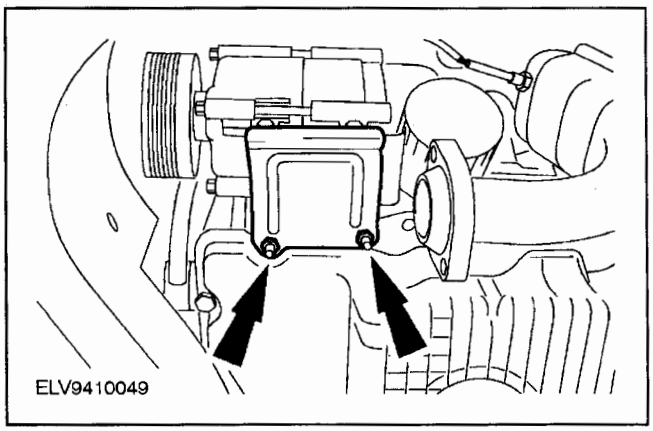


45. Check the accessory drive belt tension.
    1 Fixed cast lug.
    2 Right-hand and left-hand moving stop.
    3 Belt tensioner.
    - If the right-hand moving stop is touching the fixed cast lug, install a new accessory drive belt during installation.

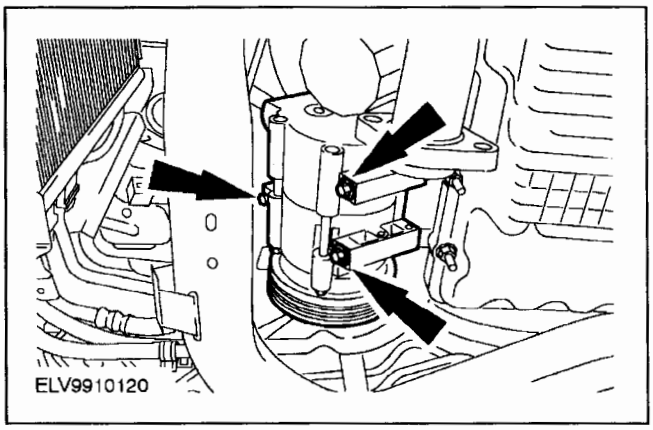


46. Remove the accessory drive belt.

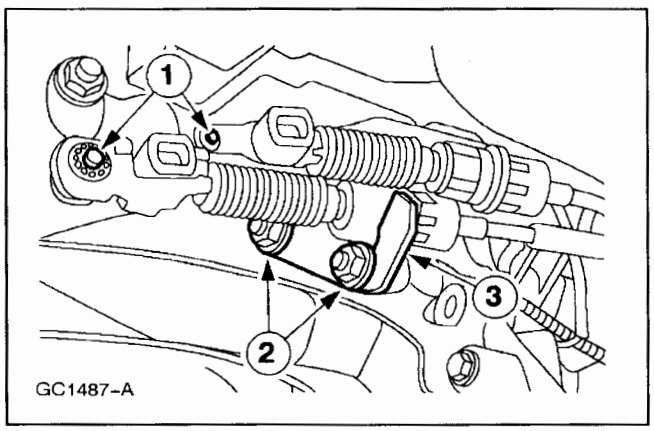
REMOVAL (Continued)



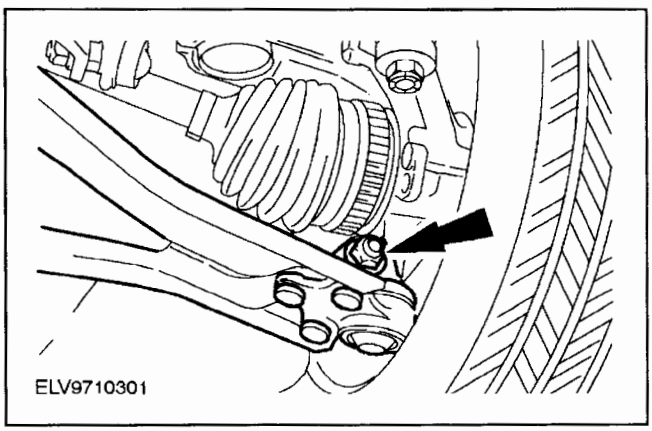
47. Remove the compressor heat shield.



48. Remove the compressor bracket bolts.
    - Secure the compressor with cable ties and position it to one side.

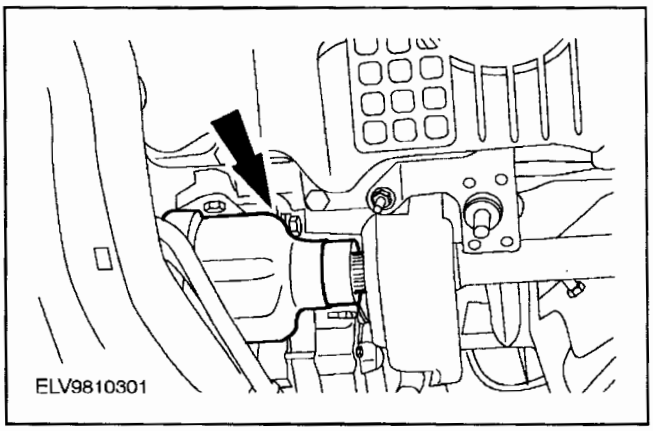


49. Disconnect the shifter cables and bracket.
    1 Disconnect the shifter cables from the gear shift lever.
    2 Remove the nuts.
    3 Position the shifter bracket to one side.



50. Remove both control arms (right-hand side shown).

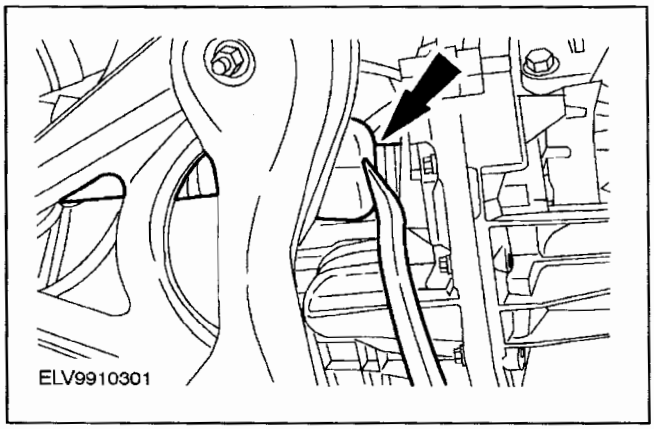
REMOVAL (Continued)



51. ⚠ **CAUTION: To avoid damage to the halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by not more than 45 degrees.**

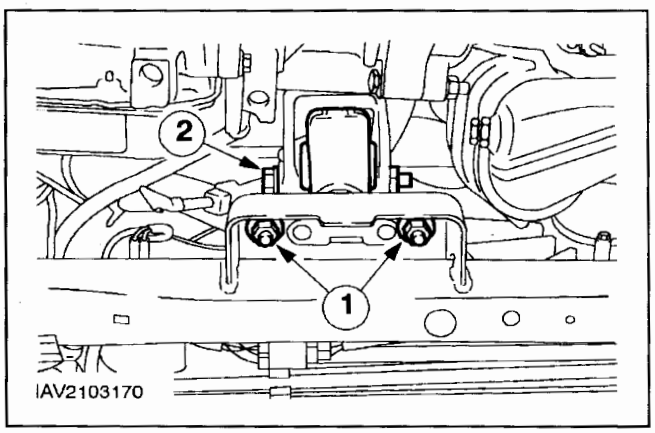
    Using a suitable copper drift, remove the right-hand front drive halfshaft from the intermediate shaft bearing and tie it up using cable ties.

    - Discard the snap-ring.

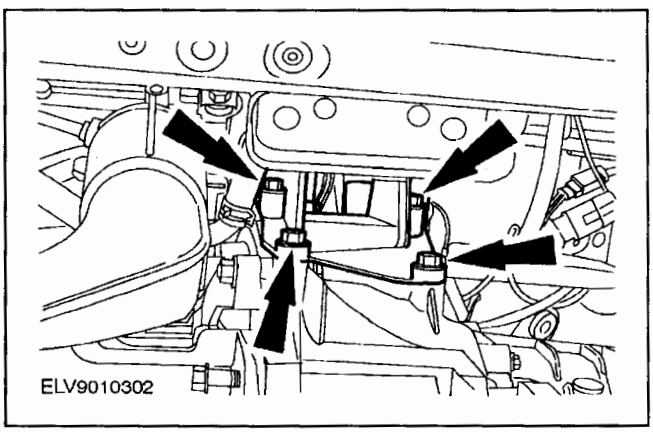


52. Using a suitable tire lever, remove the left-hand front drive halfshaft from the transaxle and secure it to one side using cable ties.

    - Discard the snap ring.

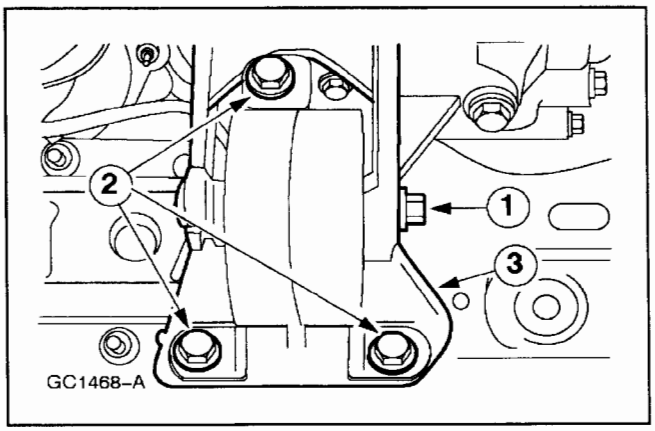


53. Remove the left-hand support insulator.
    1 Nuts
    2 Center bolt

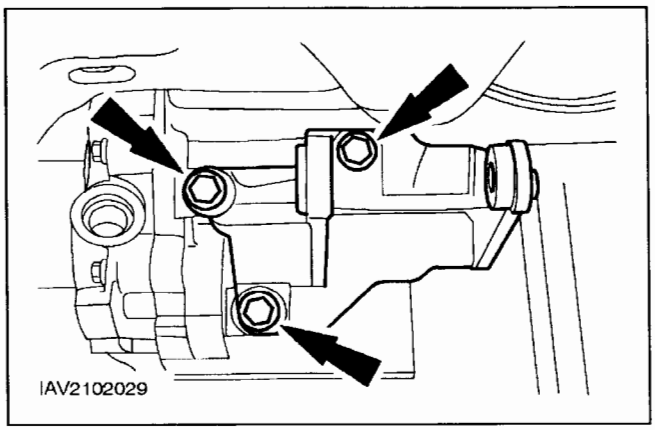


54. Remove the left-hand support insulator bracket.

REMOVAL (Continued)

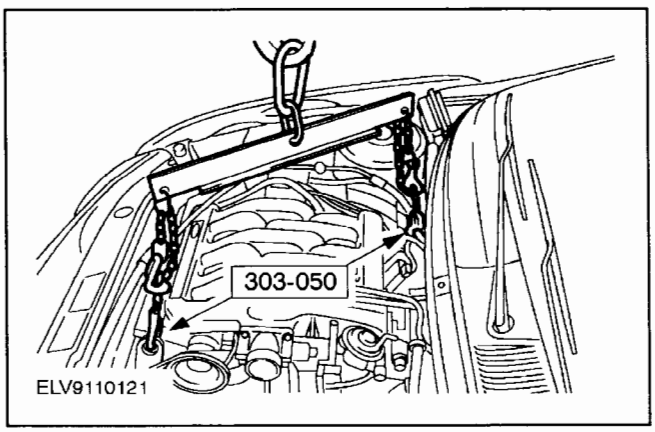


55. Remove the right-hand support insulator.
    1 Remove the through bolt.
    2 Remove the bolts.
    3 Remove the right-hand support insulator.

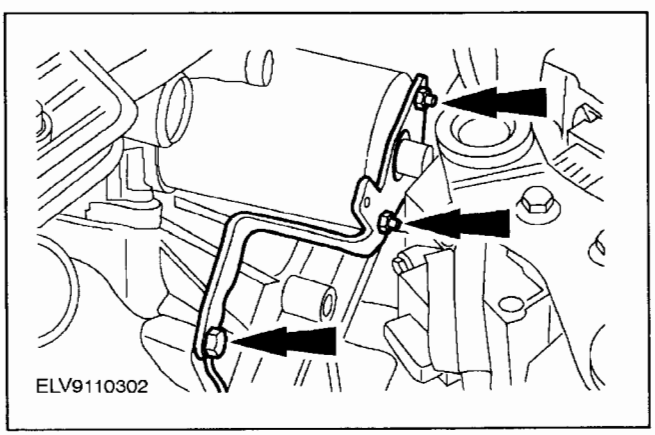


56. Remove the right-hand support insulator bracket.

57. Lower the vehicle.

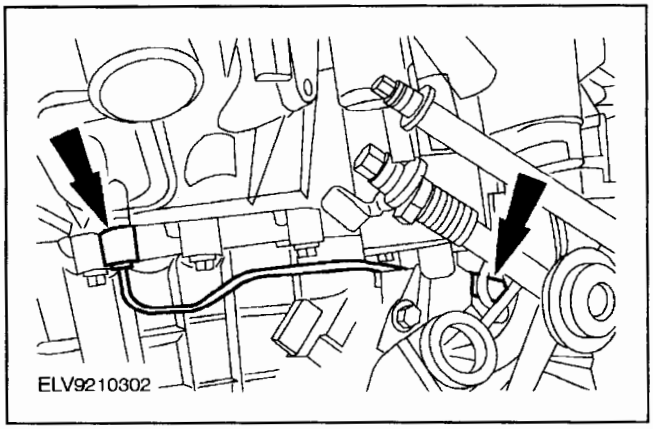


58. Install the special tool and a suitable floor crane.

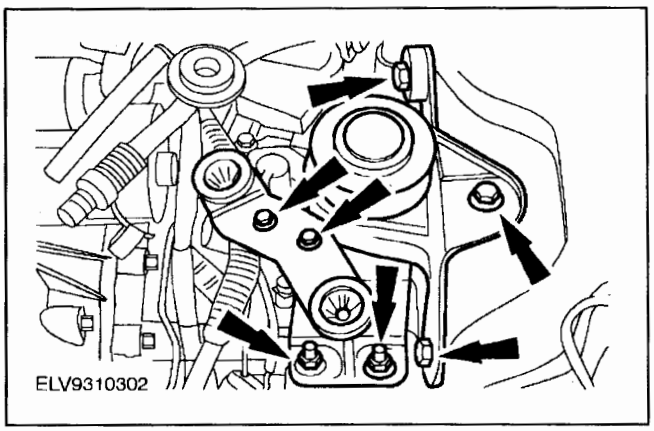


59. Remove the starter motor bracket and the ground cable from the transaxle flange.

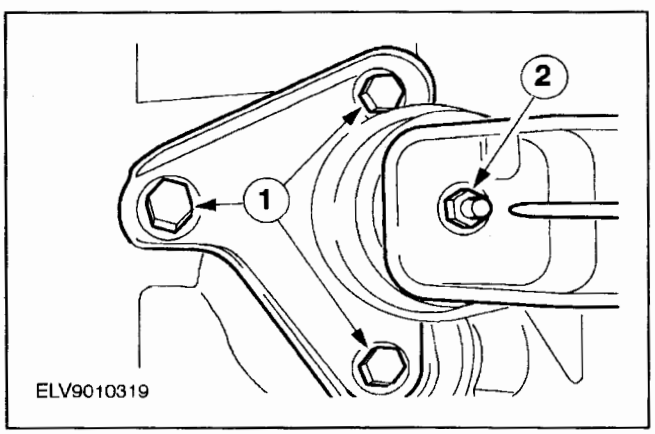
REMOVAL (Continued)



60. Remove the clutch slave cylinder hydraulic line.

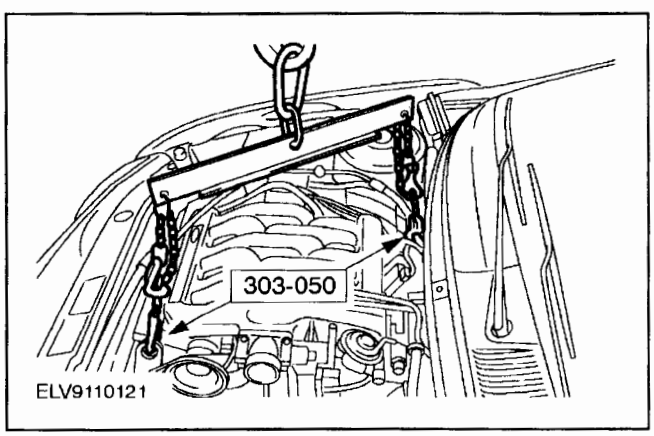


61. Remove the ACL bracket and the rear upper support insulator.



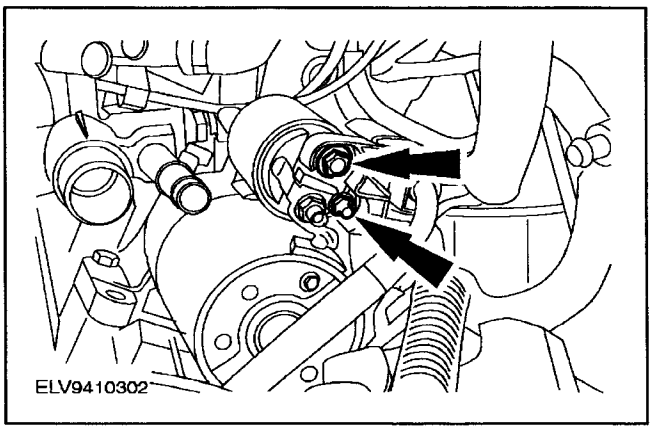
62. Remove the front upper support insulator from the side member.
    1 Remove the bolts.
    - Raise the engine/transaxle assembly slightly to reduce the pressure from the support insulator.

    2 Remove the bolt.

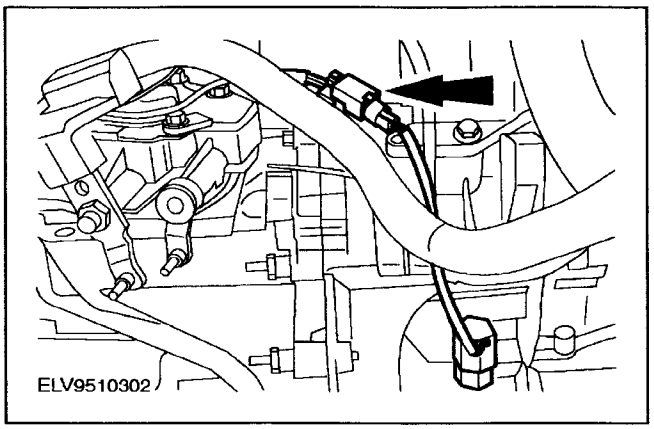


63. Using the special tool and a suitable floor crane, remove the engine/transaxle assembly.
    - Position the engine/transaxle on an assembly table.
    - Remove the special tool.

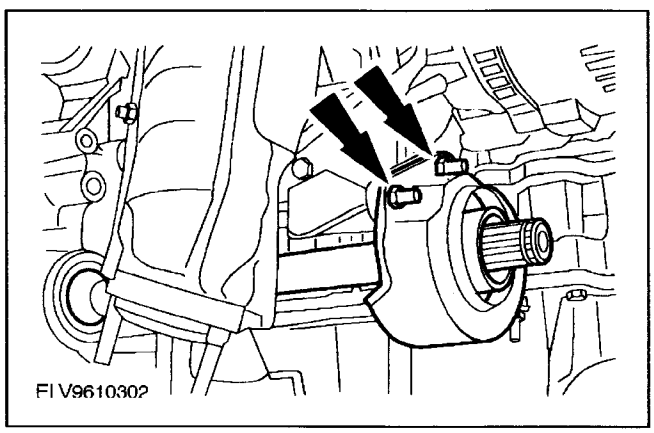
REMOVAL (Continued)



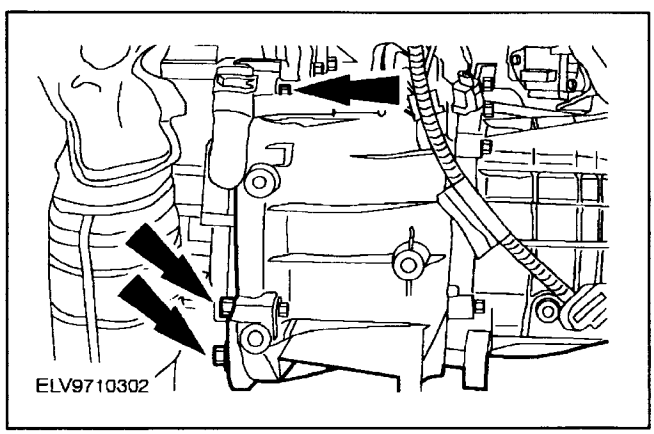
64. Disconnect the starter motor electrical connections.



65. Disconnect the vehicle speed sensor (VSS) electrical connector.

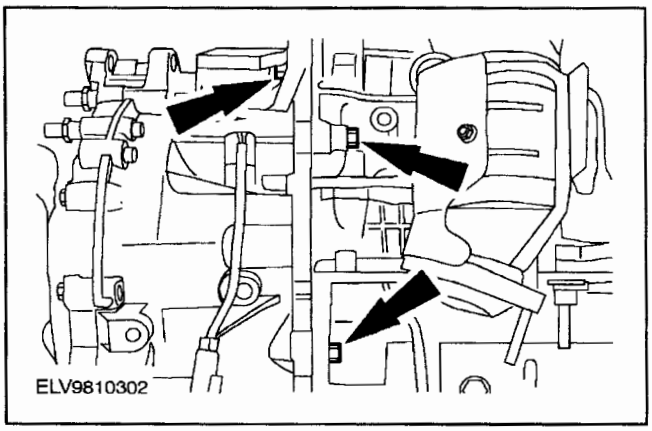


66. Remove the heat shield and the intermediate shaft.



67. Remove the transaxle flange bolts.

REMOVAL (Continued)



68. Remove the transaxle flange bolts (continued).

69. Separate the engine from the transaxle.

Engine — Vehicles with Automatic Transaxle

Special Tool(s)

 TOOL-3290-D	Separator, Ball Joint 211-001 (TOOL-3290-0)
 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)

Removal

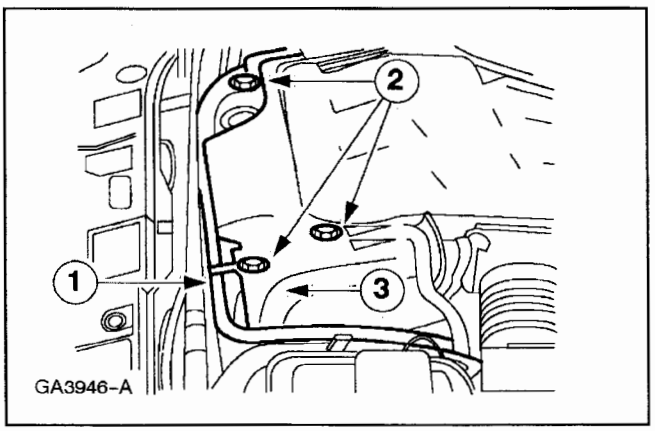
1. **NOTE:** The location of engine mountings and engine support insulators are described looking from the transaxle to the engine.

   Remove the front wheels. For additional information, refer to Section 204-04.

2. Remove the battery. For additional information, refer to Section 414-01.

3. Remove the hood.

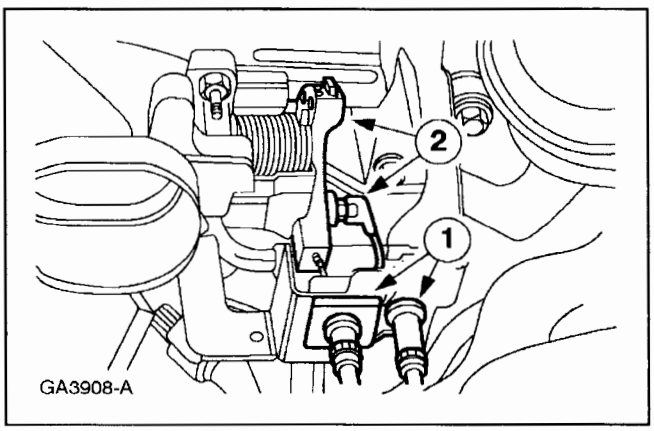
REMOVAL (Continued)



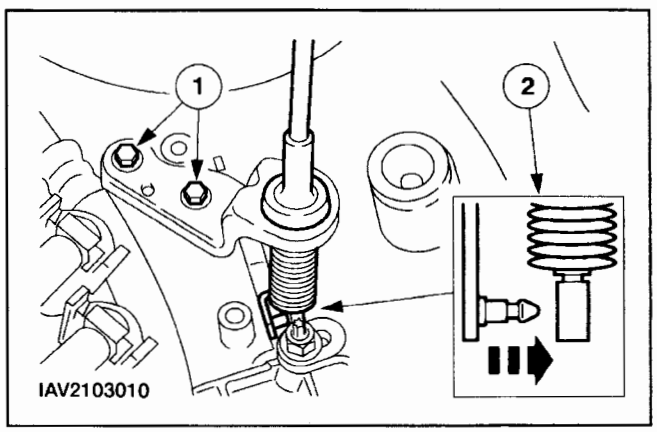
4. Remove the bolts and the water pump pulley cover.
   1 Detach the coolant hose from the clip.
   2 Remove the bolts.
   3 Remove the cover.

5. Remove the air cleaner (ACL). For additional information, refer to Section 303-12B.

6. Drain the cooling system. For additional information, refer to Section 303-03.

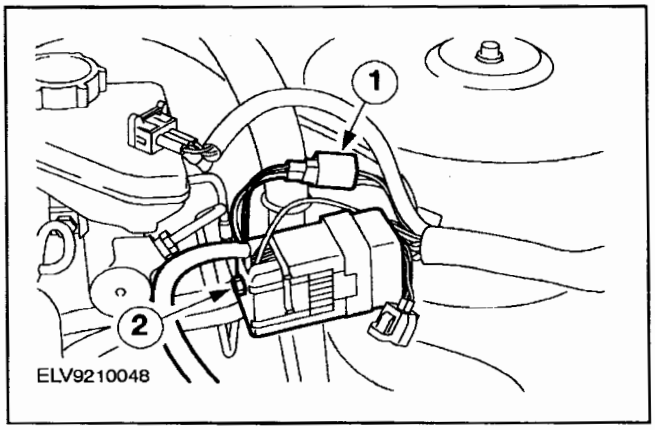


7. Disconnect the accelerator and speed control cables.
   1 Detach the cables from the bracket.
   2 Disconnect the accelerator and speed control cables.

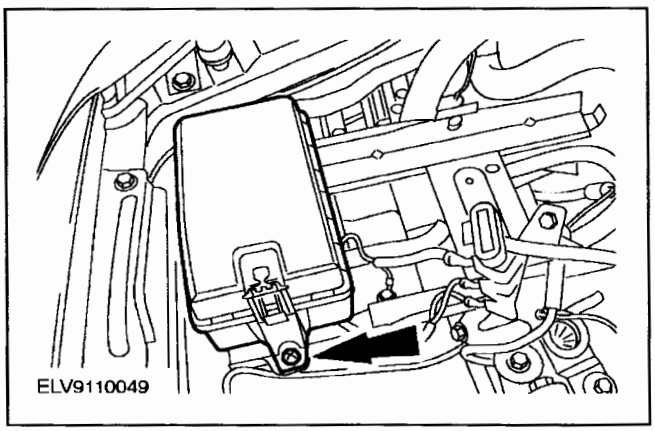


8. Remove the selector cable.
   1 Remove the bolts.
   2 Disconnect the cable.

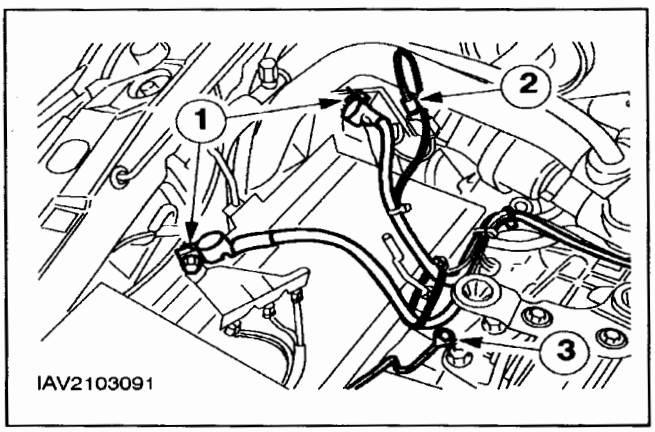
REMOVAL (Continued)



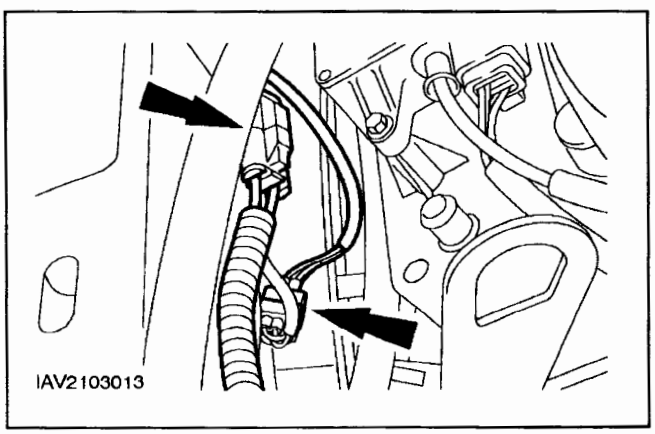
9. Disconnect the bulkhead electrical connectors.
   1 Disconnect the electrical connector.
   2 Remove the bolt and disconnect the electrical connector.



10. Detach the central junction box (CJB) and position it to one side.

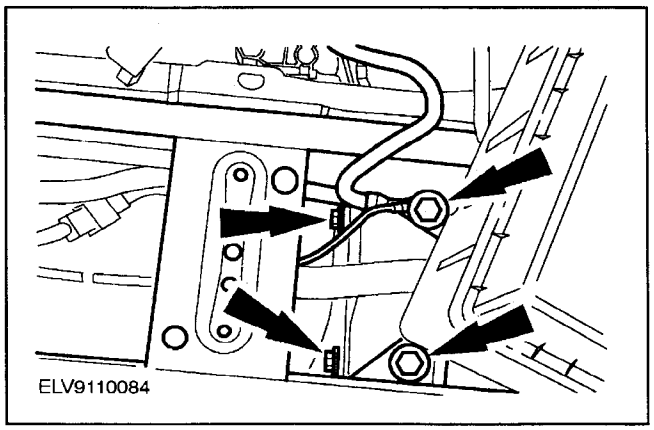


11. Disconnect the cables.
    1 Battery cables.
    2 Electrical connector.
    3 Ground cable.

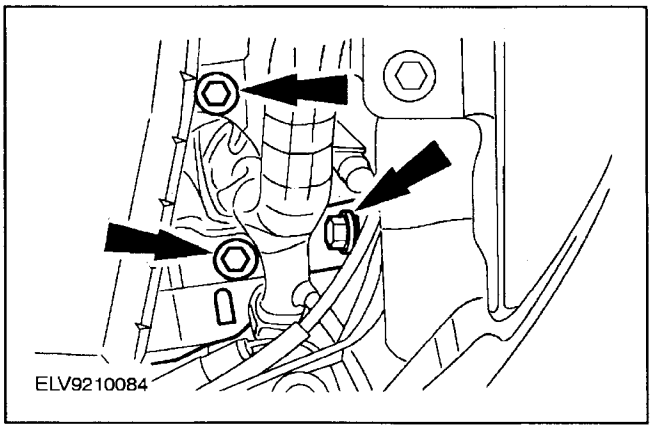


12. Disconnect the fan motor electrical connectors.

REMOVAL (Continued)

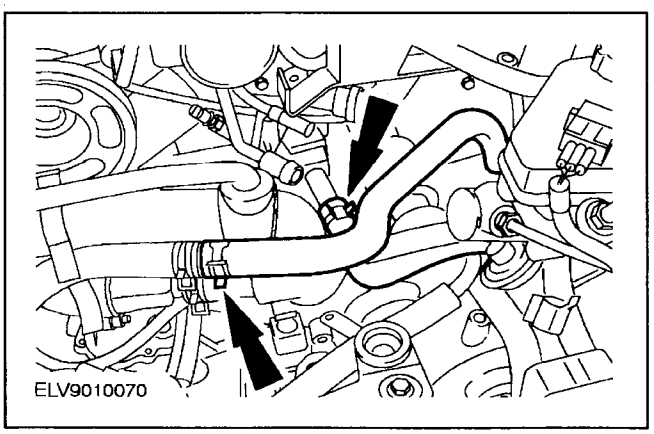


13. Remove the battery bracket bolts and remove the two ground cables.



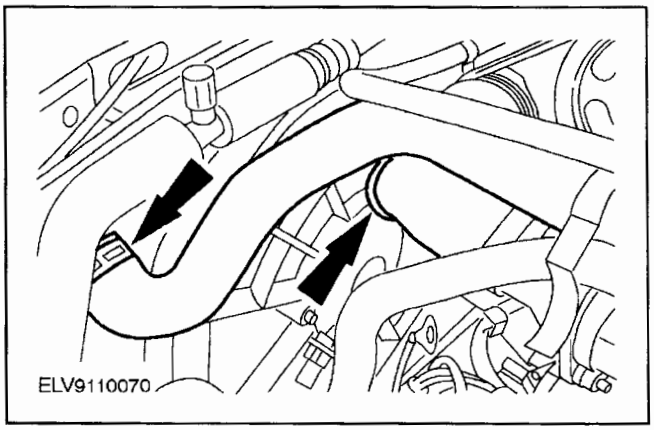
14. Remove the battery bracket.

15. Disconnect the fuel line. For additional information, refer to Section 310-00.

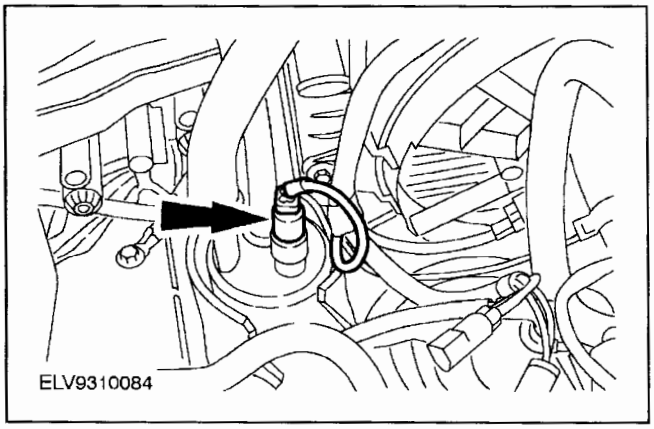


16. Disconnect the heater hoses.

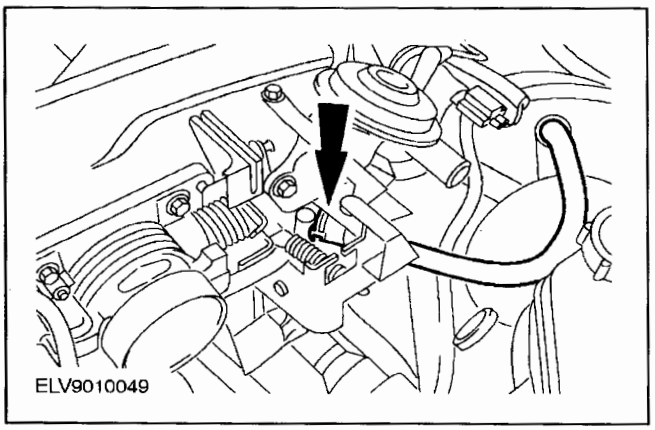
REMOVAL (Continued)



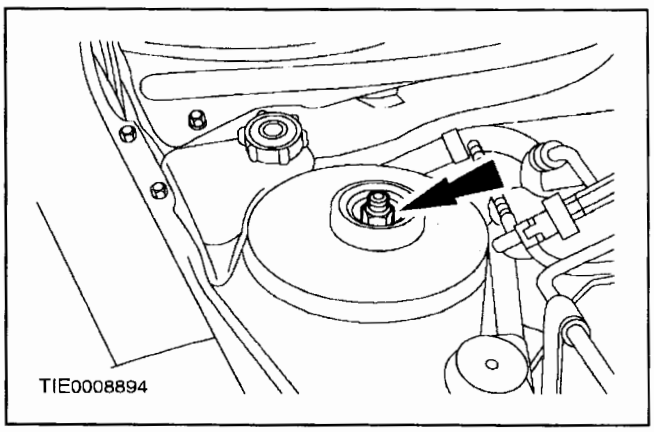
17. Disconnect the coolant hoses from the radiator and from the coolant passage.



18. Disconnect the suction accumulator electrical connector.



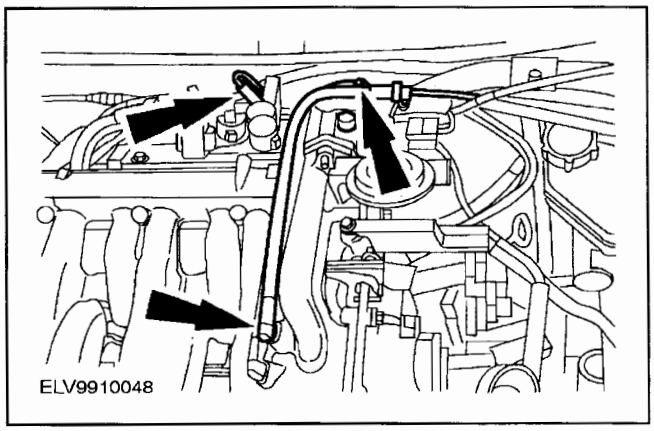
19. Disconnect the evaporative emission (EVAP) hose.



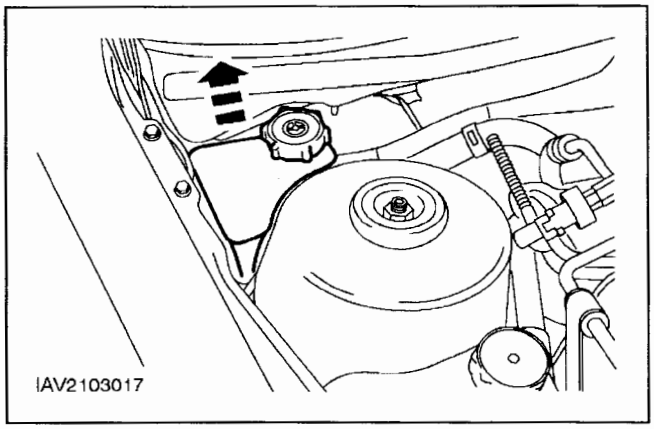
20. **NOTE:** Use an allen key to prevent the piston rod from turning.

    Loosen the suspension strut nuts five turns on both sides (right-hand side shown).

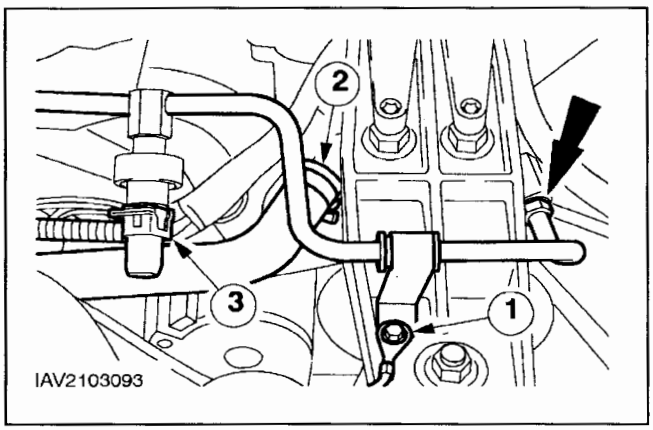
REMOVAL (Continued)



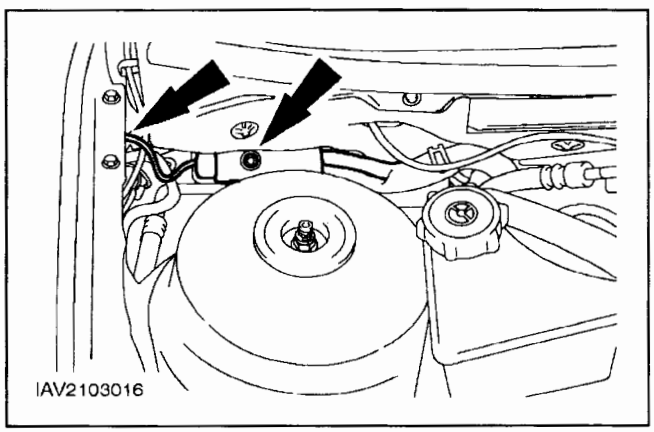
21. Disconnect the upper intake vacuum supply line and the heater control vacuum hoses.



22. Drain the power steering fluid reservoir and pull it out (push-fit) and position it to one side.

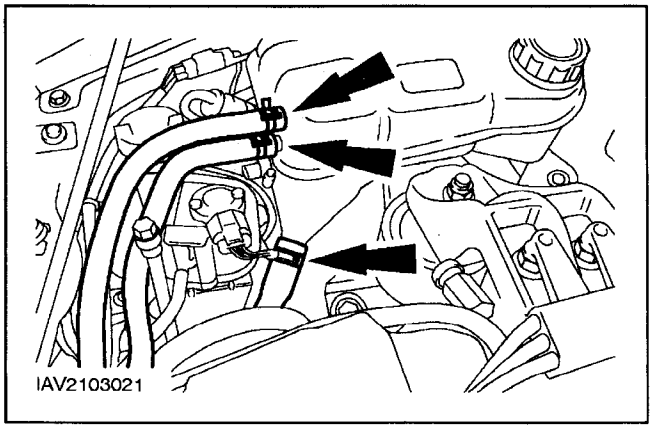


23. Disconnect the power steering hose.
    1 Remove the bolt and the ground cable.
    2 Disconnect the power steering hose and position it to one side.
    3 Disconnect the connector.

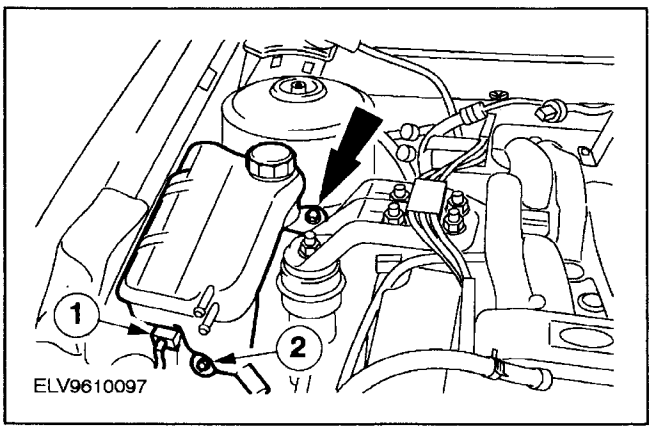


24. Disconnect the powertrain control module (PCM) and the ground cable.

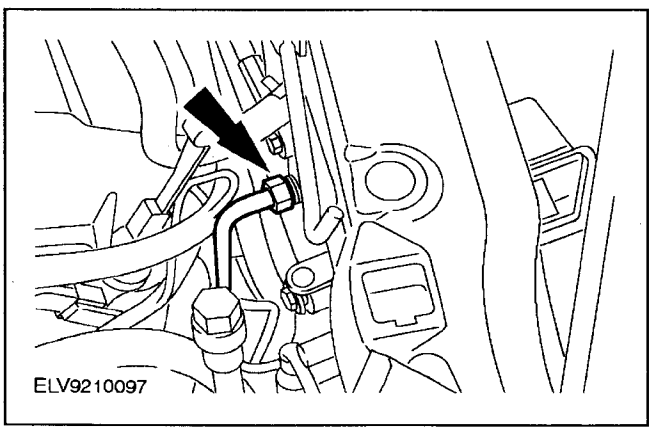
REMOVAL (Continued)



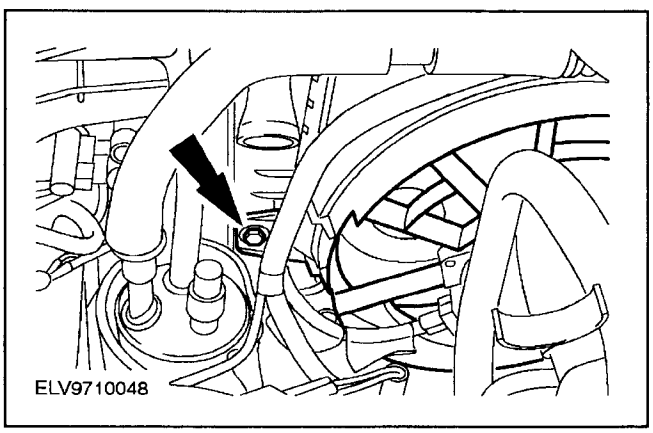
25. Disconnect the coolant expansion tank hoses.



26. Remove the coolant expansion tank.
    1 Disconnect the coolant level sensor connector.
    2 Remove the bolts.



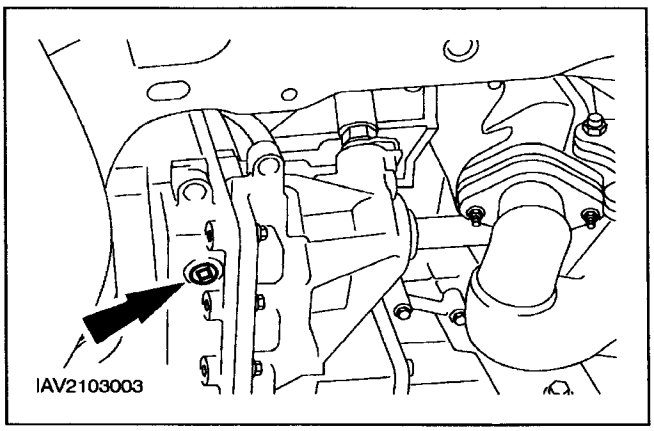
27. Remove the transaxle upper cooling tube.
    - Allow the fluid to drain into a suitable container.
    - Close off the openings with plugs.



28. Remove the fan (one screw on each side).

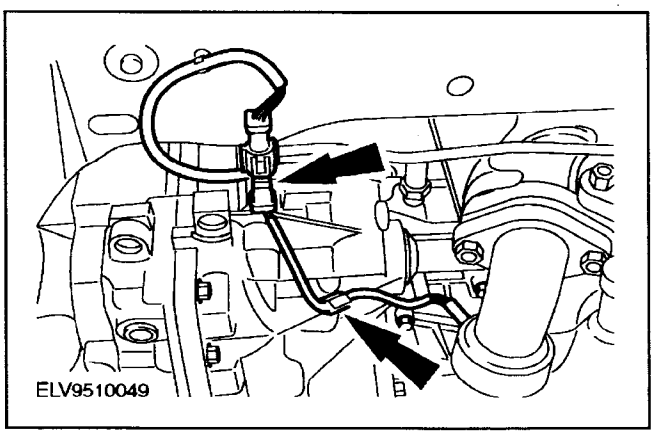
REMOVAL (Continued)

29. Raise and support the vehicle. For additional information, refer to Section 100-02.

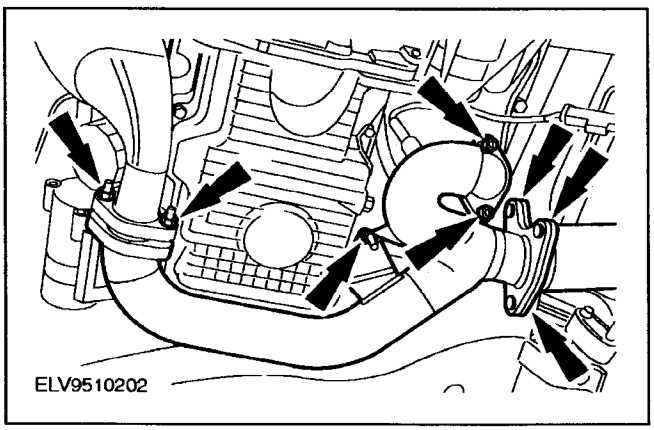


30. Remove the drain plug and drain the transmission fluid. For additional information, refer to Section 307-01.

31. Drain the engine oil.
    - Install the drain plug on completion.

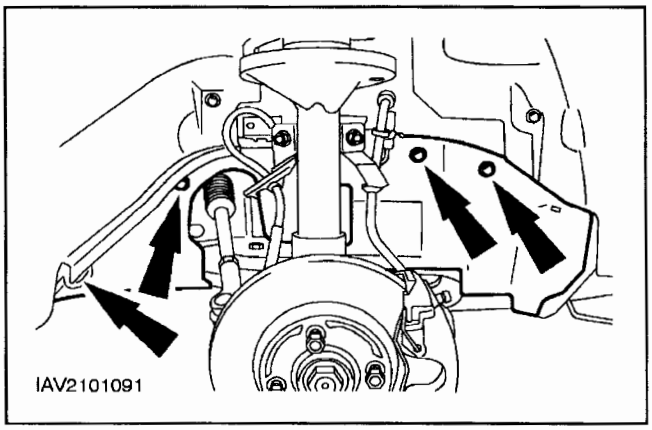


32. Disconnect the heated oxygen sensor (HO2S) electrical connector.

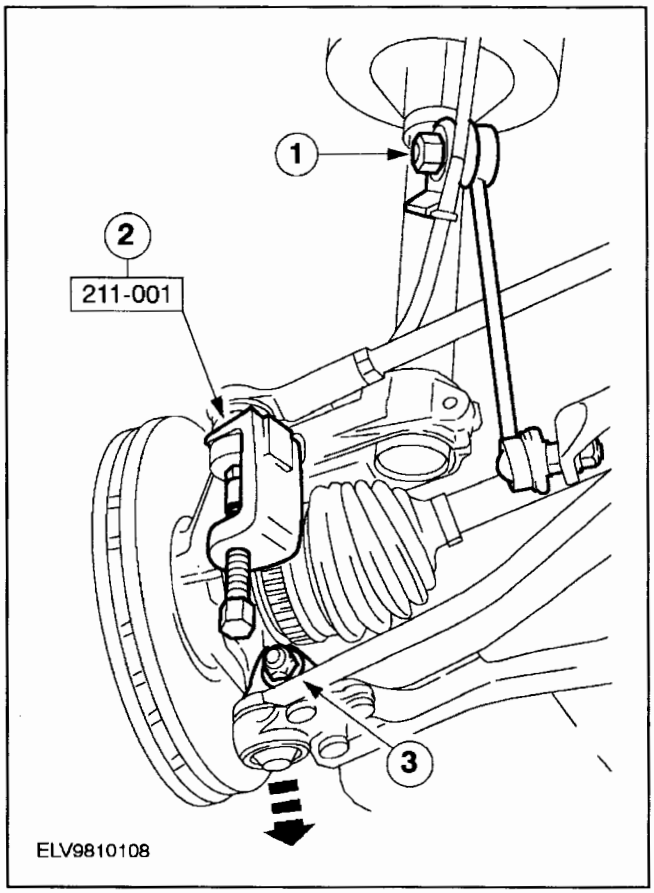


33. Remove the dual converter Y-pipe.

REMOVAL (Continued)



34. Remove the right-hand fender splash shields.



35. ⚠ **CAUTION: Do not damage the boot or the ABS sensor ring.**

NOTE: Left-hand side shown, right-hand side similar.

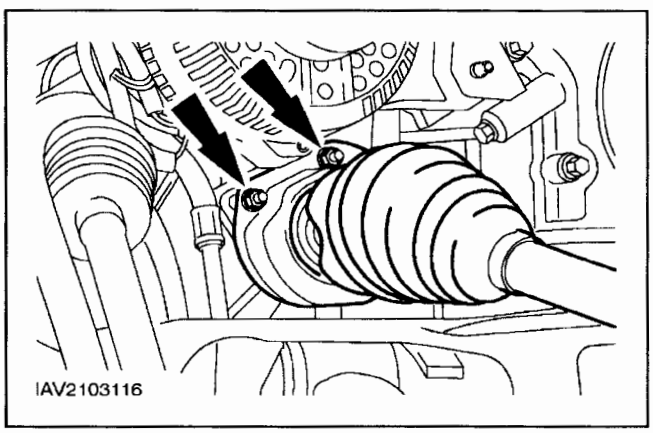
Disconnect the suspension.

1 Disconnect the stabilizer link rods.

2 Using the special tool, disconnect the tie-rod ends.

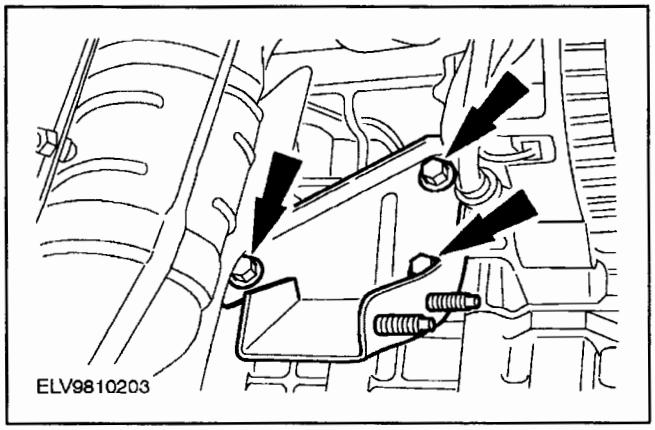
3 Disconnect the lower suspension arm ball joints.

- Disconnect the ABS wiring harness brackets from the suspension struts.



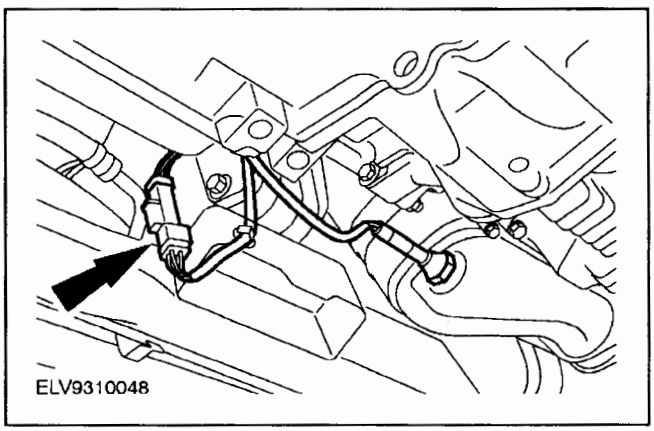
36. Remove the intermediate shaft bearing with the right-hand front drive halfshaft from the transaxle and secure it to one side with cable ties.

REMOVAL (Continued)

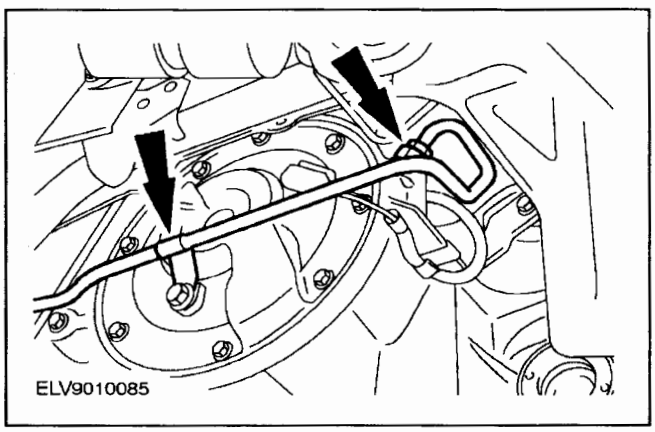


37. Remove the intermediate shaft bearing bracket.

38. Remove the left-hand front drive halfshaft from the transaxle and secure it to one side with cable ties.

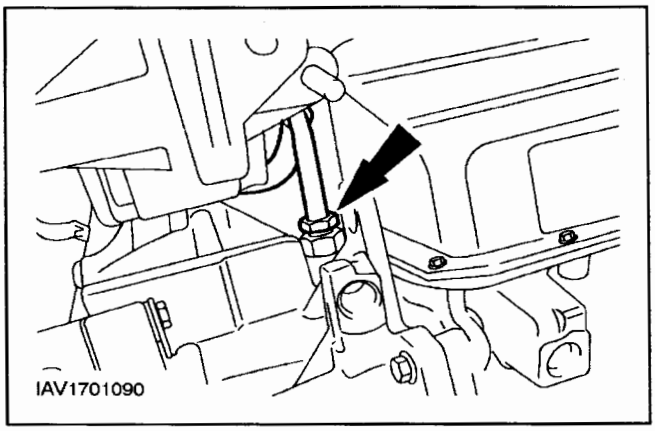


39. Disconnect and remove the HO2S electrical connector.

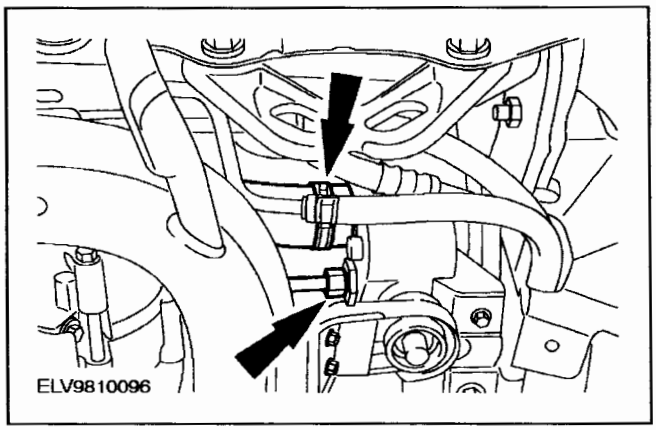


40. Remove the transaxle cooling line.

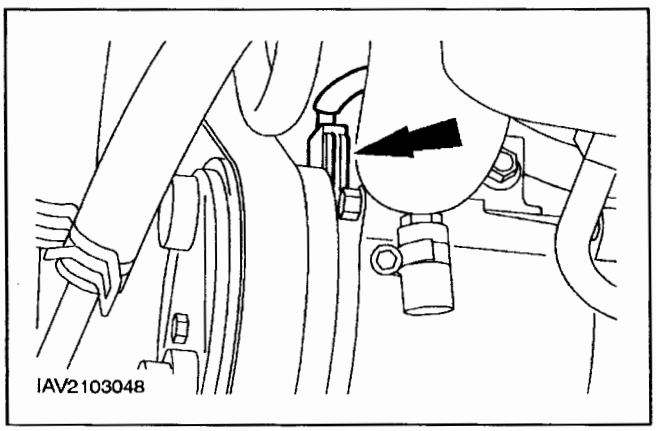
REMOVAL (Continued)



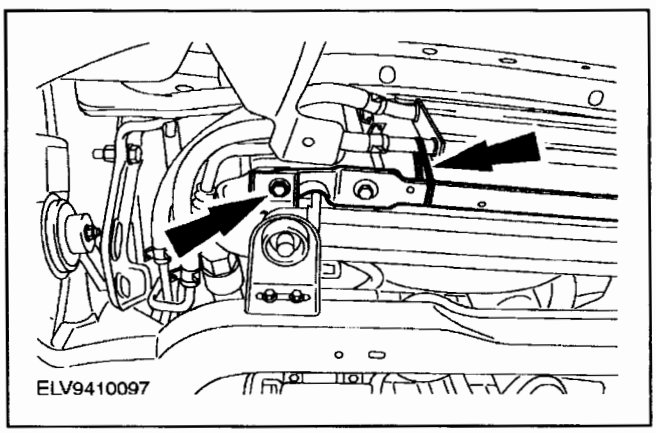
41. Remove the transaxle cooling line.



42. Remove the transaxle cooling line and the coolant hose from the radiator.

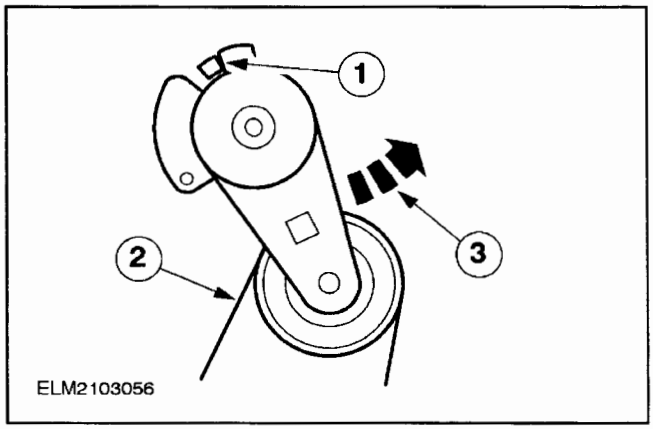


43. Disconnect the compressor electrical connector.

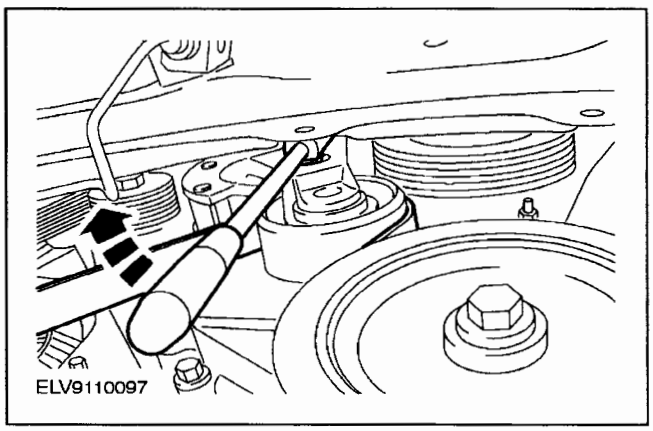


44. Remove the condenser core and secure it to one side with cable ties.

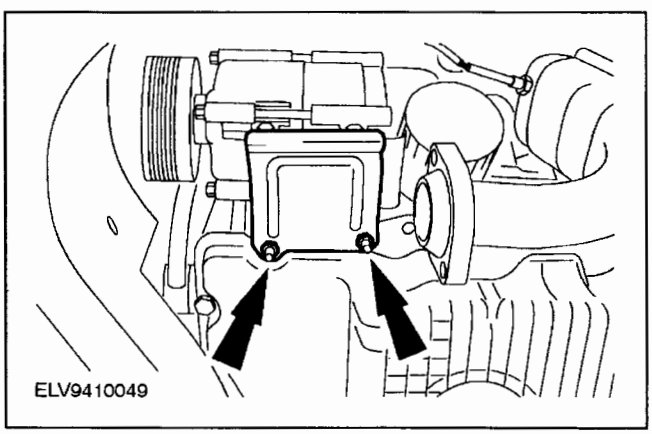
REMOVAL (Continued)



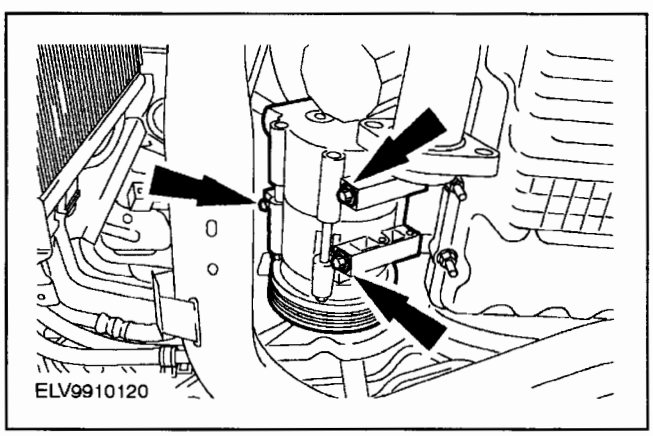
50. Check the accessory drive belt tension (continued).
    1 Right-hand stop
    2 Drive belt
    3 Tensioning direction
    - If the right-hand stop is touching the cast lug, install a new accessory drive belt during installation.



51. Remove the accessory drive belt.

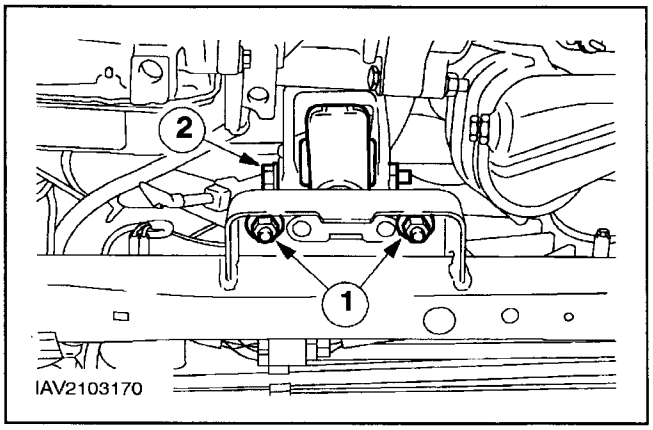


52. Remove the compressor heat shield.



53. Remove the compressor bracket bolts.
    - Secure the compressor with mechanics wire and position it to one side.

REMOVAL (Continued)

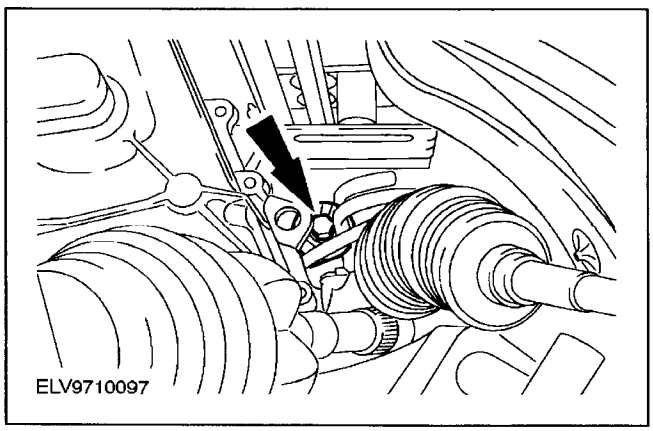


54. **NOTE:** Use a suitable jack stand to relieve pressure on the support insulator.

    Remove the left-hand support insulator.

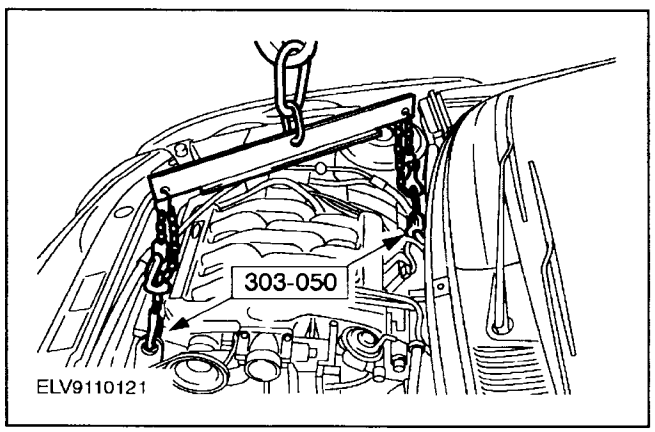
    1 Remove the nuts.

    2 Remove the center bolt.



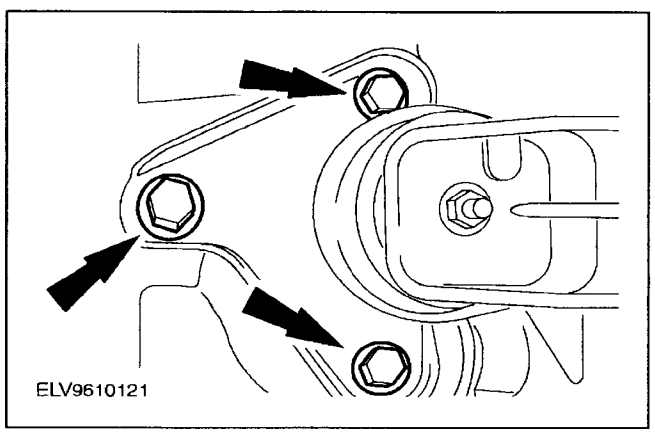
55. Remove the center bolt from the right-hand support insulator.

56. Lower the vehicle.



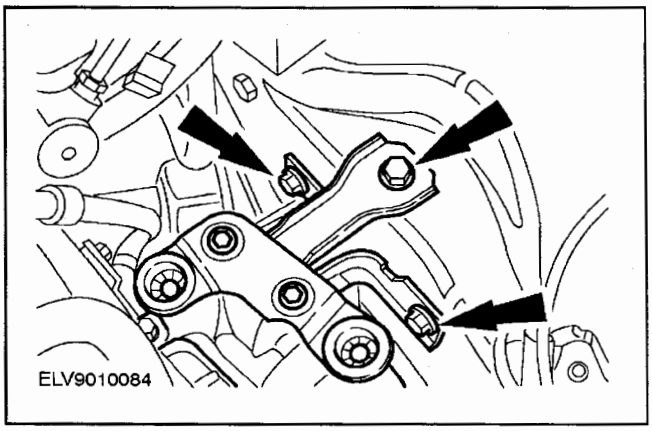
57. Using the special tool, install a suitable floor crane.

    - Raise the engine slightly to prevent pressure from the support insulator.



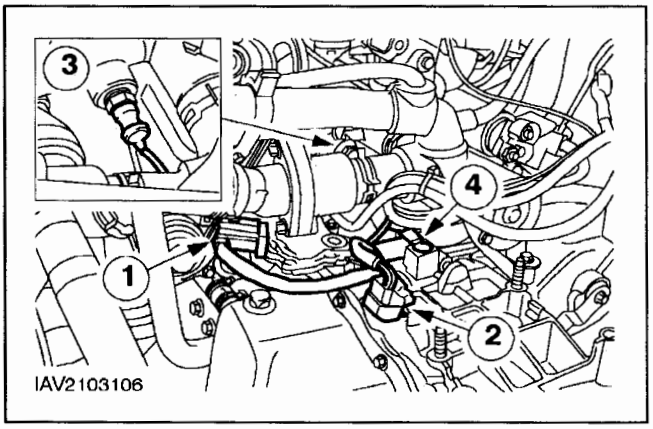
58. Remove the rear support insulator from the side member.

REMOVAL (Continued)

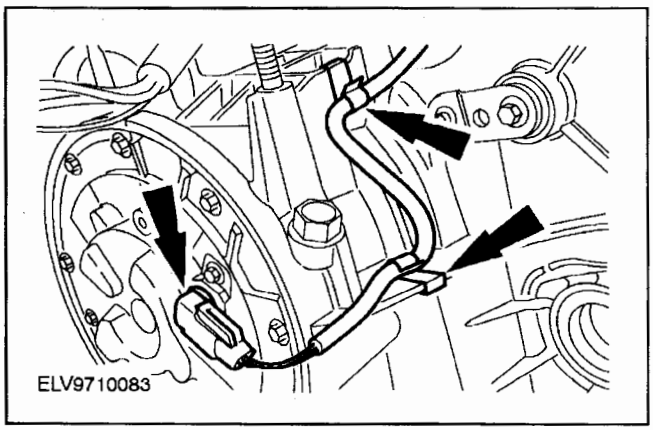


59. Remove the rear support insulator from the side member (continued).

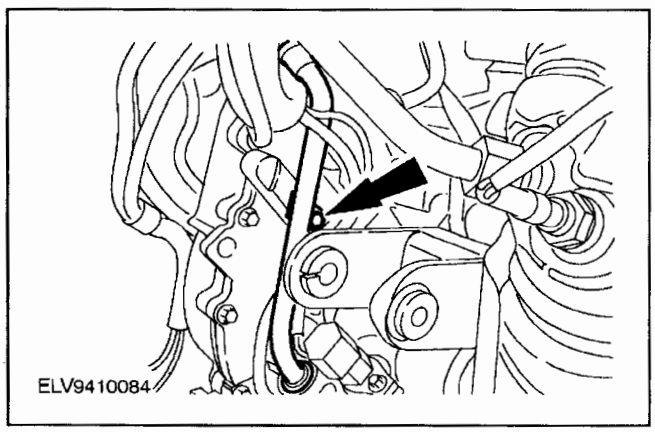
60. Remove the engine and transaxle to the top.



61. Disconnect the electrical connectors and position to one side.
    1 Transmission range (TR) sensor.
    2 Transmission control connector.
    3 Engine coolant temperature (ECT) sensor connector
    4 Position the harness to one side.

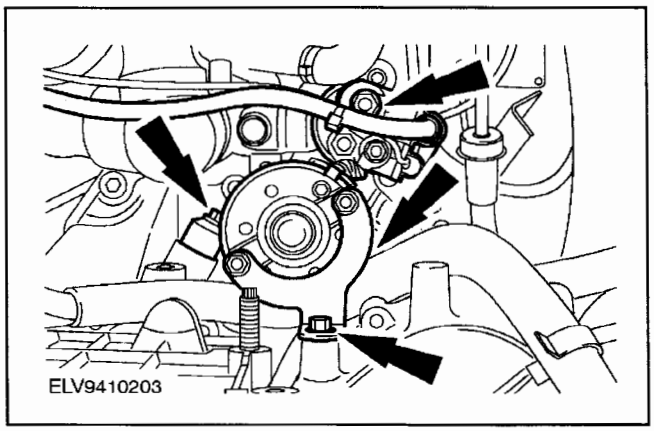


62. Disconnect the turbine shaft speed (TSS) sensor electrical connector.

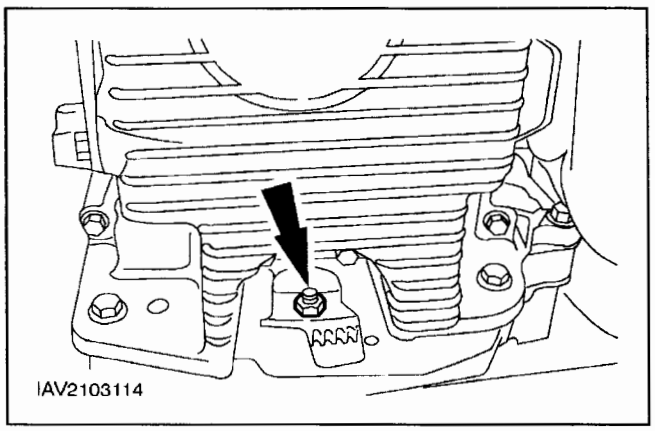


63. Remove the oil level indicator tube.

REMOVAL (Continued)



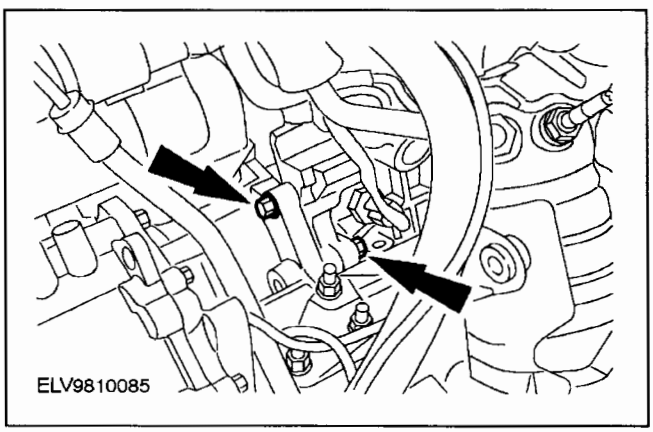
64. Disconnect the starter motor and remove the starter motor bracket.



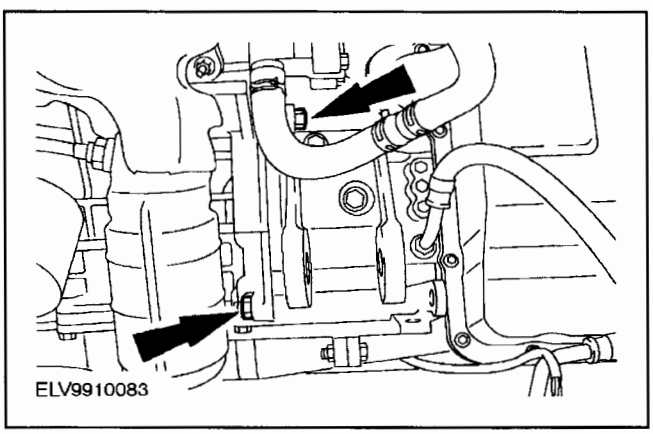
65. **NOTE:** Mark one stud and the flex plate for assembly reference.

    Disconnect the torque convertor from the engine drive plate (four nuts).

    - Remove the plastic cover.

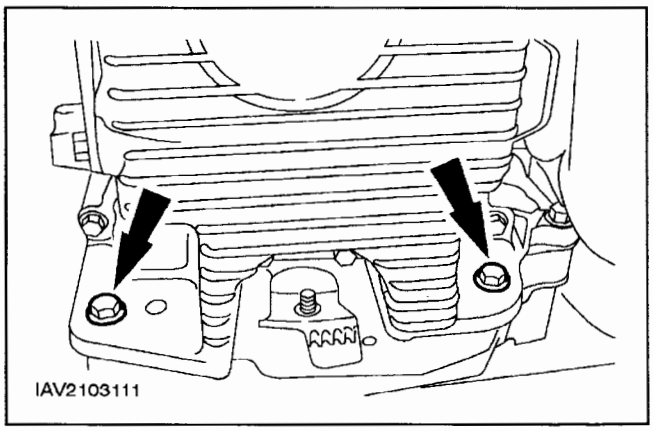


66. Remove the right-hand flange bolts.

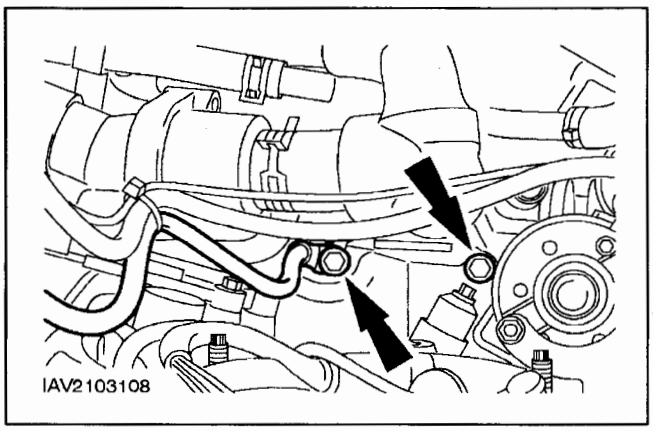


67. Remove the left-hand flange bolts.

REMOVAL (Continued)



68. Remove the lower flange bolts.



69. Remove the upper flange bolt.
    - Remove the ground cable.

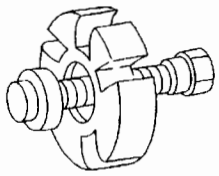
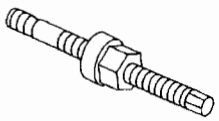
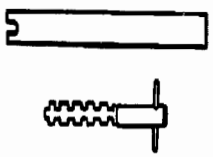
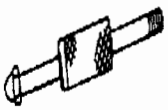
70. ⚠ **WARNING: Do not let the torque converter drop out of the transaxle. Failure to follow these instructions may result in personal injury.**

    Separate the automatic transaxle from the engine and install the special tool.

DISASSEMBLY

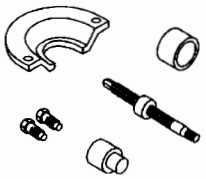
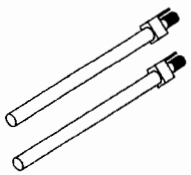
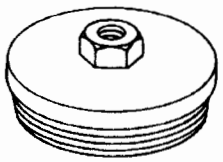
Engine

Special Tool(s)

 ST1286-A	Remover, Vibration Damper, Crankshaft 303-009 (T58P-6316-D)
 ST1287-A	Installer, Vibration Damper, Crankshaft 303-102 (T74P-6316-B)
 T92C-6700-CH	Remover, Oil Seal, Crankshaft 303-409 (T92C-6700-CH)
 T59L-100-B	Impact Slide Hammer 307-005 (T59L-100-B)

(Continued)

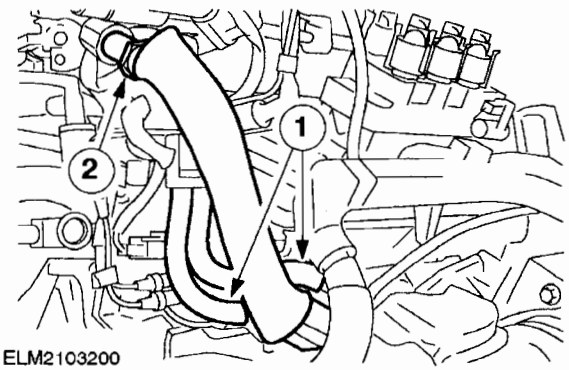
Special Tool(s)

 ST1971-A	Remover/Installer, Pulley (Water Pump Drive), Camshaft 303-S455 (T94P-6312-AH)
 ST1982-A	Connecting Rod Guides 303-462 (T94P-6136-AH)
 ST1382-A	Rear Crankshaft Seal Remover 303-519 (T95P-6701-EH)

Materials

Item	Specification
Metal surface cleaner F4AZ-19A536-RA	WSE-M5B392-A

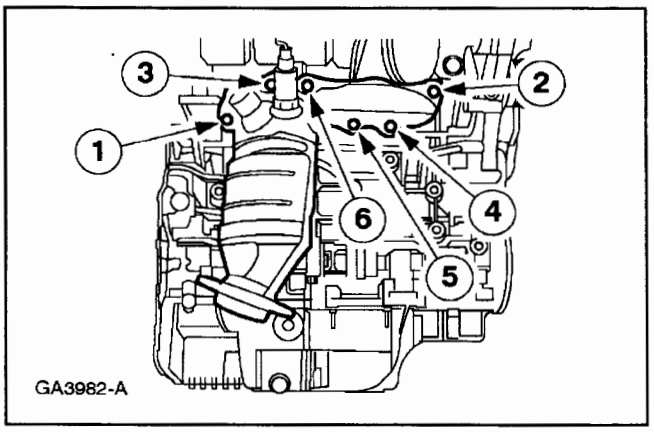
Disassembly



ELM2103200

1. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.
   1 Disconnect the hoses from the EGR tube to the differential pressure feedback EGR.
   2 Unscrew the tube fitting.

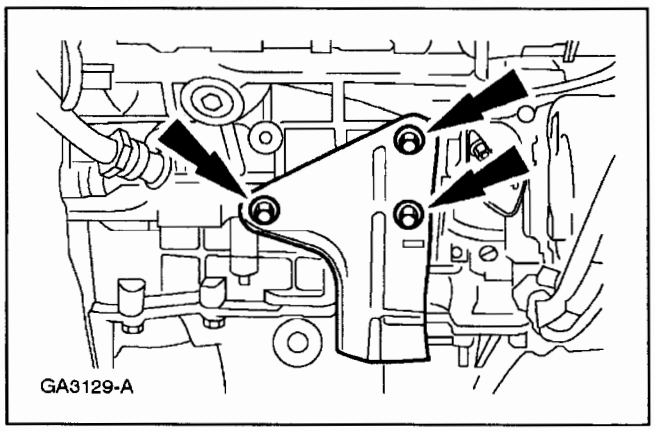
DISASSEMBLY (Continued)



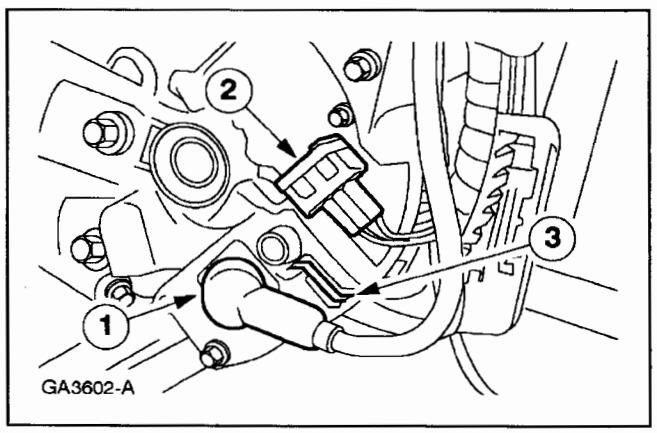
2. **NOTE:** Remove the nuts in the indicated sequence.

   Remove the right-hand exhaust manifold.

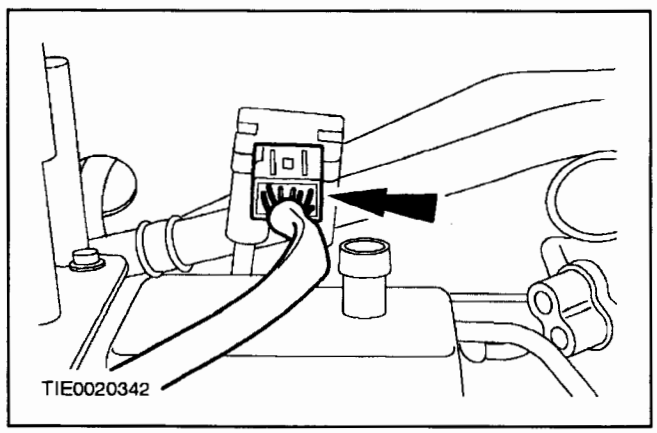
   - Discard the gasket.



3. Remove the bolts and the connecting shaft bracket from the cylinder block.

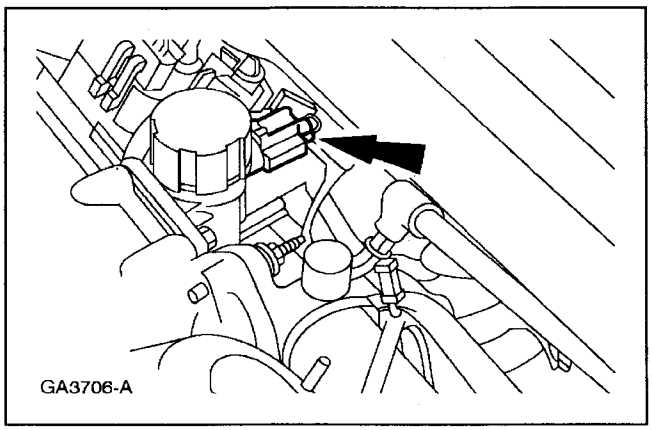


4. Disconnect the generator electrical connections.
   1 Remove the battery positive cable retaining nut.
   2 Disconnect the voltage regulator electrical connector.
   3 Disconnect the stator circuit electrical connector.

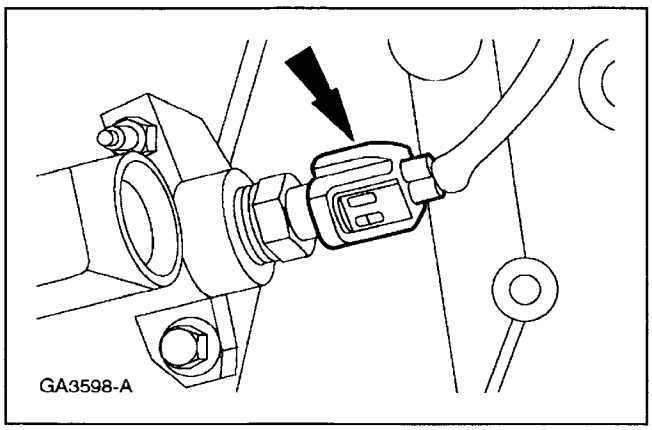


5. Disconnect the differential pressure feedback EGR electrical connector.

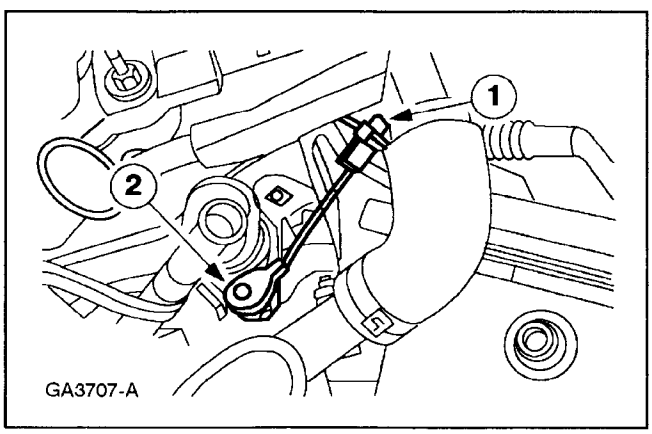
DISASSEMBLY (Continued)



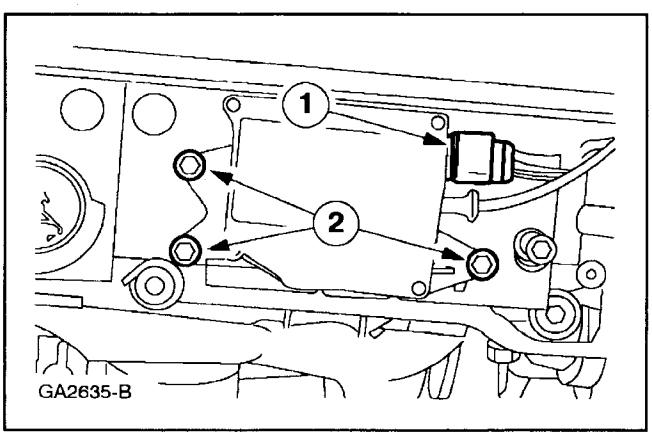
6. Disconnect the electronic vacuum regulator solenoid valve electrical connector.



7. Disconnect the engine coolant temperature (ECT) sensor and remove the wiring harness.



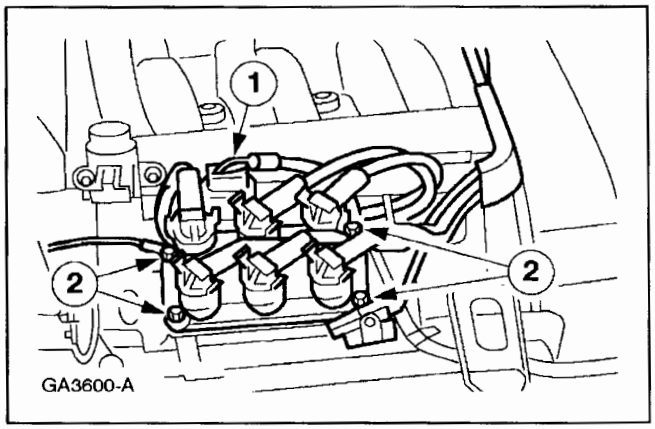
8. Disconnect the intake manifold runner control (IMRC) cable.
   1 Disconnect the IMRC cable from the retainer.
   2 Disconnect the IMRC cable end.



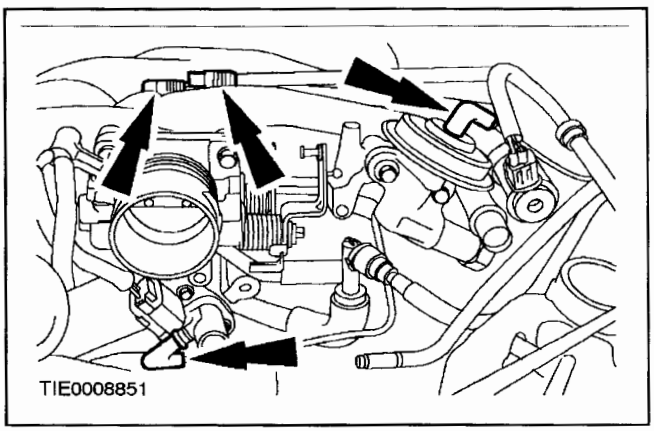
9. Remove the IMRC.
   1 Disconnect the electrical connector.
   2 Remove the bolts.

DISASSEMBLY (Continued)

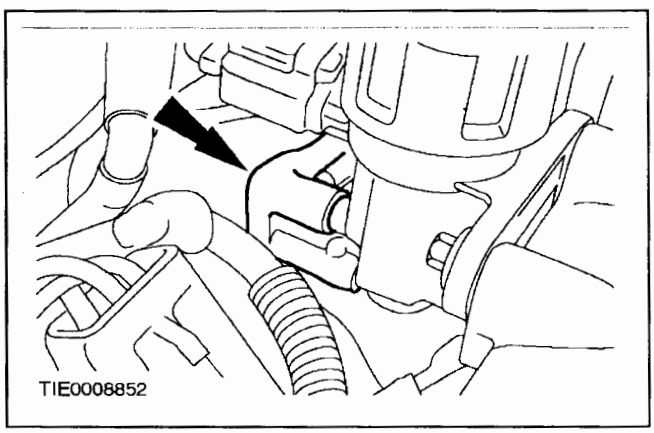
10. Disconnect the six spark plug wires from the spark plugs.



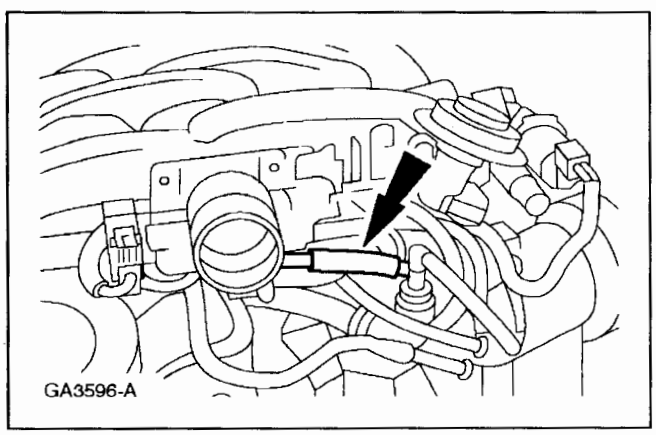
11. Remove the coil and ignition wires.
    1 Disconnect the coil electrical connector.
    2 Remove the bolts and the coil.
    - Disconnect the ground cable and the radio suppressor.



12. Disconnect the vacuum supply hoses from the upper intake manifold, the EGR valve vacuum hose and the fuel injector pressure sensor vacuum hose.

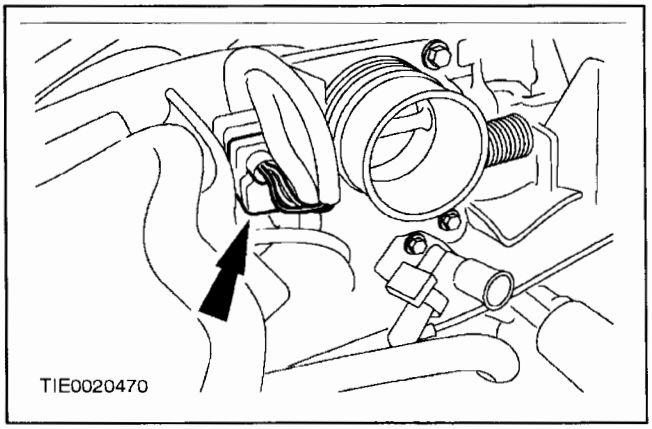


13. Disconnect the electronic vacuum regulator (EVR) hoses and remove the vacuum hose harness.

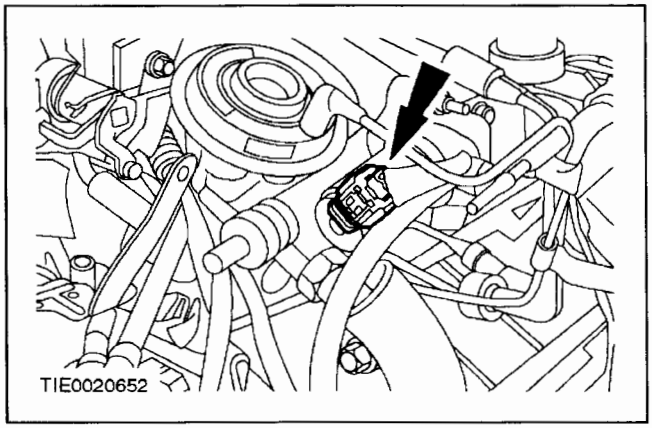


14. Disconnect the positive crankcase ventilation (PCV) hose from the throttle body.

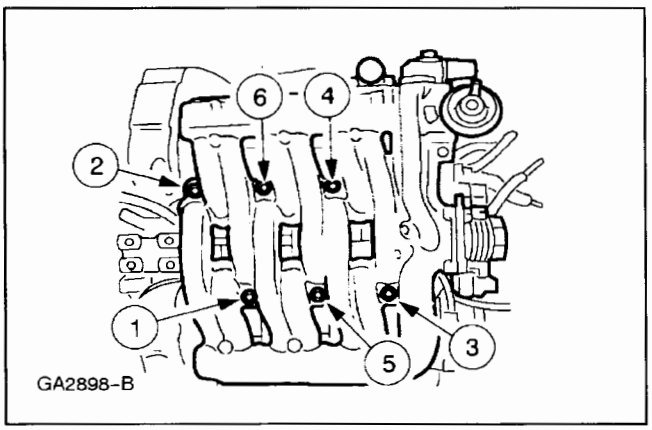
DISASSEMBLY (Continued)



15. Disconnect the throttle position (TP) sensor electrical connector.



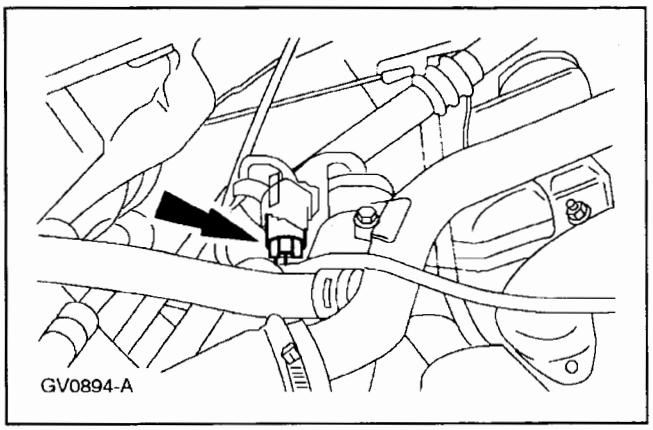
16. Disconnect the idle air control (IAC) valve electrical connector.



17. **NOTE:** Remove the bolts in the indicated sequence.

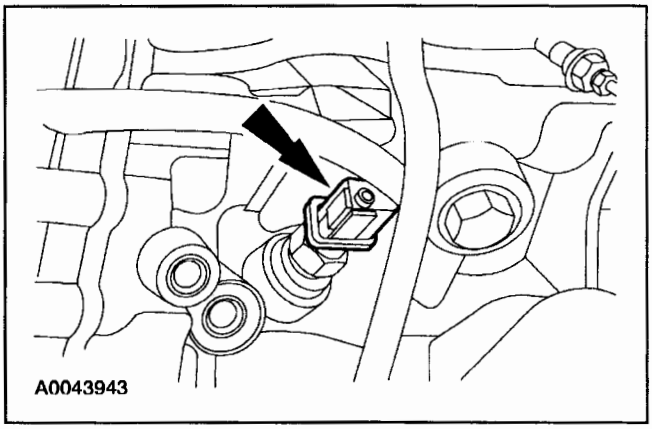
    Remove the upper intake manifold.

    - Discard the gaskets.

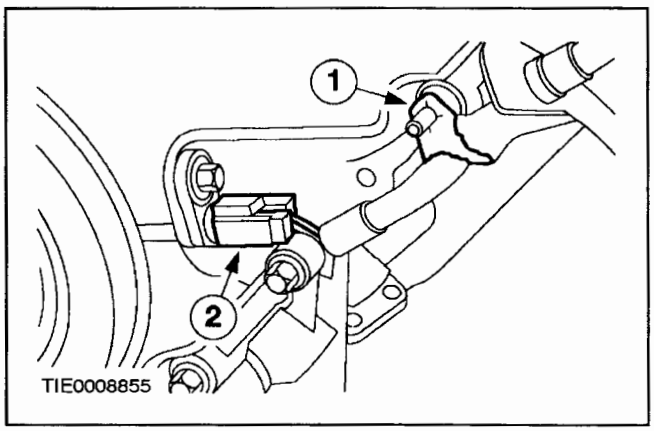


18. Disconnect the heated oxygen sensor (HO2S) electrical connector.

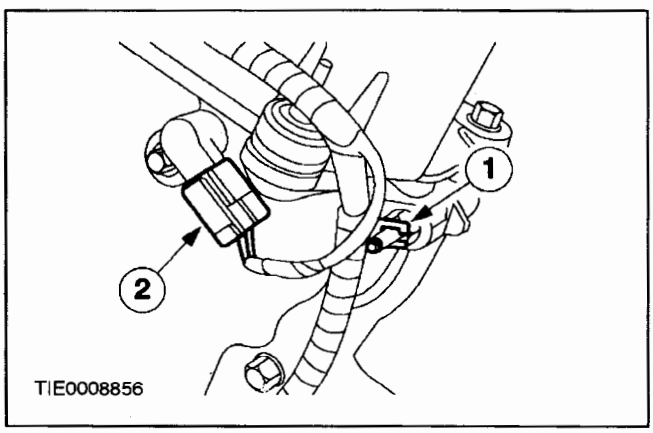
DISASSEMBLY (Continued)



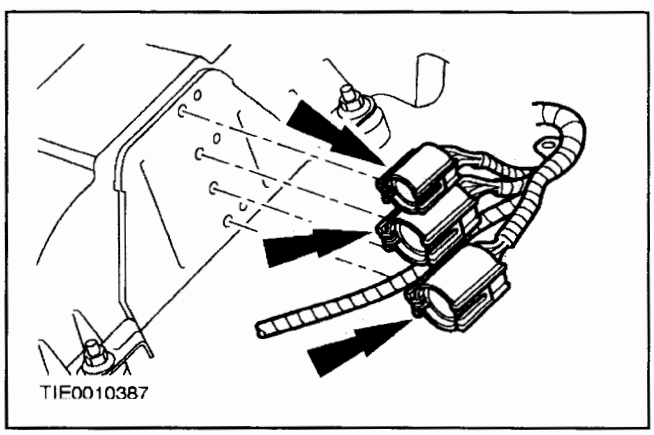
19. Disconnect the oil pressure switch electrical connector.



20. Disconnect the crankshaft position (CKP) sensor electrical connector.
    1 Detach the harness from the stud.
    2 Disconnect the electrical connector.

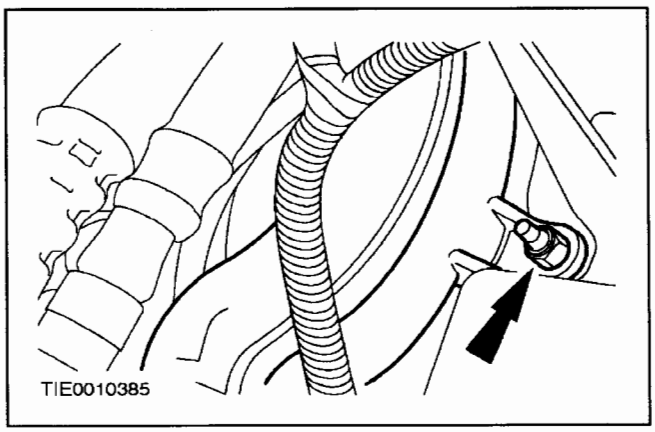


21. Disconnect the camshaft position (CMP) sensor electrical connector.
    1 Detach the harness from the stud.
    2 Disconnect the electrical connector.

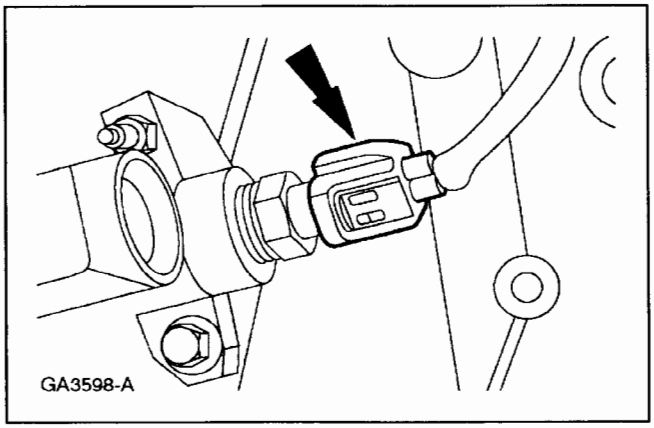


22. Detach the in-line electrical connectors.

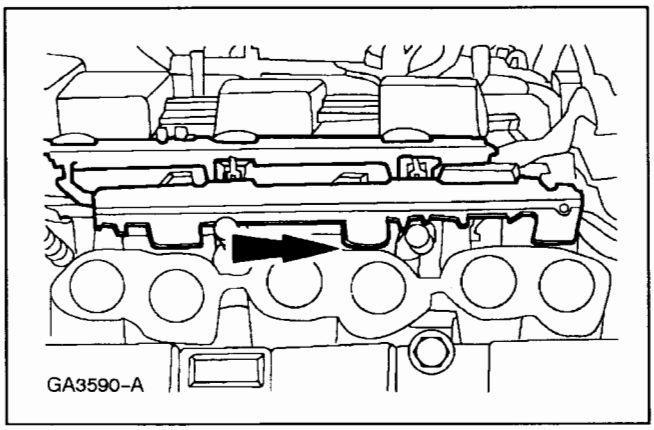
DISASSEMBLY (Continued)



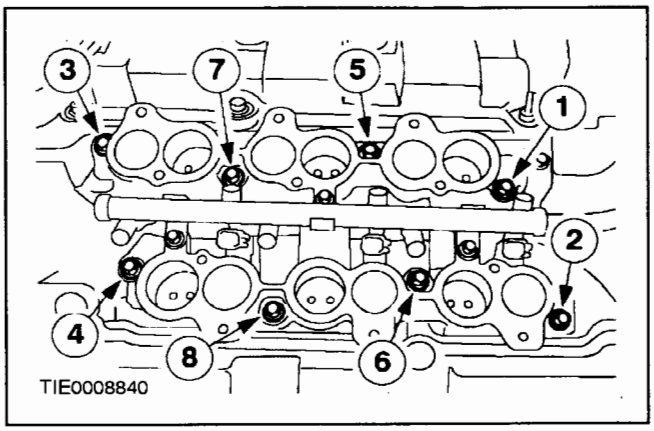
23. Remove two nuts and the wiring harness.



24. Disconnect the engine coolant temperature warning light electrical connector.



25. Disconnect the fuel injector electrical connectors and remove the wiring harness.

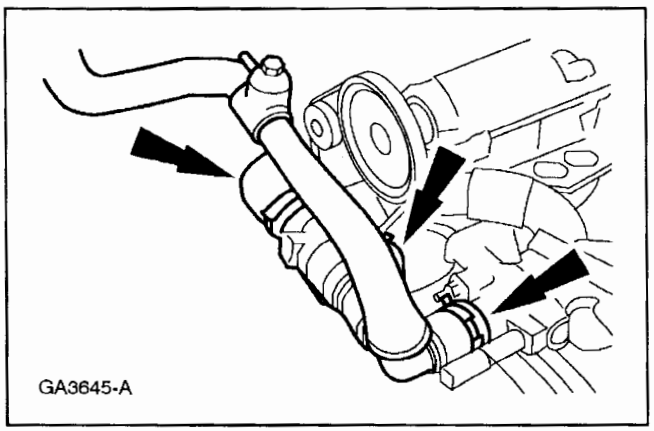


26. **NOTE:** Remove the bolts in the indicated sequence.

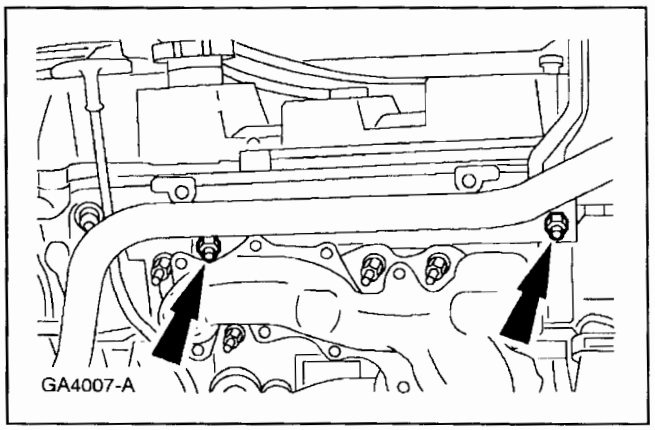
    Remove the lower intake manifold.

    - Discard the gaskets.

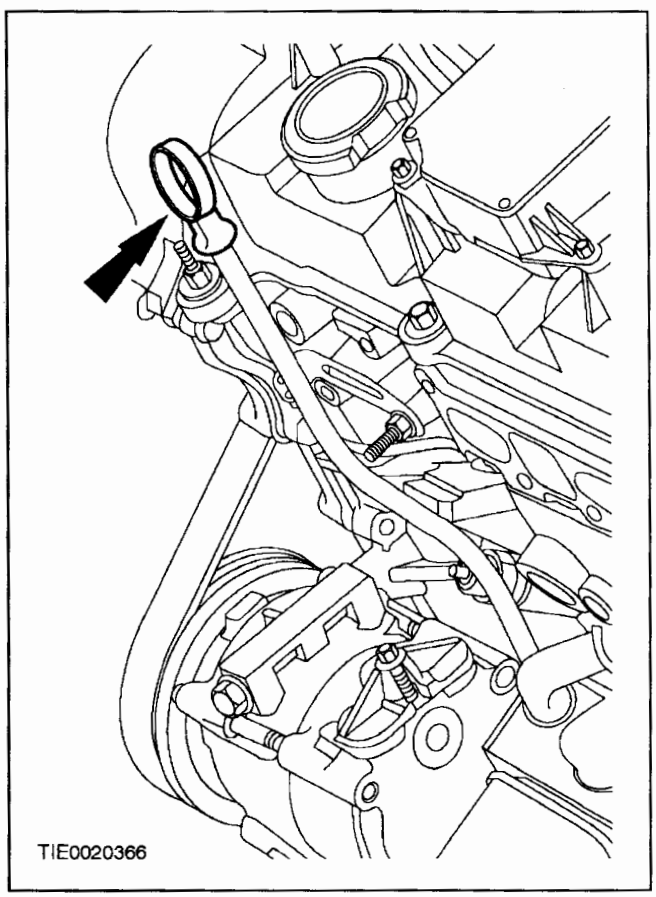
DISASSEMBLY (Continued)



27. Disconnect the coolant hoses and remove the thermostat housing.

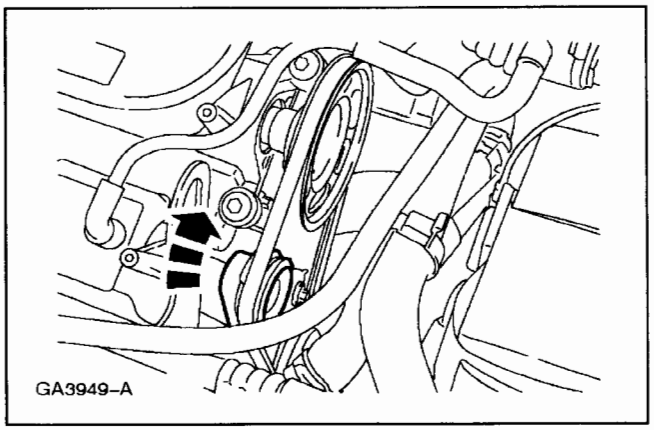


28. Disconnect the coolant distribution tube.

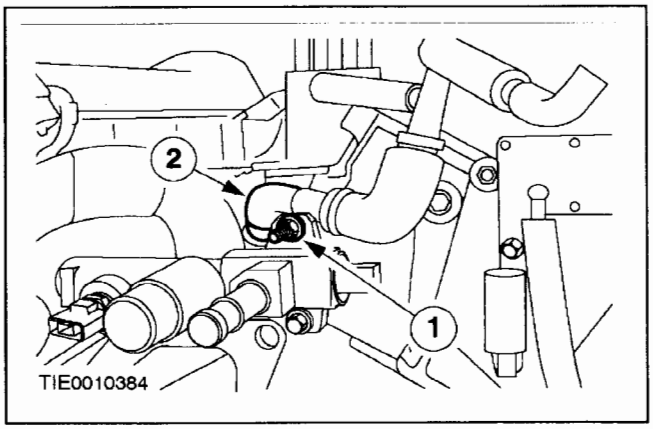


29. Remove the oil level indicator tube.

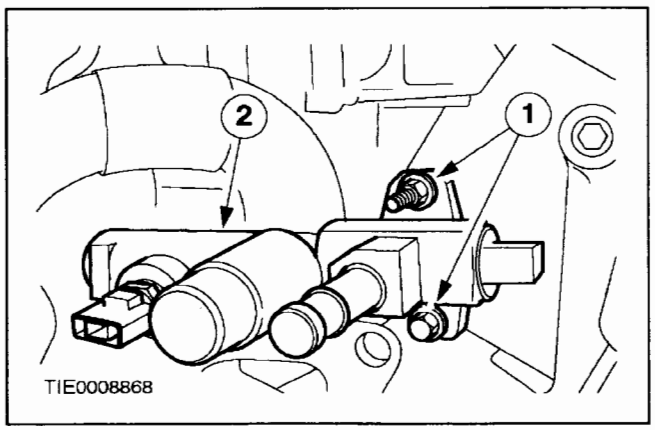
DISASSEMBLY (Continued)



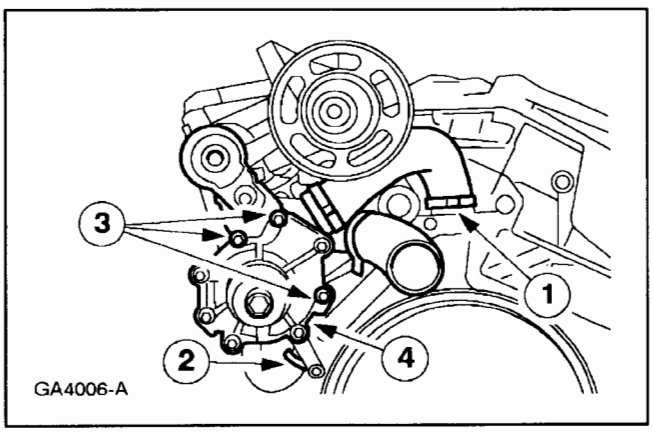
30. Remove the water pump drive belt.
    - Rotate the belt tensioner clockwise to relieve tension on the drive belt.



31. Remove the positive crankcase ventilation valve and hoses.
    1 Remove the nut.
    2 Remove the positive crankcase ventilation valve and hoses.

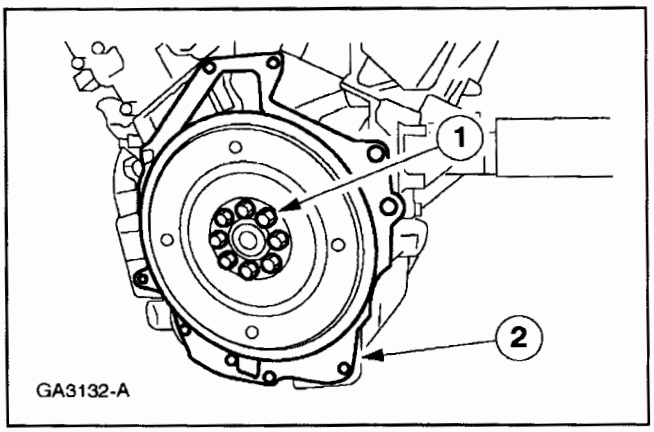


32. Remove the water bypass.
    1 Remove the bolts.
    2 Remove the water bypass.

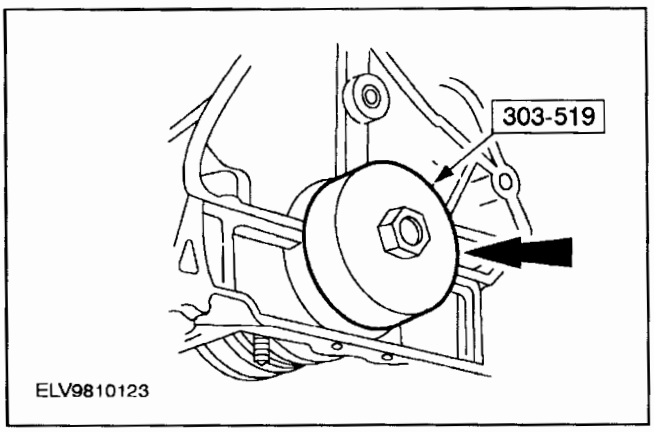


33. Remove the water pump.
    1 Disconnect the coolant hose.
    2 Disconnect the oil cooler hose.
    3 Remove the bolts.
    4 Remove the pump.

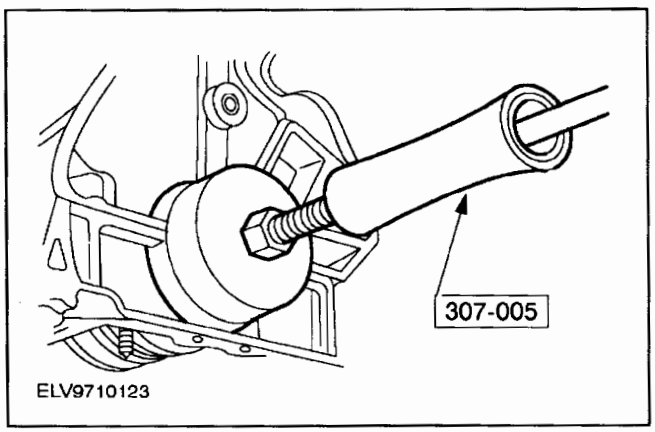
DISASSEMBLY (Continued)



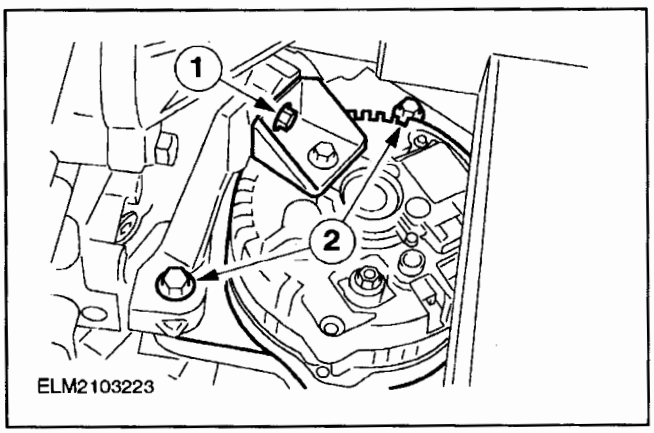
34. Remove the flywheel.
    1 Remove the bolts.
    2 Remove the backing plate.



35. Install the special tool.

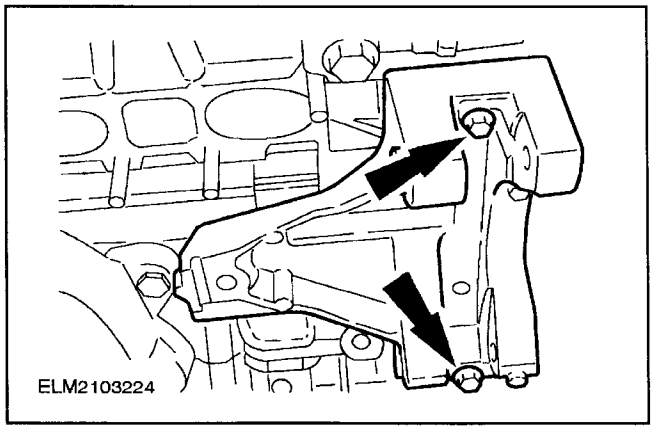


36. Remove the crankshaft oil seal.

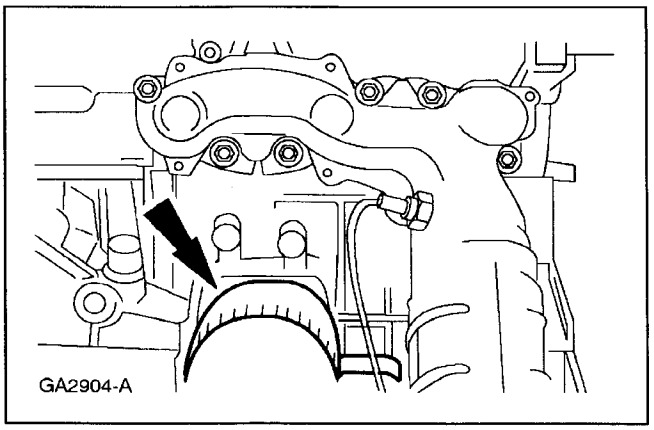


37. Remove the generator.
    1 Remove the bracket bolt.
    2 Remove the generator bolts and remove the generator.

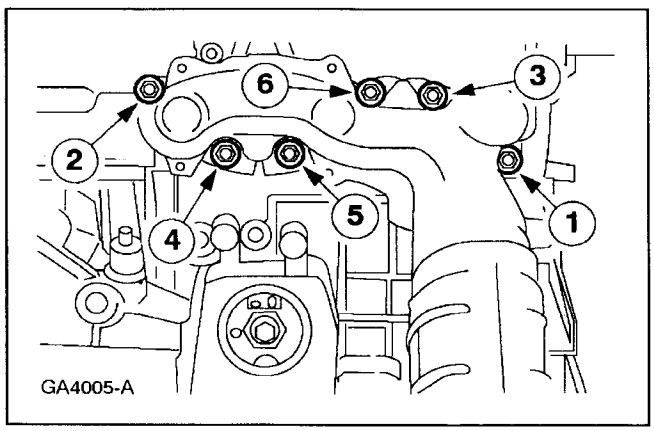
DISASSEMBLY (Continued)



38. Remove the bolts and the generator bracket.



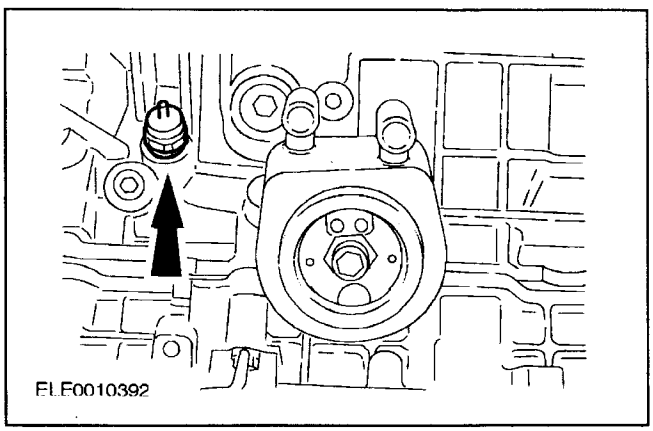
39. Remove the oil filter.



40. **NOTE:** Remove the bolts in the indicated sequence.

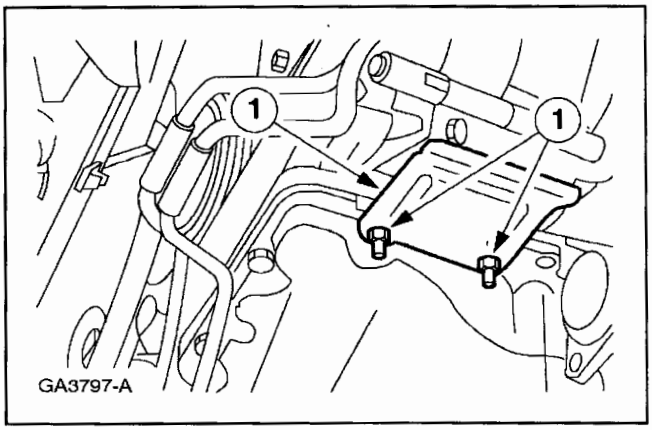
    Remove the left-hand exhaust manifold.

    - Discard the gasket.



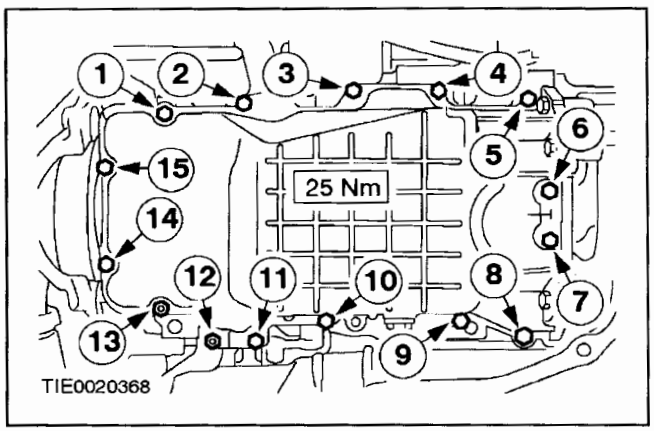
41. Remove the oil pressure switch.

DISASSEMBLY (Continued)



42. Remove the studs and the heat shield.

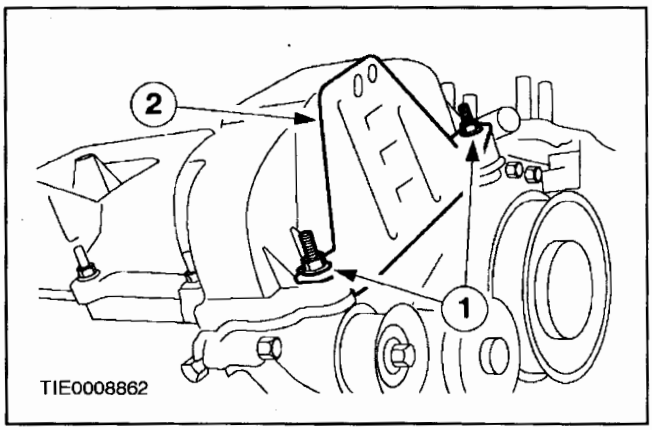
43. Drain engine oil.



44. **NOTE:** Remove the bolts and studs in the indicated sequence.

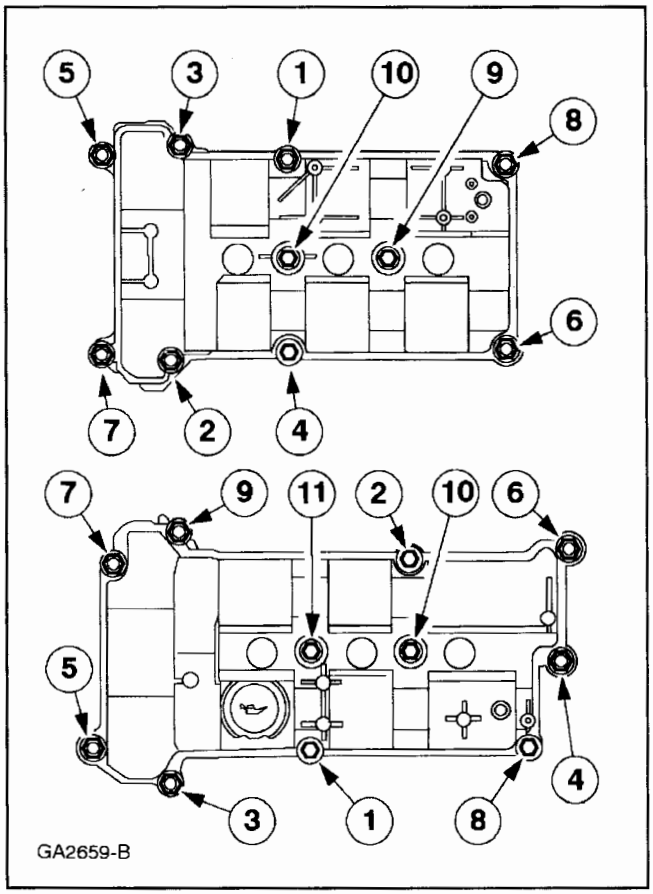
    Remove the oil pan.

    - Discard the gasket.
    - Clean and inspect oil pan and cylinder block using metal surface cleaner.



45. Remove the inline connector bracket.
    1 Remove the nuts.
    2 Remove the bracket.

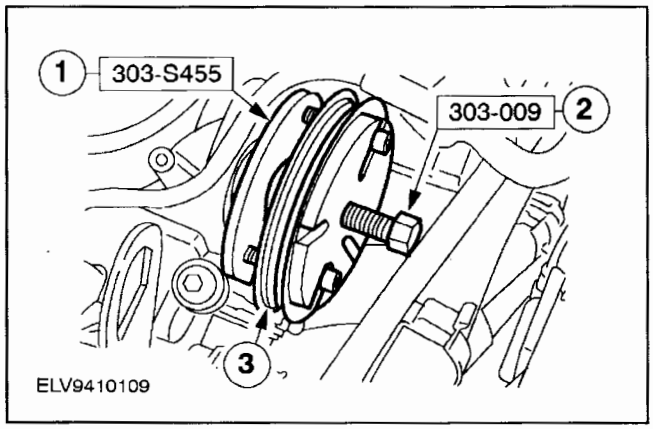
DISASSEMBLY (Continued)



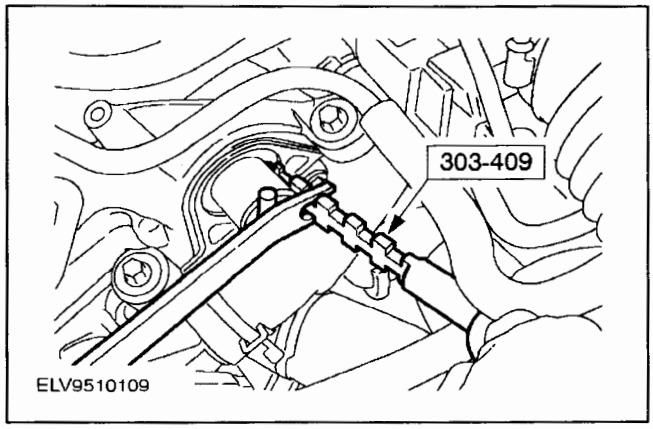
46. **NOTE:** Remove the bolts and studs in the indicated sequence.

    Remove the cylinder head covers.

    - Discard the gaskets.



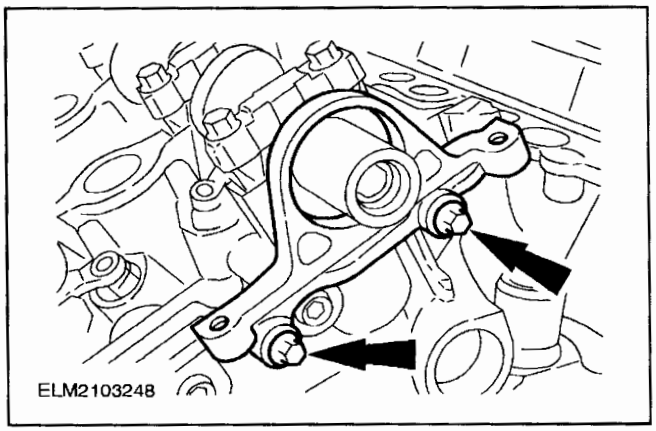
47. Using the special tools, remove the water pump drive pulley.
    1 Install the special tool.
    2 Install the special tool.
    3 Remove the water pump pulley.



48. **NOTE:** To make sure correct sealing do not scratch the camshaft.

    Using the special tools, remove and discard the camshaft oil seal.

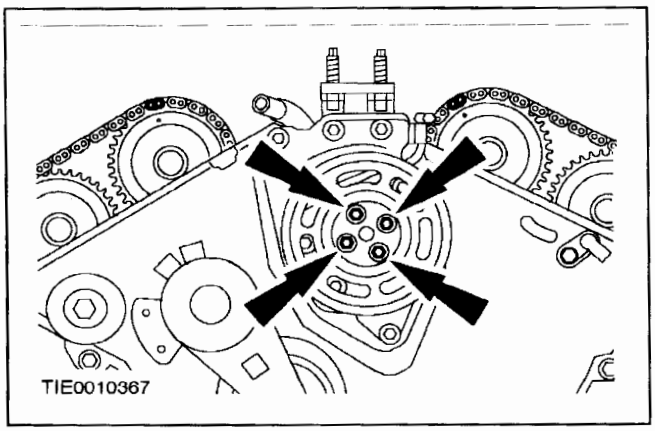
DISASSEMBLY (Continued)



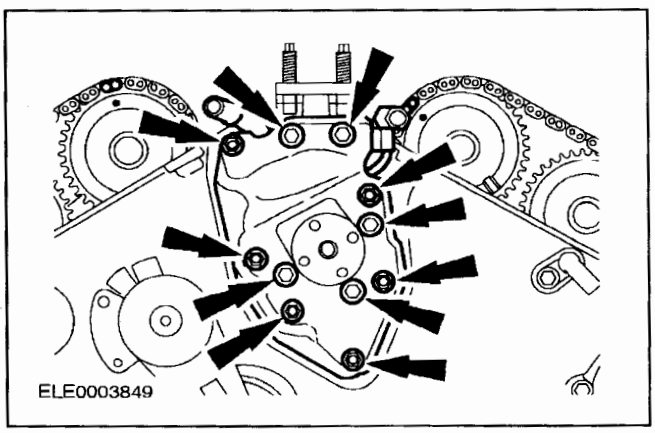
49. ⚠ **CAUTION: Protect the camshaft surface when removing the oil seal retainer.**

    Remove the bolts and the camshaft oil seal retainer.

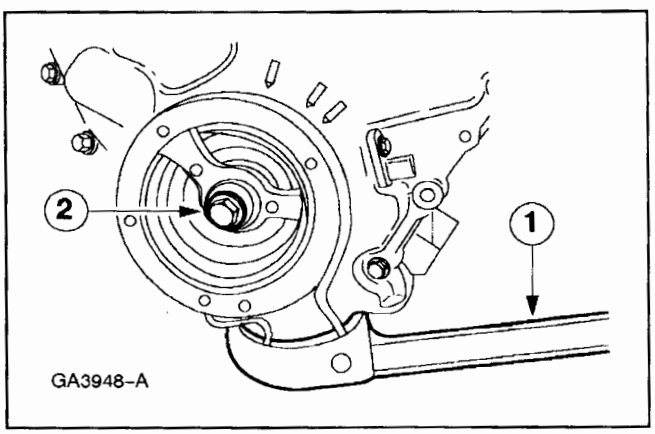
    - Discard the gasket.



50. Remove the bolts and the power steering pump pulley.



51. Remove the power steering pump and bracket.
    - Remove the five bolts.
    - Remove the six nuts.



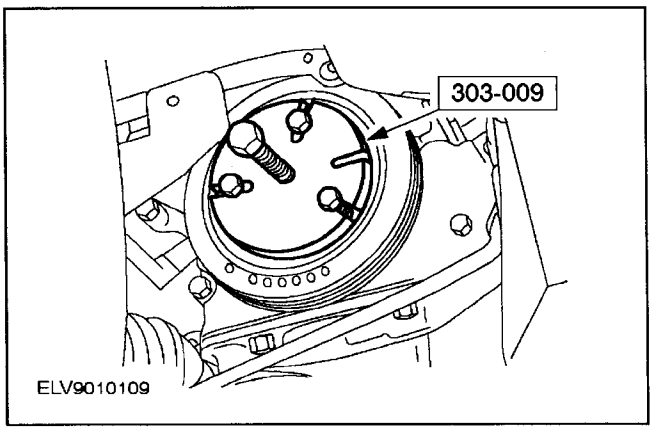
52. **NOTE:** The crankshaft pulley bolt is tightened to yield and must not be reused.

    Remove the crankshaft pulley bolt.

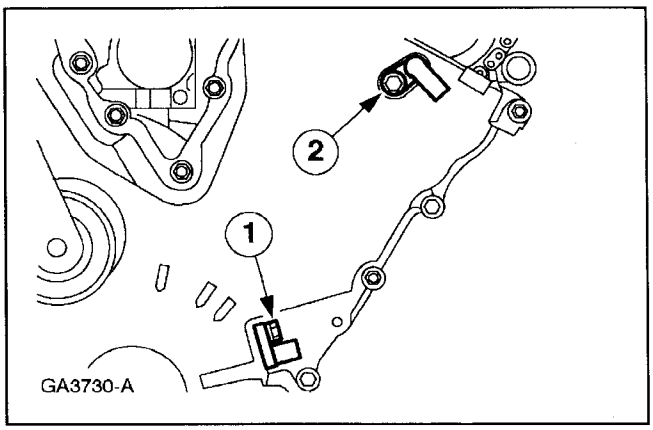
    1 Install a suitable strap wrench to hold the crankshaft pulley.

    2 Remove crankshaft pulley bolt.

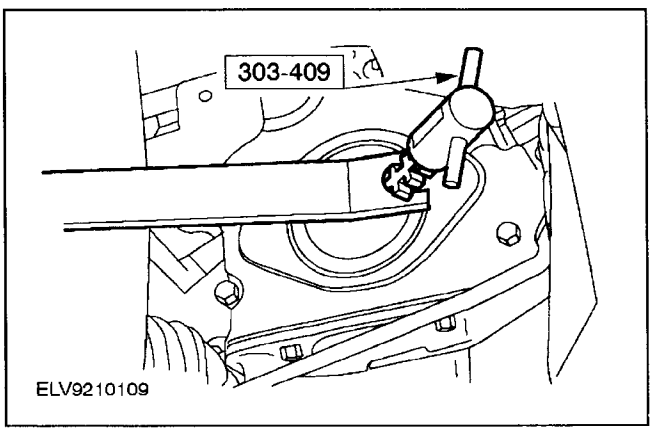
DISASSEMBLY (Continued)



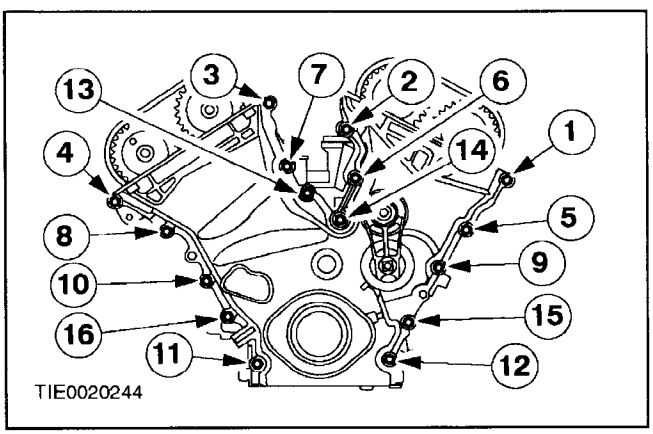
53. Using the special tool, remove the crankshaft pulley.



54. Remove the position sensors.
    1 Remove the bolt and the CKP sensor.
    2 Remove the bolt and the CMP sensor.

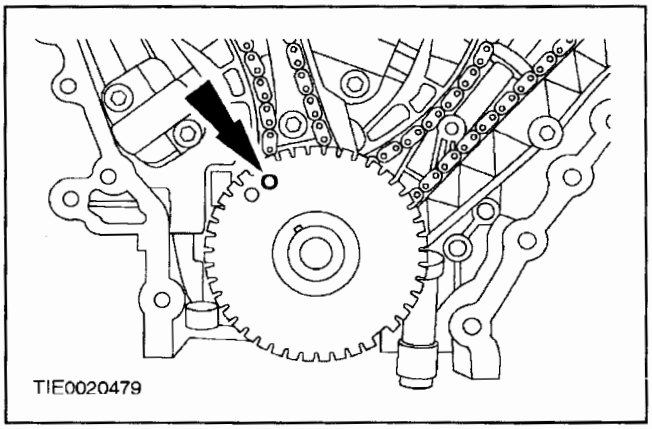


55. ⚠ **CAUTION: Protect the crankshaft surface when removing the front oil seal.**
    Using the special tool, remove the crankshaft front oil seal.



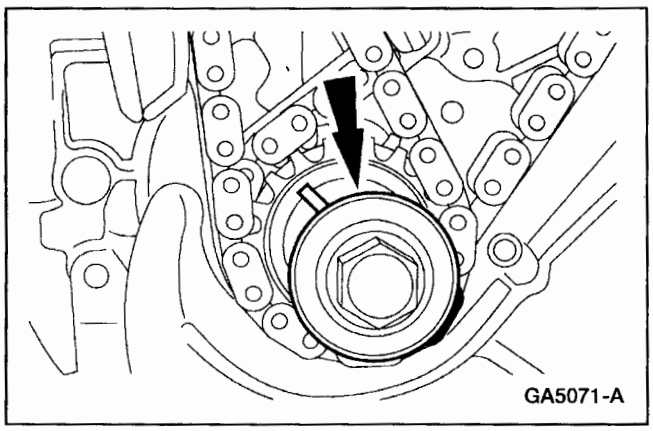
56. **NOTE:** Remove the bolts and studs in the indicated sequence.
    Remove the engine front cover.
    - Discard the gaskets.

DISASSEMBLY (Continued)

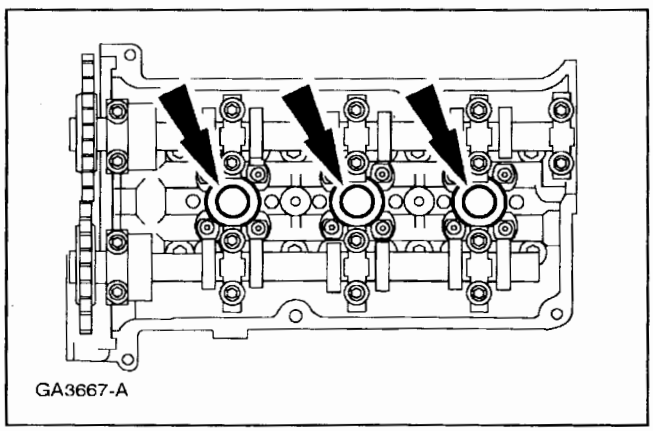

TIE0020479

57. ⚠ **CAUTION: This pulse wheel has two keyway slots and is used in several different engines. Install the pulse wheel in the slot stamped 25, color coded blue.**

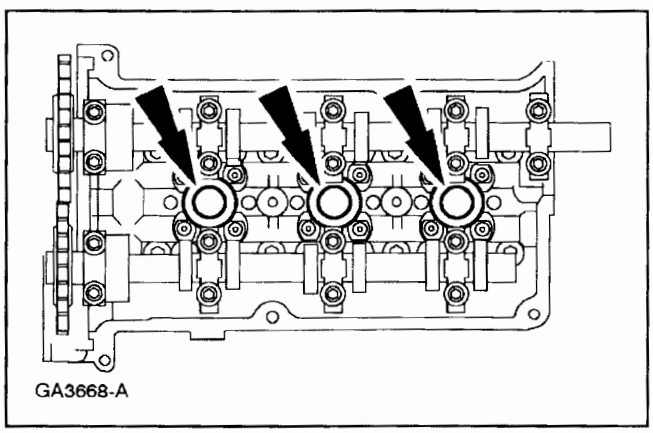
    Remove the CKP sensor pulse wheel.


GA5071-A

58. Install the crankshaft pulley and bolt.

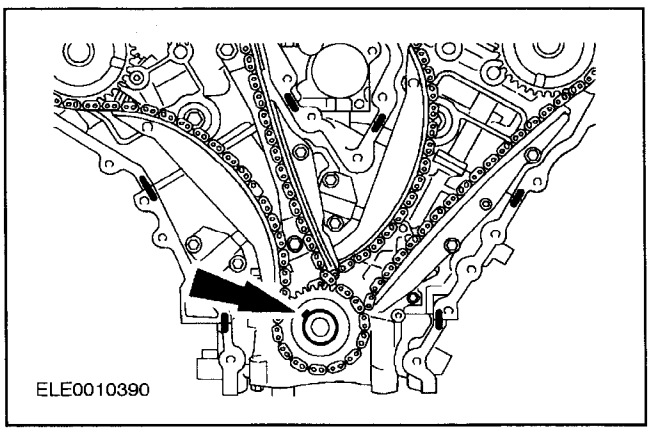

GA3667-A

59. Remove the right-hand spark plugs.


GA3668-A

60. Remove the left-hand spark plugs.

DISASSEMBLY (Continued)

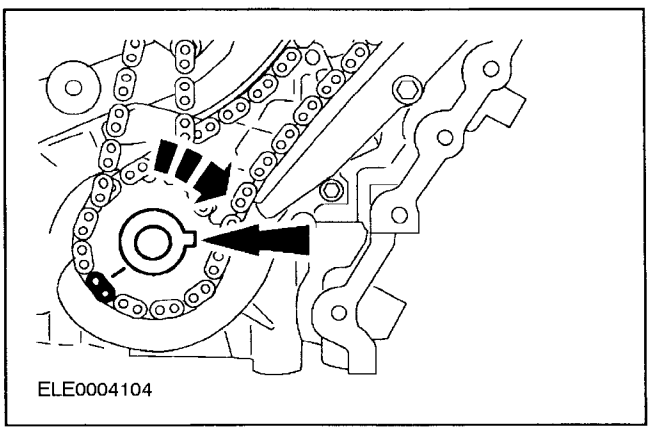

ELE0010390

61. ⚠ **CAUTION: Rotate the crankshaft clockwise to position the crankshaft keyway to the 11 o'clock position and the engine to top dead center (TDC) No. 1 cylinder, before the removal and installation of the camshafts and the roller finger followers, or damage to the engine may occur.**

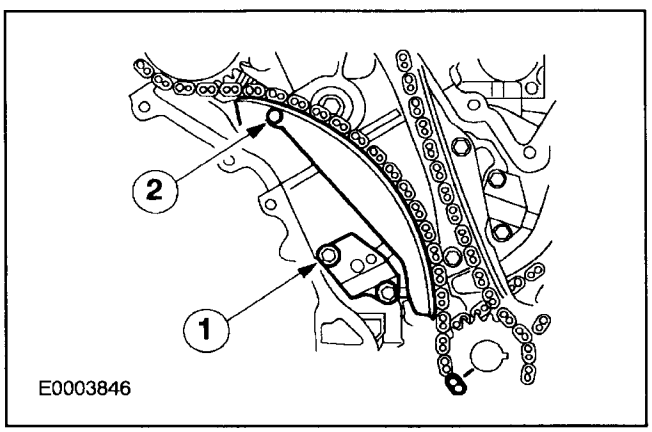
    NOTE: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

    Locate the crankshaft to the correct position.

    - Rotate the crankshaft keyway clockwise to the 11 o'clock position.


ELE0004104

62. Rotate the crankshaft clockwise to position the crankshaft keyway in the 3 o'clock position.
    - The right-hand camshafts are in the neutral position.



E0003846

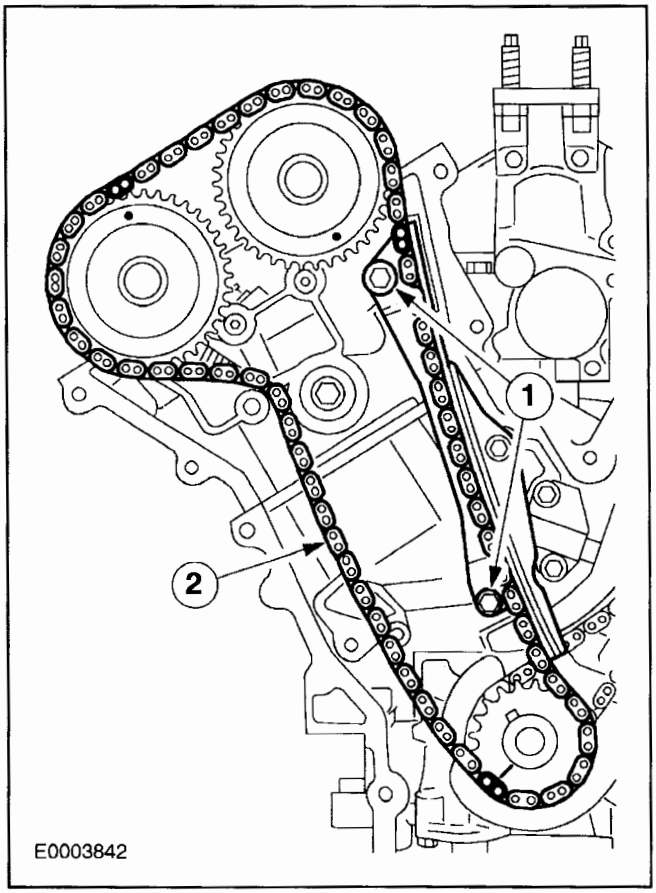
63. **NOTE:** Mark the position of all chain drive components to make sure they are assembled in their original positions.

    Remove the right-hand chain tensioner and tensioner arm.

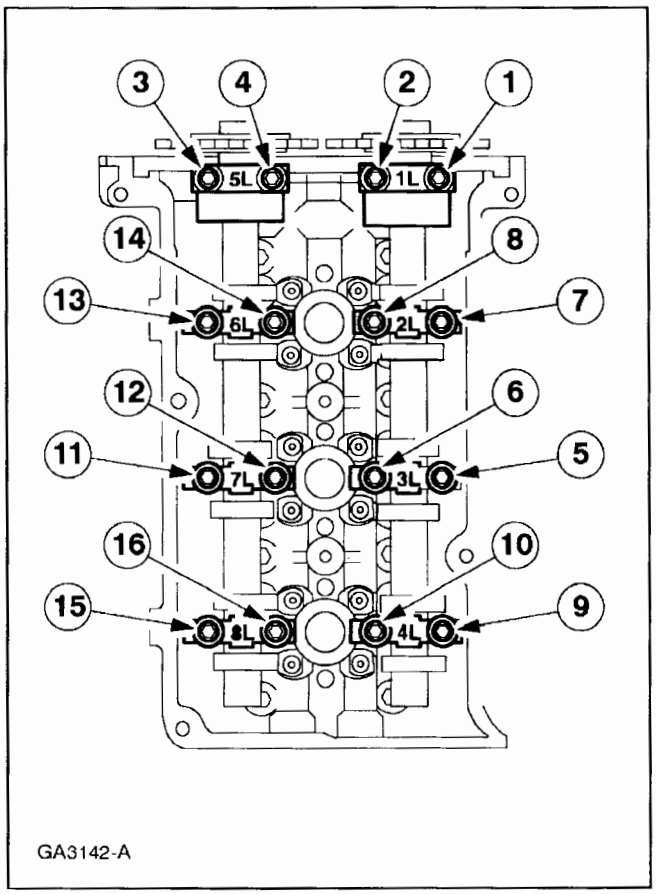
    1 Remove the bolts, the chain tensioner and the right-hand tensioner adapter plate (if equipped).

    2 Remove the timing chain tensioner arm.

DISASSEMBLY (Continued)



64. Remove the right-hand timing chain.
    1 Remove the bolts and the fixed chain guide.
    2 Remove the right-hand timing chain.



65. ⚠ **CAUTION: The cylinder head and the camshaft bearing caps are numbered to make sure they are reassembled in their original position. When removed, keep the bearing caps with the cylinder head they were removed from. Do not mix the caps.**

    NOTE: Camshaft bearing caps are doweled to the cylinder head. If necessary, use a plastic mallet to loosen the caps.

    NOTE: Remove camshaft bearing thrust caps No. 1R and 5R first. Do not loosen any other bolts until the thrust caps are removed.

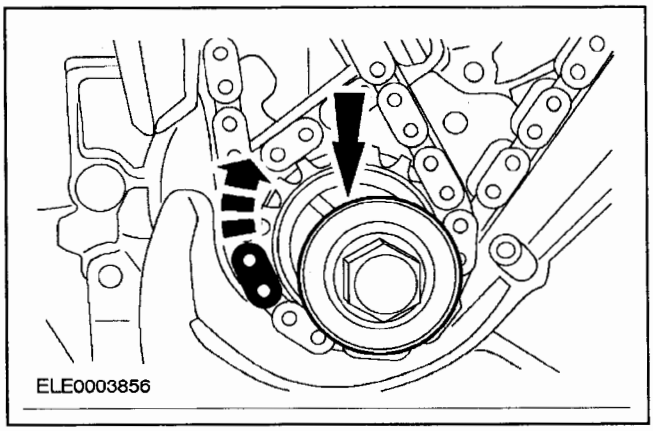
    NOTE: Loosen the remaining bolts and bearing caps in the indicated sequence in several passes to allow the camshafts to gradually raise from the cylinder head.

    Loosen the camshafts (right-hand cylinder head).

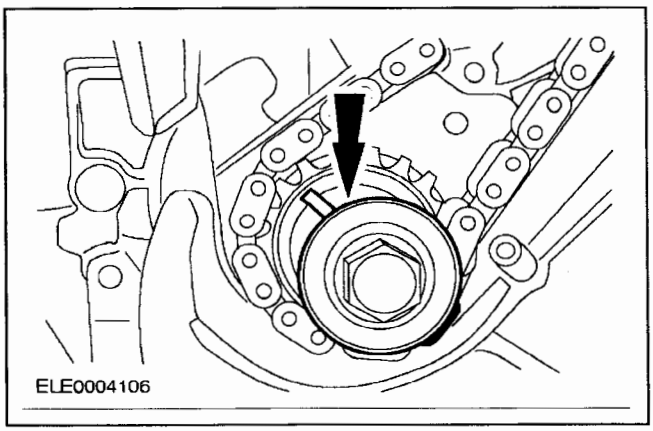
    - **NOTE:** If the camshaft followers and lash adjusters are to be re-used, mark their position to make sure they are assembled in the original location.

      Remove the roller finger followers.
    - Remove the hydraulic lash adjusters.

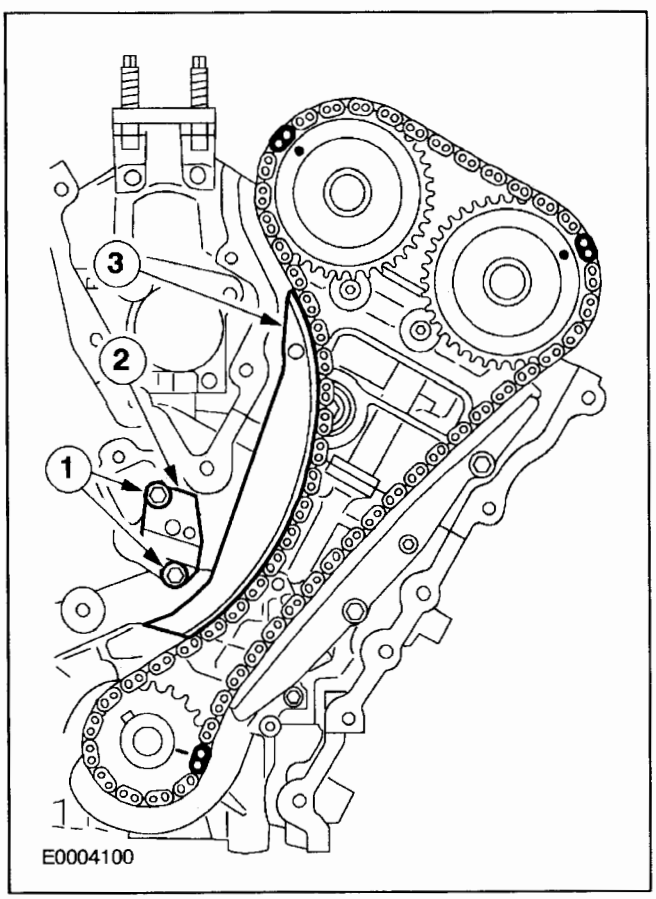
DISASSEMBLY (Continued)



66. Rotate the crankshaft clockwise two revolutions until the keyway is in the 11 o'clock position.

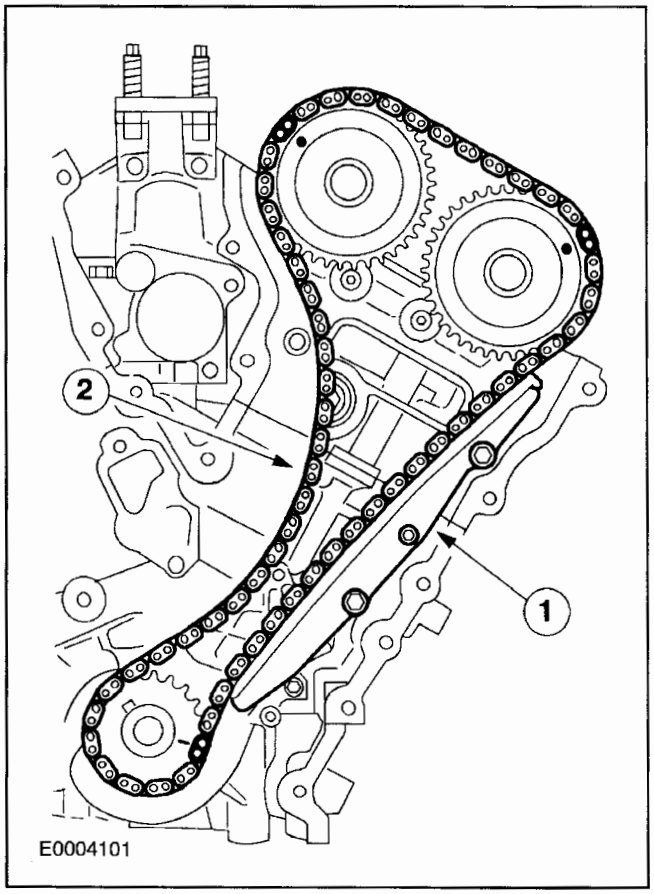


67. Remove the crankshaft pulley, bolt and washer.

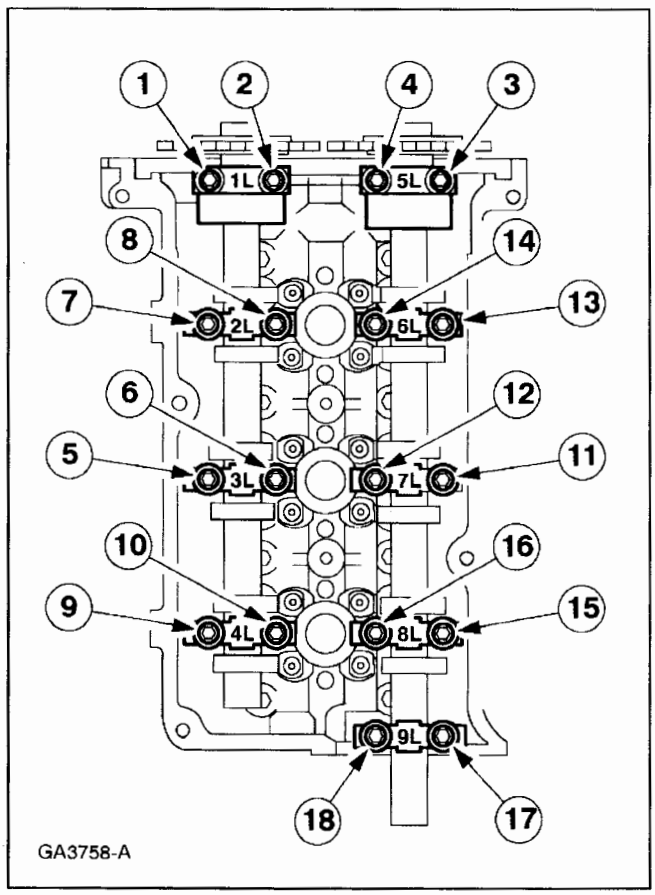


68. Remove the left-hand chain tensioner and tensioner arm.
    1. Remove the chain tensioner bolts.
    2. Remove the chain tensioner and the left-hand tensioner adapter plate (if equipped).
    3. Remove the chain tensioner arm.

DISASSEMBLY (Continued)



69. Remove the left-hand timing chain.
    1 Remove the bolts and the fixed chain guide.
    2 Remove the left-hand timing chain.



70. ⚠ **CAUTION: The cylinder head and the camshaft bearing caps are numbered to make sure they are reassembled in their original position. When removed, keep the bearing caps with the cylinder head they were removed from. Do not mix the caps.**

NOTE: Remove camshaft bearing thrust caps No. 1L and 5L first. Do not loosen any of the other bolts until the thrust caps are removed.

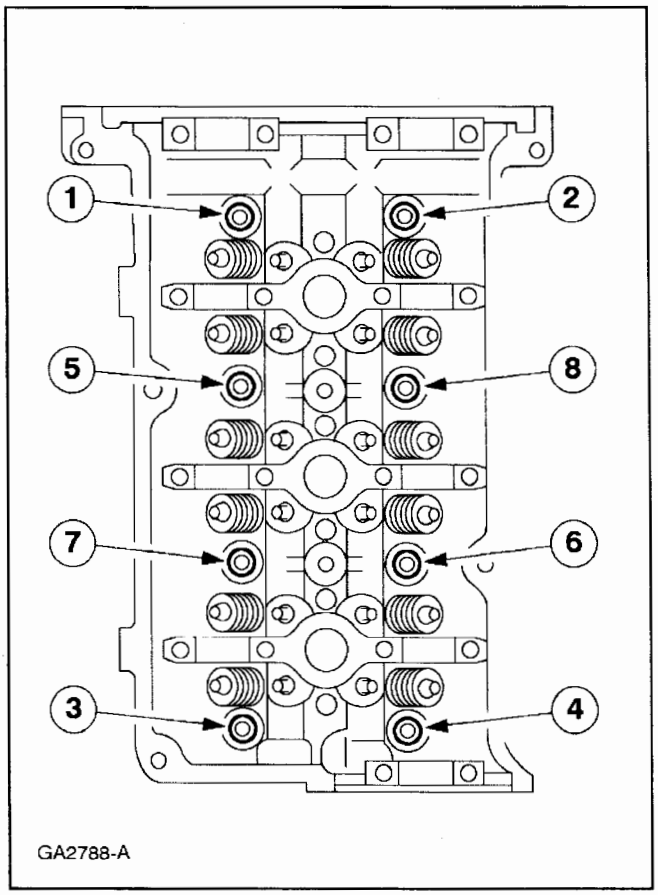
NOTE: Loosen the remaining bolts and bearing caps in the indicated sequence in several passes to allow the camshafts to gradually raise from the cylinder head.

Loosen the camshafts (left-hand cylinder head).

- **NOTE:** If the camshaft followers and lash adjusters are to be re-used, mark their position to make sure they are assembled in the original location.

  Remove the roller finger followers.
- Remove the hydraulic lash adjusters.

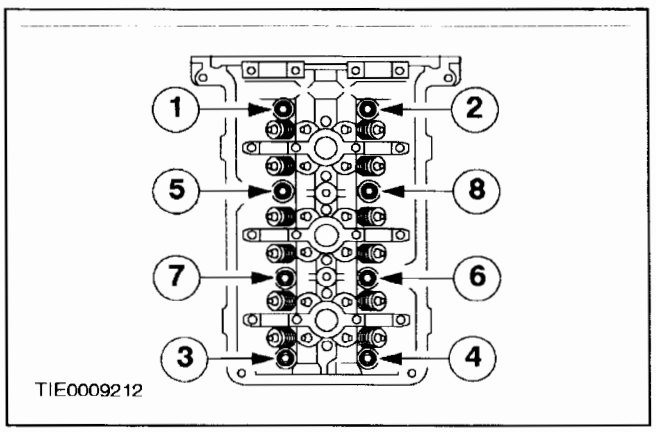
DISASSEMBLY (Continued)



71. **NOTE:** Remove the bolts in the indicated sequence.

    Remove the left-hand cylinder head.

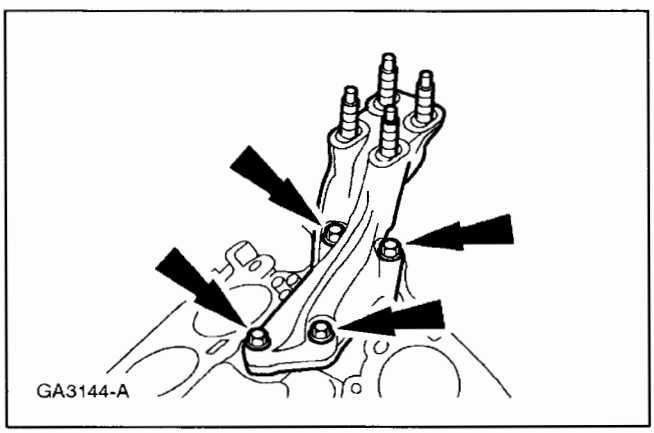
    - Remove and discard the gaskets.



72. **NOTE:** Remove the bolts in the indicated sequence.

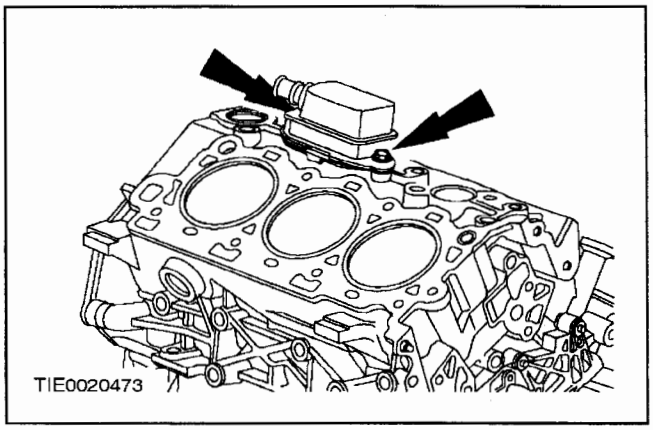
    Remove the right-hand cylinder head.

    - Remove and discard the gaskets.

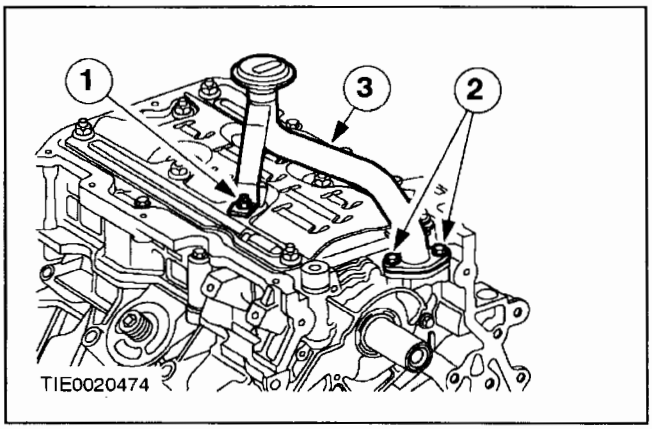


73. Remove the power steering bracket.

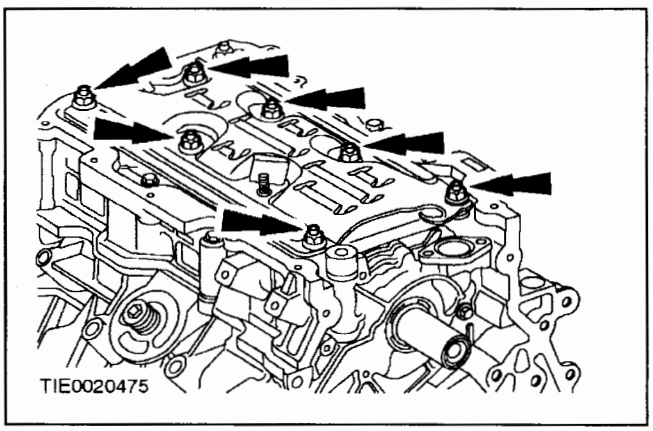
DISASSEMBLY (Continued)



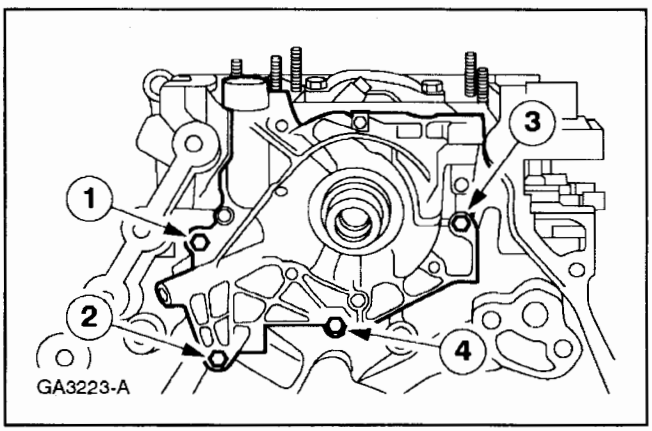
74. Remove the oil separator.
    - Remove and discard the gasket.



75. Remove the oil intake tube.
    1 Remove nut.
    2 Remove bolts.
    3 Remove the oil intake tube.



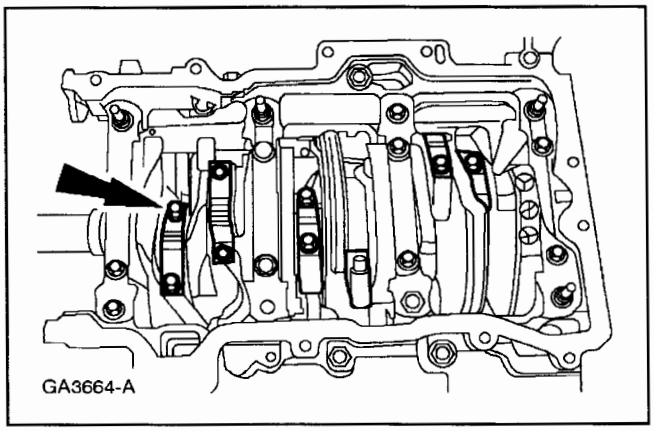
76. Remove the oil pan baffle.



77. **NOTE:** Remove the bolts in the indicated sequence.

    Remove the oil pump.

DISASSEMBLY (Continued)



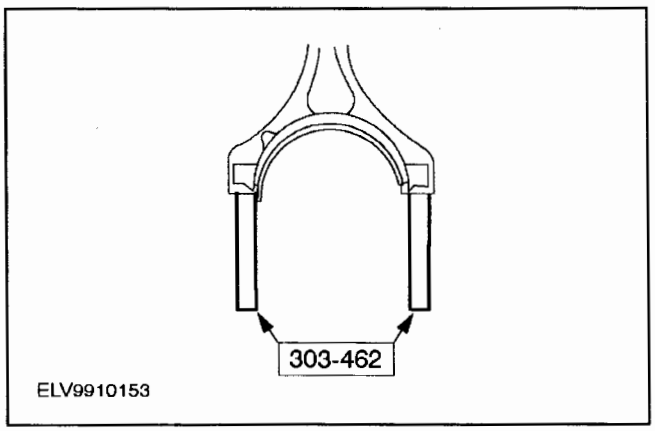
78. ⚠ **CAUTION: Pistons, connecting rods and connecting rod bearings should be numbered to make sure they are reassembled in the same position.**

NOTE: Mark the position of the connecting rod caps to the connecting rods to make sure of correct installation.

NOTE: Discard the connecting rod bolts after removal.

Remove the connecting rod bolts, the connecting rod caps and the lower connecting rod bearings.

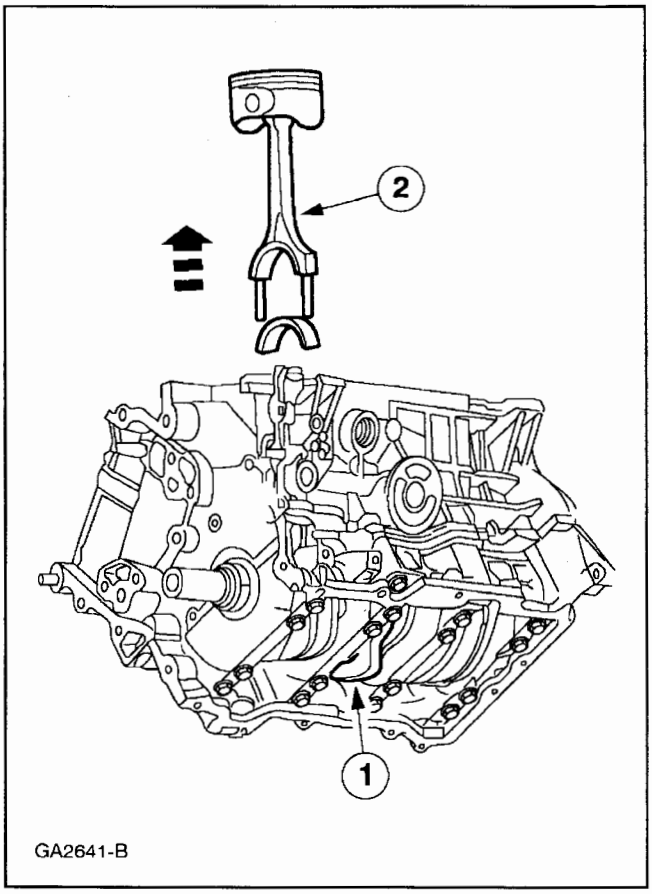
79. Inspect the tops of the cylinder bores. If necessary, remove ridge and carbon build-ups from each cylinder.



80. ⚠ **CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.**

Install the special tool to the connecting rods.

DISASSEMBLY (Continued)



GA2641-B

81. ⚠ **CAUTION: Care should be taken not to damage the connecting rod and cap joint face surfaces or possible engine damage may occur. Avoid contaminating the fracture joint surfaces with dirt or grease.**

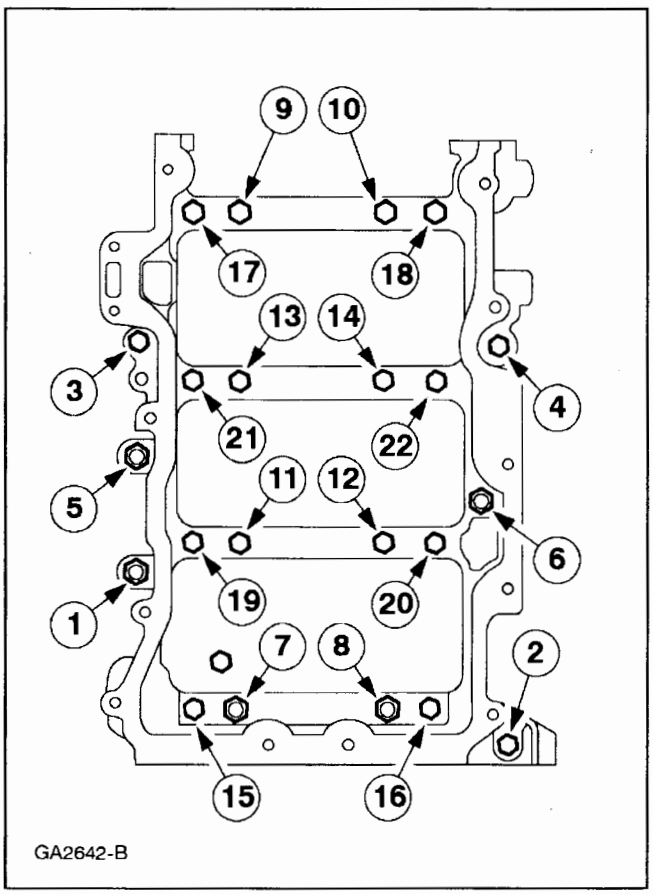
NOTE: Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge from each cylinder.

NOTE: Re-attach the connecting rods and caps after removal to avoid mismatch.

Remove the pistons.

1 Rotate the crankshaft to locate pistons at the bottom of travel.

2 Push the piston, connecting rod and upper bearing through the top of the cylinder.

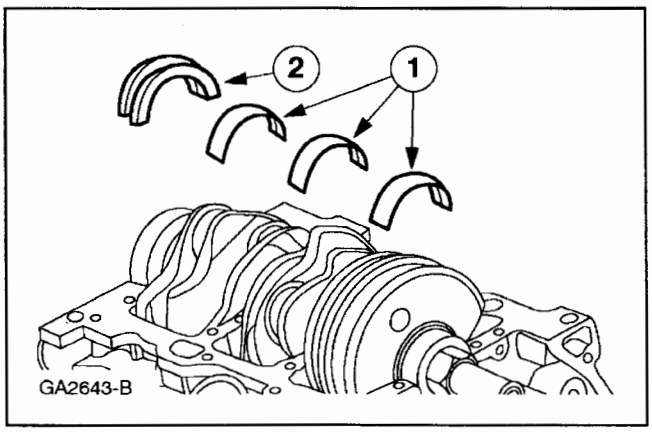


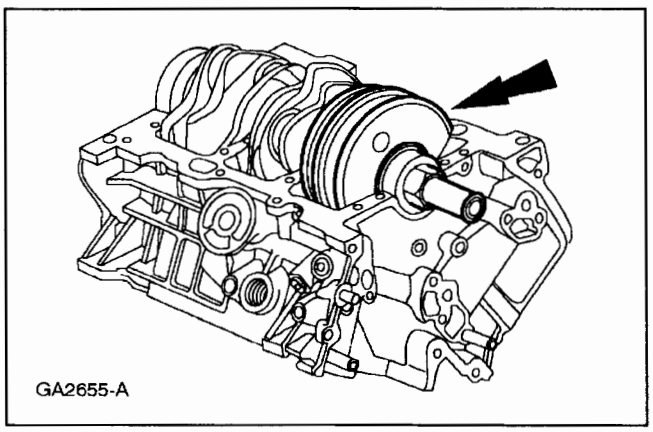
GA2642-B

82. ⚠ **CAUTION: Bolt numbers 7 through 22 are tighten-to-yield and must not be reused.**

Remove the bolts in the indicated sequence and remove the lower cylinder block.

DISASSEMBLY (Continued)





83. **NOTE:** Mark the position of the upper and lower crankshaft main bearing and the crankshaft thrust bearing for reassembly.

    Remove the lower crankshaft bearings.

    1 Remove the lower crankshaft main bearings.

    2 Remove the lower crankshaft thrust main bearing.

84. ⚠ **CAUTION: Avoid damage to any crankshaft bearing surfaces.**

    NOTE: Never remove any pipe plugs or dowels unless they are to be replaced or the cylinder block is to be washed.

    Remove the crankshaft.

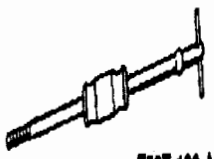
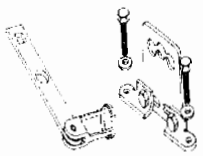
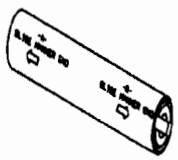
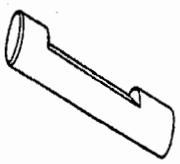
85. ⚠ **WARNING: Eye protection is required during the use of compressed air. Failure to follow these instructions may result in personal injury.**

    Clean the cylinder block with a soap and water solution. Dry the cylinder block completely with compressed air.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

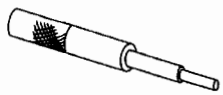
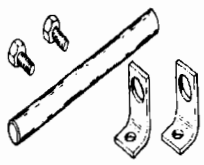
Cylinder Head

Special Tool(s)

 T50T-100-A	Slide Hammer 100-001 (T50T-100-A)
 T89P-6565-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 T94P-6510-AH	Remover, Oil Seal, Valve Stem 303-468 (T94P-6510-AH)
 T94P-6510-CH	Installer, Oil Seal, Valve Stem 303-470 (T94P-6510-CH)

(Continued)

Special Tool(s)

 ST1985-A	Valve Guide, Remover/Replacer 303-346 (T89P-6510-A)
 T87C-6565-A	Compressor, Valve Spring 303-300 (T87C-6565-A)

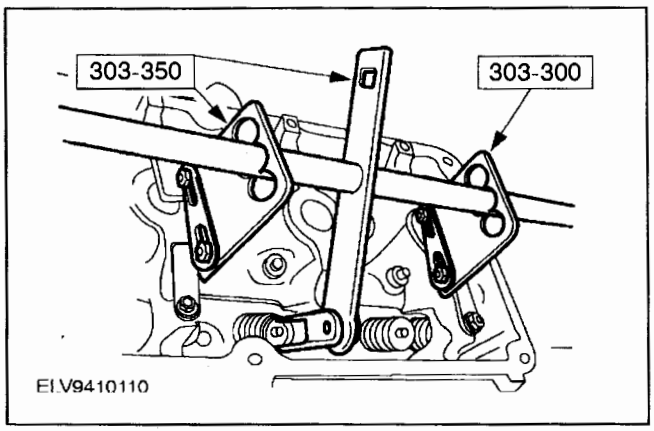
Materials

Item	Specification
Engine oil —	WSS-M2C153-H
Sealer —	SM-4G-4644-AA/AB

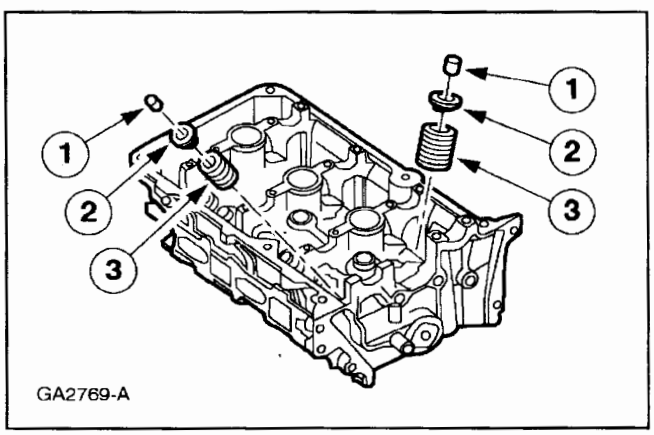
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Disassembly

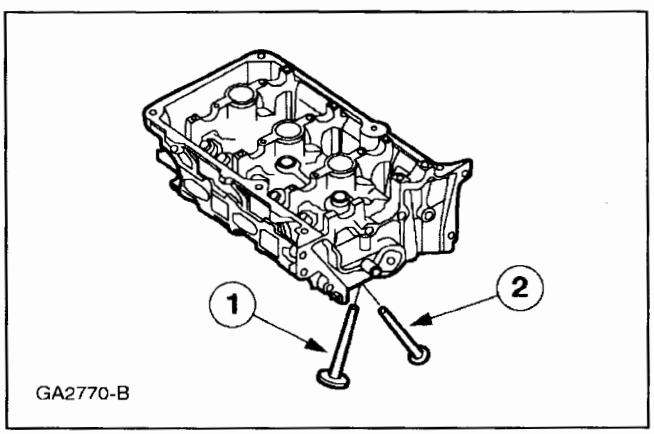
⚠ CAUTION: If the cylinder head valve components are to be reused, mark the position of the valve components to make sure they are reassembled in the same position.



1. Using the special tools, compress the valve springs.

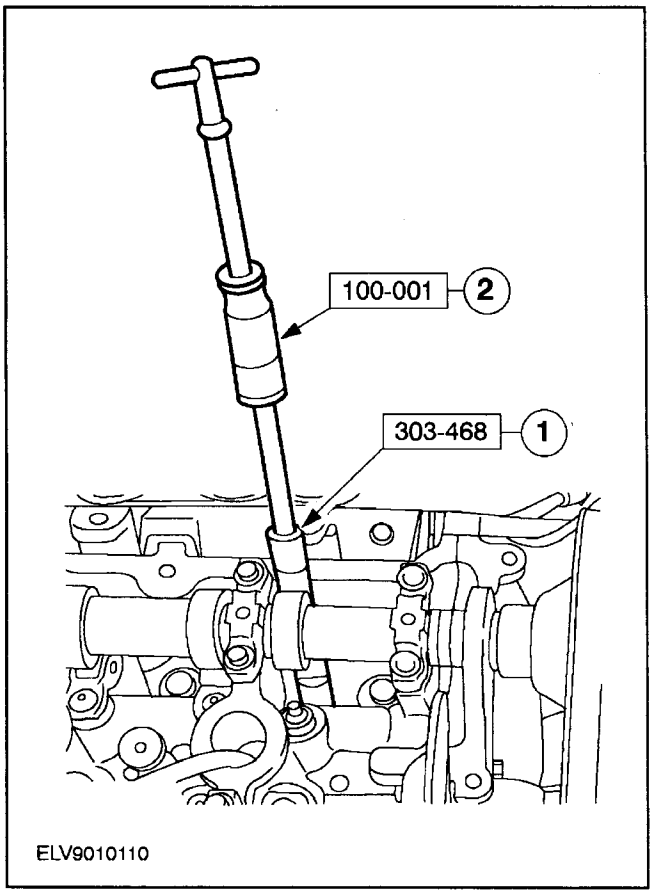


2. Remove the valve spring retainers and the valve springs.
   1 Remove the valve collets.
   2 Remove the valve spring retainers.
   3 Remove the valve springs.



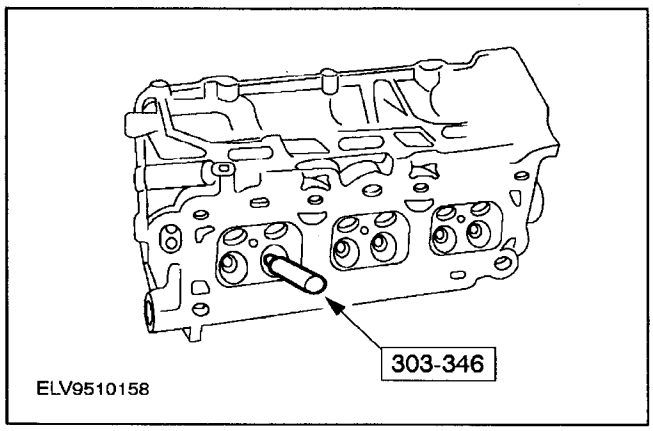
3. Remove the valves from the cylinder heads.
   1 Remove the intake valves.
   2 Remove the exhaust valves.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



4. Using the special tool, remove the valve stem seals.
   1 Install special tool.
   2 Install special tool and remove the valve seal.

5. Inspect the cylinder heads and the related components. For additional information, refer to Section 303-00. Install new components as necessary.



6. **NOTE:** Valve guides should never be removed unless they are to be serviced.

   Using the special tool, remove the valve guides as necessary.

   - Drive the valve guides out from the bottom of the cylinder head.

7. **NOTE:** Never remove pipe plugs or alignment dowels unless they are to be serviced.

   Remove the pipe plugs and alignment dowels as necessary to clean the cylinder heads.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Assembly

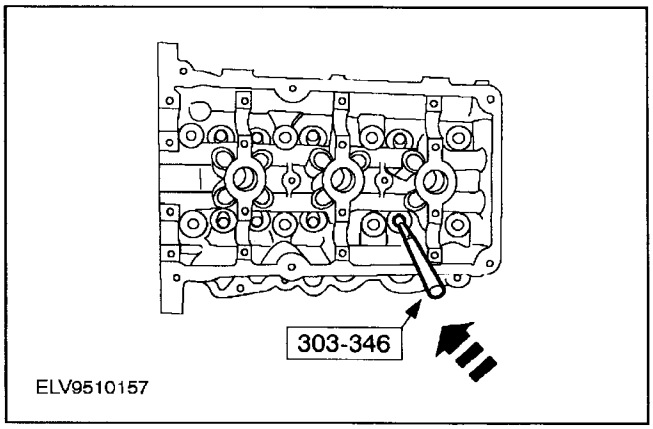
1. **⚠ WARNING: Eye protection is required during use of compressed air. Failure to follow these instructions may result in personal injury.**

   ⚠ CAUTION: The cylinder head surface finish is measured in microns. For correct head gasket sealing, avoid any contact of finish with metallic objects.

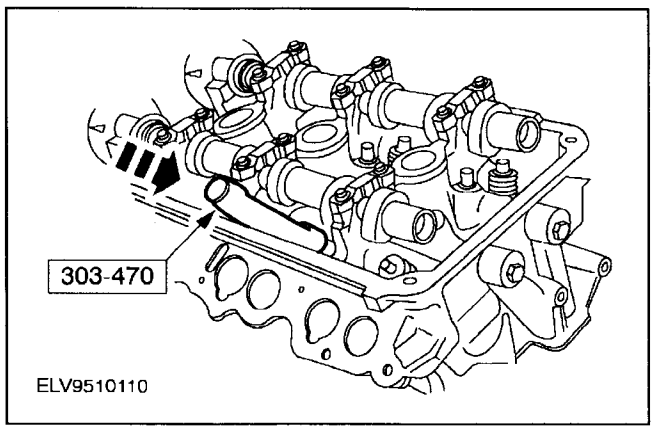
   Clean gasket material, dirt and foreign material from cylinder heads. Wash with a suitable soap and water solution and dry completely using compressed air if pipe plugs have been removed.

   - If gasket material remains on the cylinder head after cleaning, use a plastic tipped scraper to remove remaining material.

2. Install the pipe plugs and alignment dowels to cylinder heads, if removed.
   - Apply pipe sealant to plugs prior to installation. Use sealer or equivalent meeting Ford Specification SM-4G-4644-AA/AB.

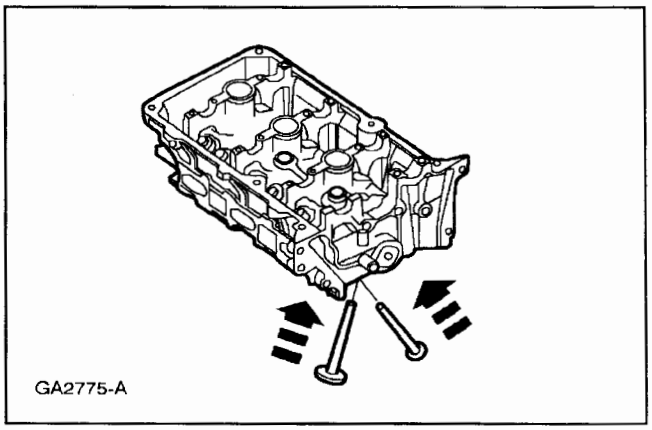


3. Using the special tool, install the valve guides, if removed.



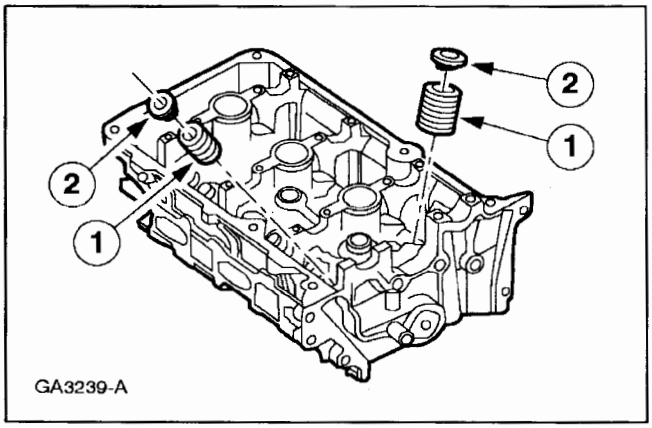
4. Using the special tool, install the valve stem seals onto the valve guides.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GA2775-A

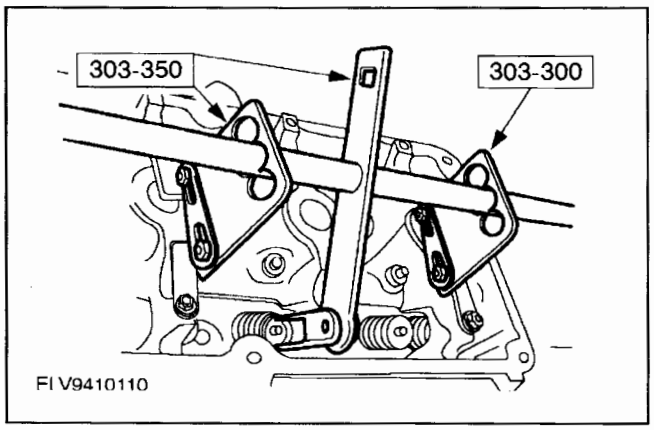
5. **NOTE:** Lubricate the valve stems and guides with clean engine oil before installation.

   Install the valves into the cylinder heads.



GA3239-A

6. Install the valve springs and the valve spring retainers.
   1 Install the valve springs.
   2 Install the valve spring retainers.

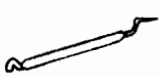


FI V9410110

7. Using the special tools, install the valve collets.

Piston

Special Tool(s)

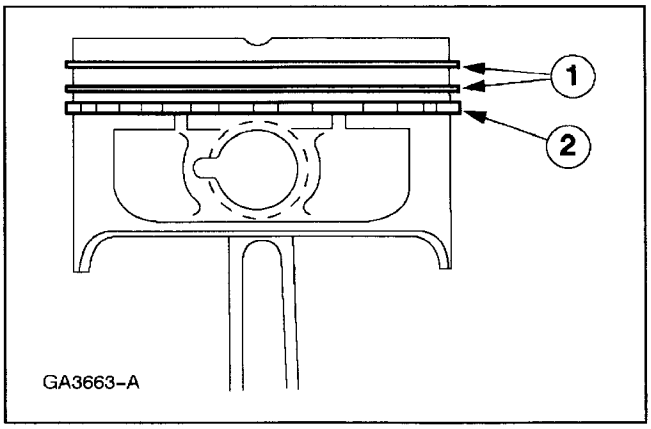
 ST1219-A	O-Ring Tool 100-010 (T71P-19703-C)

Materials

Item	Specification
Engine oil —	WSS-M2C153-H

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Disassembly

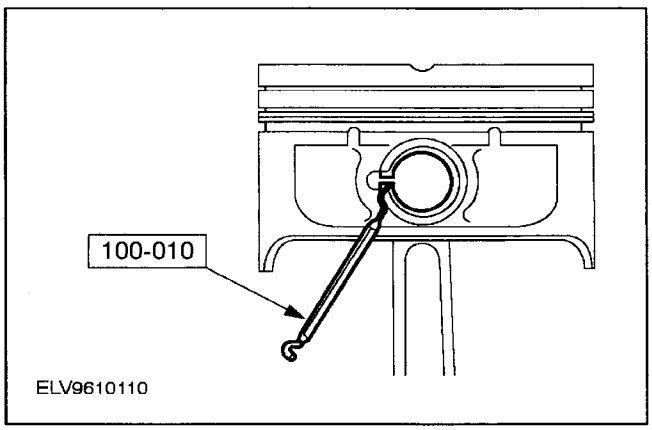


1. **NOTE:** Mark the pistons to make sure assembly with the original connecting rods and installation in the same cylinders from which they were removed.

   Remove the piston rings from the piston and discard.

   1 Remove the two compression rings.

   2 Remove the two oil control ring segments and the spacer.



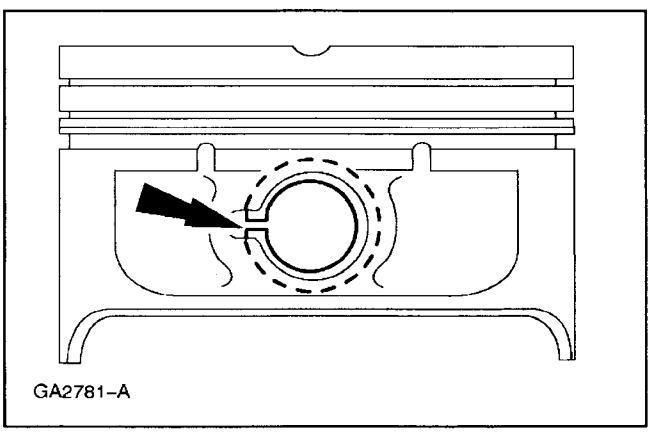
2. ⚠ **WARNING: The retaining ring has a tendency to spring out during removal. Cover the end of the pin bore with a hand or shop rag when removing the retaining ring. Eye protection should be worn. Failure to follow these instructions may result in personal injury.**

   Using the special tool, remove the two piston pin retaining rings.

3. Push the piston pin from the piston and connecting rod.

Assembly

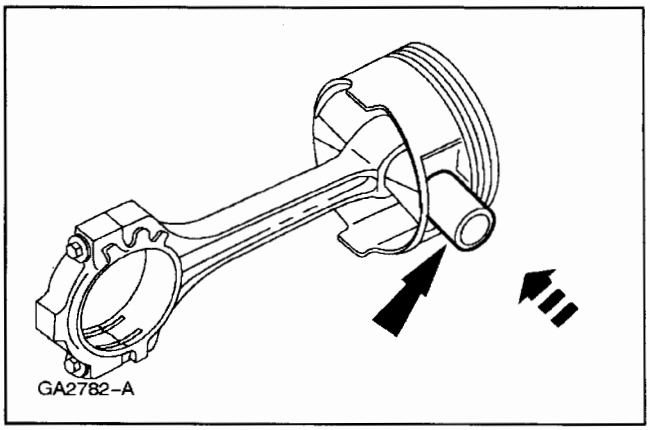
1. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00.



2. **NOTE:** Check each end of the piston pin for an identification mark. If present, install the piston pin with the identification mark toward the front of the engine.

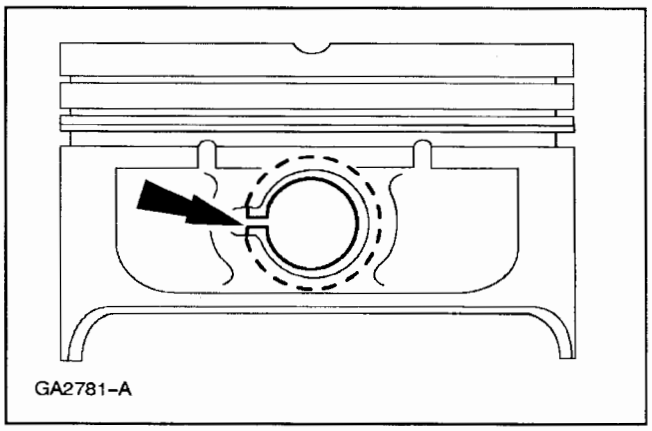
   Install a new piston pin retaining ring into one side of the piston pin bore.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



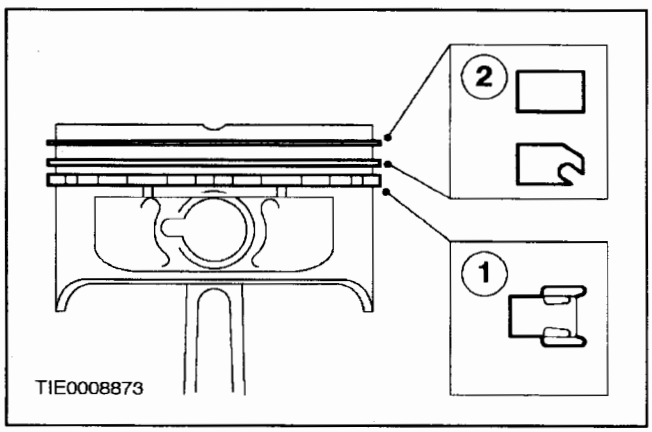
3. Lubricate and start the piston pin in the piston and connecting rod.

4. Push the piston pin through the piston until it bottoms on the retaining ring.



5. Install a new piston pin retaining ring on the opposite side of the piston pin bore.
   - Make sure that the connecting rod moves freely after assembly.

6. Check the end gap of all piston rings. For additional information, refer to Section 303-00.



7. **NOTE:** Install piston rings from the top side of piston. Avoid scratching the Teflon coating on the piston skirts if present.

   NOTE: Assemble the lower compression ring with the scraper groove down.

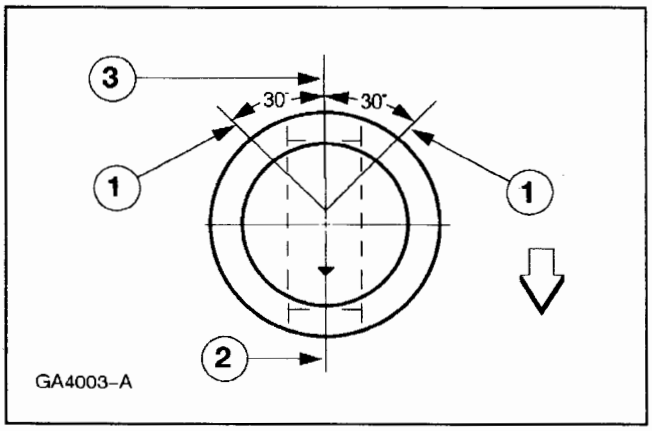
   NOTE: Position the oil control ring spacer so the cut ends are pointed toward the piston dome.

   Install the piston rings.

   1 Install the two oil control ring segments and spacer.

   2 Use a piston ring expander and install the two compression rings.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

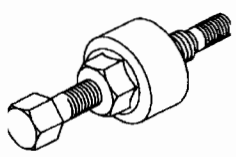
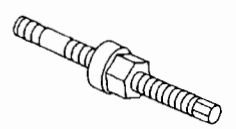
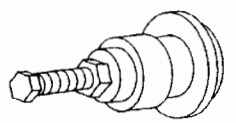


8. Position the compression rings, oil control rings and expander gaps.
   1 Position the oil control segment ring gap.
   2 Position the expander ring and lower compression ring gaps.
   3 Position the upper compression ring gap.

ASSEMBLY

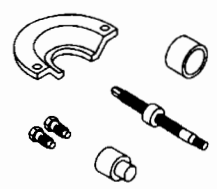
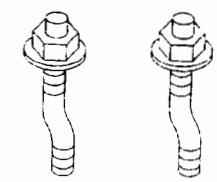
Engine

Special Tool(s)

 ST1586-A	Installer, Pulley, Power Steering Pump 211-185 (T91P-3A733-A)
 ST1287-A	Installer, Vibration Damper, Crankshaft 303-102 (T74P-6316-B)
 ST1327-A	Installer, Oil Seal (Rear), Crankshaft 303-178 (T82L-6701-A)
 ST1328-A	Aligner/Installer, Oil Seal, Crankshaft 303-335 (T88T-6701-A)

(Continued)

Special Tool(s)

 ST1971-A	Remover/Installer, Pulley (Water Pump Drive), Camshaft 303-S455 (T94P-6312-AH)
 ST1333-A	Adapters, Rear Crank Seal Replacer 303-384 (T91P-6701-A)

Materials

Item	Specification
Engine oil —	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19562-EA	WSE-M4G323-A4
Metal Surface Cleaner F4A2-19A536-RA	WSE-M5B392-A
Gasket maker F8AZ-19B508-AB	WSK-M2G348-A5

ASSEMBLY (Continued)

Assembly

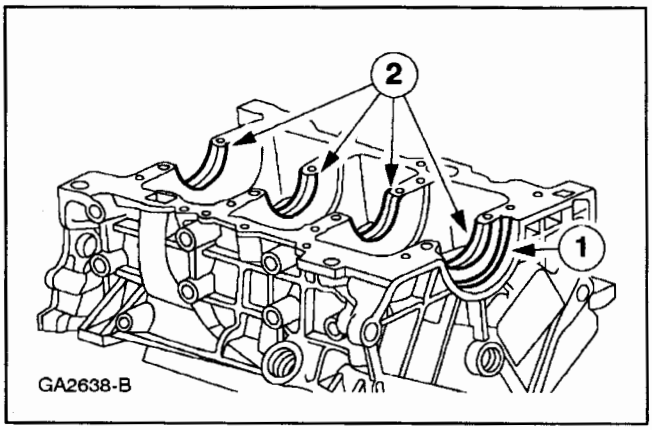
1. ⚠ **CAUTION: Use only a plastic scraper when removing old gasket material.**

   Clean all the mating faces and reusable parts thoroughly and check for damage.

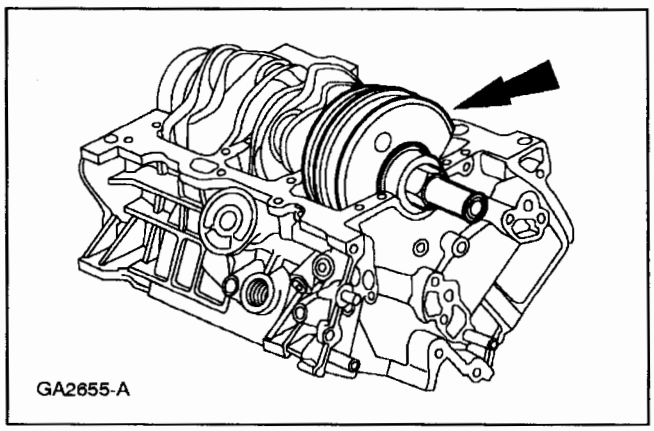
2. **NOTE:** Never remove pipe plugs or alignment dowels unless they are to be serviced.

   Reseal oil passage blanking plugs with gasket maker, as necessary.

3. Select the crankshaft main bearing shells.
   - 11-digit codes are stamped on the rear surface of the cylinder block and on the crankshaft flange to assist in selecting the correct main bearing shells. For additional information, refer to Specifications.



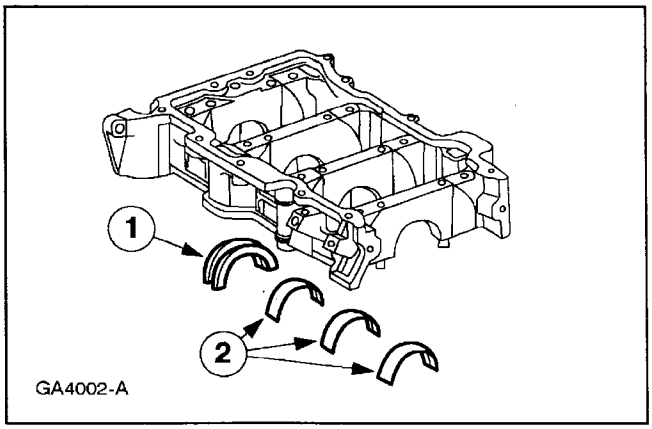
4. Install the upper crankshaft bearings and thrust washer into the cylinder block.
   1 Install the upper crankshaft thrust washer.
   2 Install the upper crankshaft main bearings.
   - Lubricate the bearings and thrust washer with clean engine oil.



5. ⚠ **CAUTION: Avoid damage to any crankshaft journal bearing surfaces.**

   Install the crankshaft.

ASSEMBLY (Continued)



6. **NOTE:** Using a suitable lever or similar tool position the crankshaft rearward before installation of upper thrust bearings.

   NOTE: Visually inspect the bearings to verify that the bearing oil holes align with cylinder block oil feed holes

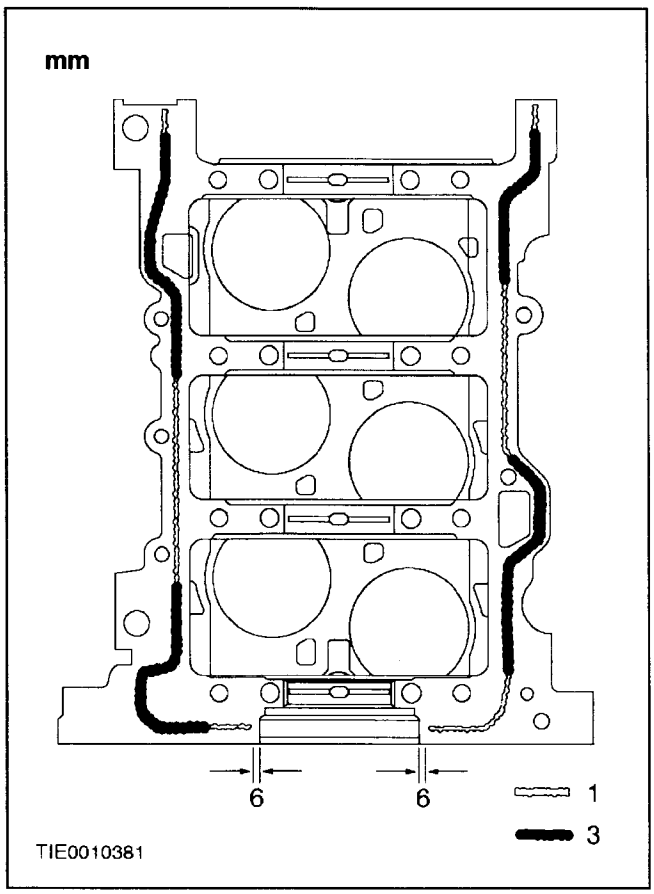
   NOTE: Align the assembly tab on the thrust bearing to the machining spot face on cylinder block.

   Install the lower crankshaft bearings into the cylinder block.

   1 Install the lower crankshaft thrust main bearing into the lower cylinder block.

   2 Install the lower crankshaft main bearings into the lower cylinder block.

   - Lubricate the bearings and the thrust washer with clean engine oil.



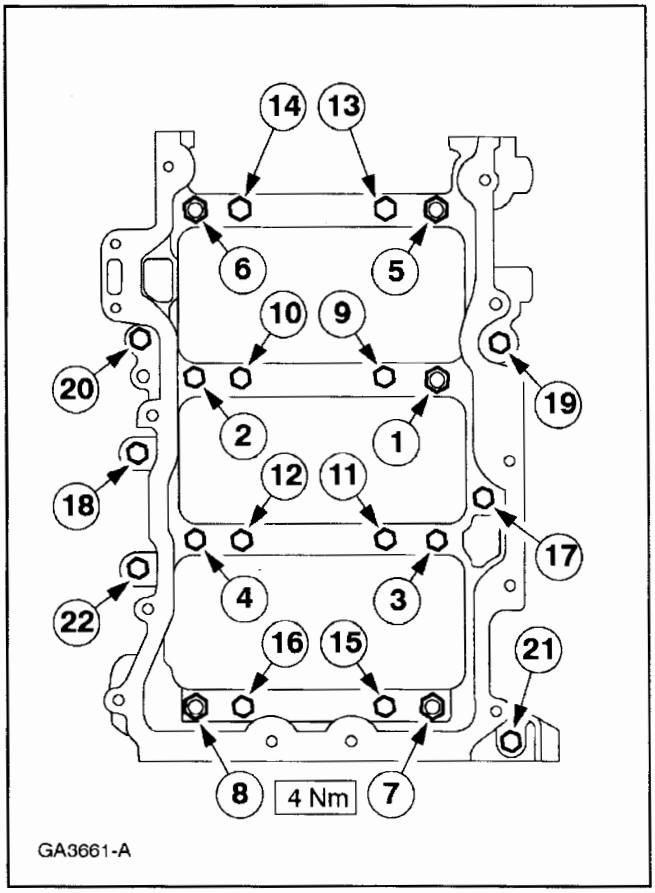
7. **NOTE:** Silicone gasket and sealant application must stop 6 mm from the rear crankshaft bore on each side.

   NOTE: Install the lower cylinder block and tighten all bolts to specification within six minutes of applying silicone gasket and sealant.

   Apply a bead of silicone gasket and sealant to the cylinder block housing.

   - Apply a 3 mm bead to area shown.
   - Apply a 1 mm bead to area shown.

ASSEMBLY (Continued)



8. ⚠ **CAUTION: Make sure all the dowels are fully seated into the lower cylinder block before tightening the bolts.**

NOTE: Tighten the bolts in the indicated sequence.

NOTE: Do not lubricate the lower cylinder block bolts.

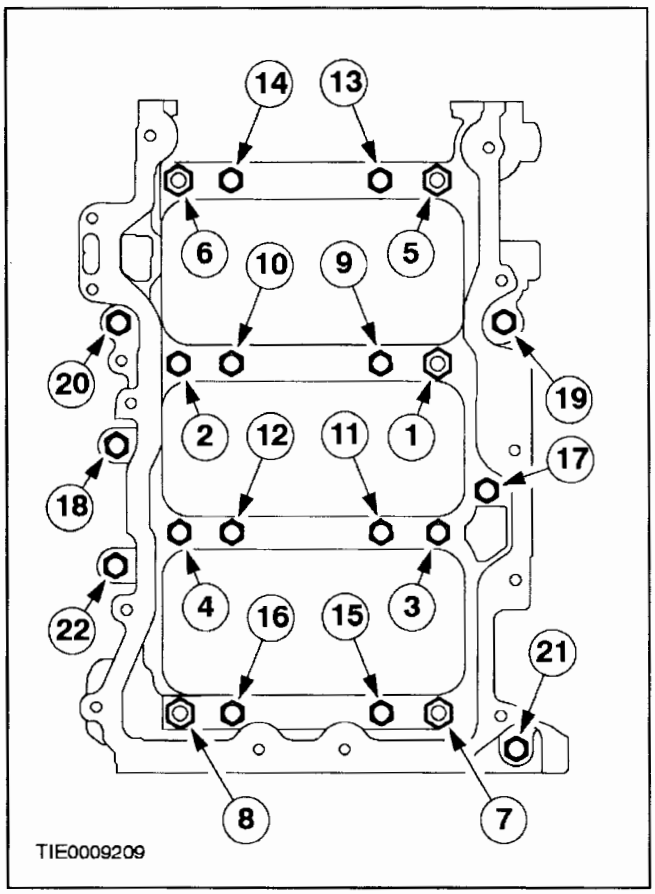
NOTE: Do not rotate the crankshaft until all the bolts are tightened to specification.

NOTE: Before installing the fasteners use a lever or similar tool to lightly seat the crankshaft forward.

NOTE: Bolts must be tightened to specification within six minutes of applying silicone gasket and sealant.

Position the bulkhead housing on the cylinder block and tighten the fasteners in the indicated sequence.

- Push the crankshaft rearward to seat the crankshaft thrust washer.



9. ⚠ **CAUTION: Bolts 1 through 16 are tighten-to-yield and must be replaced.**

Complete the tightening sequence in four stages as indicated.

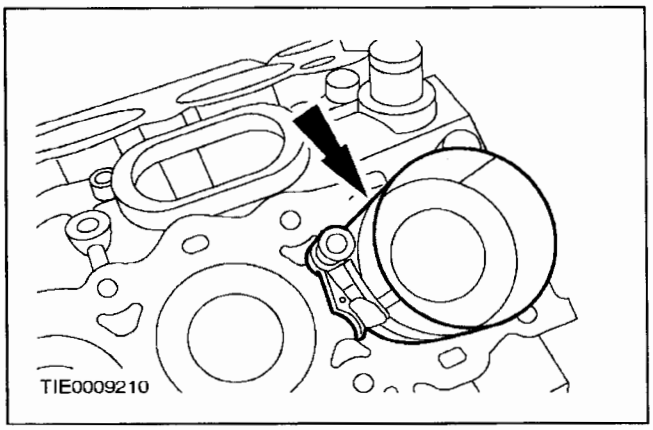
- Stage 1: Bolts 1-8, 25 Nm
- Stage 2: Bolts 9-16, 40 Nm
- Stage 3: Bolts 1-16, 90 degrees
- Stage 4: Bolts 17-22, 25 Nm
- Check that the crankshaft rotates freely.

ASSEMBLY (Continued)

10. Remove excess silicone gasket and sealant which may squeeze out at the front cover sealing surface.

11. **⚠ CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and the cylinder bore surfaces.**

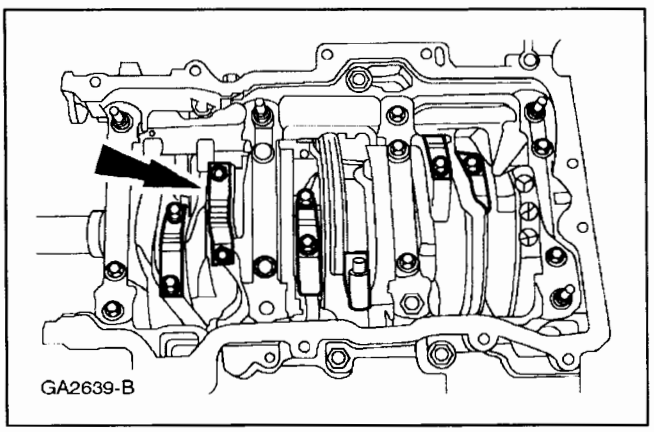
    Position the crankshaft with the journal at the bottom of the stroke.



12. **NOTE:** Install the pistons with the arrow to front of the engine.

    Compress the rings and install the piston and connecting rod.

    - Lubricate all engine components with clean engine oil.



13. **⚠ CAUTION: When assembling the connecting rods and the connecting rod caps, it is imperative that bearing slots and tangs be located on the same side of the connecting rods.**

    ⚠ CAUTION: Connecting rod bolts are tighten to yield and must not be reused.

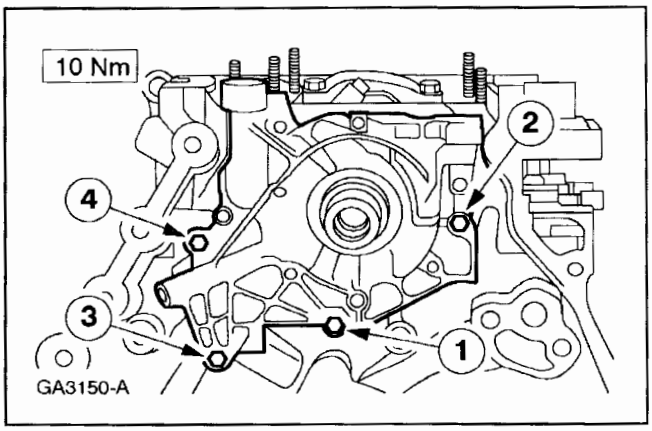
    Position the connecting rod cap on the appropriate connecting rod and alternately tighten the bolts in three stages as indicated.

    - Stage 1: 23 Nm
    - Stage 2: 43 Nm
    - Stage 3: 90 degrees

14. Check the connecting rod side clearance. For additional information, refer to Section 303-00.

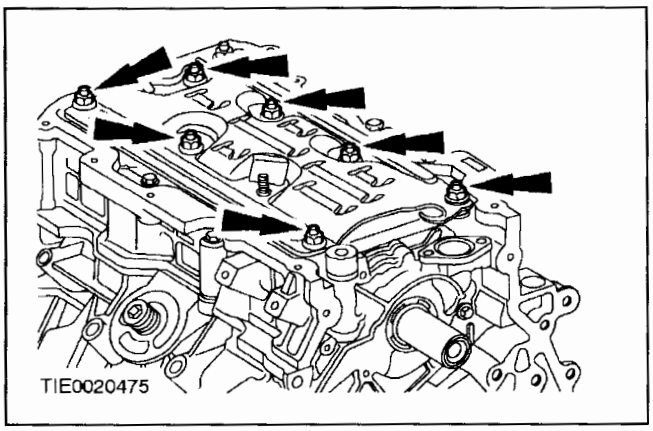
15. Rotate the crankshaft to make sure the crankshaft and pistons are operating correctly.

ASSEMBLY (Continued)

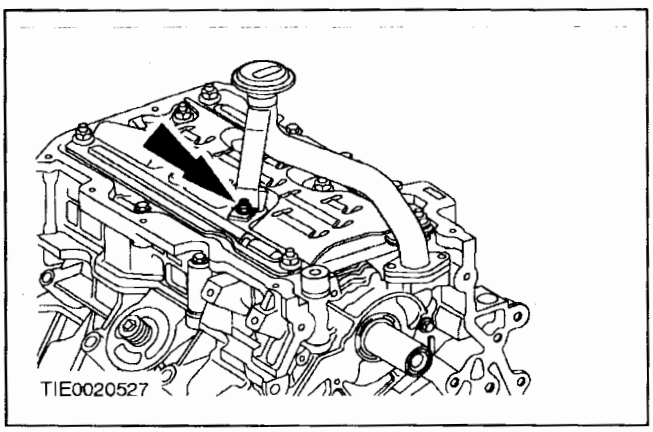


16. **NOTE:** Tighten the bolts in the indicated sequence.

    Install the oil pump.

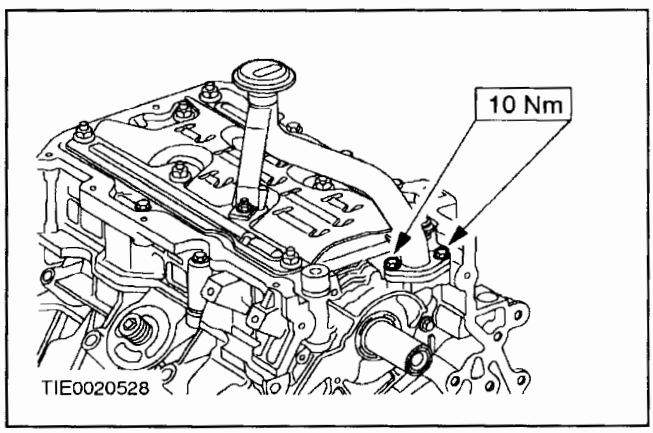


17. Position the oil pan baffle and install the nuts in two stages.
    - Stage 1: 5 Nm
    - Stage 2: 45 degrees (one-eighth turn)



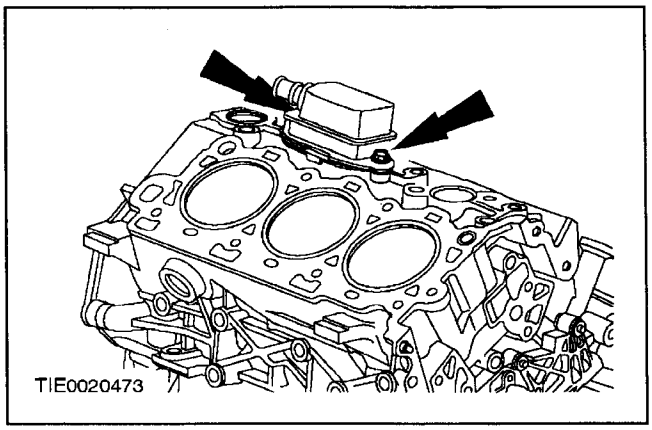
18. **NOTE:** Lubricate a new O-ring seal with engine oil before installation.

    Position the oil intake tube and install the bracket nut in two stages.
    - Stage 1: 5 Nm
    - Stage 2: 45 degrees (one-eighth turn)

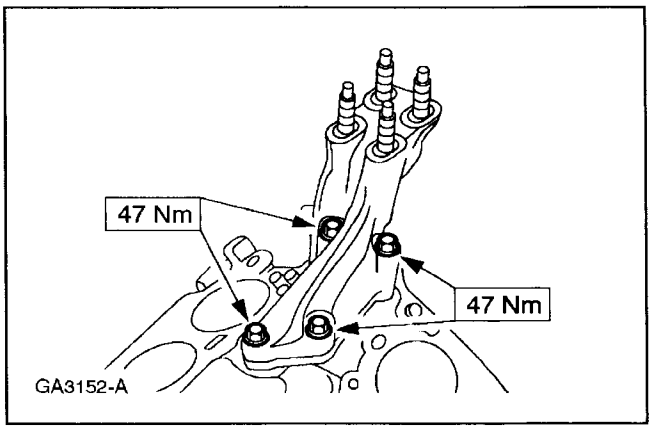


19. Install the oil intake tube bolts.

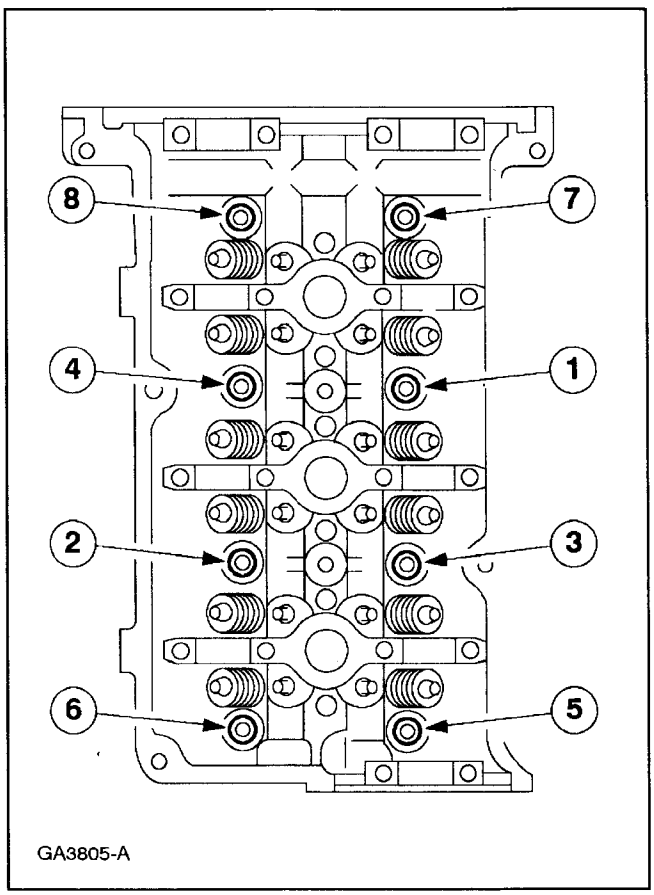
ASSEMBLY (Continued)



20. Install the oil separator.
    - Use a new gasket with the guide(s) facing the cylinder block.



21. Install the power steering pump bracket.
    - Align the bracket with the locating sleeves.



22. ⚠ **CAUTION: Cylinder head bolts are installed and tightened in two phases.**

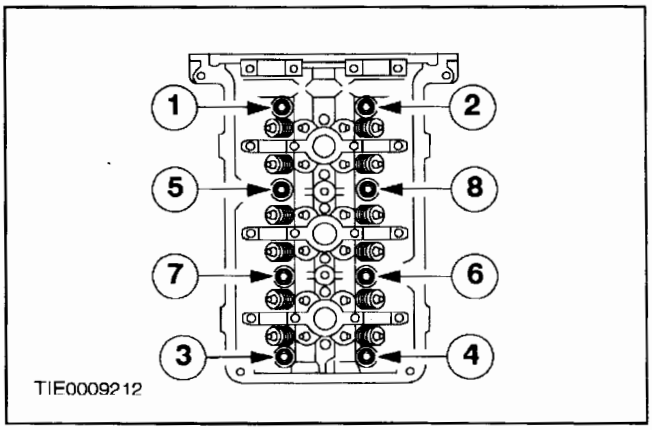
    NOTE: Tighten the bolts in the indicated sequence in two stages.

    NOTE: Left-hand shown, right-hand similar.

    NOTE: Left-hand and right-hand cylinder head gaskets are not interchangeable.

    Install the cylinder heads.
    - Use a new cylinder head gasket and align the cylinder head with the locating sleeves.
    - Insert new cylinder head bolts with washers.
    - Stage 1: 40 Nm
    - Stage 2: 90 degrees

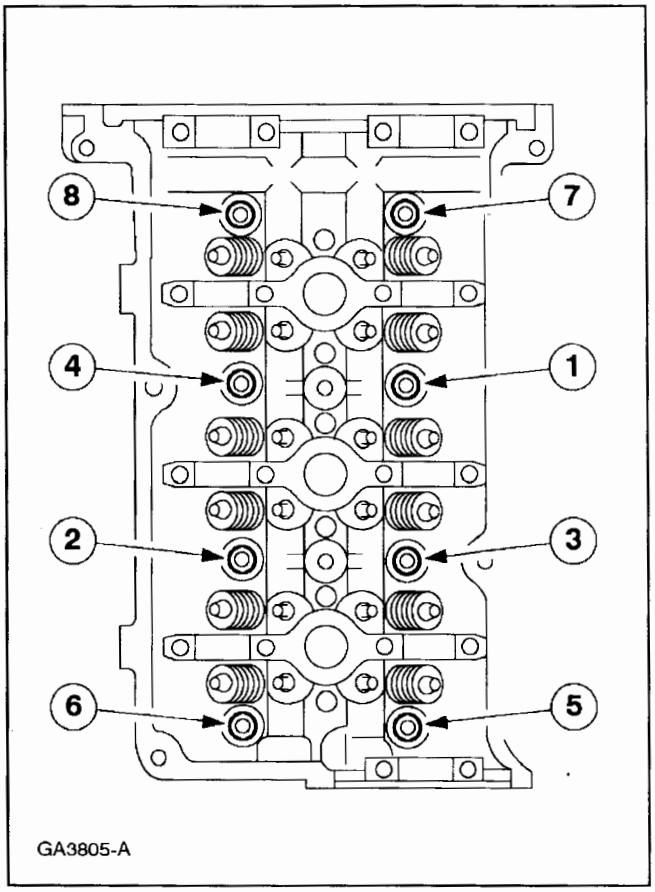
ASSEMBLY (Continued)



23. **NOTE:** Right-hand shown, left-hand similar.

    NOTE: Loosen the bolts in the indicated sequence one full turn (360 degrees).

    Loosen the cylinder head bolts.



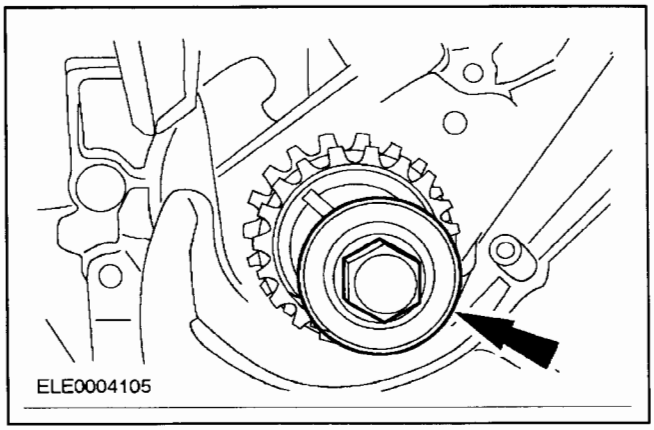
24. **NOTE:** Left-hand shown, right-hand similar.

    Tighten the cylinder head bolts in the indicated sequence in three stages.

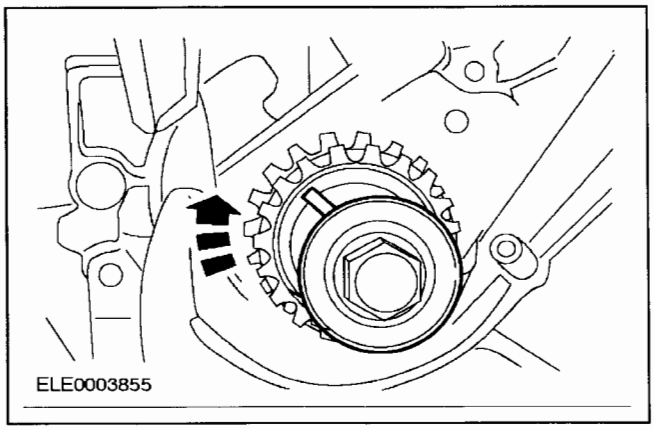
    - Stage 1: 40 Nm
    - Stage 2: 90 degrees
    - Stage 3: Loosen 360 degrees (one full turn) in reverse order.
    - Stage 4: 40 Nm
    - Stage 5: 90 degrees
    - Stage 6: 90 degrees

25. Check all camshaft specifications. For additional information, refer to Section 303-00.

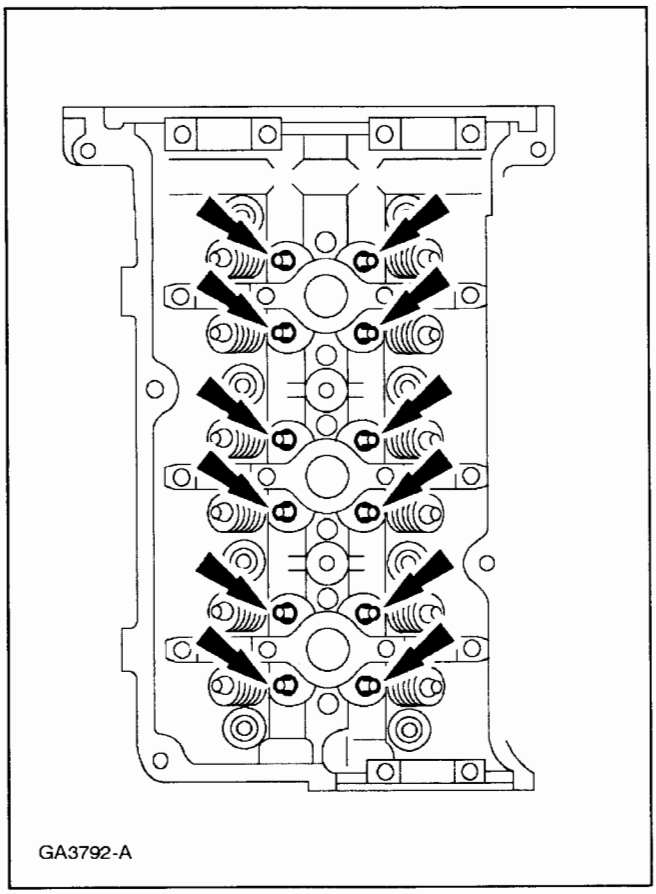
ASSEMBLY (Continued)



26. Install the crankshaft pulley washer and bolt.

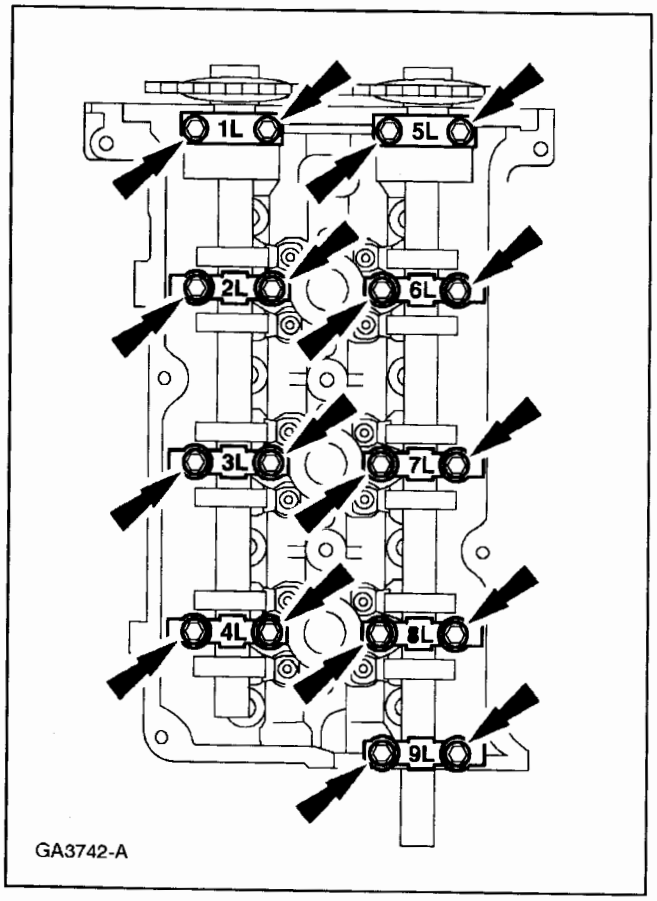


27. Position the crankshaft.
    - Turn the key clockwise to the 11 o'clock position.



28. **NOTE:** Left-hand shown, right-hand similar.
    Install the hydraulic lash adjusters.
    - Lubricate the hydraulic lash adjusters with clean engine oil before installation.

ASSEMBLY (Continued)



29. **NOTE:** Lubricate the camshafts with clean engine oil before installation.

    Install the left-hand camshafts.

30. ⚠ **CAUTION: Do not install thrust caps 1L and 5L at this time, or damage to the thrust caps may occur.**

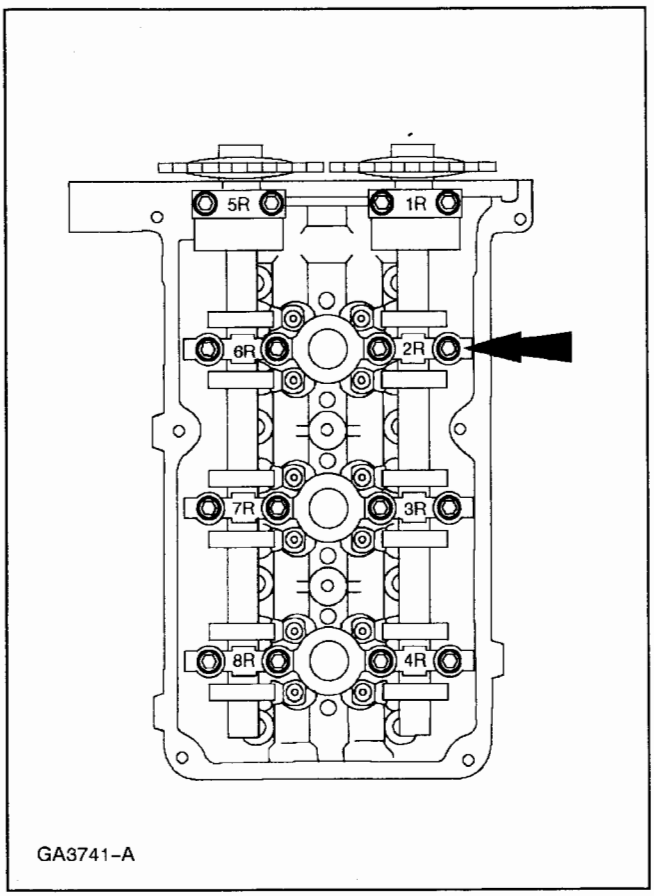
    Install the left-hand camshaft caps in their original positions.

    - Loosely install the camshaft cap bolts.

31. **NOTE:** Lubricate the camshafts with clean engine oil before installation.

    Install the right-hand camshafts.

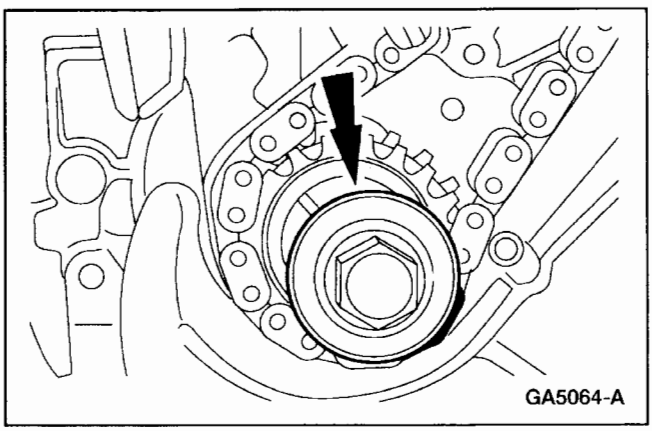
ASSEMBLY (Continued)



32. ⚠ **CAUTION: Do not install thrust caps 5R and 1R at this time or damage to the thrust caps may result.**

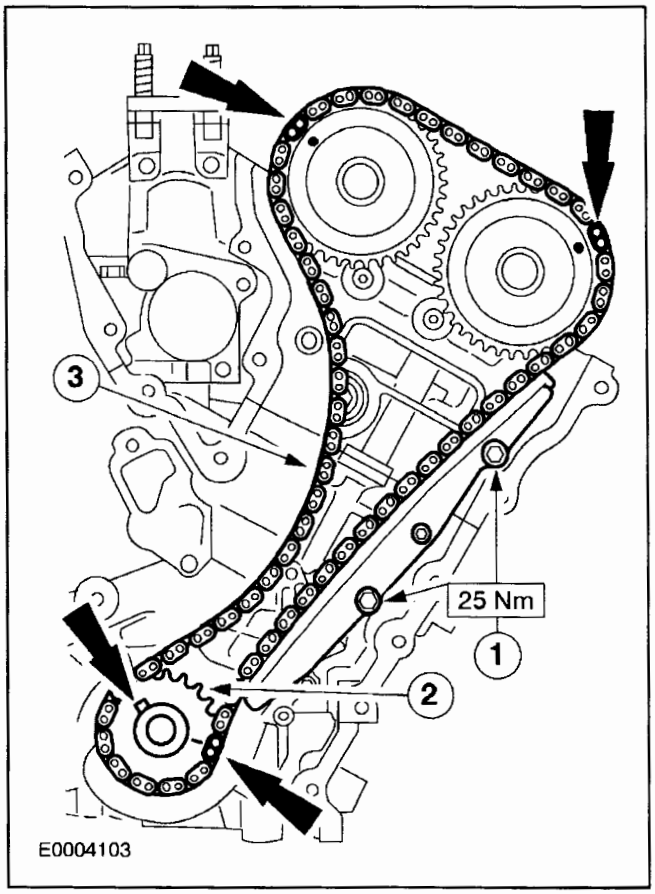
    Install the right-hand camshaft caps in their original positions.

    - Loosely install the camshaft cap bolts.



33. Remove the crankshaft pulley bolt and washer, while maintaining the 11 o'clock crankshaft keyway position.

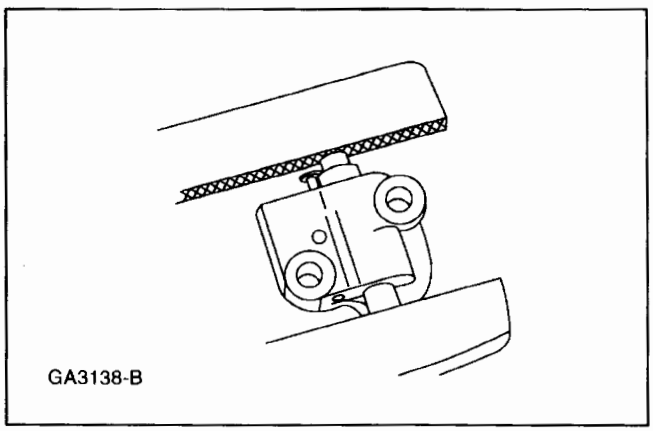
ASSEMBLY (Continued)



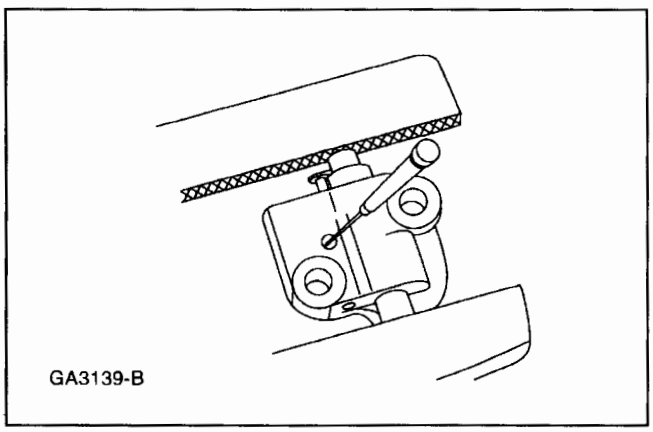
34. **NOTE:** The colored links of the timing chain and the marks on the timing sprockets must line up.

    Install the left-hand timing chain.

    1 Install the left-hand chain guide and bolts (black material).
    2 Install the crankshaft sprocket.
    3 Install the timing chain.



35. Grip the left-hand timing chain tensioner in a vise with jaw protectors.



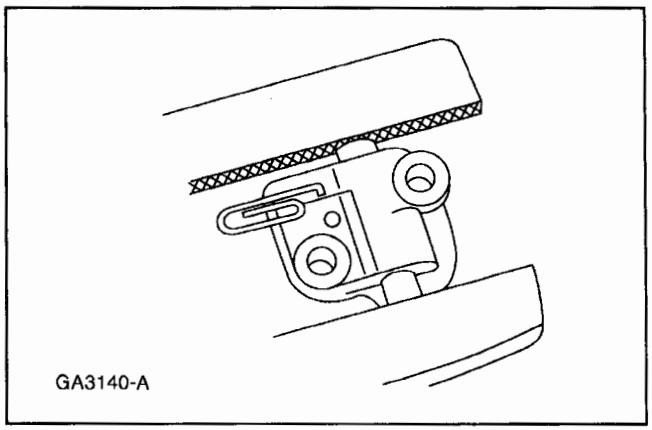
36. ⚠ **CAUTION: During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.**

    Hold the left-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.

ASSEMBLY (Continued)

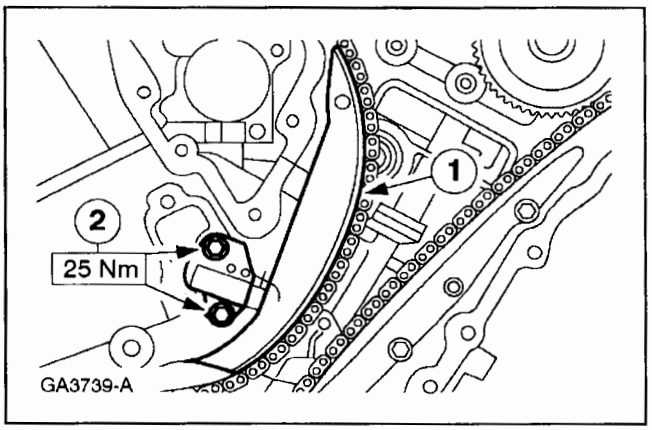
37. **NOTE:** The piston should retract with minimal force. If binding occurs, reposition the tensioner to eliminate side loading.

    Slowly compress the left-hand timing chain tensioner.



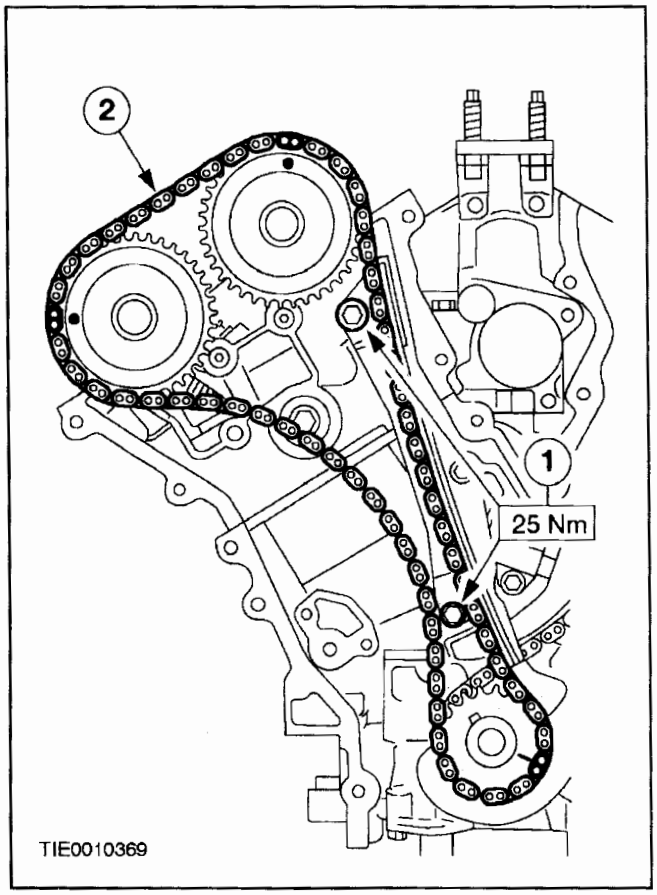
38. **NOTE:** The wire must remain in the timing chain tensioner until the tensioner is installed into the engine with the piston bottomed in the bore.

    Retain piston with a 1.5 mm wire or paper clip.



39. Install the left-hand timing chain tensioner.
    1. Install the left-hand tensioner arm (black material).
    2. Install the tensioner adapter plate left-hand, the timing chain tensioner and bolts.

ASSEMBLY (Continued)

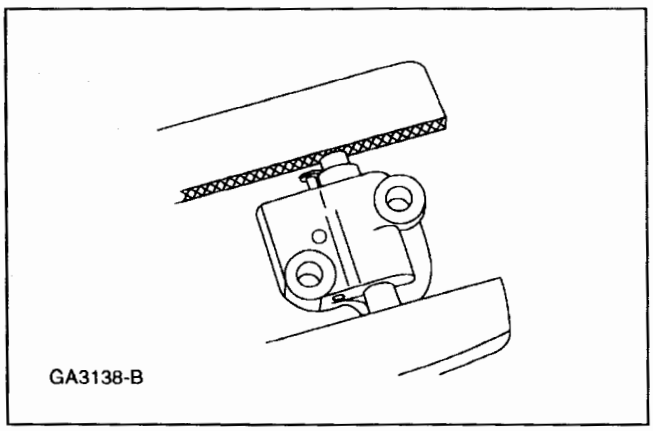


40. **NOTE:** The colored links of the timing chain and the marks on the sprocket must line up.

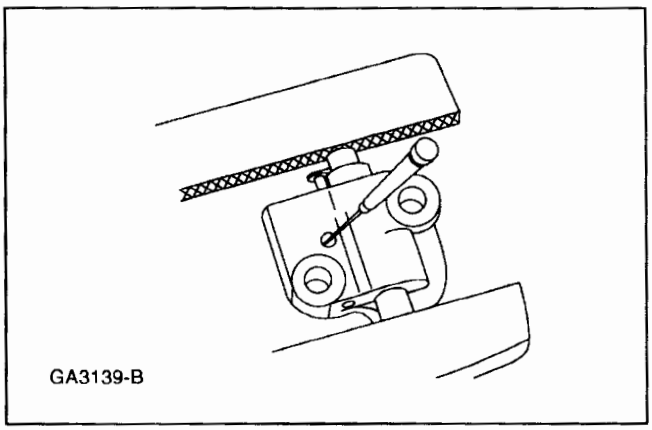
    Install the right-hand timing chain.

    1 Install the tensioner arm and bolts (tan material)

    2 Install the timing chain.



41. Grip the right-hand timing chain tensioner in a vise with jaw protectors.



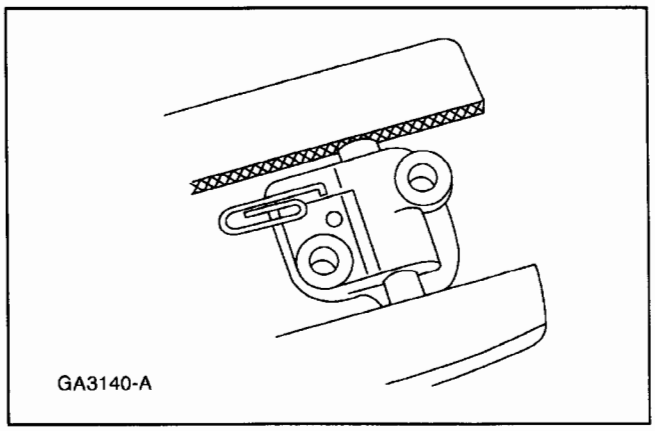
42. ⚠ **CAUTION: During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore, or damage to the ratchet stem will result.**

    Hold the right-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.

ASSEMBLY (Continued)

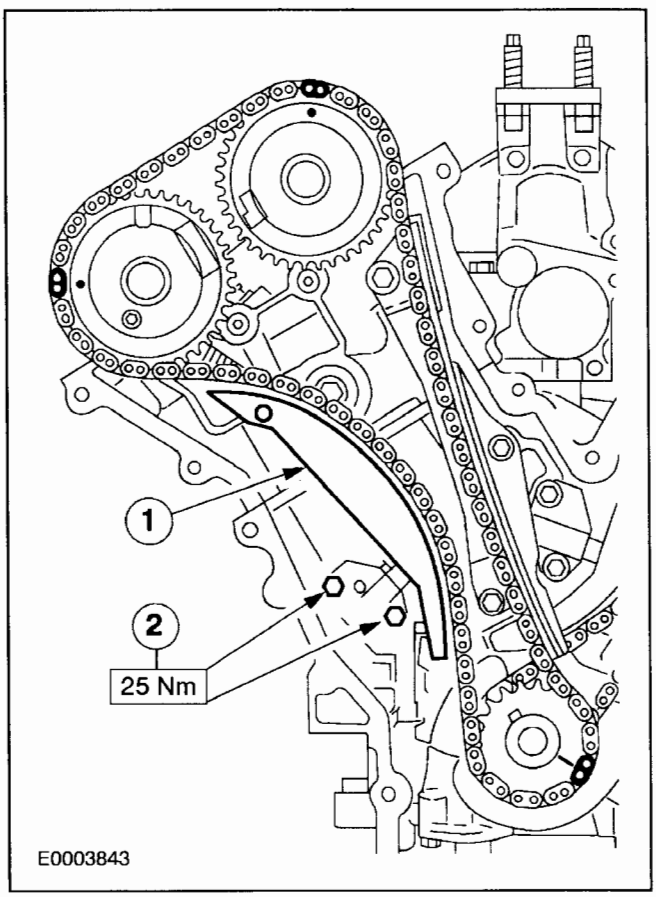
43. **NOTE:** The piston should retract with minimal force. If binding occurs, reposition the tensioner to eliminate side loading.

    Slowly compress the right-hand timing chain tensioner.



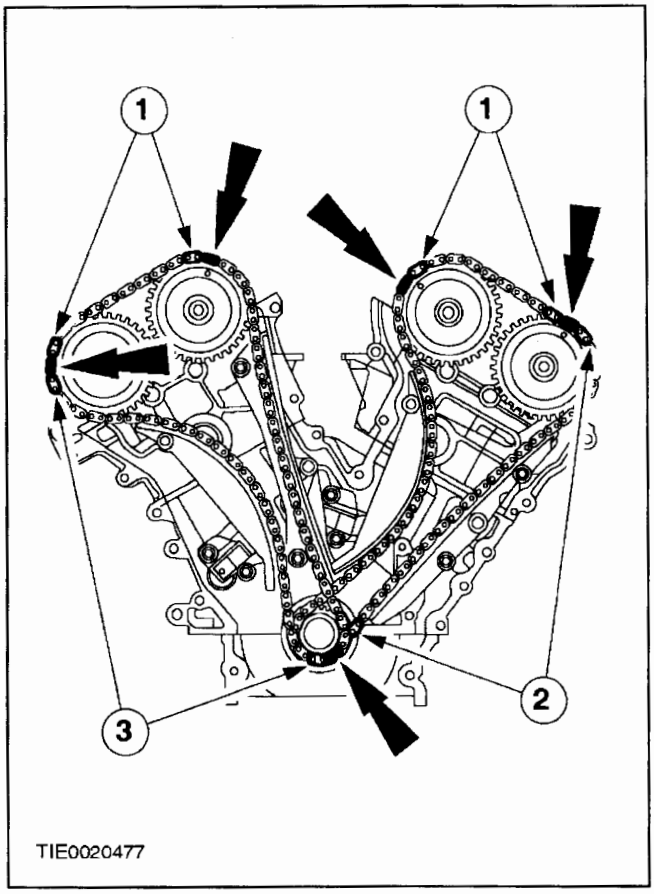
44. **NOTE:** The wire must remain in the timing chain tensioner until the tensioner is installed with the piston bottomed in the bore.

    Retain piston with a 1.5 mm wire or paper clip.



45. Install the right-hand timing chain tensioner.
    1. Install the tensioner arm (tan material).
    2. Install the tensioner adapter plate right-hand, the timing chain tensioner and bolts.

ASSEMBLY (Continued)



TIE0020477

46. **NOTE:** Ignore the timing flags on the rear of the camshaft sprockets.

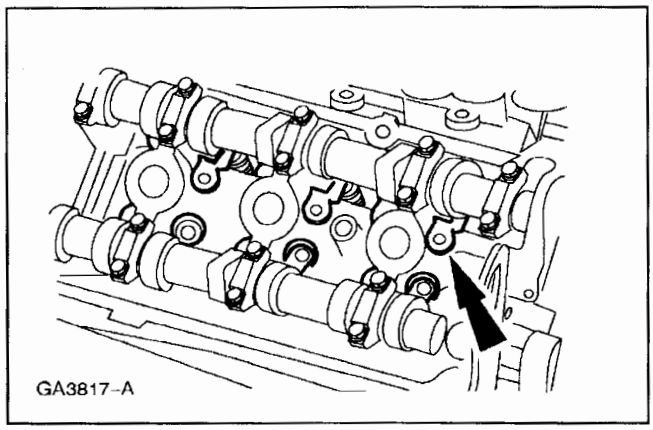
    NOTE: Check the number of timing chain links between the camshaft front timing marks and the timing marks on the crankshaft sprockets.

    Check the camshaft timing.

    1 10 links.

    2 23 links.

    3 25 links.


GA3817-A

47. ⚠ **CAUTION: The crankshaft keyway must be in the 11 o'clock position before installation of the left-hand cylinder head roller finger followers.**

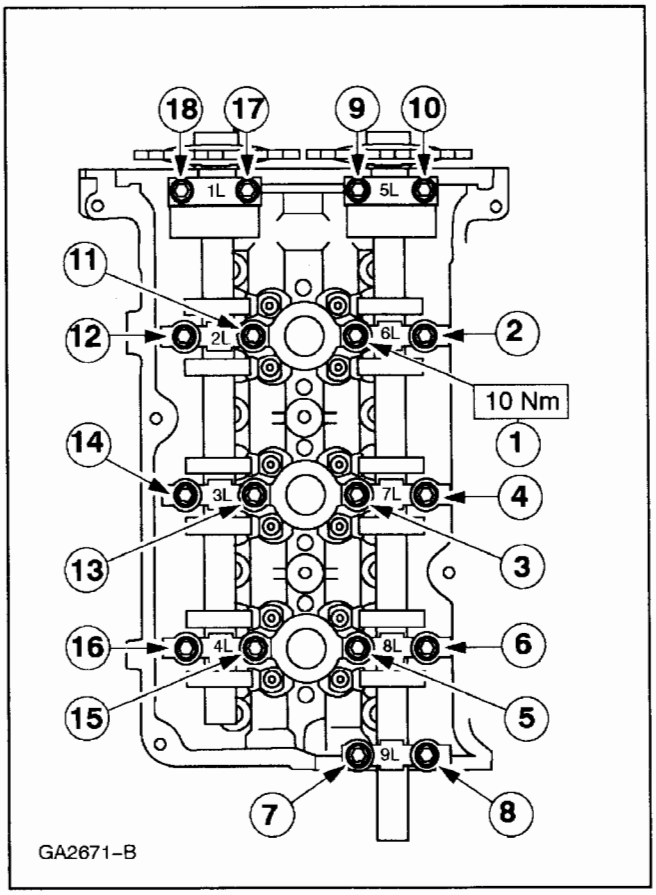
    NOTE: Check that all the timing marks and reference flags are in the correct position before installing the roller finger followers.

    NOTE: Lash adjusters and roller finger followers must be installed in their original positions.

    Install the left-hand lash adjusters and roller finger followers.

    - Lubricate the roller finger followers with clean engine oil.

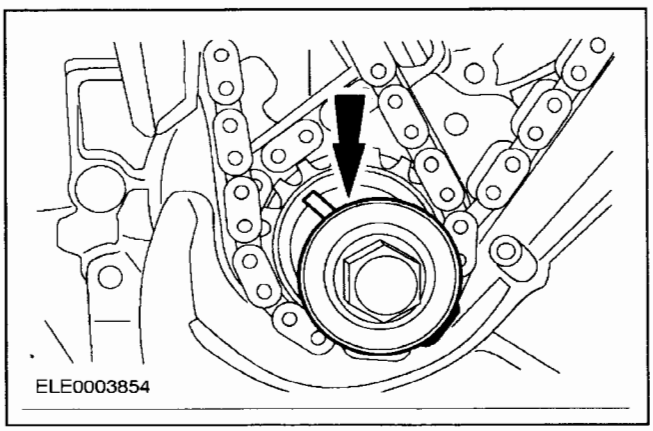
ASSEMBLY (Continued)



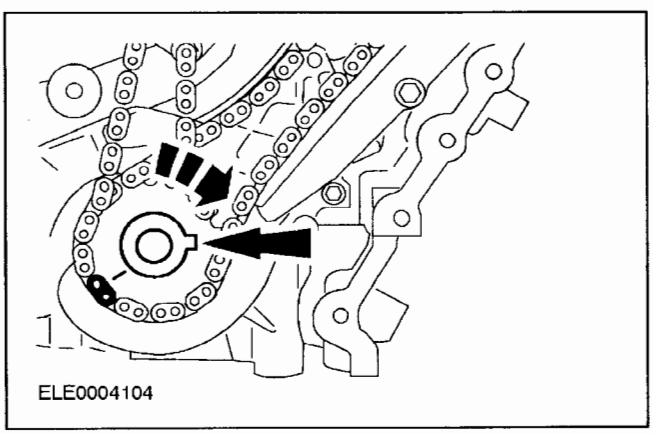
48. ⚠ **CAUTION: Do not install the left-hand cylinder head camshaft journal thrust caps until the camshaft journal caps are installed or damage to the thrust caps may occur.**

NOTE: With left-hand cylinder head roller finger followers installed, align camshaft end play using thrust caps as a guide before tightening the journal caps.

Tighten the left-hand camshaft cap bolts in the indicated sequence in several passes.



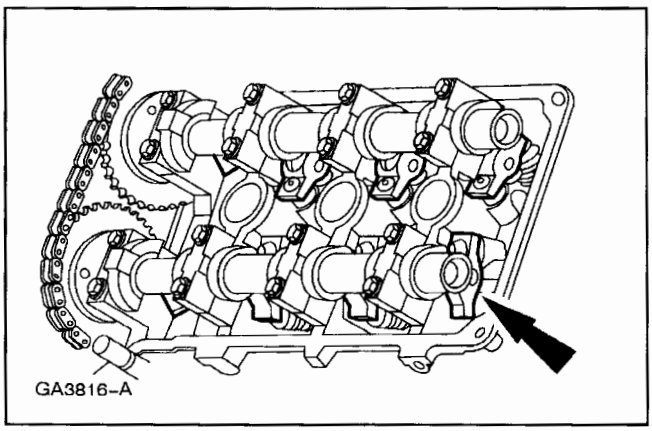
49. Remove the crankshaft pulley, washer and bolt.



50. ⚠ **CAUTION: Rotating the crankshaft counterclockwise may cause the timing chains to bind and may cause engine damage.**

Rotate the engine clockwise to locate the crankshaft keyway to the 3 o'clock position.

ASSEMBLY (Continued)

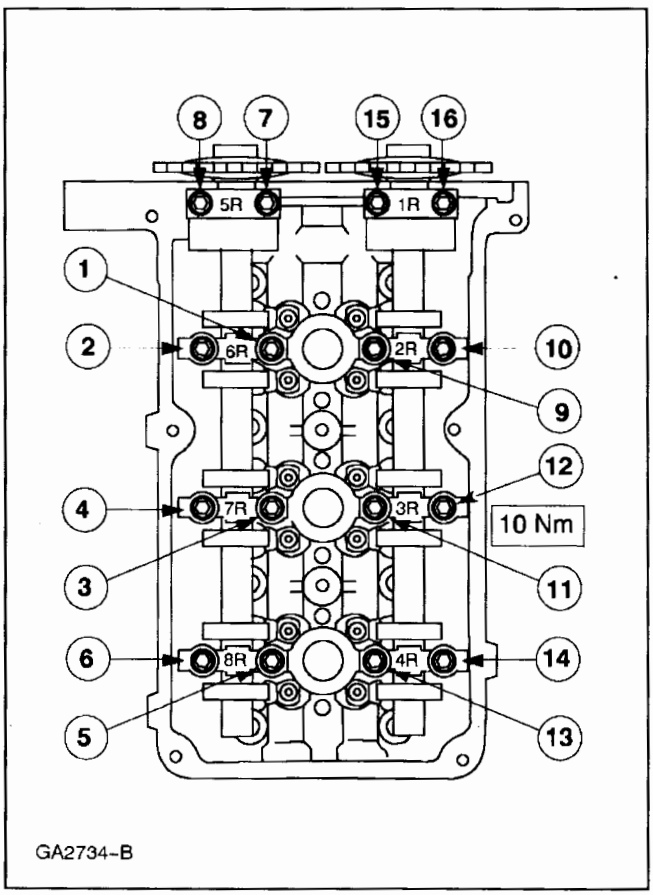

GA3816-A

51. ⚠ **CAUTION: The crankshaft keyway must be in the 3 o'clock position before installation of the right-hand cylinder head roller finger followers. Failure to do so may lead to engine damage.**

    NOTE: Roller finger followers must be installed in their original locations.

    Install the right-hand roller finger followers.

    - Lubricate the roller finger followers with clean engine oil.

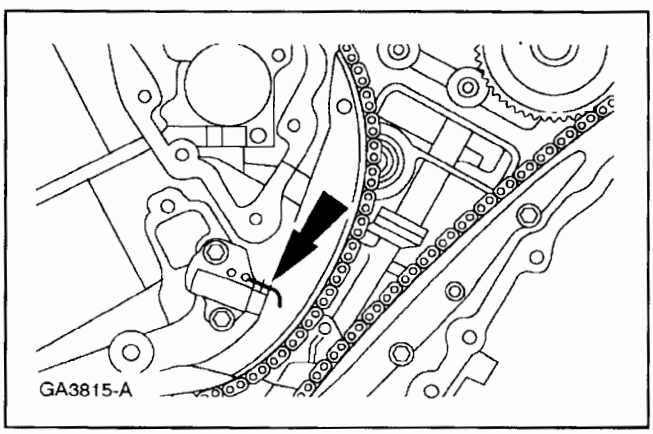


GA2734-B

52. ⚠ **CAUTION: Do not install the right-hand cylinder head camshaft journal thrust caps until the camshaft journal caps are installed, or damage to the thrust caps may occur.**

    NOTE: With right-hand cylinder head roller finger followers installed, align camshaft end play using the thrust caps as a guide before tightening journal caps.

    Tighten the right-hand camshaft cap bolts in the indicated sequence in several passes.

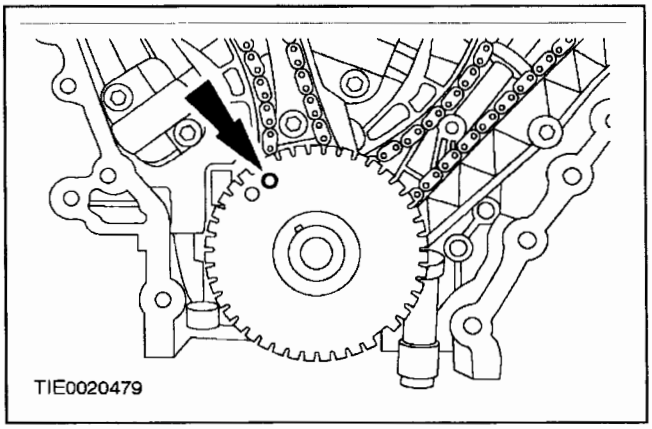

GA3815-A

53. **NOTE:** Left-hand shown, right-hand similar.

    Remove the right-hand and left-hand chain tensioner retaining wires.

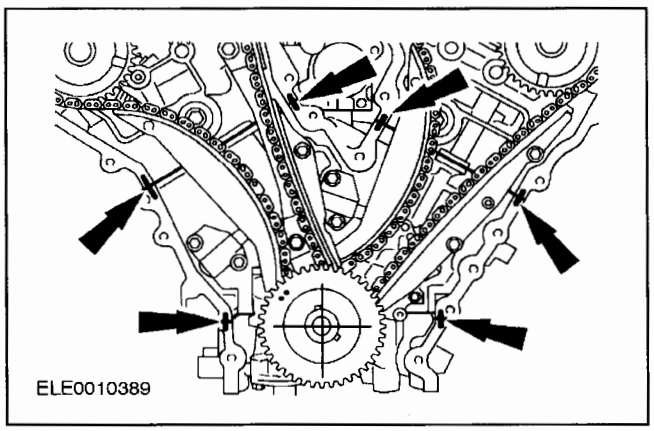
ASSEMBLY (Continued)

54. Remove the crankshaft pulley bolt and washer.



55. ⚠ **CAUTION: This pulse wheel has two keyway slots and is used in several different engines.**

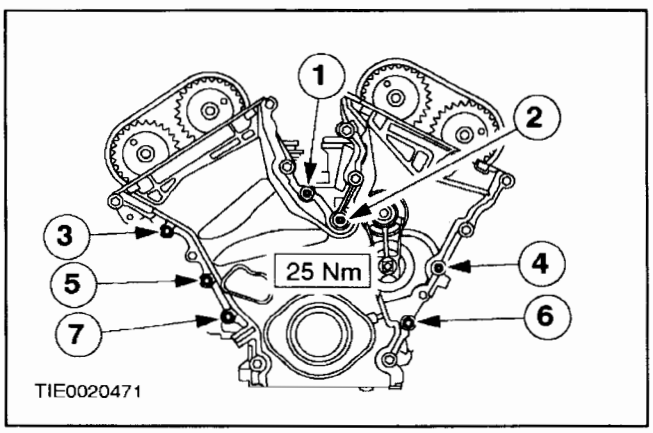
    Install the pulse wheel in the keyway slot stamped 25, color coded blue.



56. **NOTE:** Install the engine front cover within six minutes of applying the silicone gasket and sealant.

    Apply a 6 mm dot of silicone gasket and sealant to the mating faces.

    - Clean the front cover to cylinder block and cylinder head sealing surfaces with metal surface cleaner.

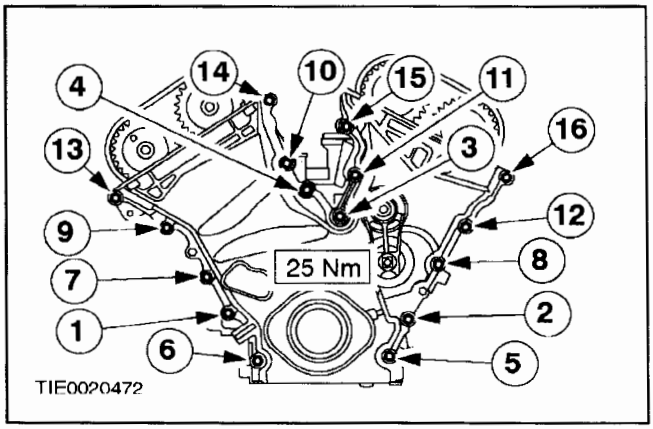


57. **NOTE:** The engine front cover must be installed in a two-step sequence.

    Install the engine front cover.

    - Use new gaskets in the engine front cover.
    - Note locating dowels and the locations of the studs.
    - Install the bolts and studs in the indicated sequence and tighten in two steps.
    - Tighten the bolts and studs one-quarter turn (90 degrees) after engine front cover contacts cylinder block and cylinder heads.

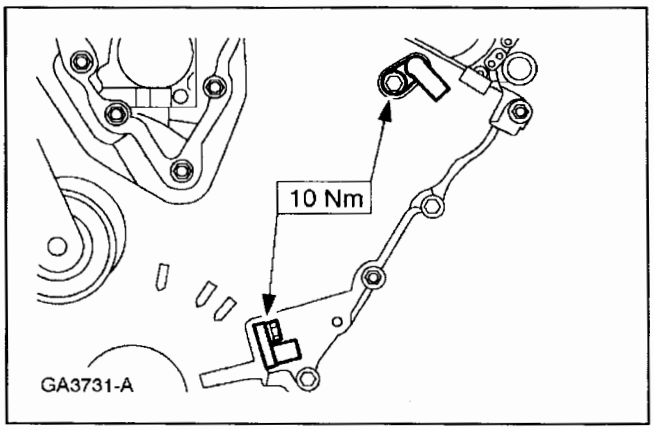
ASSEMBLY (Continued)



58. **NOTE:** Tighten the bolts and studs in the indicated sequence.

    NOTE: 3, 4, 8, 10, 11, 14, 15,16 are stud locations.

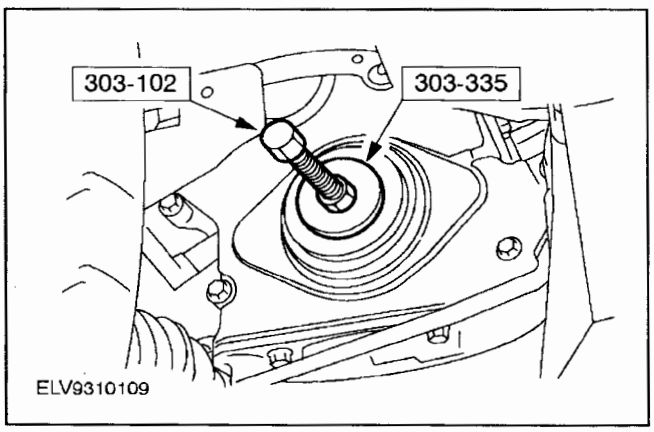
    Install the remaining engine front cover bolts and studs.



59. **NOTE:** Lightly lubricate the new O-ring seals with clean engine oil before installation.

    Install the sensors and wiring brackets.

    - Install the CKP sensor.
    - Install the CMP sensor.



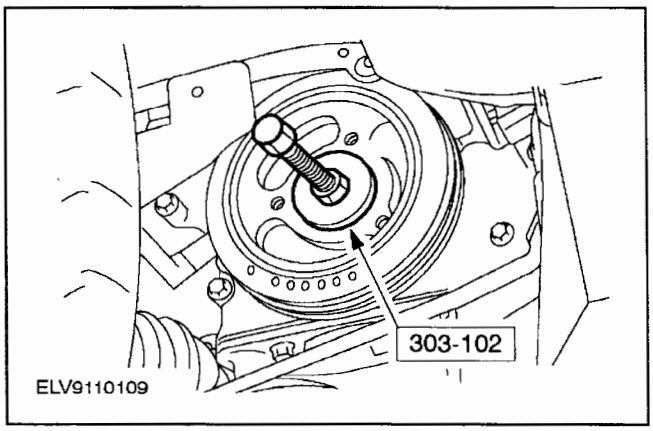
60. Using the special tools, install the crankshaft front oil seal.

    - Lubricate the outer ring and sealing lip with engine oil.

61. Apply silicone gasket and sealant to the front of the crankshaft on the inside diameter surface of the crankshaft pulley at the keyway.

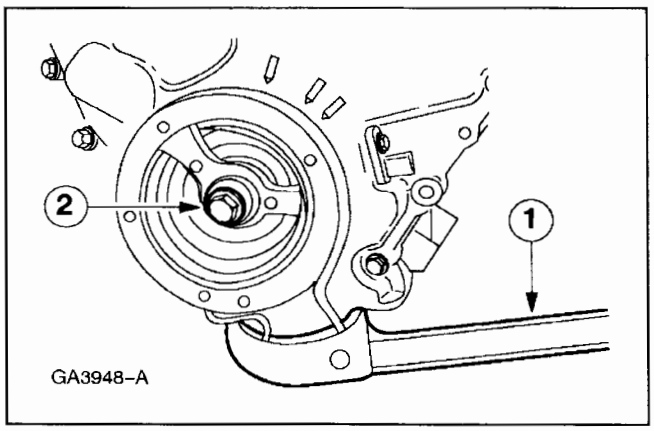
    - Before applying the silicone gasket and sealant, clean the sealing surfaces with metal surface cleaner to remove all residues that may interfere with the silicone gasket and sealant ability to adhere.

ASSEMBLY (Continued)



62. **NOTE:** Use the crankshaft pulley bolt washer for installation.

    Using the special tool, install the crankshaft pulley.



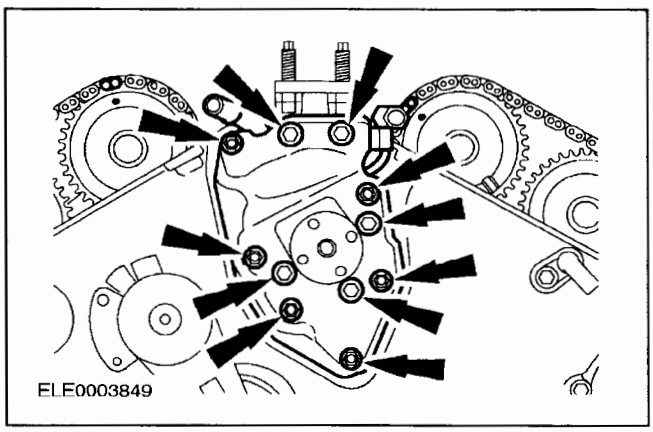
63. **NOTE:** Use a new bolt.

    Install the crankshaft pulley.

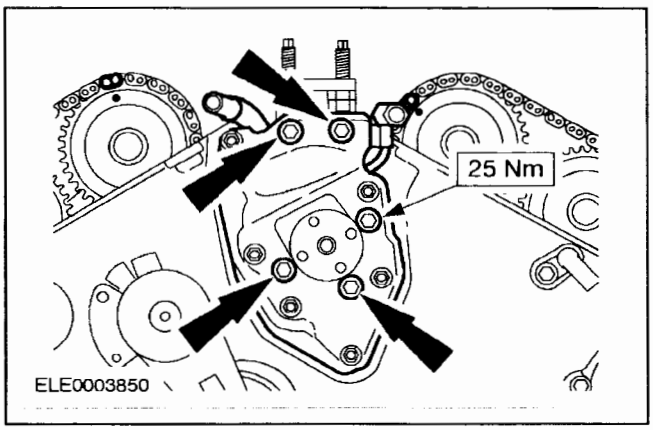
    1 Use a suitable strap wrench to hold the crankshaft pulley.

    2 Tighten the crankshaft pulley bolt in four stages.

    - Stage 1: 120 Nm
    - Stage 2: Back off bolt one full turn
    - Stage 3: 50 Nm
    - Stage 4: 90 degrees



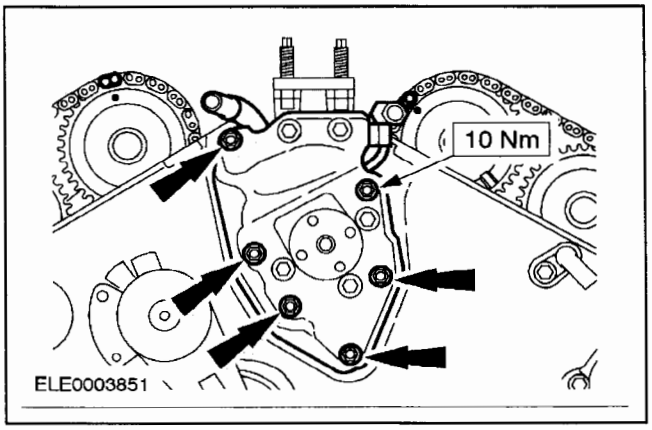
64. Install the power steering pump and bracket.
    - Loosely install all bolts and studs.



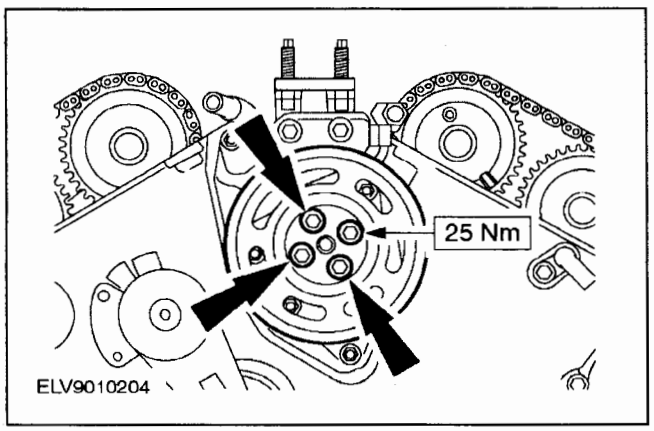
65. **NOTE:** The longer 84 mm bolts should be tightened first.

    Tighten the power steering pump bolts.

ASSEMBLY (Continued)



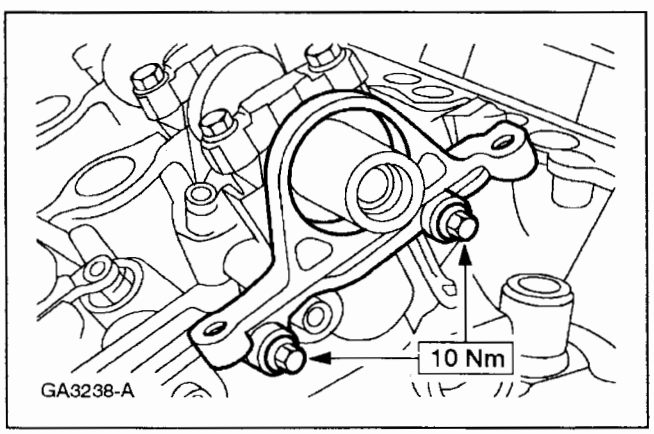
66. Tighten the power steering pump stud nuts.



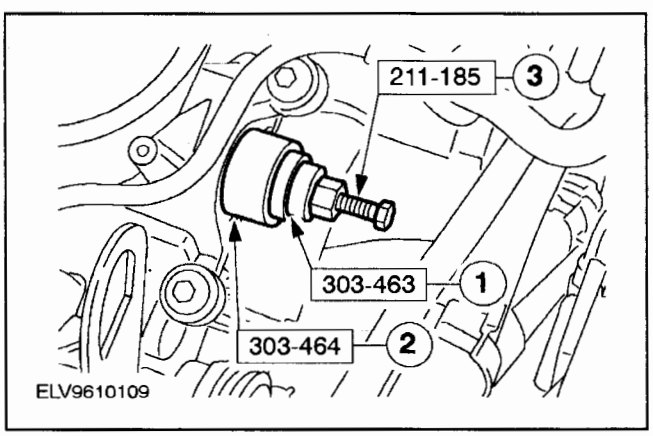
67. ⚠ **CAUTION: Tightening the pulley with the dimple facing the power steering pump, will bend the pulley.**

NOTE: The dimple on the pulley must face toward the front of the engine.

Install the power steering pump belt pulley.



68. Install the camshaft oil seal retainer.
    - Use a new gasket and align the retainer on the locating dowels.



69. ⚠ **CAUTION: The running surface of the camshaft must not be damaged.**

NOTE: Lubricate the camshaft oil seal with engine oil.

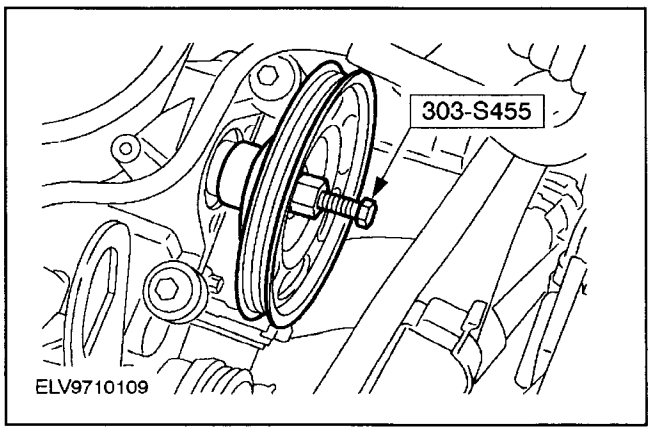
Using the special tools, install the camshaft oil seal.

1 Install the special tool.

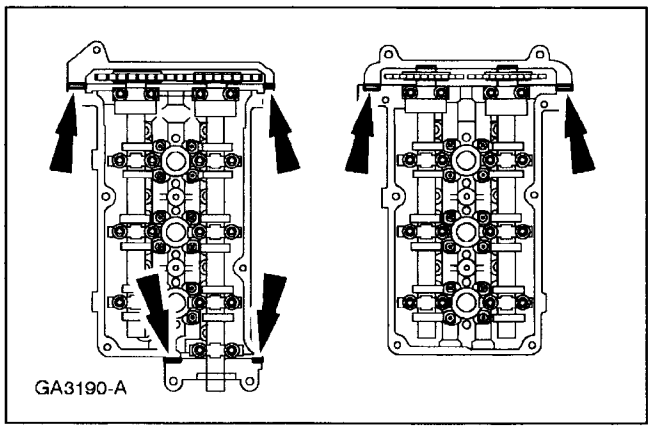
2 Position a new camshaft oil seal and the special tool.

3 Install the special tool and install the camshaft oil seal.

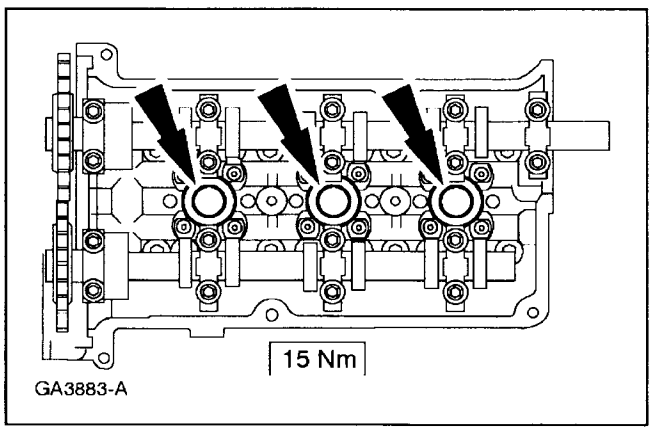
ASSEMBLY (Continued)



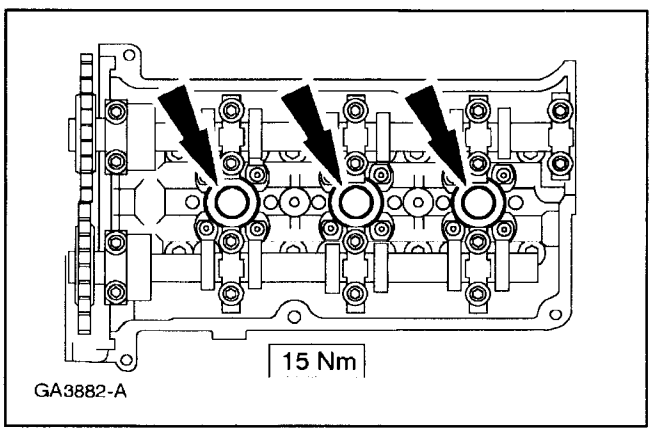
70. Using the special tool, install the water pump drive pulley.



71. Coat the mating faces of the cylinder heads with silicone gasket and sealant.

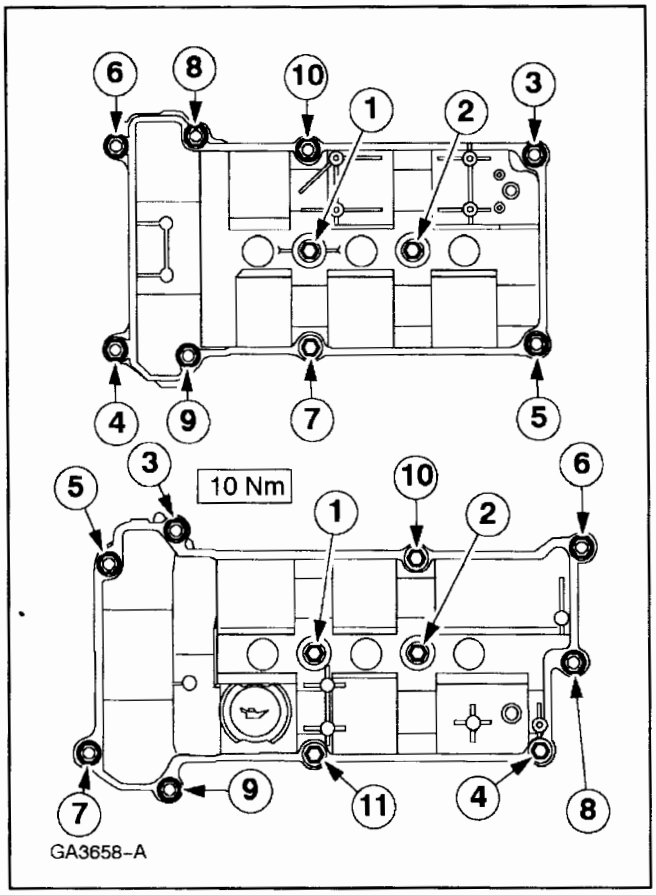


72. Install the left-hand spark plugs.

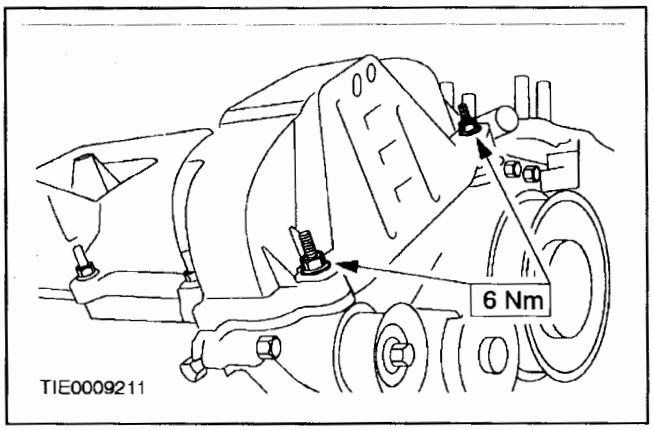


73. Install the right-hand spark plugs.

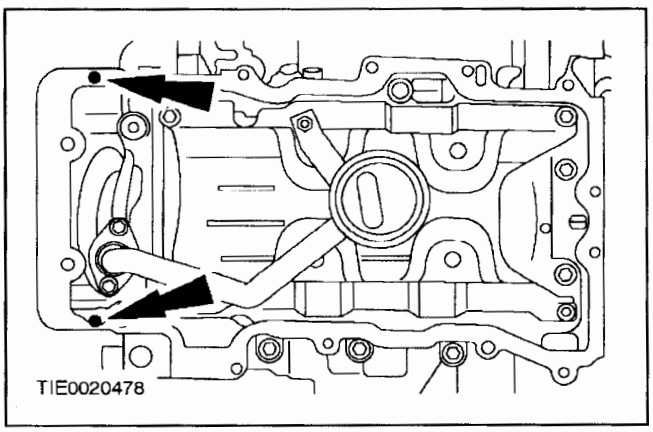
ASSEMBLY (Continued)



74. **NOTE:** Install the bolts in the indicated sequence.
    Install the cylinder head covers.
    - Use new gaskets.

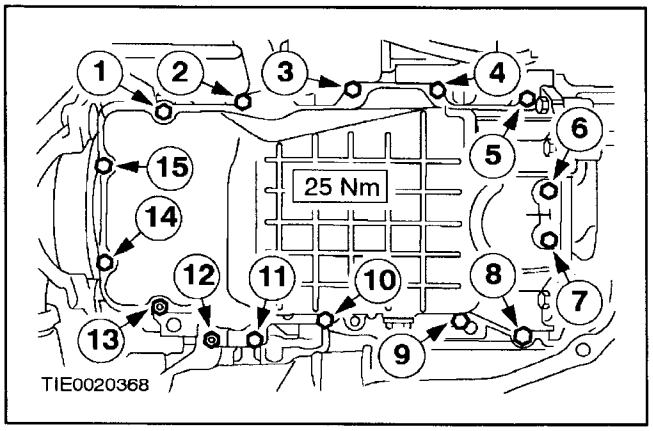


75. Install the fuel charging wiring bracket to the cylinder head cover.



76. Coat the mating faces with silicone gasket and sealant.
    - Apply a 10 mm diameter dot of silicone gasket and sealant onto the cylinder block at the indicated areas.

ASSEMBLY (Continued)



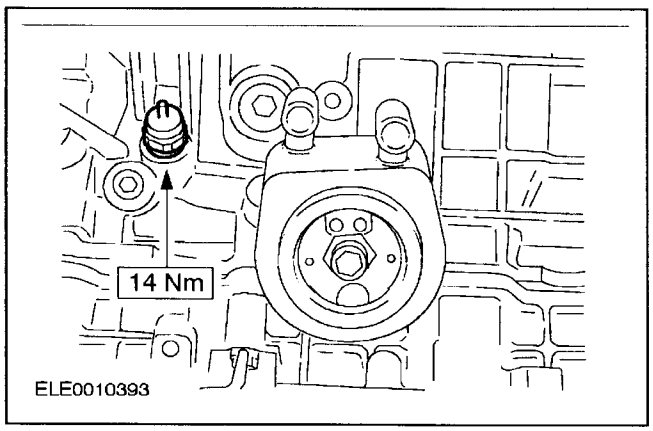
77. **NOTE:** Note the locations of the studs.

    NOTE: Install the oil pan and tighten the bolts within six minutes of applying silicone gasket and sealant.

    NOTE: Install the oil pan and tighten the bolts within six minutes of applying sealant.

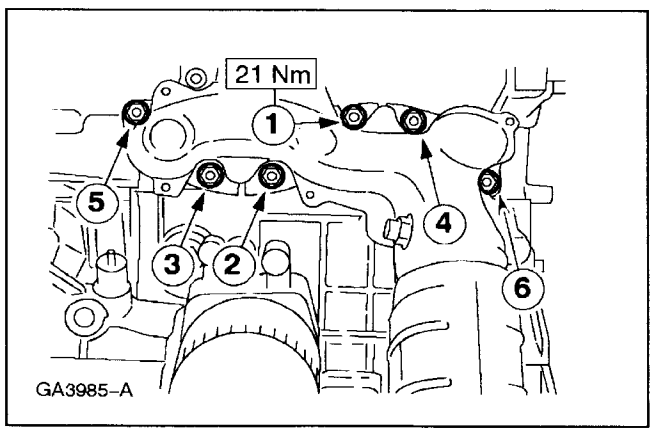
    Install the oil pan.

    - Use a new gasket.



78. **NOTE:** High output engine shown. Base engine does not have an oil cooler.

    Install the oil pressure switch.

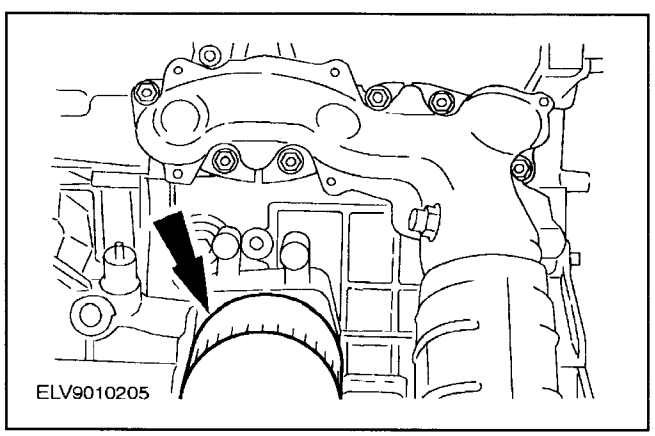


79. **NOTE:** If studs were removed, install short end of studs into the cylinder head.

    NOTE: Install the nuts in the indicated sequence.

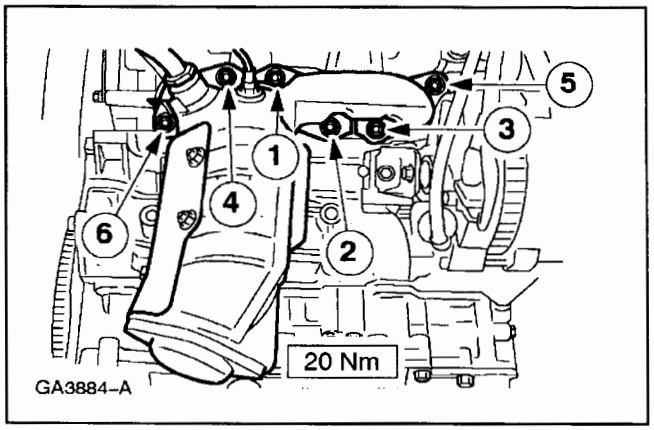
    Install the left-hand exhaust manifold with the catalytic converter.

    - Use a new gasket.

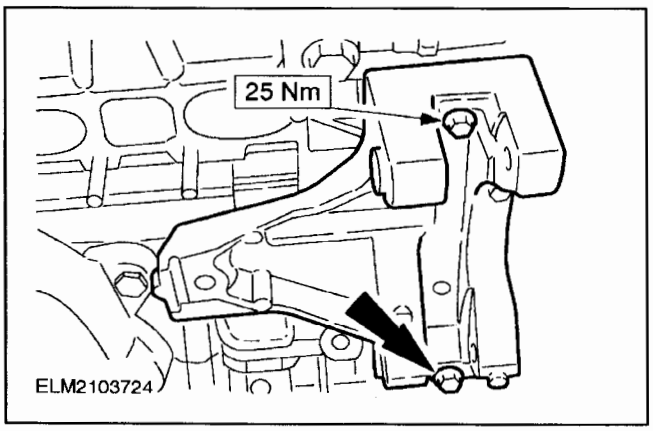


80. Install the oil filter.

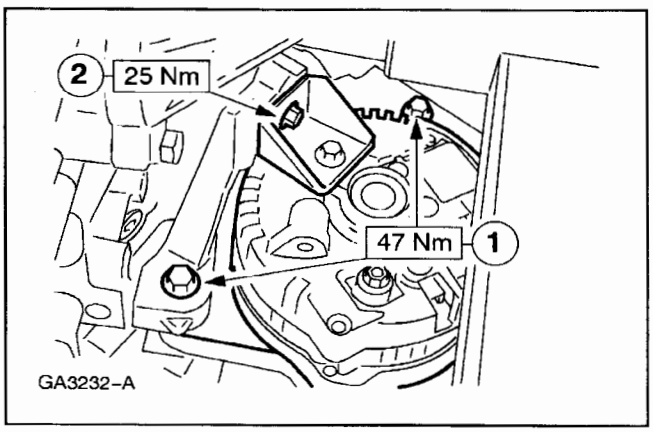
ASSEMBLY (Continued)



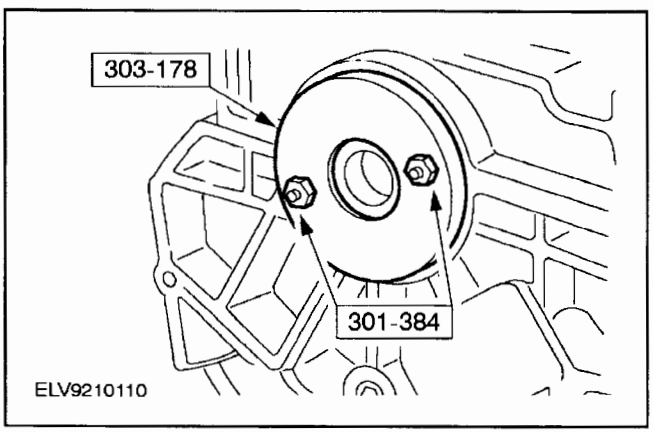
81. Position the right-hand exhaust manifold and install the nuts in the indicated sequence.



82. Install the generator bracket.



83. Install the generator.
    1 Install the generator bolts.
    2 Install the bracket bolt.

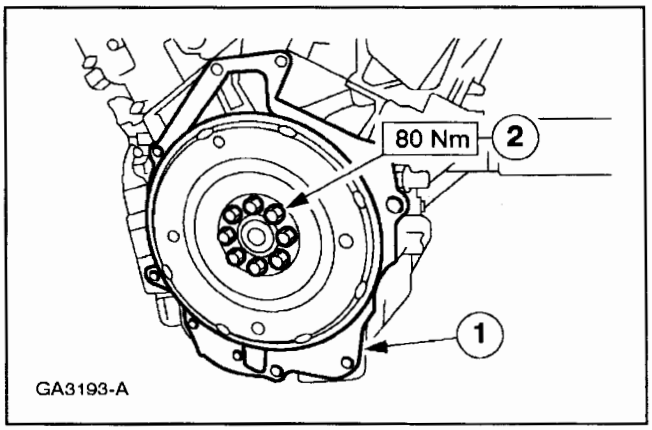


84. **NOTE:** Alternate bolt tightening to correctly seat the crankshaft rear oil seal until it is flush with the cylinder block.

    Using the special tools, install the crankshaft rear oil seal.

    - Lubricate the outer ring and sealing lip with engine oil.

ASSEMBLY (Continued)

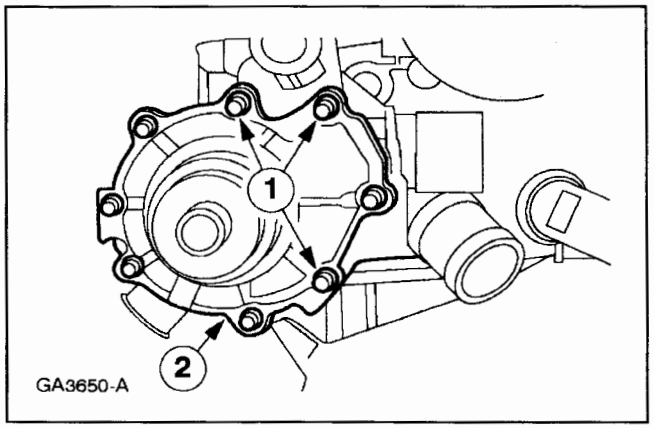


85. **NOTE:** Use a suitable strap wrench to hold the crankshaft pulley.

    Install the flywheel.

    1 Install the backing plate.

    2 Install the flywheel and tighten the bolts working diagonally.

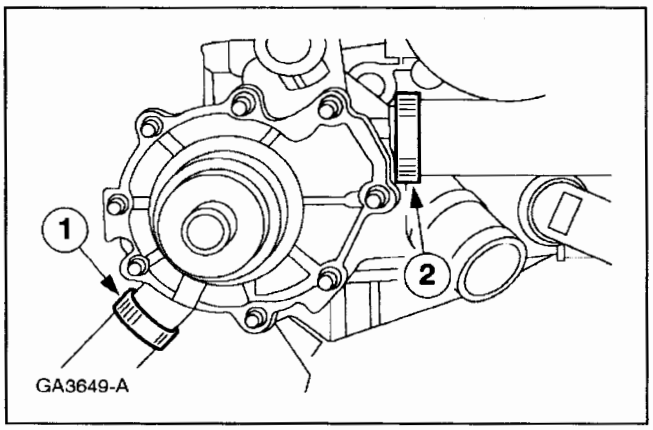


86. Install the water pump.

    1 Position the water pump.

    2 Install new bolts and tighten them in two stages.

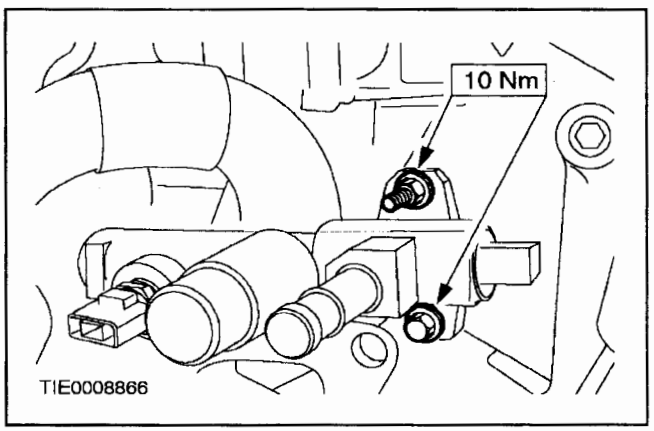
    - Stage 1: 10 Nm
    - Stage 2: 90 degrees



87. Connect the water pump coolant hoses.

    1 Connect the coolant hose to the oil filter adapter.

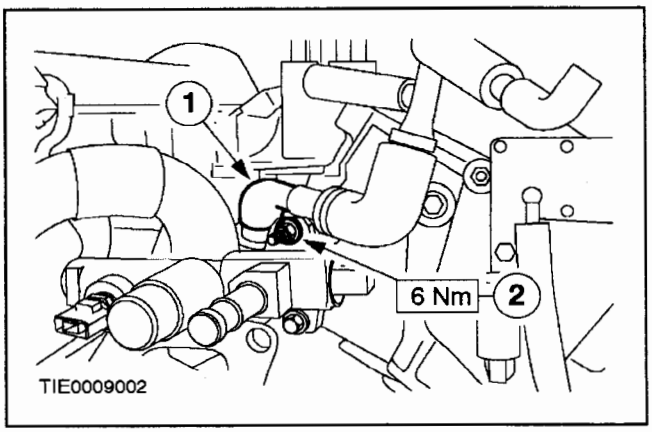
    2 Connect the coolant hose to the cylinder block.



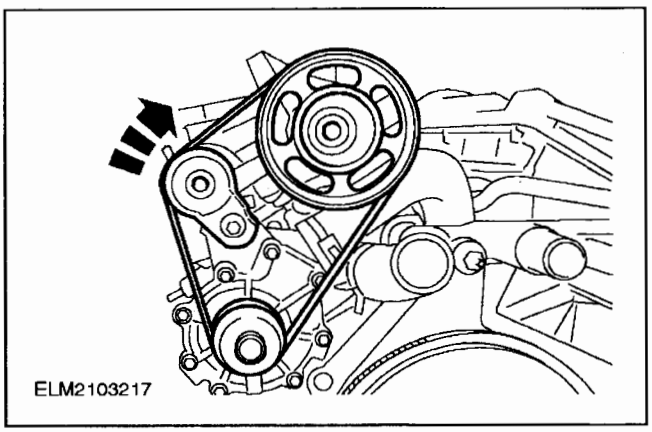
88. Install the water bypass.

    - Use new O-ring seals and lubricate them with coolant.

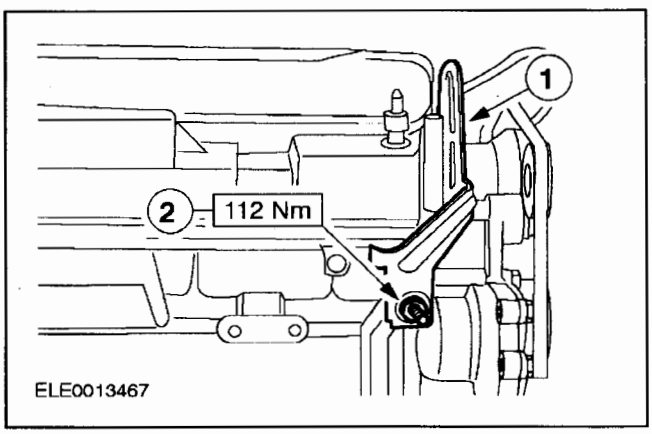
ASSEMBLY (Continued)



89. Install the positive crankcase ventilation valve and hoses.
    1 Connect the positive crankcase ventilation valve and hoses.
    2 Install the bracket nut.

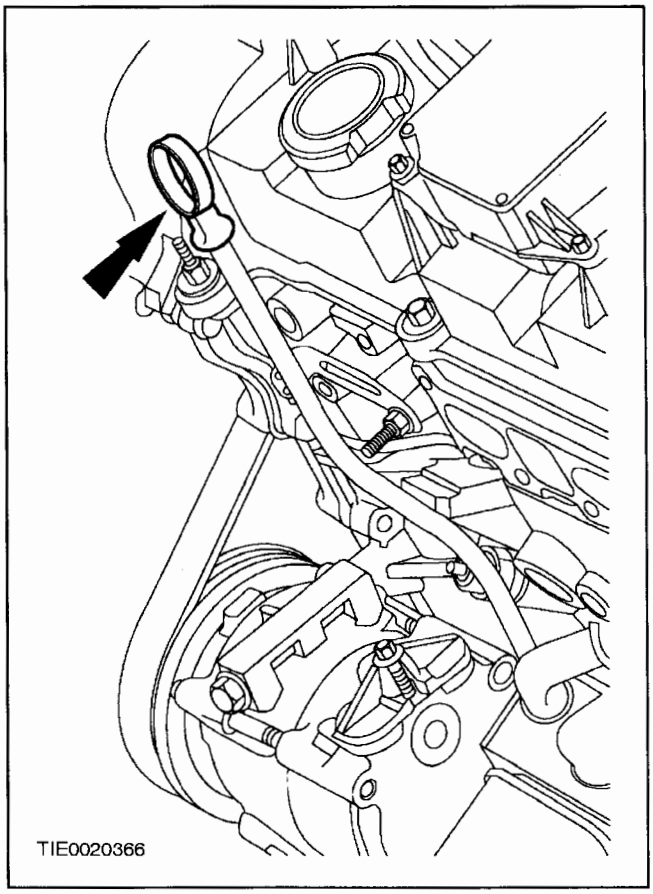


90. Install the water pump drive belt.
    - Rotate the belt tensioner clockwise to relieve tension on the belt.



91. Install the left-hand engine lifting eye.
    1 Position the lifting eye.
    2 Install the bolt.

ASSEMBLY (Continued)

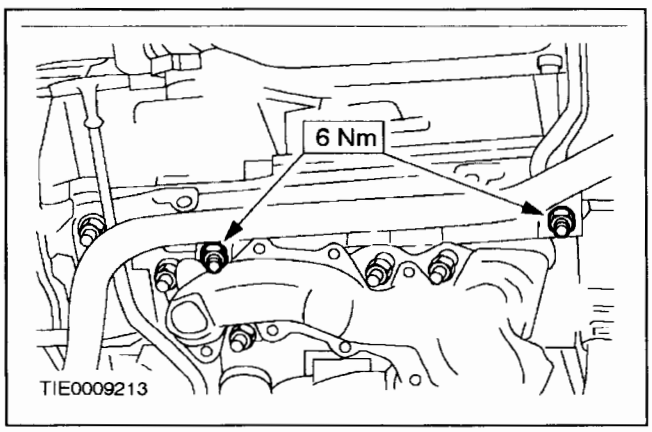


92. **NOTE:** Install the O-ring seal on the oil level indicator tube and lubricate with clean engine oil before installation.

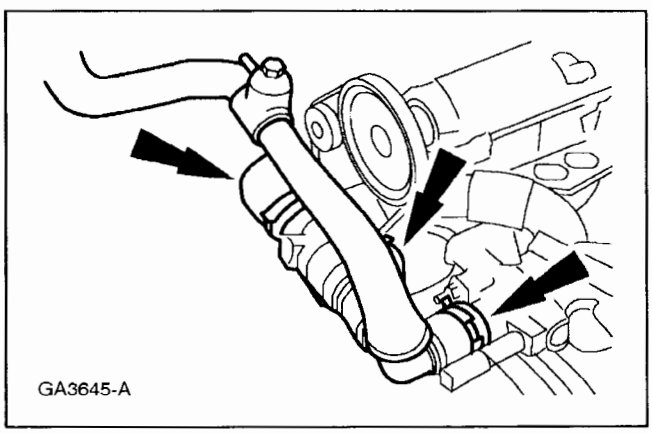
    Install the oil level indicator tube.

    1 Position the oil level indicator tube using a twisting motion.

    2 Install the oil level indicator tube bracket bolt.

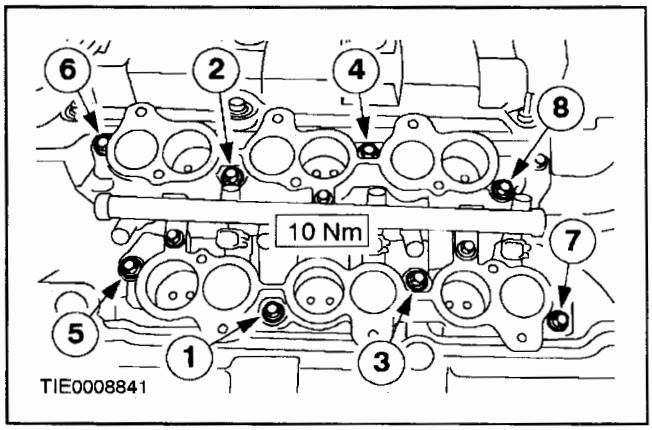


93. Install the coolant distribution tube.



94. Install the thermostat housing with the coolant hoses.

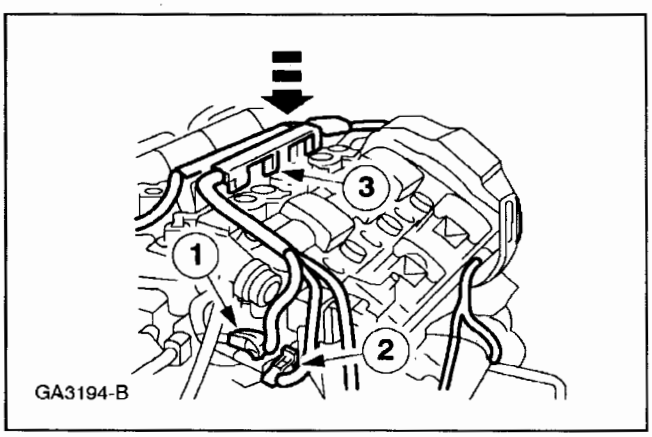
ASSEMBLY (Continued)



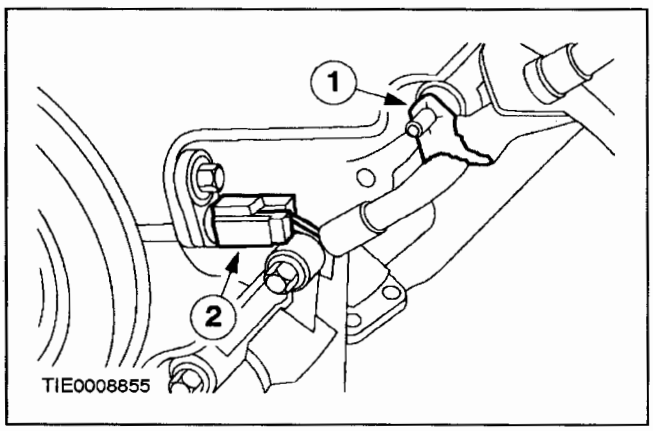
95. **NOTE:** Use new gaskets with the locating lugs facing downwards.

    NOTE: Install the bolts in the indicated sequence.

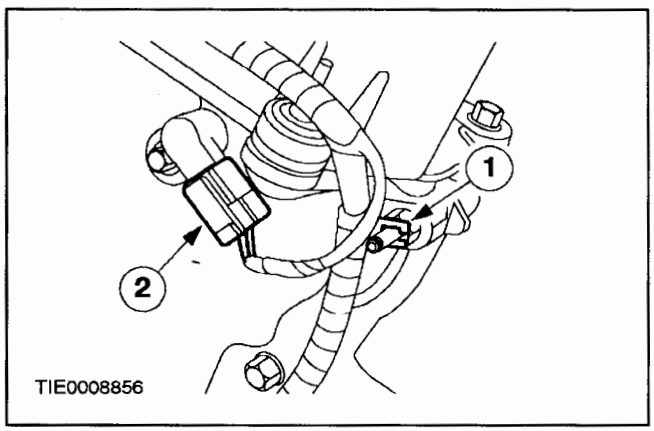
    Install the lower part of the intake manifold.



96. Install the fuel injection system wiring harness.
    1 Connect the fuel injector electrical connectors beginning at the front of the engine.
    2 Connect the ECT sensor electrical connector.
    3 Connect the DPFE sensor electrical connector.

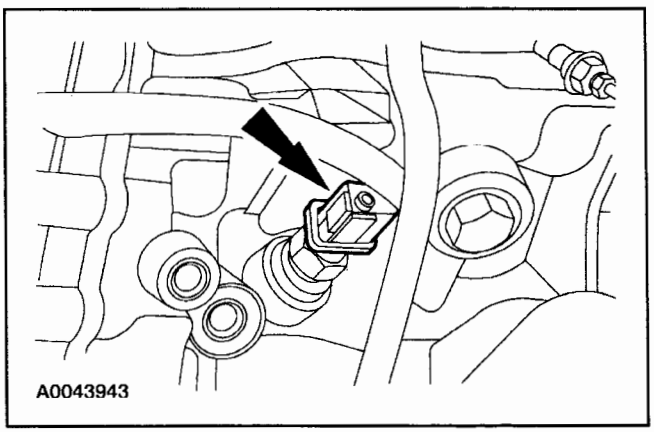


97. Connect the CKP sensor electrical connector.
    1 Attach the harness clip.
    2 Connect the CKP sensor electrical connector.

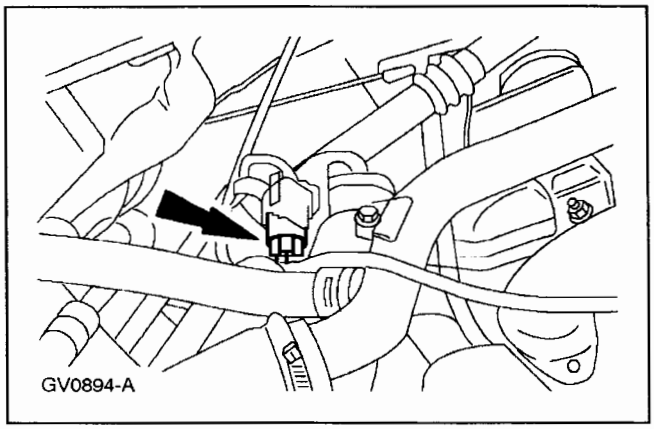


98. Connect the CMP sensor electrical connector.
    1 Attach the harness clip.
    2 Connect the CMP sensor electrical connector.

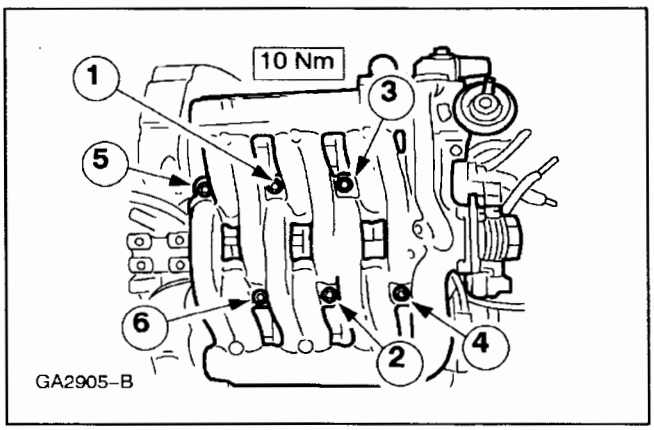
ASSEMBLY (Continued)



99. Connect the oil pressure switch electrical connector.



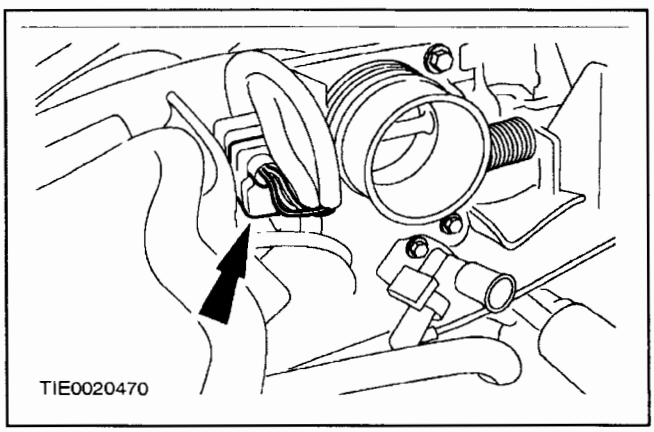
100. Connect the heated oxygen sensor (HO2S) electrical connector.



101. **NOTE:** Use new gaskets with the locating lugs pointing downwards.

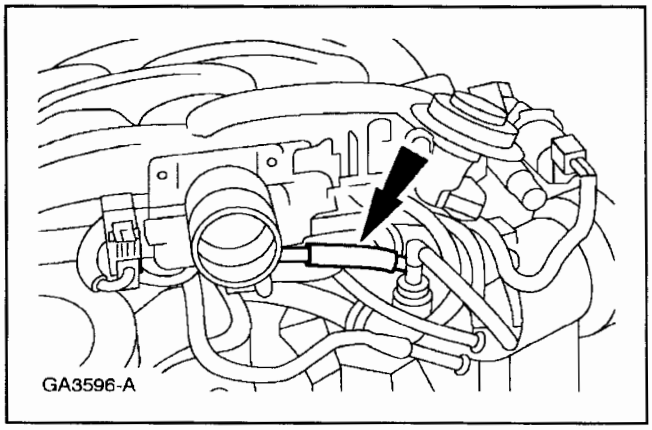
NOTE: Install the bolts in the indicated sequence.

Install the upper part of the intake manifold.

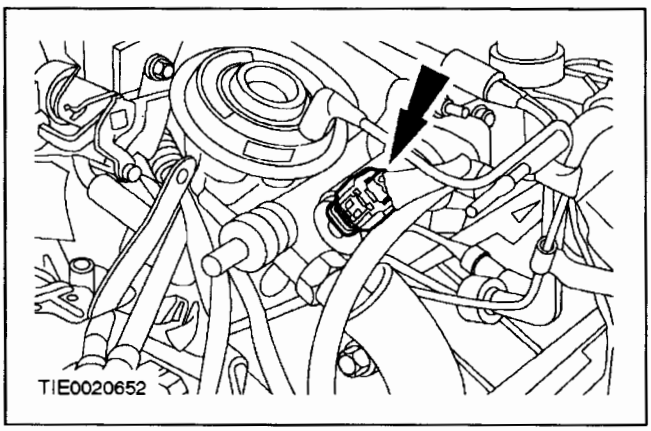


102. Connect the throttle position (TP) sensor and the fuel injector pressure sensor electrical connectors.

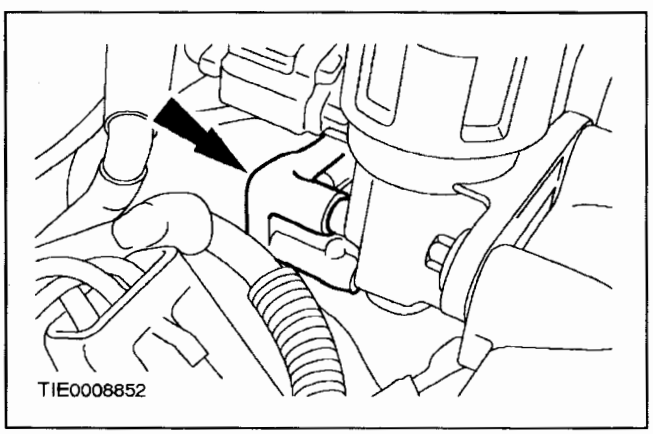
ASSEMBLY (Continued)



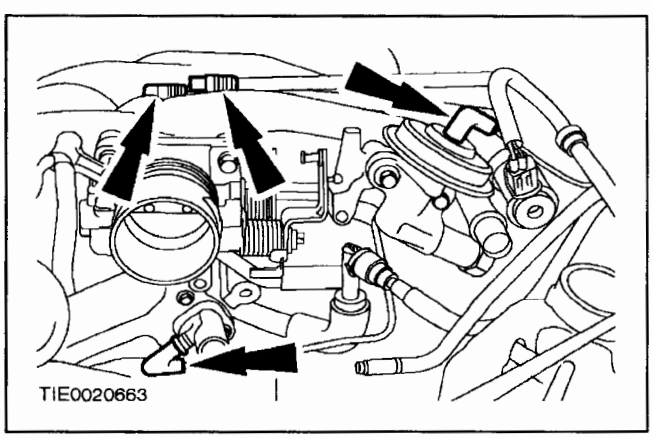
103. Connect the positive crankcase ventilation hose to the throttle body.



104. Connect the idle air control (IAC) valve electrical connector.

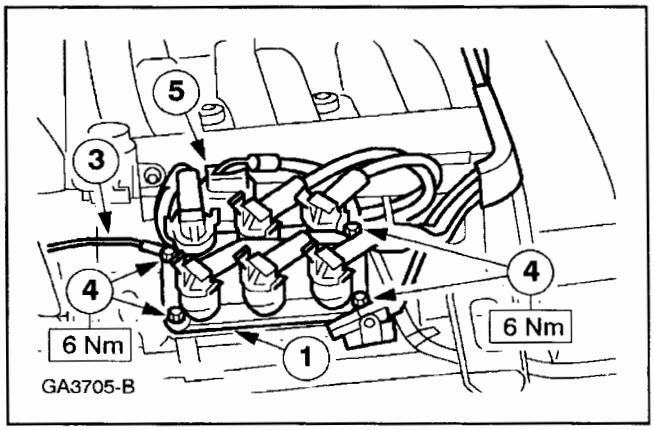


105. Position the vacuum harness and connect the vacuum lines.



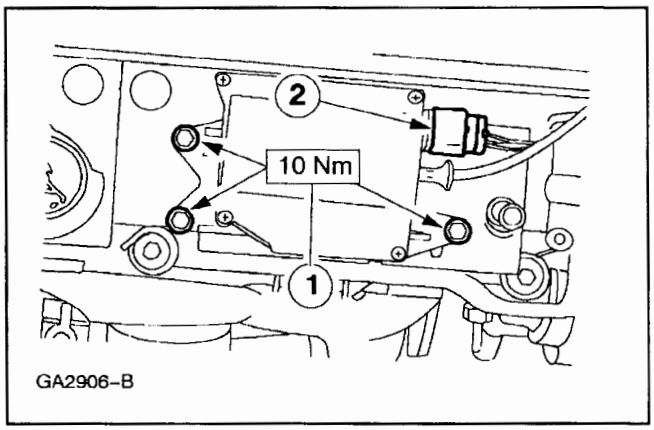
106. Connect the EGR valve and the intake manifold vacuum hoses.

ASSEMBLY (Continued)

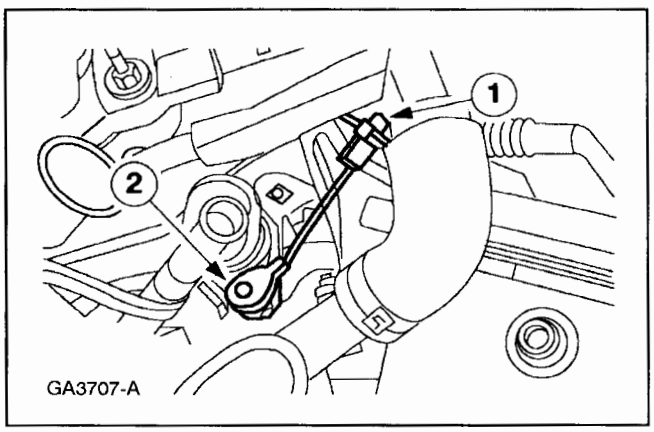


107. Install the ignition coil.
    1 Position the coil.
    2 Position the capacitor.
    3 Position the ground cable.
    4 Install the bolts.
    5 Connect the ignition coil electrical connector.

108. Connect the six spark plug wires to the spark plugs.



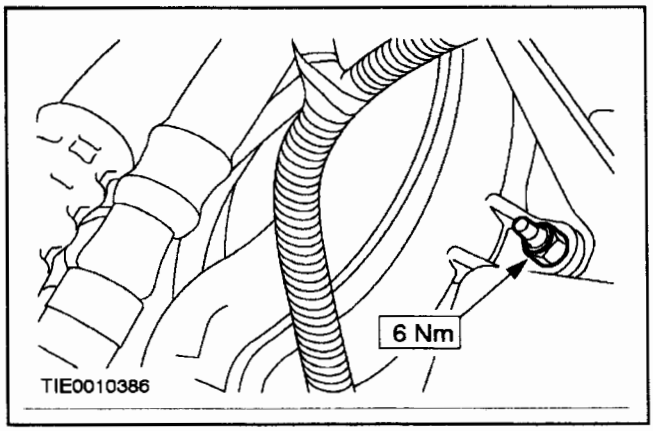
109. Install the IMRC control unit.
    1 Install the bolts.
    2 Connect the electrical connector.



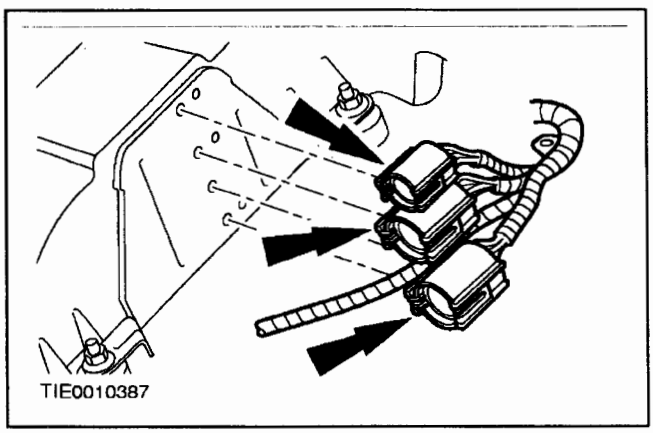
110. Connect the IMRC cable.
    1 Connect the cable to the retainer.
    2 Connect the cable end.

111. Position the wiring harness.

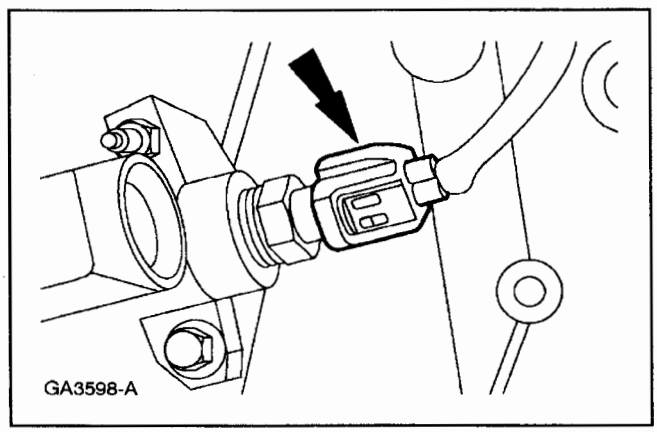
ASSEMBLY (Continued)



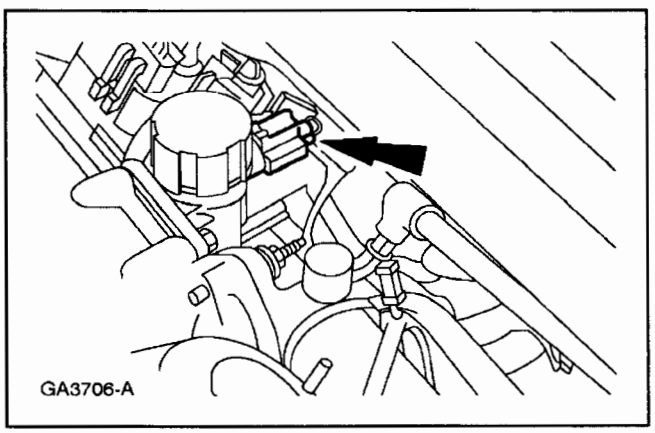
112. Attach the wiring harness to the right-hand valve cover and install two nuts.



113. Attach the in-line connectors to the bracket.

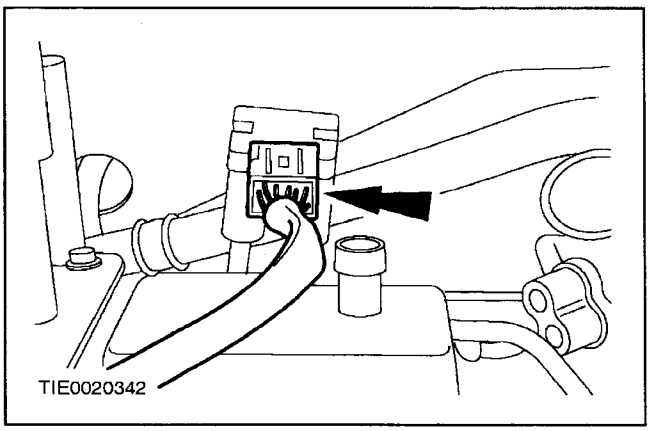


114. Connect the engine coolant temperature (ECT) sensor electrical connector.

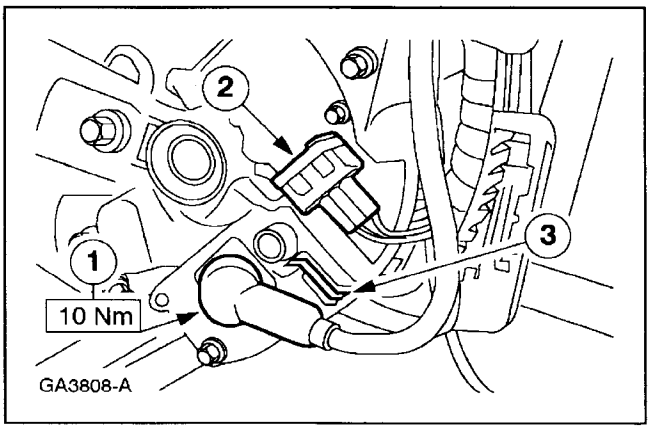


115. Connect the EGR vacuum regulator solenoid electrical connector.

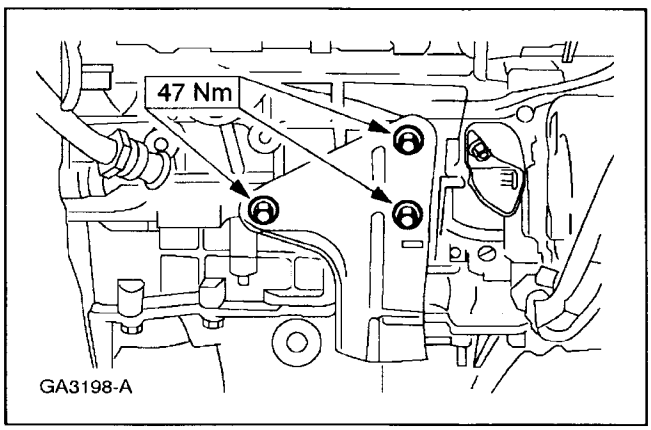
ASSEMBLY (Continued)



116. Connect the DPFE sensor electrical connector.



117. Connect the generator electrical connections.
    1 Install the battery positive cable.
    2 Install the voltage regulator electrical connector.
    3 Position the stator circuit electrical connector.

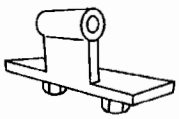
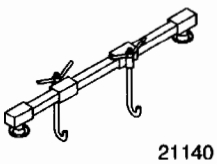
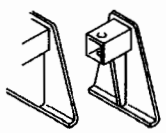


118. Install the connecting shaft bracket to the cylinder block.

INSTALLATION

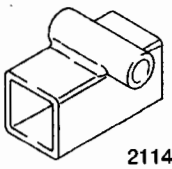
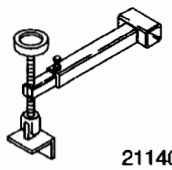
Engine — Vehicles with Manual Transaxle

Special Tool(s)

 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)
 21172	Gauge, Powertrain Alignment 502-003 (T94P-6000-AH)
 21140	Support Bar, Engine 303-290
 2114001	Adaptor for 303-290 303-290-01

(Continued)

Special Tool(s)

 2114002	Adaptor for 303-290 303-290-02
 2114003	Adaptor for 303-290 303-290-03

Materials

Item	Specification
Manual transmission fluid —	ESD-M2C186-A
High performance Super DOT 4 Brake Fluid —	ESD-M6C57-A
Engine oil WSS-M2C153-H	WSS-M2C153-H
Cable ties	
Two Rivets — 4 mm	

Installation

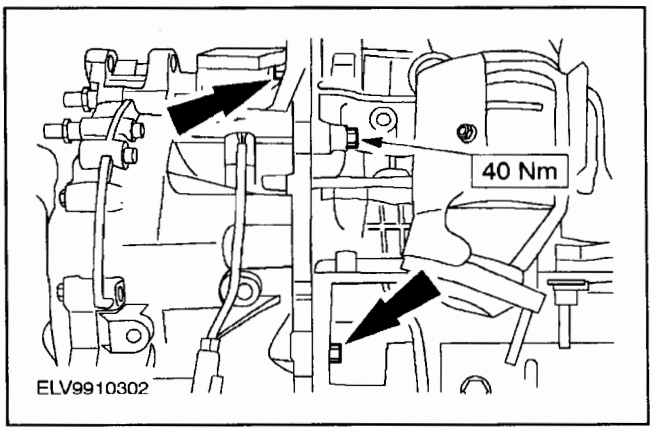
All vehicles

1. General instructions.
   - **NOTE:** The location of the support insulators are described looking from the transaxle to the engine.

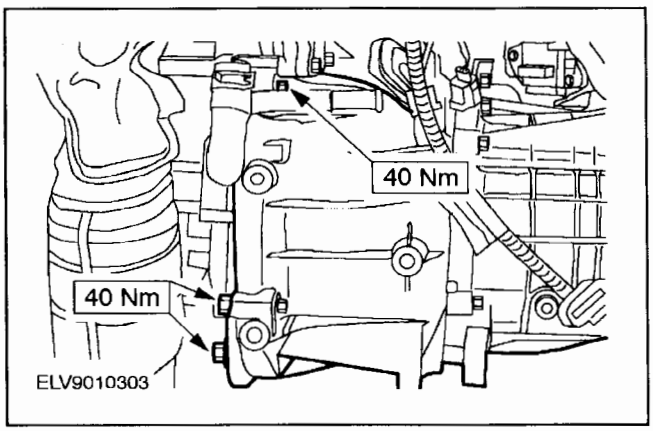
     New self-locking nuts must be installed.

2. Install the engine to the transaxle and screw in all flange bolts.

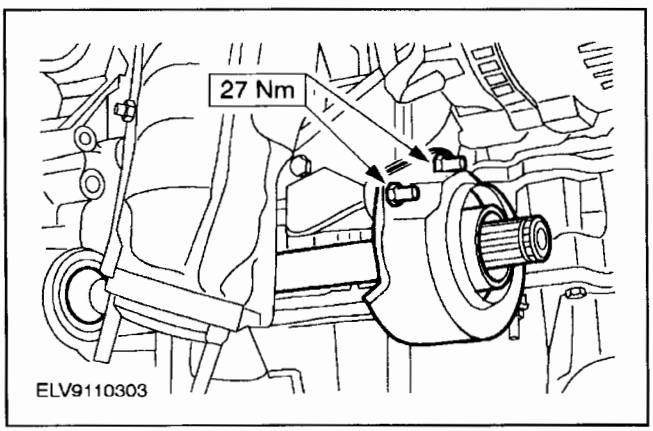
INSTALLATION (Continued)



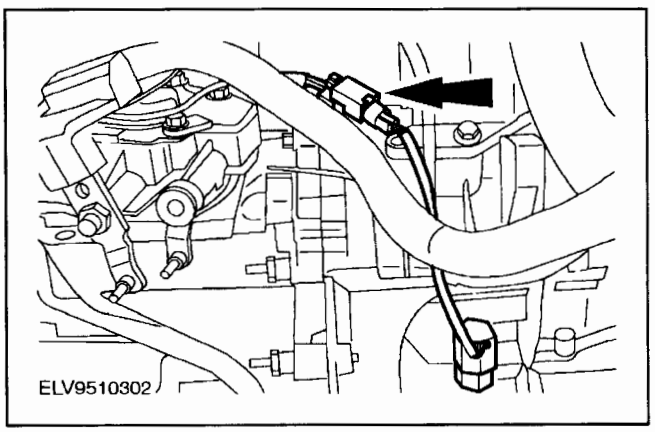
3. Install the transaxle flange bolts.



4. Install the transaxle flange bolts (continued).

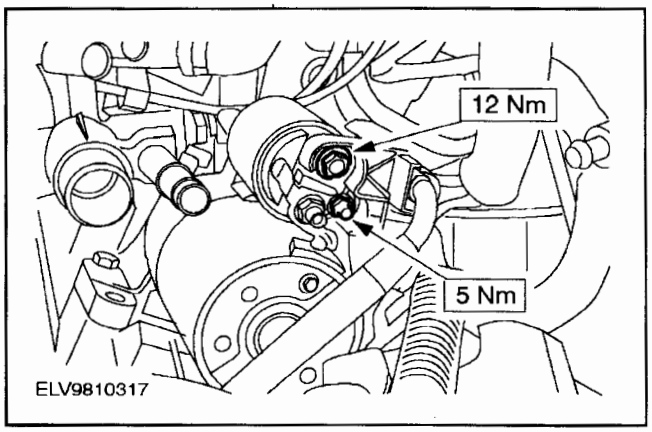


5. Install the intermediate shaft and the heat shield.

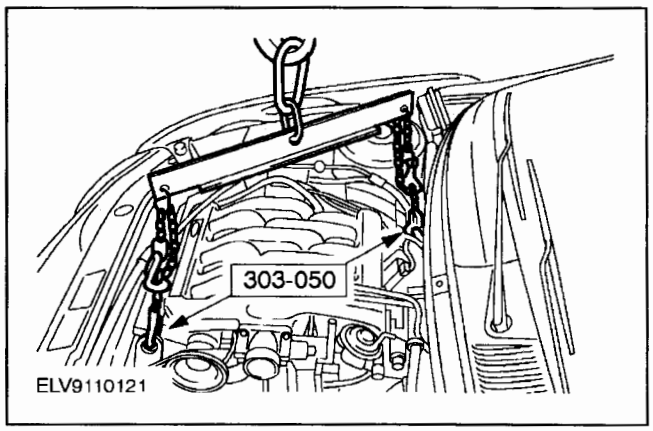


6. Connect the vehicle speed sensor (VSS) electrical connector.

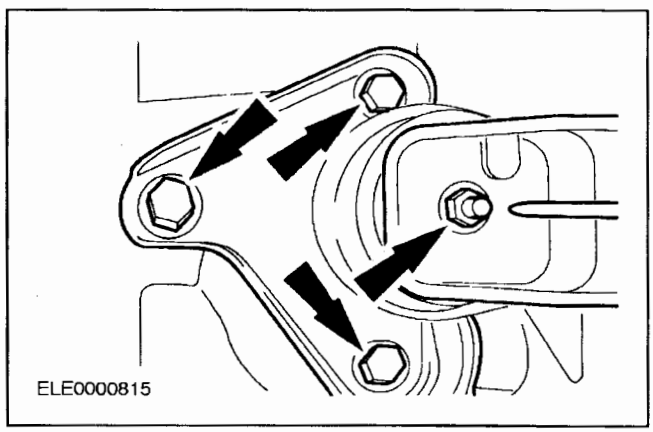
INSTALLATION (Continued)



7. Connect the starter motor electrical connections.

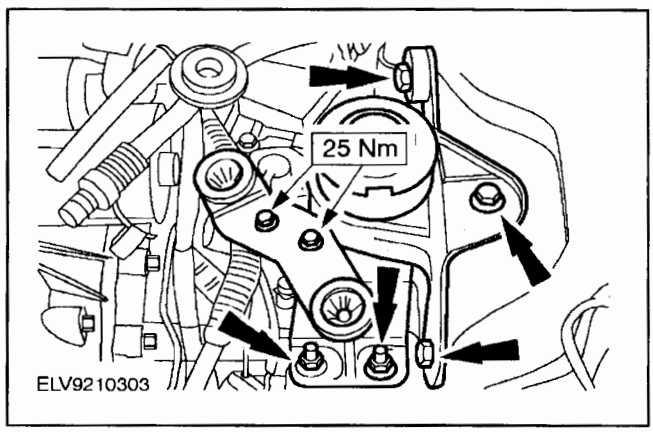


8. Using the special tool and a suitable floor crane , install the engine/transaxle assembly.



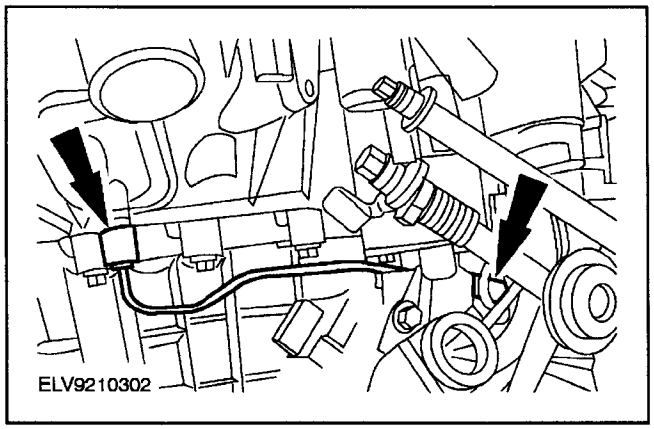
9. **NOTE:** Loosely screw in the bolts.

   Install the front upper support insulator to the side member.

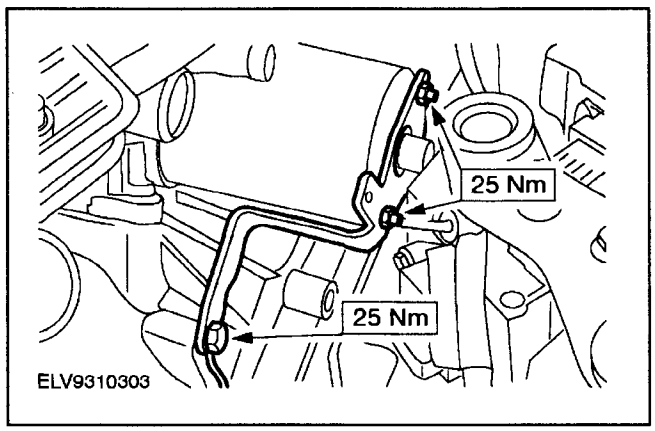


10. Install the air cleaner bracket and hand tighten the rear upper support insulator.

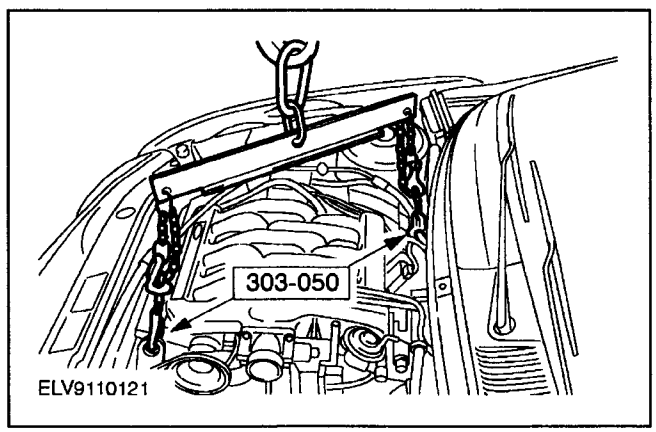
INSTALLATION (Continued)



11. Install the clutch slave cylinder hydraulic line.

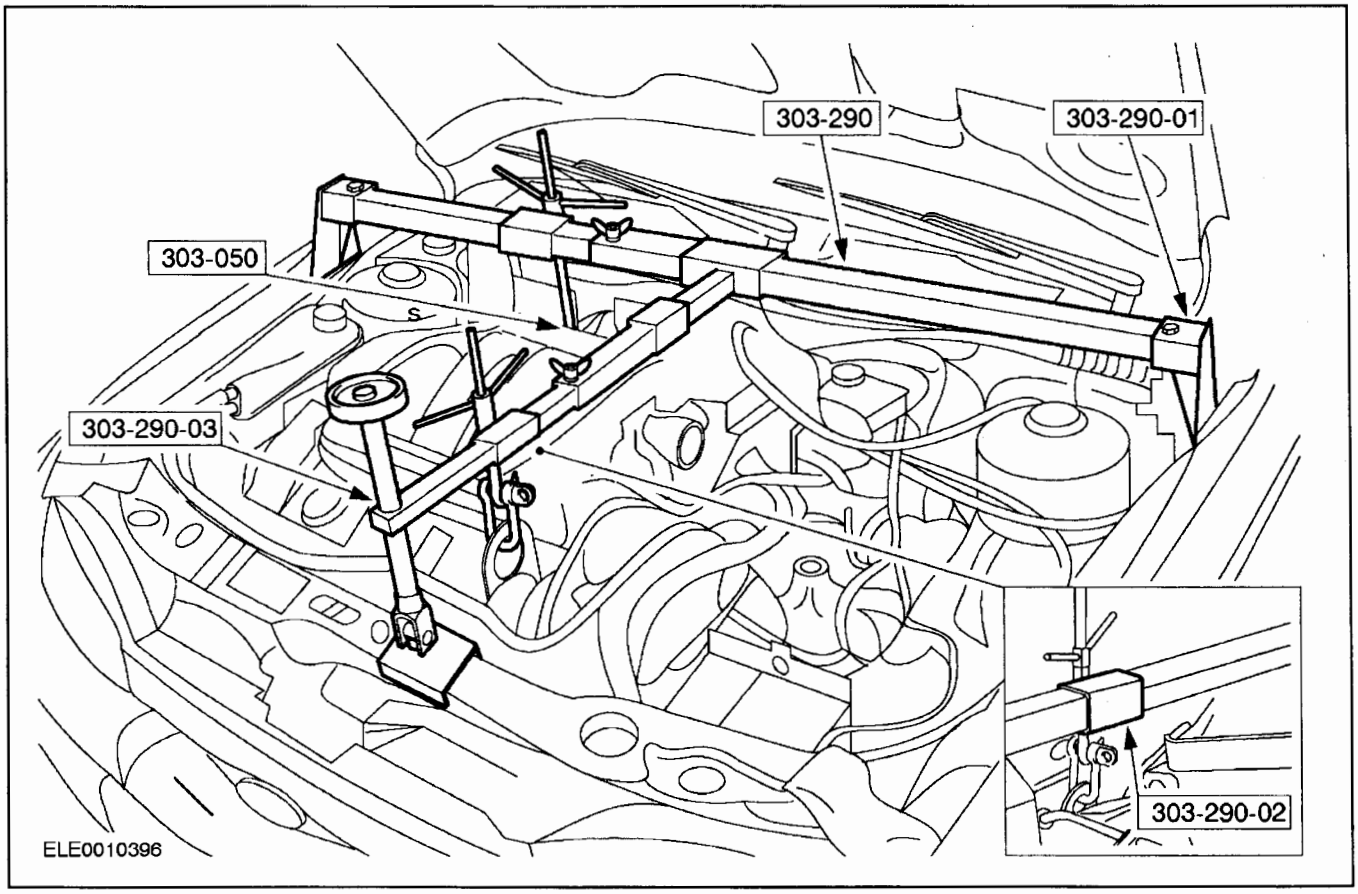


12. Install the starter motor bracket and the ground cable to the transaxle flange.



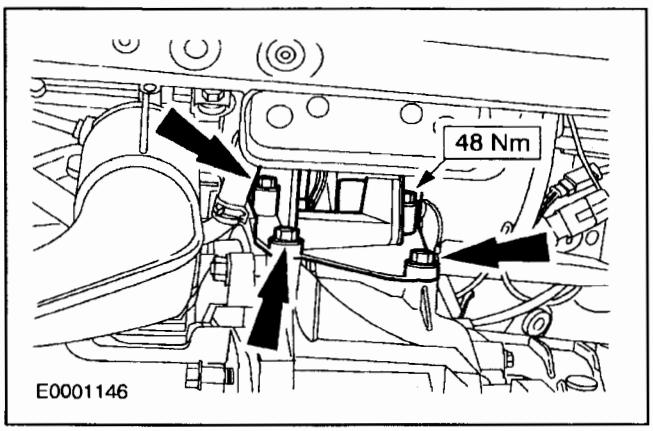
13. Remove the special tool and the suitable floor crane.

INSTALLATION (Continued)



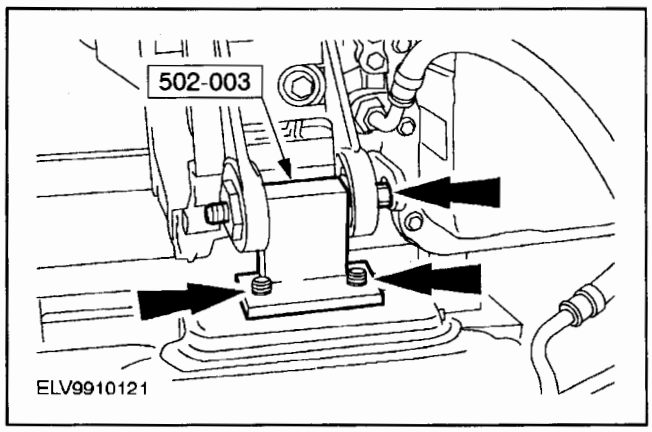
14. Install the special tool.

15. Raise and support the vehicle. For additional information, refer to Section 100-02.



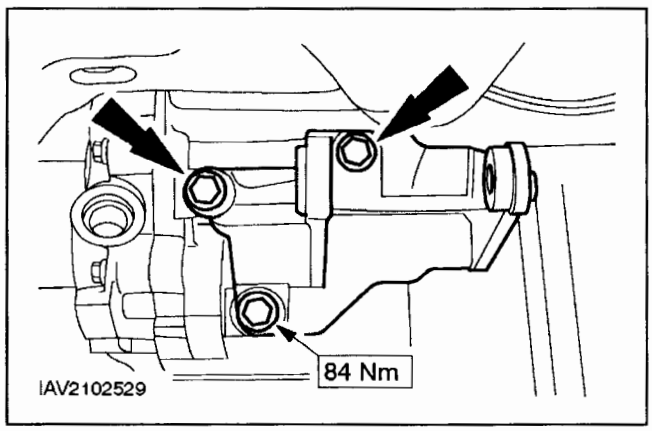
16. Install the left-hand support insulator bracket.

INSTALLATION (Continued)

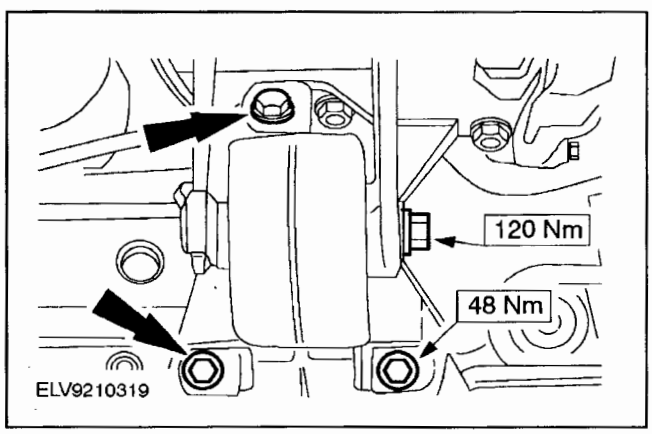


17. **NOTE:** The special tool is marked with an arrow and "front".

    Install the special tool at the installation place of the left-hand support insulator.

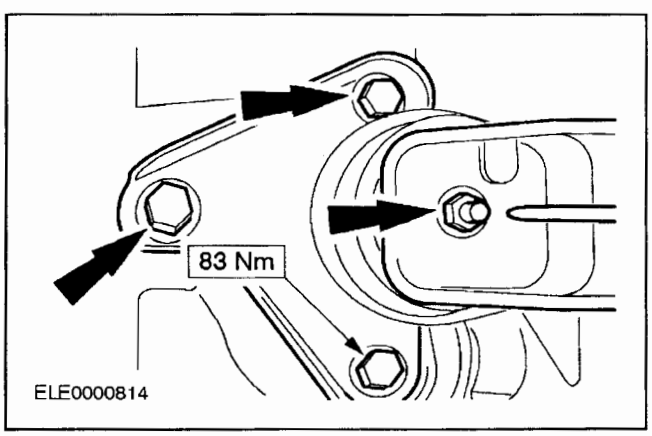


18. Install the right-hand support insulator bracket.



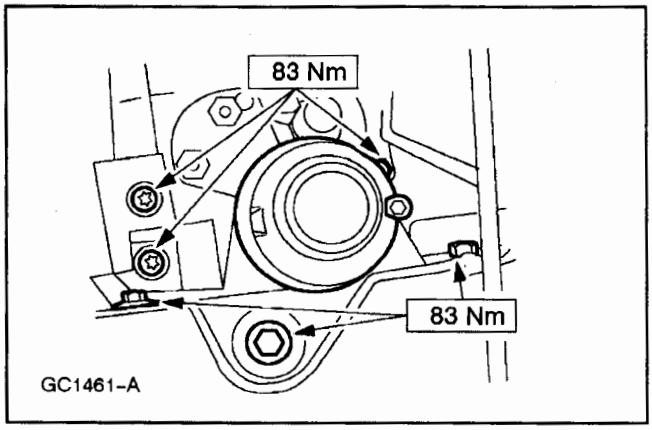
19. Install the right-hand support insulator.

20. Lower the vehicle.



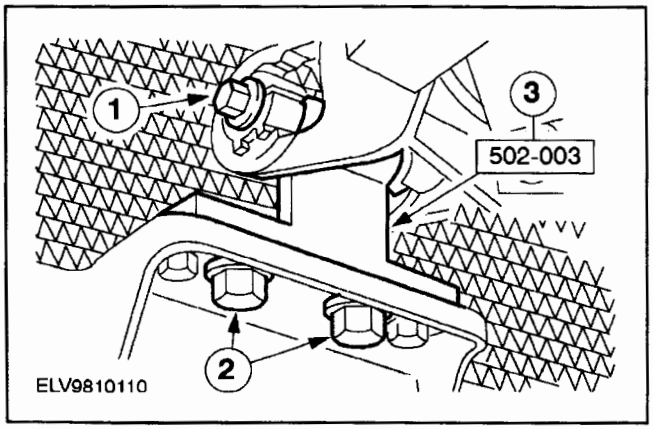
21. Tighten the front upper support insulator bolts.

INSTALLATION (Continued)

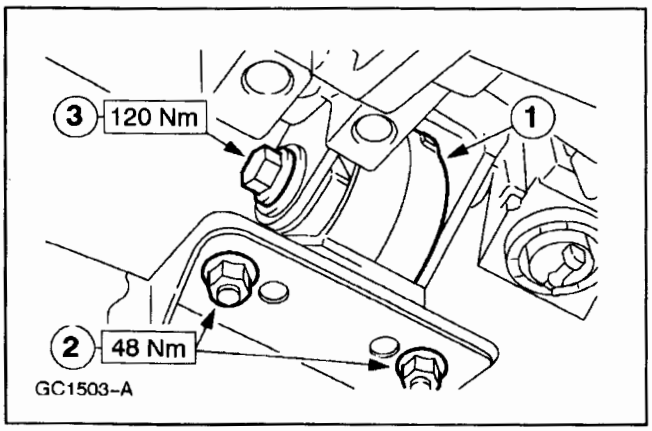


22. Tighten the upper support insulator bolts.

23. Raise and support the vehicle. For additional information, refer to Section 100-02.



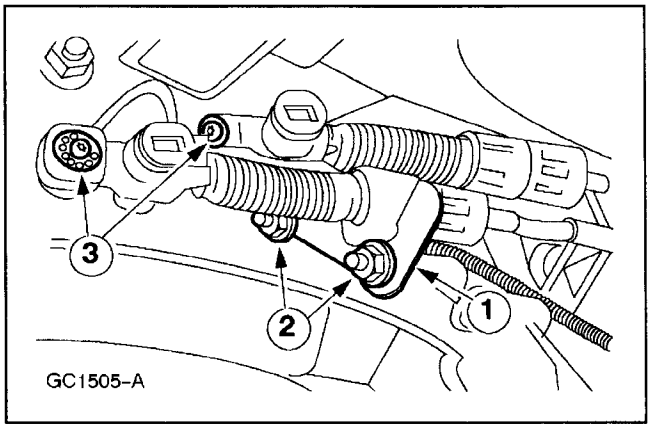
24. Remove the special tool.
    1 Remove the through bolt.
    2 Remove the bolts.
    3 Remove the special tool.



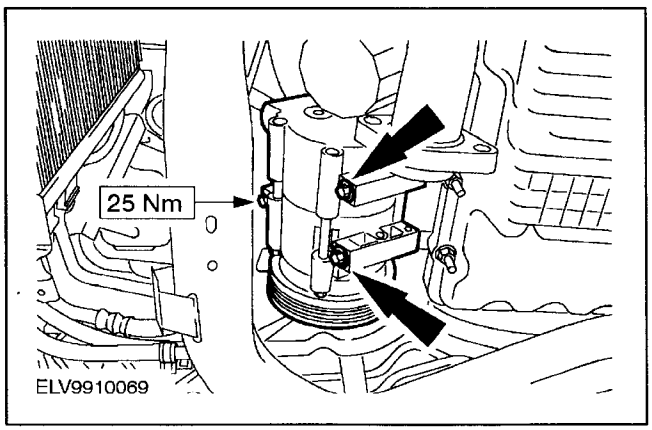
25. **NOTE:** Verify that the left-hand support insulator is centered in the transaxle bracket and in perfect front to rear alignment before tightening the through bolt.

    Install the left-hand support insulator.
    1 Position the front support insulator.
    2 Install the nuts.
    3 Install the through bolt.

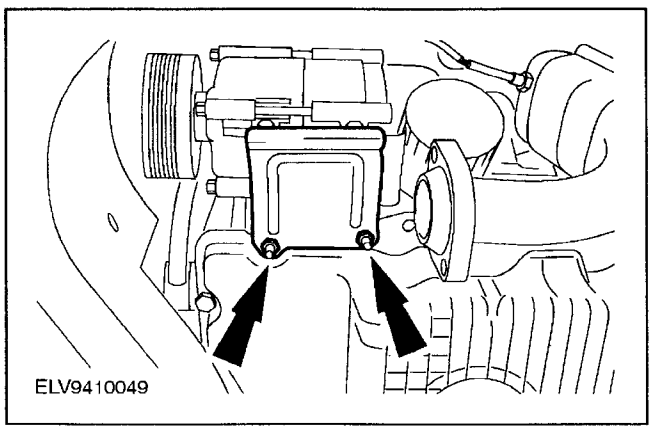
INSTALLATION (Continued)



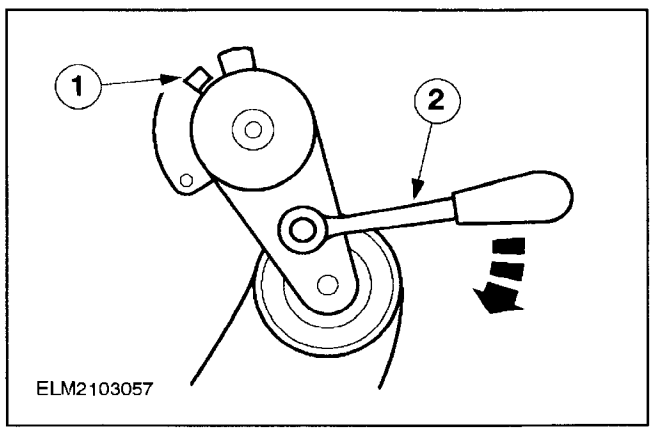
26. Install the shifter cables and bracket.
    1 Position the shifter bracket.
    2 Install the nuts.
    3 Attach the shifter cables.



27. Install the compressor.

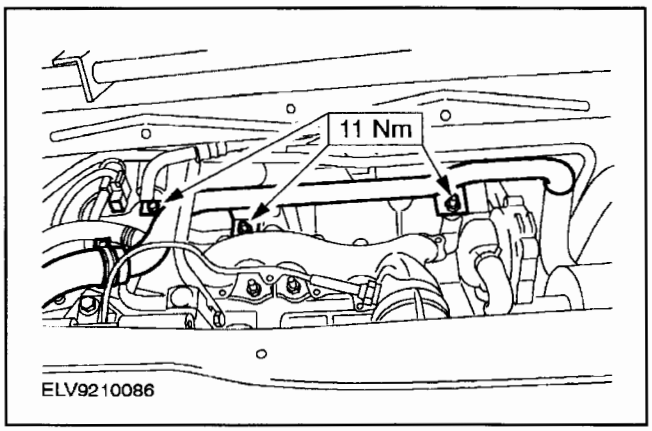


28. Install the compressor heat shield.

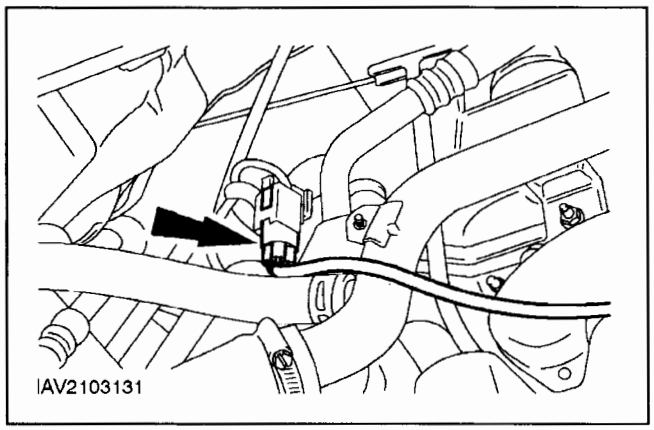


29. Install the accessory drive belt.
    1 Left-hand stop
    2 3/8'' square drive (ratchet)
    - Push the belt tensioner as far as the left-hand stop using the square drive (ratchet) and install the accessory drive belt.

INSTALLATION (Continued)

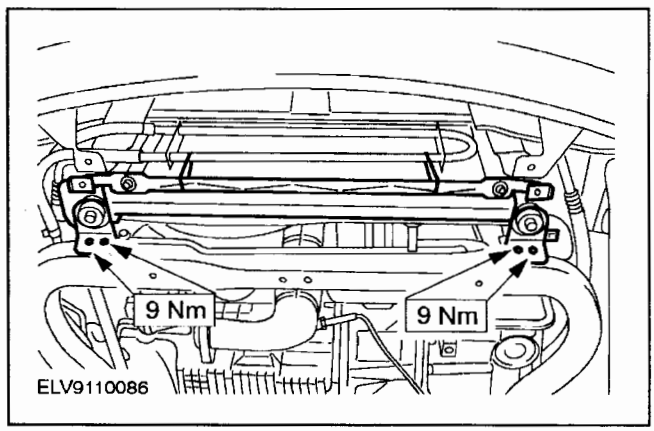


30. Install the coolant hose.

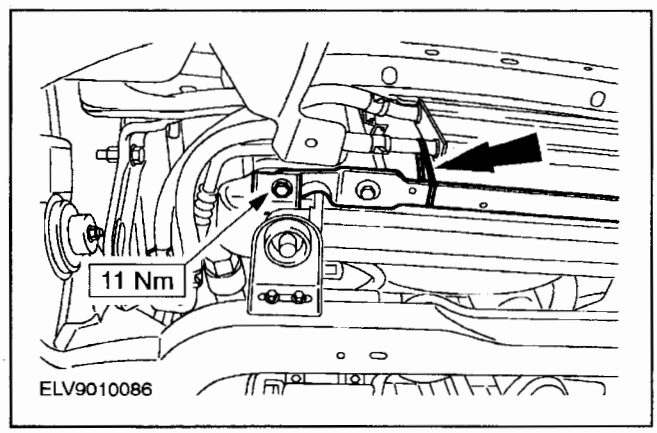


31. Connect the heated oxygen sensor (HO2S) electrical connector.

32. Insert the fan and secure it with cable ties .

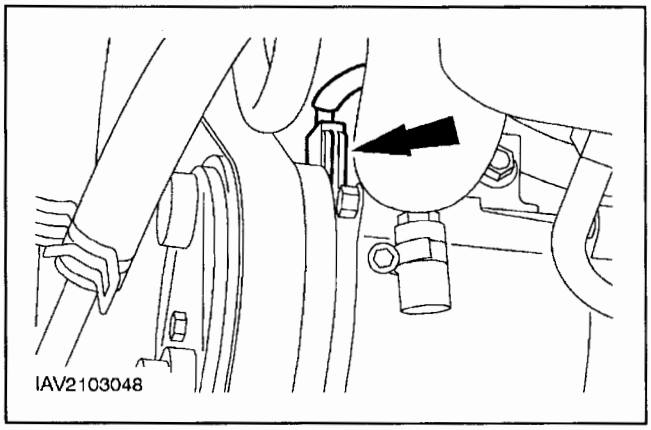


33. Install the radiator.

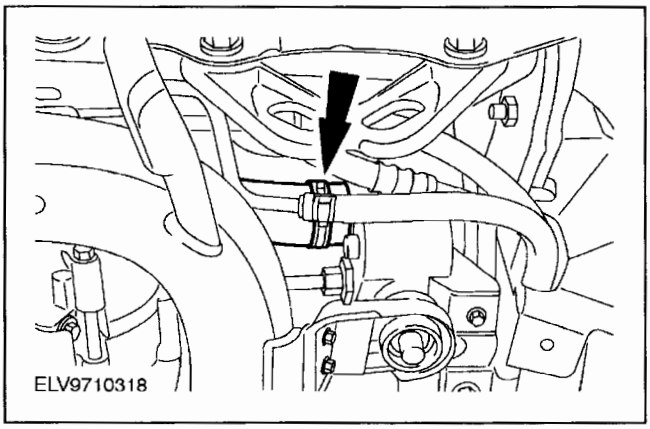


34. Attach condenser core to the radiator.
    - Cut the cable ties.

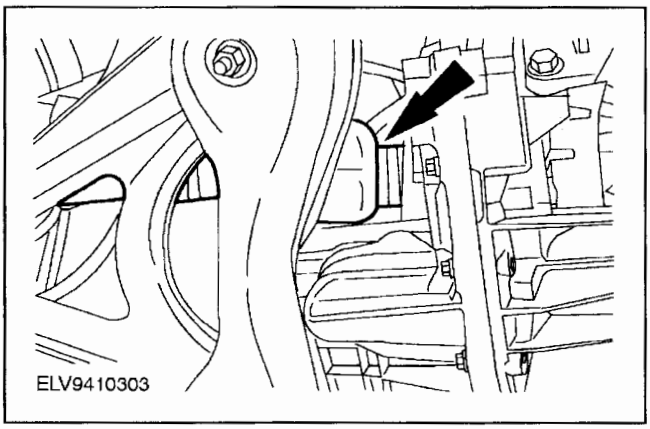
INSTALLATION (Continued)



35. Connect the compressor electrical connector.



36. Install the coolant hose to the radiator.

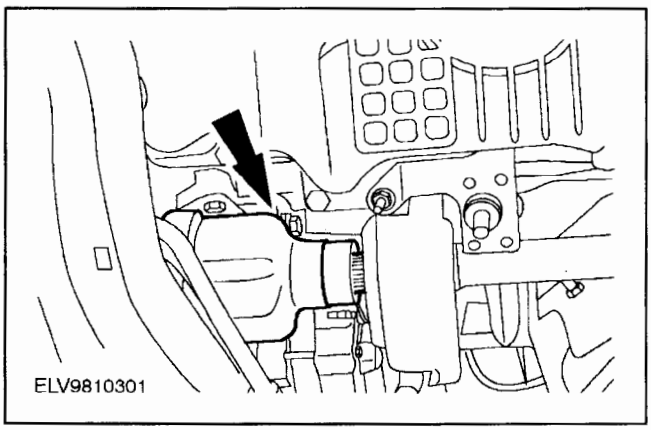


37. ⚠ **CAUTION: To avoid damage to the halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by more than 45 degrees.**

NOTE: Do not damage the oil seal.

Install the right-hand front drive halfshaft.

- Check that the snap ring engages correctly.

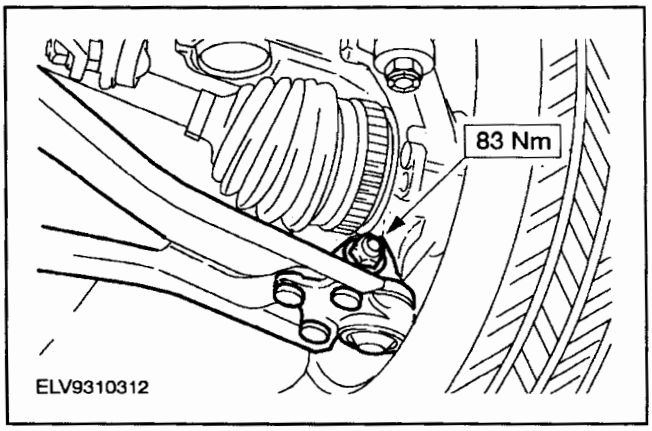


38. **NOTE:** Do not damage the oil seal.

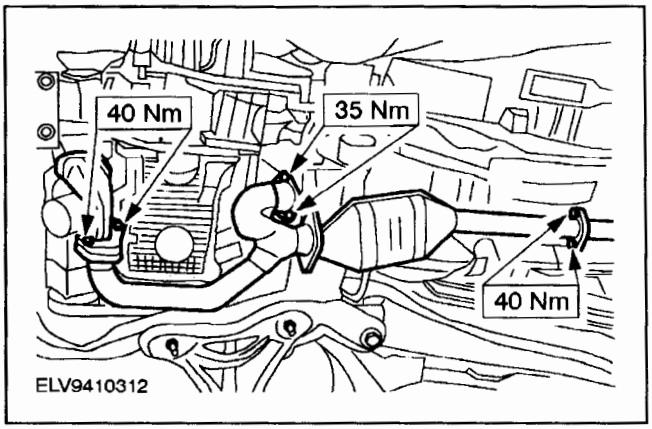
Install the right-hand front drive halfshaft.

- Check that the snap ring engages correctly.

INSTALLATION (Continued)

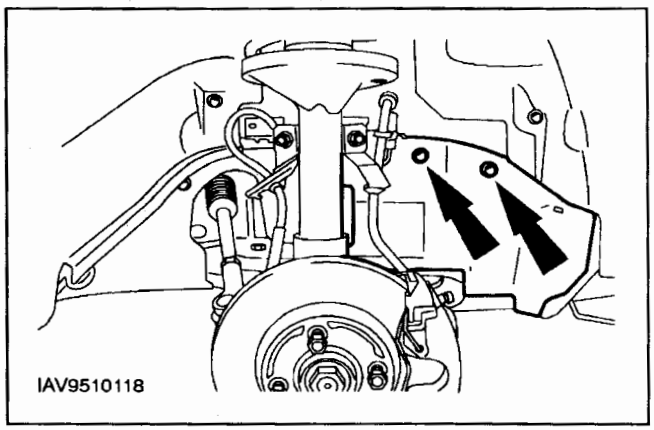


39. Install the both control arms (right-hand side shown).



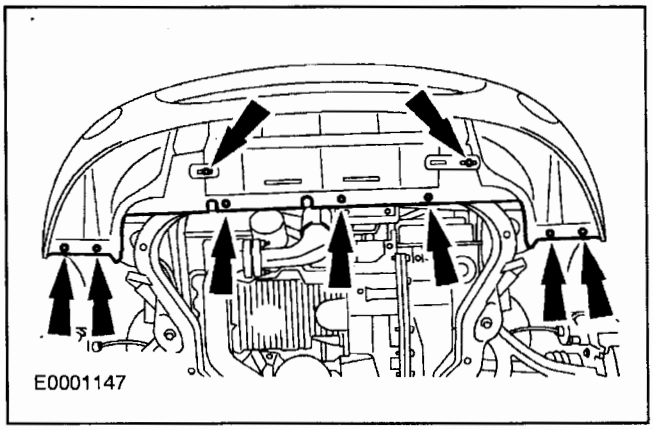
40. Install the dual converter Y-pipe and the three-way catalytic converter (TWC).
    - Install the gaskets.

41. Fill the transaxle with manual transmission fluid . For additional information, refer to Section 308-03.



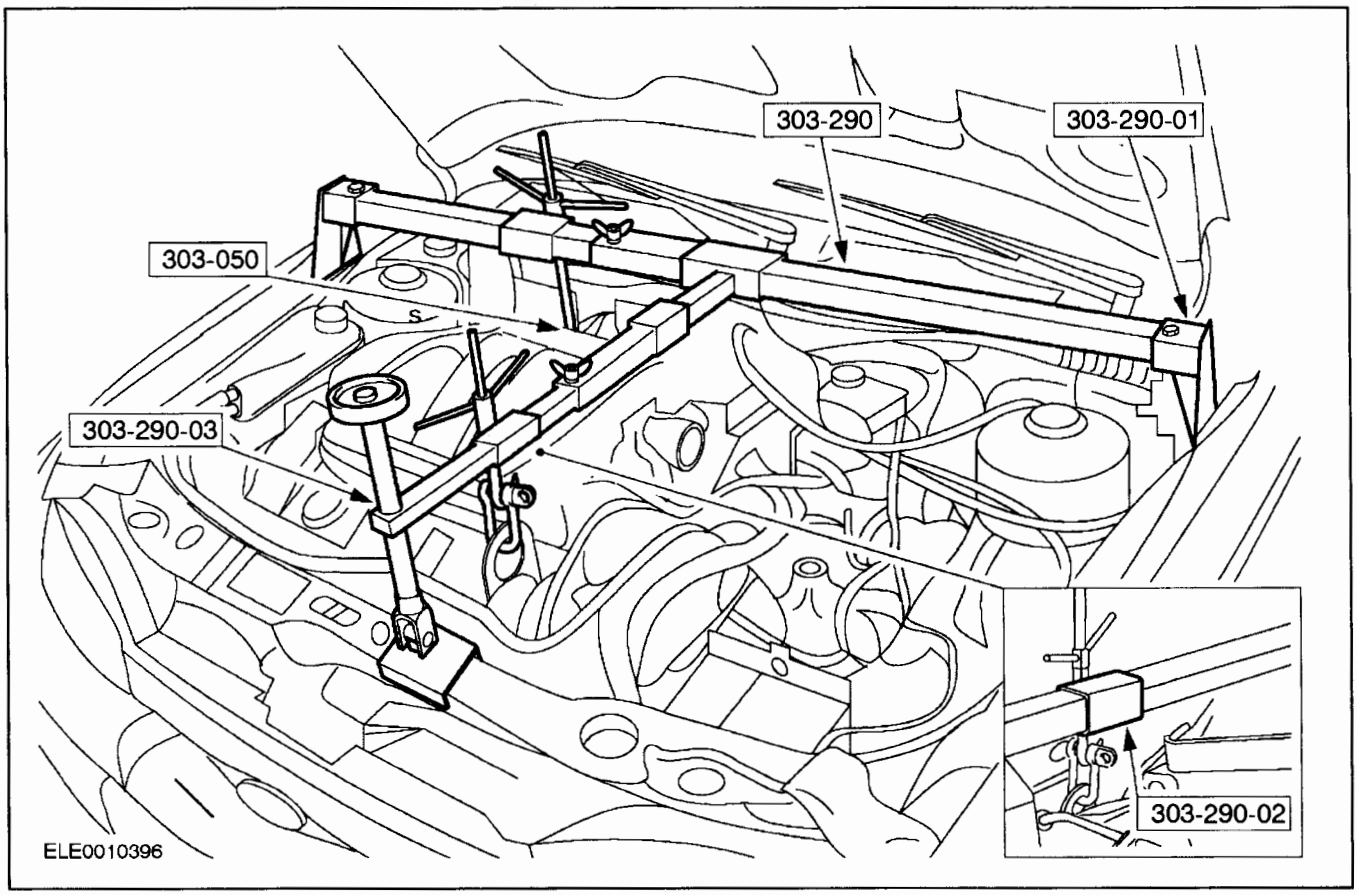
42. Install the right-hand front fender splash shield (shown with wheel removed).

INSTALLATION (Continued)



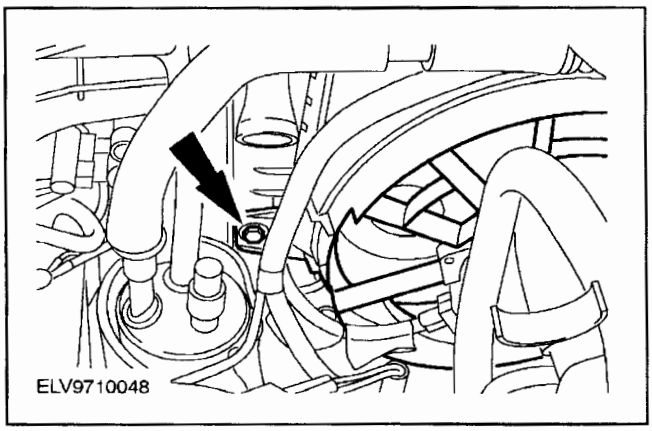
43. Install the radiator splash shield.

44. Lower the vehicle.

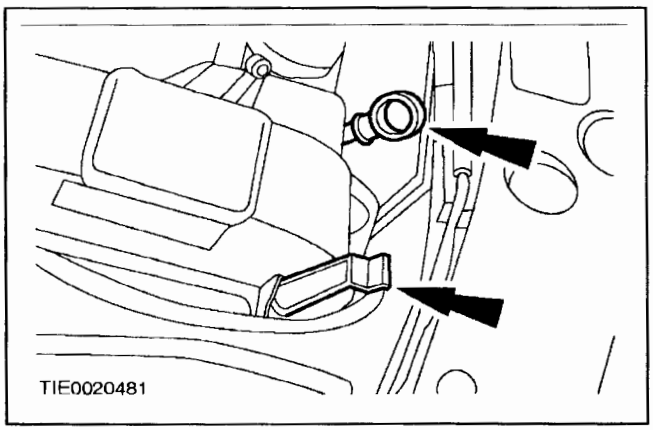


45. Remove the special tools.

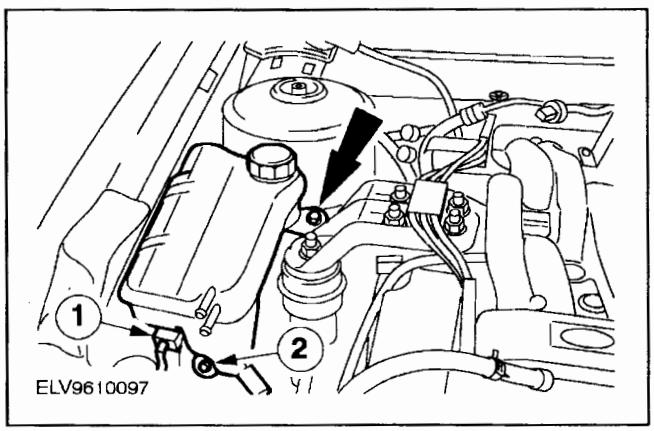
INSTALLATION (Continued)



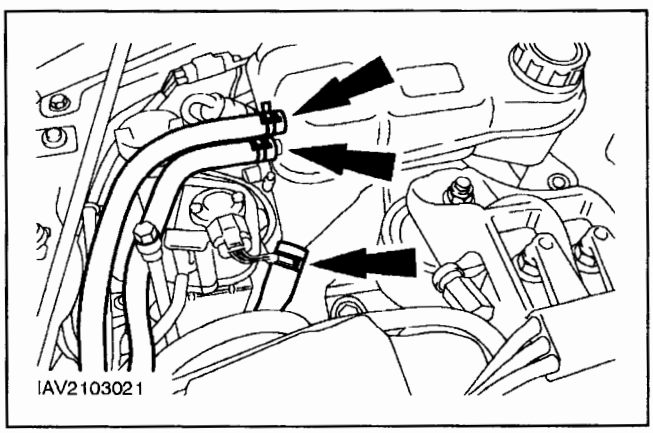
46. Install the fan to the radiator (one screw on each side).



47. Install the oil level indicator and the HO2S electrical connector bracket.

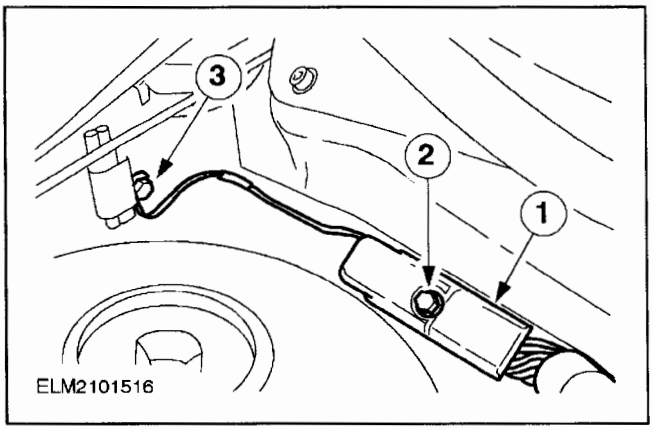


48. Install the coolant expansion tank.
    1 Connect the coolant level sensor.
    2 Install the bolts.

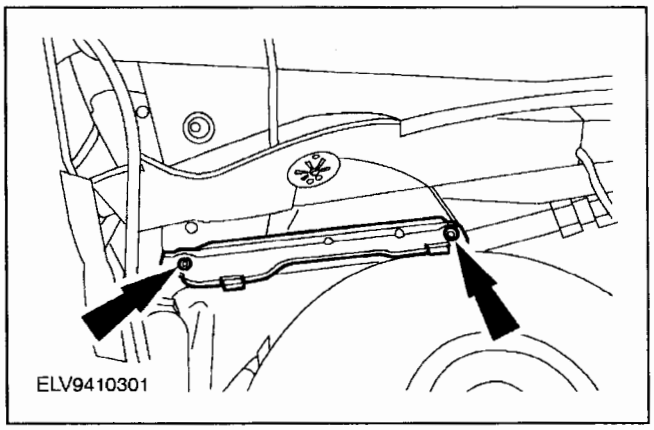


49. Connect the coolant expansion tank hoses.

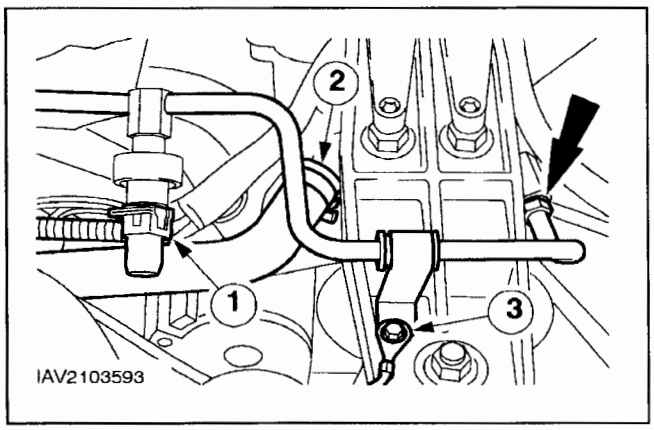
INSTALLATION (Continued)



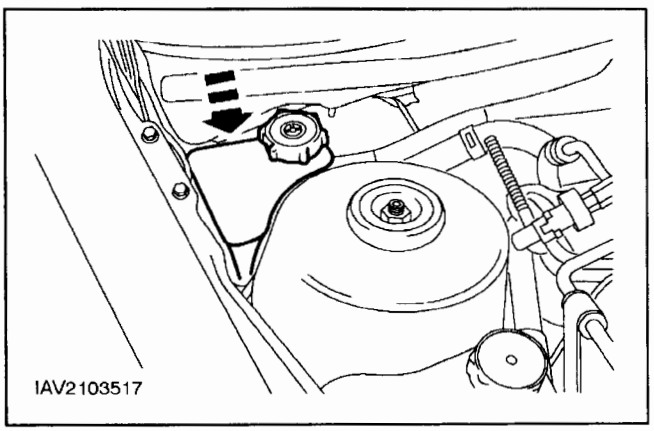
50. Connect the powertrain control module (PCM) electrical connector.
    1 Connector
    2 Bolt
    3 Ground cable



51. **NOTE:** Use new rivets.
    Install the PCM cover plate.

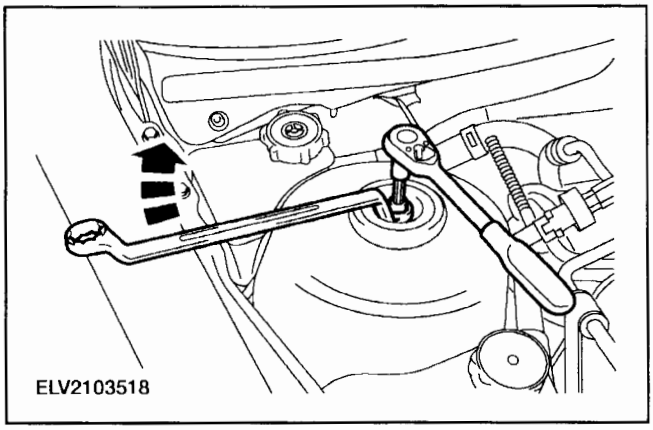


52. Connect the power steering lines.
    1 Connect the electrical connector.
    2 Connect the power steering lines.
    3 Install the bolt and the ground cable.

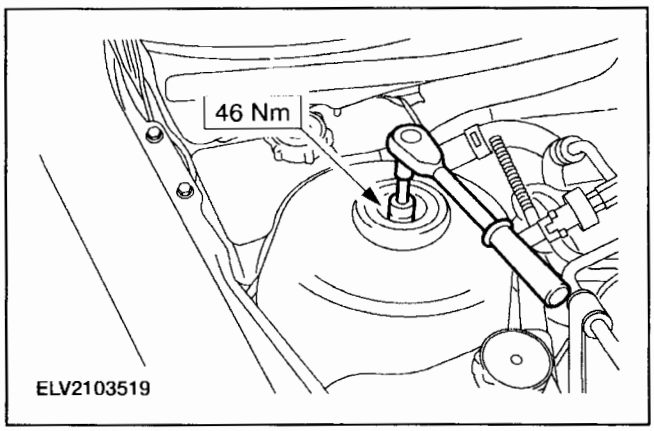


53. Install the power steering fluid reservoir.

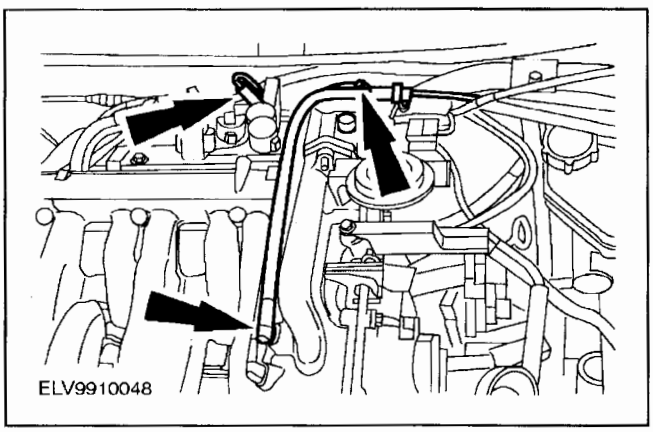
INSTALLATION (Continued)



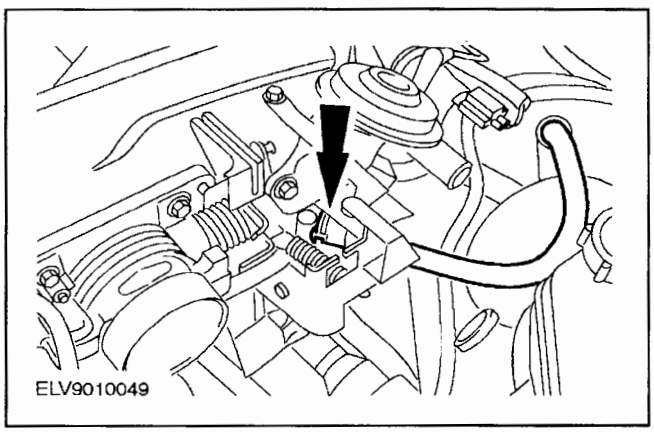
54. **NOTE:** New nuts are not required.
    Pre-tighten the nut on both suspension struts.



55. Tighten the nut on both suspension struts.

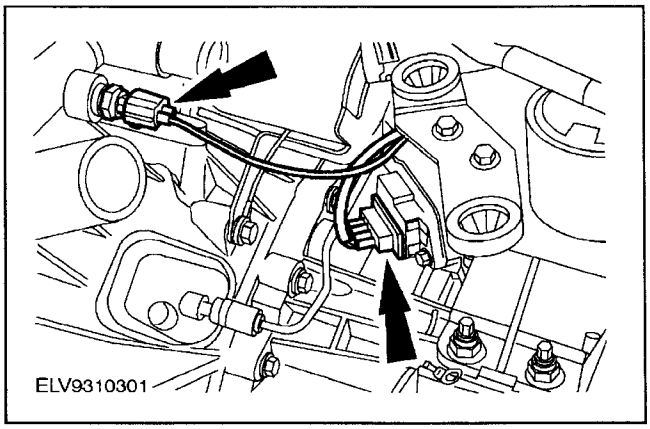


56. Connect the upper intake vacuum supply line and the heater control vacuum hoses.

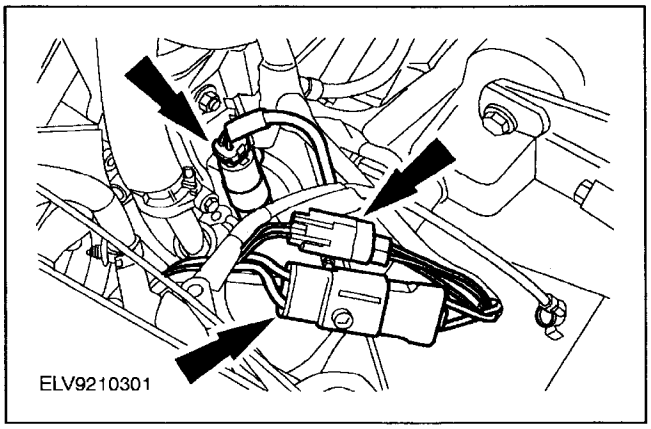


57. Connect the evaporative control (EVAP) hose.

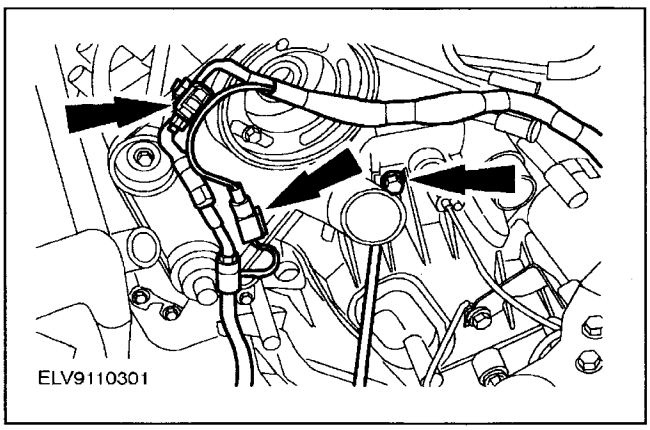
INSTALLATION (Continued)



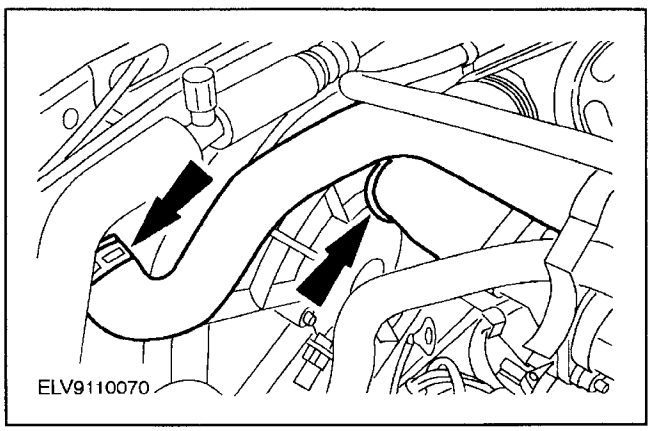
58. Connect the engine coolant temperature (ECT) sensor and the reverse lamp electrical connectors.



59. Connect the suction accumulator electrical connector and the two fan electrical connectors.

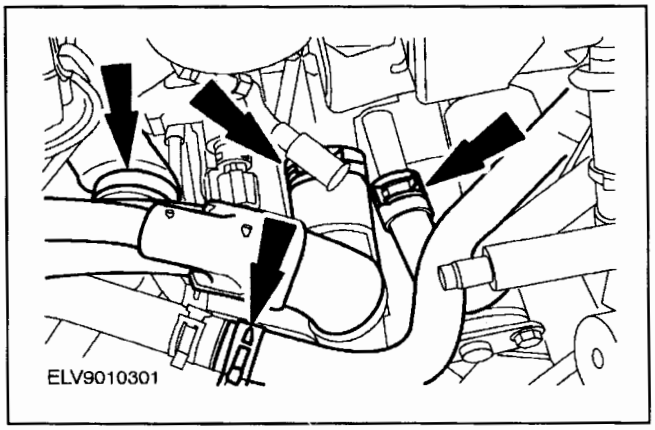


60. Connect the battery positive cable, the electrical connector and install the transaxle housing bolt with the ground cable.

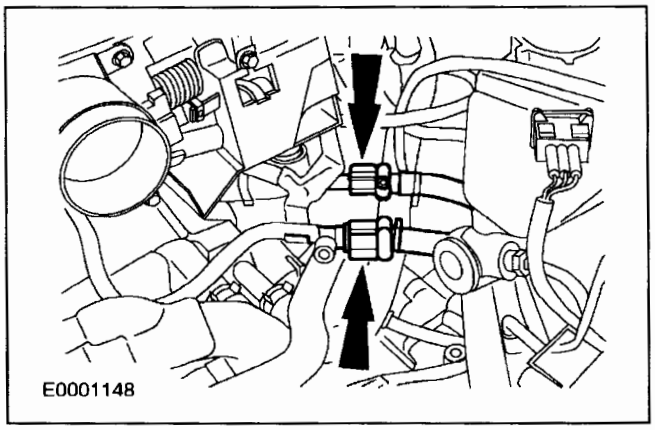


61. Connect the coolant hoses to the radiator and to the coolant passage.

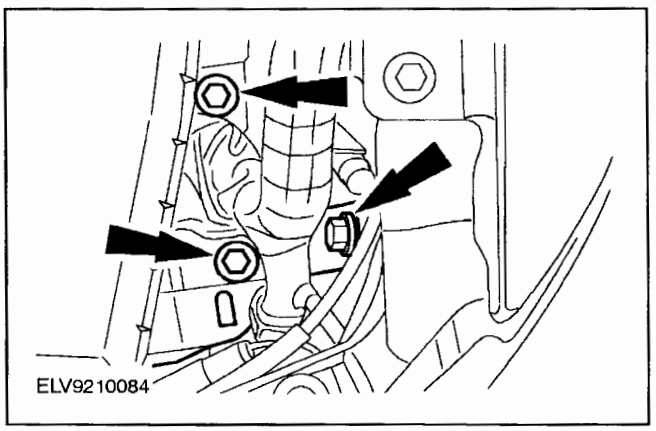
INSTALLATION (Continued)



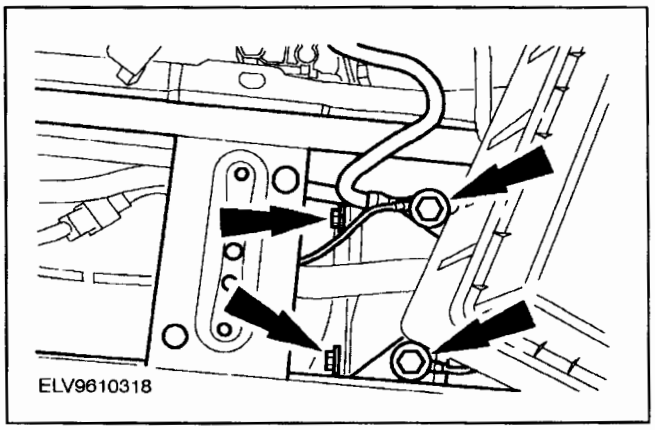
62. Connect the coolant hoses.



63. Connect the fuel lines and attach the safety clips.

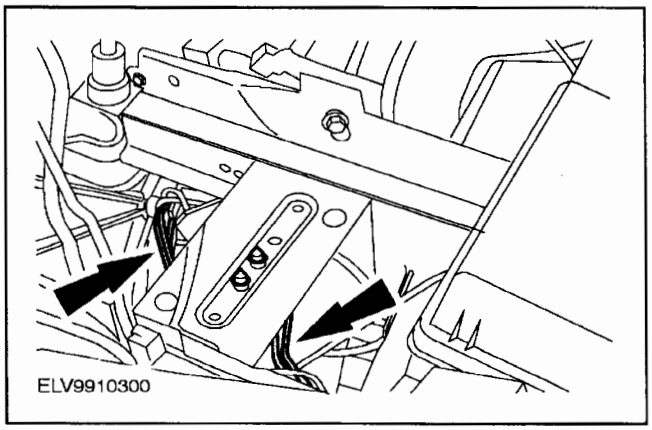


64. Install the battery tray.

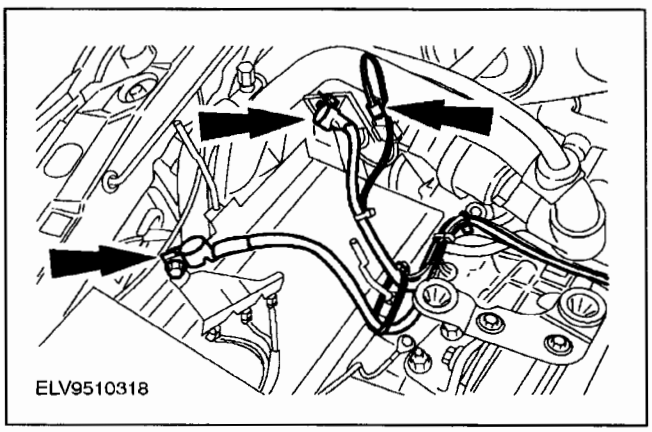


65. Install the four battery tray bolts and the three ground cables.

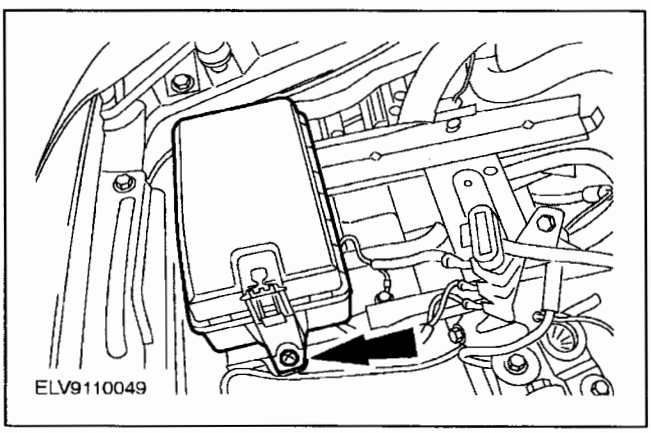
INSTALLATION (Continued)



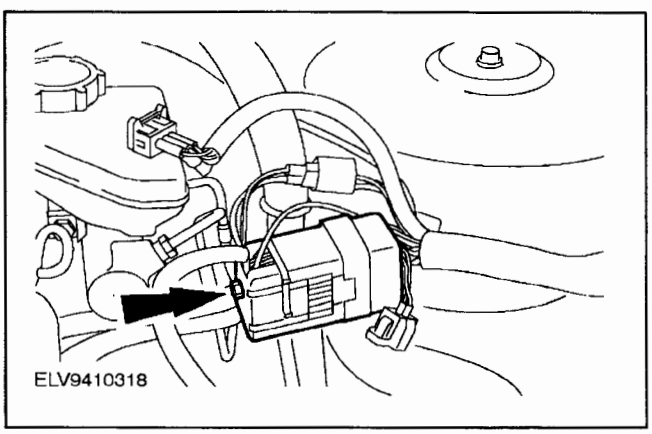
66. Install the fan motor electrical connectors to the battery tray.



67. Connect the battery cables and the electrical connector.

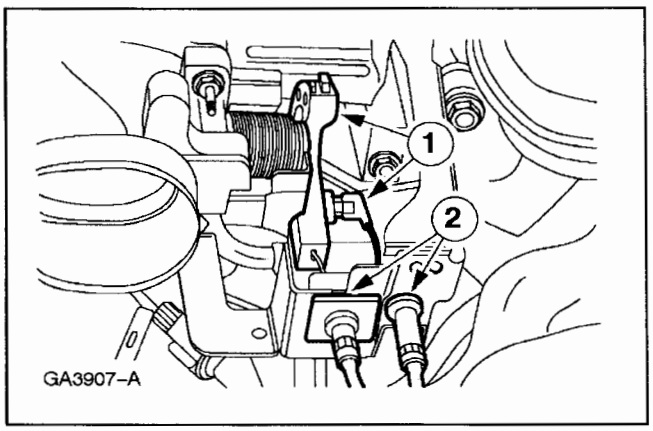


68. Install the central junction box (CJB).



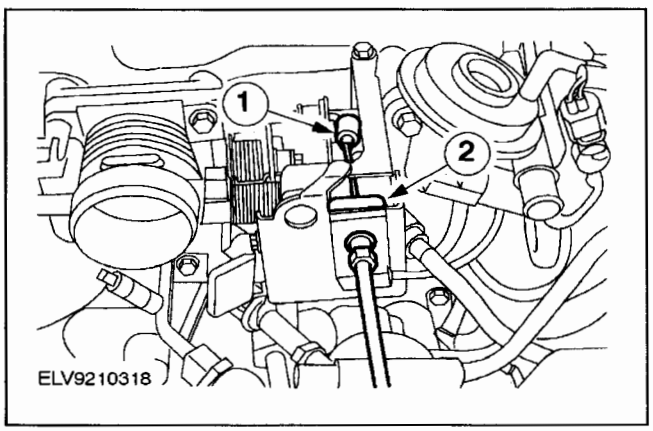
69. Connect the bulkhead electrical connector.

INSTALLATION (Continued)



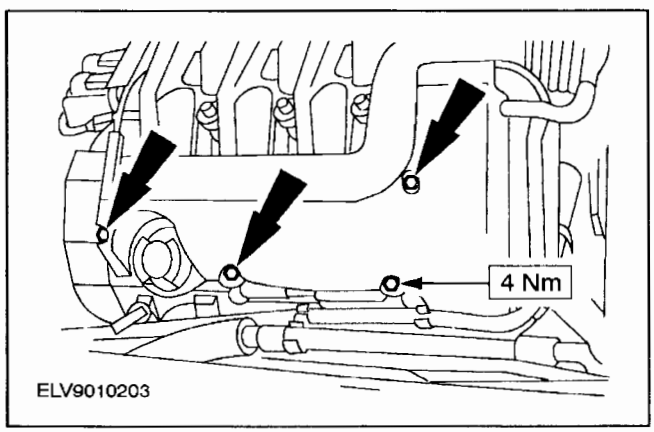
Vehicles with speed control

70. Connect the accelerator and speed control cables.
    1 Connect the accelerator and speed control cables.
    2 Clip the cables into the bracket.



Vehicles without speed control

71. Connect the accelerator cable.
    1 Connect the accelerator cable.
    2 Clip the cable into the bracket.



All vehicles

72. Install the water pump pulley cover.
    - Position the coolant hose in the clip and install the cover.

73. Install the air cleaner. For additional information, refer to Section 303-12B.

74. Fill the engine with engine oil.

75. Fill the engine cooling system. For additional information, refer to Section 303-03.

INSTALLATION (Continued)

76. Install the battery. For additional information, refer to Section 414-01.

77. Fill and bleed the power steering system. For additional information, refer to Section 211-00.

78. Bleed the clutch system. For additional information, refer to Section 308-00.

79. Install the hood.

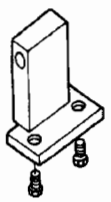
80. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

    Finishing operations.

    - Check the routing of the vacuum hoses and wiring and secure them with cable ties .
    - Check the fluid level after the road test and correct as necessary.
    - Check the engine and cooling system for leaks (visual inspection).

Engine — Vehicles with Automatic Transaxle

Special Tool(s)

 T70P-6000	Lifting bracket, Engine 303-050 (T70P-6000)
 T94P-6000-AH	Gauge, Powertrain Alignment 502-003 (T94P-6000-AH)

Materials

Item	Specification
Engine oil —	WSS-M2C153-H
High-temperature grease —	ESD-M1C220-A
Automatic transmission fluid —	ESP-M2C166-A

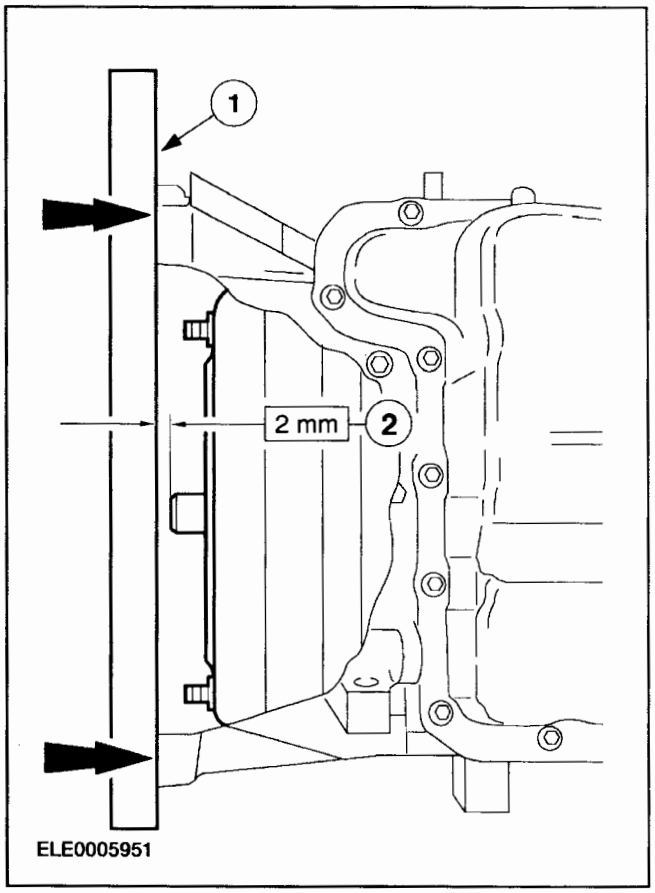
INSTALLATION (Continued)

Installation

1. General instructions.
   - **NOTE:** The location of the engine mountings and support insulators are described looking from the transaxle to the engine.

     New self-locking nuts must be installed.

2. Move the selector lever into the "D" position.



3. **NOTE:** The torque converter hub must engage fully in the oil pump drive gear.

   Check the installation depth of the torque converter.

   1 Lay a suitable straightedge on the automatic transaxle flange.

   2 Check the installation depth between the transaxle flange and the torque converter centering spigot for the correct clearance.

4. Apply a thin layer of high-temperature grease to the centering spigot bore on the torque converter.

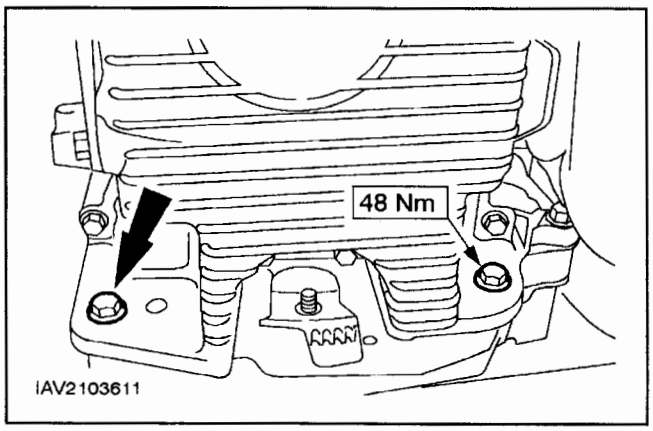
INSTALLATION (Continued)

5. ⚠ **CAUTION: The torque converter must remain at the correct installation depth throughout the whole installation procedure. Check that the adapter plate is in correct position.**

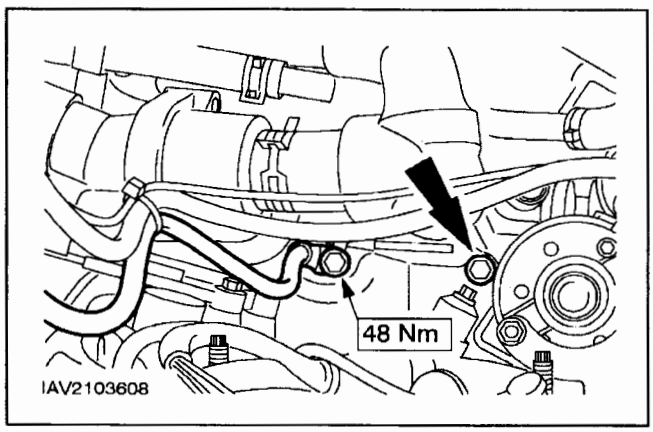
   NOTE: Make sure that the index marks on the flexplate and the stud made during removal line up.

   Using a floor crane bring the engine into the installation position on the automatic transaxle and install the engine drive plate to the stud of the torque converter.

6. Screw in all the flange bolts.



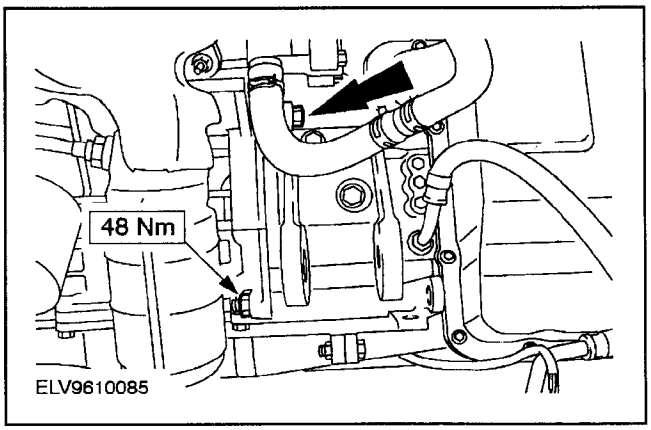
7. Install the lower flange bolts.



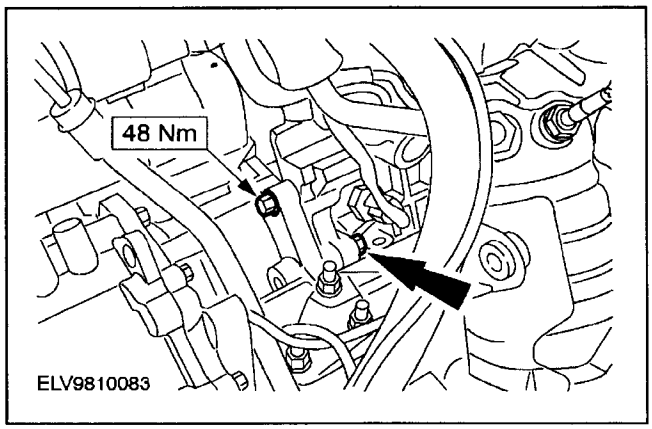
8. **NOTE:** Install the ground cable.

   Install the upper flange bolts.

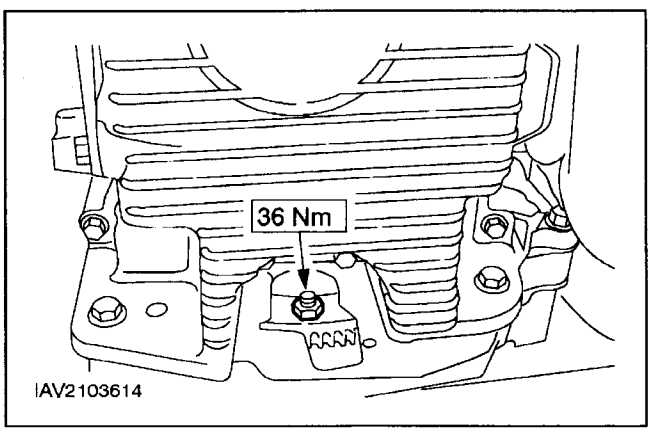
INSTALLATION (Continued)



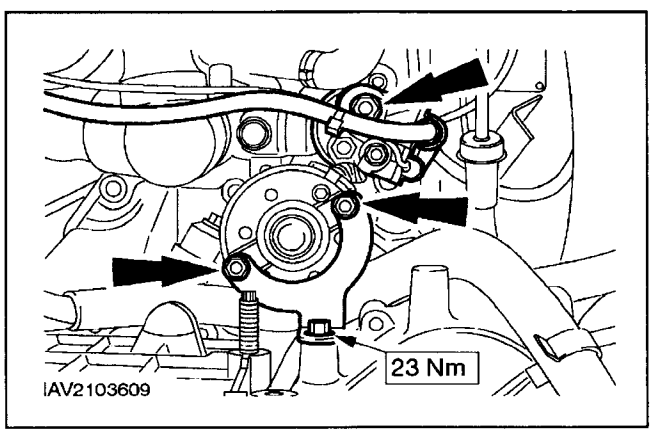
9. Install the left-hand flange bolts.



10. Install the right-hand flange bolts.

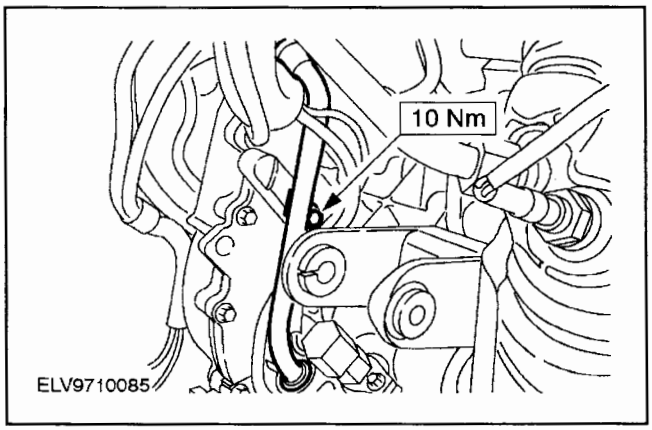


11. Attach the torque converter to the engine drive plate (four nuts).
    - Install the plastic cover.

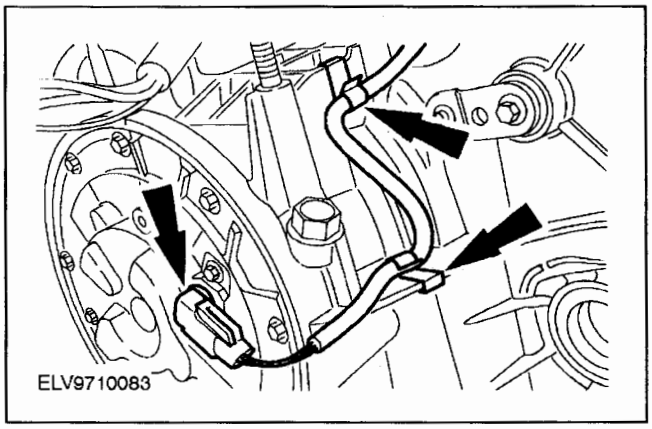


12. Install the starter motor bracket and electrical connector to the starter motor.

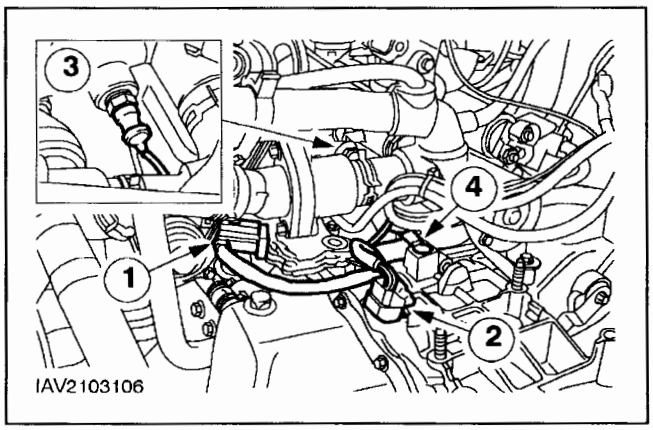
INSTALLATION (Continued)



13. Install the oil level indicator tube.



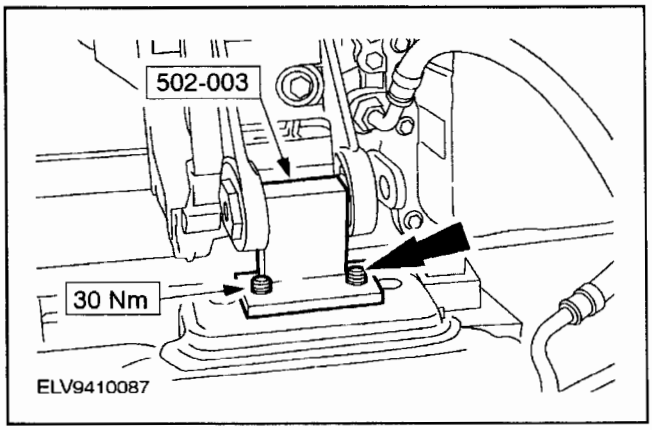
14. Connect the turbine shaft speed (TSS) sensor electrical connector.



15. Connect the electrical connectors.
    1 Transmission range (TR) sensor.
    2 Transmission control connector.
    3 Engine coolant temperature (ECT) sensor connector
    4 Attach the wiring harness.

16. Raise and support the vehicle. For additional information, refer to Section 100-02.

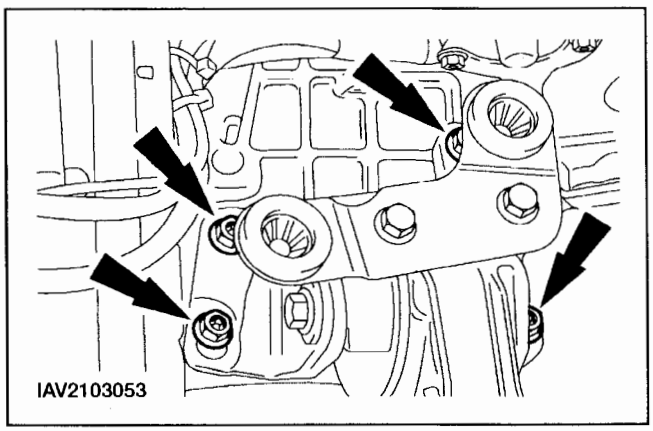
INSTALLATION (Continued)



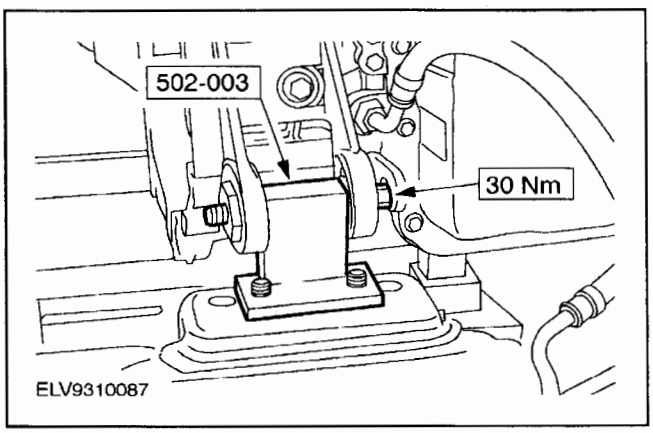
17. **NOTE:** The special tool is marked with an arrow and "front".
    Install the special tool.

18. Lower the vehicle.

19. **NOTE:** Correct position of the support insulator.
    Install the engine and transaxle assembly.

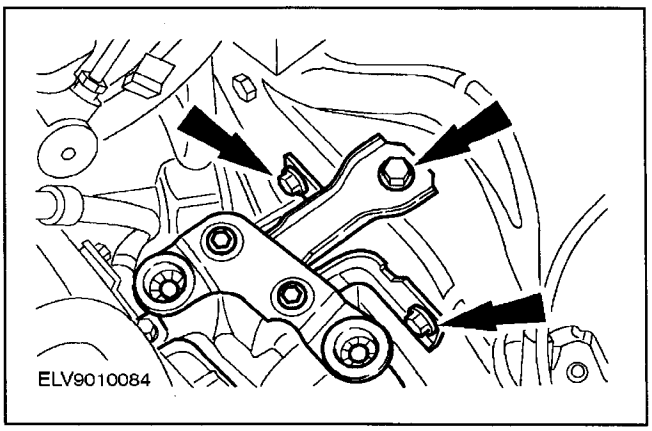


20. Loosen the nuts of the rear transaxle mount.

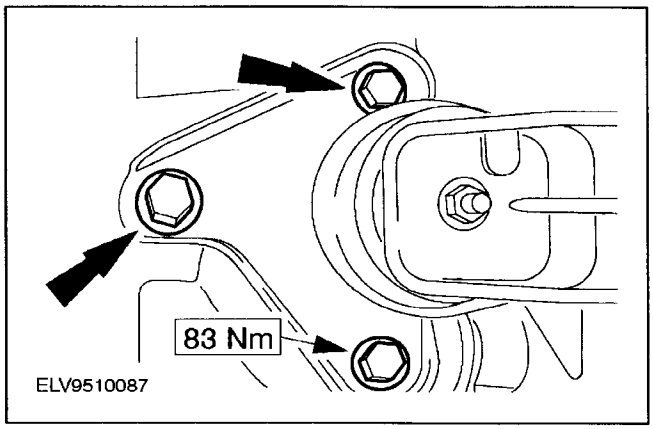


21. Screw the center bolt into the special tool and tighten it.

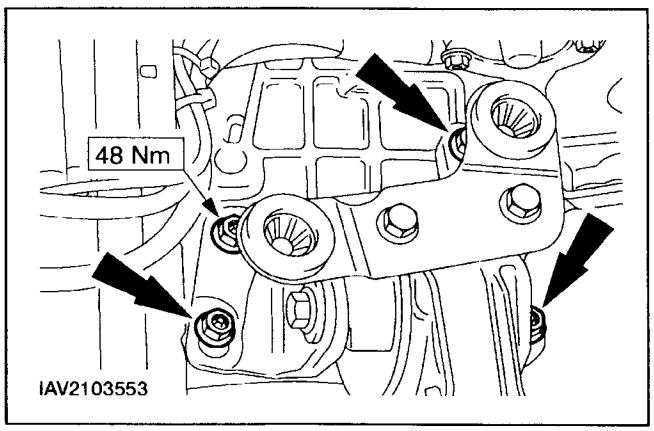
INSTALLATION (Continued)



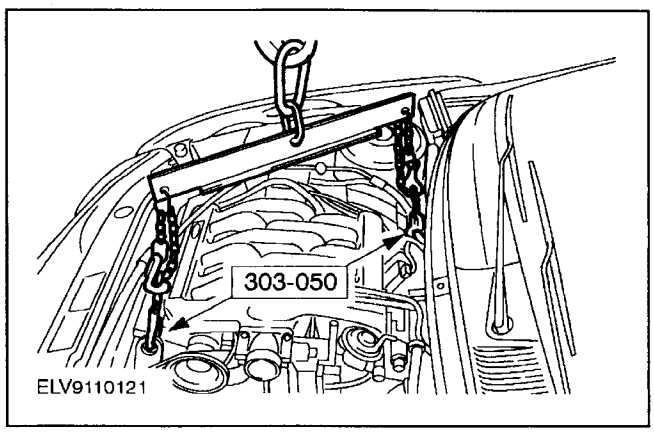
22. Install the transaxle rear mount to the side member.



23. Install the engine front upper mount to the side member.

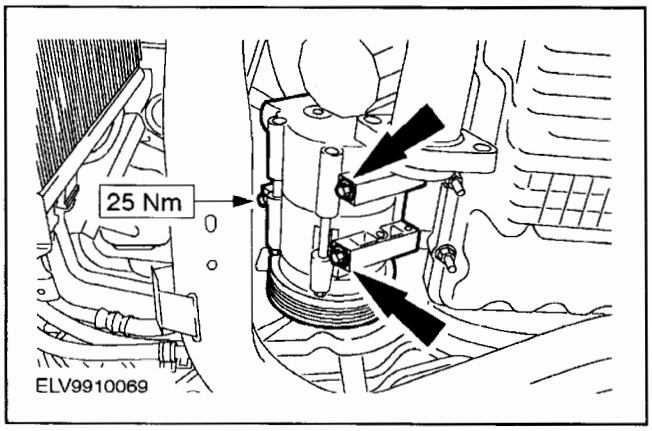


24. Tighten the nuts of the transaxle rear mount.

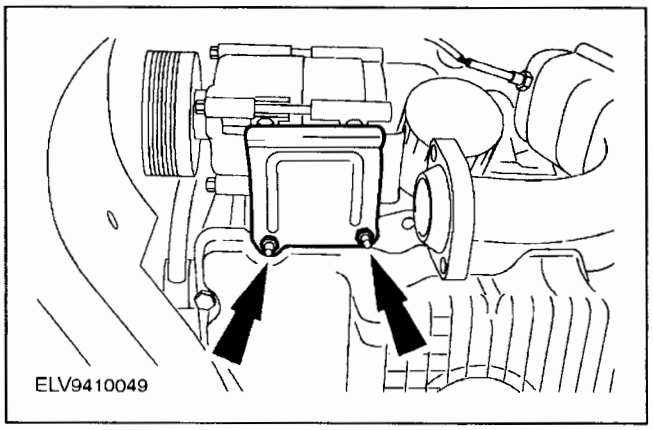


25. Remove the special tool.

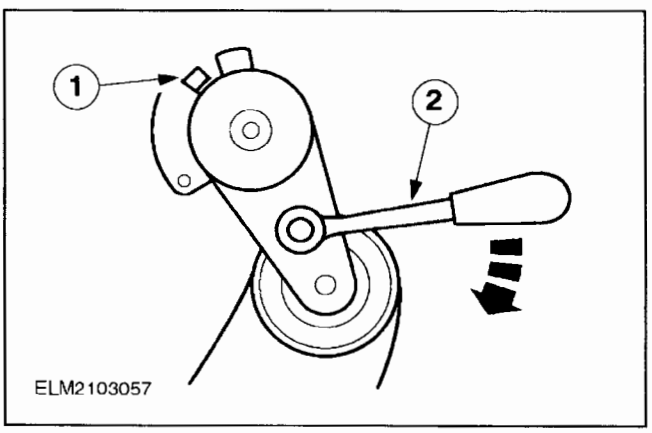
INSTALLATION (Continued)



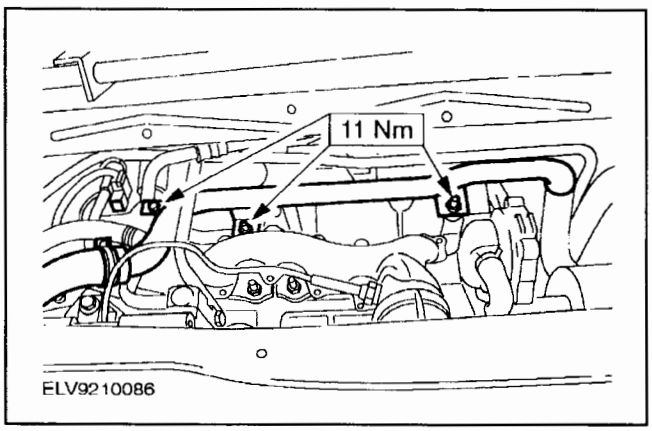
32. Install the compressor.



33. Install the compressor heat shield.

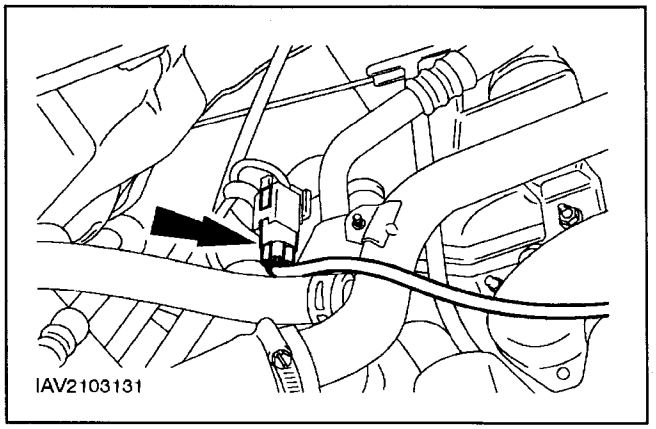


34. Install the accessory drive belt.
    1 Left-hand stop.
    2 3/8'' square drive (ratchet).
    - Push the belt tensioner as far as the left-hand stop using the square drive ratchet and install the accessory drive belt.



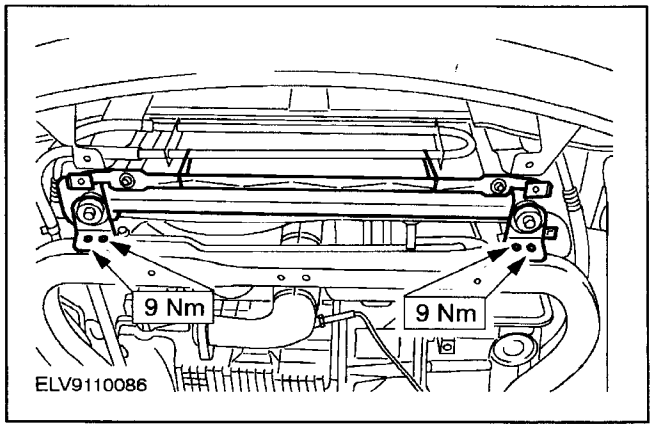
35. Install the coolant hose.

INSTALLATION (Continued)

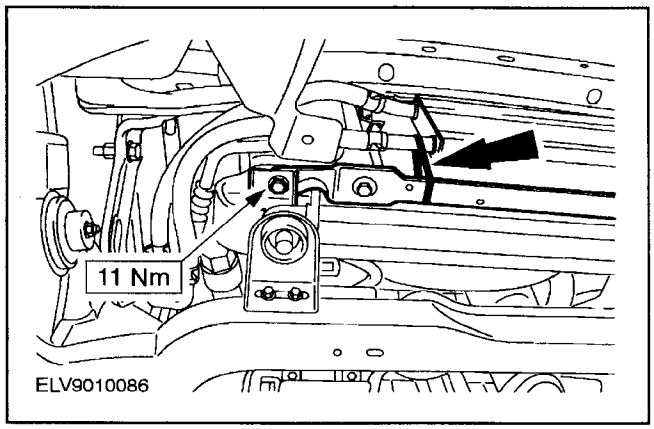


36. Connect the heated oxygen sensor (HO2S) electrical connector.

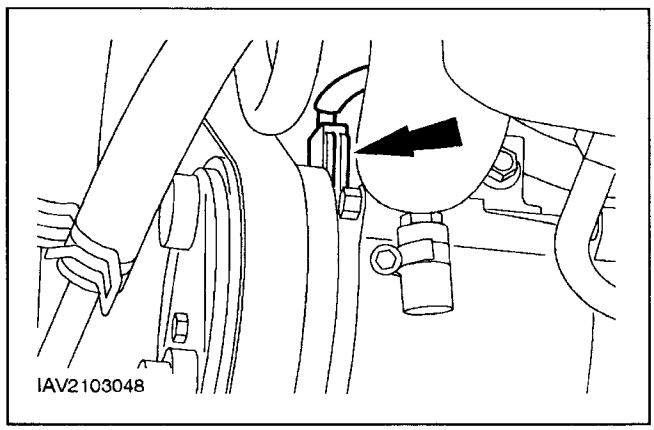
37. Position the fan shroud assembly in the vehicle.



38. Install the radiator.

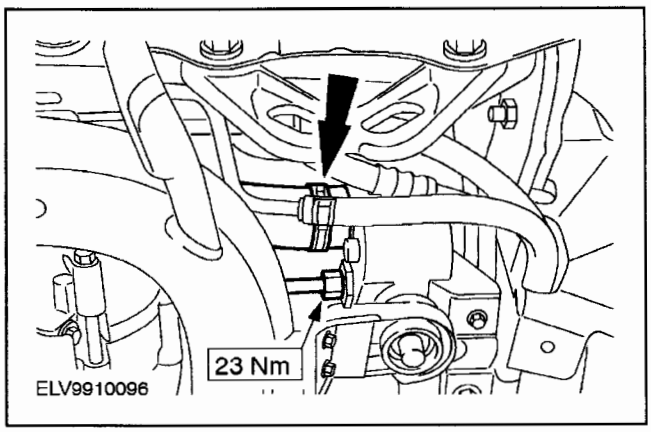


39. Attach the condenser core to the radiator.

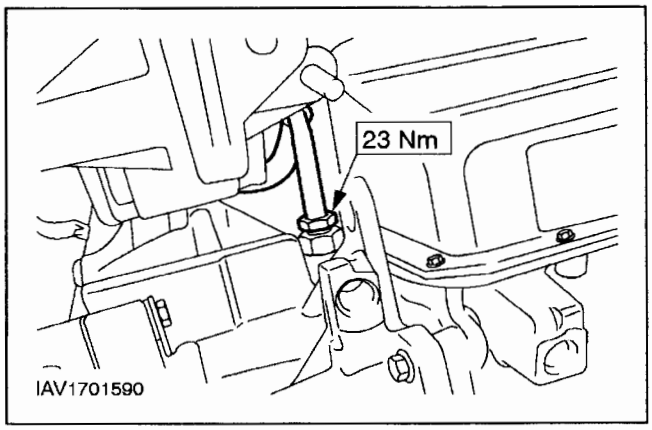


40. Connect the compressor electrical connector.

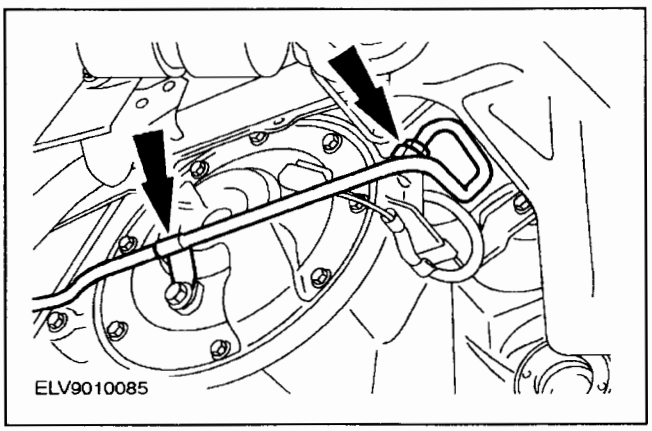
INSTALLATION (Continued)



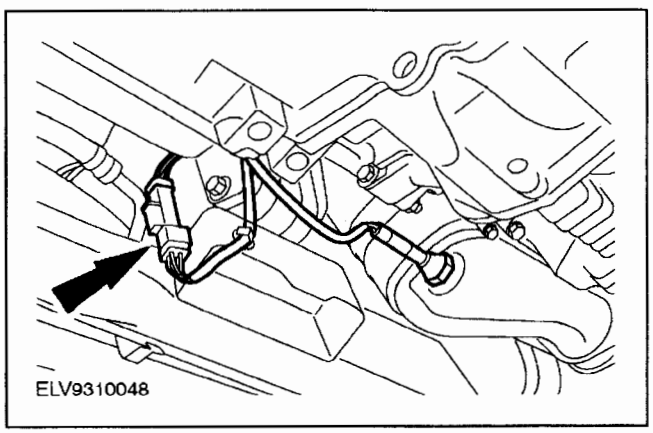
41. Attach the transaxle lower cooling line and the coolant hose to the radiator.



42. Install the transaxle cooling line.

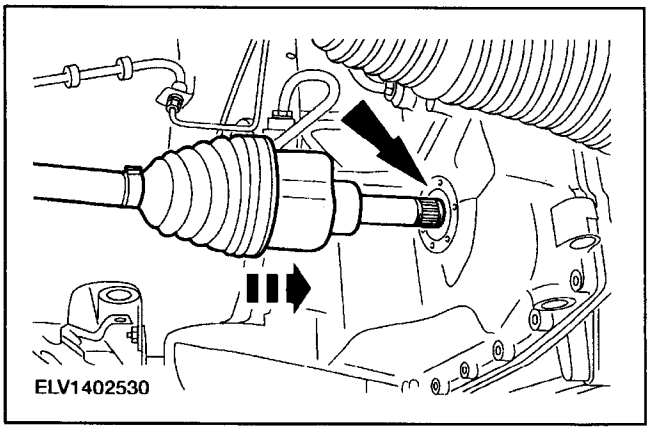


43. Install the transaxle cooling line.



44. Connect and install the HO2S electrical connector.

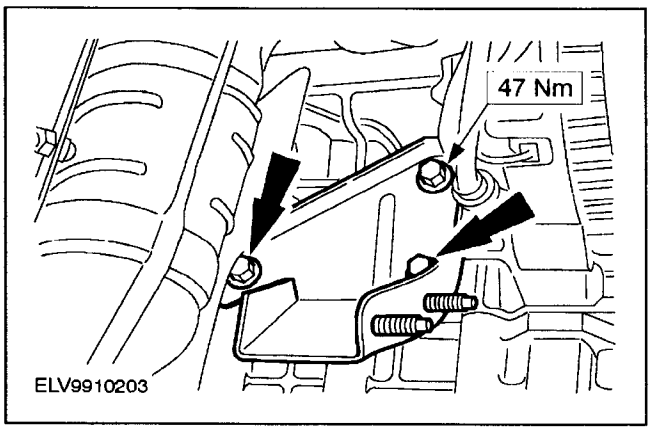
INSTALLATION (Continued)



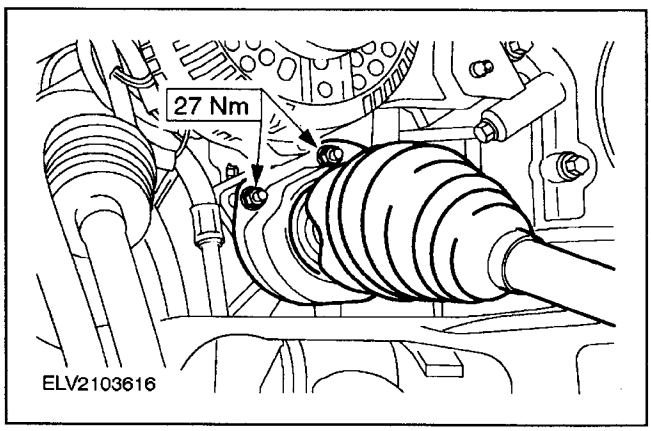
45. **CAUTION: To avoid damage to the halfshaft joints and boots, do not bend the inner halfshaft joint by more that 18 degrees, the outer one by more than 45 degrees.**

    NOTE: Do not damage the oil seal. Check that the snap-ring engages correctly.

    Install the left-hand front drive halfshaft.



46. Install the intermediate shaft bearing bracket.

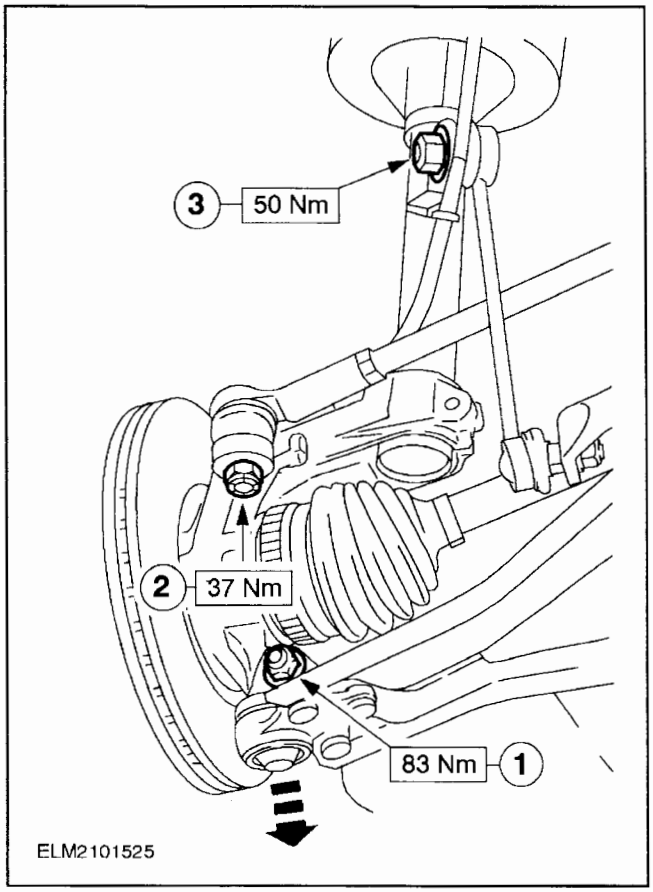


47. **CAUTION: If an intermediate shaft bracket with two sets of holes (one set for CD4E application and one set for MTX application) is installed, take care to install the mounting bolts into the correct holes.**

    CAUTION: To avoid damage to the halfshaft joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by more than 45 degrees.

    Install the right-hand front drive halfshaft and the intermediate shaft bearing.

INSTALLATION (Continued)



48. ⚠ **CAUTION: Do not damage the boot or the ABS sensor ring**

NOTE: Left-hand side shown, right-hand side similar.

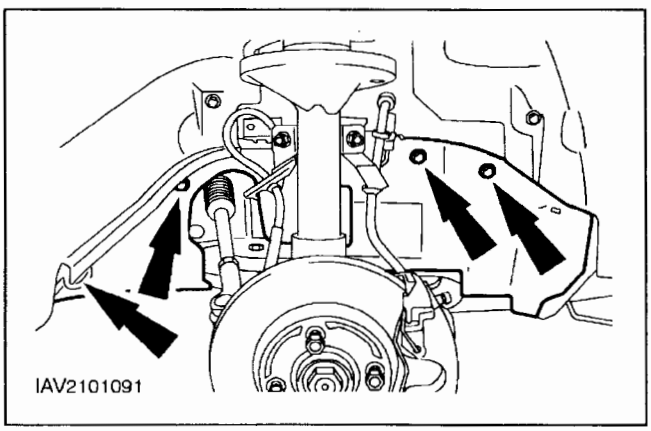
Install the suspension.

1 Install the lower arm ball joint to the wheel knuckle.

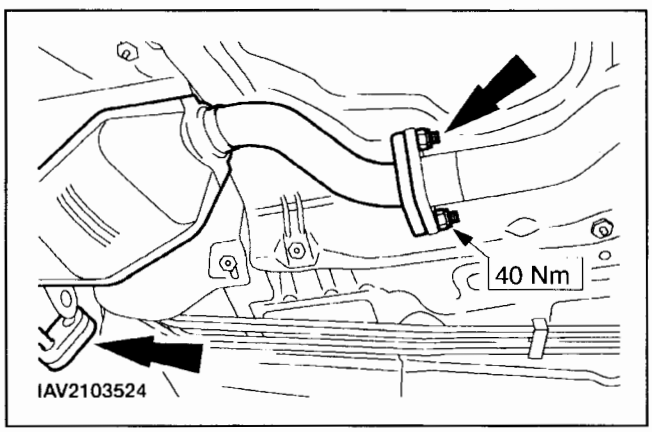
2 Install the tie-rod end.

3 Install the stabilizer link rod to the strut.

- Attach the ABS wiring harness bracket to the strut.

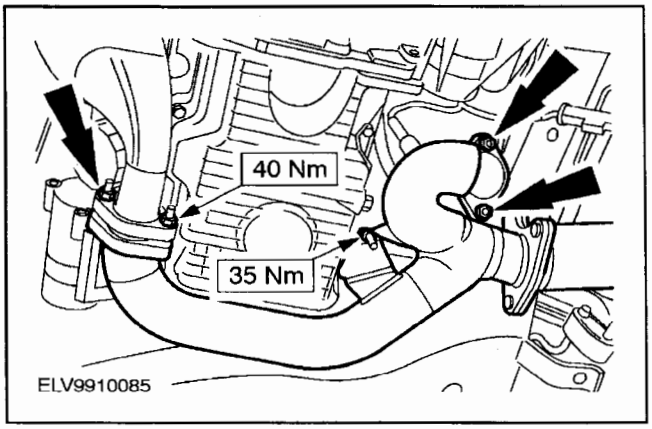


49. Install the right-hand fender splash shields.

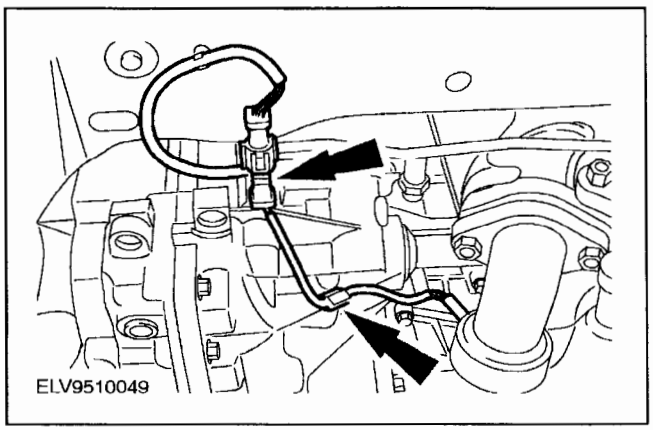


50. Install the dual converter Y-pipe.

INSTALLATION (Continued)

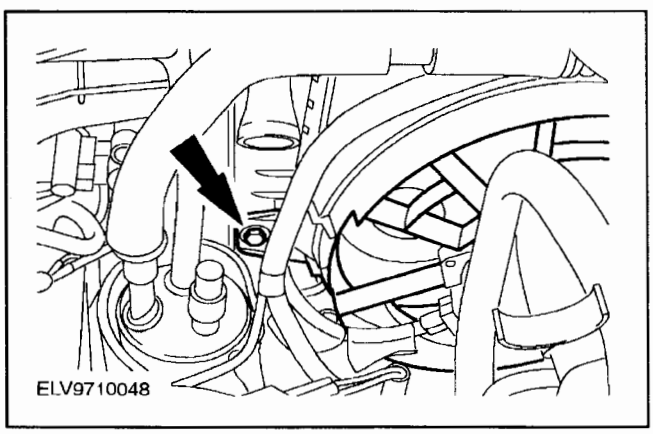


51. Install the dual converter Y-pipe (cont.).

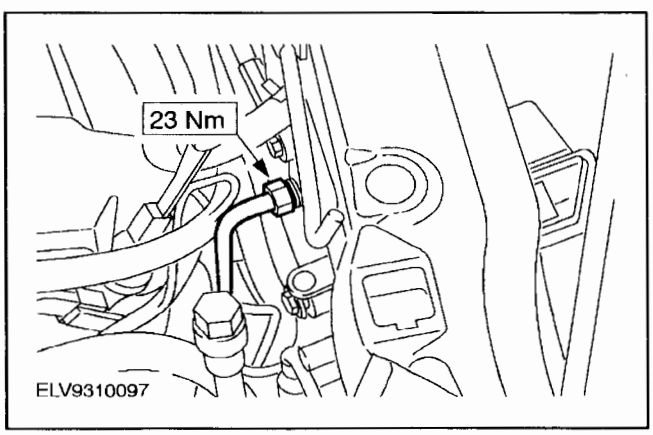


52. Connect and attach the HO2S electrical connector.

53. Lower the vehicle.

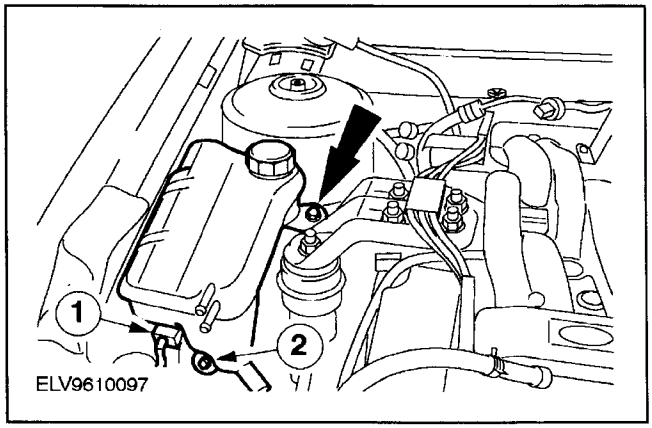


54. Install the fan to the radiator (one screw on each side).

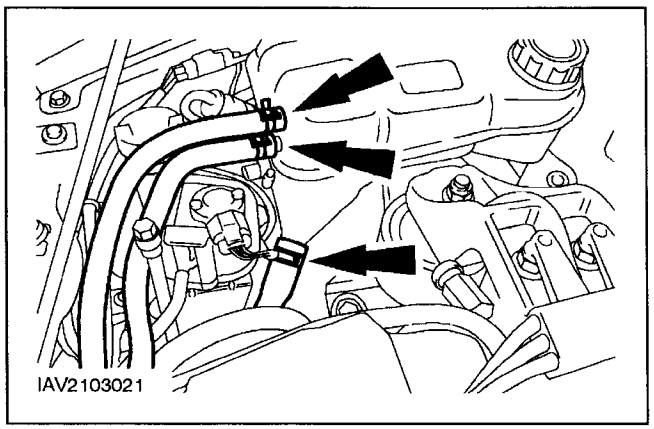


55. Install the transaxle upper line tube.

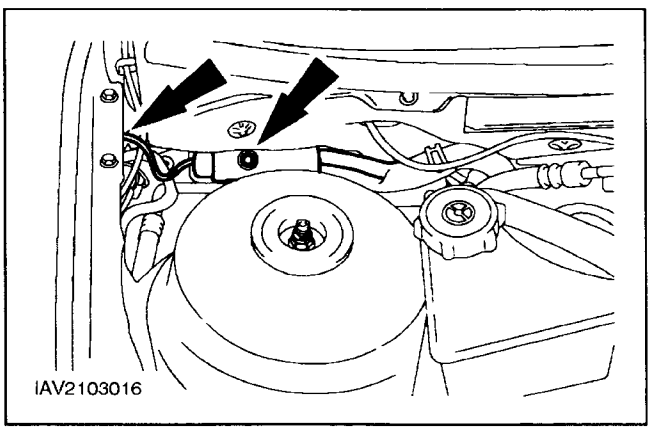
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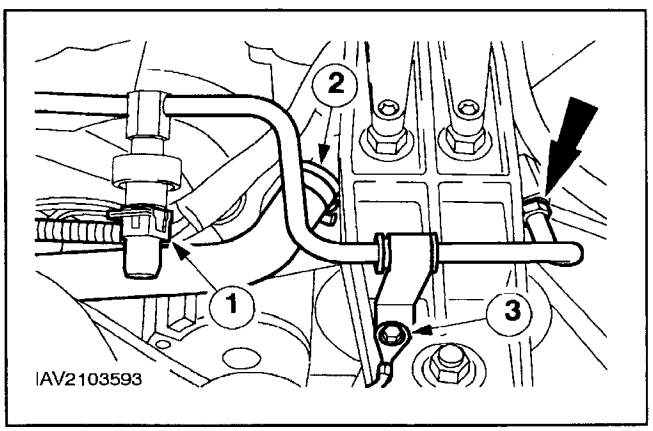
56. Install the coolant expansion tank.
    1 Connect the coolant level sensor.
    2 Install the bolts.



57. Connect the coolant expansion tank hoses.

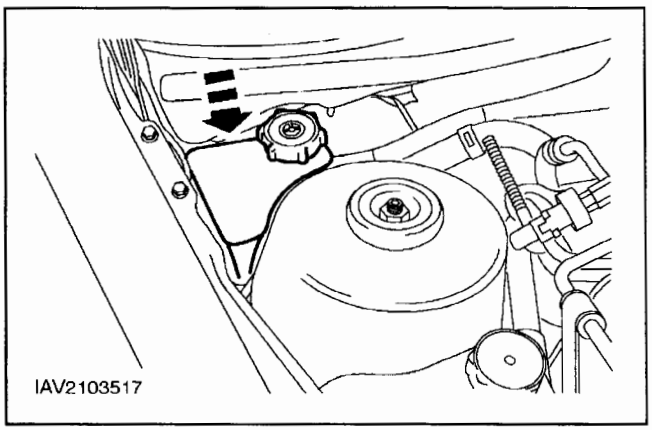


58. Connect the powertrain control module (PCM) and attach the ground cable.

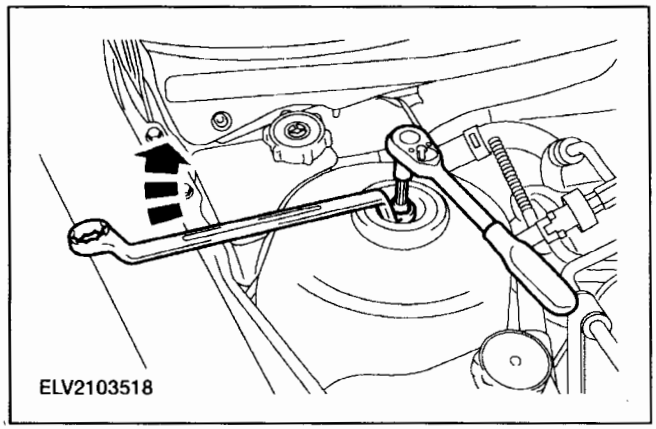


59. Connect the power steering lines.
    1 Connect the connector.
    2 Connect the power steering lines.
    3 Install the bolt and the ground cable.

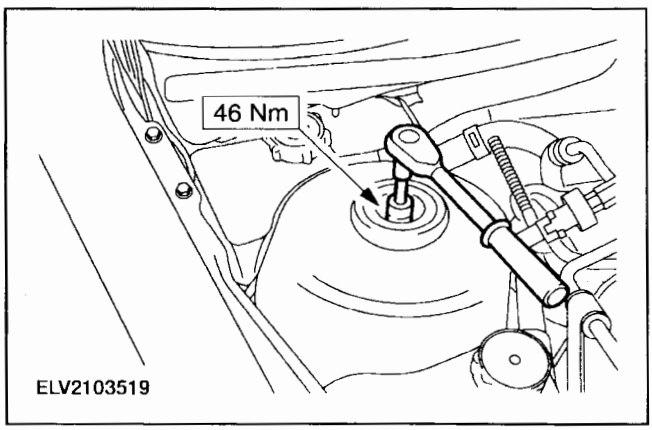
INSTALLATION (Continued)



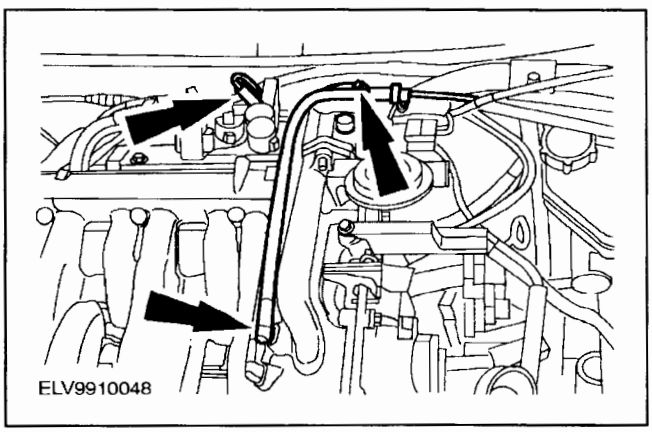
60. Install the power steering fluid reservoir.



61. **NOTE:** New nuts do not need to be installed.
    Pre-tighten the nut on both suspension struts.

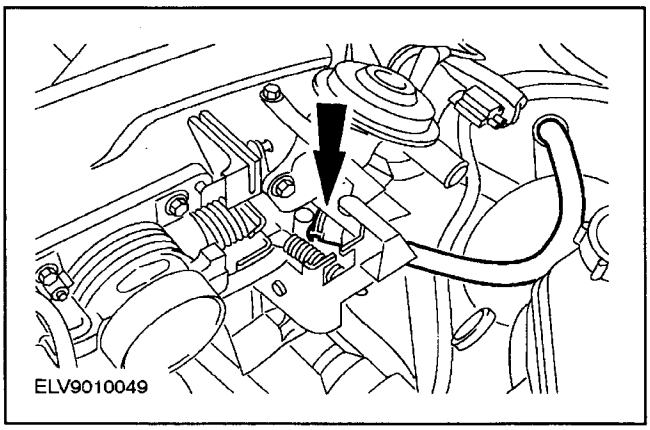


62. Tighten the nut on both suspension struts.

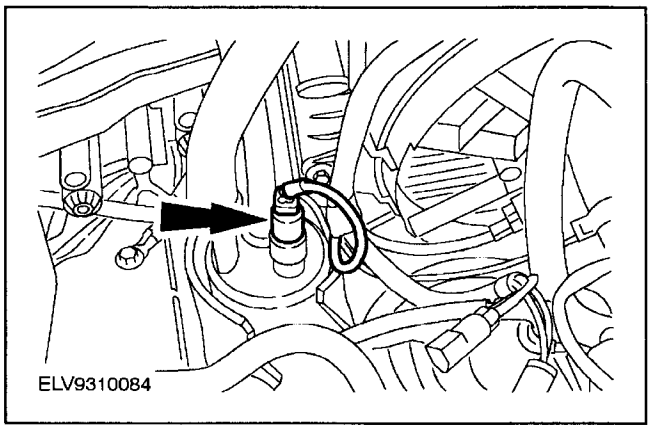


63. Connect the upper intake vacuum supply line and the heater control vacuum hoses.

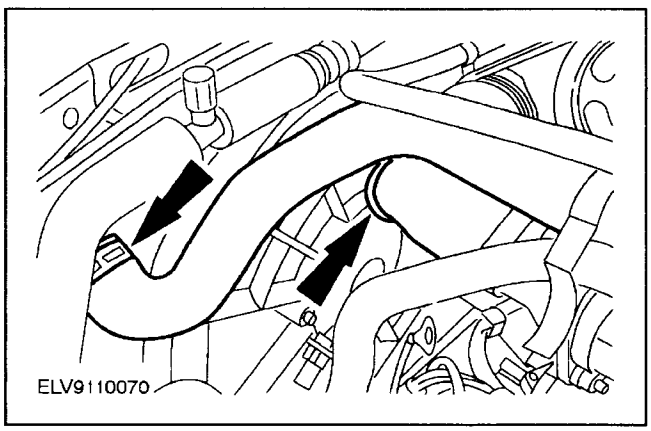
INSTALLATION (Continued)



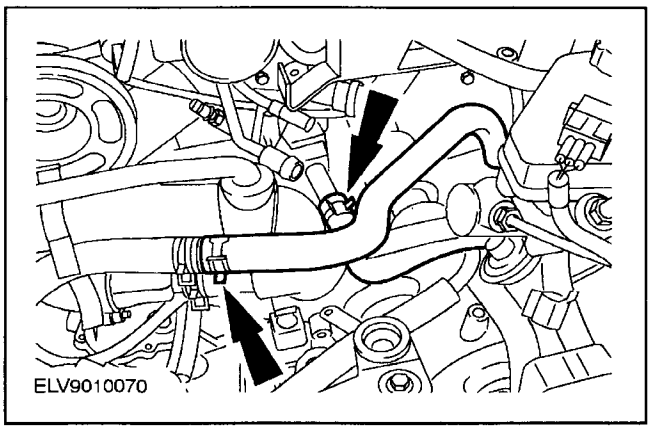
64. Connect the evaporative emission (EVAP) hose.



65. Connect the suction accumulator electrical connector.

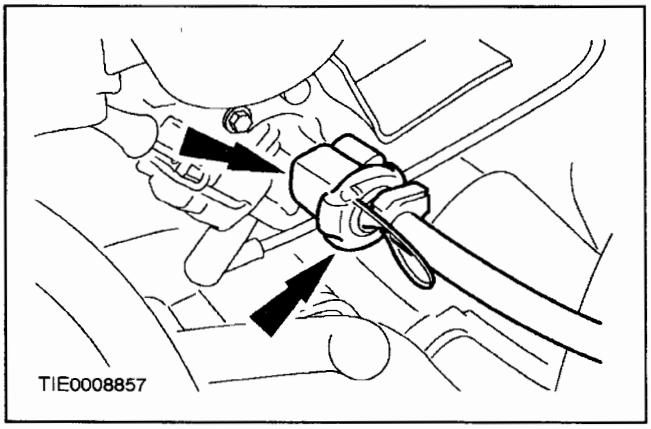


66. Attach the coolant hoses to the radiator and to the coolant passage.

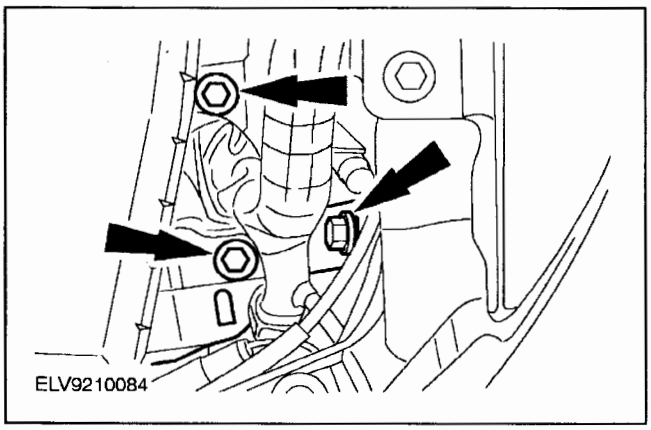


67. Connect the heater hoses.

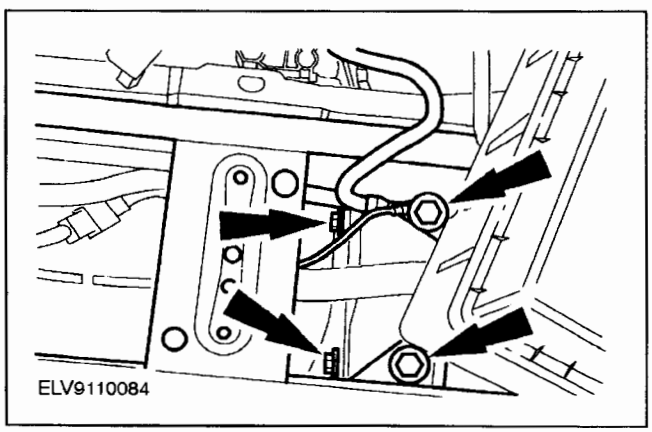
INSTALLATION (Continued)



68. Connect the fuel lines and attach the safety clips.

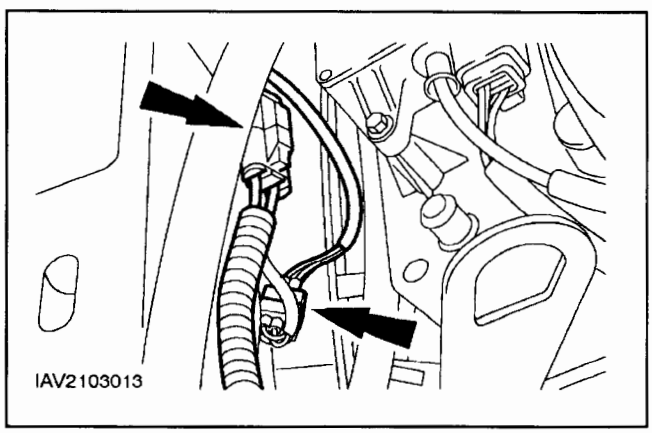


69. Install the battery bracket.



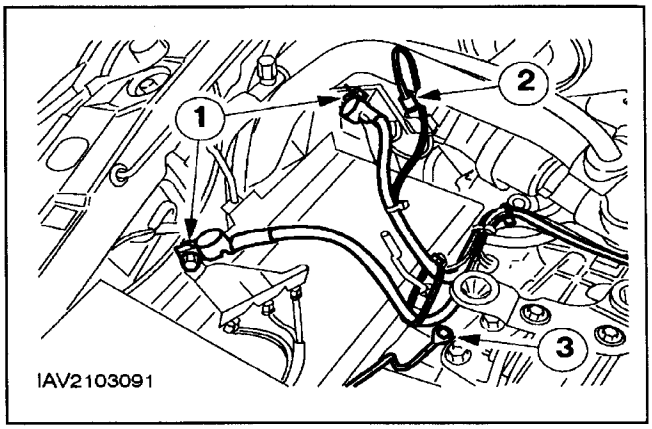
70. **NOTE:** Install the two ground cables together with one of the bracket screws.

    Install the battery bracket (continued).

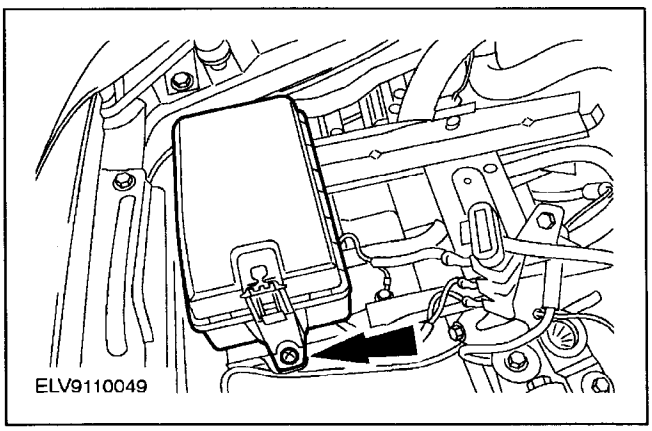


71. Connect the fan motor electrical connectors.

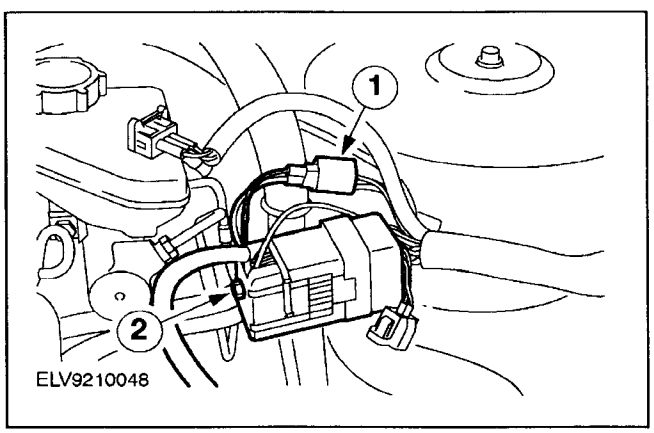
INSTALLATION (Continued)



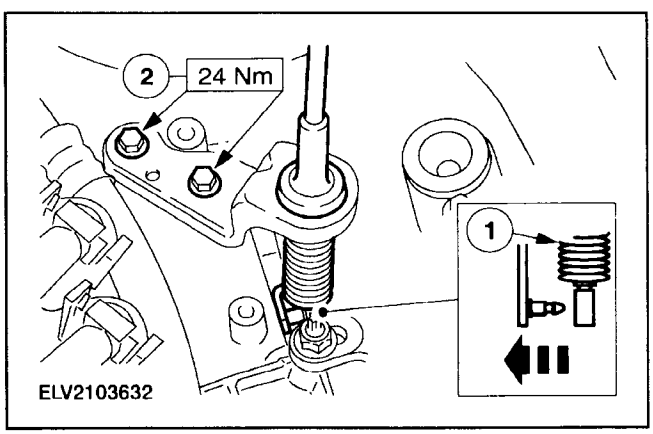
72. Connect the cables.
    1 Battery cable
    2 Electrical connector.
    3 Ground cable



73. Install the central junction box (CJB).



74. Connect the bulkhead connectors.
    1 Connect the electrical connector.
    2 Connect the bulkhead connector and install the bolt.

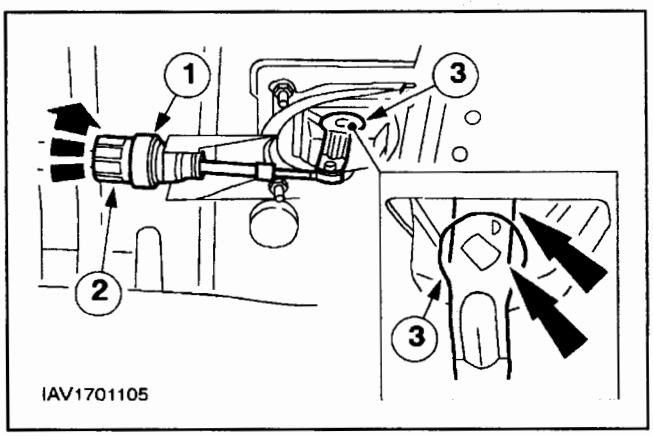


75. Install the selector cable.
    1 Push the selector cable into the selector lever and clip it in place.
    2 Install the selector cable bracket.

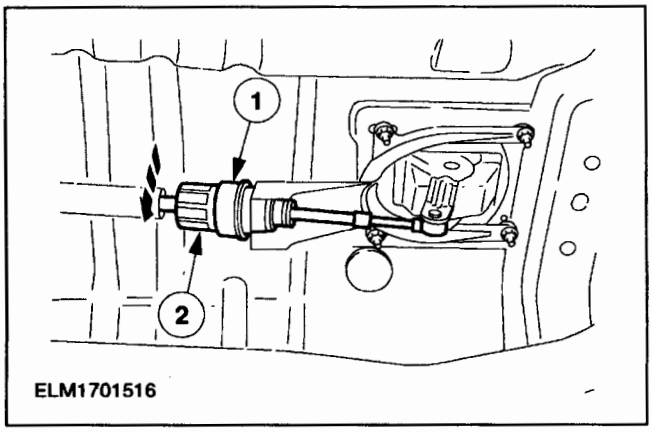
INSTALLATION (Continued)

76. Raise and support the vehicle. For additional information, refer to Section 100-02.

77. Remove the exhaust system rear heat shield.



78. Move the selector lever on the automatic transaxle into the "D" position and check the selector cable adjustment.
    1 Hold the adjusting mechanism still.
    2 Open the selector cable lock.
    3 The markings on the selector lever must line up.

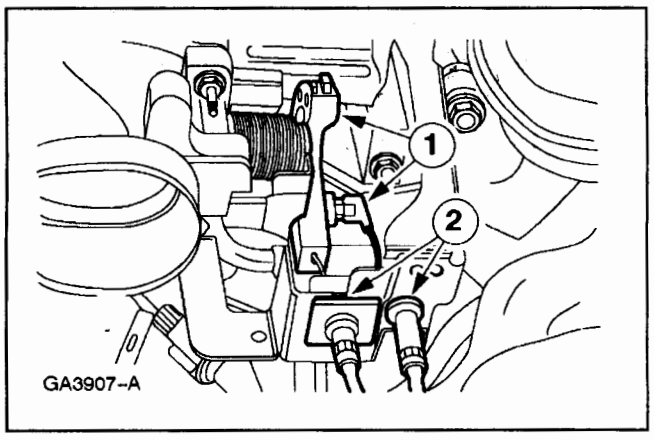


79. Lock the selector cable in place.
    1 Hold the adjusting mechanism still.
    2 Close the selector cable lock.

80. Install the exhaust system rear heat shield.

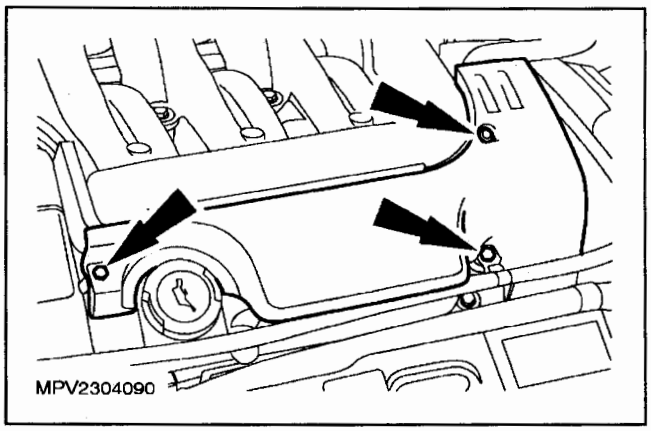
81. Install the front wheels. For additional information, refer to Section 204-04.

82. Lower the vehicle.



83. Connect the accelerator and speed control cables.
    1 Connect the cables.
    2 Clip the cables into the bracket.

INSTALLATION (Continued)



84. Install the water pump pulley cover.
    - Position the coolant hose in the clip and install the cover.

85. Install the hood.
    - Connect the hoses, install the screws and install the damping matting.

86. Install the air cleaner. For additional information, refer to Section 303-12B.

87. Fill the engine with engine oil.

88. Fill the engine cooling system. For additional information, refer to Section 303-03.

89. Fill the transaxle with automatic transmission fluid. For additional information, refer to Section 307-01.

90. Install the battery. For additional information, refer to Section 414-01.

91. Fill and bleed the power steering system. For additional information, refer to Section 211-00.

92. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

    Finishing operations.
    - Check the routing of the vacuum hoses and wiring and secure them with cable ties .
    - Check the fluid levels after the road test and correct as necessary.
    - Check the engine and cooling system for leaks (visual inspection).

SECTION 303-03 Engine Cooling

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SPECIFICATIONS

General Specifications

Item	Specification
Motorcraft Specialty Orange Engine Coolant VC-2	WSS-M97B44-P

Antifreeze

Specific gravity (providing no other additive is in coolant)	Approximate percentage of anti-freeze (by volume)	Remains fluid to	Solidifies at
1,061 at + 15°C (58°F)	50	-25°C (-13°F)	-30°C (-22°F)

Cooling System Refill Capacities

Engine	Automatic Transaxle	Manual Transaxle
2.0 L	7.1L (7.5 qt)	6.6L (7.0 qt)
2.5L	8.6L (9.1 qt)	8.4L (8.9 qt)

Cooling System Pressure Specification

Description	Pressure kPa (psi)
Radiator Pressure Test	138 (20)
Pressure Relief Cap Pressure	89-128 (13-18)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Thermostat housing cover bolts - 2.0L	9	—	80
Thermostat housing bolts - 2.0L	9	—	80
Thermostat housing bolts - 2.5L	18	13	—

(Continued)

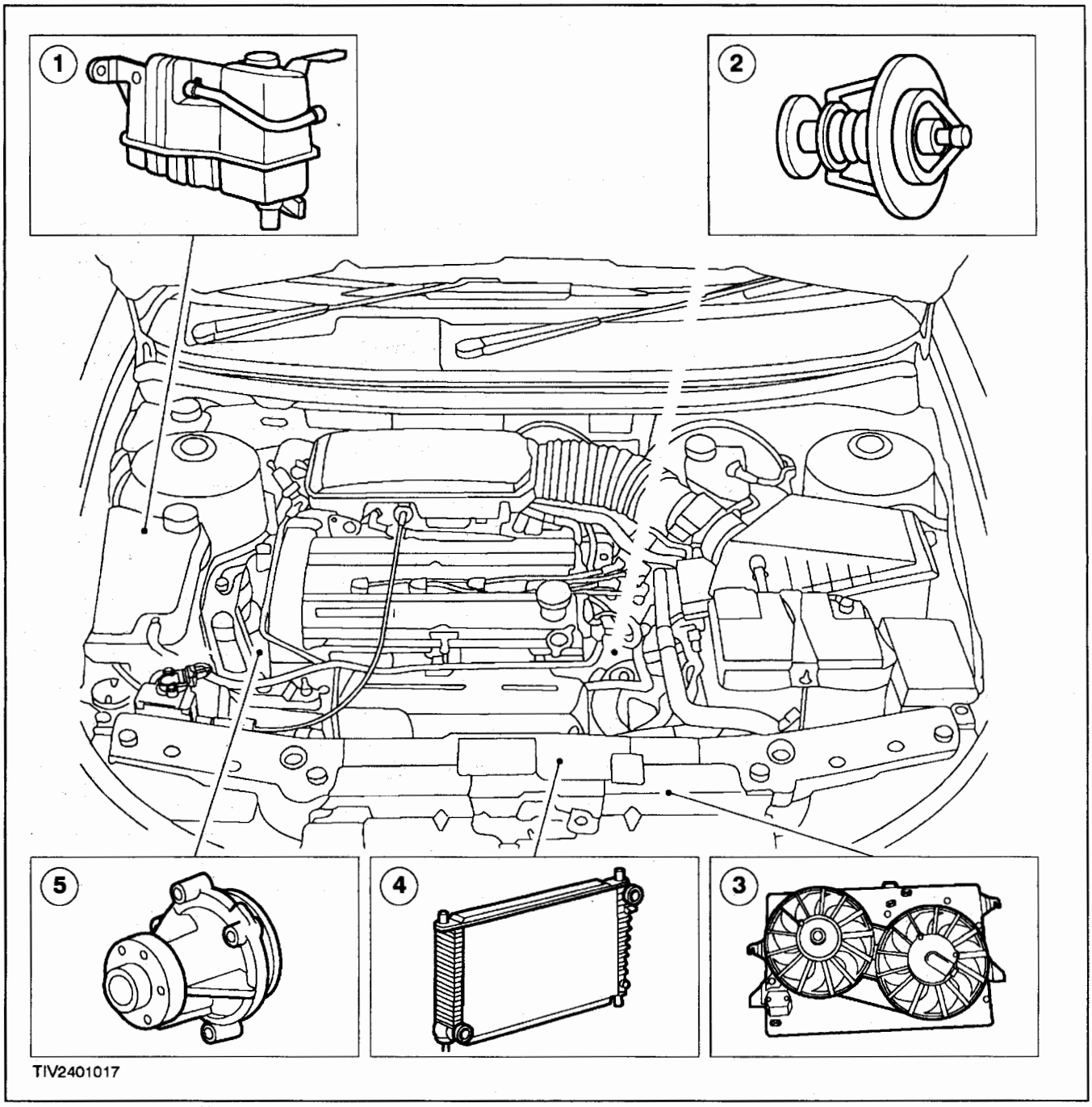
Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Water pump bolts - 2.0L	18	13	—
Water pump bolts - 2.5L	18	13	—
Water pump pulley bolts - 2.0L	12	9	—
Engine support bracket bolts	50	37	—
Engine support bracket nuts	80	59	—
Ground lead bolt	12	9	—
Transaxle cooling line union	27	20	—
Air conditioning (A/C) radiator bolts	4	—	35
Radiator bolts	10	—	89
Water pump belt tensioner bolt - 2.5L	10	—	89
A/C suction accumulator bolts	11	8	—

DESCRIPTION AND OPERATION

Engine Cooling

2.0L



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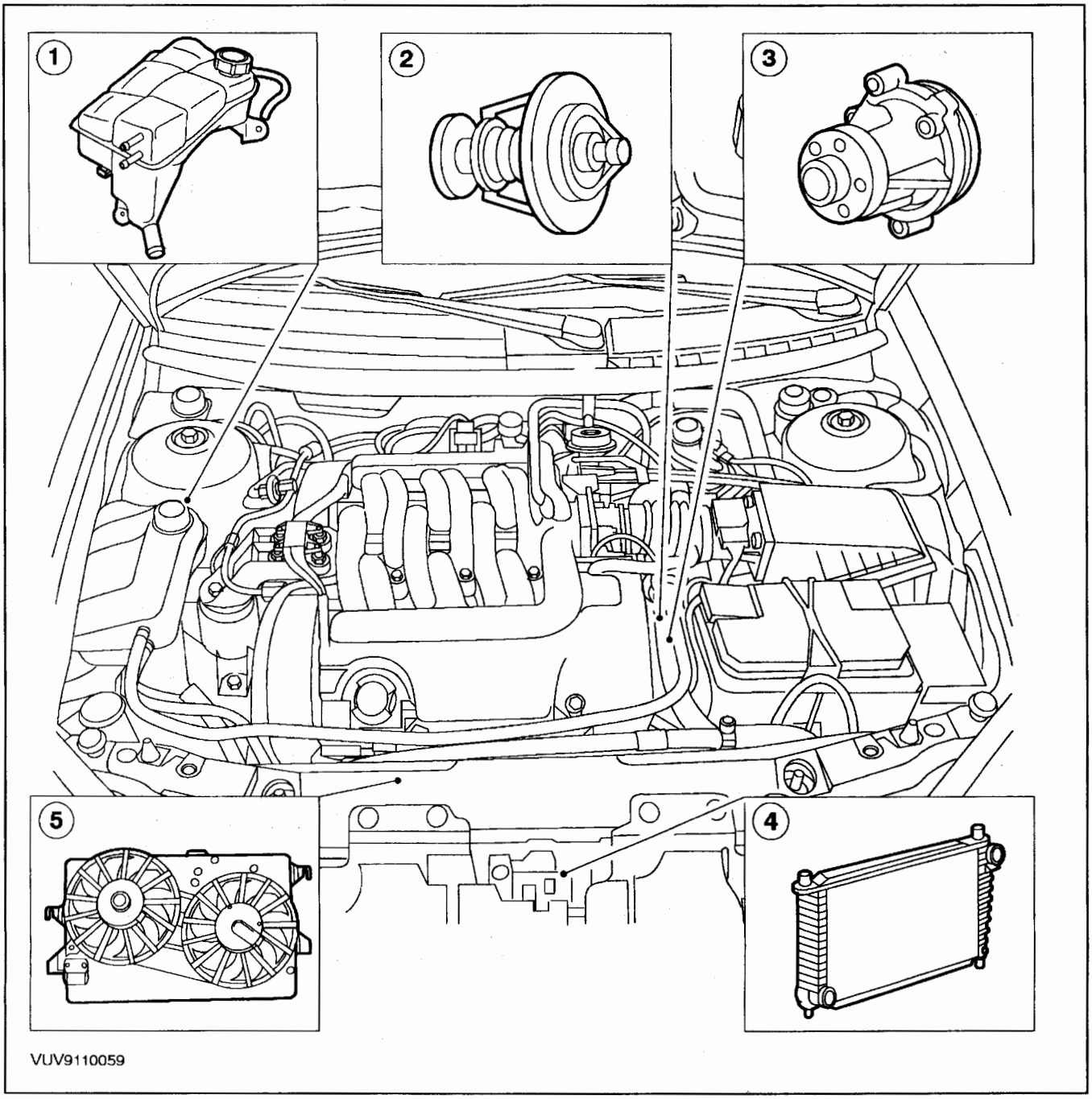
Item	Part Number	Description
1	—	Coolant expansion tank
2	—	Thermostat
3	—	Electric fans

Item	Part Number	Description
4	—	Radiator
5	—	Water pump

(Continued)

DESCRIPTION AND OPERATION (Continued)

2.5L



Item	Part Number	Description
1	—	Coolant expansion tank
2	—	Thermostat
3	—	Water pump

(Continued)

Item	Part Number	Description
4	—	Radiator
5	—	Electric fans

DESCRIPTION AND OPERATION (Continued)

⚠ WARNING: Never remove the coolant expansion tank cap under any circumstances while the engine is operating. Failure to follow these instructions may result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot water or steam blow out of the cooling system, use extreme care when removing the coolant expansion tank cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant expansion tank cap and turn it slowly until the pressure begins to release, step back while the pressure is released from the cooling system. When certain all the pressure has been released (still with a cloth) turn and remove the coolant expansion tank cap. Failure to follow these instructions may result in personal injury.

⚠ WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan blade has been examined for possible cracks and separation. Failure to follow this instruction may result in personal injury.

⚠ WARNING: Disconnect the fan control wiring prior to performing any underhood service since the cooling fan motor could cycle if the ignition switch is left in the RUN position. Failure to follow this instruction may result in personal injury.

NOTE: The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion damage.

The cooling system consists of the following:

- Radiator
- Coolant expansion tank cap
- Thermostat
- Water pump
- Engine cooling fan motors and fan blades which are activated by the powertrain control module (PCM) through two ISO relays in the battery junction box located near the battery in the engine compartment.
- A separate coolant expansion tank located beside the radiator helps to maintain the correct volume of engine coolant.

The water pump is of a conventional design and is driven by the left-hand side intake camshaft through a drive belt on 2.5L vehicles and by the crankshaft pulley through the accessory drive belt on 2.0L vehicles.

The thermostat:

- Is located in the thermostat housing.
- Allows rapid engine warm-up by restricting engine coolant flow at lower operating temperatures.
- Assists in keeping the engine operating temperature within predetermined limits.

The engine cooling system operates as follows:

- Coolant enters the radiator through the radiator inlet tank.
- Coolant flows through the radiator tubes and is cooled by air passing over the cooling fins assisted by the fan control and the fan blades.
- Coolant is then circulated from the radiator outlet tank where it mixes with coolant from the radiator coolant expansion tank and passes through the coolant thermostat housing.
- Coolant then goes through the water pump and into the cylinder block and cylinder heads on the 2.5L vehicles and through the cylinder head and into the cylinder block on 2.0L vehicles.
- Coolant then flows out of the engine through the water crossover (2.5L engine) or through the coolant thermostat housing (2.0L engine) to complete the circuit.

Refer to Specifications for the cooling system capacity.

Electrical System

The fan control system consists of:

- Powertrain Control Module (PCM).
- Air Conditioning (A/C) pressure cut - off switch.
- High speed cooling fan control (FC) relay.
- Low speed cooling fan control (FC) relay.
- Engine cooling fan resistor.
- Engine cooling fan motor.

DESCRIPTION AND OPERATION (Continued)

The powertrain control module (PCM) determines the cooling fan motor requirements and controls the fan operation through the low speed fan control and high speed fan control outputs. The PCM outputs complete the ground side of the relay coil circuits. Power to the relay coil circuits is provided by the PCM power relay.

If low speed fan operation is required, the PCM grounds the low speed fan control output. This energizes the low speed FC relay coil which closes the low speed FC relay contacts. Power flows through the fuse 2 (60A), the low speed FC relay contacts, the engine cooling fan resistor, and the engine cooling fan to ground. The engine cooling fan resistor provides thermal overload protection for the low speed fan control circuit.

If high speed fan operation is required the PCM grounds the high speed FC relay coil which closes the high speed FC relay contacts. Power flows through the fuse 2 (60A), the high speed FC relay contacts and the engine cooling fan to ground.

High speed fan operation may also be commanded by the dual pressure A/C pressure switch. The medium pressure contacts of the A/C pressure switch turn on the high speed cooling fan when A/C head pressure reaches a predetermined level grounding the air conditioning pressure switch. This grounds the high speed FC relay circuit. This closes the high speed FC relay contacts and turns on the high speed cooling fan.

If A/C head pressure drops below the predetermined level, the medium pressure contacts open returning the high speed FC relay operation to the PCM.

Coolant Recovery System

NOTE: When the coolant thermostat is closed, there is no flow through the radiator coolant expansion tank.

A pressurized radiator coolant expansion tank system is used which continuously separates the air from the cooling system.

- When the coolant thermostat is open, coolant flows through the hose from the bottom of the coolant expansion tank into the radiator lower hose.
- The coolant expansion tank separates any trapped air from the cooling system and replenishes the system through its coolant expansion tank hose attached to the water outlet hose.

The coolant expansion tank serves as the location for:

- Service fill.
- Coolant expansion during warm-up.
- System pressurization from the coolant expansion tank cap.
- Air separation during operation.
- The coolant expansion tank is designed to have approximately 0.5 to 1 liter of air when cold to allow for coolant expansion.

Radiator

Aluminum Core, Crossflow

The radiator is of the tube and louvered fin core - type with the tubes arranged horizontally for crossflow of the coolant.

- Two tanks, one at each side of the radiator, provides uniform distribution of the coolant to the crossflow tubes.
- The radiator tank on the right-hand side of the radiator contains a transaxle oil cooler for the automatic transaxle fluid (if equipped).

Cooling Fan, Electric

⚠ **WARNING: The engine electric cooling fan motor may come on at any time without warning, even if the engine is not running. Failure to follow these instructions may result in personal injury.**

The fan control system consists of:

- Fan blades.
- Two, two-speed cooling fan motors attached to a fan shroud located behind the radiator.
- The cooling fan motors are wired to operate only when the ignition switch is in the RUN position, thereby preventing cooling fan motor operation after the ignition switch is turned to the OFF position.

Coolant Thermostat

When the coolant is cold, the coolant thermostat is in the closed position and the coolant flow is restricted to the cylinder block, cylinder head(s) and heater system.

As the engine coolant temperature increases, the coolant thermostat opens and allows the coolant to pass into the radiator.

Engine Coolant

The Organic Acid Technology (OAT) engine coolant is formulated to last for 10 years or 240,000km (150,000 miles). The coolant is silicate free and orange in color. OAT engine coolant should not be mixed with conventional engine coolant.

DESCRIPTION AND OPERATION (Continued)

Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Specialty Orange Engine Coolant VC-2, or equivalent, meeting Ford specification WSS-M97B44-D.
- Do not add/mix Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A, or equivalent, meeting Ford specification WSS-M97B51-A1 (yellow color). Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B44-D. Not all coolant recycling processes meet this Ford specification. Use of such a coolant may harm the engine and cooling system components. Do not mix coolant types.

DIAGNOSIS AND TESTING

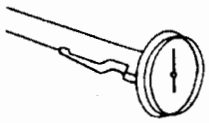
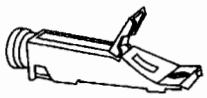
Engine Cooling

Special Tool(s)

 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
 ST2061-A	Radiator/Heater Core Pressure Tester 014-R1072 or equivalent
 ST1626-A	Service Coolant Temperature Monitor Harness 007-00064 or equivalent

(Continued)

Special Tool(s)

 ST1396-A	0 to 200 Degrees F Dial Thermometer 023-R0007 or equivalent
 ST1720-A	Battery/Anti-Freeze Tester 014-R1060 or equivalent

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

DIAGNOSIS AND TESTING (Continued)

Visual Inspection Chart

Mechanical	Electrical
• Leaks • Coolant expansion tank • Electric fan(s) • Radiator	• Fuse • Wiring harness • Loose or corroded connector(s) • Engine cooling temperature (ECT) sensor

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. Inspect the coolant condition.
   1 Inspect the coolant color.
   - If Motorcraft Specialty Orange Engine Coolant VC-2, or equivalent, meeting Ford specification WSS-M97B44-D has a clear or light orange color, this indicates higher water content than required.
   - Dark brown could indicate unauthorized stop leak may have been used. Use Motorcraft Cooling System Stop Leak Pellets VC-6, or equivalent, meeting Ford specification ESE-M99B37-B5 except as noted in ES-F6SE-19A511-AA only.
   - A light or reddish brown color indictes that rust may be present in the cooling system. Flush the system and refill with the correct mixture of water and Motorcraft Orange Specialty Coolant. For additional information, refer to Cooling System Flushing in this section.
   - An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to Section 303-00.
   - A milky brown color may indicate that either engine oil or transmission fluid is entering the cooling system. If transmission fluid is suspected the cause may be a leaky radiator. Pressure test the cooling system. For additional information, refer to the component tests in this section. If engine oil is suspected, the cause of the leak may be internal to the engine. For additional information, refer to Section 303-00.
   - If transmission fluid is contaminated with engine coolant, the cause may be a leaky radiator. Pressure test the cooling system. For additional information, refer to the component tests in this section.

   2 If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Battery/Anti-Freeze Tester. The freezing point should be in the range -50°F to -10°F. If the vehicle is driven in cold climates less than -34°F, it may be necessary to increase the coolant concentration to get adequate freeze protection.
   - Maximum coolant concentration is 60/40
   - Minimum coolant concentration is 40/60

   3 Adjust coolant range and level if necessary.
   - If coolant is low, add specified coolant mixture only.
   - If the engine coolant tests weak, add straight engine coolant until the readings are within acceptable levels.
   - If the engine coolant tests strong, remove some of the engine coolant and add water until the readings are within acceptable levels.
5. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Loss of coolant	• Hoses. • Hose connections. • Radiator. • Water pump. • Heater core. • Gaskets. • Engine casting cracks. • Engine block core plugs.	• GO to Pinpoint Test A.
• The engine overheats	• Engine coolant. • Thermostat. • Fuse. • Circuit. • Fan motor. • Engine coolant temperature (ECT) sensor. • Powertrain control module (PCM).	• GO to Pinpoint Test B.
• The engine does not reach normal operating temperature	• Thermostat. • Electric fans.	• GO to Pinpoint Test C.
• Engine block heater does not operate properly	• Block heater power cable. • Block heater.	• GO to Pinpoint Test D.

Pinpoint Tests

PINPOINT TEST A: LOSS OF COOLANT

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 VISUAL INSPECTION	
	1 Visually inspect for loss of coolant. • Is the engine cooling system leaking? → **Yes** REPAIR the components in question. REFER to the appropriate section. → **No** CARRY OUT the Pressure Test. REFER to the Component Tests in this Section.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B: THE ENGINE OVERHEATS

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK COOLANT	
⚠ **WARNING: Never remove the expansion tank cap under any circumstances while the engine is operating. Failure to follow these instructions may result in damage to the cooling system of the engine and/or personal injury. To avoid having scalding hot water or steam blow out of the cooling system, use extreme care when removing the expansion tank cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the expansion tank cap and turn it slowly until the pressure begins to release, step back while the pressure is released from the cooling system. When certain all the pressure has been released (still with a cloth) turn and remove the expansion tank cap. Failure to follow these instructions may result in personal injury.**	
	[1] Inspect the coolant level and condition. • Is the coolant OK? → **Yes** GO to **B2**. → **No** If coolant is weak or contaminated, FLUSH and REFILL with new coolant as necessary. If the coolant is low, REFILL the system and CARRY OUT the Component Test. REFER to the Component Tests in this Section.
B2 CHECKTHERMOSTAT	
	[1] Carry out the component test in this section. • Is the thermostat OK? → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1]. → **No** INSTALL a new thermostat.

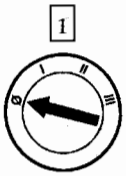
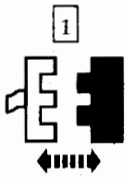
PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECKTHERMOSTAT	
	[1] Carry out the component test in this section. • Is the thermostat OK? → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1]. → **No** INSTALL a new thermostat.

1 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST D: ENGINE BLOCK HEATER DOES NOT OPERATE CORRECTLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK ELECTRICAL CONNECTOR AND WIRE	
	[2] Check for corroded terminals on the electrical connector. [3] Check for broken, cracked or cut wires. • Are the connector and wires OK? → **Yes** GO to **D2**. → **No** REPAIR or INSTALL as necessary. GO to **D2**.
D2 CHECK CONTINUITY OF ELECTRICAL CONNECTOR AND WIRE	
 Block Heater	[2] Check resistance in circuits 1, 2 and 3 of the block heater power cable. • Is the resistance in circuits 1, 2, and 3 5 ohms or less? → **Yes** INSTALL a new block heater. TEST the system for normal operation. → **No** INSTALL a new power cable. TEST the system for normal operation.

DIAGNOSIS AND TESTING (Continued)

Component Tests

Pressure Test

⚠ WARNING: Never remove the expansion tank cap under any circumstances while the engine is operating. Failure to follow these instructions may result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot water or steam blow out of the cooling system, use extreme care when removing the expansion tank cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the expansion tank cap and turn it slowly until the pressure begins to release, step back while the pressure is released from the cooling system. When certain all the pressure has been released (still with a cloth) turn and remove the expansion tank cap. Failure to follow these instructions may result in personal injury.

1. Switch the engine off.
2. Open the hood and install protective fender covers.
3. Carefully remove the coolant expansion tank cap from the coolant expansion tank to relieve pressure in the cooling system. Add coolant to coolant expansion tank as necessary.
4. Install the adapter fitting from Pressure Tester tightly between overflow/air purge nipple and overflow/air purge hose at the coolant expansion tank. Reinstall the coolant expansion tank cap.
5. Attach the pressure pump and gauge to the adapter fitting and pressurize the cooling system to the coolant expansion tank cap lower limit. Refer to Specification.
6. Pressurize the cooling system. Observe the gauge reading for approximately two minutes. Pressure should not drop during this time.
   - If system holds pressure, proceed to Step 8.
   - If the pressure drops, check for leaks at the engine to heater core hoses, engine to radiator hoses, bypass hose, water valve hose (if applicable), thermostat housing gasket, radiator and heater core, etc. Also refer to engine system checks if a leak cannot be located in the cooling system. Correct any leaks found and recheck the system.
7. Release the system pressure by loosening the coolant expansion tank cap. Check the coolant level. Replenish as necessary with the correct coolant solution.
8. Check the radiator overflow hose for any obstructions which may block the flow of coolant either to or from the coolant expansion tank.
9. Conduct the expansion tank cap Pressure Test in this section.

Coolant Expansion Tank Cap Pressure Test

⚠ WARNING: Never remove the expansion tank cap under any circumstances while the engine is operating. Failure to follow these instructions may result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot water or steam blow out of the cooling system, use extreme care when removing the expansion tank cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the expansion tank cap and turn it slowly until the pressure begins to release, step back while the pressure is released from the cooling system. When certain all the pressure has been released (still with a cloth) turn and remove the expansion tank cap. Failure to follow these instructions may result in personal injury.

1. Remove the expansion tank cap from the radiator coolant expansion tank.
2. Use water to clean in area of rubber seal and vacuum relief valve. Immerse expansion tank cap in water and install expansion tank cap pressure test adapter from Pressure Tester on the expansion tank cap.

NOTE: If the plunger of the pump is depressed too quickly, an erroneous pressure reading will result.

3. Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing, and note highest pressure reading obtained.
4. Release pressure by turning the pressure relief screw counterclockwise. Then tighten the pressure relief screw and repeat Step 5 at least twice to make sure the pressure test reading is repeatable and within acceptable gauge reading limits of the expansion tank cap.

DIAGNOSIS AND TESTING (Continued)

5. If the pressure test gauge readings are not within acceptable gauge reading limits, install a new expansion tank cap.

Thermostat Test

The thermostat should be replaced only after the following tests have been carried out.

Thermostat Test, Electrical

⚠ CAUTION: Always vent the exhaust to the outside when carrying out this test.

NOTE: Procedure is most accurate if carried out indoors at less than 37.8°C (100°F) ambient air. This test may be performed with or without the hood open and with the engine warm or cold.

1. Check the coolant level in the radiator and engine coolant expansion tank. Fill as required.
2. With the key OFF, disconnect the engine coolant temperature (ECT) sensor electrical connector and attach Service Coolant Temperature Monitor Harness as a jumper between the PCM and the ECT. Attach Digital Multimeter to the thermostat monitor harness. Voltage values (0 to 5 V) may now be monitored while the sensor retains its connection to the harness.

NOTE: Running this test with the vehicle in gear or with the A/C compressor clutch engaged (running) will cause improper diagnosis.

3. Place transmission in Park (P) or Neutral (N).
4. Start the engine and allow to idle throughout this test. Allow the engine to run for 2 minutes, then record the ECT voltage. Record the ECT voltage every 60 seconds. When the ECT voltage trend changes direction or only changes slightly (0.03 volts or less) from the previous reading, record this as the thermostat opening voltage. Use the voltage and corresponding coolant temperature chart listed below.

Coolant Temperature °C (°F)	ECT (Volts)
20 (68)	3.09
40 (104)	2.15
70 (158)	1.04
80 (176)	0.79

(Continued)

Coolant Temperature °C (°F)	ECT (Volts)
90 (194)	0.61
95 (203)	0.53
105 (221)	0.41

5. If the thermostat opening voltage is greater than 0.79 volts and less than 0°C (76°F), replace the thermostat.
6. If the thermostat opening voltage is less than 0.79 volts and greater than 80°C (176°F), the thermostat is OK and should not be changed. Refer to the Symptom Chart for further instructions.

Thermostat Test, Mechanical

NOTE: Fully open means the thermostat valve lifts a distance of 5.8 mm (0.2 in) or more off the valve seat.

Remove the thermostat and immerse in a boiling antifreeze and water mixture. The thermostat should begin to open at 86-90°C (187-194°F) 2.0L engine, 84-88°C (183-190°F) 2.5L engine and be fully open at 102°C (216°F) 2.0L engine, 99°C (210°F) 2.5L engine. Install a new thermostat if it does not operate as specified.

If heat is not available, check the thermostat for leakage. Hold the thermostat up to a lighted background. Leakage of light around the thermostat valve at room temperature indicates that the thermostat should be replaced. Some thermostats have a small leakage notch at one location on the perimeter of the thermostat valve, which is considered normal.

Radiator Leak Test, Removed From the Vehicle

⚠ CAUTION: Do not leak test an aluminum radiator in the same water that is used to leak test copper/brass radiators. Flux and caustic cleaners may be present in the test water which will corrode aluminum.

Clean the radiator before leak testing to prevent contamination of the test tank. Leak test the radiator in clean water with 138 kPa (20 psi) air pressure.

A separate clean test tank is recommended for aluminum radiators. If a separate tank is not available for aluminum radiator testing, rinse the test tank each time before testing an aluminum radiator.

GENERAL PROCEDURES

Cooling System Draining, Filling And Bleeding

Materials

Item	Specification
Motorcraft Specialty Orange Engine Coolant VC-2 or equivalent	WSS-M97B44-D

Draining

1. **⚠ WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is releasd from the cooling system. When certain all the pressure has been released turn and remove the pressure relief cap (still with a cloth). Failure to follow these instructions may result in personal injury.**

   ⚠ CAUTION: The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated, it must be recycled or disposed of correctly and new coolant added.

   NOTE: Less than 80% of coolant capacity can be recovered with the engine in the vehicle. Add new coolant if dirty, rusty or contaminated.

   Release the pressure in the cooling system by slowly turning the pressure relief cap one half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

2. Place a suitable container below the radiator draincock.

3. Close the radiator draincock when finished.

GENERAL PROCEDURES (Continued)

Filling

1. **⚠ CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency, and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.**

   ⚠ CAUTION: When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water. To maintain the integrity of the coolant and the cooling system:

   - **Add Motorcraft Specialty Orange Engine Coolant VC-2, or equivalent, meeting Ford specification WSS-M97B44-D.**
   - **Do not add Motorcraft Premium Engine Coolant VC-4-A, or equivalent, meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A, or equivalent, meeting Ford specification WSS-M97B51-A1 (yellow color). Mixing coolant may degrade the coolant's corrosion protection.**
   - **Do not add alcohol, methanol, or brine, or any engine coolants mixed with alcohol or methanol. These can cause engine damage from overheating or freezing.**
   - **Do not mix with recycled coolant unless it meets the requirements of Ford specification WSS-M97B44-D. Not all coolant recycling processes meet this Ford specification. Use of such a coolant may harm the engine and cooling system components.**

   Add the correct engine coolant mixture to the degas bottle and install the pressure relief cap.

2. Move the temperature blend selector to the full warm position.

3. Run the engine until it reaches operating temperature.

4. Turn the engine off and allow to cool.

GENERAL PROCEDURES (Continued)

5. ⚠ **WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions can reuslt in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released turn and remove the pressure relief cap (still with a cloth). Failure to follow these instructions may result in personal injury.**

   Remove the pressure relief cap.

6. Add the correct engine coolant mixture to the degas bottle until the coolant level is between the "COOLANT FILL LEVEL" marks. Install the pressure relief cap.

7. Repeat above steps until the degas bottle level is OK.

Bleeding

1. Select maximum heater temperature and blower motor speed settings. Position control to discharge air at the A/C vents in the instrument panel.

2. Start the engine and allow it to idle. While the engine is idling, feel for hot air at the A/C vents.

3. ⚠ **CAUTION: If the air discharge remains cool and the engine coolant temperature gauge does not move, the engine coolant level is low in the engine and must be filled. Stop the engine, allow to cool, and fill the cooling system as described.**

   Start the engine and allow it to idle until normal operating temperature is reached. Hot air should discharge from the A/C vents. The engine coolant temperature gauge should maintain a stabilized reading in the middle of the NORMAL range and the upper radiator hose should feel hot to the touch.

GENERAL PROCEDURES (Continued)

4. Shut the engine off and allow it to cool.
5. Check the engine for coolant leaks.
6. Check the engine coolant level in the degas bottle and fill as necessary.

Cooling System Flushing

1. To remove rust, sludge and other foreign material from the cooling system, use Motorcraft Cooling System Flush VC-1 or equivalent meeting Ford specification ESR-M14P7-A that is safe for use with aluminum radiators. Remove the thermostat prior to pressure flushing. This cleaning restores cooling system efficiency and helps prevent overheating. A pulsating or reversed direction of flushing water will loosen sediment more quickly than a steady flow in the normal coolant flow direction. In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method using Cooling System Flusher 164-R3670 or equivalent. Dispose of old coolant and flushing water contaminated with antifreeze and cleaning chemicals in accordance with local, state and federal laws.
2. **⚠ CAUTION: Radiator internal pressure must not exceed 138 kPa (20 psi). Damage may result.**

   Backflush the radiator with the radiator in an upside down position with a high-pressure water hose in the lower hose location and backflush.
3. Remove thermostat. For additional information, refer to Thermostat—Vehicles with 2.0L Engine or Thermostat—Vehicles with 2.5L Engine in this section.
4. Backflush the engine. Position the high-pressure water hose into the engine through the engine return and backflush the engine.
5. Backflush the heater core. For additional information, refer to Heater Core Backflushing in this section.

GENERAL PROCEDURES (Continued)

Heater Core Backflushing

⚠ **CAUTION: The heater core must be backflushed separately from the engine cooling system for correct backflush water flow direction through the heater core. All engine cooling system flushing and backflushing procedures must include a separate backflushing of the heater or A/C system heater core after the flushing or backflushing of the engine cooling system to prevent the engine cooling system particles from clogging the heater core tubes and reducing (or eliminating) coolant flow through the heater core.**

1. Disconnect the outlet heater water hose from the engine and install a garden hose with a female fitting adapter into the end of the heater outlet water hose. Secure with a hose clamp.

2. Connect the female hose end of the heater outlet water hose to the male end of a water supply garden hose.

3. Disconnect the heater inlet water hose from the engine and allow it to drain into a suitable container.

4. Turn the water supply valve ON and OFF several times so that the surge action will help to dislodge larger, stubborn particles from the heater core tubes. Allow water pressure to flow for approximately five minutes.

5. Remove the hose clamp and garden hose with the female adapter from the heater outlet water hose and reconnect the heater outlet water hose onto the engine.

6. Connect the heater inlet water hose onto the engine.

7. Fill the cooling system. For additional information refer to Cooling System Draining, Filling And Bleeding in this section.

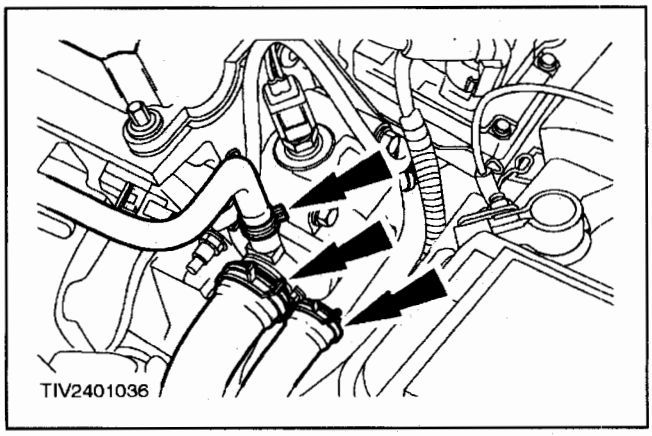
8. Test the system for correct heater performance with the specified engine cooling system conditions.

REMOVAL AND INSTALLATION

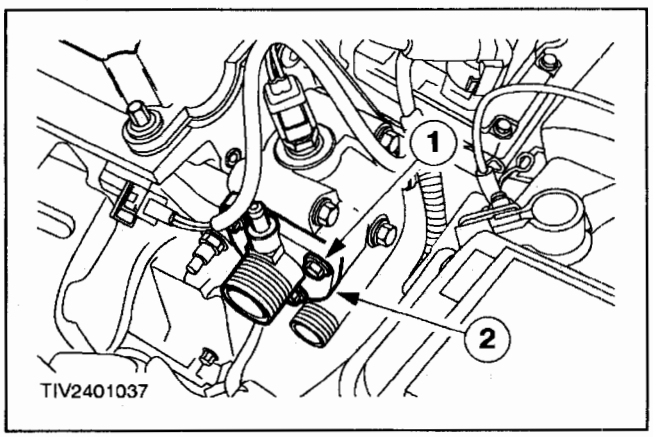
Thermostat — Vehicles with 2.0L Engine

Removal

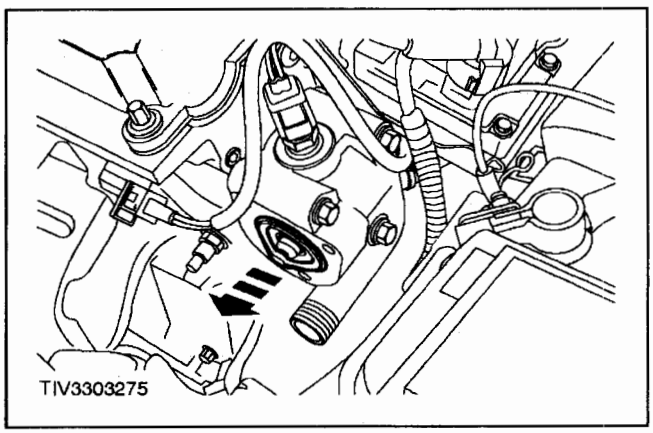
1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.



2. Disconnect the thermostat hoses.



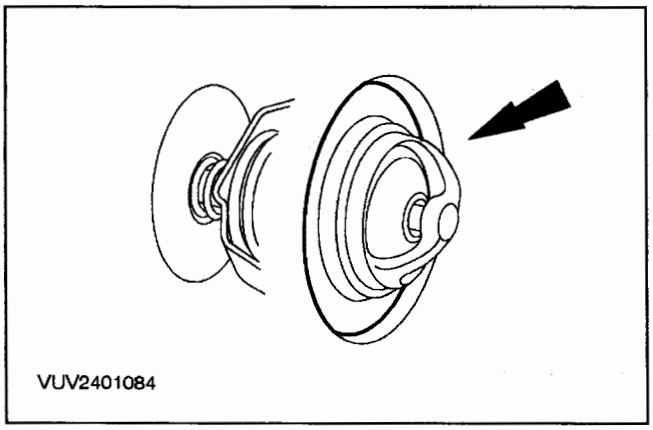
3. Remove the thermostat cover.
   1 Remove the three bolts.
   2 Remove the cover.

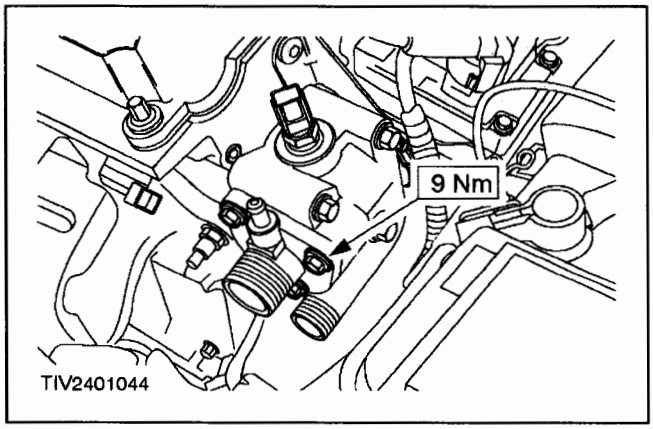


4. Remove the thermostat.
   - Discard the O-ring seal.

REMOVAL AND INSTALLATION (Continued)

Installation


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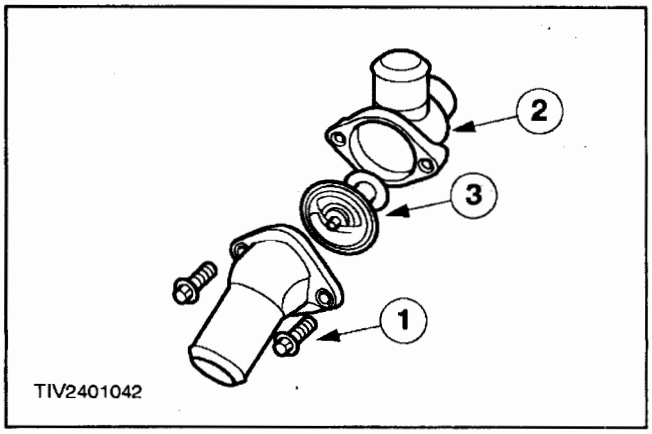
1. To install, reverse the removal procedure.
   - Install a new O-ring seal.
2. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Thermostat — Vehicles with 2.5L Engine

Removal

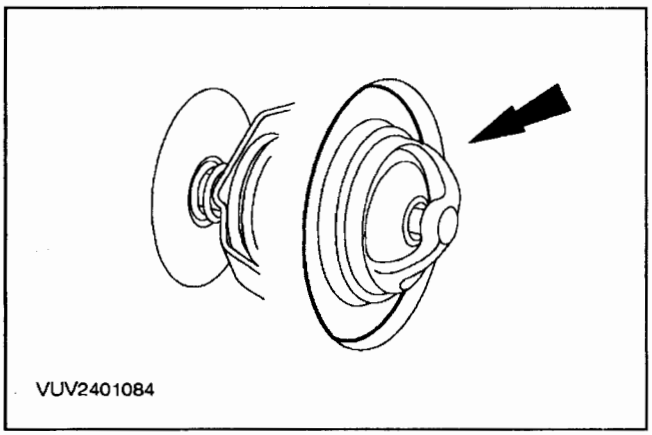
1. Remove the thermostat. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

REMOVAL AND INSTALLATION (Continued)

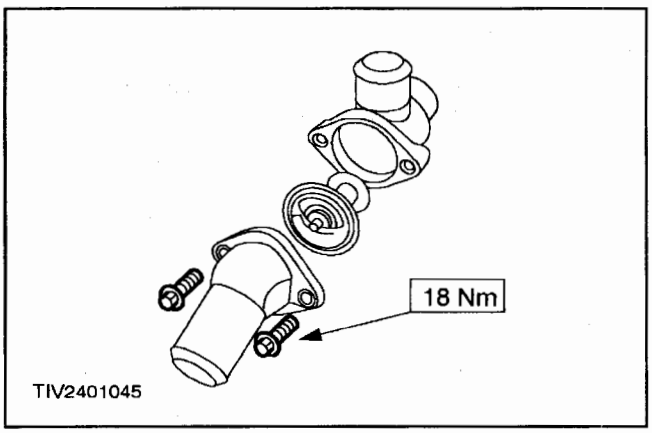


2. Remove the thermostat.
   1 Remove the two bolts.
   2 Separate the housing.
   3 Remove the thermostat.
   - Discard the O-ring seal.

Installation



1. To install, reverse the removal procedure.
   - Install a new O-ring seal.

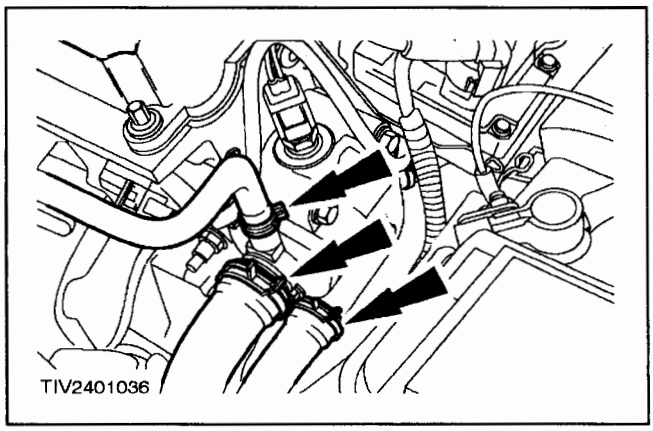


Thermostat Housing — Vehicles with 2.0L Engine

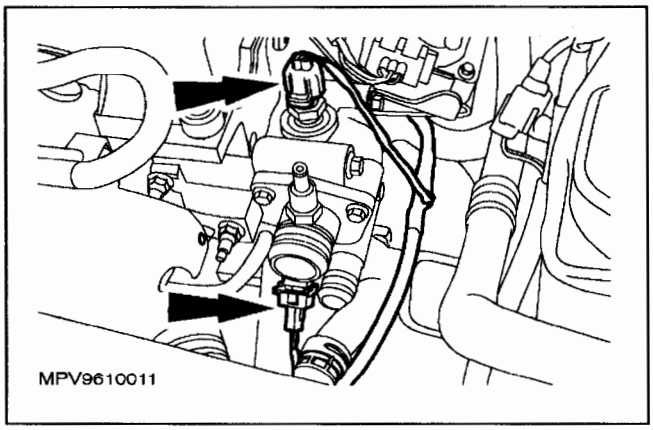
Removal

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

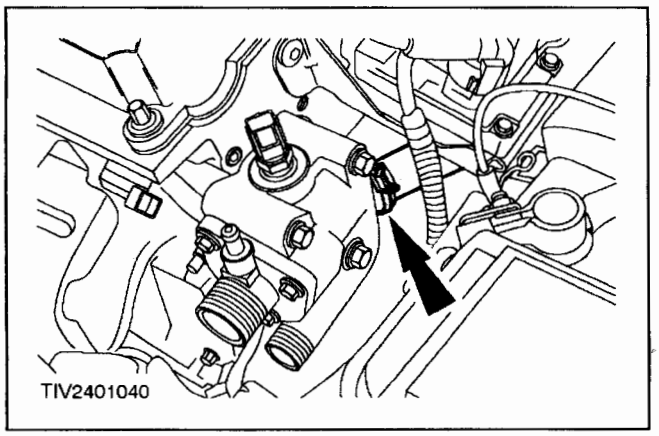
REMOVAL AND INSTALLATION (Continued)



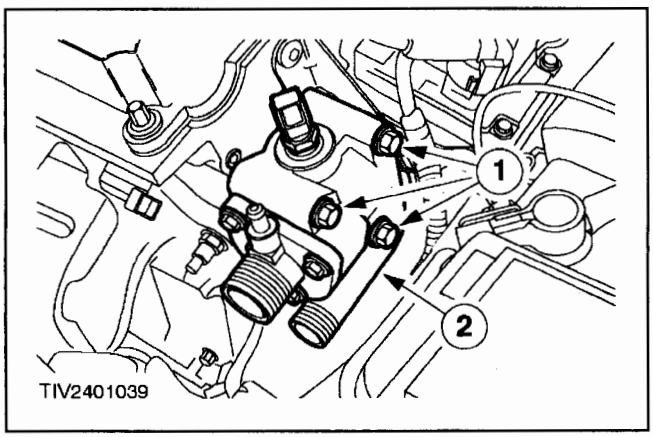
2. Disconnect the thermostat housing coolant hoses.



3. Disconnect the engine coolant temperature sensor and the temperature gauge sender electrical connectors.

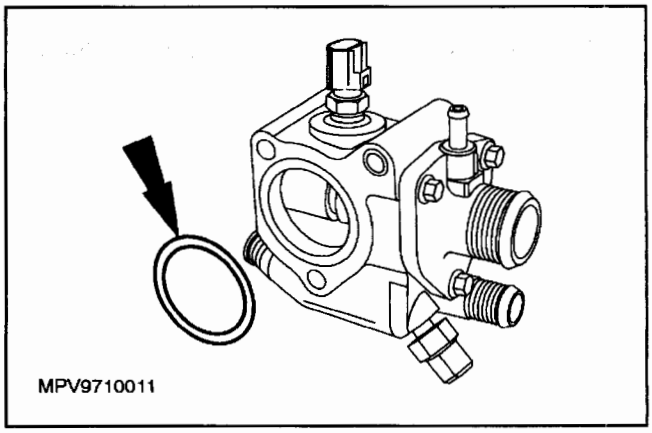


4. Disconnect the thermostat housing coolant hose.



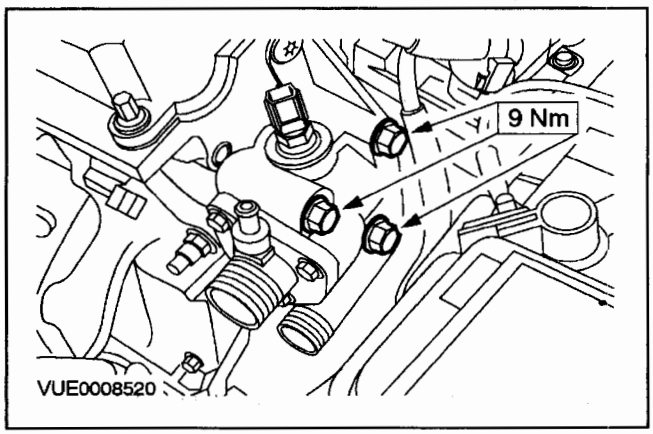
5. Remove the thermostat housing.
   1 Remove the bolts.
   2 Remove the housing.

REMOVAL AND INSTALLATION (Continued)



6. Remove and discard the O-ring seal.

Installation



1. To install, reverse the removal procedure.

2. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Thermostat Housing — Vehicles with 2.5L Engine

Special Tool(s)

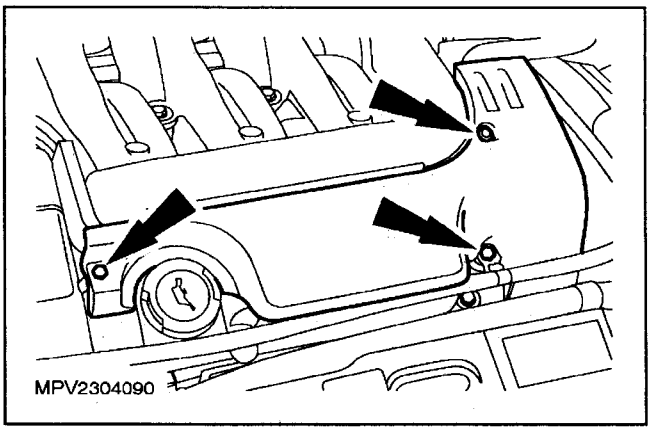
 24003	Remover/Installer, Cooling Hose Clamp 303-397 (24-003)

Removal

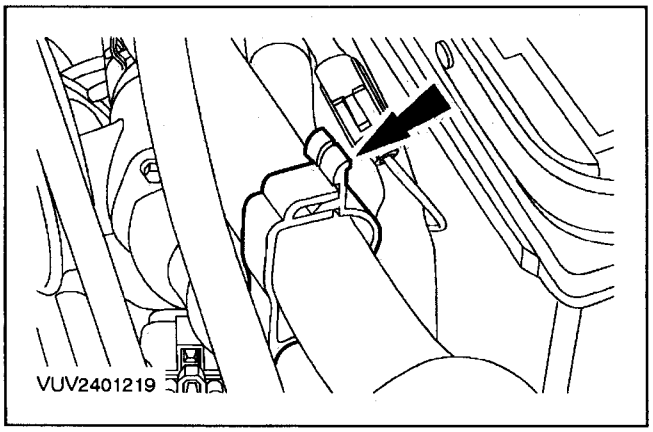
1. Disconnect the battery ground cable.

REMOVALANDINSTALLATION (Continued)

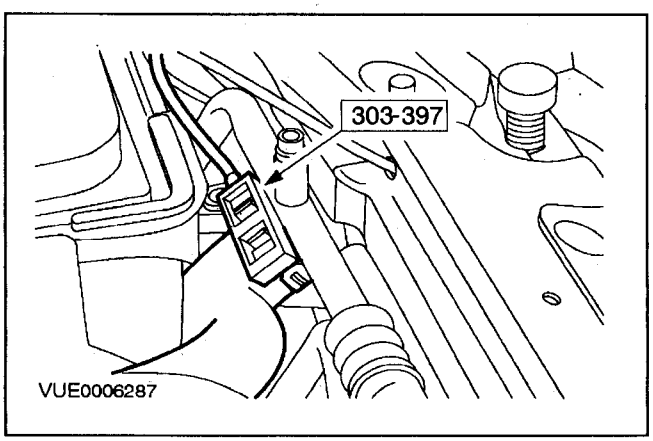
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.



3. Remove the engine cover.

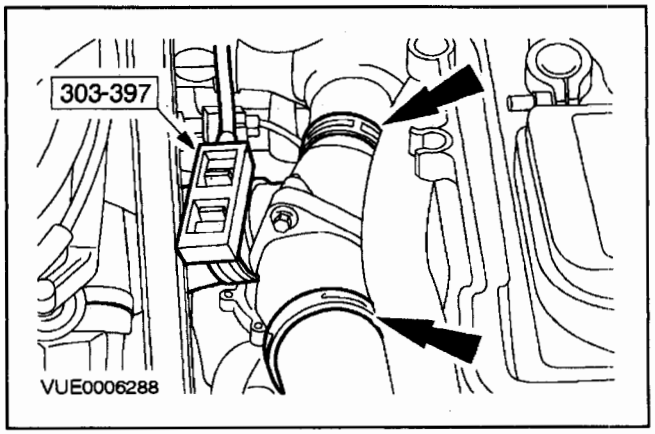


4. Remove the coolant hose retaining clip.



5. Using the special tool, disconnect the radiator upper coolant hose.

REMOVAL AND INSTALLATION (Continued)



6. Using the special tool, disconnect the coolant hoses and remove the thermostat housing.

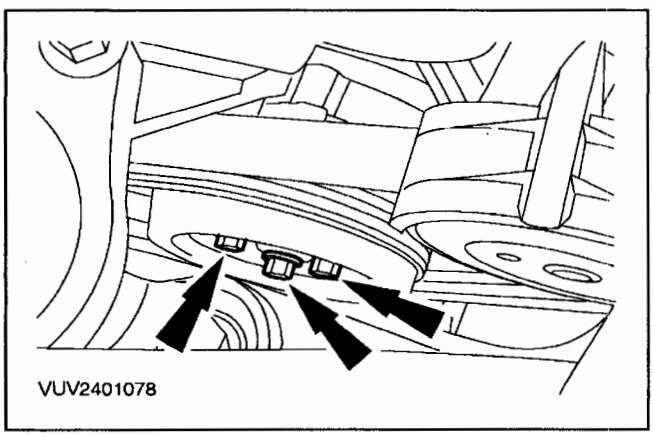
Installation

1. To install, reverse the removal procedure.
2. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Water Pump — Vehicles with 2.0L Engine

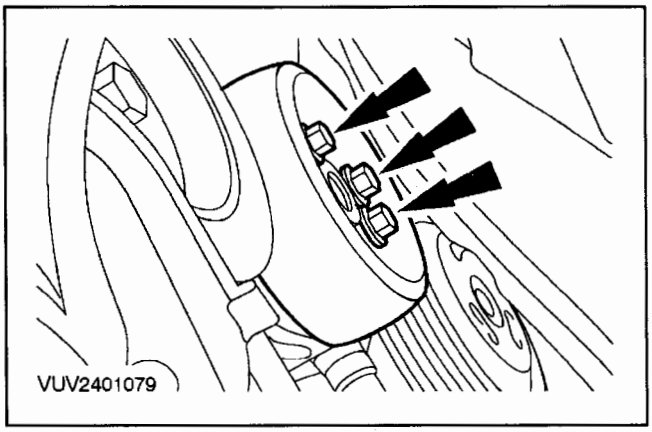
Removal

1. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.



2. Loosen the water pump pulley bolts.
3. Remove the accessory drive belt. For additional information, refer to Section 303-05.

REMOVAL AND INSTALLATION (Continued)

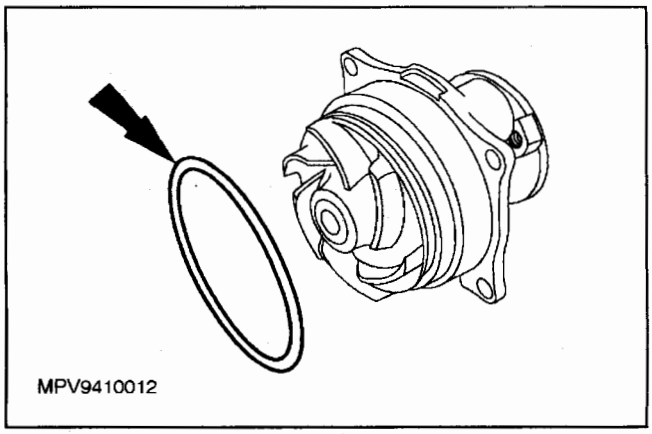


4. Remove the water pump bolts.

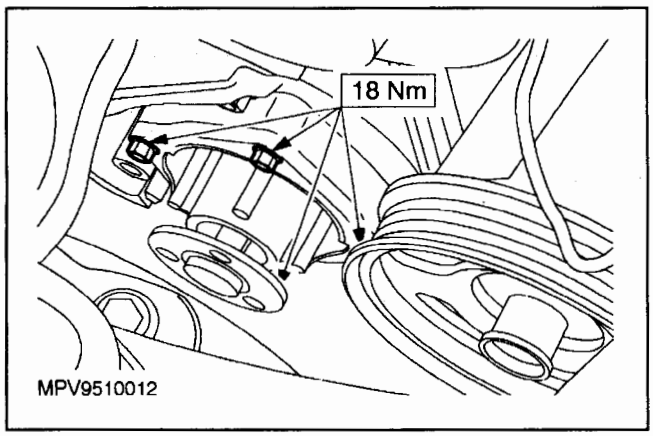
5. Raise and support the vehicle. For additional information, refer to Section 100-02.

6. Remove the water pump.

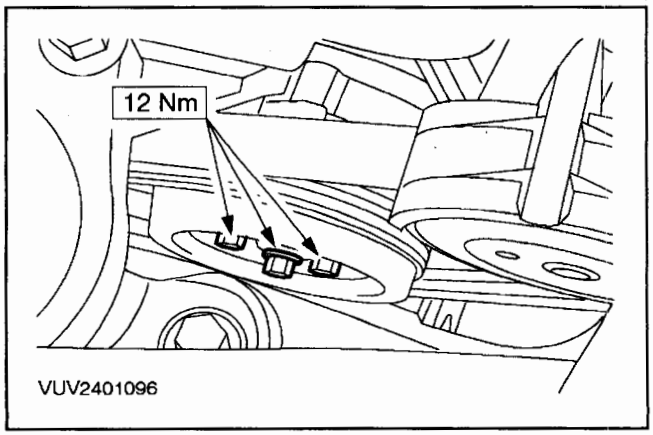
Installation



1. To install, reverse the removal procedure.



REMOVAL AND INSTALLATION (Continued)



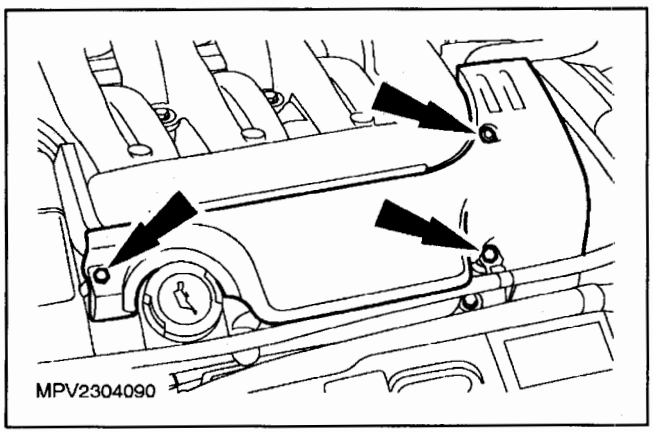
2. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Water Pump — Vehicles with 2.5L Engine

Removal

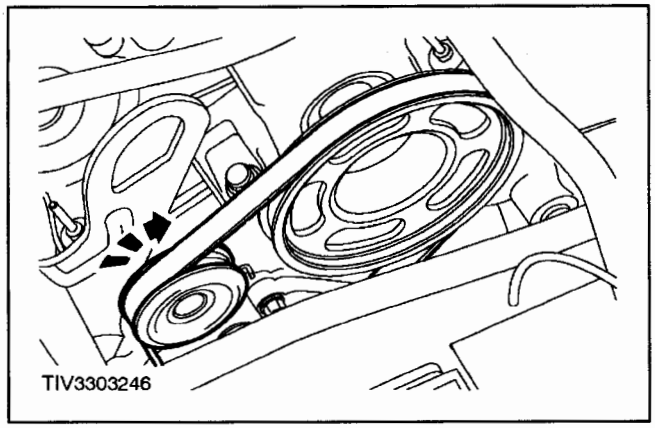
All vehicles

1. Remove the battery. For additional information, refer to Section 414-01.
2. Remove the air cleaner. For additional information, refer to Section 303-12B.
3. Remove the thermostat housing. For additional information, refer to Thermostat Housing—Vehicles with 2.5L Engine in this section.



4. Remove the engine cover.

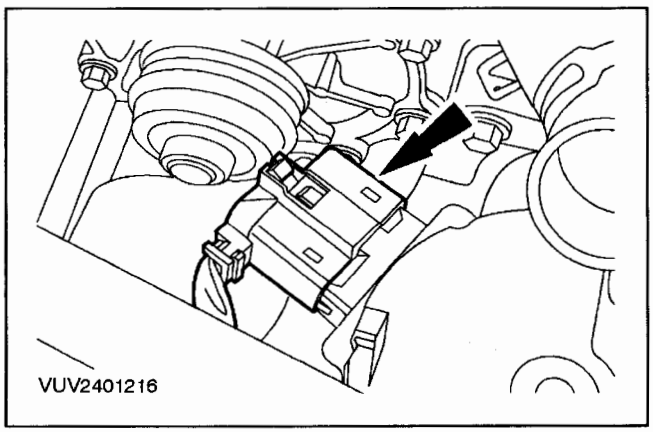
REMOVAL AND INSTALLATION (Continued)



5. Rotate the belt tensioner clockwise by hand.

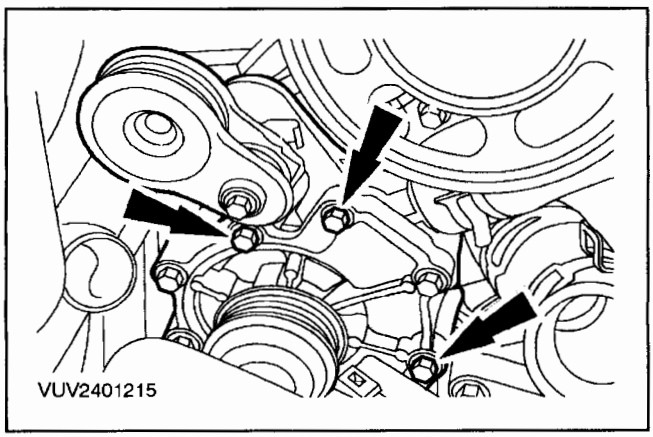
6. Remove the belt.

Vehicles with automatic transaxle



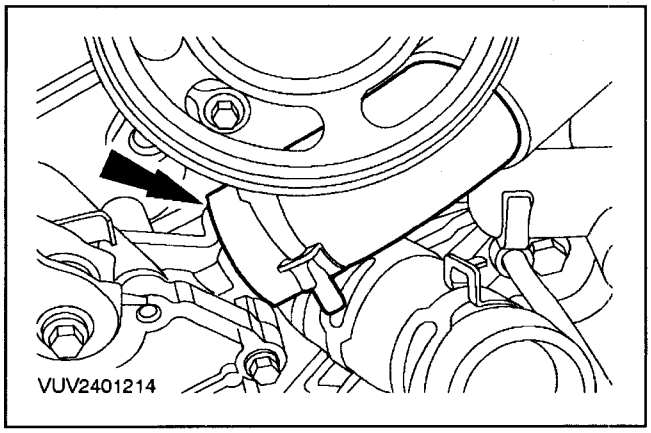
7. Disconnect the transmission range selector electrical connector.

All vehicles

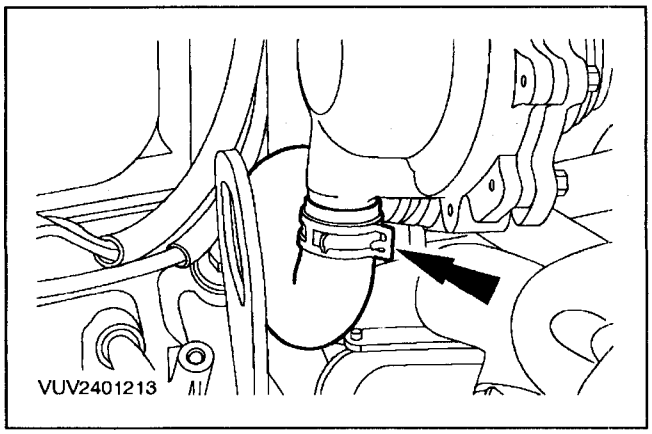


8. Remove the water pump bolts.

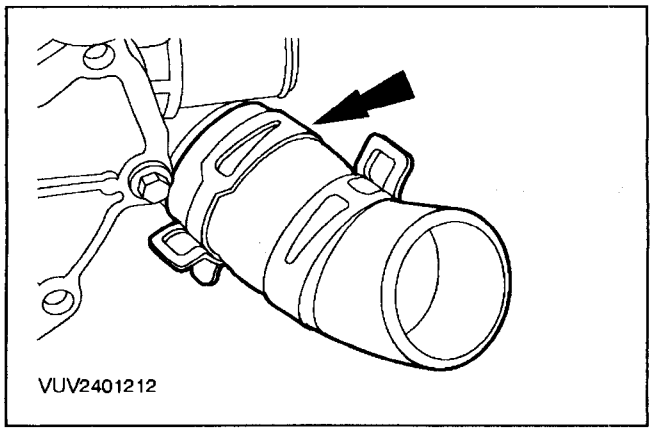
REMOVAL AND INSTALLATION (Continued)


VUV2401214

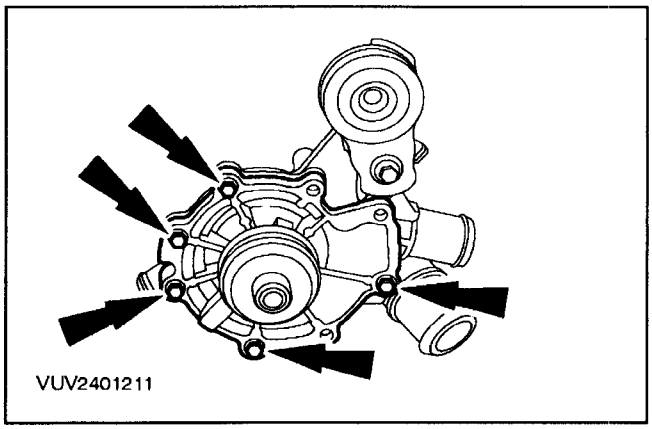
9. Disconnect the coolant hose from the water pump.


VUV2401213

10. Disconnect the heater hose and remove the water pump.


VUV2401212

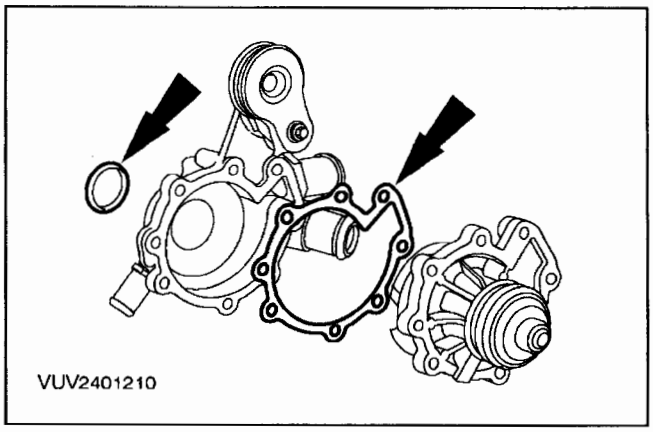
11. Remove the coolant hose.

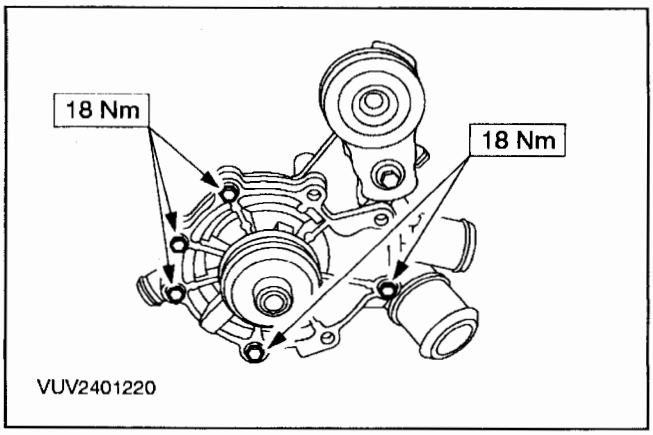

VUV2401211

12. Remove the water pump from the housing.
    - Discard the water pump gasket and O-ring seal.

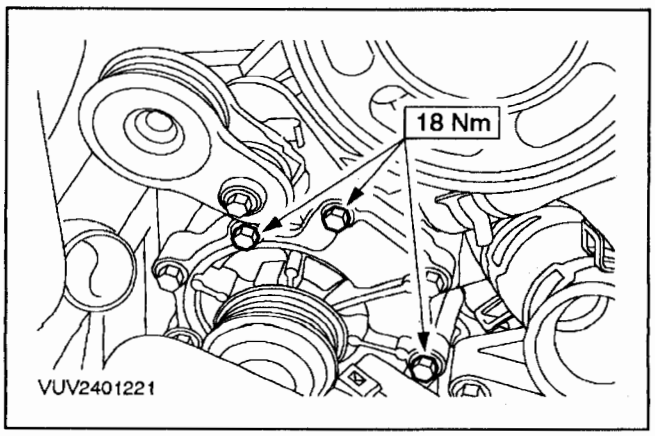
REMOVAL AND INSTALLATION (Continued)

Installation


VUV2401210



VUV2401220



VUV2401221

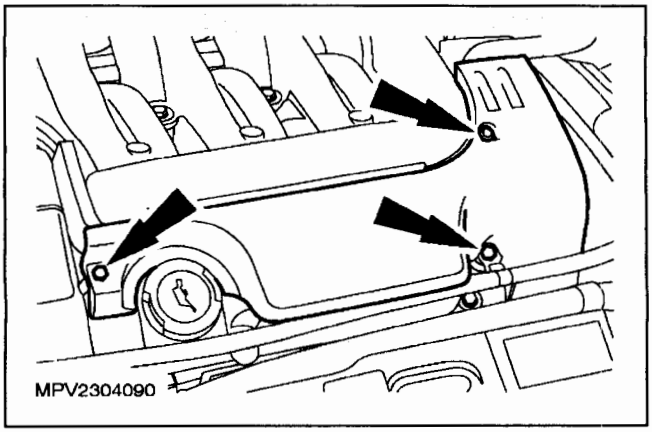
1. To install, reverse the removal procedure.
   - Install a new water pump gasket and O-ring seal.

2. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

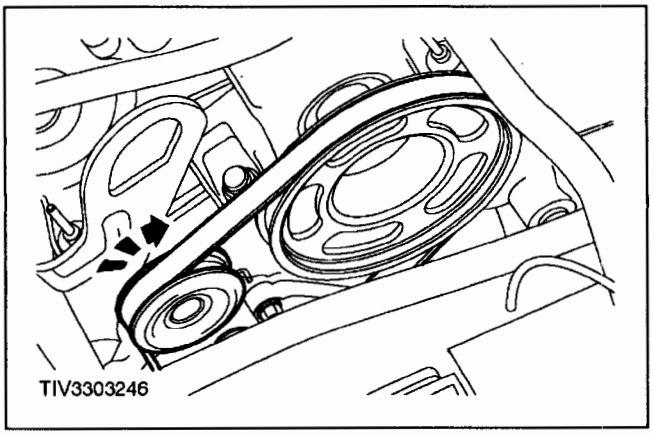
REMOVAL AND INSTALLATION (Continued)

Water Pump Belt — Vehicles with 2.5L Engine

Removal



1. Remove the engine cover.



2. Rotate the belt tensioner clockwise by hand.
3. Remove the belt.

Installation

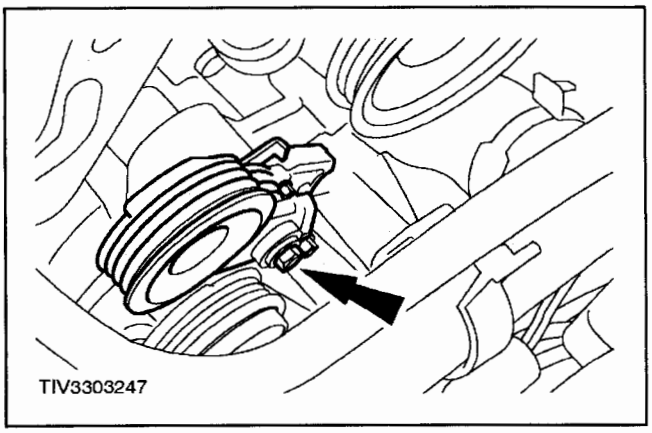
1. To install, reverse the removal procedure.

Water Pump Belt Tensioner — Vehicles with 2.5L Engine

Removal

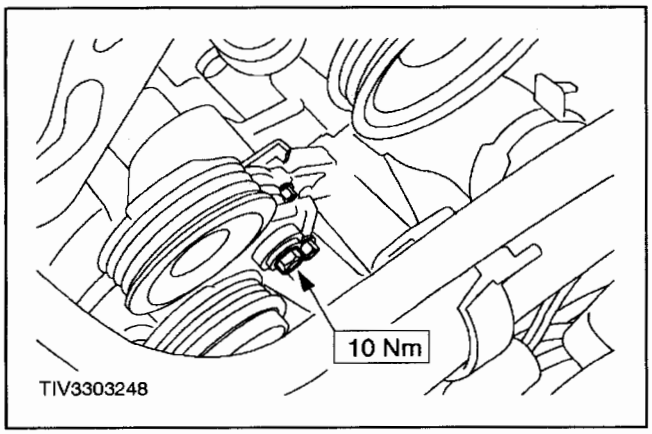
1. Remove the water pump drive belt. For additional information, refer to Water Pump—Vehicles with 2.5L Engine in this section.

REMOVAL AND INSTALLATION (Continued)



2. Remove the belt tensioner.

Installation



1. To install, reverse the removal procedure.

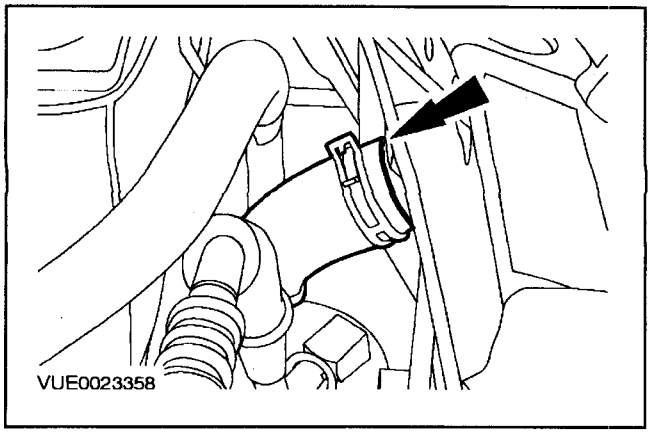
Radiator

Removal

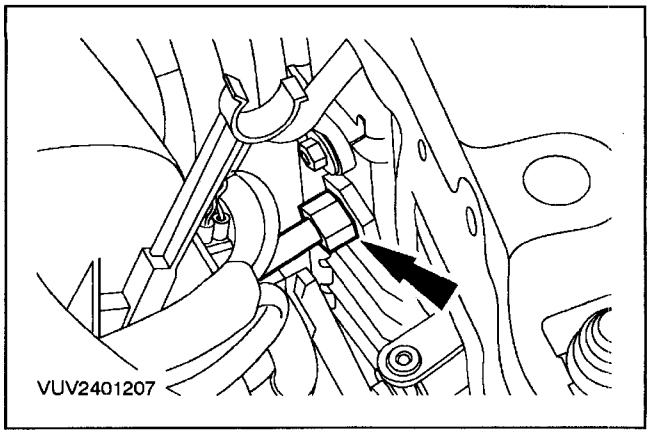
All vehicles

1. Disconnect the battery ground cable.
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

REMOVALANDINSTALLATION (Continued)

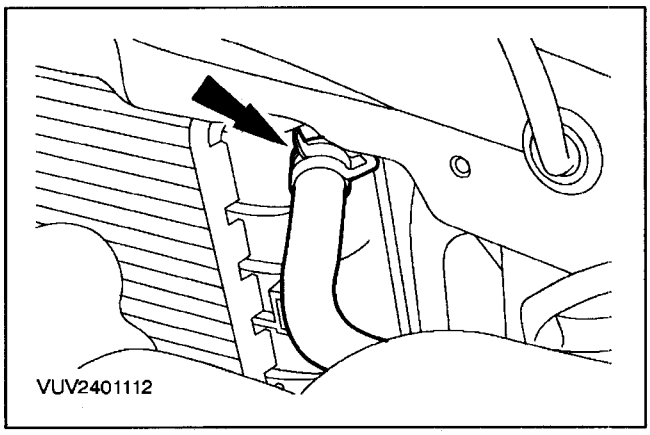


3. Disconnect the radiator upper coolant hose.



Vehicles with automatic transaxle

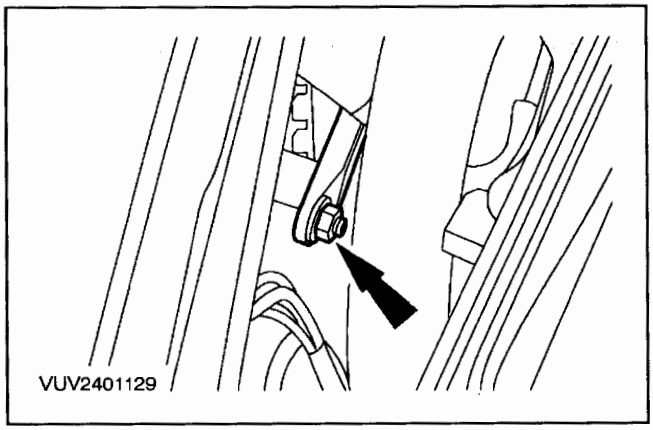
4. Disconnect the transaxle upper cooling line.



Vehicles with 2.5L engine

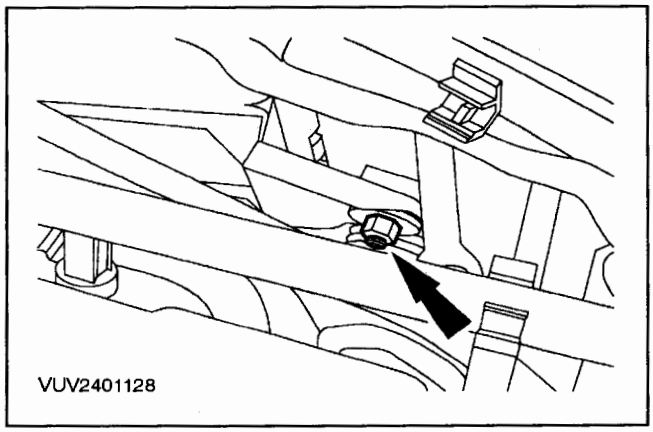
5. Disconnect the coolant expansion tank hose.

REMOVAL AND INSTALLATION (Continued)



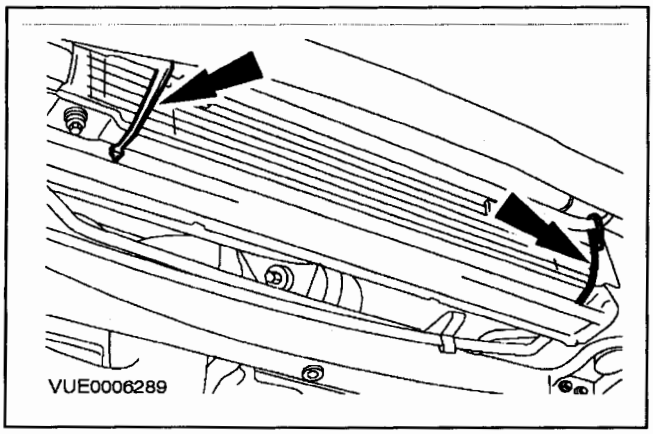
All vehicles

6. Remove the fan shroud nut.



7. Detach the fan shroud and secure to one side.

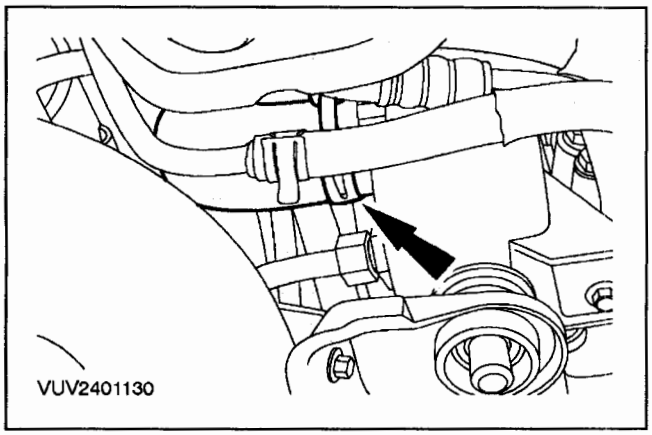
8. Raise and support the vehicle. For additional information, refer to Section 100-02.



Vehicles with air conditioning

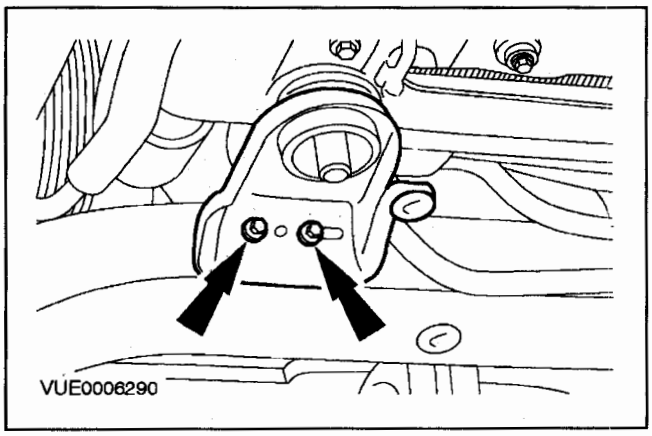
9. Secure the air conditioning condenser.

REMOVAL AND INSTALLATION (Continued)



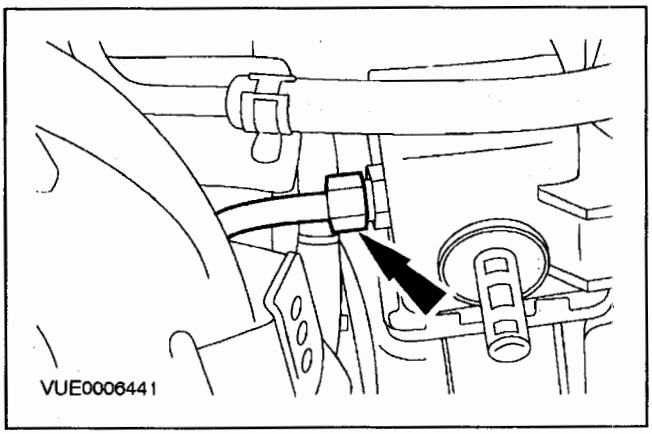
All vehicles

10. Disconnect the radiator lower coolant hose.



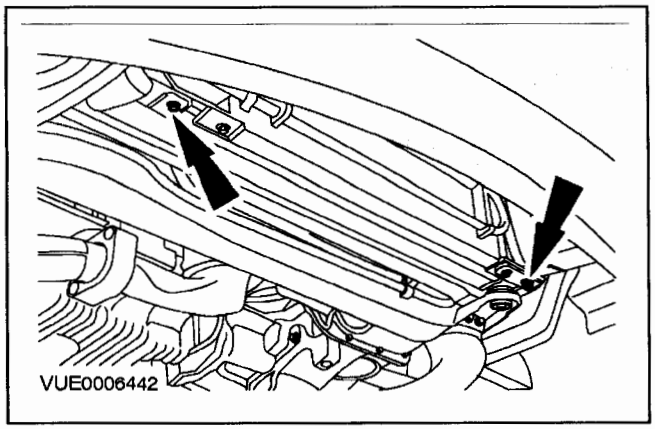
11. Remove the radiator right hand bracket.

Vehicles with automatic transaxle



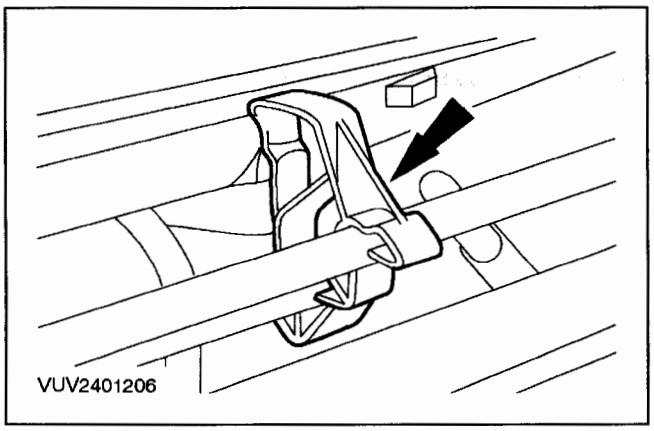
12. Disconnect the transaxle lower cooling line.

REMOVAL AND INSTALLATION (Continued)



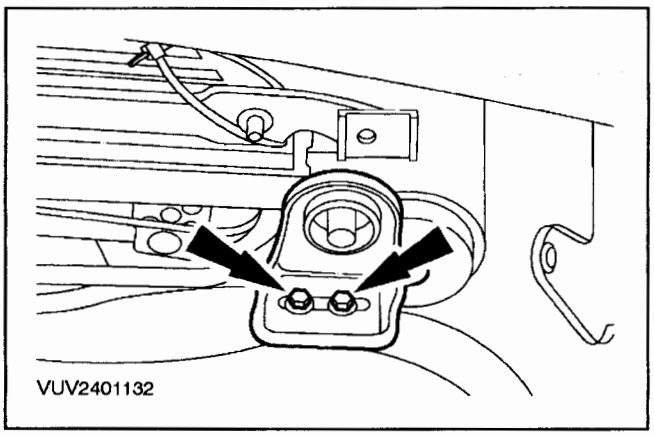
Vehicles with air conditioning

13. Detach the air conditioning condenser.



Vehicles with automatic transaxle

14. Detach the transaxle cooling lines.

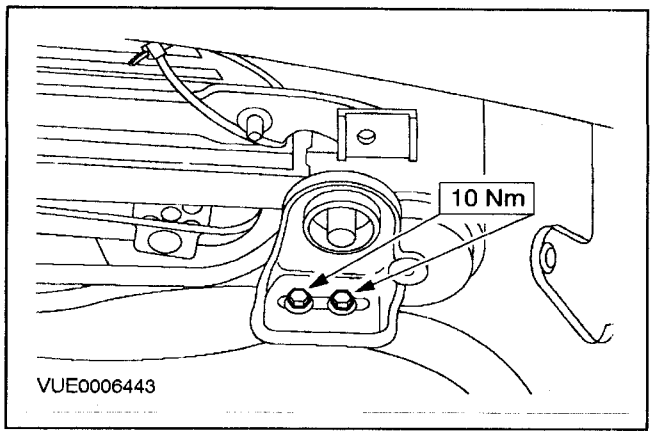


All vehicles

15. Remove the radiator left hand bracket and remove the radiator.

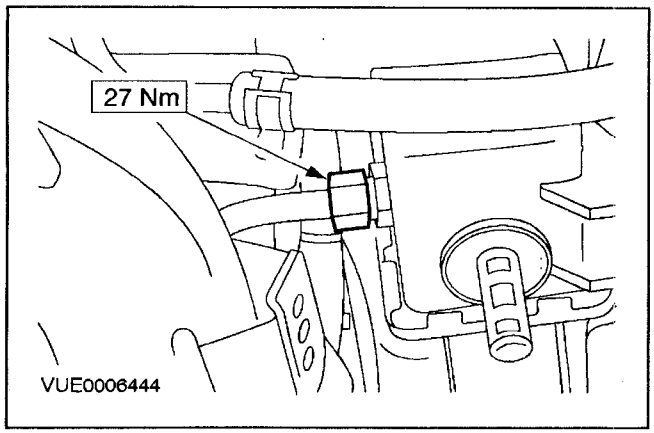
REMOVAL AND INSTALLATION (Continued)

Installation

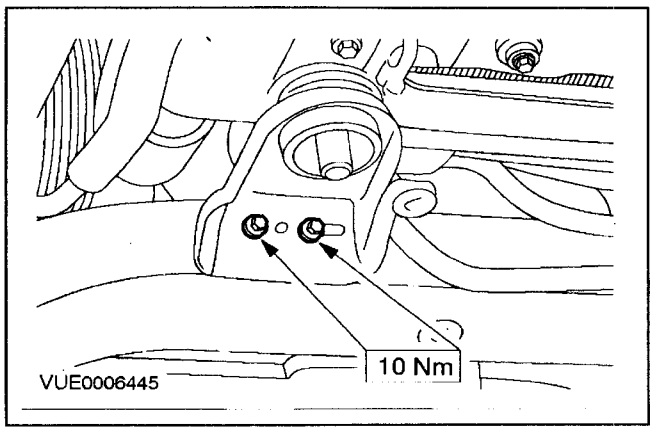


All vehicles

1. To install, reverse the removal procedure.

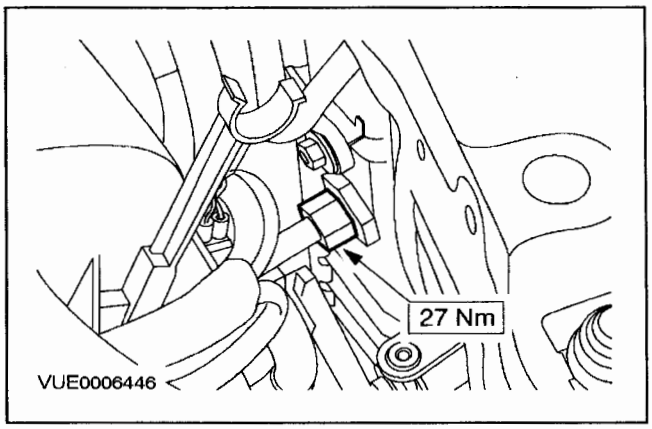


Vehicles with automatic transaxle



All vehicles

REMOVAL AND INSTALLATION (Continued)



Vehicles with automatic transaxle

2. Fill the transaxle. For additional information, refer to Section 307-01.

All vehicles

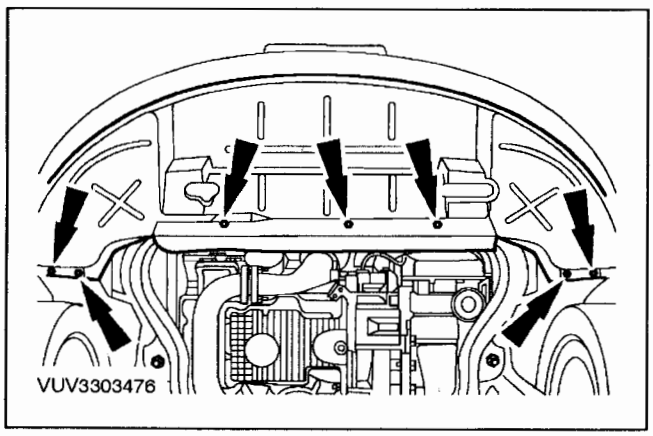
3. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Cooling Fan Motor — Vehicles with 2.0L Engine

Removal

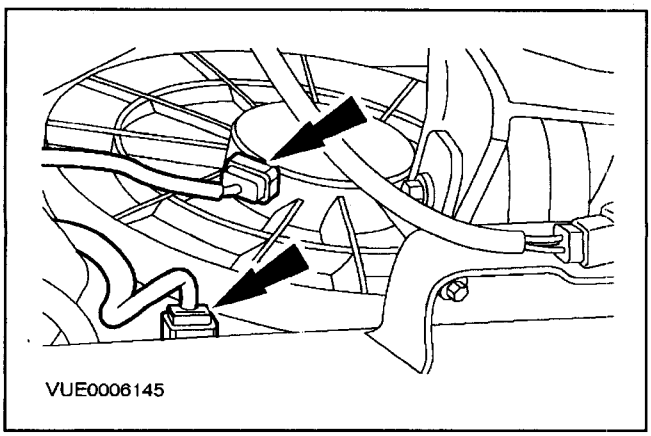
All vehicles

1. Disconnect the battery ground cable.
2. Raise and support the vehicle. For additional information, refer to Section 100-02.

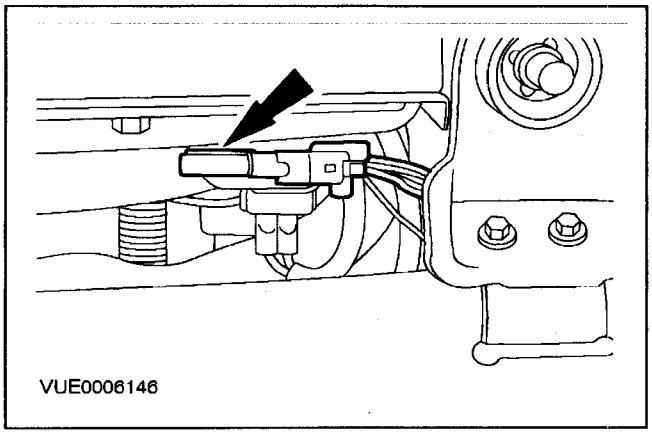


3. Remove the radiator splash shield.

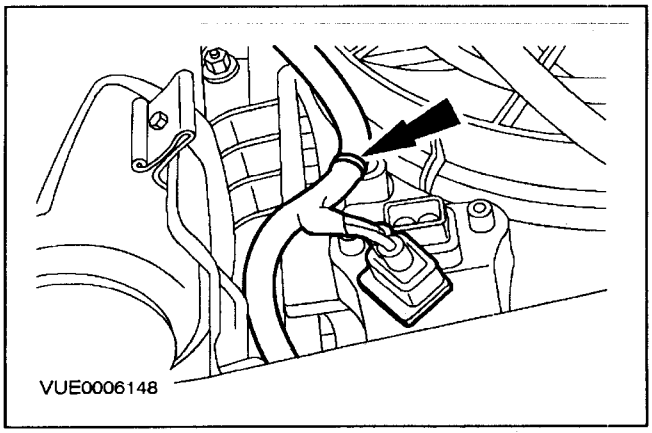
REMOVAL AND INSTALLATION (Continued)


VUE0006145

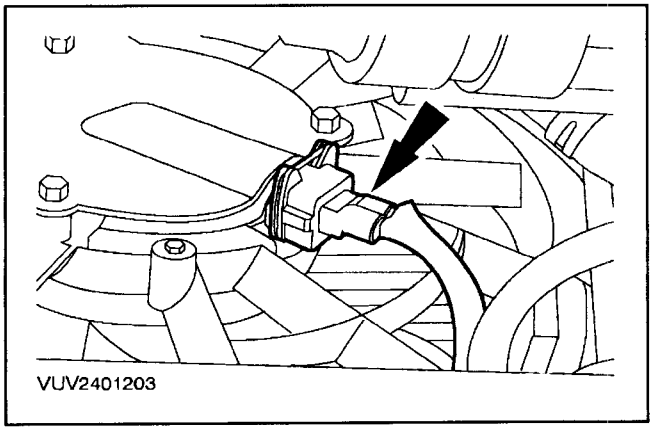
4. Disconnect the cooling fan motor and the cooling fan resistor electrical connectors.


VUE0006146

5. Detach the diode electrical connector.

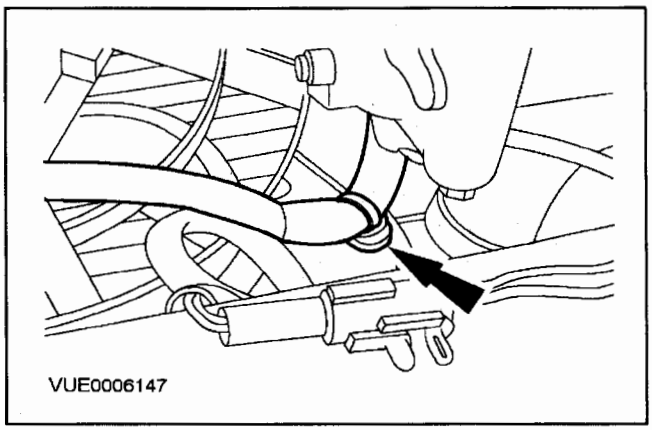

VUE0006148

6. Detach the wiring harness.


VUV2401203

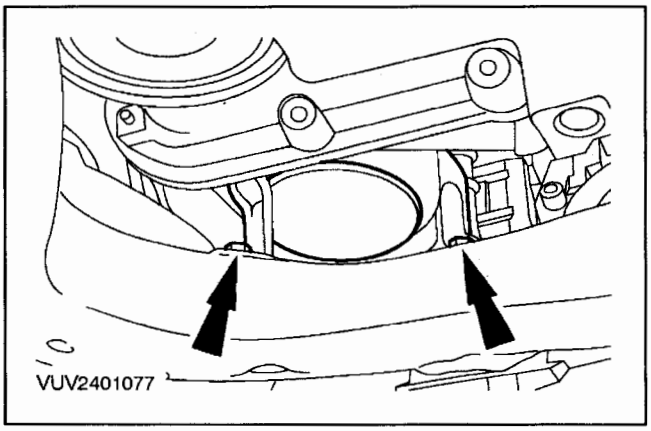
7. Disconnect the cooling fan motor electrical connector.

REMOVAL AND INSTALLATION (Continued)



8. Detach the wiring harness.

Vehicles with air conditioning

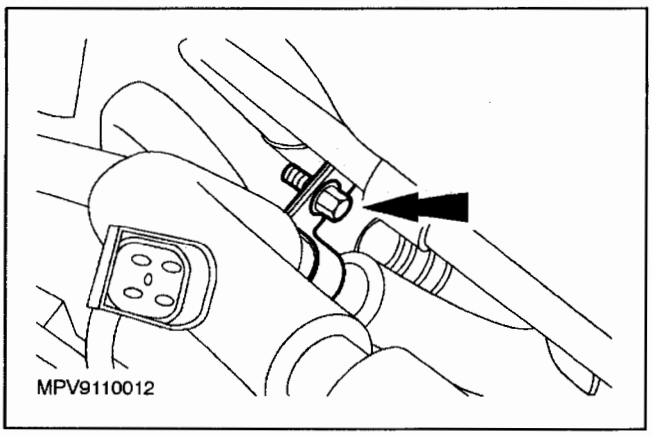


9. Detach the suction accumulator and secure to one side.

All vehicles

10. Lower the vehicle.

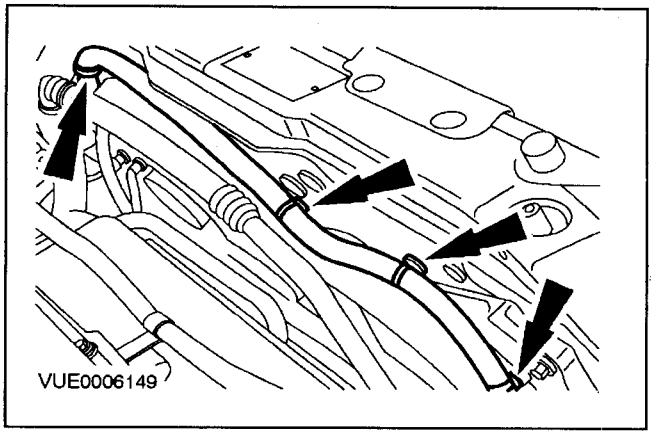
Vehicles with air conditioning



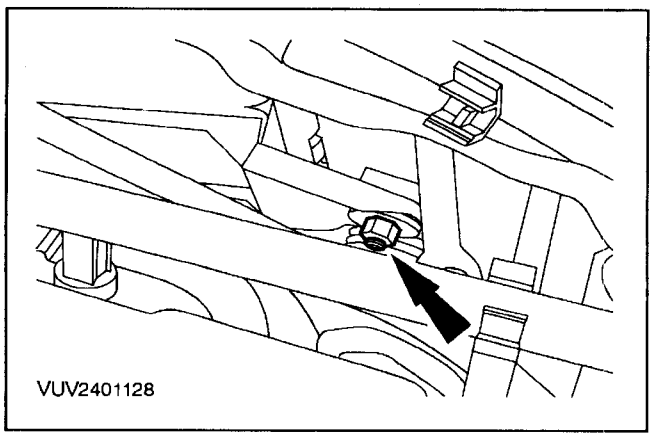
11. Detach the air conditioning tube.

REMOVALANDINSTALLATION (Continued)

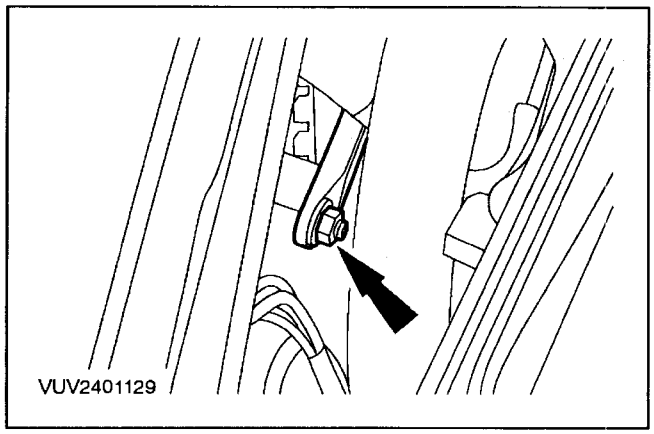
All vehicles



12. Detach the wiring harness.



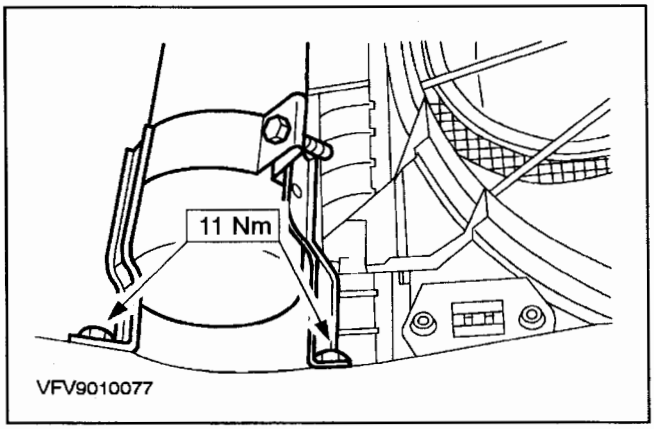
13. Remove the fan shroud nut.



14. Remove the fan shroud.

REMOVALANDINSTALLATION (Continued)

Installation

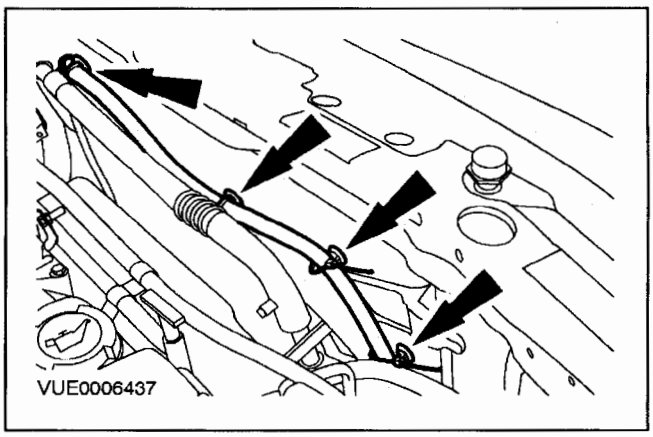


1. To install, reverse the removal procedure.

Cooling Fan Motor — Vehicles with 2.5L Engine

Removal

1. Disconnect the battery ground cable.

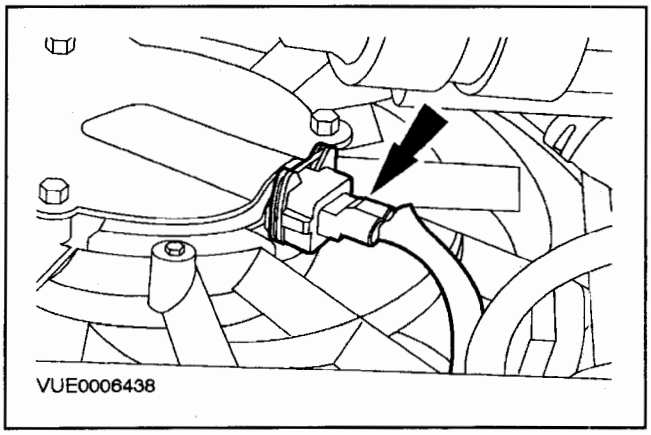


2. Detach the wiring harness.

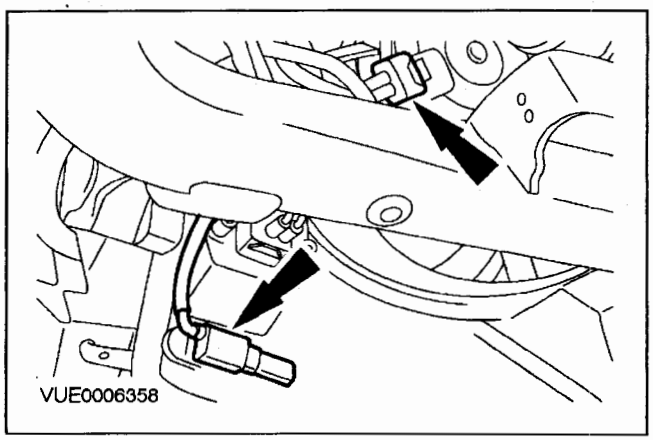
3. Remove the radiator. For additional information, refer to Radiator in this section.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.

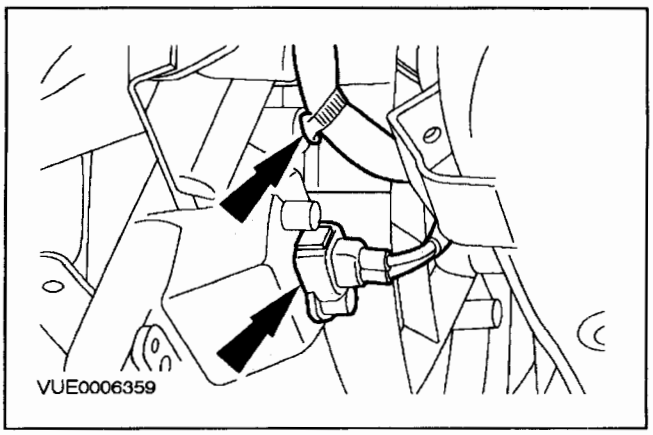
REMOVALANDINSTALLATION (Continued)



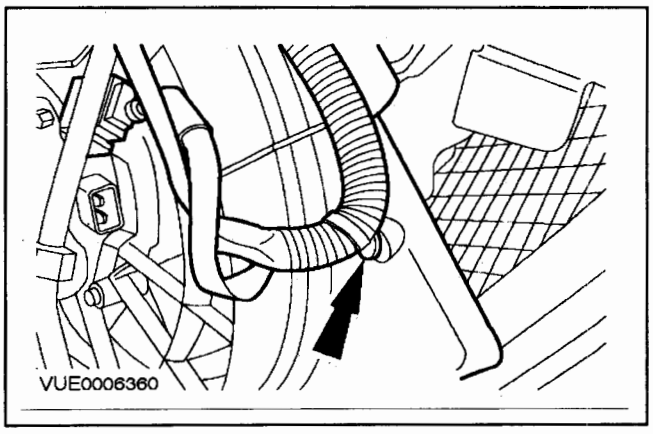
5. Disconnect the cooling fan motor electrical connector.



6. Disconnect the cooling fan motor electrical connector and detach the cooling fan motor diode electrical connector.



7. Disconnect the electrical connector and detach the wiring harness.



8. Detach the wiring harness and remove the cooling fan motor.

REMOVAL AND INSTALLATION (Continued)

Installation

1. To install, reverse the removal procedure.

SECTION 303-04A Fuel Charging and Controls — 2.0L Zetec

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SPECIFICATIONS 303-04A-2
DESCRIPTION AND OPERATION
Fuel Charging And Controls 303-04A-2
DIAGNOSIS AND TESTING
Fuel Charging And Controls 303-04A-3
REMOVAL AND INSTALLATION
Throttle Body — Vehicles With Speed Control 303-04A-3
Throttle Body — Vehicles Without Speed Control 303-04A-6
Fuel Injectors 303-04A-9
Fuel Charging Wiring Harness 303-04A-10
Fuel Injection Supply Manifold — Vehicles Without Returnless Fuel System 303-04A-13
Fuel Injection Supply Manifold — Vehicles With Returnless Fuel System 303-04A-18
Fuel Pressure Regulator 303-04A-21

SPECIFICATIONS

General Specifications

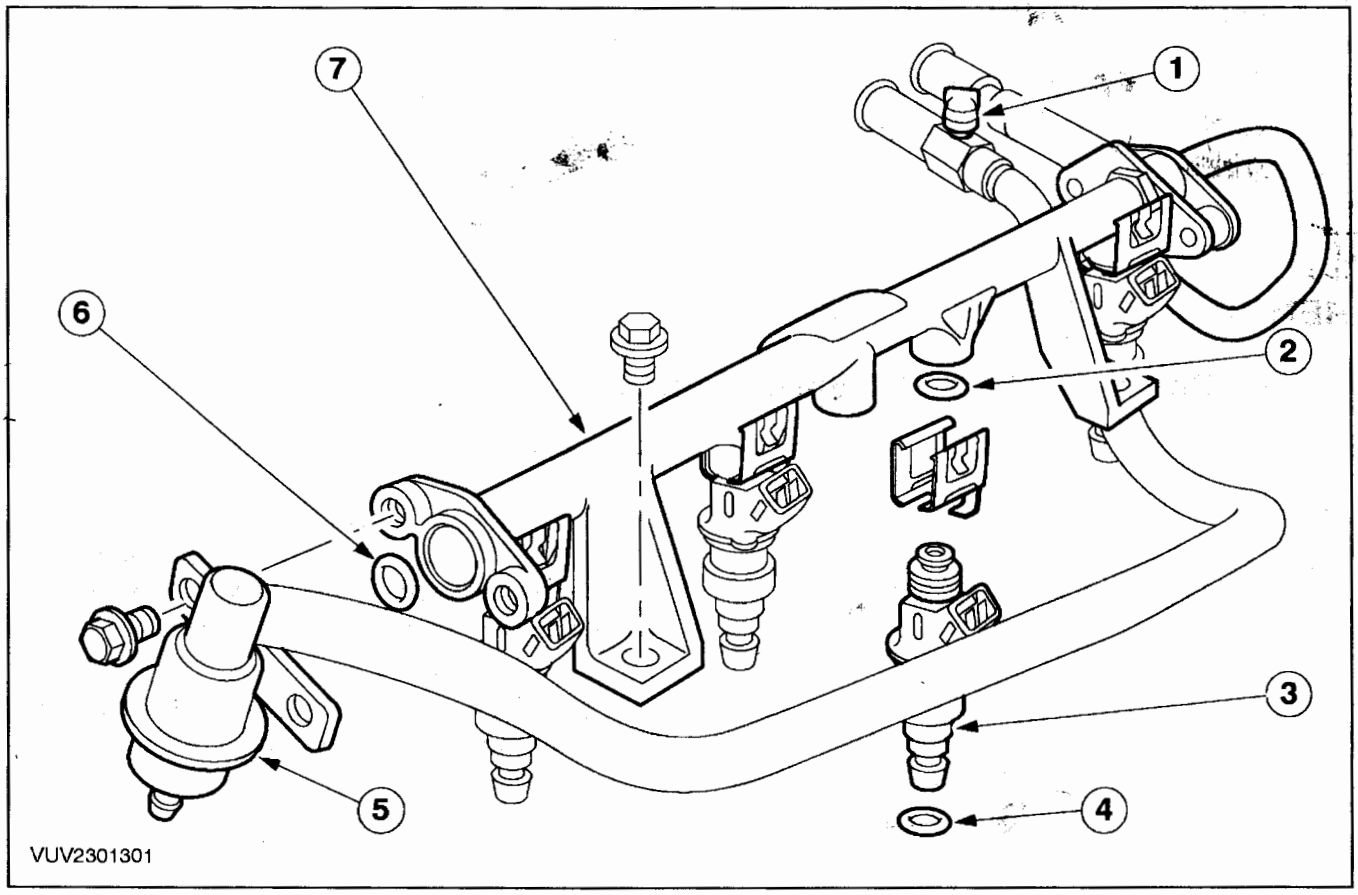
Item	Specification
Engine Oil XO - 10W30 - QSP or DSP	WSS-M2C-153-H

Torque Specifications

Description	Nm	Lb-In
Fuel injection supply manifold bolts	10	89
Throttle body bolts	10	89

DESCRIPTION AND OPERATION

Fuel Charging And Controls



Item	Part Number	Description
1	—	Fuel pressure relief (Schrader) valve
2	—	Fuel injector upper O-ring seal
3	—	Fuel injector
4	—	Fuel injector lower O-ring seal

Item	Part Number	Description
5	—	Fuel pressure regulator
6	—	Fuel pressure regulator O-ring seal
7	—	Fuel injection supply manifold

(Continued)

The fuel charging system consists of a supply manifold, a pressure regulator and four fuel injectors.

DESCRIPTION AND OPERATION (Continued)

The supply manifold is a one-piece aluminium die casting with machined holes for the fuel pressure regulator and the fuel injectors. The supply manifold is retained to the engine by two bolts.

The pressure regulator is fitted directly into the supply manifold and is retained by two bolts. Sealing is achieved by means of an O-ring seal. The pressure regulator is of the vacuum operated, spring loaded diaphragm type and is designed to maintain a constant pressure in the supply manifold with excess fuel being returned to the fuel tank.

The fuel injectors are fitted directly into the supply manifold and are retained by the supply manifold when assembled to the intake manifold. Sealing is achieved by means of upper and lower O-ring seals. The fuel injectors are activated sequentially by the powertrain control module which modifies fuelling by adjusting fuel injector opening times according to engine operating conditions.

DIAGNOSIS AND TESTING

Fuel Charging And Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

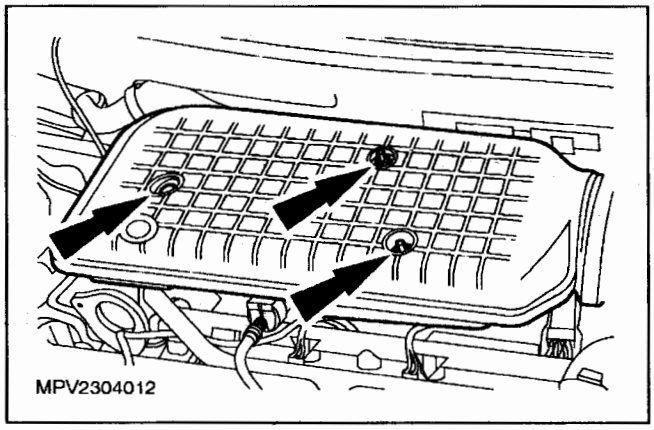
REMOVAL AND INSTALLATION

Throttle Body — Vehicles With Speed Control

Removal

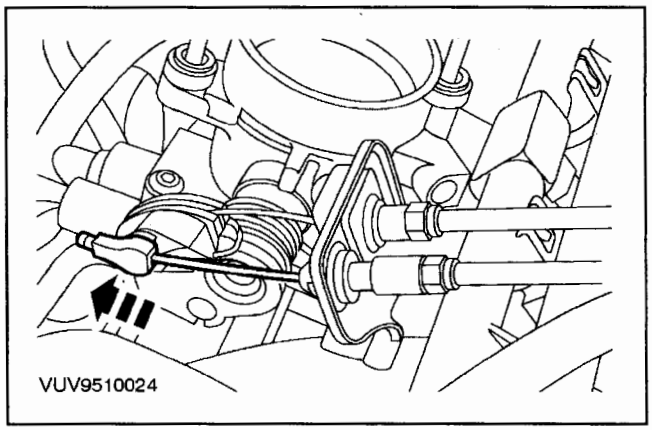
⚠ **CAUTION: Do not attempt to clean the throttle body. The bore and the throttle plate has a special coating applied during manufacture which should not be removed.**

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12A.
2. Remove the intake air resonator.

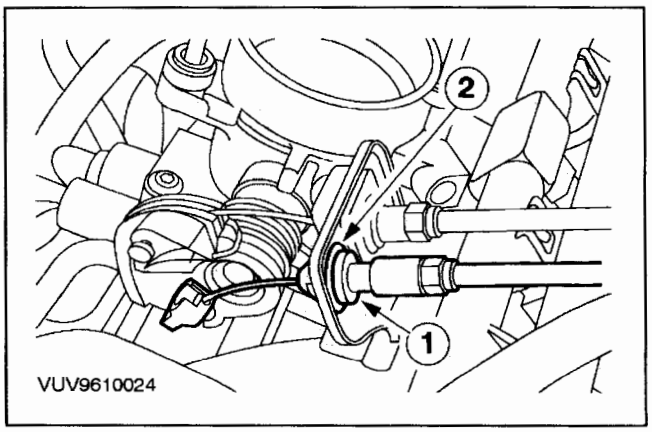

MPV2304012

1 Can be purchased as a separate item.

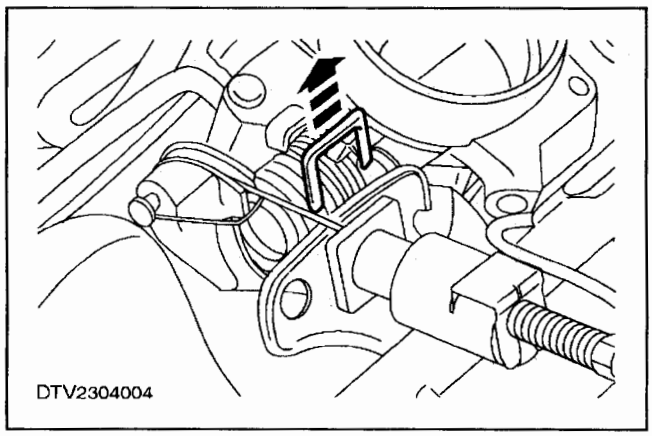
REMOVAL AND INSTALLATION (Continued)



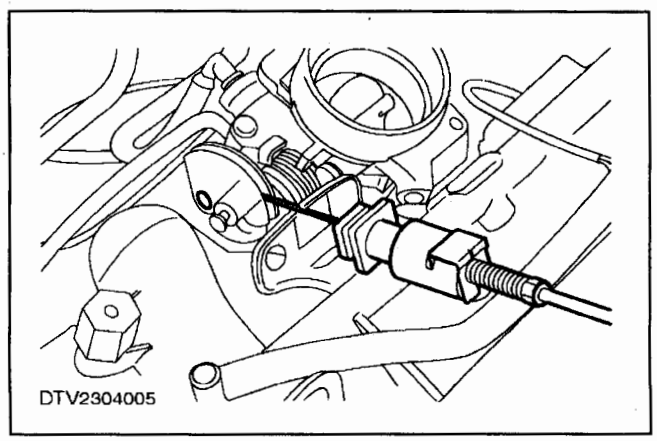
3. Disconnect the speed control cable from the throttle body.



4. Remove the speed control cable from the bracket.
   1 Detach the cable from the bracket.
   2 Push the retaining clip from the bracket and pull the cable out.

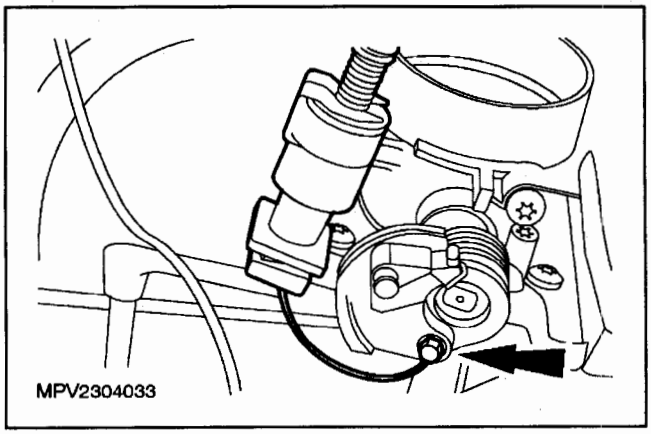


5. Remove the accelerator cable retaining clip.

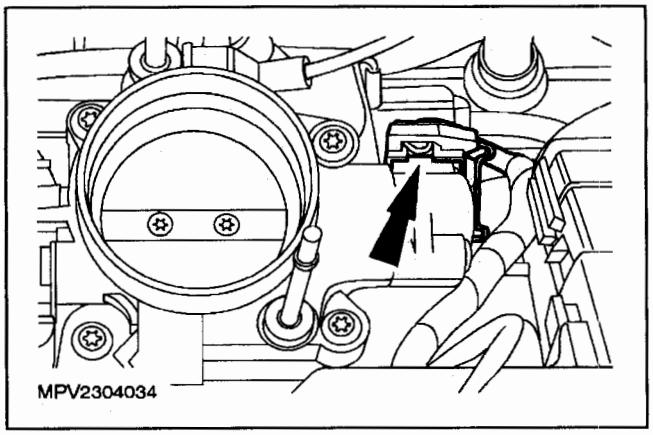


6. Disconnect the accelerator cable from the bracket.

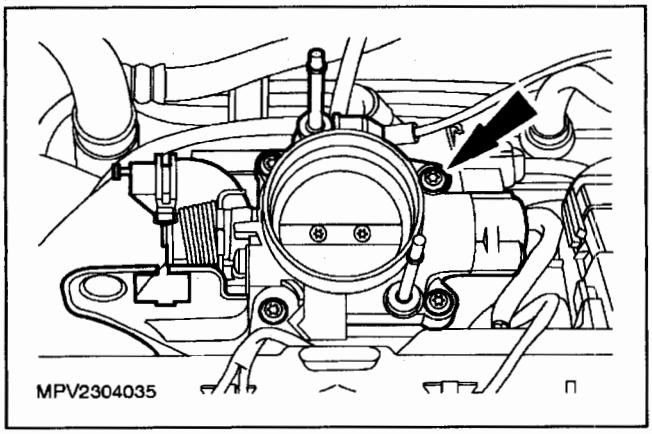
REMOVAL AND INSTALLATION (Continued)



7. Disconnect the accelerator cable from the throttle body.



8. Disconnect the throttle position sensor electrical connector.



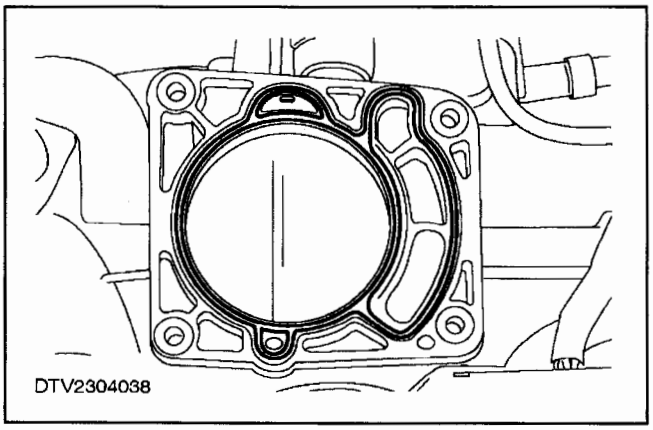
9. Remove the throttle body assembly.
   - Discard the throttle body gasket.

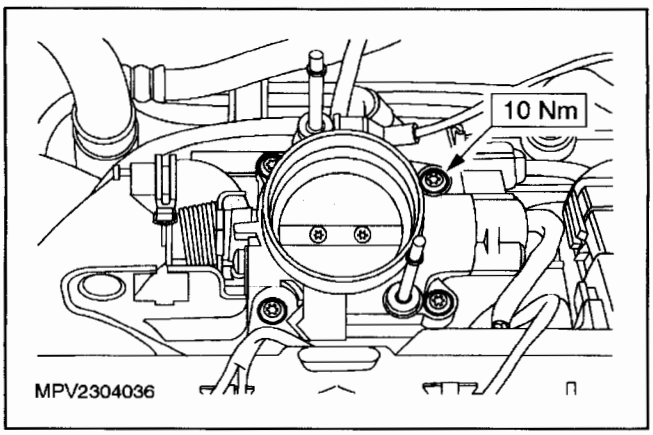
REMOVALANDINSTALLATION (Continued)

Installation

⚠ **CAUTION: Do not attempt to clean the throttle body. The bore and the throttle plate has a special coating applied during manufacture which should not be removed.**

NOTE: Install a new throttle body gasket.





1. To install, reverse the removal procedure.

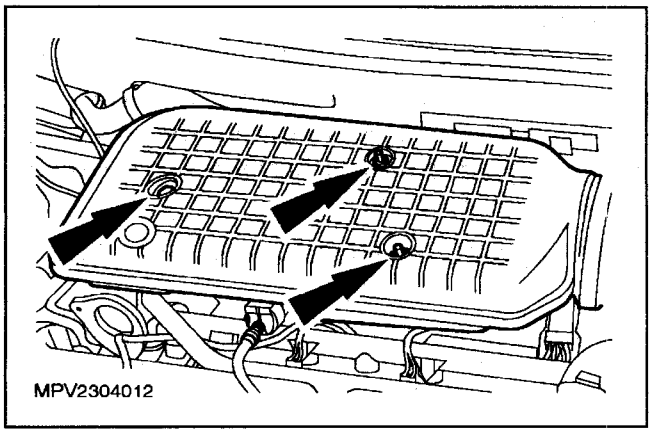
Throttle Body — Vehicles Without Speed Control

Removal

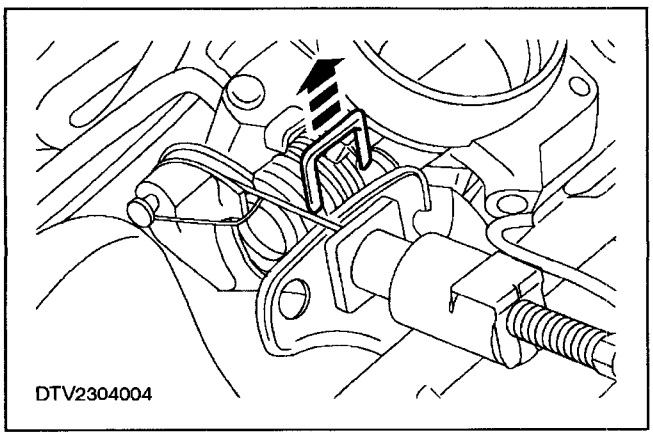
⚠ **CAUTION: Do not attempt to clean the throttle body. The bore and the throttle plate has a special coating applied during manufacture which should not be removed.**

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12A.

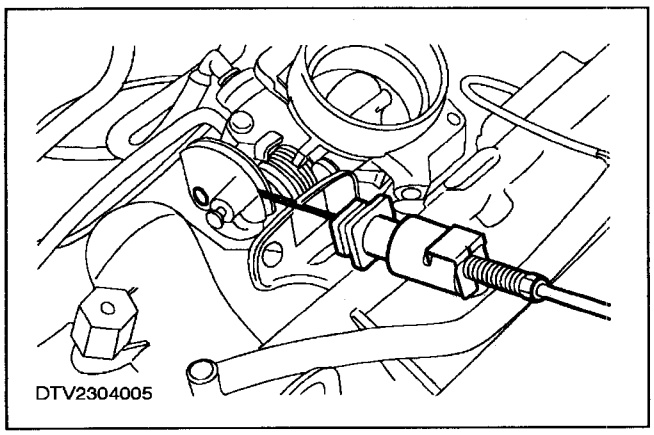
REMOVAL AND INSTALLATION (Continued)



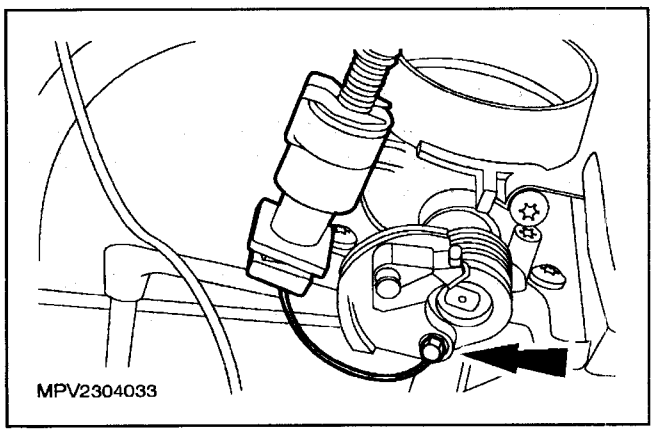
2. Remove the intake air resonator.



3. Remove the accelerator cable retaining clip.

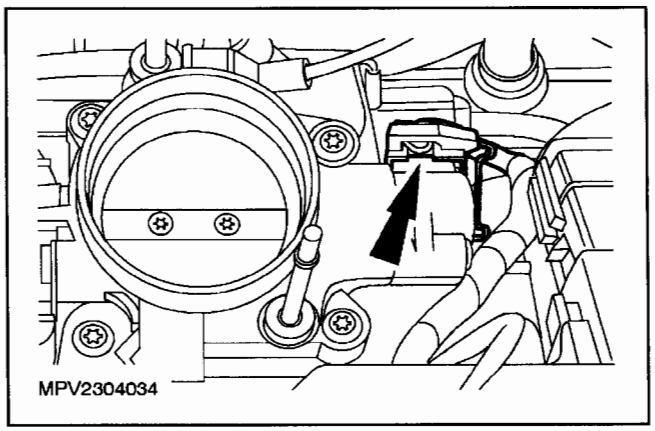


4. Disconnect the accelerator cable from the bracket.

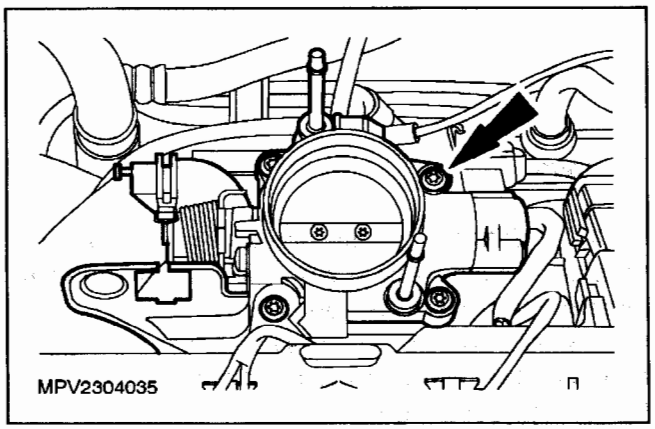


5. Disconnect the accelerator cable from the throttle body.

REMOVAL AND INSTALLATION (Continued)



6. Disconnect the throttle position sensor electrical connector.

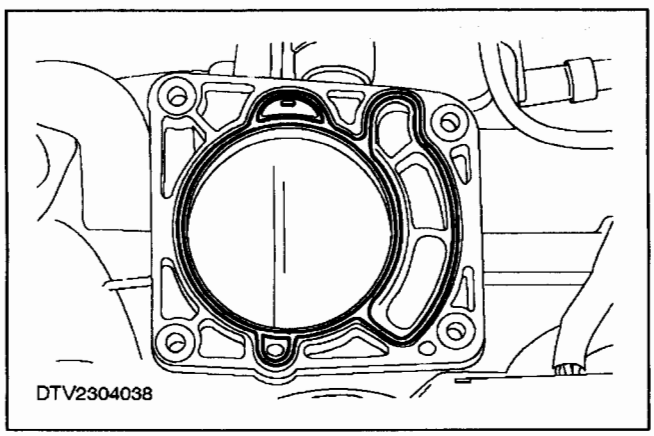


7. Remove the throttle body assembly.
   - Discard the throttle body gasket.

Installation

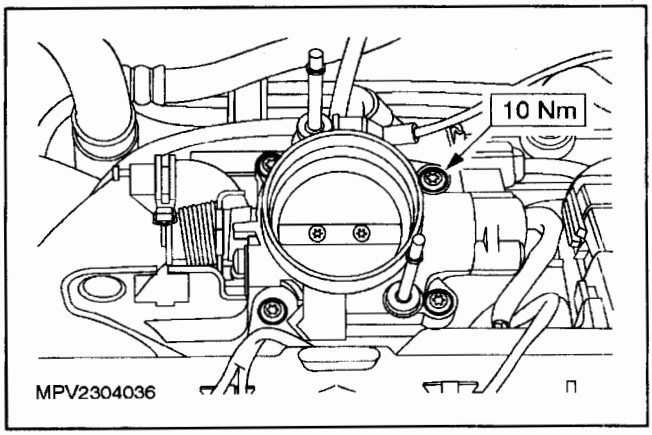
⚠ **CAUTION: Do not attempt to clean the throttle body. The bore and the throttle plate has a special coating applied during manufacture which should not be removed.**

NOTE: Install a new throttle body gasket.



1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION (Continued)

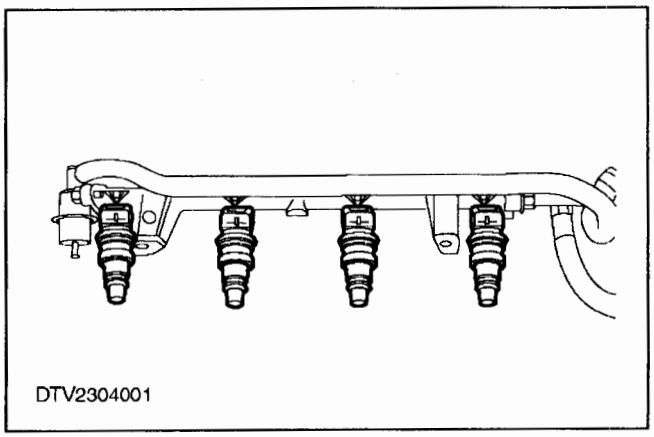


Fuel Injectors

Removal

⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

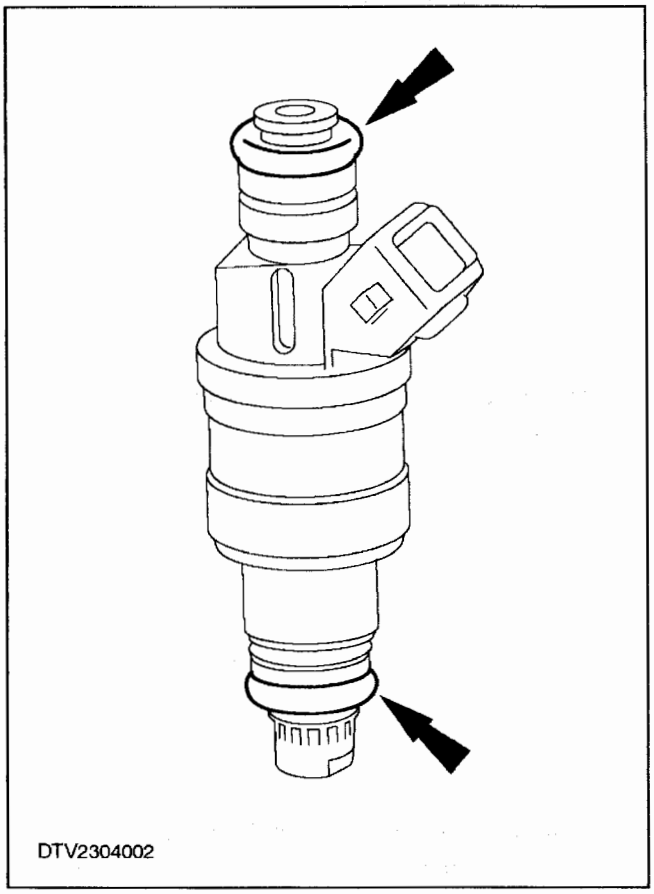
1. Remove the fuel injection supply manifold assembly. For additional information, refer to Fuel Injection Supply Manifold—Vehicles Without Returnless Fuel System or Fuel Injection Supply Manifold—Vehicles With Returnless Fuel System in this section.



2. Remove the fuel injectors.

REMOVAL AND INSTALLATION (Continued)

Installation


DTV2304002

1. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

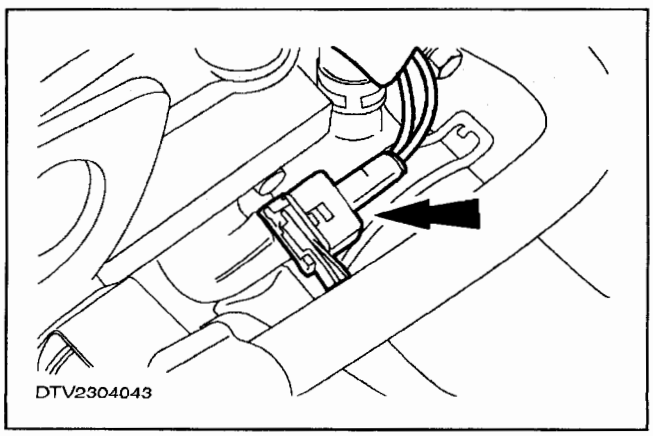
   NOTE: Install new fuel injector O-ring seals.

   To install, reverse the removal procedure.

   - Lubricate the fuel injector O-ring seals with clean engine oil, XO-10W30-QSP or DSP or equivalent meeting Ford specification WSS-M2C-153-H, to aid installation.

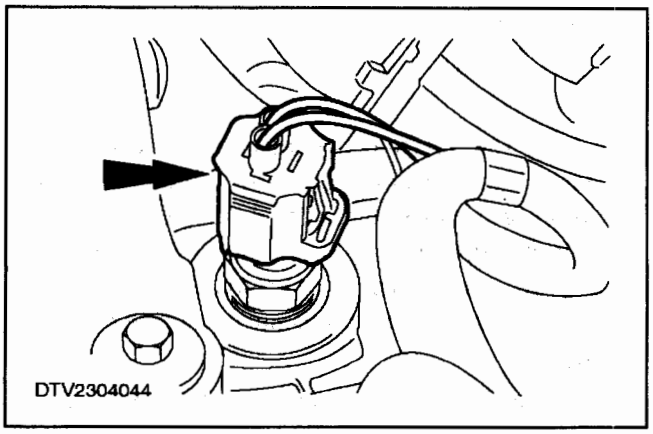
Fuel Charging Wiring Harness

Removal

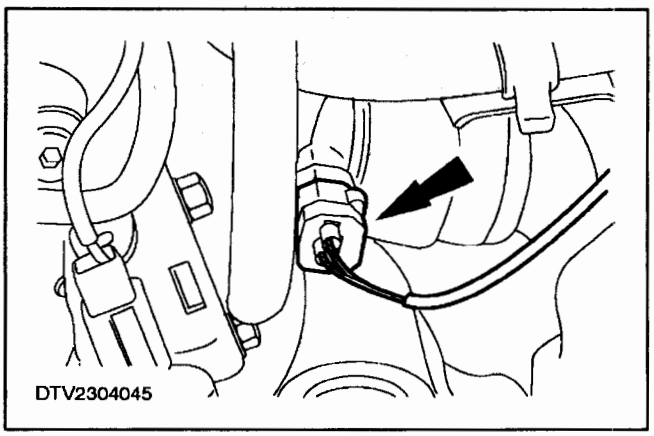

DTV2304043

1. Disconnect the battery ground cable.
2. Disconnect the camshaft position sensor electrical connector.

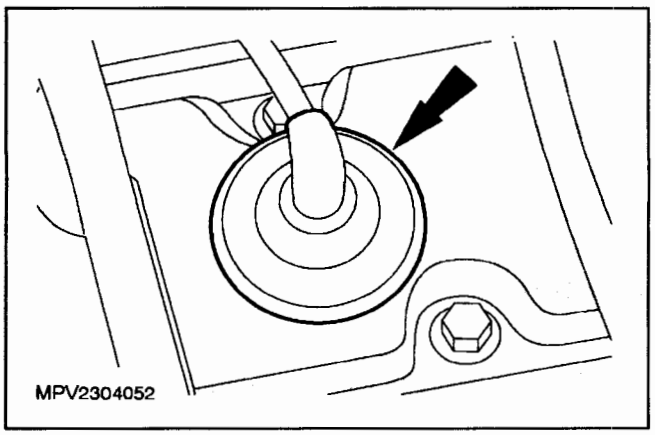
REMOVAL AND INSTALLATION (Continued)



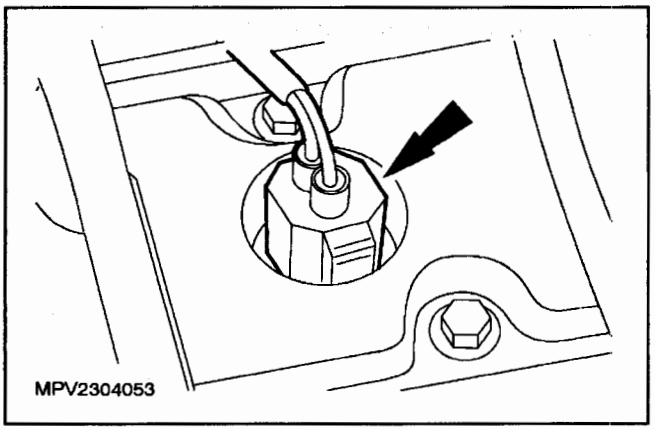
3. Disconnect the engine coolant temperature sensor electrical connector.



4. Disconnect the idle air control valve electrical connector.

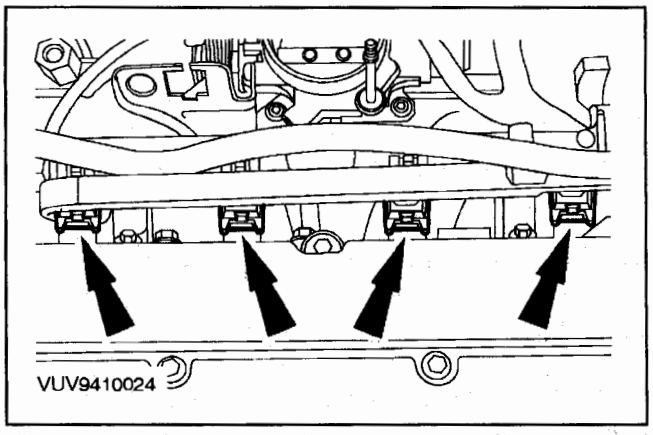


5. Remove the variable camshaft timing solenoid electrical connector grommet from the engine cover.

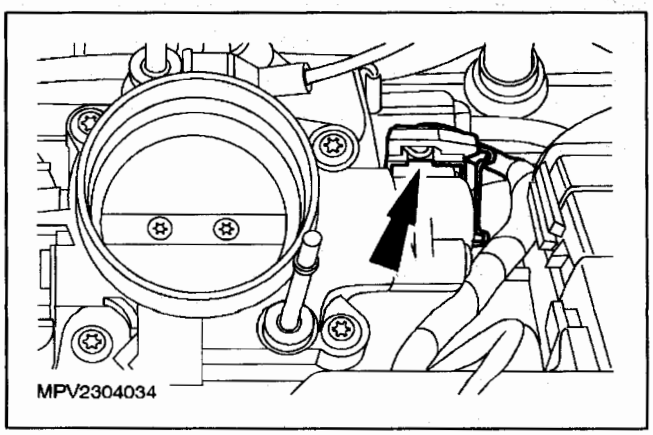


6. Disconnect the variable camshaft timing solenoid electrical connector.

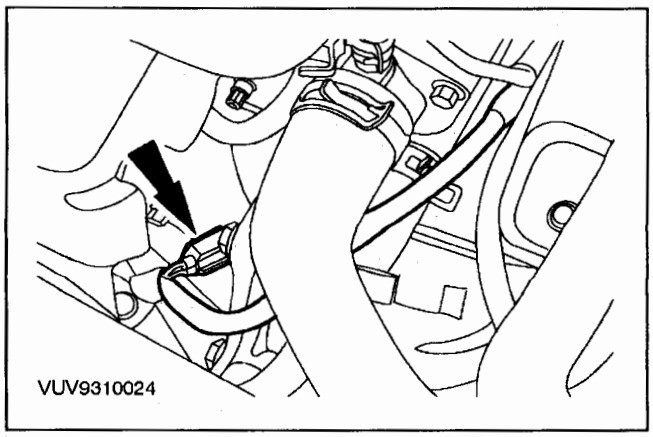
REMOVAL AND INSTALLATION (Continued)



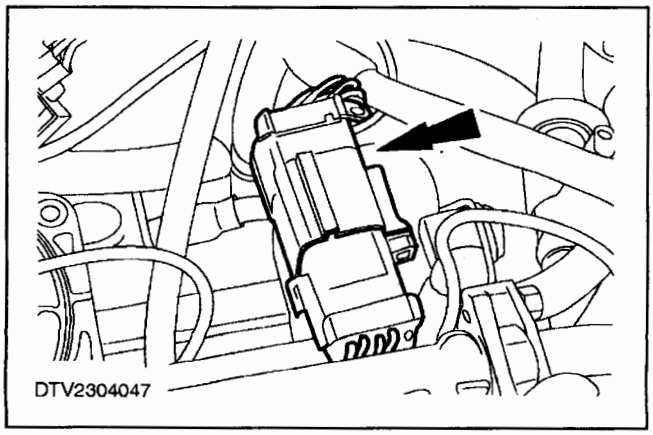
7. Disconnect the fuel injector electrical connectors.



8. Disconnect the throttle position sensor electrical connector.



9. Disconnect the crankshaft position sensor electrical connector.



10. Disconnect the fuel injection wiring harness electrical connector.

11. Remove the fuel injection wiring harness.

REMOVAL AND INSTALLATION (Continued)

Installation

1. To install, reverse the removal procedure.

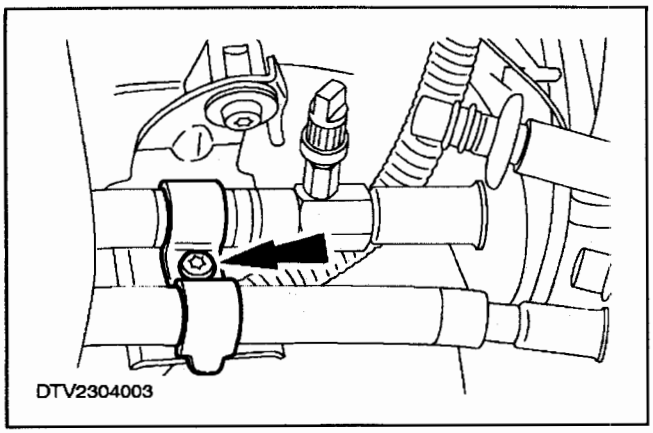
Fuel Injection Supply Manifold — Vehicles Without Returnless Fuel System

Removal

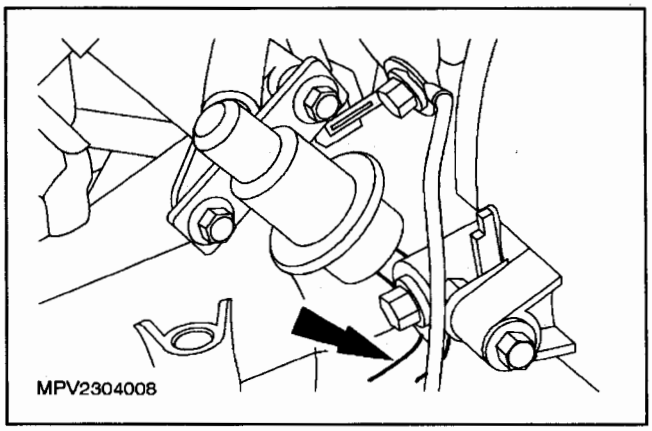
⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

All vehicles

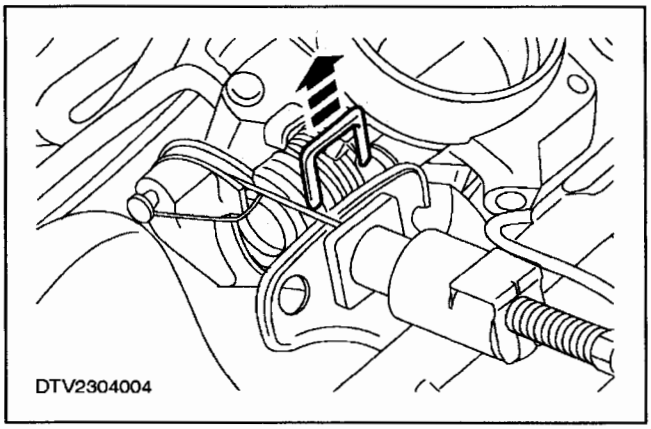
1. Release the fuel system pressure. For additional information, refer to Section 310-00.
2. Remove the air cleaner outlet tube and resonator. For additional information, refer to Section 303-12A.
3. Disconnect the fuel supply and return pipe spring lock couplings. For additional information, refer to Section 310-00.
4. Remove the fuel supply and return hose clamp.


DTV2304003

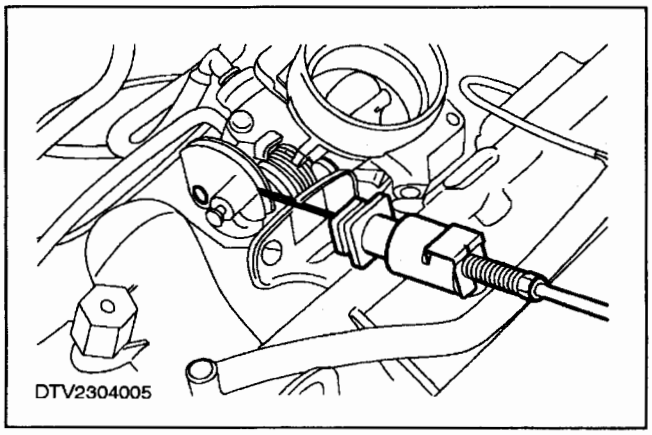
REMOVAL AND INSTALLATION (Continued)



5. Disconnect the vacuum hose from the fuel pressure regulator.

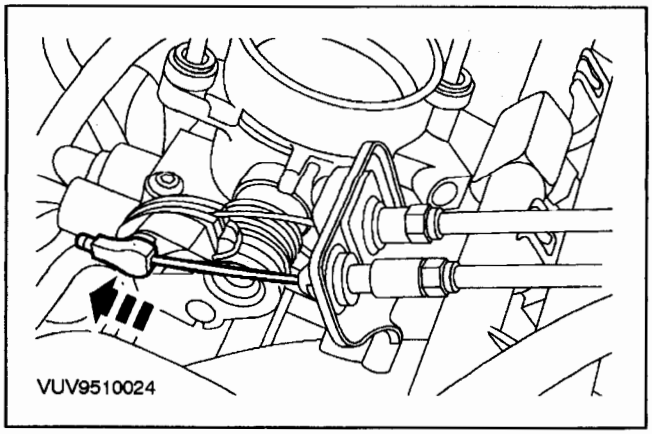


6. Remove the accelerator cable retaining clip.



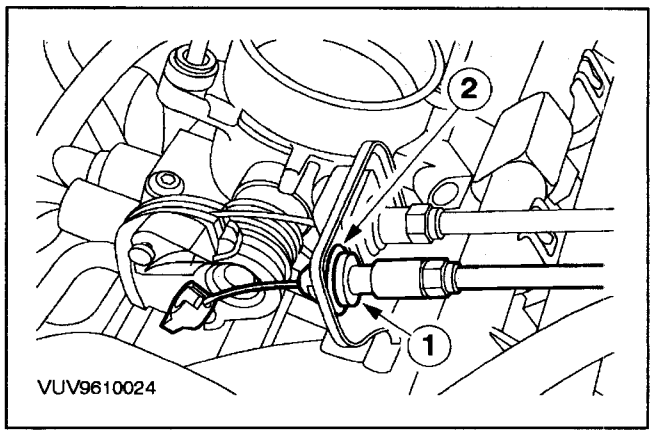
7. Disconnect the accelerator cable from the bracket.

Vehicles with speed control



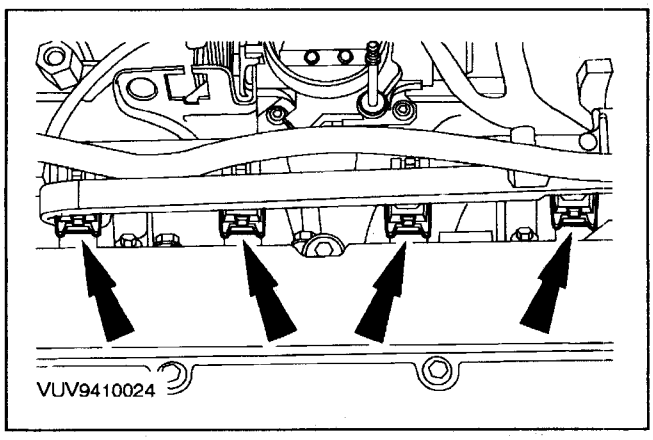
8. Disconnect the speed control cable from the throttle body.

REMOVAL AND INSTALLATION (Continued)

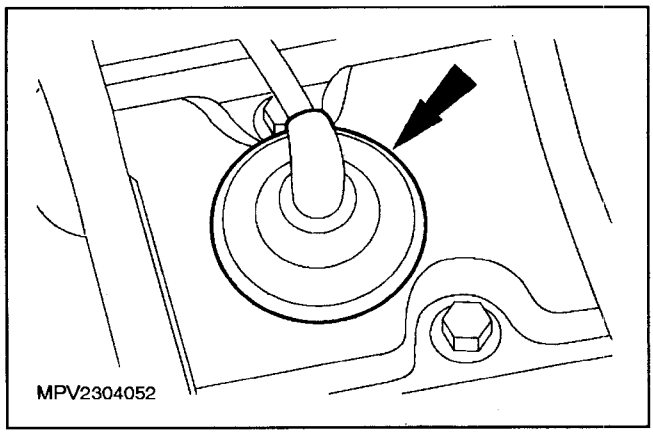


9. Remove the speed control cable from the bracket.
   1 Detach the cable from the bracket.
   2 Push the retaining clip from the bracket and pull the cable out.

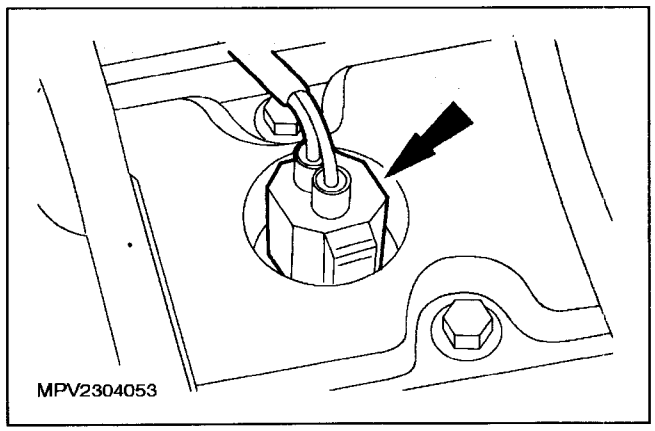
All Vehicles



10. Disconnect the fuel injector electrical connectors.

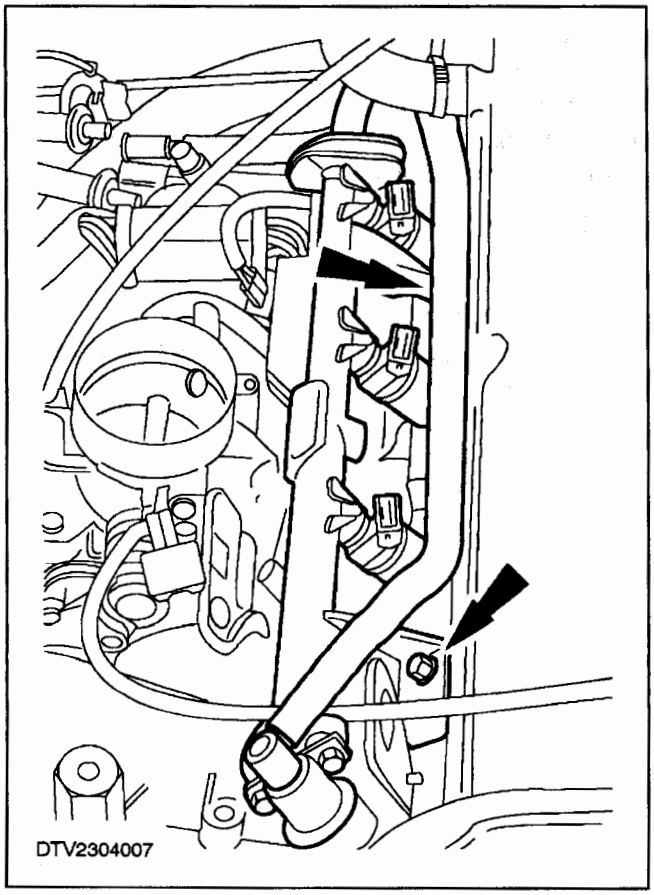


11. Remove the variable camshaft timing solenoid electrical connector grommet from the engine cover.



12. Disconnect the variable camshaft timing solenoid electrical connector.

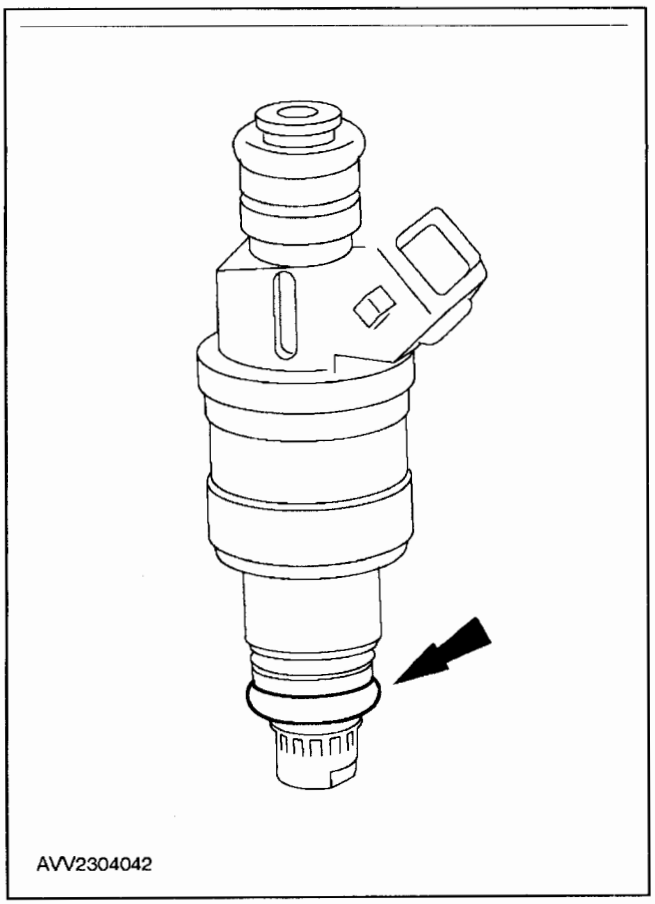
REMOVAL AND INSTALLATION (Continued)



13. Position the fuel injection wiring harness to one side.

14. Remove the fuel injection supply manifold assembly.

REMOVAL AND INSTALLATION (Continued)



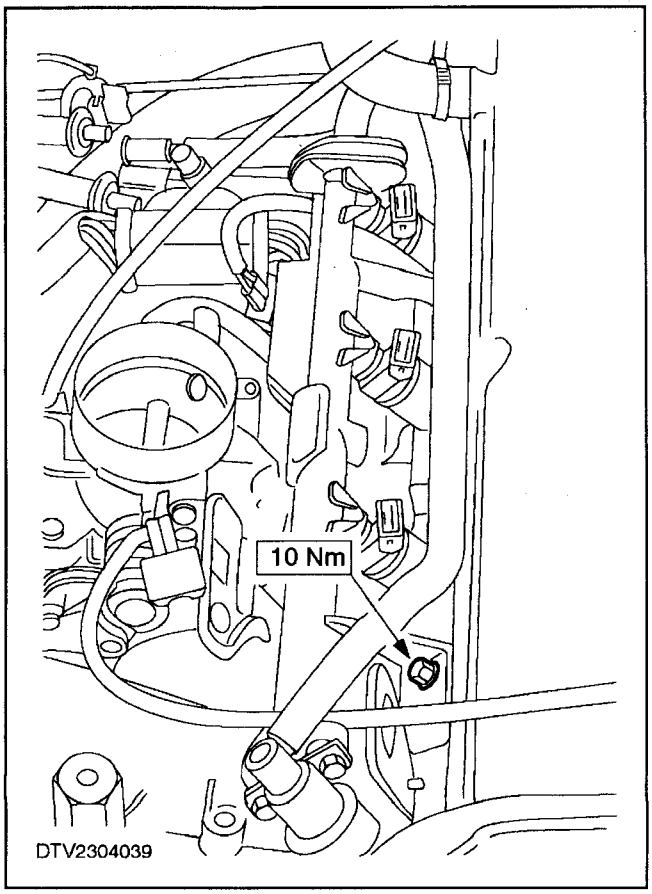
Installation

⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

NOTE: Install a new fuel injector lower O-ring seal.

1. To install, reverse the removal procedure.
   - Lubricate the fuel injector lower O-ring seal with clean engine oil, XO-10W30-QSP or DSP or equivalent meeting Ford specification WSS-M2C-153-H, to aid installation.

REMOVAL AND INSTALLATION (Continued)



Fuel Injection Supply Manifold — Vehicles With Returnless Fuel System

Removal

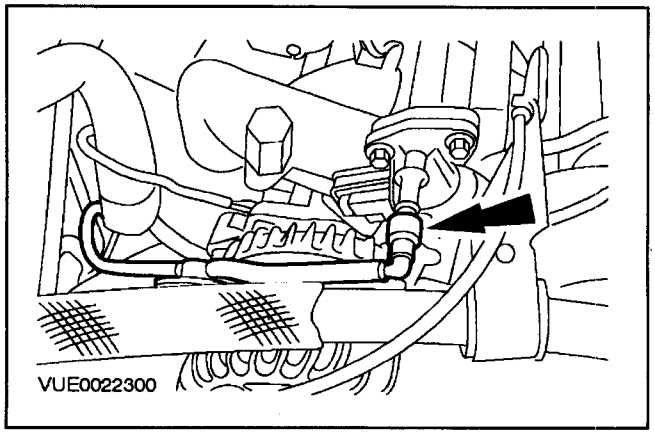
⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

All Vehicles

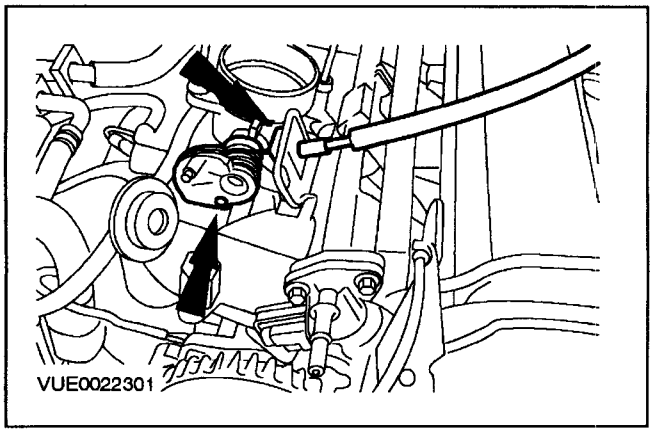
1. Release the fuel system pressure. For additional information, refer to Section 310-00.

2. Remove the air cleaner outlet tube and resonator. For additional information, refer to Section 303-12A.

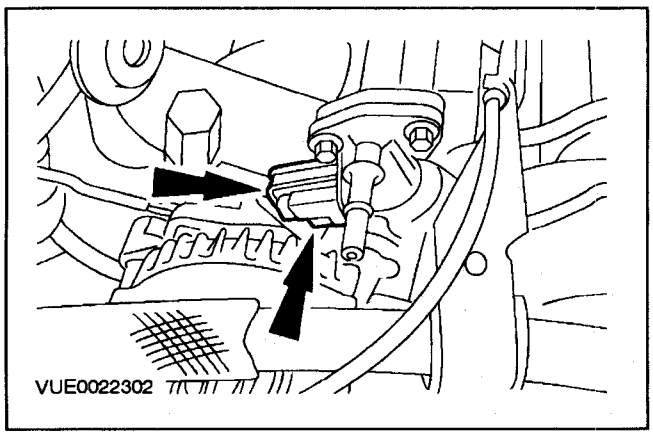
REMOVAL AND INSTALLATION (Continued)


VUE0022300

3. Disconnect the fuel supply line from the fuel injection supply manifold. For additional information, refer to Section 310-00.

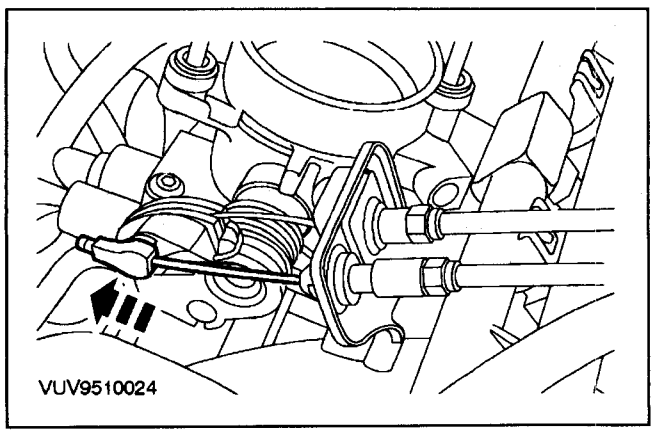

VUE0022301

4. Disconnect the accelerator cable from the accelerator cable bracket.


VUE0022302

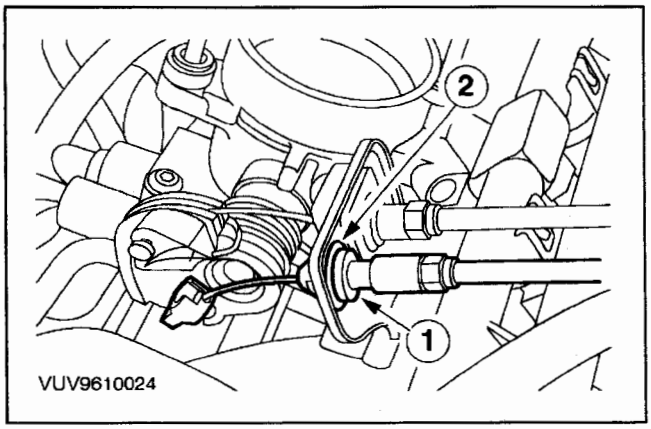
5. Disconnect the electrical connector and vacuum line from the fuel pressure regulator.

Vehicles with speed control


VUV9510024

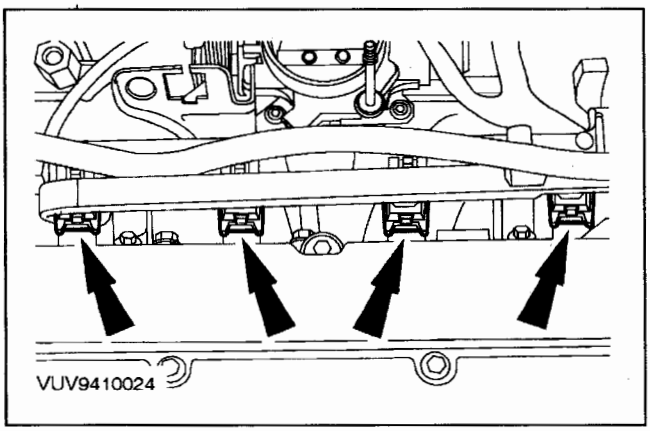
6. Disconnect the speed control cable from the throttle body.

REMOVAL AND INSTALLATION (Continued)



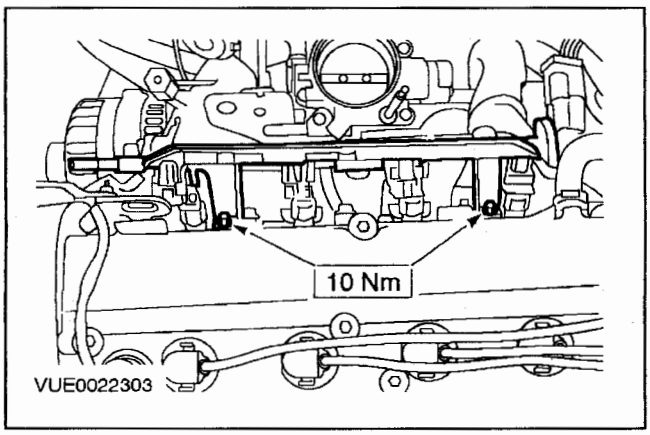
7. Remove the speed control cable from the bracket.
   1 Detach the cable from the bracket.
   2 Push the retaining clip from the bracket and pull the cable out.

All Vehicles



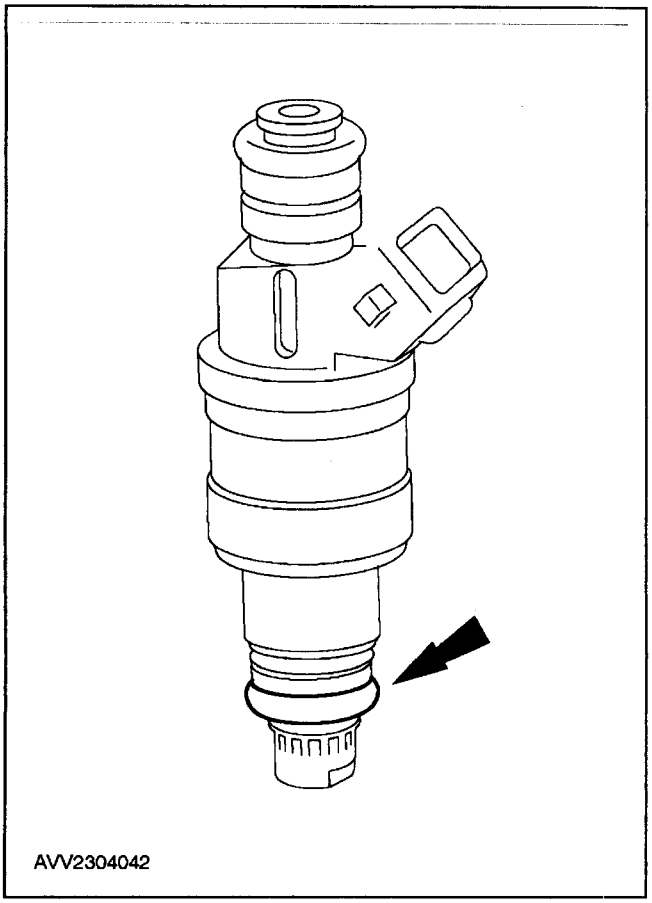
8. Disconnect the fuel injector electrical connectors.

9. Position the fuel injection wiring harness to one side.



10. Remove the fuel injection supply manifold.

REMOVAL AND INSTALLATION (Continued)



Installation

1. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

   NOTE: Install a new fuel injector lower O-ring seal.

   To install, reverse the removal procedure.

   - Lubricate the fuel injector lower O-ring seal with clean engine oil, XO-10W30-QSP or DSP or equivalent meeting Ford specification WSS-M2C-153-H, to aid installation.

Fuel Pressure Regulator

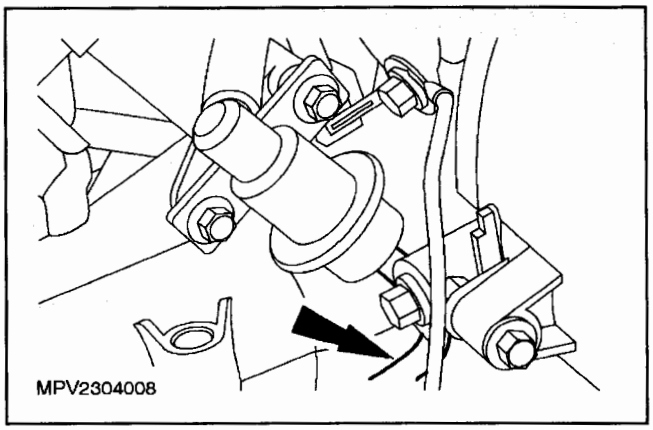
Removal

⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

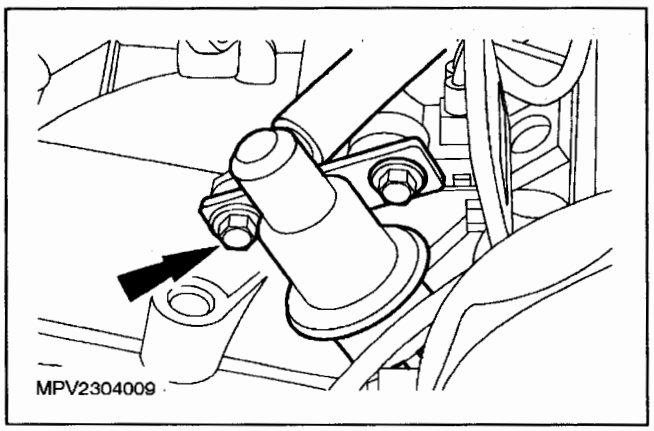
1. Release the fuel system pressure. For additional information, refer to Section 310-00.

2. Disconnect the fuel return hose spring lock coupling. For additional information, refer to Section 310-00.

REMOVAL AND INSTALLATION (Continued)

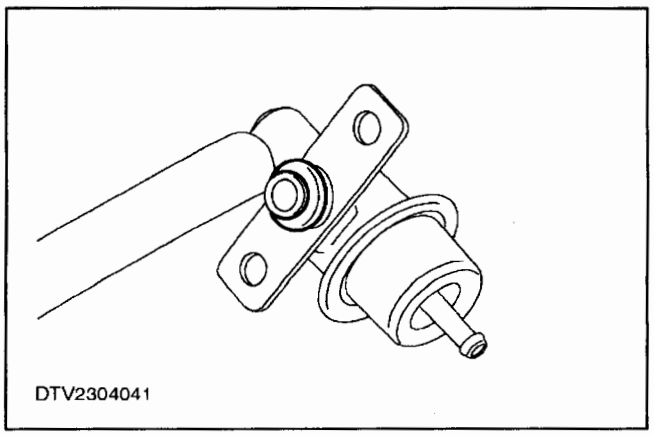


3. Disconnect the vacuum hose from the fuel pressure regulator.



4. Remove the fuel pressure regulator and pipe assembly.

Installation



1. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

   NOTE: Install a new pressure regulator O-ring seal.

   To install, reverse the removal procedure.

   - Lubricate the fuel pressure regulator O-ring seal with clean engine oil, XO-10W30-QSP or DSP or equivalent meeting Ford specification WSS-M2C-153-H, to aid installation.

SECTION 303-04B Fuel Charging and Controls — 2.5L

CONTENTS PAGE

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Fuel Charging And Controls 303-04B-3
DIAGNOSIS AND TESTING
Fuel Charging And Controls 303-04B-4
REMOVAL AND INSTALLATION
Throttle Body 303-04B-4
Fuel Charging Wiring Harness 303-04B-7
Fuel Injection Supply Manifold — Vehicles Without Returnless Fuel System 303-04B-12
Fuel Injection Supply Manifold — Vehicles With Returnless Fuel System 303-04B-16
Fuel Pressure Regulator 303-04B-19

SPECIFICATIONS

General Specifications

Item	Specification
Engine Oil XO-10W20-QSP or DSP	WSS-M2C-153-H

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Throttle body to intake manifold	10	—	89
Accelerator cable bracket	10	—	89

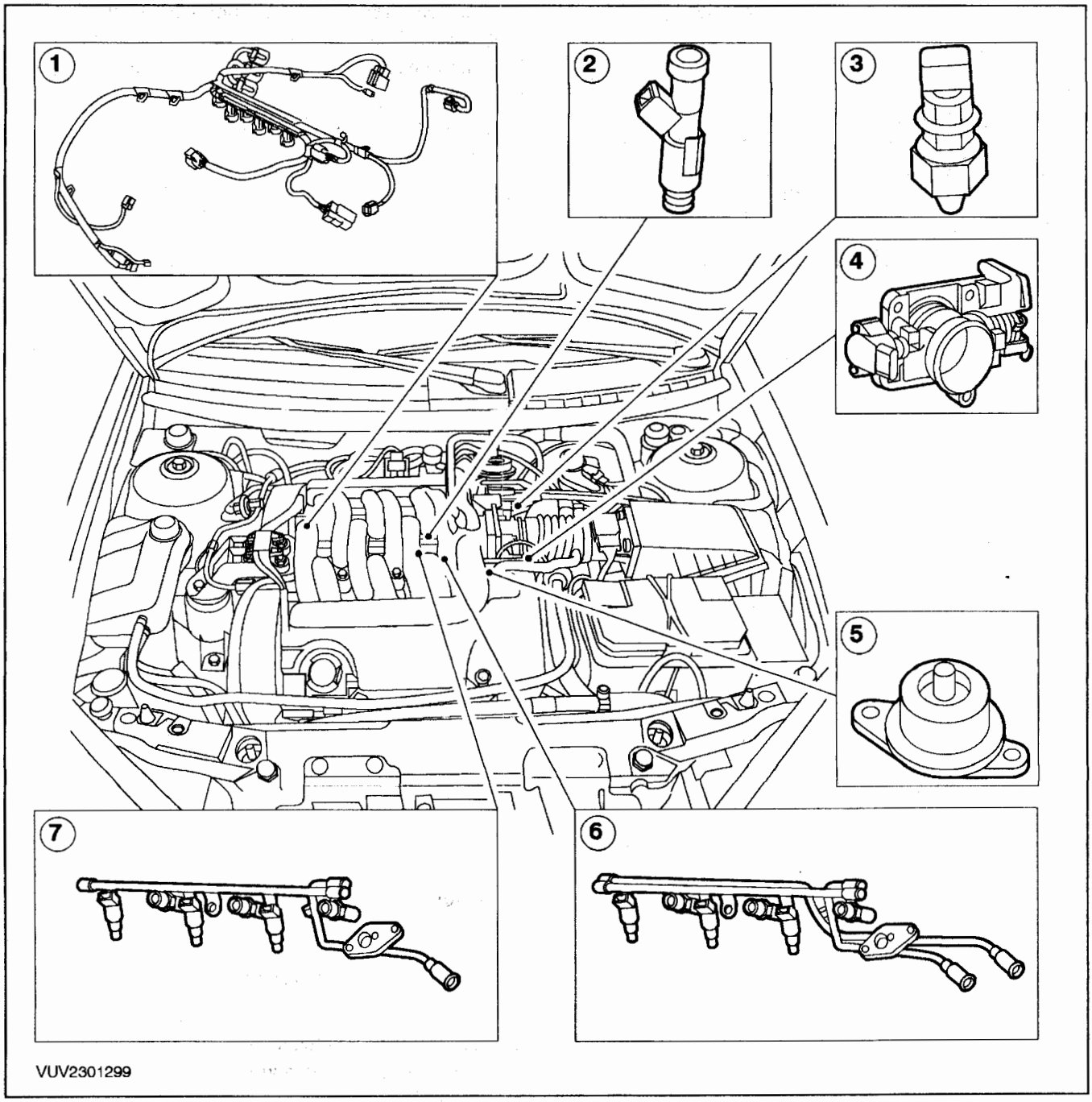
(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Fuel injection supply manifold to intake manifold	10	—	89
Fuel pressure regulator	6	—	53
Fuel pressure relief valve	8	—	71
Air conditioning (A/C) compressor bolts	25	18	—

DESCRIPTION AND OPERATION

Fuel Charging And Controls



Item	Part Number	Description
1	—	Fuel injection wiring harness
2	—	Fuel injector
3	—	Fuel pressure relief valve
4	—	Throttle body

(Continued)

Item	Part Number	Description
5	—	Fuel pressure regulator
6	—	Supply manifold (vehicles without returnless fuel system)
7	—	Supply manifold (vehicles with returnless fuel system)

DESCRIPTION AND OPERATION (Continued)

The fuel injection equipment of the 2.5L engine consists of a fabricated supply manifold, into which is fitted a fuel pressure regulator and six injectors.

The injectors are of the top feed type, mounted directly to the supply manifold. O-ring seals are fitted to the top and bottom of the injectors. The electronic injectors are activated sequentially by the Powertrain Control Module (PCM) via individual electrical connectors.

The fuel pressure regulator for the 2.5L engine is a vacuum operated, diaphragm type. The fuel pressure is regulated by the vacuum, generated in the engine plenum. This acts on the diaphragm, controlling a valve that regulates the fuel flow. This allows acceptable fuel pressure to be maintained over all operating demands of the engine, excess fuel being returned to the fuel tank. The regulator is attached directly to the supply manifold, where it is sealed with O-rings on the flow side and a compression seal on the return side.

The supply manifold is mounted to the engine by four bolts. Rubber hoses supply and return fuel to and from the rail, but feature quick - release couplings to facilitate easy removal of the complete assembly (vehicles without returnless fuel system). A rubber hose supplies fuel to the fuel rail, but features a quick - release coupling to facilitate easy removal of the complete assembly (vehicles with returnless fuel system).

DIAGNOSIS AND TESTING

Fuel Charging And Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

REMOVAL AND INSTALLATION

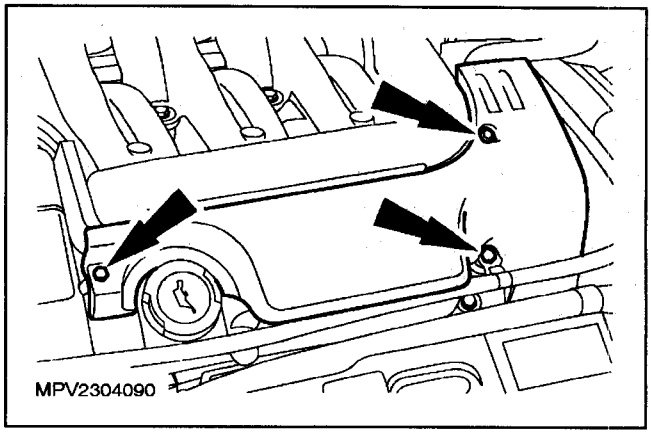
Throttle Body

Removal

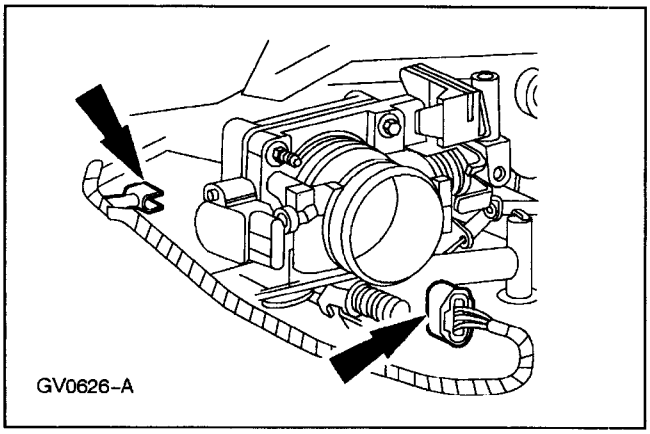
1. Disconnect the battery ground cable.
2. Remove the air cleaner assembly and outlet tube. For additional information, refer to Section 303-12B.

1 Can be purchased as a separate item.

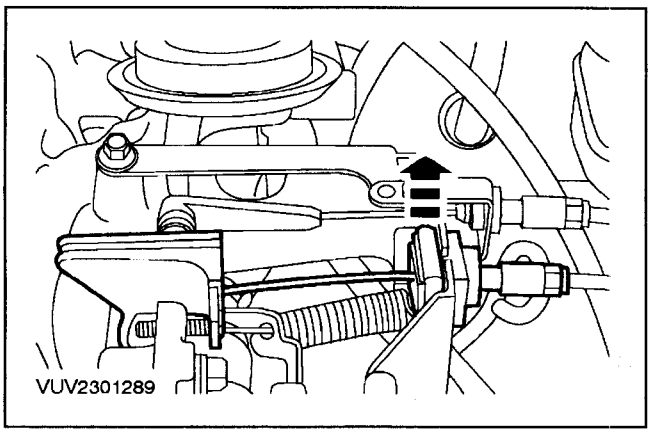
REMOVAL AND INSTALLATION (Continued)



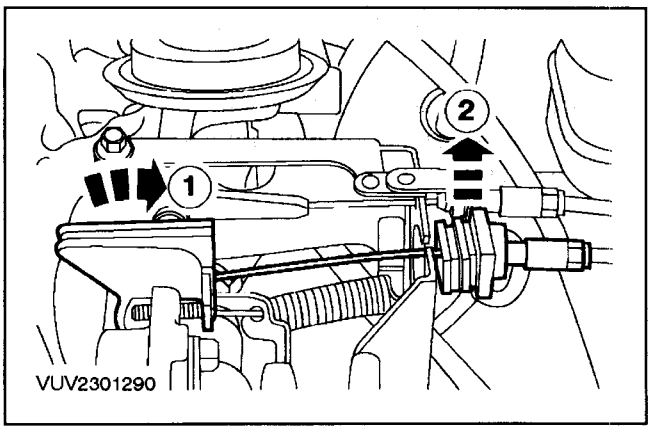
3. Remove the engine cover.



4. Disconnect the throttle position (TP) sensor electrical connector.
   - Remove the wiring retainer from the throttle body stud.

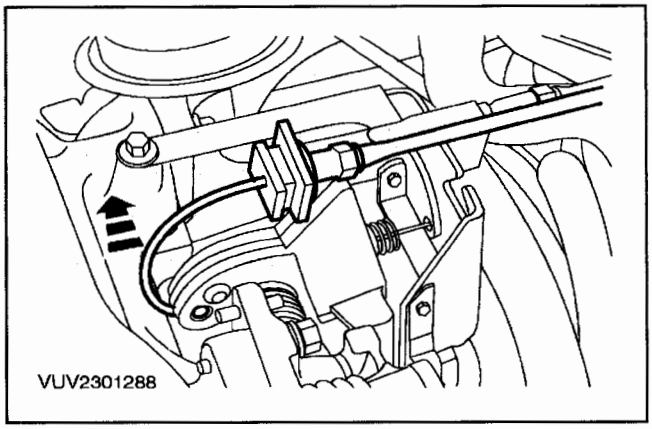


5. Remove the accelerator cable retaining clip.

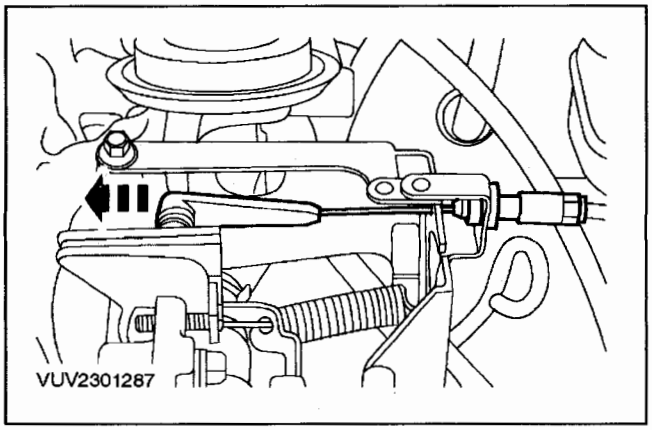


6. Detach the accelerator cable from the bracket.
   1 Rotate the quadrant.
   2 Lift the cable out of the bracket.

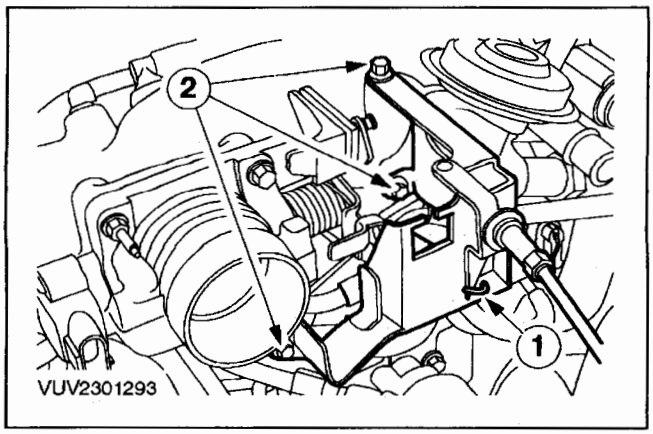
REMOVAL AND INSTALLATION (Continued)



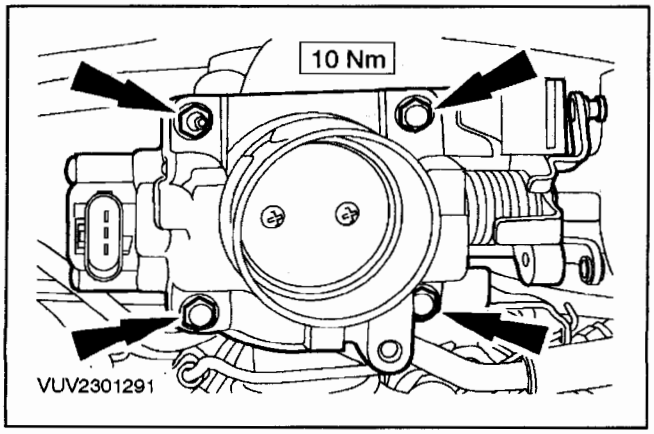
7. Disconnect the accelerator cable from the quadrant.



8. Disconnect the speed control cable.



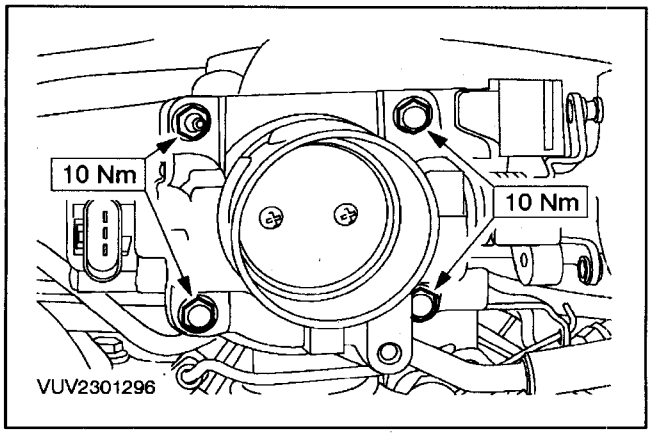
9. Remove the accelerator bracket.
   1 Remove the bolts.
   2 Detach the spring.

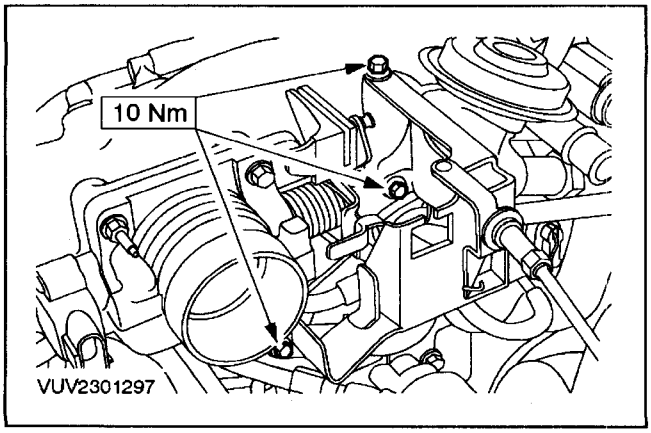


10. Remove the throttle body.

REMOVAL AND INSTALLATION (Continued)

Installation





1. **NOTE:** If scraping is necessary, do not damage gasket surfaces or drop material into the manifold.

   To install, reverse the removal procedure.

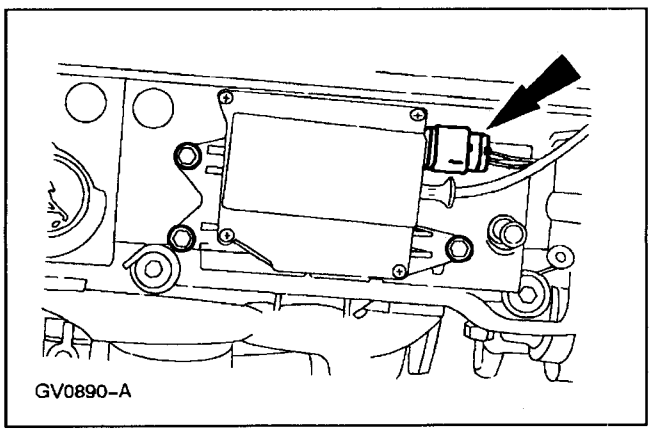
   - Clean the throttle body and intake manifold mating surfaces and install a new gasket.

Fuel Charging Wiring Harness

Removal

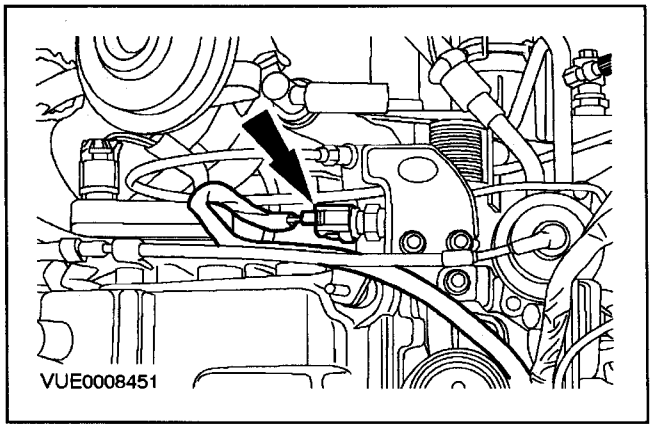
All vehicles

1. Remove the upper intake manifold. For additional information, refer to Section 303-01B.

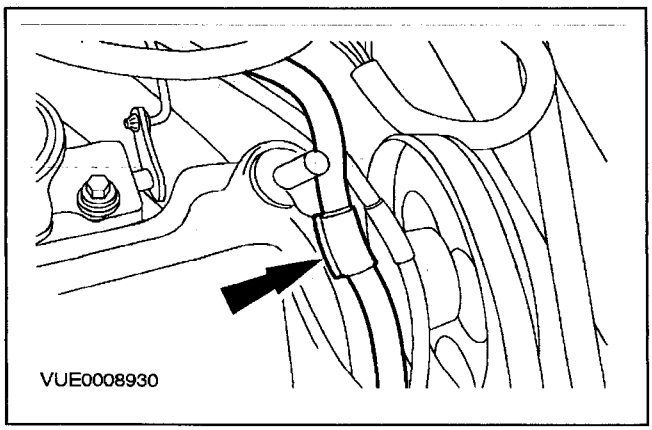


2. Disconnect the intake manifold runner control (IMRC) actuator electrical connector.

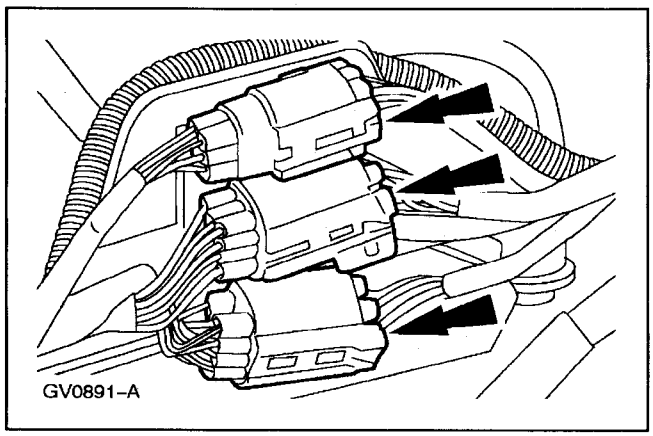
REMOVAL AND INSTALLATION (Continued)



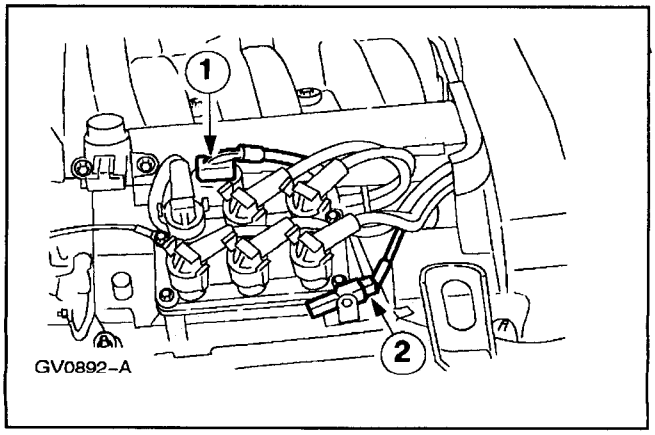
3. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



4. Disconnect the retainer and detach the wiring harness.

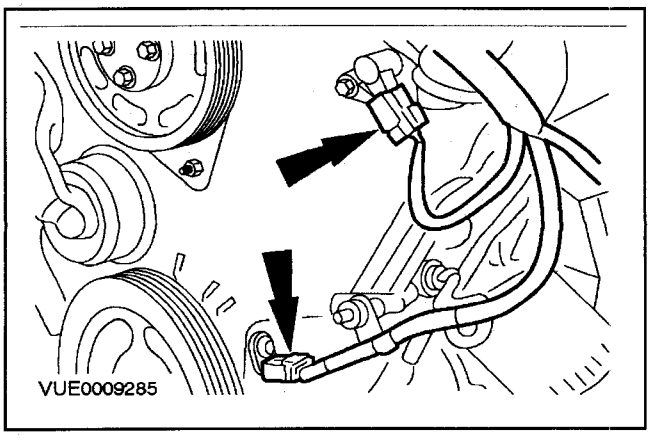


5. Disconnect the fuel charging wiring harness main in-line electrical connectors and detach the clips.



6. Disconnect the following electrical connectors.
   1 Ignition coil.
   2 Radio capacitor.

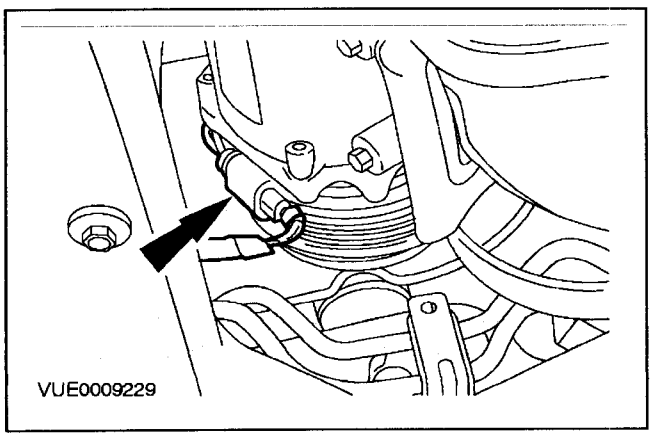
REMOVAL AND INSTALLATION (Continued)



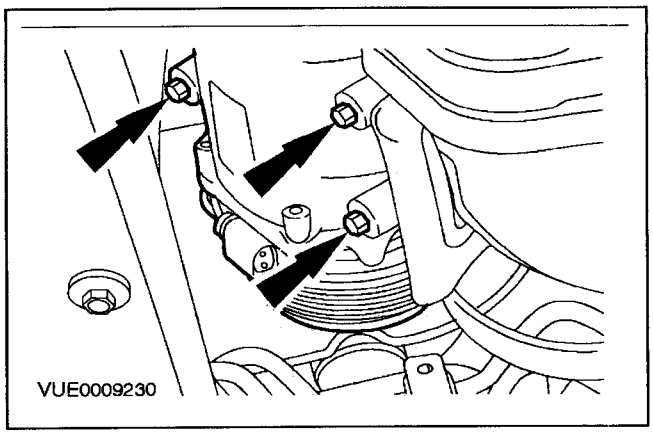
7. Disconnect the crankshaft position (CKP) sensor and camshaft position (CMP) sensor electrical connectors (accessory drive belt removed for clarity).

8. Raise and support the vehicle. For additional information, refer to Section 100-02.

Vehicles with air conditioning

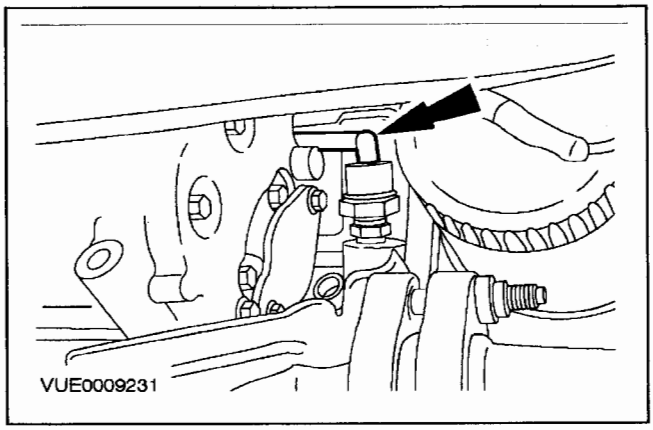


9. Disconnect the air conditioning (AC) compressor electrical connector.



10. Secure the AC compressor to one side.

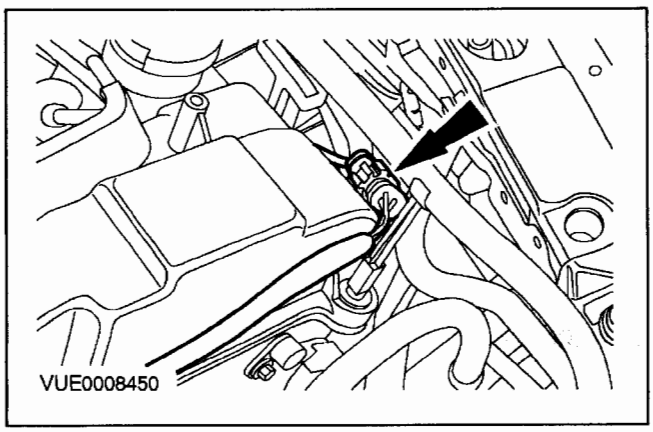
REMOVAL AND INSTALLATION (Continued)



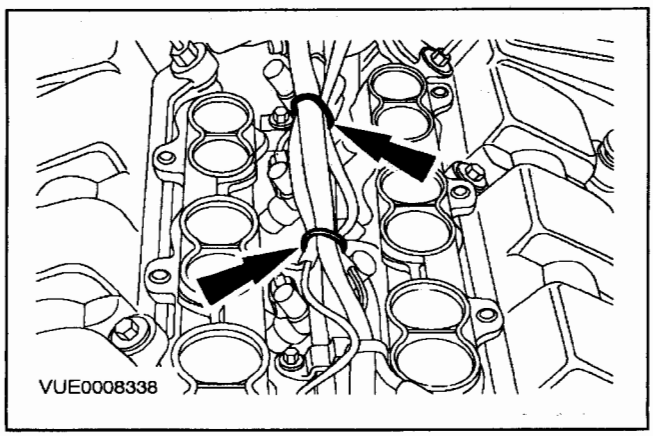
All vehicles

11. Disconnect the engine oil pressure (EOP) switch electrical connector.

12. Lower the vehicle.

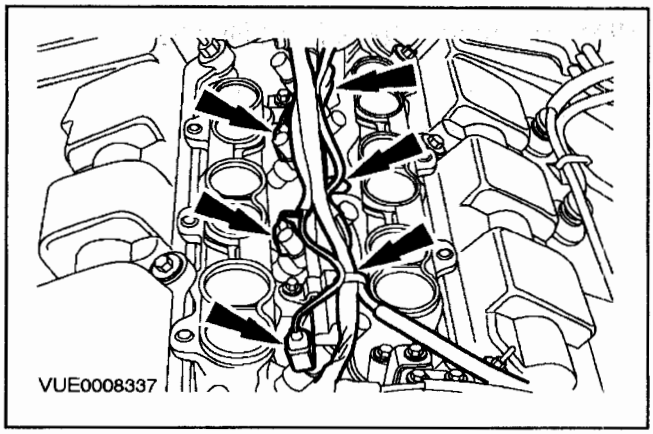


13. Disconnect the heated oxygen sensor (HO2S) electrical connector.

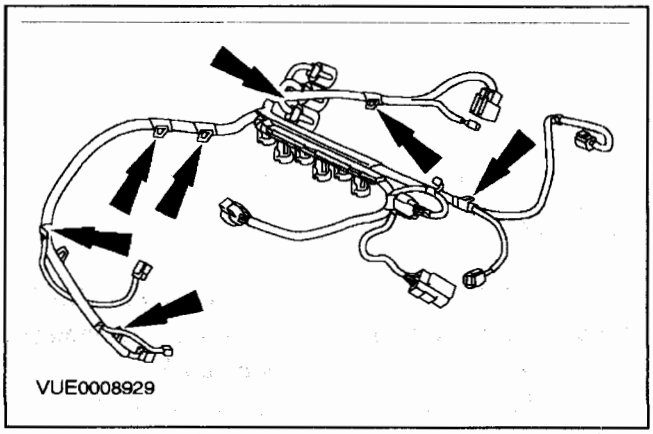


14. Detach the fuel charging wiring harness.

REMOVAL AND INSTALLATION (Continued)

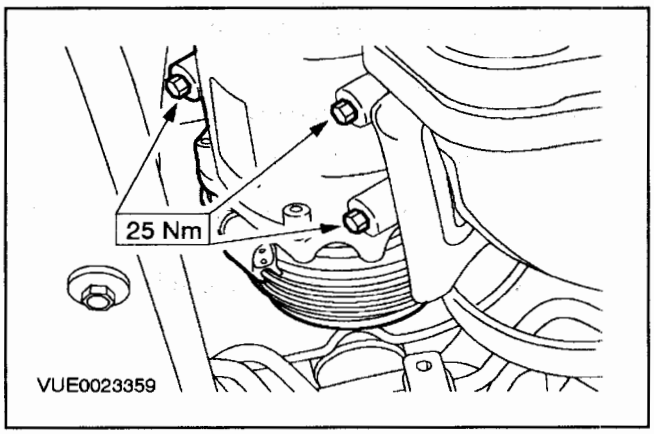


15. Disconnect the six fuel injector electrical connectors.



16. Remove the seven wiring harness retainers and remove the fuel injection wiring harness.

Installation



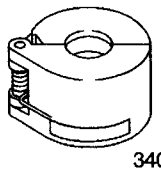
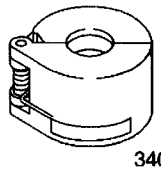
1. **NOTE:** When installing the six fuel injector electrical connectors, begin at the front of the engine, and install sequentially working toward the rear.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION (Continued)

Fuel Injection Supply Manifold — Vehicles Without Returnless Fuel System

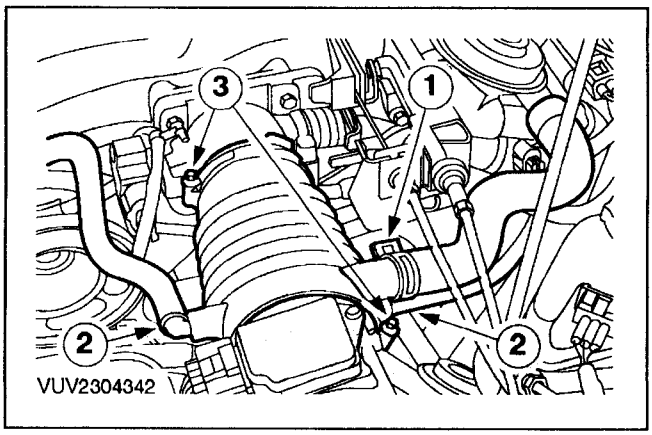
Special Tool(s)

 34001	Disconnect Tool, Spring-Lock Coupling 310-D004 (23-039)
 34001	Disconnect Tool, Spring-Lock Coupling 310-D005 (23-039)

Removal

⚠ **CAUTION: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

1. Disconnect the battery ground cable.

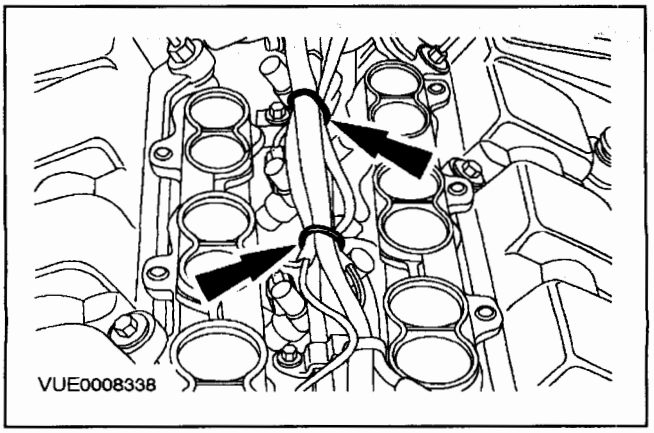


2. Remove the air cleaner outlet tube.
   1 Disconnect the air intake bypass hose.
   2 Disconnect the positive crankcase ventilation hoses.
   3 Remove the air cleaner outlet tube.

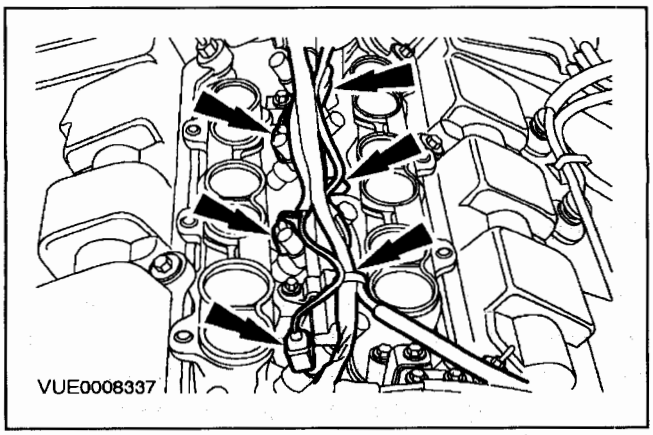
3. Release the fuel pressure. For additional information, refer to Section 310-00.

4. Remove the upper intake manifold. For additional information, refer to Section 303-01B.

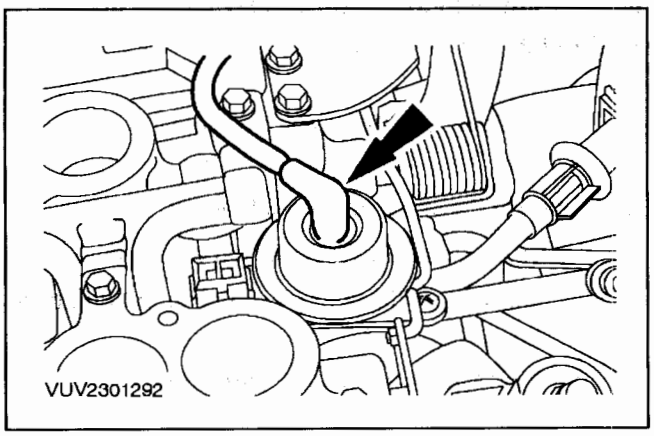
REMOVAL AND INSTALLATION (Continued)



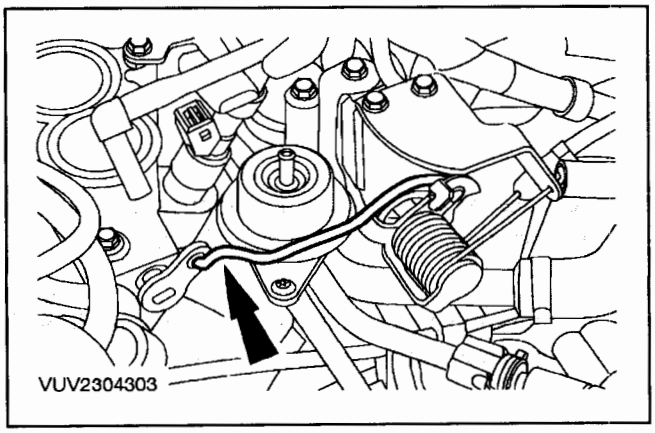
5. Detach the fuel injection wiring harness.



6. Disconnect the six fuel injector electrical connectors.

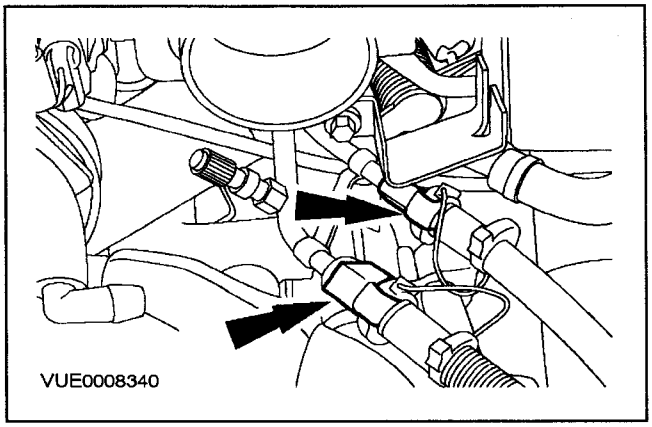


7. Disconnect the vacuum line from the fuel pressure regulator.

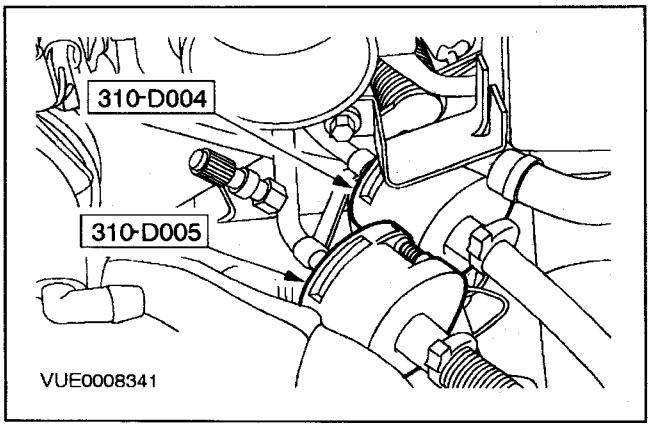


8. Disconnect the intake manifold runner control (IMRC) operating rod.

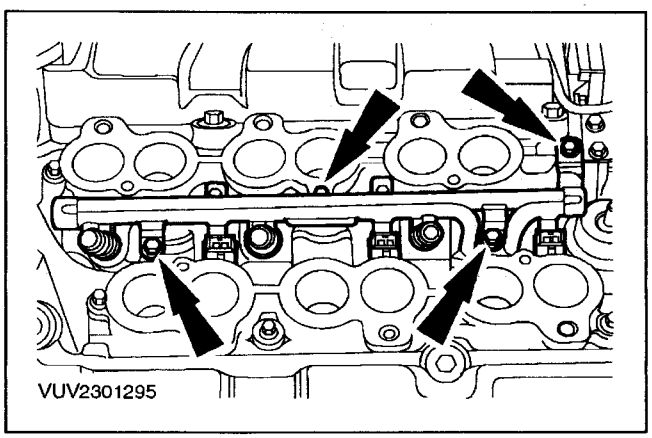
REMOVAL AND INSTALLATION (Continued)



9. Detach the fuel supply and the fuel return line clips.

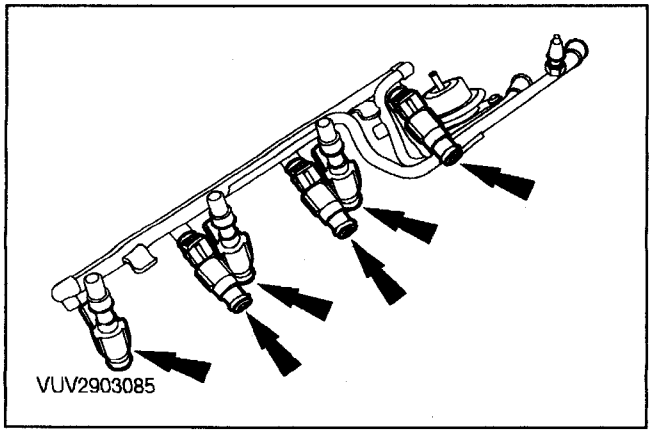


10. Using the special tools, disconnect the fuel supply and the fuel return hoses.



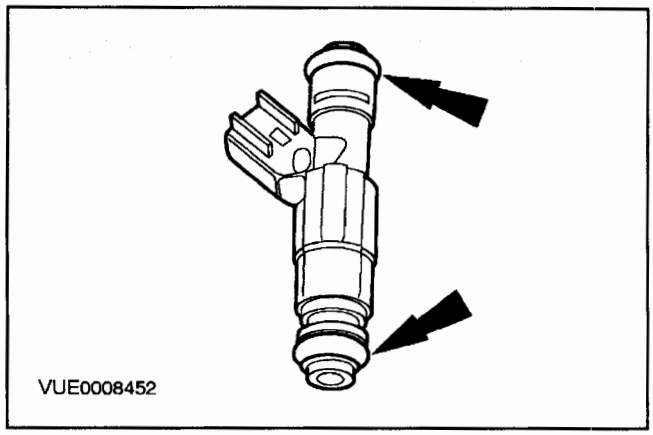
11. **NOTE:** The fuel supply manifold and fuel injectors are removed as an assembly.

    Remove the fuel supply manifold.



12. Remove the fuel injectors from the fuel supply manifold.

REMOVAL AND INSTALLATION (Continued)



13. Remove and discard the O-ring seals.

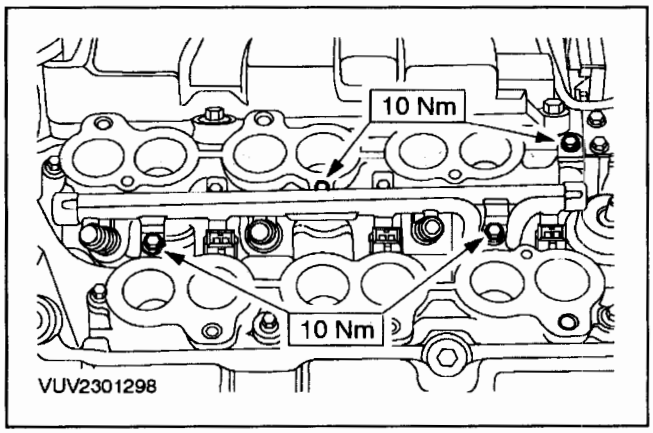
Installation

⚠ CAUTION: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

⚠ CAUTION: Never use silicone grease to lubricate the O-ring seals as it will clog the injectors.

NOTE: Install new fuel injector O-ring seals.

1. To install, reverse the removal procedure.
   - Lubricate the fuel injector O-ring seals with clean engine oil to aid installation.
   - When installing the six fuel injectors begin at the front of the engine and install sequentially working toward the rear.



2. Check the fuel system for fuel leaks.

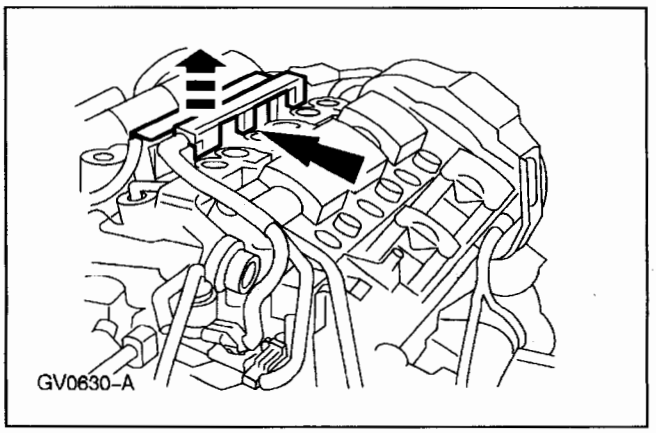
REMOVAL AND INSTALLATION (Continued)

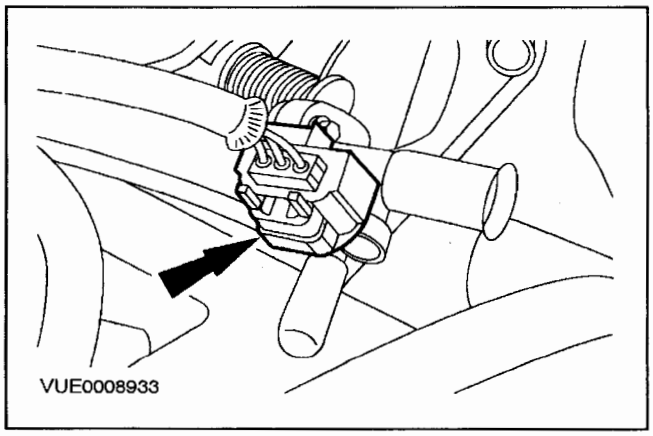
Fuel Injection Supply Manifold — Vehicles With Returnless Fuel System

Removal

⚠ **CAUTION: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may cause personal injury.**

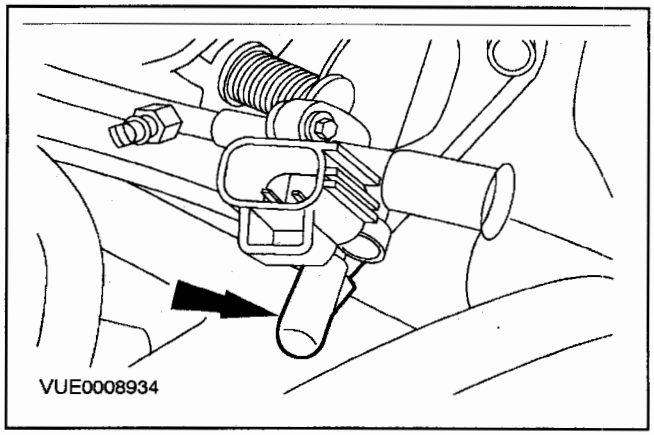
1. Remove the air cleaner assembly outlet tube. For additional information, refer to Section 303-12B.
2. Disconnect the fuel line. For additional information, refer to Section 310-00.
3. Remove the upper intake manifold. For additional information, refer to Section 303-01B.
4. Disconnect the six electrical connectors from the fuel injectors and position the harness to one side.



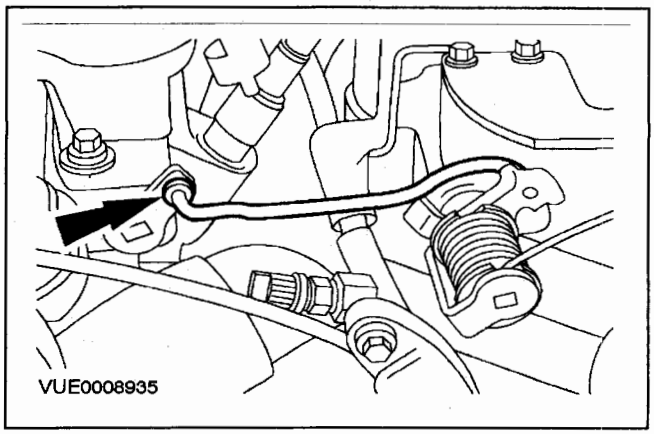


5. Disconnect the fuel pressure sensor electrical connector.

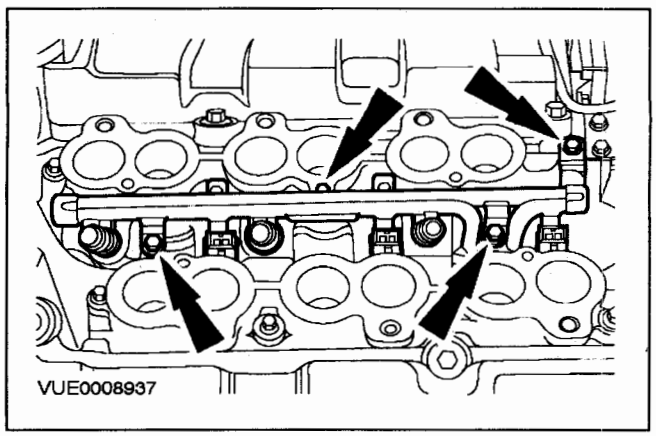
REMOVAL AND INSTALLATION (Continued)



6. Disconnect the vacuum line.

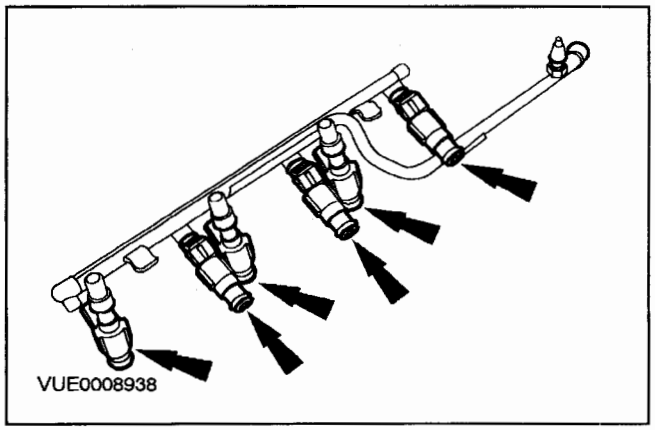


7. Disconnect the intake manifold runner control (IMRC) operation rod.



8. **NOTE:** The fuel injection supply manifold and fuel injectors are removed as an assembly.

   Remove the fuel supply manifold.

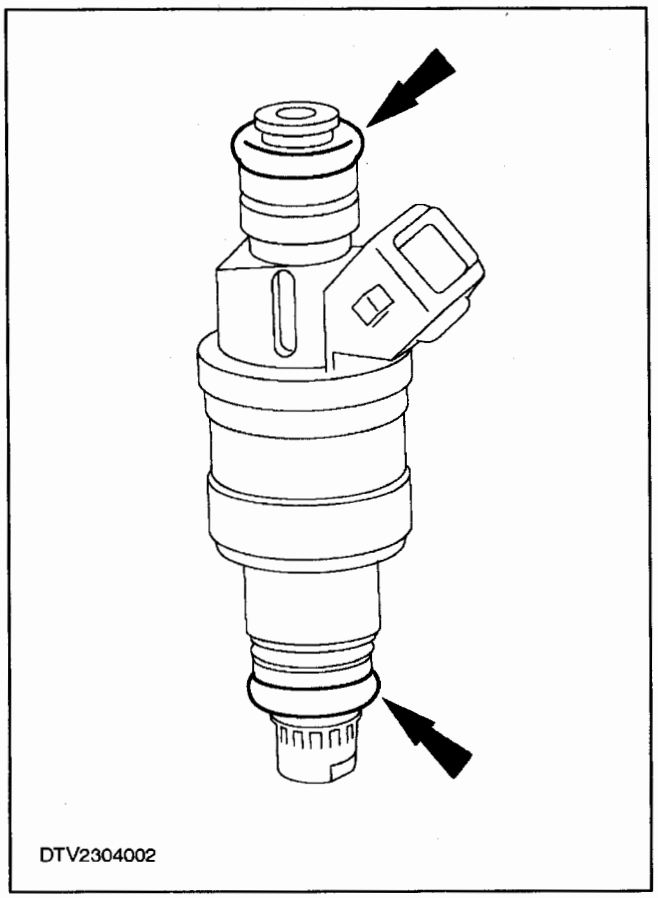


9. Remove the fuel injectors from the supply manifold.

REMOVAL AND INSTALLATION (Continued)

Installation

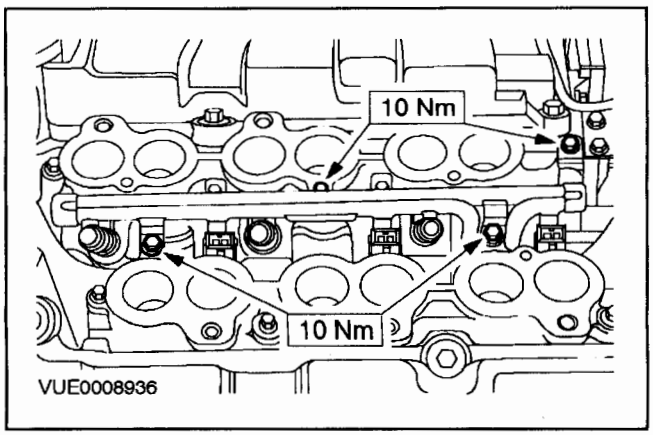
⚠ **CAUTION: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may cause personal injury.**


DTV2304002

1. ⚠ **CAUTION: Never use silicone grease. It will clog the injectors**

   Install new fuel injector O-ring seals.

   - Lubricate the fuel injector O-ring seals with clean engine oil, OX-10W30-QSP or DSP or equivalent meeting Ford specification WSS-M2C-153-H, to aid installation.



VUE0008936

2. To install, reverse the removal procedure.
   - When installing the six fuel injectors begin at the front of the engine and install sequentially working towards the rear.
   - Check for fuel leaks.

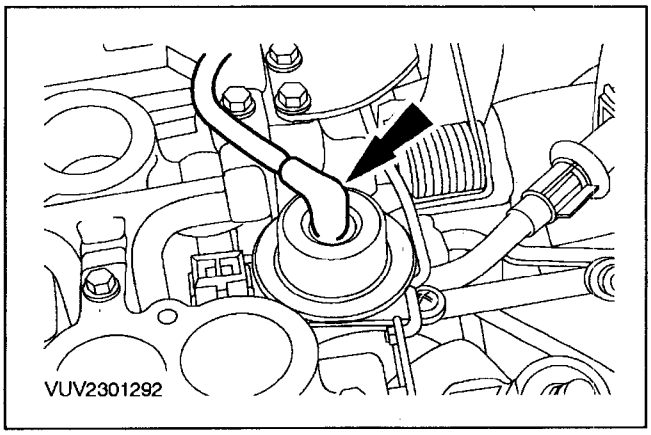
REMOVAL AND INSTALLATION (Continued)

Fuel Pressure Regulator

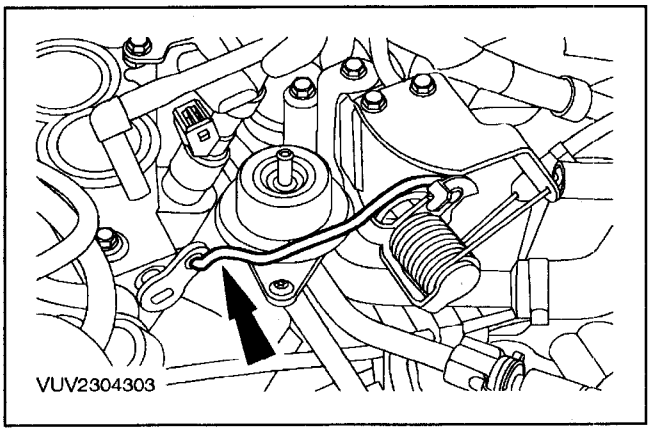
Removal

⚠ **CAUTION: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

1. Release the fuel pressure. For additional information, refer to Section 310-00.
2. Remove the upper intake manifold. For additional information, refer to Section 303-01B.

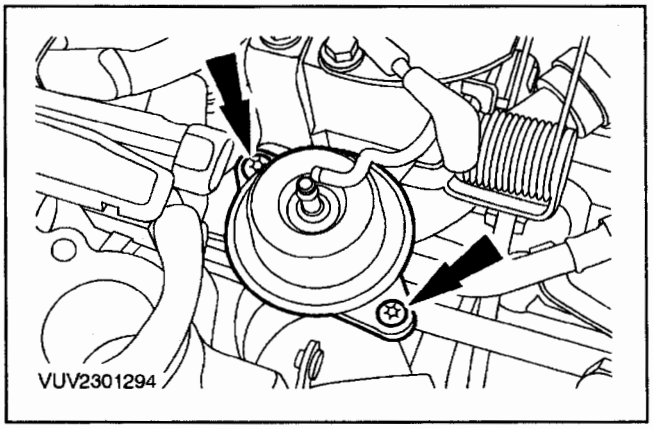


3. Disconnect the vacuum line from the fuel pressure regulator.



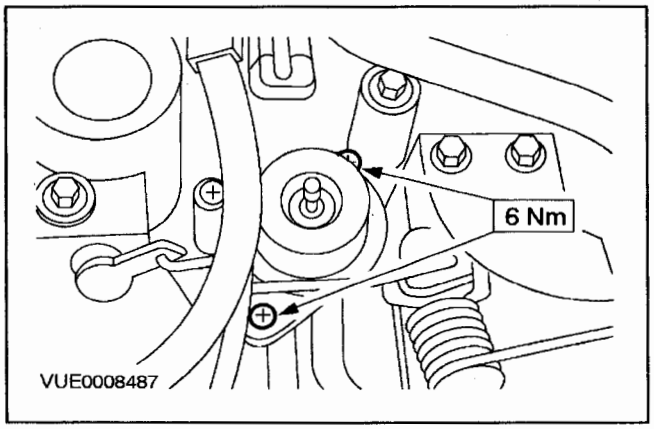
4. Disconnect the intake manifold runner control (IMRC) operating rod.

REMOVAL AND INSTALLATION (Continued)



5. Remove the fuel pressure regulator.
   - Discard the O-rings seals.

Installation



1. **CAUTION: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.**

   CAUTION: Install the fuel pressure regulator outlet tube into the fuel supply manifold carefully to avoid damaging the seals.

   NOTE: Install new fuel pressure regulator O-ring seals.

   To install, reverse the removal procedure.
   - Lubricate the fuel pressure regulator O-ring seals with clean engine oil, to aid installation.
   - Check for fuel leaks.

SECTION 303-05 Accessory Drive

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Accessory Drive Belt Idler Pulley — Vehicles with 2.0L Engine 303-05-11
Accessory Drive Belt Idler Pulley — Vehicles with 2.5L Engine 303-05-11

SPECIFICATIONS

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Belt tensioner bolts, 2.0L	25	18	—
Belt tensioner bolts, 2.5L	25	18	—
Belt tensioner bolts — water pump, 2.5L	10	—	89

(Continued)

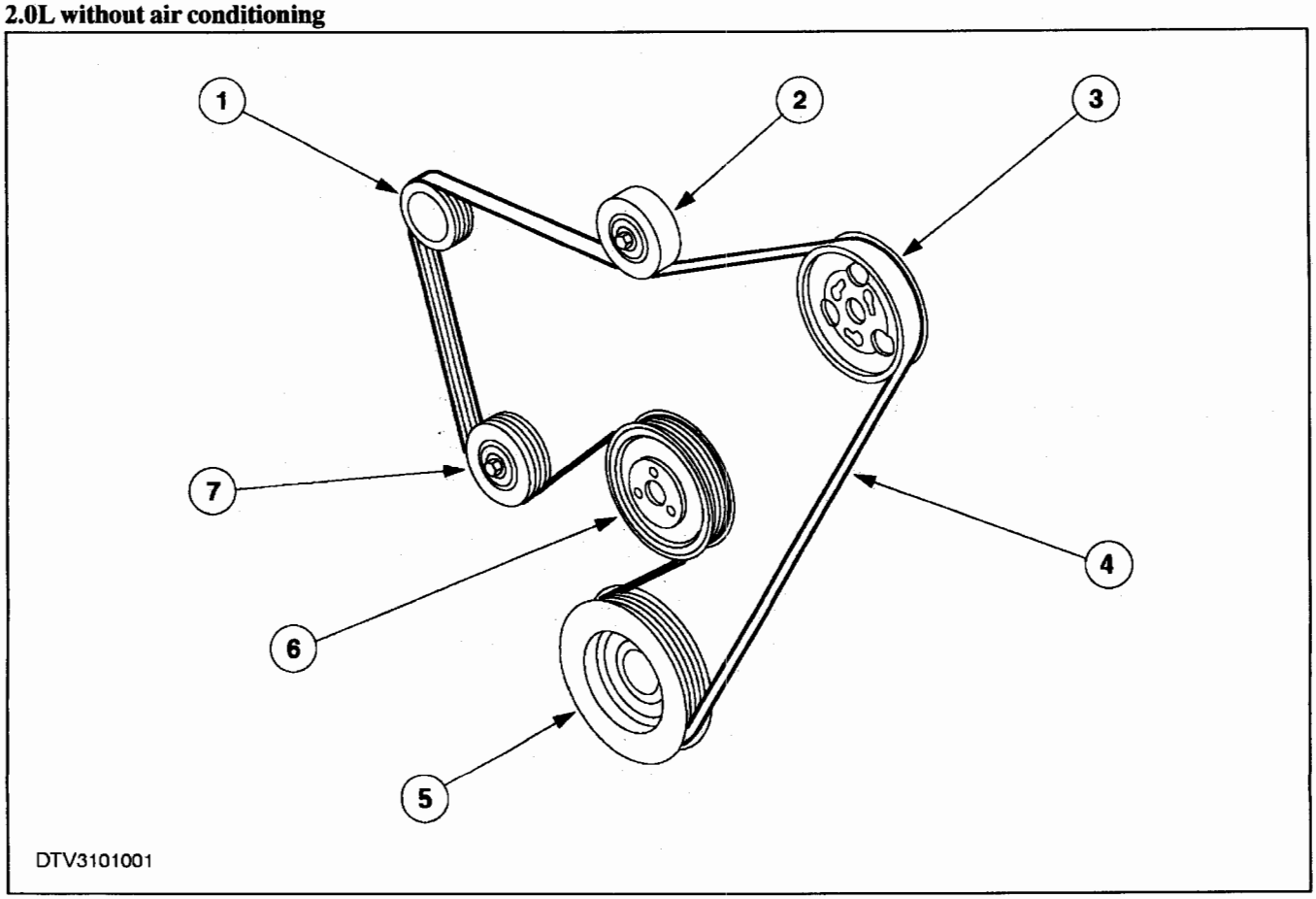
Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Belt idler pulley bolt, 2.0L	48	35	—
Belt idler pulley bolt, 2.5L	10	—	89

DESCRIPTION AND OPERATION

Accessory Drive

2.0L without air conditioning



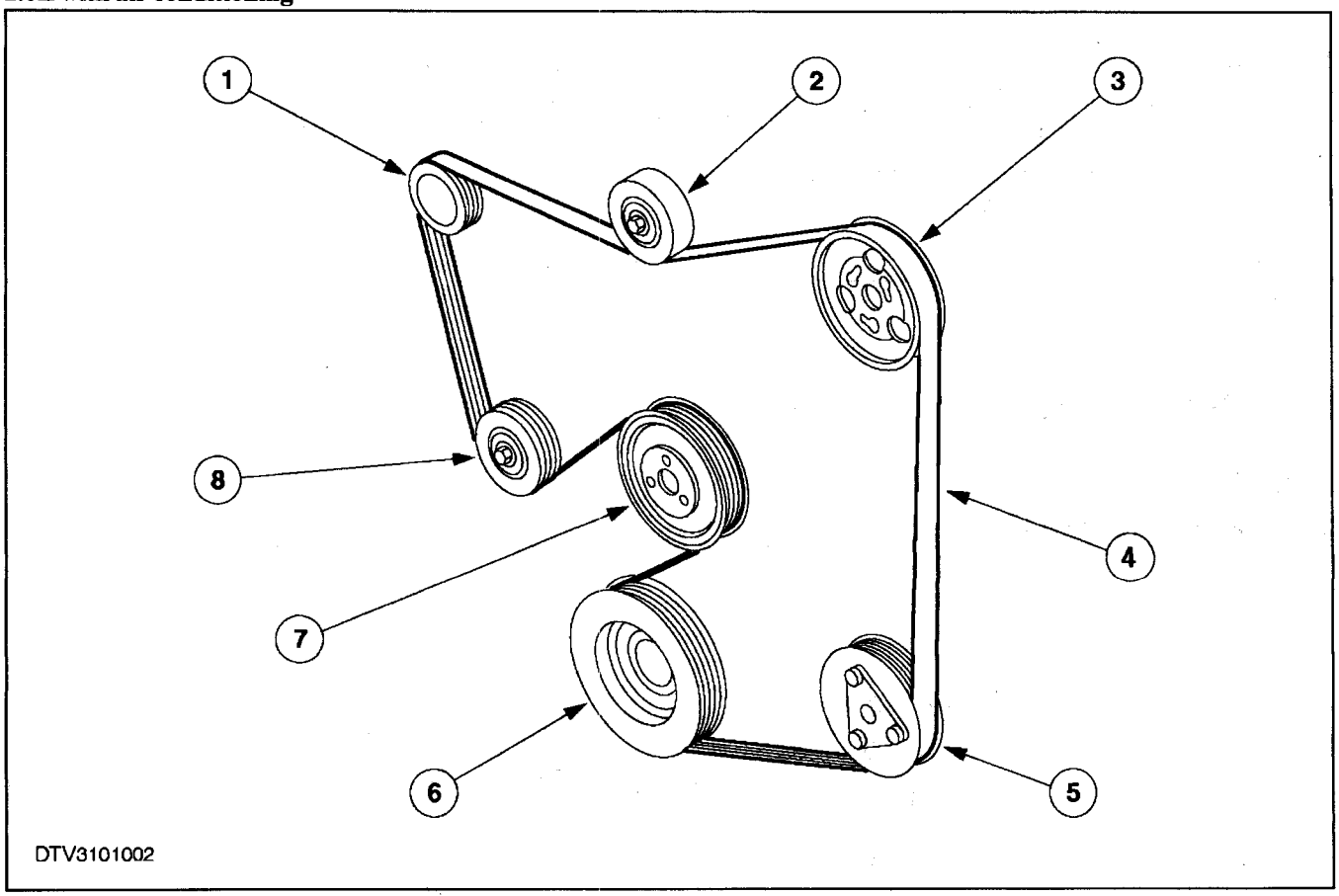
Item	Part Number	Description
1	—	Generator pulley
2	—	Belt idler pulley
3	—	Power steering pump pulley
4	—	Accessory drive belt

(Continued)

Item	Part Number	Description
5	—	Crankshaft pulley
6	—	Water pump pulley
7	—	Belt tensioner

DESCRIPTION AND OPERATION (Continued)

2.0L with air conditioning



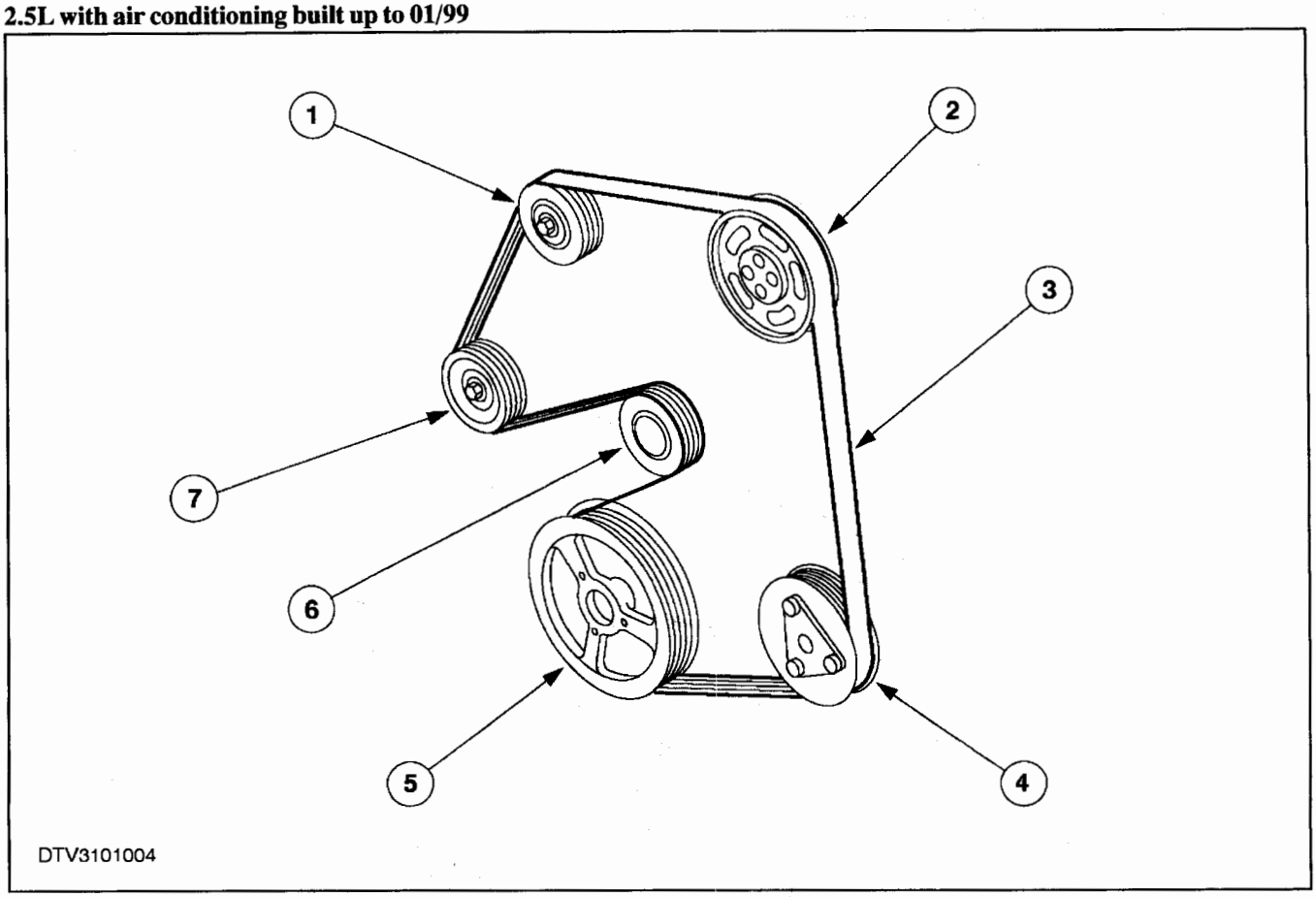
Item	Part Number	Description
1	—	Generator pulley
2	—	Belt idler pulley
3	—	Power steering pump pulley
4	—	Accessory drive belt

Item	Part Number	Description
5	—	A/C pulley
6	—	Crankshaft pulley
7	—	Water pump pulley
8	—	Belt tensioner

(Continued)

DESCRIPTION AND OPERATION (Continued)

2.5L with air conditioning built up to 01/99



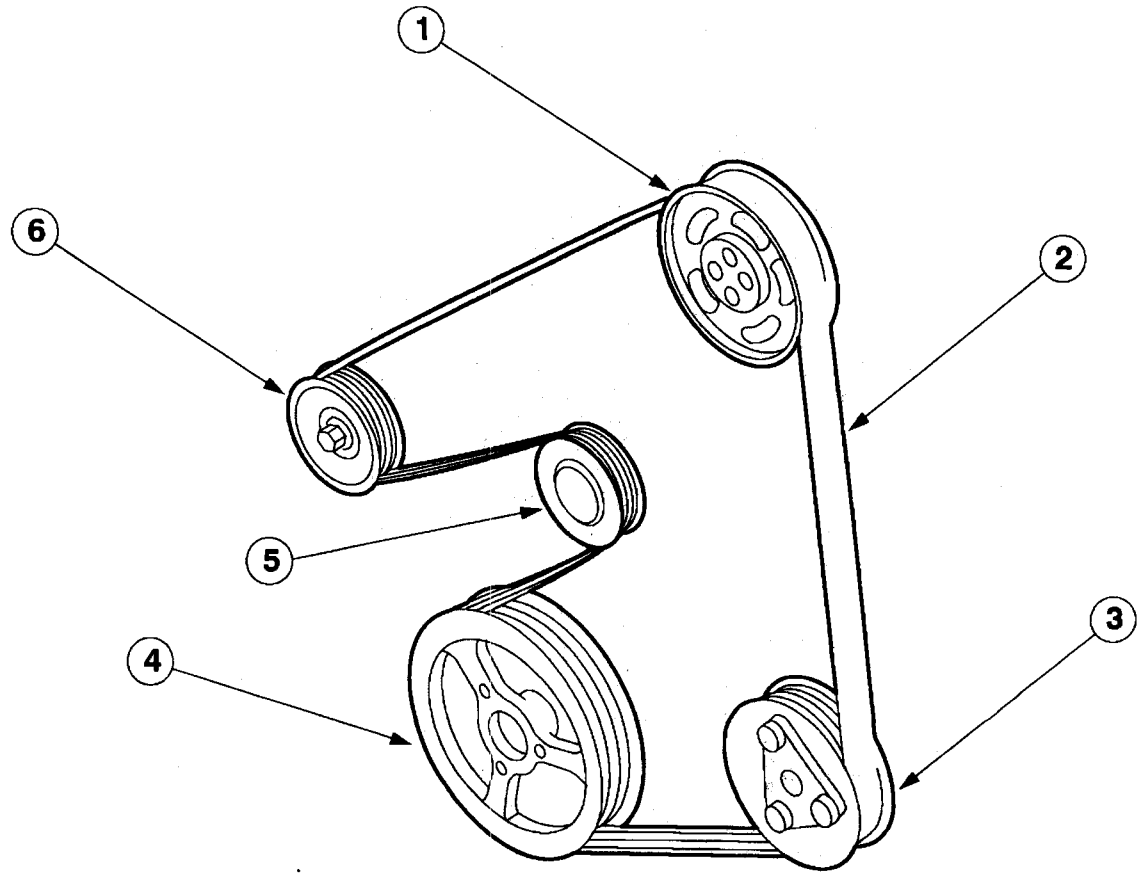
Item	Part Number	Description
1	—	Belt idler pulley
2	—	Power steering pump pulley
3	—	Accessory drive belt
4	—	Air conditioning pump pulley

Item	Part Number	Description
5	—	Crankshaft pulley
6	—	Belt tensioner
7	—	Generator pulley

(Continued)

DESCRIPTION AND OPERATION (Continued)

2.5L with air conditioning built 01/99 onwards



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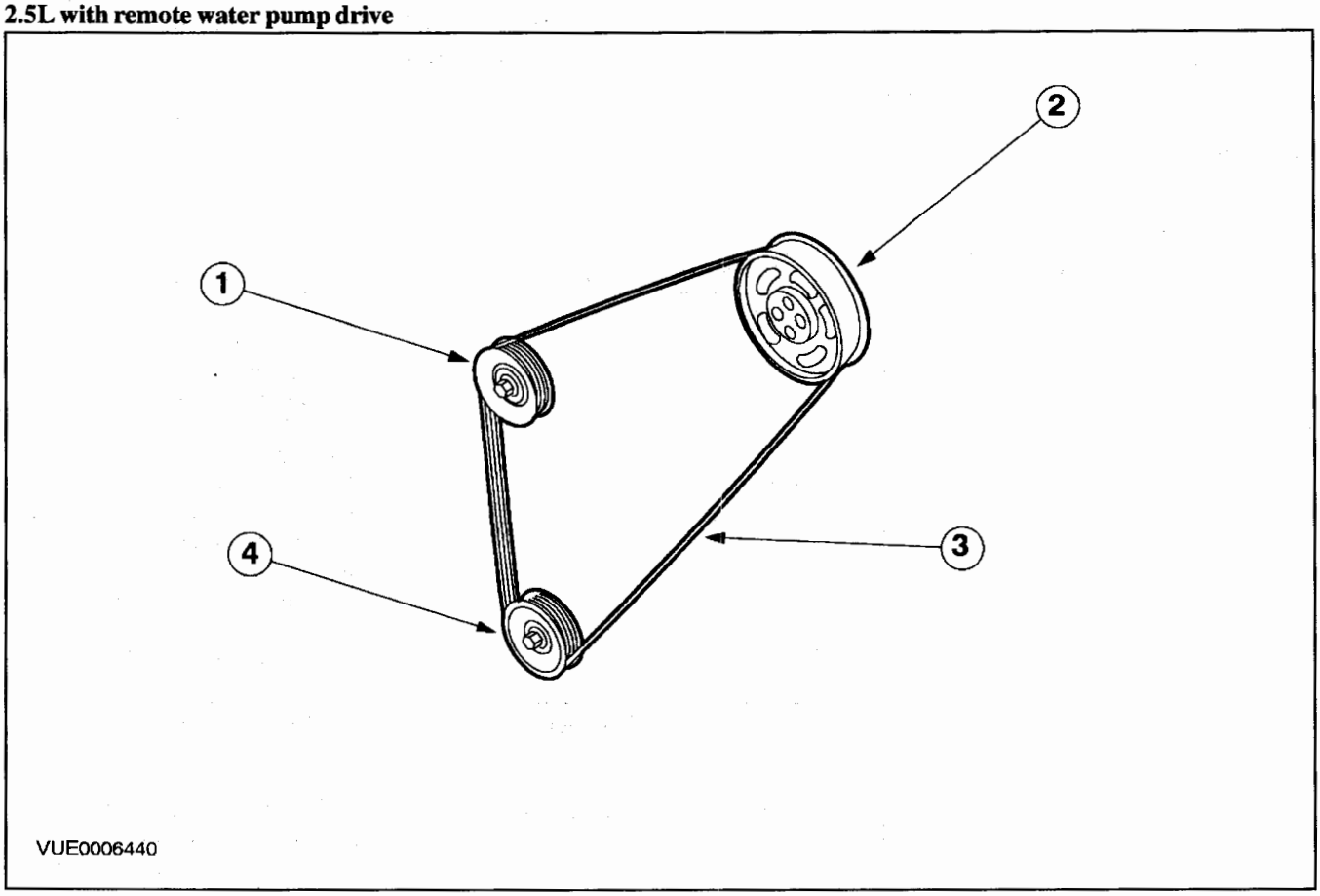
Item	Part Number	Description
1	—	Power steering pump pulley
2	—	Accessory drive belt
3	—	Air conditioning pump pulley

Item	Part Number	Description
4	—	Crankshaft pulley
5	—	Belt tensioner
6	—	Generator pulley

(Continued)

DESCRIPTION AND OPERATION (Continued)

2.5L with remote water pump drive



Item	Part Number	Description
1	—	Belt tensioner
2	—	Water pump pulley

Item	Part Number	Description
3	—	Water pump belt
4	—	Water pump drive pulley

(Continued)

Belt Tensioner

Automatic tensioners are calibrated to provide the correct amount of tension to the belt for a given accessory drive system. Unless a spring within the tensioner assembly breaks, or some other mechanical part of the tensioner fails, there is no need to check the tensioner for correct tension.

DIAGNOSIS AND TESTING

Accessory Drive

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Damaged or contaminated belt • Belt tension • Belt tensioner • Pulleys • Loose hardware

DIAGNOSIS AND TESTING (Continued)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Belt noise or squeal	• Pulley(s).	• DETERMINE where the noise is coming from. CHECK pulley alignment, freedom of rotation or damage. REPAIR or INSTALL new parts as necessary.
	• Lubricant or other contamination.	• CHECK belt for contamination. REMOVE belt and wash with detergent and water. If belt cannot be cleaned or is damaged, INSTALL a new belt.
	• Belt.	• CHECK belt for correct application.
• Belt does not hold tension	• Belt cracking or damaged.	• INSPECT belt for cracking or damage. INSTALL a new belt if required.
	• Tensioner worn or damaged.	• CHECK belt tensioner for damage and correct operation. INSTALL a new belt tensioner if required.

Component Tests

Belt Tensioner — Mechanical

The only mechanical check that needs to be made is a check for tensioner ''stick grab, or bind''.

1. Remove the belt in the area of the tensioner.
2. Using the correct tool, rotate the tensioner from its relaxed position through its full stroke and back to the relaxed position to make sure there is no '' stick, grab or bind'', and to make sure that there is tension on the tensioner spring.
3. If the tensioner meets the above criteria, proceed to test the tensioner dynamically. If the tensioner does not meet the above criteria install a new tensioner, for additional information, refer to Belt Tensioner.

Belt Tensioner — Dynamic

The automatic belt tensioner can be checked dynamically as follows:

1. With the engine running, observe belt tensioner movement, The tensioner should move (respond) when the air conditioning clutch cycles (if equipped), or when the engine is accelerated rapidly. If the tensioner movement is constant without air conditioning clutch cycling or engine acceleration, a pulley or shaft is probably bent, or a pulley is out of round. Excessive belt rideout (uneven depth of grooves in the belt) can cause excessive tensioner movement. Check condition by installing a new belt.
2. With the engine off, check routing of the belt. Refer to the illustrations under Description and Operation.
3. Inspect the belt tensioner wear indicator to confirm the belt is within operating range. Install a new belt if necessary.
4. Rotate the belt tensioner and check for a binding or seized condition. Install a new tensioner if necessary.

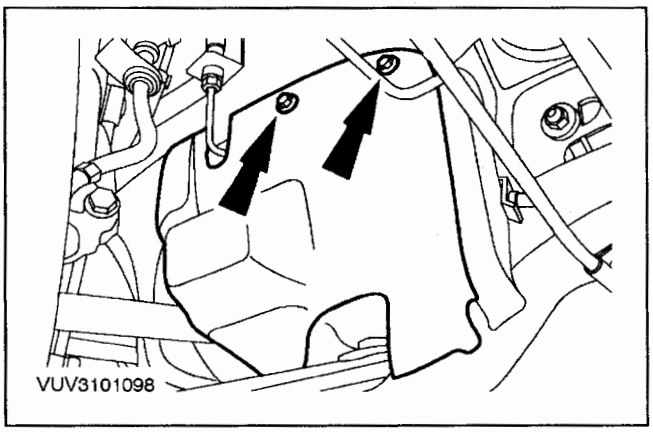
REMOVAL AND INSTALLATION

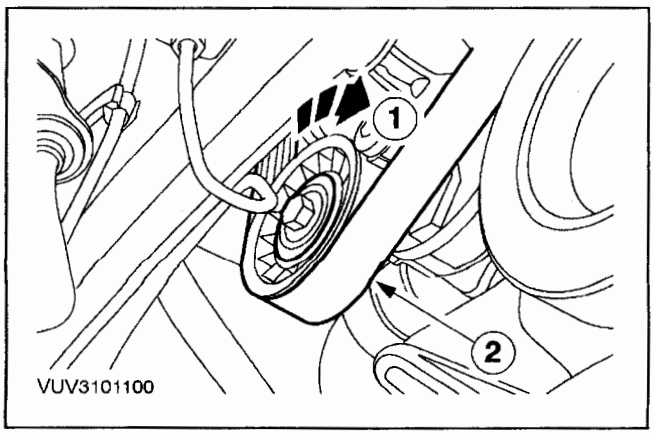
Accessory Drive Belt

Removal

Vehicles with 2.0L engine

1. Raise and support the vehicle. For additional information, refer to Section 100-02.
2. Remove the right-hand front wheel. For additional information, refer to Section 204-04.
3. Remove the splash shield.

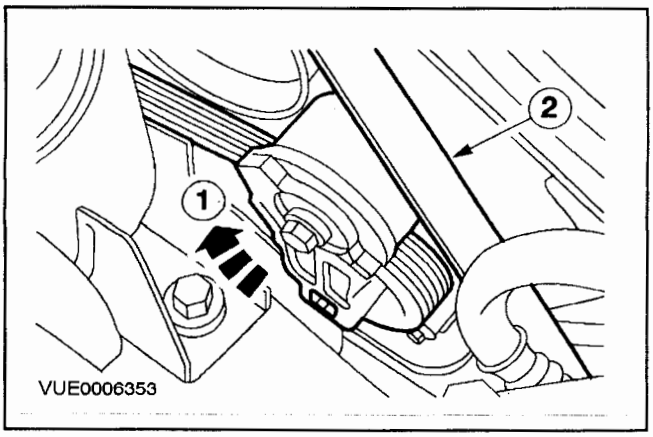




4. Remove the accessory drive belt.
   1 Slacken the accessory drive belt by turning the accessory drive belt tensioner in a clockwise direction.
   2 Remove the accessory drive belt.

Vehicles with 2.5L engine

5. Remove the accessory drive belt tensioner.
   1 Rotate the accessory drive belt tensioner clockwise.
   2 Remove the accessory drive belt.



REMOVAL AND INSTALLATION (Continued)

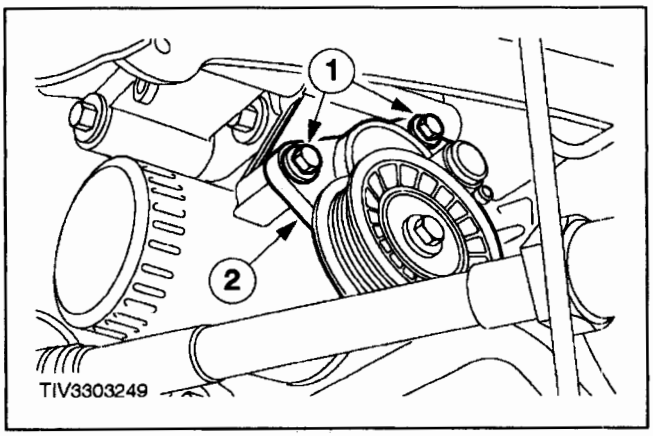
Installation

1. To install, reverse the removal procedure.

Accessory Drive Belt Tensioner — Vehicles with 2.0L Engine

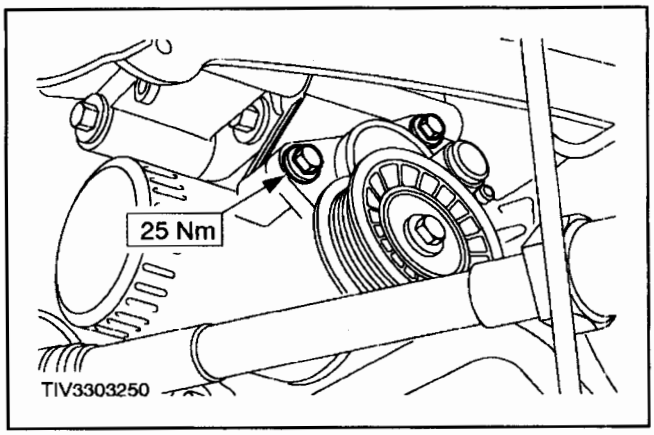
Removal

1. Remove the accessory drive belt. For additional information, refer to Accessory Drive Belt in this section.



2. Remove the belt tensioner.
   1 Remove the bolts.
   2 Remove the tensioner.

Installation

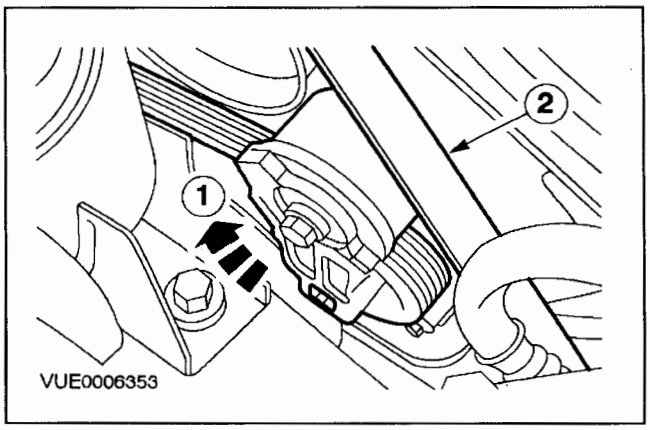


1. To install, reverse the removal procedure.

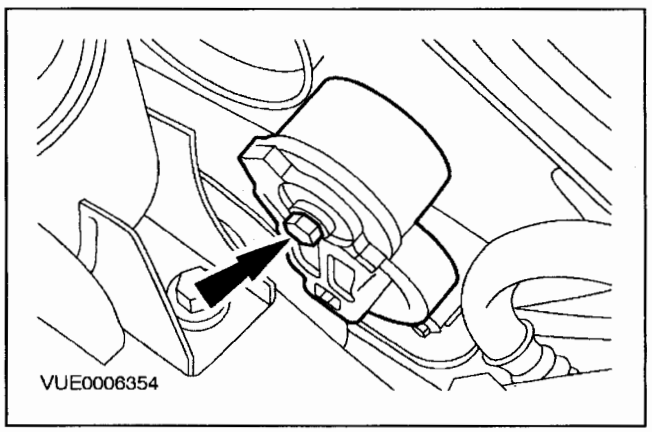
REMOVAL AND INSTALLATION (Continued)

Accessory Drive Belt Tensioner — Vehicles with 2.5L Engine

Removal

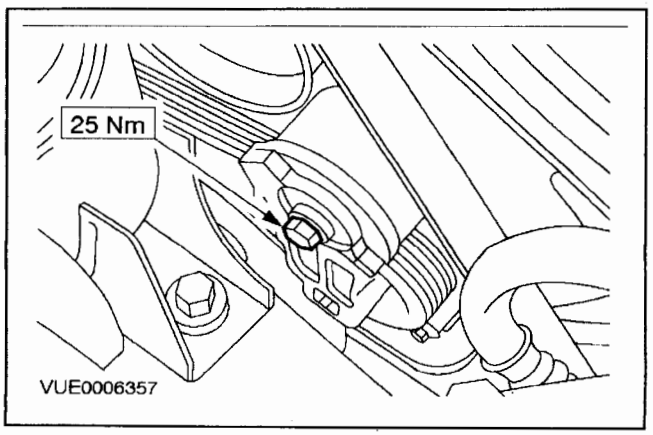


1. Remove the accessory drive belt.
   1 Rotate the accessory drive belt tensioner clockwise.
   2 Remove the accessory drive belt.



2. Remove the accessory drive belt tensioner.

Installation



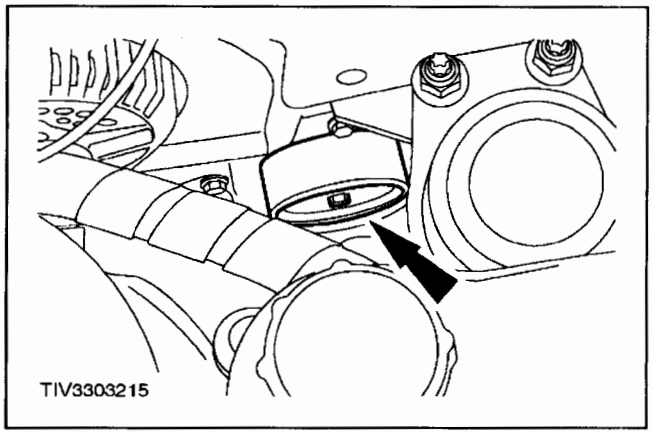
1. To install, reverse the removal procedure.

REMOVAL AND INSTALLATION (Continued)

Accessory Drive Belt Idler Pulley — Vehicles with 2.0L Engine

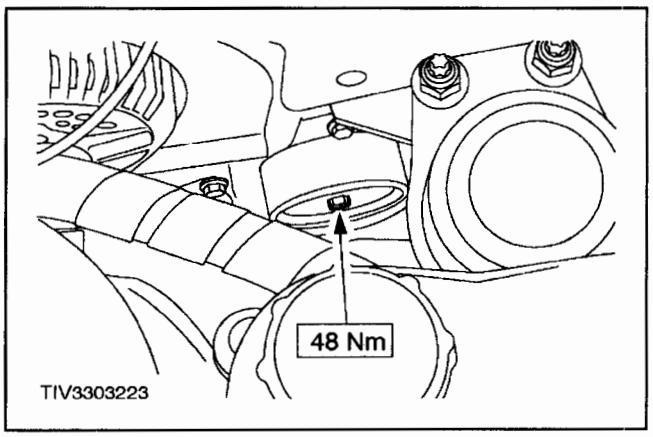
Removal

1. Remove the accessory drive belt. For additional information, refer to Accessory Drive Belt in this section.



2. Remove the belt idler pulley.

Installation



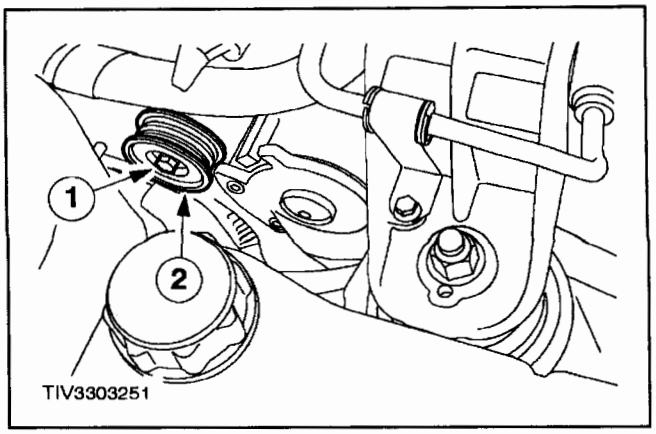
1. To install, reverse the removal procedure.

Accessory Drive Belt Idler Pulley — Vehicles with 2.5L Engine

Removal

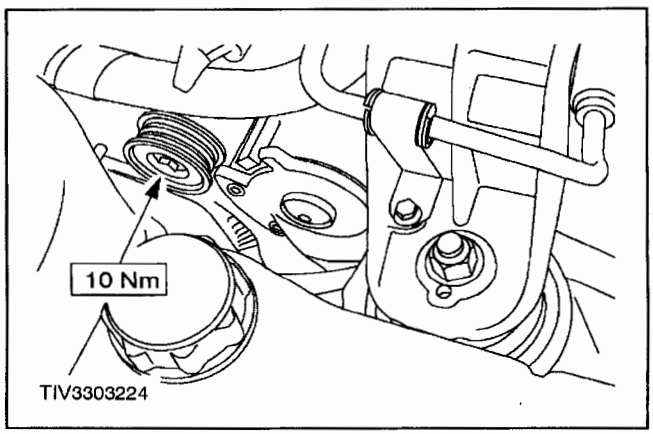
1. Remove the accessory drive belt. For additional information, refer to Accessory Drive Belt in this section.

REMOVAL AND INSTALLATION (Continued)



2. Remove the accessory drive belt idler pulley.
   1 Remove the bolt.
   2 Remove the accessory drive belt idler pulley.

Installation



1. To install, reverse the removal procedure.

SECTION 303-06 Starting System

CONTENTS PAGE

SPECIFICATIONS 303-06-2
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Starting System 303-06-2
DIAGNOSIS AND TESTING
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Inspection and Verification 303-06-3
Symptom Chart 303-06-4
Pinpoint Tests 303-06-4
Component Tests 303-06-13
REMOVAL AND INSTALLATION
Starter Motor — Vehicles with 2.0L Engine 303-06-14
Starter Motor — Vehicles with 2.5L Engine 303-06-16

SPECIFICATIONS

General Specifications

Item	Specification
Maximum load	800 amps
No load	60 - 80 amps
Maximum starter motor circuit voltage drop	0.5 volt
Low-temperature grease	WSG-M1C218-B2

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Starter motor bolts	25	18	—
Air cleaner bracket bolts	25	18	—
Starter motor bracket bolt	25	18	—

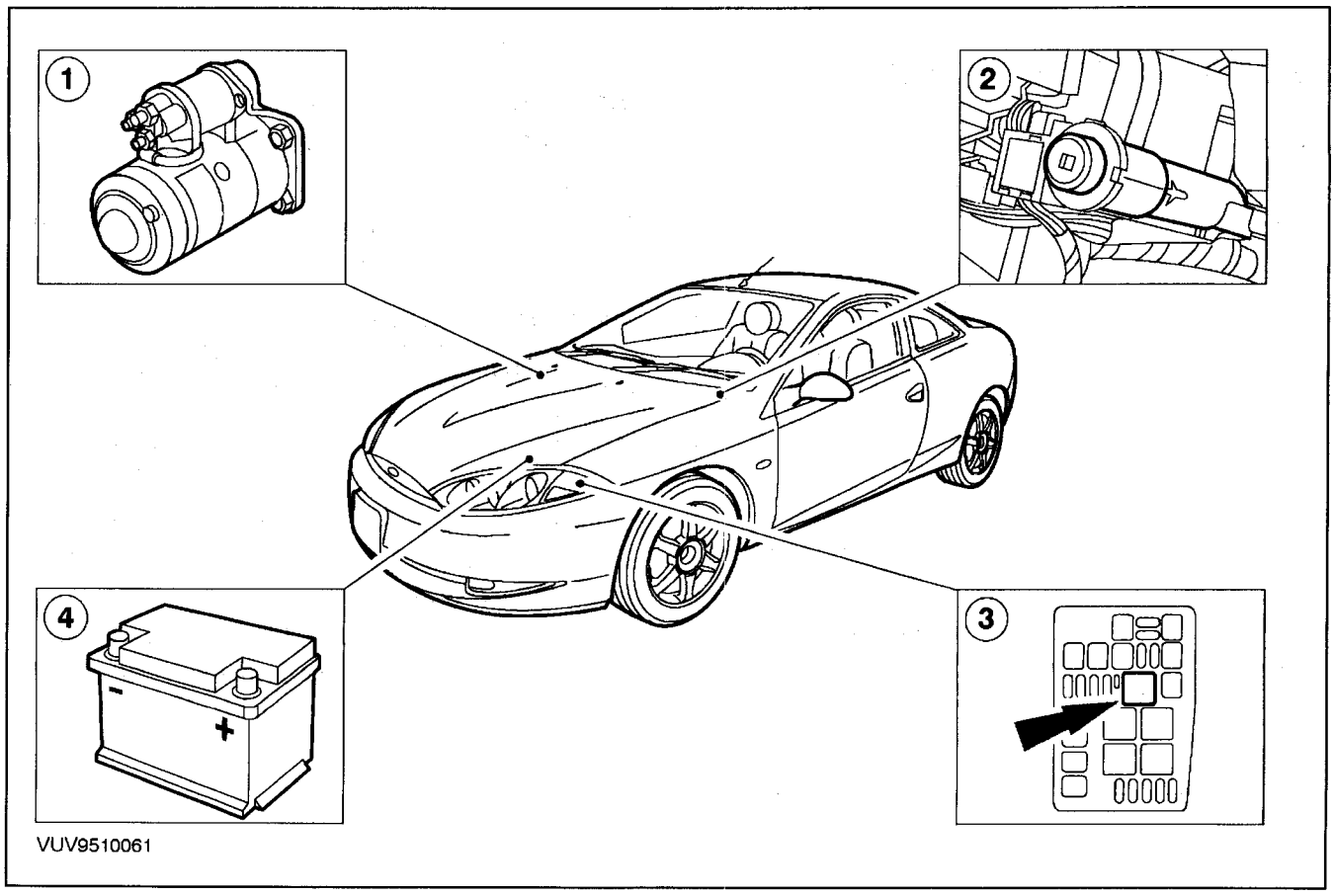
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Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Starter motor bracket nuts	17	13	—
Starter motor electrical connector nut — 2.0L	8	—	71
Starter motor electrical connector nut	5	—	44
Starter motor electrical connector nut — 2.5L	12	9	—
Water crossover pipe bolts	10	—	89
Positive crankcase ventilation (PCV) pipe bolt	6	—	53

DESCRIPTION AND OPERATION

Starting System



DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
1	—	Starter motor (2.0L shown, 2.5L similar)
2	—	Ignition switch
3	—	Starter motor relay
4	—	Battery

(Continued)

The function of the starting system is to crank the engine at a speed fast enough to allow the engine to start. Heavy cables, connectors and switches are used in the system because of the large currents required.

The starting system consists of a gear reduced starter motor, battery, remote control switch (ignition switch) and relay.

Vehicles equipped with automatic transaxle have a transmission range sensor attached to the circuit which prevents operation of the starter motor unless NEUTRAL or PARK are selected.

Vehicles equipped with a manual transaxle have a start inhibit switch in the starter control circuit, which prevents operation of the starter motor unless the clutch pedal is in the applied position.

The sequence of operation is as follows:

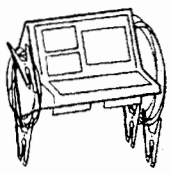
- Ignition switch in the start position III.
- Starter relay activated.
- Voltage provided to the starter motor solenoid.
- Starter solenoid engages the drive pinion to the ring rear.
- Starter solenoid switches the battery current to the starter motor.
- System remains engaged until the ignition switch is released.

DIAGNOSIS AND TESTING

Starting System

Refer to Wiring Diagrams Cell 20 for schematic and connector information.

Special Tool(s)

 ST1137-A	Digital Volt Ohm Meter 105-R0051 or equivalent
 ST1179-A	Starter, Alternator, Battery, Regulator, Electrical Tester 010-00730 - S.A.B.R.E. or equivalent

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Starter motor. • Battery.	• Fuse 10 (20A). • Wiring harness(es). • Electrical connectors.

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Engine does not crank but relay clicks	• Battery. • Starter motor • Relay. • Circuit	• GO to Pinpoint Test A.
• Engine does not crank and relay does not click	• Battery. • Fuse. • Relay. • Circuit. • Starter motor. • Ignition switch.	• GO to Pinpoint Test B.
• Engine cranks slowly	• Battery. • Circuitry. • Starter motor.	• GO to Pinpoint Test C.
• Unusual starter motor noise	• Starter motor. • Flywheel ring gear.	• CHECK flywheel ring gear. REFER to Section 303-00. • INSPECT starter motor for alignment, cracked case. MAKE SURE the mounting bolts are tightened. If necessary, INSTALL a new starter motor.
• The starter spins but the engine does not crank	• Starter motor.	• INSPECT the flywheel ring gear for missing teeth. CHECK starter motor for correct mounting. If concern persists, INSTALL a new starter motor.

Pinpoint Tests

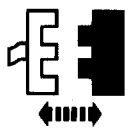
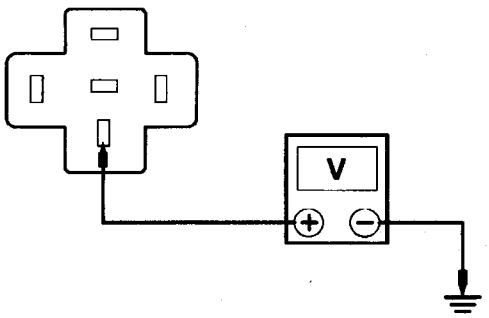
PINPOINT TEST A: THE ENGINE DOES NOT CRANK AND THE RELAY CLICKS

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK THE BATTERY	
	1 Check the battery. Refer to Section 414-00. • Is the battery OK? → **Yes** GO to **A2**. → **No** INSTALL a new battery. TEST the system for normal operation.

(Continued)

DIAGNOSIS AND TESTING (Continued)

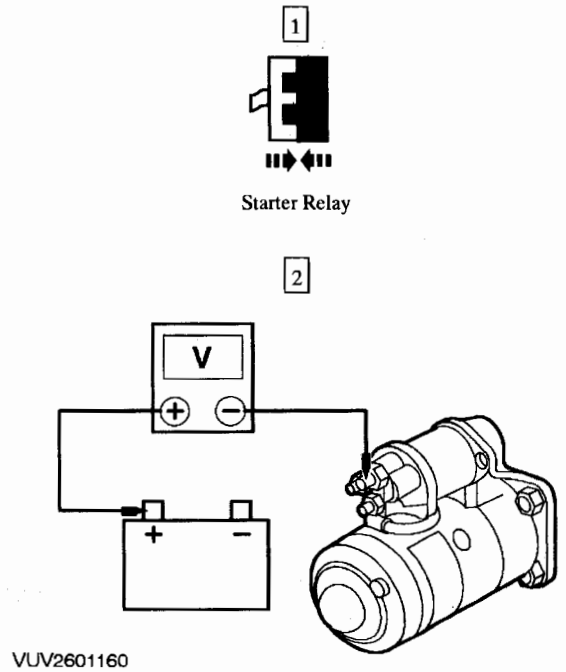
PINPOINT TEST A: THE ENGINE DOES NOT CRANK AND THE RELAY CLICKS (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A2 CHECK THE STARTER RELAY	
1  Starter Relay	2 Carry out the ISO mini relay component test. Refer to the wiring diagrams. • Is the relay OK? → **Yes** GO to **A3**. → **No** INSTALL a new starter relay. TEST the system for normal operation.
A3 CHECK VOLTAGE TO STARTER RELAY	
1  VUV9110062	1 Measure the voltage between starter relay C52 pin 3, harness side and ground. • Is the voltage greater than 10 volts? → **Yes** GO to **A4**. → **No** If the headlamps operate, INSTALL a new battery junction box. TEST the system for normal operation. Otherwise, REPAIR circuit 30-DA3. TEST the system for normal operation.
A4 CHECK THE STARTER MOTOR	
	1 Perform the starter motor no-load test. Refer to Starter Motor No-Load Test. • Is the starter OK? → **Yes** INSTALL the starter motor, GO to **A5**. → **No** INSTALL a new starter motor. TEST the system for normal operation.

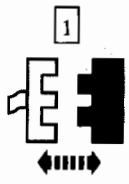
(Continued)

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: THE ENGINE DOES NOT CRANK AND THE RELAY CLICKS (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A5 CHECK THE STARTER MOTOR FEED	
	2 Measure the voltage between the positive battery terminal and starter motor 30 terminal with the ignition key in the III (start) position. • Is the voltage less than 0.5 volts? → **Yes** REPAIR circuit 50-BB10. TEST the system for normal operation. → **No** INSTALL a new positive battery cable. TEST the system for normal operation.

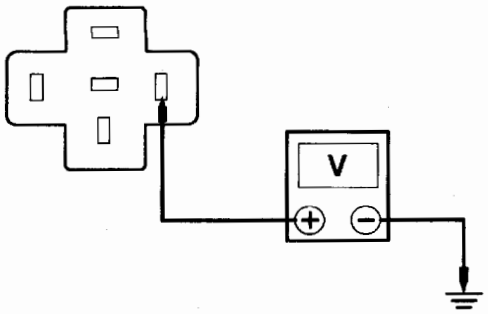
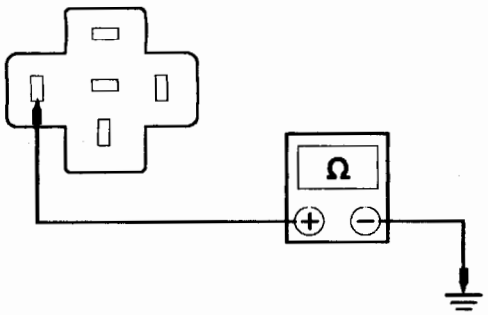
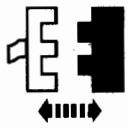
PINPOINT TEST B: THE ENGINE GOES NOT CRANK AND THE RELAY DOES NOT CLICK

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE BATTERY	
	1 Check the battery. Refer to Section 414-00. • Is the battery OK? → **Yes** GO to **B2**. → **No** INSTALL a new battery. TEST the system for normal operation.
B2 CHECK SWITCHED POWER TO THE STARTER RELAY	
	

(Continued)

DIAGNOSIS AND TESTING (Continued)

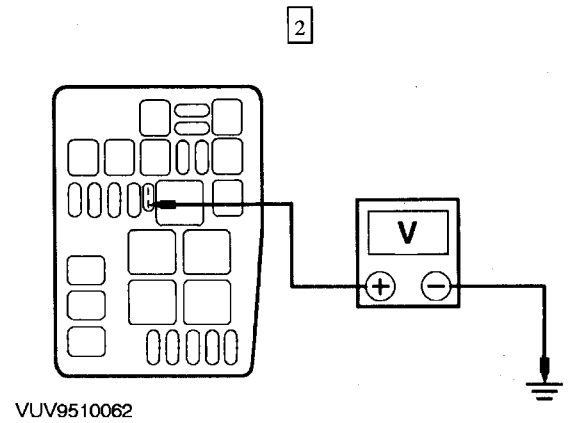
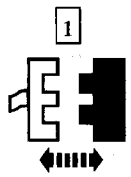
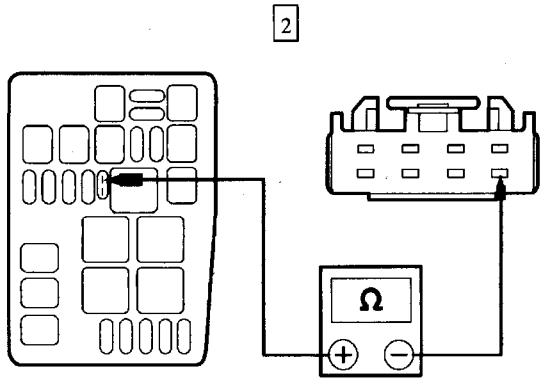
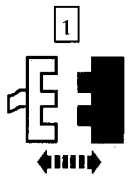
PINPOINT TEST B: THE ENGINE GOES NOT CRANK AND THE RELAY DOES NOT CLICK (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B2 CHECK SWITCHED POWER TO THE STARTER RELAY (Continued)	
2  VUV9310062	2 Measure the voltage between starter relay C52 pin 2, harness side and ground with the ignition key in the III (start) position. • Is the voltage greater than 10 volts? → **Yes** GO to **B3**. → **No** GO to **B4**.
B3 CHECK GROUND SIGNAL FOR THE STARTER RELAY	
1  VUV9410062	1 Measure the resistance between starter relay C52 pin 1, harness side and ground with the ignition key in the III (start) position. • Is the resistance less than 5 ohms? → **Yes** INSTALL a new starter relay. TEST the system for normal operation. → **No** If manual transmission, GO to **B6**. If automatic transmission, GO to **B9**.
B4 CHECK DIODE	
1  Diode C61	

(Continued)

DIAGNOSIS AND TESTING (Continued)

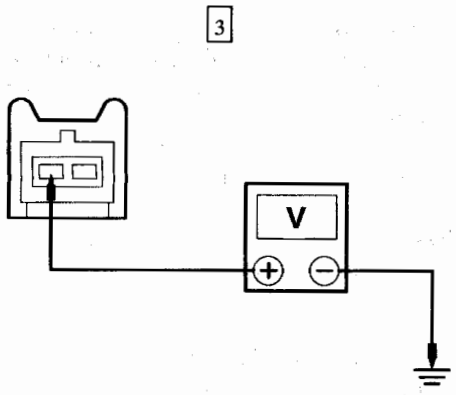
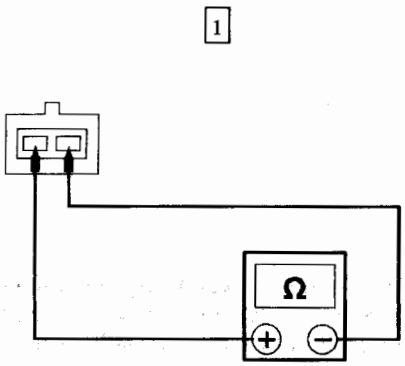
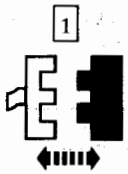
PINPOINT TEST B: THE ENGINE GOES NOT CRANK AND THE RELAY DOES NOT CLICK (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B4 CHECK DIODE (Continued)	
 VUV9510062	2 Measure the voltage between the diode C61 pin 1, harness side and ground with the ignition key in the III (start) position • Is the voltage greater than 10 volts? → **Yes** INSTALL a new diode. TEST the system for normal operation. → **No** GO to **B5**.
B5 CHECK CIRCUIT 50 BB11 FOR OPEN	
 Ignition Switch C456  VUV9610062	2 Measure the resistance between ignition switch C456 pin 5, circuit 50-BB11 (GY/WH), harness side and diode C61 pin 1, harness side. • Is the resistance less than 5 ohms? → **Yes** INSTALL a new ignition switch. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
B6 CHECK CIRCUIT TO CLUTCH PEDAL	
 Start Inhibit Switch C1919  Starter Relay	

(Continued)

DIAGNOSIS AND TESTING (Continued)

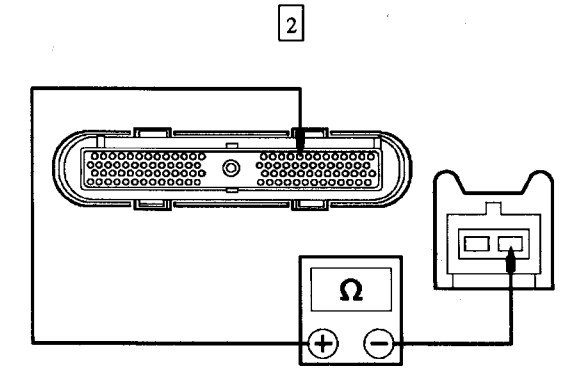
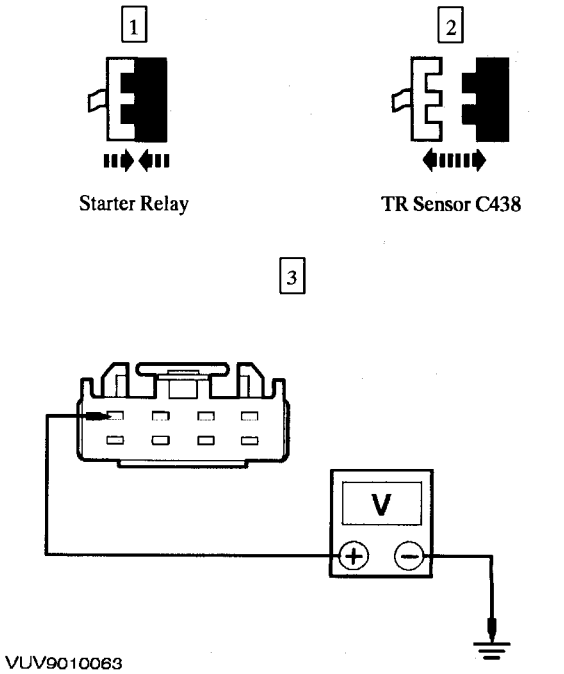
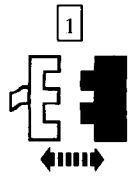
PINPOINT TEST B: THE ENGINE GOES NOT CRANK AND THE RELAY DOES NOT CLICK (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B6 CHECK CIRCUIT TO CLUTCH PEDAL (Continued)	
 VUV9710062	3 Measure the voltage between start inhibit switch C1919 pin 2, circuit 31S-BB12 (BK/YE), harness side and ground with the ignition key in the III (start) position. • Is the voltage greater than 10 volts? → **Yes** GO to **B7**. → **No** REPAIR the circuit. TEST the system for normal operation.
B7 CHECK START INHIBIT SWITCH	
 VUV9810062	1 Measure the resistance between the start inhibit switch pin 1 and pin 2, component side. Note the reading with the clutch pedal pressed in and with the pedal released. • Is the resistance less than 5 ohms with the clutch pedal pressed, and greater than 10,000 ohms with the pedal released? → **Yes** GO to **B8**. → **No** ADJUST the start inhibit switch. REPEAT this Pinpoint Test, if necessary INSTALL a new start inhibit switch. TEST the system for normal operation.
B8 CHECK CIRCUIT 31 - BB6	
 PCM C421	

(Continued)

DIAGNOSIS AND TESTING (Continued)

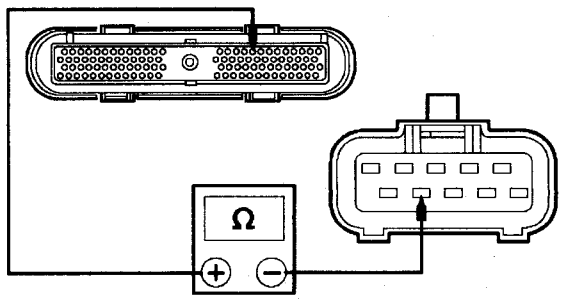
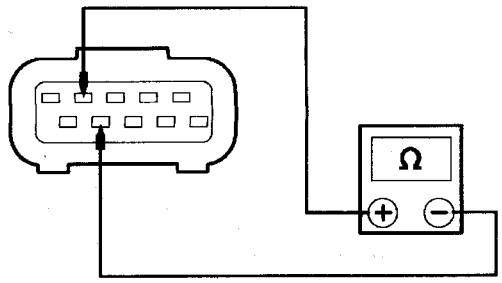
PINPOINT TEST B: THE ENGINE GOES NOT CRANK AND THE RELAY DOES NOT CLICK (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B8 CHECK CIRCUIT 31 - BB6 (Continued)	
	2 Measure the resistance between start inhibit switch C1919 pin 1, circuit 31-BB6 (BK), harness side and PCM C421 pin 18, circuit 31S-BB12 (BK/YE), harness side. • Is the resistance less than 5 ohms? → **Yes** INSTALL the start inhibit switch. GO to **B12**. → **No** REPAIR circuit 31-BB6 (BK) and 31S-BB12 (BK/YE). TEST the system for normal operation.
B9 CHECK SIGNAL TO TRANSMISSION RANGE SENSOR	
	3 Measure the voltage between TR sensor C438 pin 4, circuit 31S-BB12 (BK/GN), harness side and ground with the ignition key in the III (start) position. • Is the voltage greater than 10 volts? → **Yes** GO to **B10**. → **No** REPAIR the circuit. TEST the system for normal operation.
B10 CHECK CIRCUIT 31S - PF9	
	

(Continued)

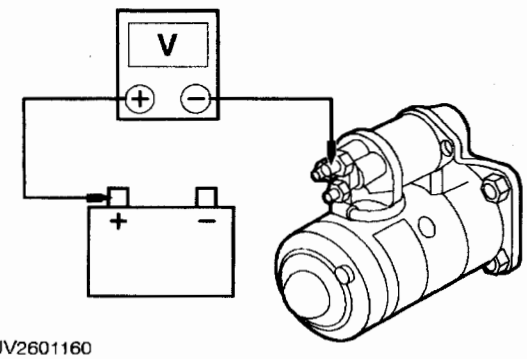
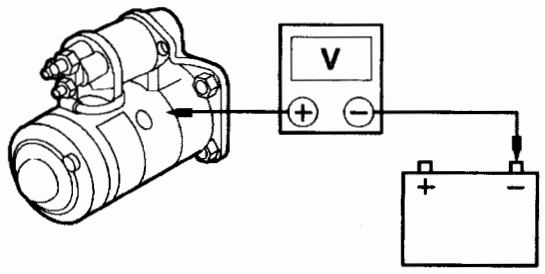
DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B: THE ENGINE GOES NOT CRANK AND THE RELAY DOES NOT CLICK (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B10 CHECK CIRCUIT 31S - PF9 (Continued)	
2  VUV9010062	2 Measure the resistance between TR sensor C438 pin 9, circuit 31S-PF9 (BK/GN), harness side and PCM C421 pin 18, circuit 31S-PF9 (BK/GN), harness side. • Is the resistance less than 5 ohms? → **Yes** GO to **B11**. → **No** REPAIR the circuit. TEST the system for normal operation.
B11 CHECK TR SENSOR	
1  VUV9110063	1 Measure the resistance between the TR sensor pin 4 and pin 9, component side. • Is the resistance less than 5 ohms? → **Yes** CONNECT the TR sensor. GO to **B12**. → **No** ADJUST the TR sensor. REFER to Section 307-01. If the concern persists, INSTALL a new TR sensor.
B12 CHECK COIL SIDE CIRCUIT	
	1 Install the EEC V 104-Pin Breakout Box. 2 Using a test meter lead, connect pin 18 and pin 77 of the EEC V 104-Pin Breakout Box. 3 Momentarily turn the ignition key to the III (start) position. • Did the starter motor turn the engine? → **Yes** For vehicles with anti-theft, REFER to Section 419-01B. For vehicles without anti-theft; INSTALL a new PCM. TEST the system for normal operation. → **No** GO to Pinpoint Test A.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST C: THE ENGINE CRANKS SLOWLY

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE STARTER MOTOR LOAD	
	1 Perform the starter motor load test on the starter motor. Refer to Starter Motor Load Test. • Is the starter motor OK? → **Yes** GO to **C2**. → **No** INSTALL a new starter motor. TEST the system for normal operation
C2 CHECK FOR VOLTAGE DROP	
1  VUV2601160	1 Measure the voltage between starter motor B terminal, component side and the positive battery terminal with the ignition key in the III (start) position. • Is the voltage less than 0.5 volts? → **Yes** GO to **C3**. → **No** CLEAN and TIGHTEN all positive battery cable connections. TEST the system for normal operation. If the concern persists, INSTALL a new positive battery cable.
C3 CHECK FOR GROUND CONNECTION	
1  VUV9510063	1 Measure the voltage between the starter motor case and battery negative terminal with the ignition key in the III (start) position. • Is the voltage less than 0.5 volts? → **Yes** DIAGNOSE the battery and charging system. REFER to Section 414-00. → **No** CLEAN and TIGHTEN all negative battery cable connections, starter motor mounting and body to engine ground strap. TEST the system for normal operation. If the concern persists, INSTALL a new negative battery cable.

DIAGNOSIS AND TESTING (Continued)

Component Tests

Starter Motor - Load

The battery must be fully charged before performing the Starter Motor Load Test. For battery inspection and testing, refer to Section 414-00.

1. Set the parking brake and shift the transmission into NEUTRAL.
2. To prevent the engine from starting, disconnect the ignition coil electrical connector.
3. **NOTE:** Make sure that the rheostat is at the maximum counterclockwise position.

   Connect Starter Alternator, Battery Regulator Electrical Tester (SABRE).
4. Connect the remote starter switch across the starter relay S-and battery terminal.
5. Turn the key to II (run).
6. Crank the engine with the remote starter switch and determine the exact reading on the voltmeter.
7. Stop cranking the engine and reduce the resistance of the carbon pile rheostat until the voltmeter indicates the same reading as obtained in step 6. The ammeter will indicate the starter current draw under load. Check this with the value listed in General Specifications.

Starter Motor - No-Load

1. Remove the starter motor; Refer to Starter Motor in this Section.
2. Connect Starter Alternator, Battery Regulator Electrical Tester (SABRE) to a fully charged battery, and a remote starter switch to the starter motor.
3. Engage the remote starter switch. The pinion should shift to the crank position and the starter motor should operate smoothly.
4. While the starter motor is operating, check the voltmeter and ammeter readings.
5. The voltage should be greater than 11.0 volts and the amperage should be no more than 70 amps.
6. If the voltage is lower than specified, or if the amperage is higher than specified; refer to Symptom Chart - Starter Motor No-Load Test Results to determine the cause and corrective action.

Symptom Chart - Starter Motor - No-Load Test Results

Symptom Chart

Condition	Possible Sources	Action
• Normal current and speed	• Battery. • Switches. • Wiring.	• RECHECK battery, switches and wiring, including voltage drop tests, if cranking starter motor operation on engine is slow or sluggish.
• Current flow with test circuit switch open	• Solenoid contacts.	• TEST and, if necessary, INSTALL a new solenoid assembly.
• Failure to operate with very little or no current	• Solenoid winding. • Field circuit. • Armature coil or commutator bars. • Brush springs or brushes.	• INSPECT and TEST solenoid assembly. • INSPECT and TEST frame and field coil assembly. • INSPECT armature. • INSPECT brushes and brush springs.
• Failure to operate with high current	• Bearing or drivetrain. • Terminals or fields.	• INSPECT bearing, armature, driveshaft and related drive parts. • INSPECT and TEST frame and field coil assembly, solenoid assembly and brush installations for shorts.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart (Continued)

Condition	Possible Sources	Action
• Low speed with high current	• Bushings, gear reduction unit, armature shaft, pole shoe or driveshaft. • Armature. • Armature or fields.	• INSPECT bearing, armature, driveshaft and gear reduction gears. • INSPECT and TEST armature. • INSPECT and TEST frame and field coil assembly and armature.
• Low speed with normal or low current	• Connections, leads or commutator. • Solenoid winding. • Field circuit. • Armature coils or commutator bars. • Brush springs or brushes.	• INSPECT internal wiring, electrical connections and armature commutator. • INSPECT and TEST solenoid assembly. • INSPECT and TEST frame and field coil assembly. • INSPECT armature. • INSPECT brushes and brush springs.
• High speed with high current	• Fields.	• INSPECT and TEST field and frame assembly.

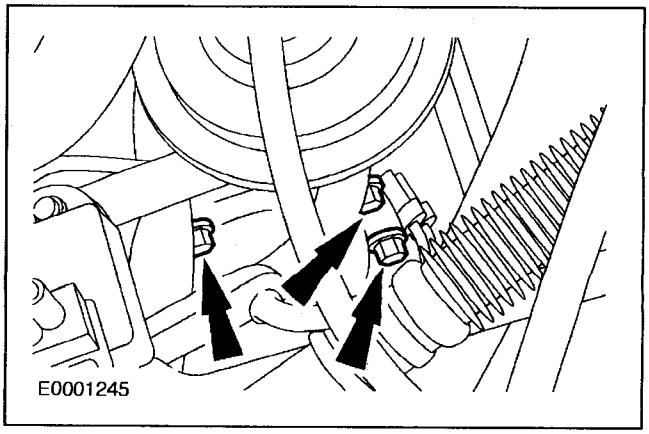
REMOVAL AND INSTALLATION

Starter Motor — Vehicles with 2.0L Engine

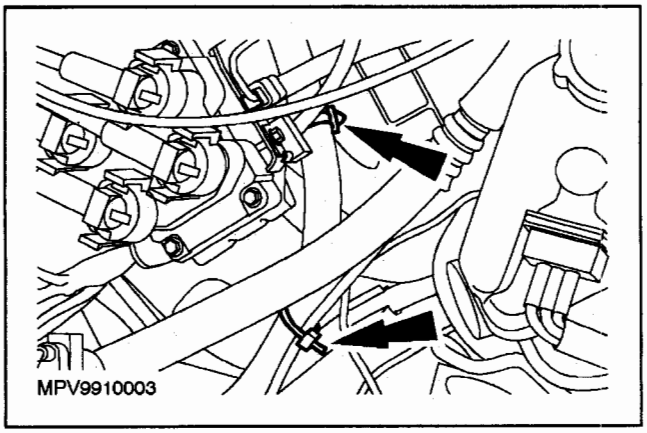
Removal

1. Disconnect the battery ground cable.
2. Remove the air cleaner. For additional information, refer to Section 303-12A.
3. **NOTE:** The engine ground cable is secured by one of the starter motor bolts.

   Remove the starter motor upper bolts.

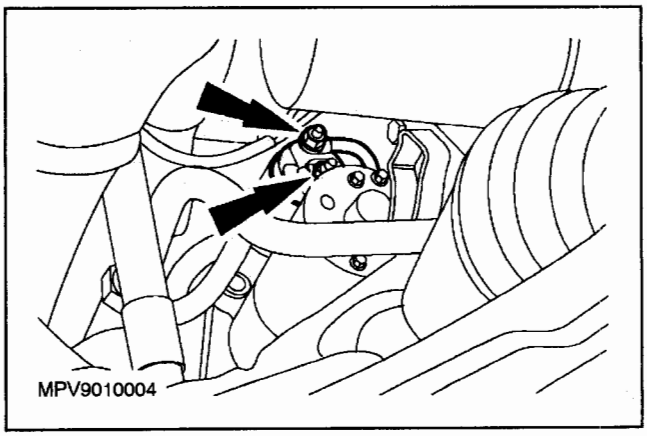


REMOVAL AND INSTALLATION (Continued)



4. Cut the cable ties.

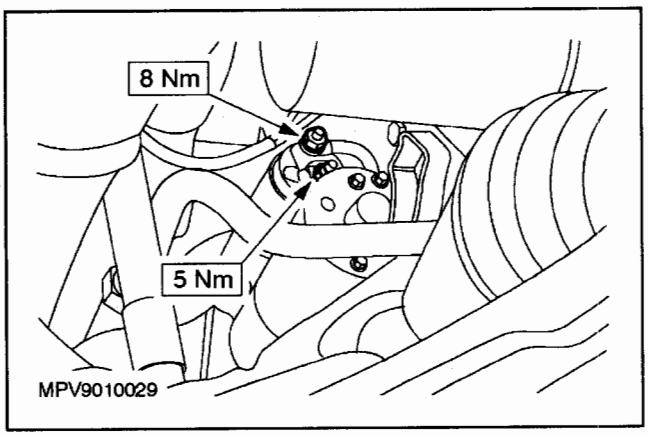
5. Raise and support the vehicle. For additional information, refer to Section 100-02.



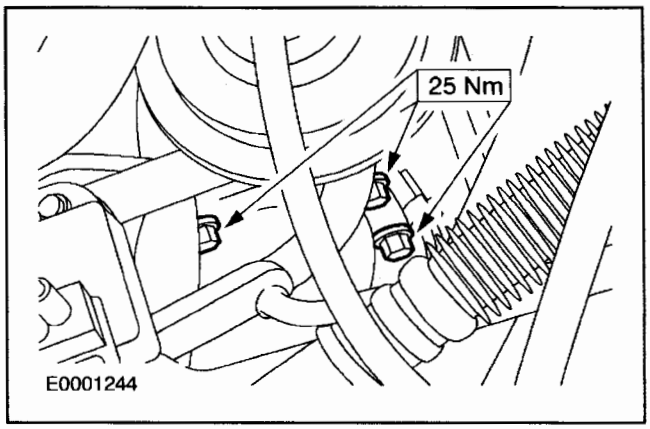
6. Disconnect the starter motor electrical connectors and remove starter motor.

Installation

1. To install, reverse the removal procedure.

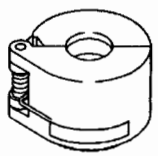
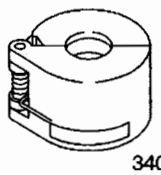


REMOVAL AND INSTALLATION (Continued)



Starter Motor — Vehicles with 2.5L Engine

Special Tool(s)

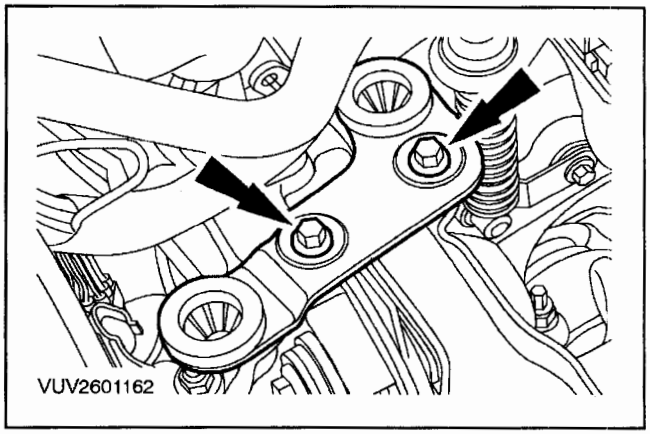
 23033	Adaptor, Fuel Pressure Test 310-042
 34001	Disconnect Tool, Spring-Lock Coupling 310-D005
 34001	Disconnect Tool, Spring-Lock Coupling 310-D004

Removal

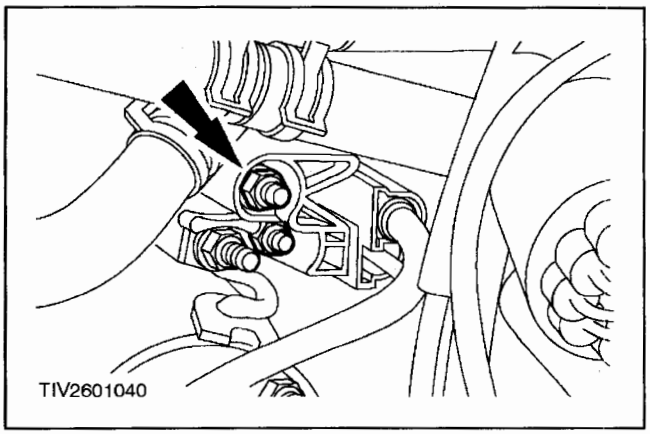
1. Drain the cooling system For additional information, refer to Section 303-03.

2. Remove the lower intake manifold. For additional information, refer to Section 303-01B.

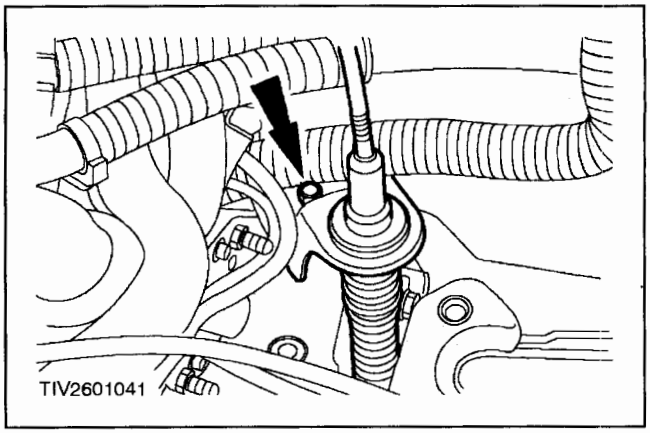
REMOVAL AND INSTALLATION (Continued)



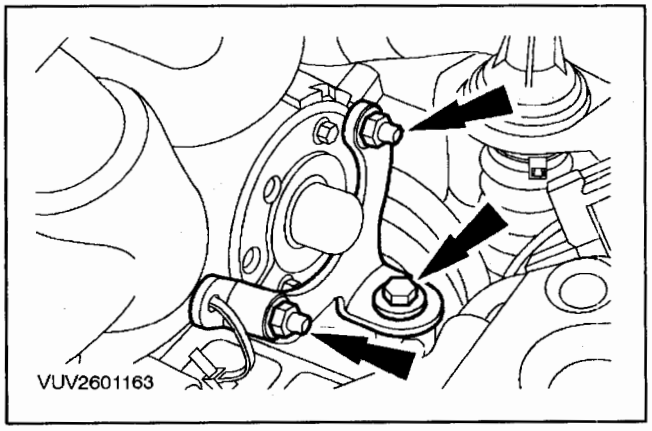
3. Remove the air cleaner bracket.



4. Disconnect the starter motor electrical connectors.

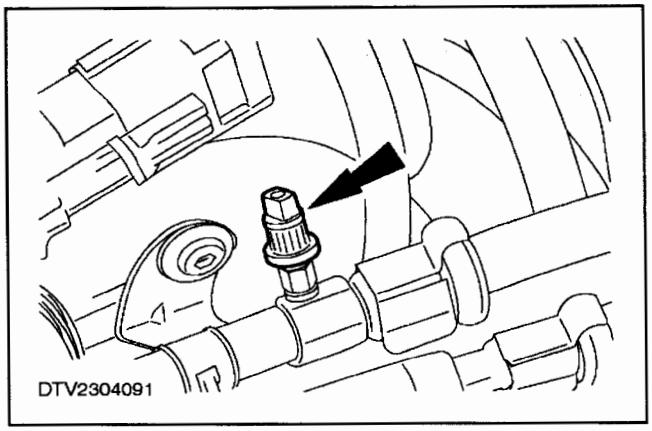


5. Remove the shift cable bracket bolts and reposition the shift cable to one side.
   - Disconnect the shift cable.

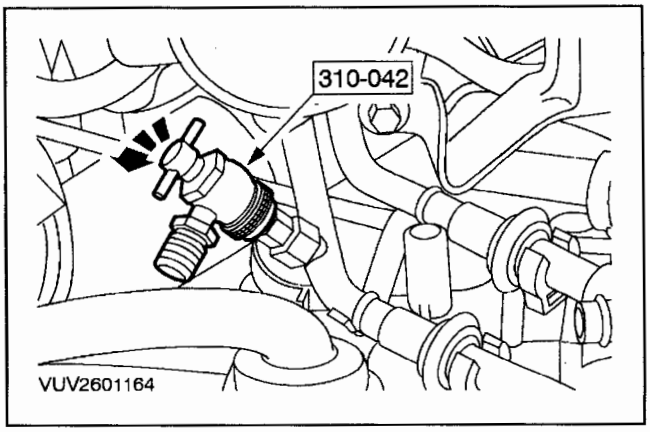


6. Remove the starter motor support bracket.

REMOVAL AND INSTALLATION (Continued)



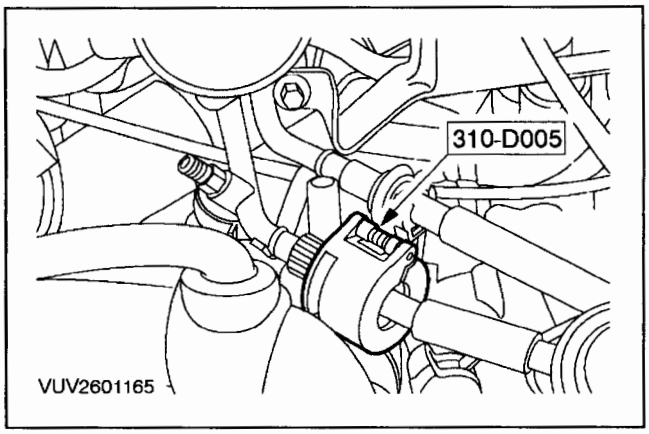
7. Remove the schrader valve cap.



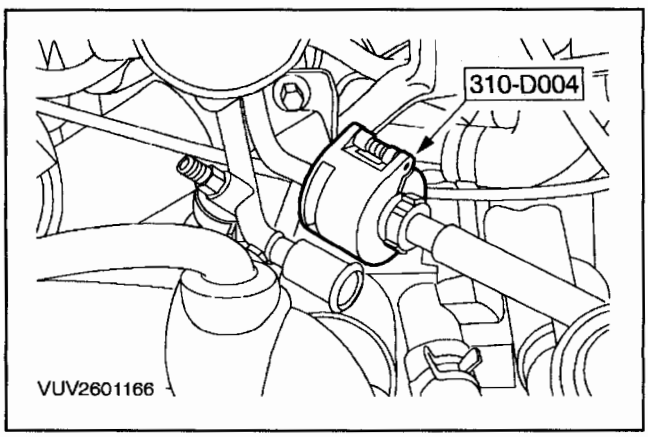
8. ⚠ **WARNING: Make sure the tap is turned fully clockwise before fitting the fuel pressure gauge to the Schrader valve. Failure to follow this instruction may result in personal injury.**

   NOTE: When relieving the fuel pressure, catch any displaced fuel in a suitable container.

   Using the special tool, turn the tap fully counterclockwise to relieve the fuel pressure.

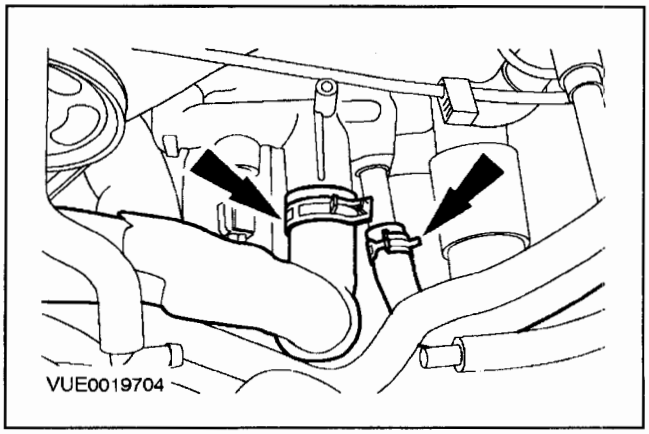


9. Using the special tool, disconnect the fuel return pipe.

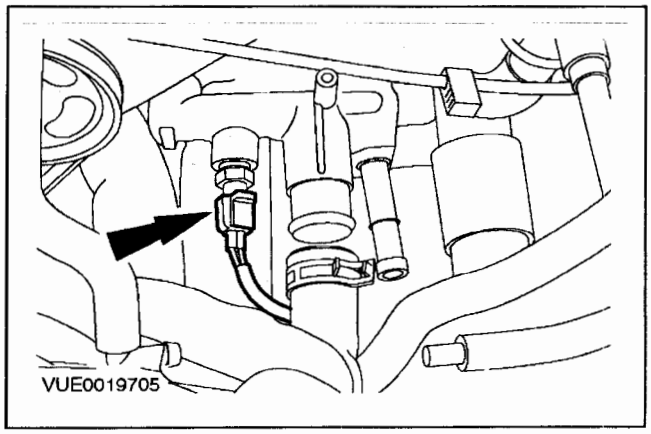


10. Using the special tool, disconnect the fuel supply pipe.

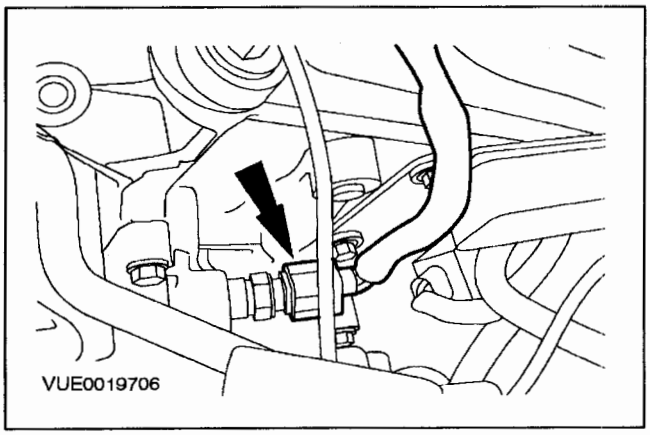
REMOVAL AND INSTALLATION (Continued)



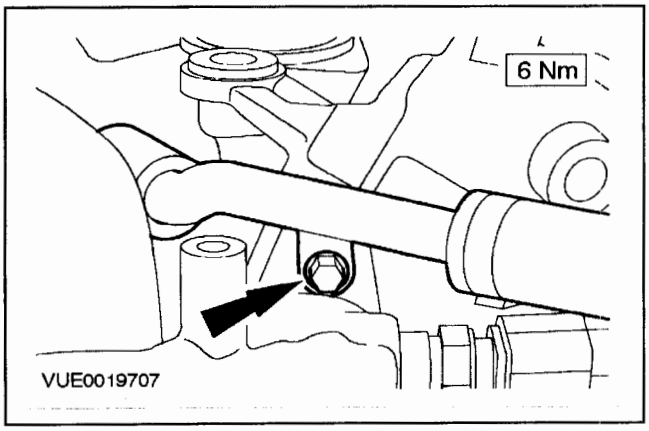
11. Disconnect the cooling system hoses from the crossover pipe.



12. Disconnect the coolant temperature sensor electrical connector.

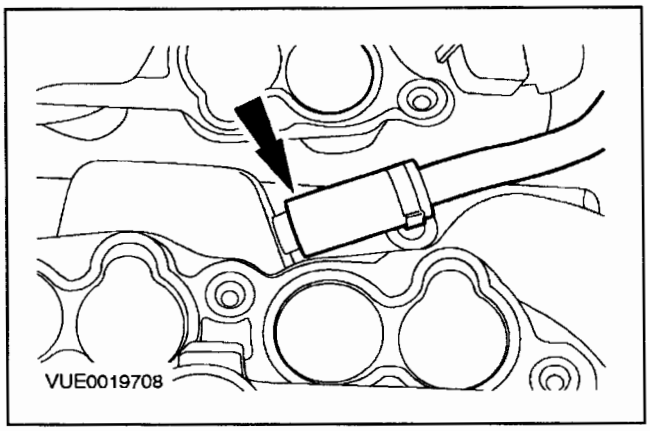


13. Disconnect the engine coolant temperature sensor electrical connector.

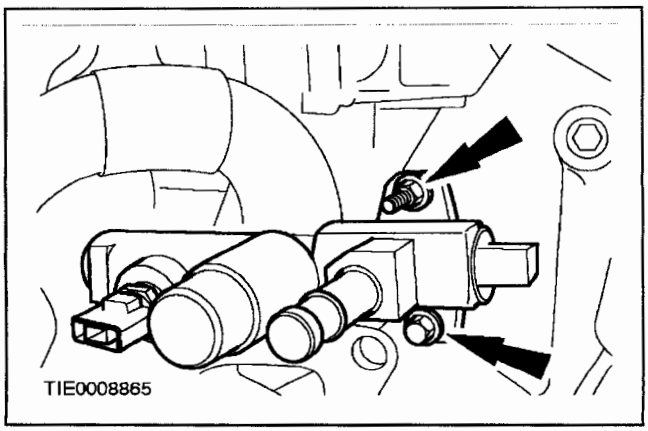


14. Remove the accelerator cable guide and positive crankcase ventilation (PCV) pipe nut.

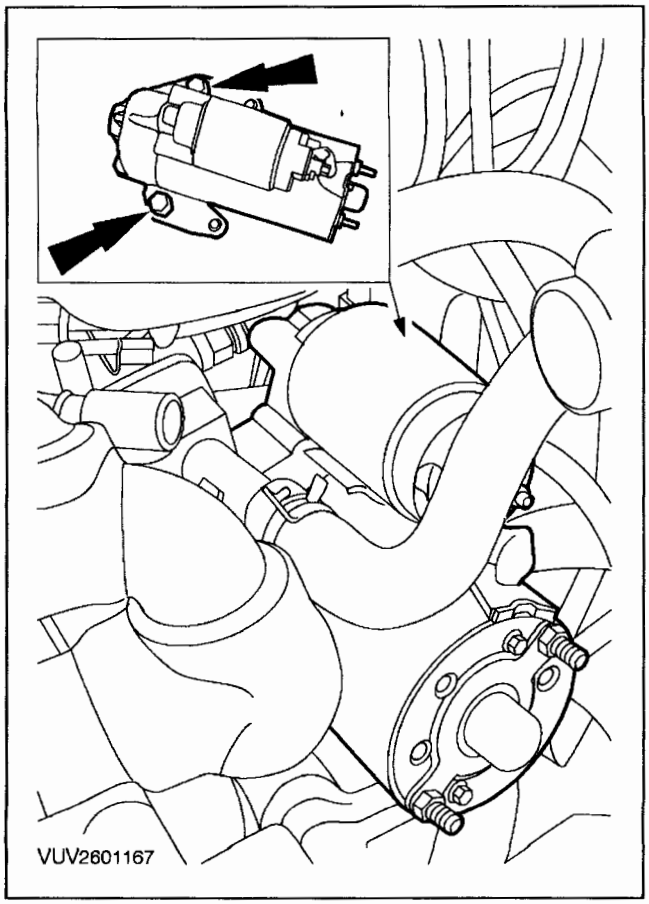
REMOVAL AND INSTALLATION (Continued)



15. Remove the PCV hose.



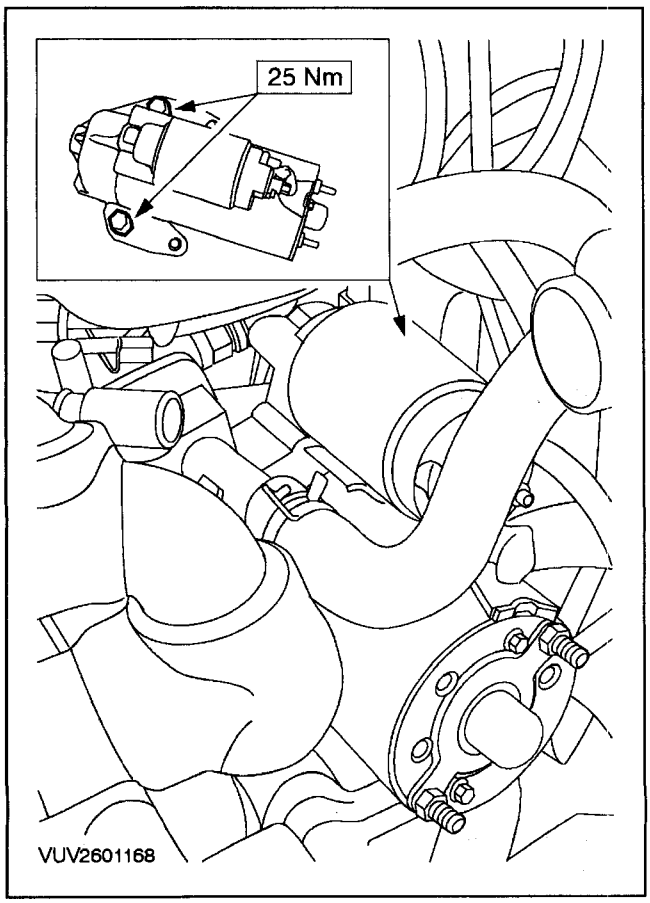
16. Remove the water crossover pipe.

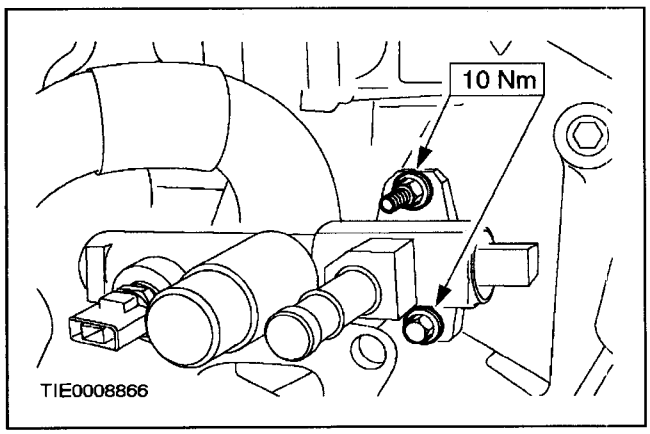


17. Remove the starter motor retaining bolts and starter motor.

REMOVAL AND INSTALLATION (Continued)

Installation

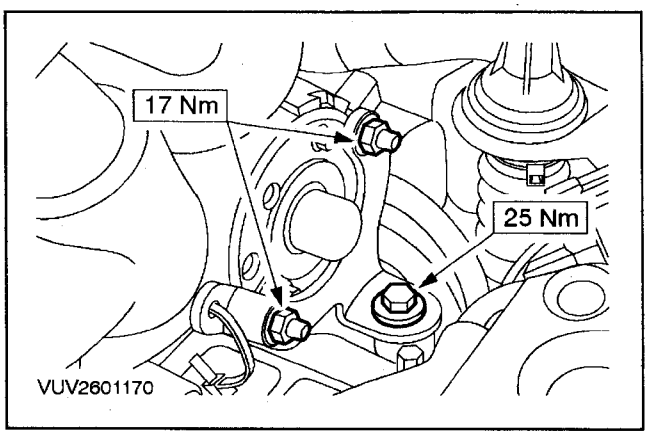


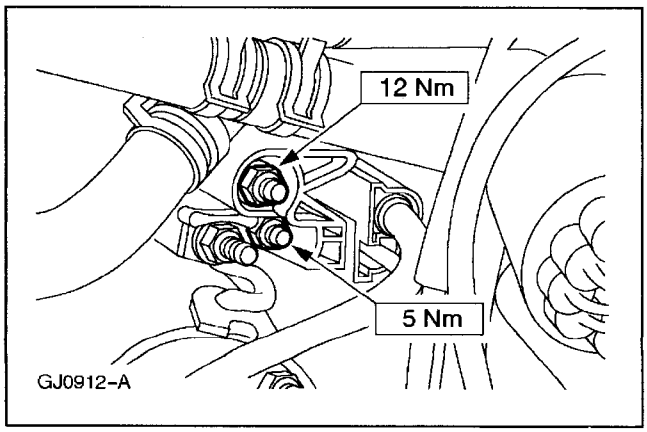


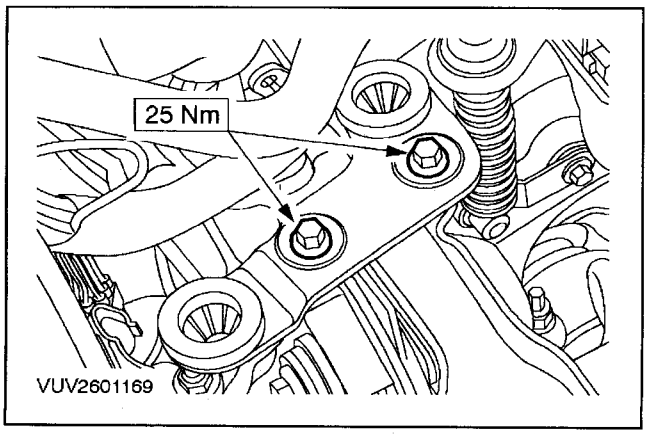
1. **NOTE:** Install new water crossover pipe O-ring seals and make sure the seals are lubricated with coolant to aid with installation.

   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION (Continued)







SECTION 303-07A Engine Ignition — 2.0L Zetec

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SPECIFICATIONS 303-07A-2
DESCRIPTION AND OPERATION
Engine Ignition 303-07A-2
DIAGNOSIS AND TESTING
Engine Ignition 303-07A-3
REMOVAL AND INSTALLATION
Ignition Coil 303-07A-3
Ignition Coil Bracket 303-07A-4
Spark Plug Wires 303-07A-6

SPECIFICATIONS

General Specifications

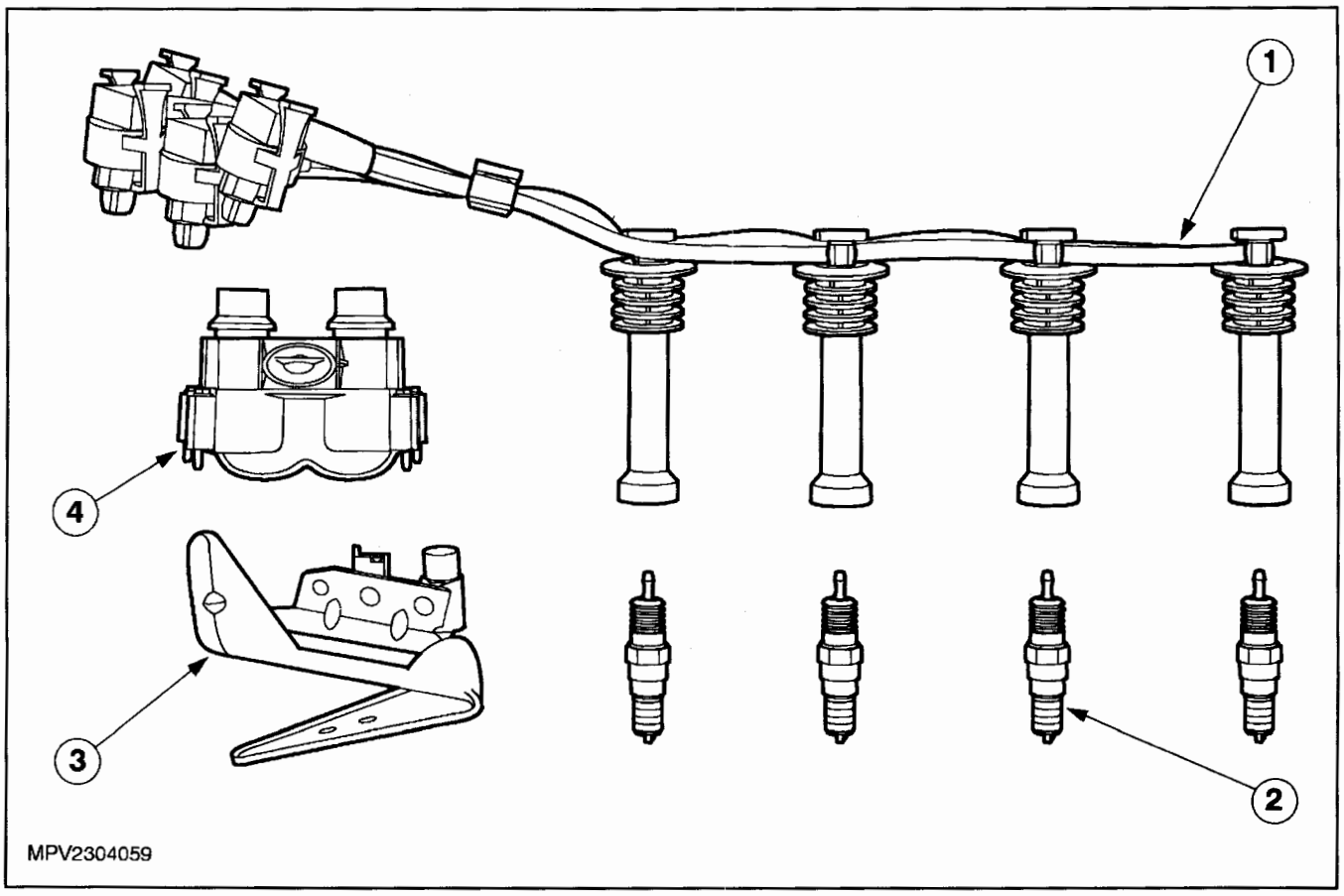
Item	Specification
Silicone Dielectric Compound D7AZ-19A331-A (Spark plug connector)	ESE-M1C171-A
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA (Spark plug thread)	ESE-M12A4-A

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Ignition coil bolts	6	—	53
Ignition coil bracket bolts	20	15	—
Spark plugs	15	11	—

DESCRIPTION AND OPERATION

Engine Ignition



Item	Part Number	Description
1	—	Spark plug wires
2	—	Spark plugs

Item	Part Number	Description
3	—	Ignition coil bracket
4	—	Ignition coil

(Continued)

DESCRIPTION AND OPERATION (Continued)

The ignition system consists of an ignition coil, spark plug wires and spark plugs.

The crankshaft position sensor signal is the basis for ignition timing calculations. The alternating voltage signal from the crankshaft position sensor is digitized by the powertrain control module. This digitized signal is then used to position the closing time of the primary circuit of the ignition coil.

Ignition angle is determined by the powertrain control module in response to engine operating conditions. Once ignition angle has been determined, the powertrain control module interrupts the current to the primary circuit of the ignition coil thus triggering the ignition spark which is supplied to the cylinders through the spark plug wires and spark plugs.

The ignition coils are triggered by the powertrain control module in pairs (cylinders 1 and 4 and cylinders 3 and 2) sending one ignition spark to the firing cylinder and one ignition spark to the corresponding cylinder on the exhaust stroke.

DIAGNOSIS AND TESTING

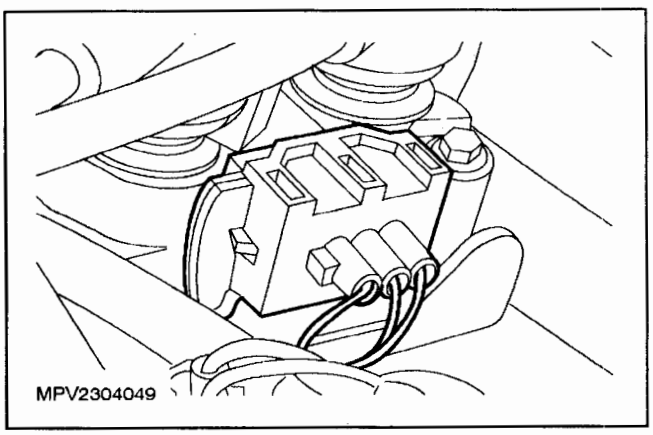
Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

REMOVAL AND INSTALLATION

Ignition Coil

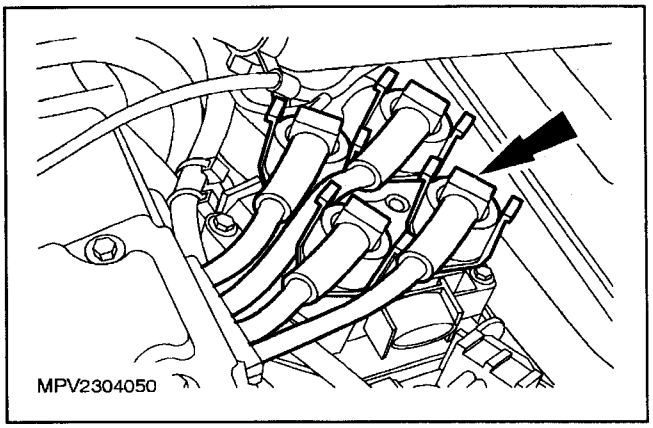
Removal



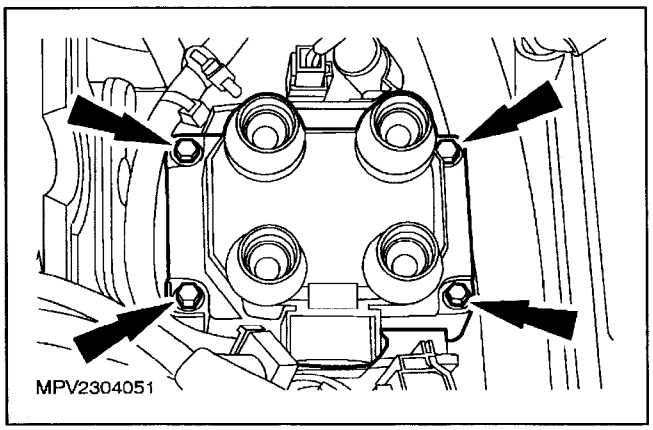
1. Disconnect the ignition coil electrical connector.

1 Can be purchased as a separate item.

REMOVALANDINSTALLATION (Continued)

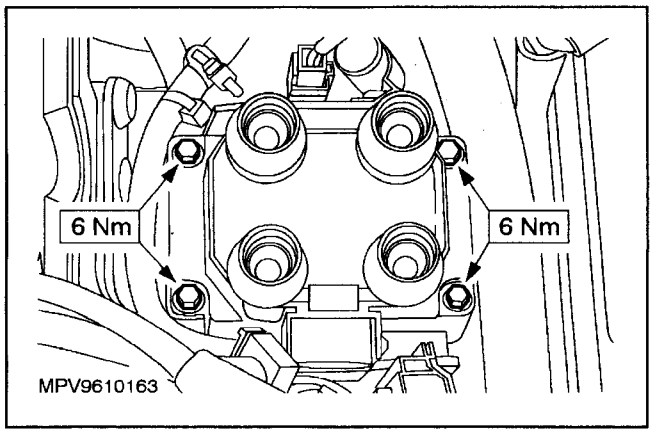


2. Disconnect the spark plug wires from the ignition coil.



3. Remove the ignition coil bolts.

Installation



1. To install, reverse the removal procedure.

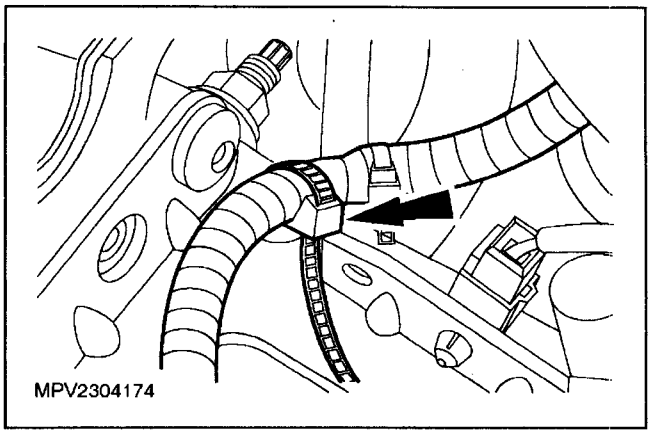
Ignition Coil Bracket

Removal

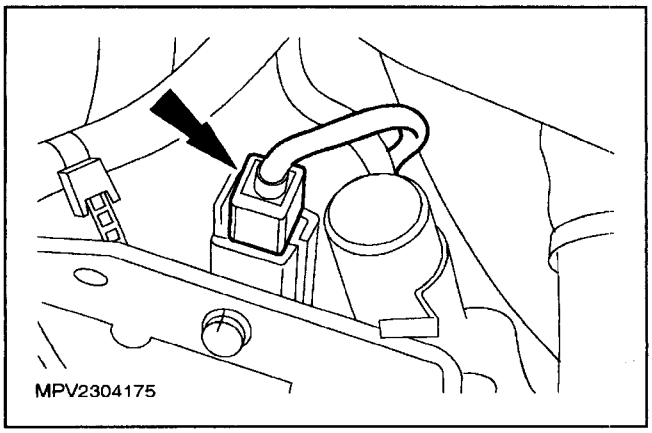
1. Remove the air cleaner. For additional information, refer to Section 303-12A or Section 303-12B.

REMOVAL AND INSTALLATION (Continued)

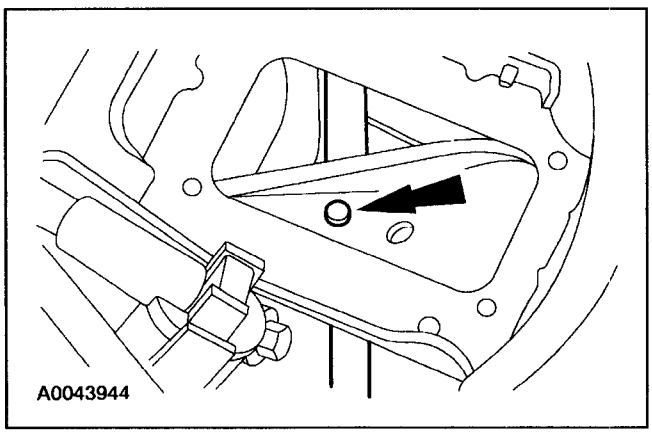
2. Remove the ignition coil. For additional information, refer to Ignition Coil in this section.



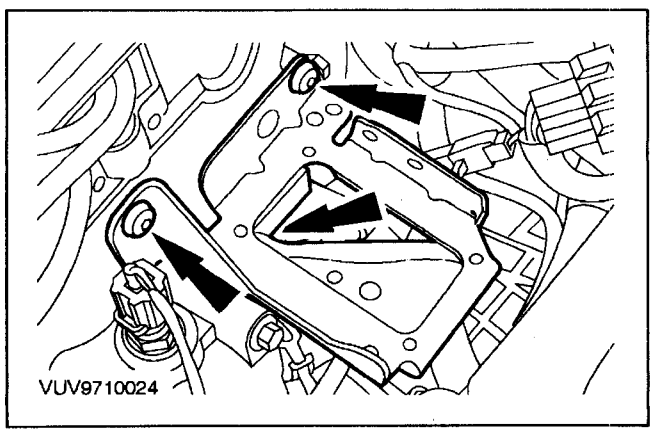
3. Remove the cable tie which retains the ignition coil wiring harness to the ignition coil bracket.



4. Disconnect the radio suppressor electrical connector.



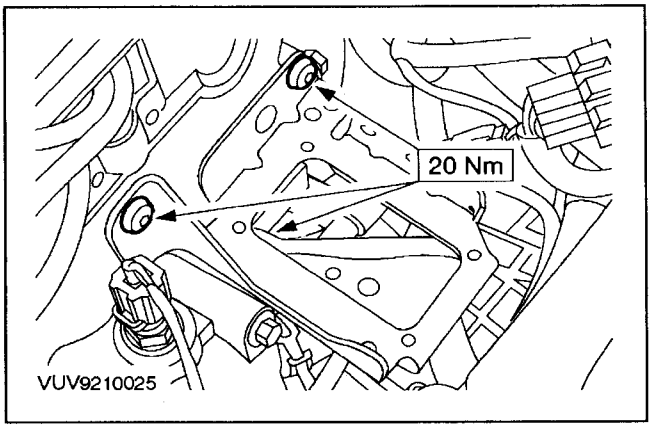
5. Detach the crankshaft position sensor and camshaft position sensor wiring harness from the ignition coil bracket.



6. Remove the ignition coil bracket.

REMOVAL AND INSTALLATION (Continued)

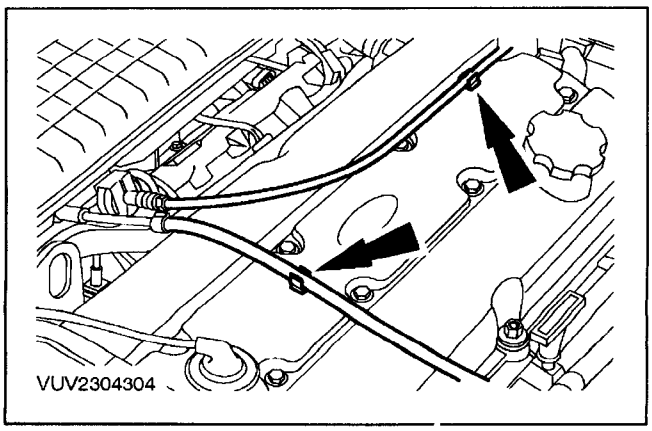
Installation



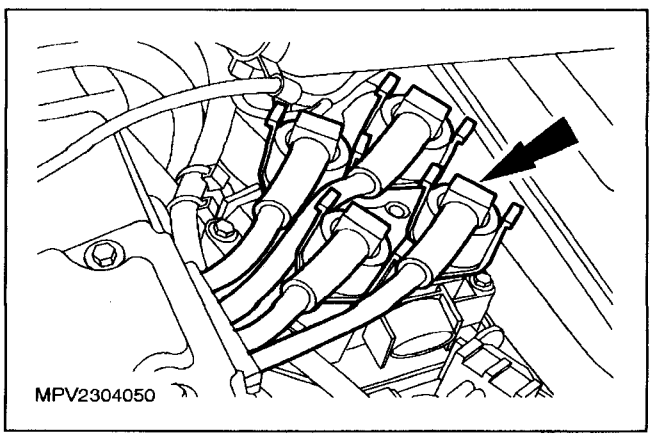
1. To install, reverse the removal procedure.

Spark Plug Wires

Removal

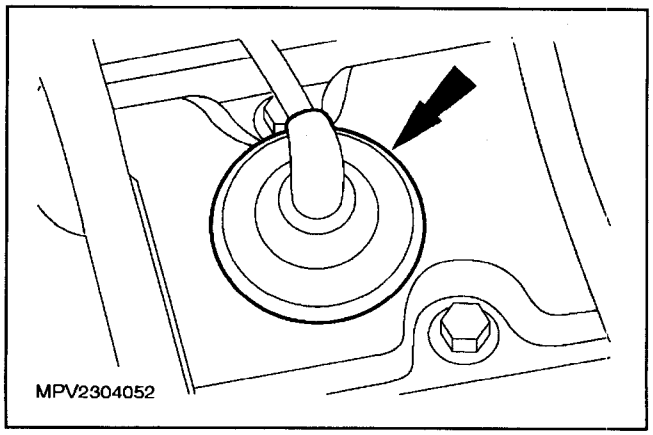


1. Detach the throttle cable and the speed control cable from the engine cover.

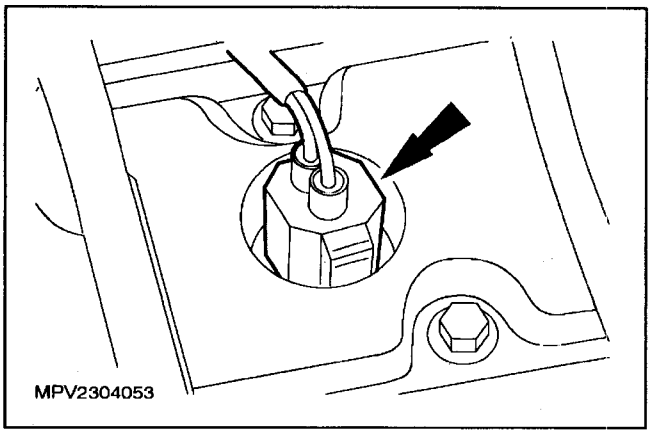


2. Disconnect the spark plug wires from the ignition coil.

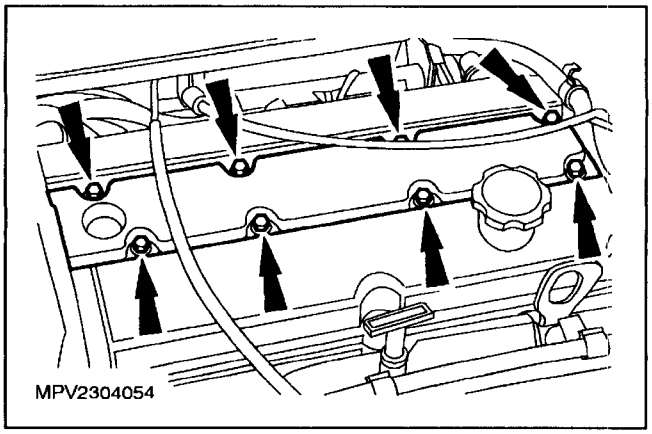
REMOVAL AND INSTALLATION (Continued)



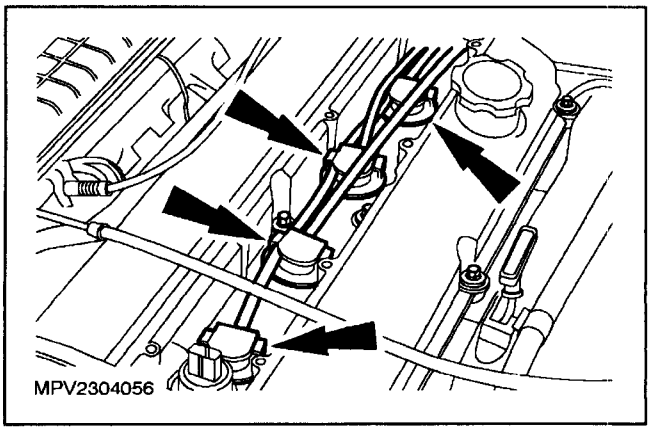
3. Remove the variable camshaft timing solenoid electrical connector grommet from the engine cover.



4. Disconnect the variable camshaft timing solenoid electrical connector.



5. Remove the engine cover.



6. ⚠ **CAUTION: When disconnecting the spark plug connectors do not pull on the wire.**

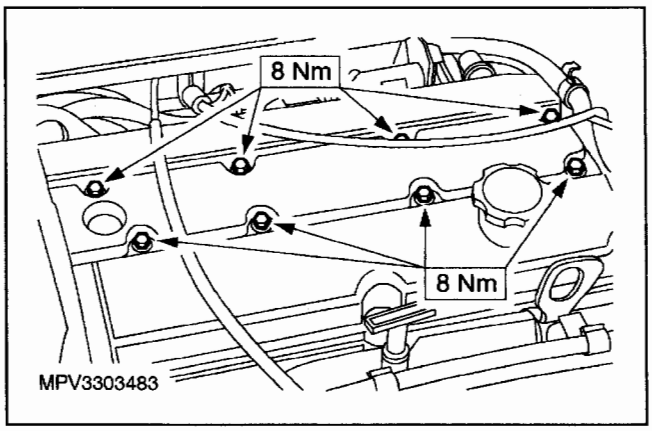
   NOTE: Unclip the wire from the retainer and rotate the connector to break the seal on the spark plug.

   Using a rotating movement, disconnect the spark plug wires from the spark plugs.

7. Remove the spark plug wires.

REMOVAL AND INSTALLATION (Continued)

Installation



1. **NOTE:** Lubricate the spark plug wire connectors with silicon dielectic compound, D7AZ-19A331-A or equivalent, meeting Ford specification ESE-M1C171-A to aid installation.

   To install, reverse the removal procedure.

SECTION 303-07B Engine Ignition — 2.5L

CONTENTS **PAGE**

SPECIFICATIONS 303-07B-2
DESCRIPTION AND OPERATION
Engine Ignition 303-07B-2
DIAGNOSIS AND TESTING
Engine Ignition 303-07B-3
REMOVAL AND INSTALLATION
Ignition Coil 303-07B-3
Spark Plug Wires 303-07B-5

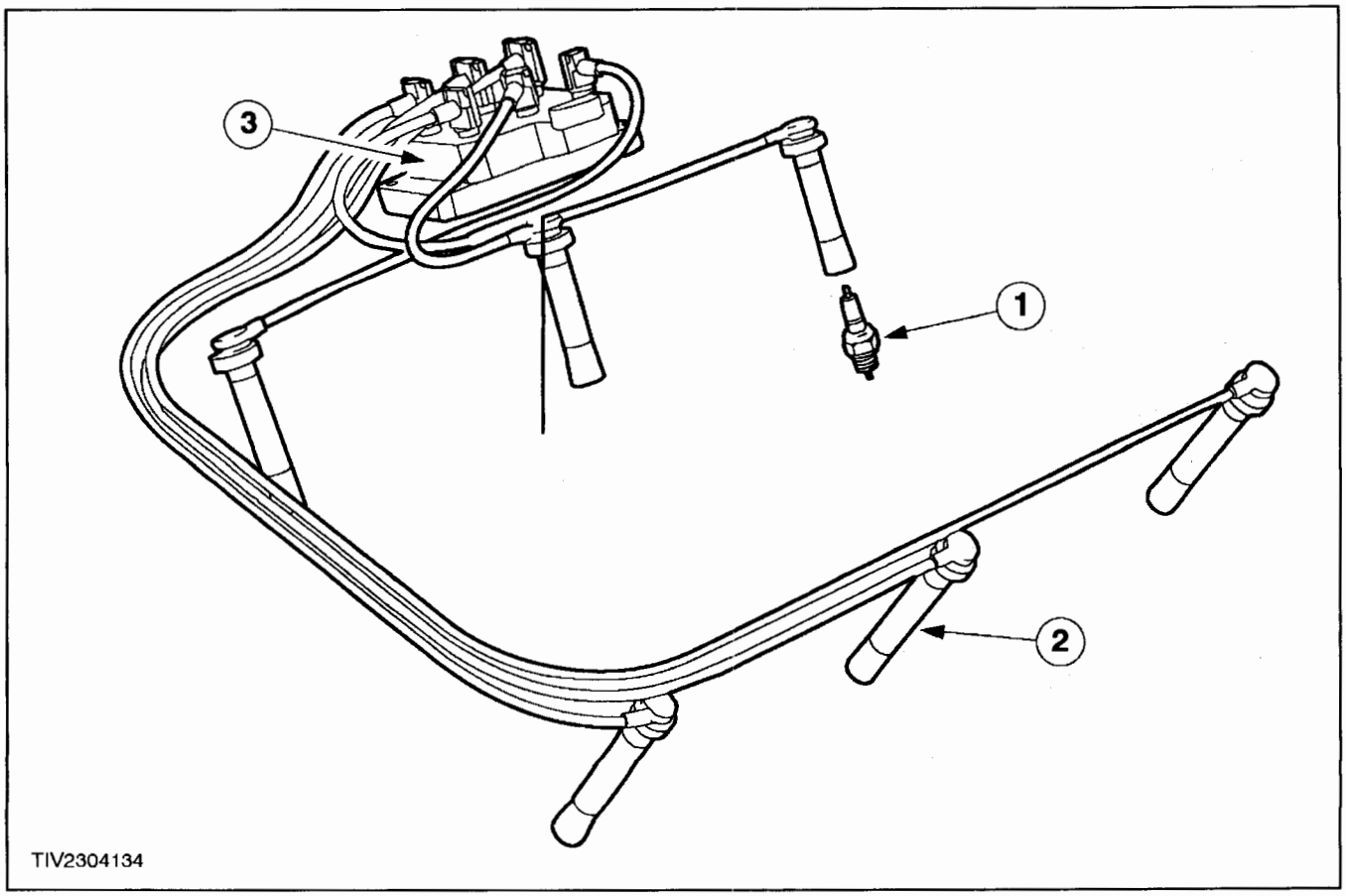
SPECIFICATIONS

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Ignition coil bolts	6	—	53
Spark plugs	15	11	—
Intake manifold runner control actuator bolts	10	—	89

DESCRIPTION AND OPERATION

Engine Ignition



Item	Part Number	Description
1	—	Spark plug
2	—	Spark plug wire
3	—	Ignition coil

The ignition system consists of an ignition coil, spark plug wires and spark plugs.

DESCRIPTION AND OPERATION (Continued)

The crankshaft position sensor signal is the basis for ignition timing calculations. The alternating voltage signal from the crankshaft position sensor is digitized by a pulse former within the powertrain control module. This digitized signal is then used to position the closing time of the primary circuit of the ignition coil.

Ignition timing is determined by the powertrain control module in response to engine operating conditions based on stored data tables or maps. Once ignition timing has been determined, the powertrain control module interrupts the current to the primary circuit of the ignition coil thus triggering the ignition spark. This spark is supplied to the cylinders through the spark plug wires and spark plugs.

The ignition coils are triggered by the powertrain control module in pairs (cylinders 1 and 5, cylinders 4 and 3 and cylinders 2 and 6) sending one ignition spark to the firing cylinder and one ignition spark to the corresponding cylinder on the exhaust stroke.

DIAGNOSIS AND TESTING

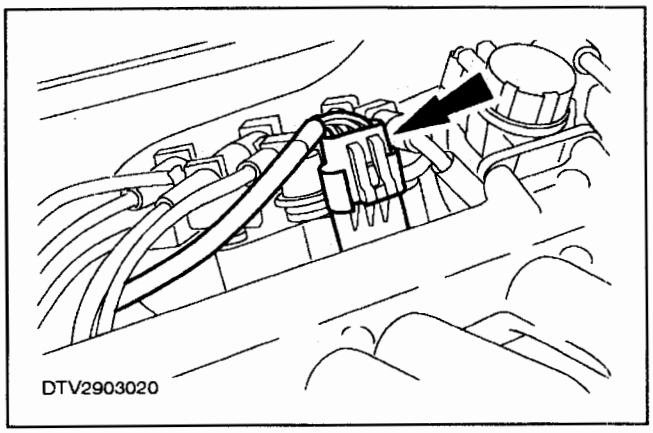
Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

REMOVAL AND INSTALLATION

Ignition Coil

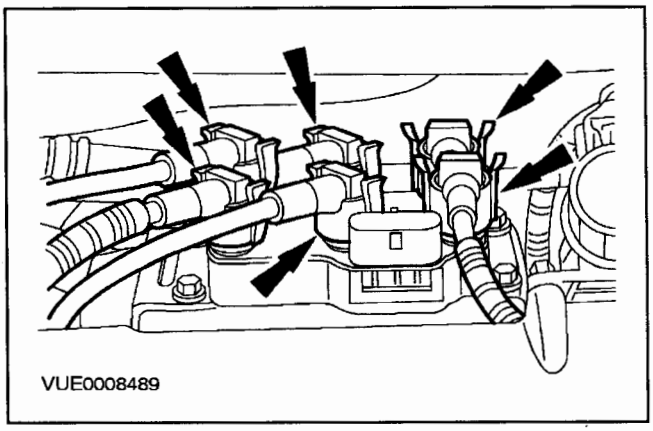
Removal


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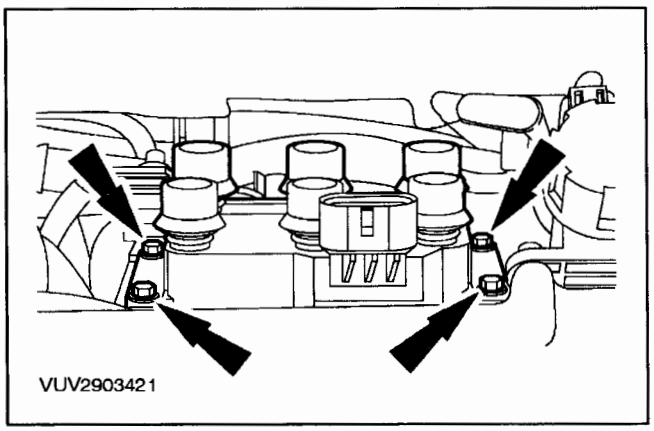
1. Disconnect the ignition coil electrical connector.

1 Can be purchased as a separate item.

REMOVAL AND INSTALLATION (Continued)

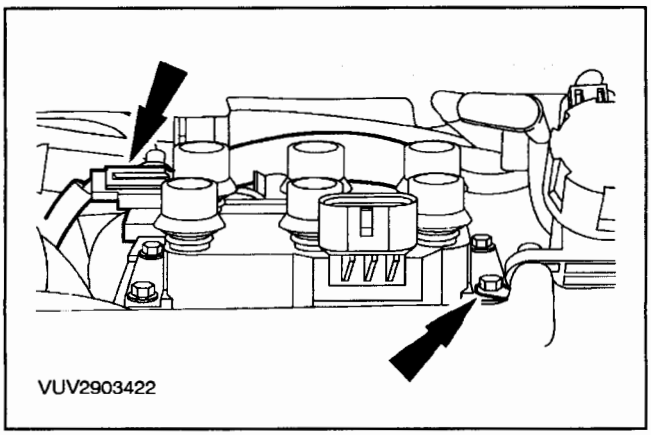

VUE0008489

2. Disconnect the spark plug wires from the ignition coil.


VUV2903421

3. Remove the ignition coil.
   - Remove the ground wire and suppressor from the bolts.

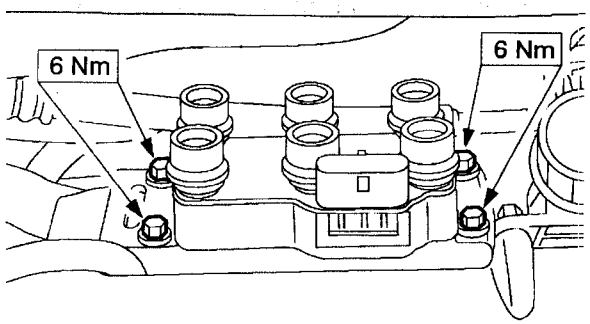
Installation


VUV2903422

1. **NOTE:** When installing the ignition coil, make sure the ground wire and suppressor are connected.

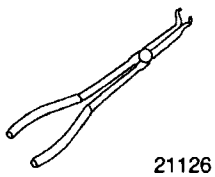
   To install, reverse the removal procedure.

REMOVAL AND INSTALLATION (Continued)

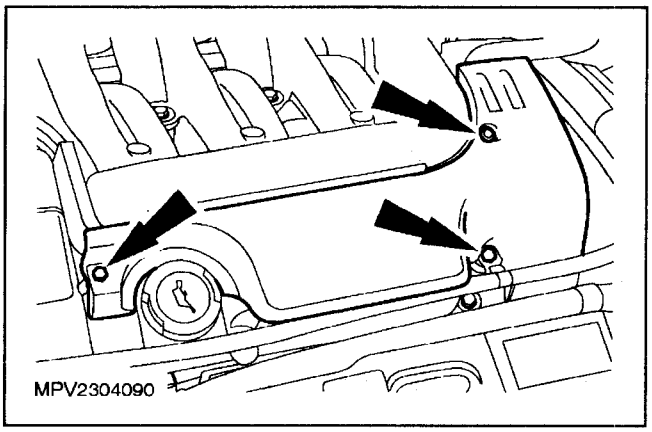


Spark Plug Wires

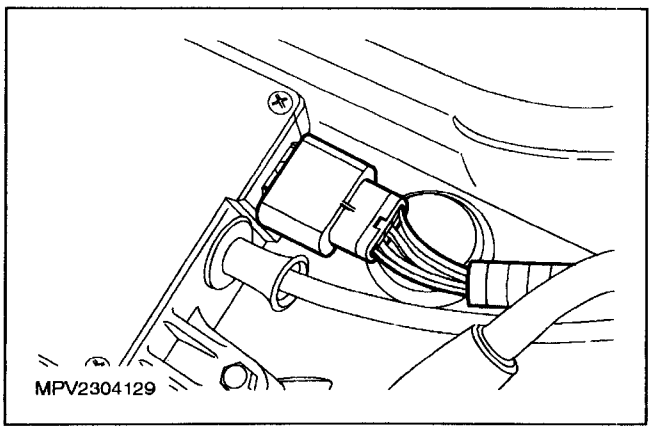
Special Tool(s)

 21126	Pliers, Connector, Spark Plug 303-622 (21-226)

Removal

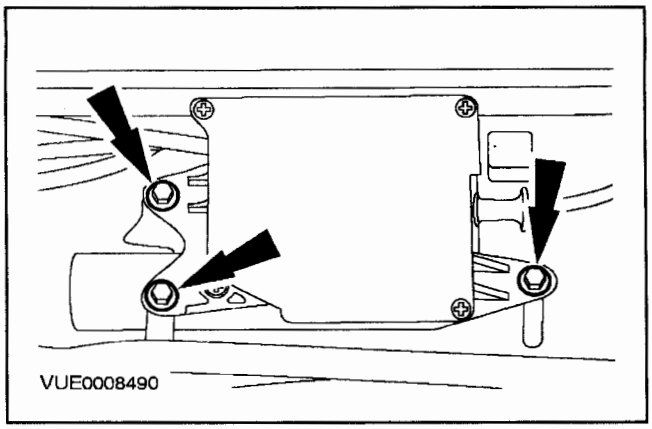


1. Remove the engine cover.

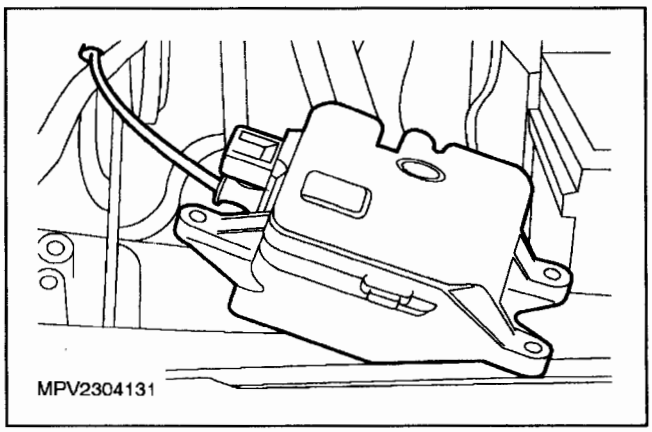


2. Disconnect the variable intake system actuator electrical connector.

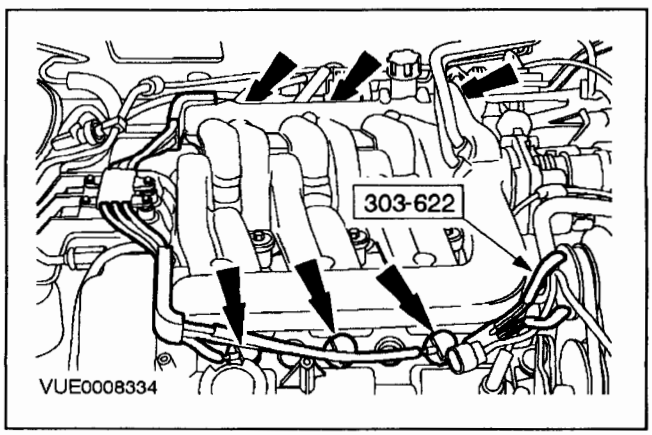
REMOVAL AND INSTALLATION (Continued)



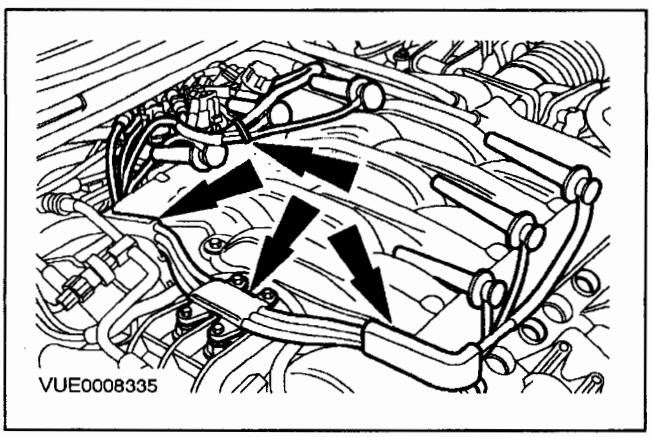
3. Remove the variable intake system actuator bolts.



4. Position the variable intake system actuator to one side.

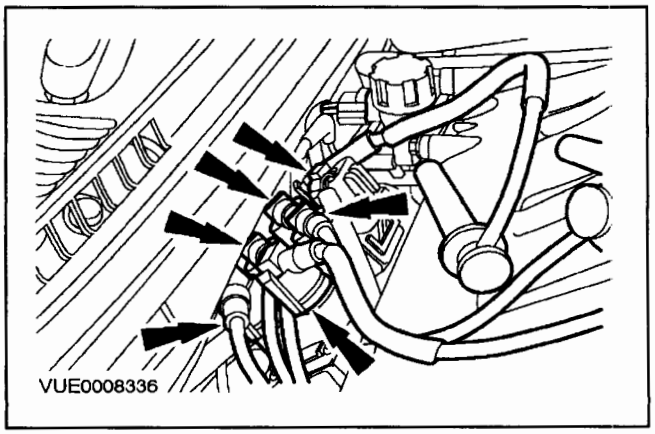


5. Using the special tool, disconnect the six spark plug wires from the spark plugs.



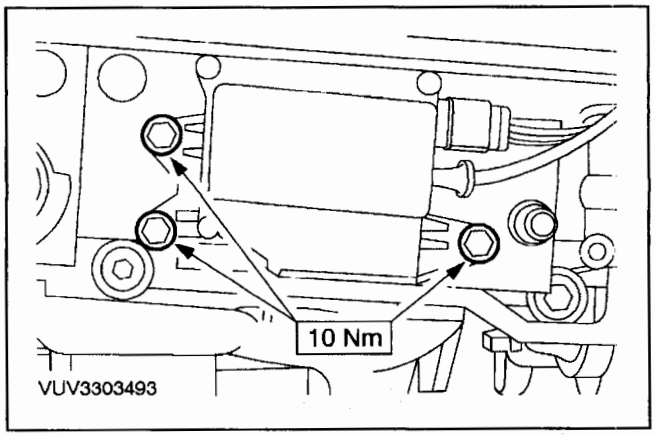
6. Open the spark plug wire separators.

REMOVAL AND INSTALLATION (Continued)



7. Remove the spark plug wires.

Installation



1. To install, reverse the removal procedure.

SECTION 303-08 Engine Emission Control

CONTENTS **PAGE**

SPECIFICATIONS 303-08-2
DESCRIPTION AND OPERATION
Engine Emission Control 303-08-2
Positive Crankcase Ventilation System 303-08-2
Exhaust Gas Recirculation System 303-08-2
DIAGNOSIS AND TESTING
Engine Emission Control 303-08-2
REMOVAL AND INSTALLATION
Exhaust Gas Recirculation (EGR) Valve 303-08-3
Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube 303-08-5
Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System 303-08-10
Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid 303-08-12

SPECIFICATIONS

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Exhaust gas recirculation valve bolts	5	—	44
Exhaust gas recirculation valve tube unions	40	30	—
Differential pressure feedback exhaust gas recirculation sensor nuts	5	—	44

(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Exhaust gas recirculation vacuum regulator valve bolts	6	—	53
Engine roll restrictor bracket bolts	48	35	—
Engine roll restrictor bolt	120	89	—
Engine roll restrictor bolts	48	35	—

DESCRIPTION AND OPERATION

Engine Emission Control

Positive Crankcase Ventilation System

The positive crankcase ventilation system consists of a valve and several hoses.

The positive crankcase ventilation system recycles crankcase gases back through the engine where they mix with the incoming air/fuel charge.

The positive crankcase ventilation valve regulates the amount of ventilation air and crankcase gas supplied to the intake manifold and also prevents backfiring into the crankcase.

The positive crankcase ventilation system helps to reduce hydrocarbon emissions from the engine.

Exhaust Gas Recirculation System

The exhaust gas recirculation system consists of a valve, a vacuum regulator valve, a tube and a differential pressure sensor.

The exhaust gas recirculation system recycles measured quantities of exhaust gas back through the engine where they mix with the incoming air/fuel charge.

The powertrain control module controls the vacuum regulator valve with grounding pulses. This regulates the amount and duration of the vacuum signal supplied to the exhaust gas recirculation valve and thus the valve lift and opening time are controlled.

The differential pressure sensor provides the powertrain control module with data relating to the exact amount of exhaust gas being recirculated by measuring the differential pressure across a calibrated orifice in the supply hose. Thus, closed loop control is achieved.

DIAGNOSIS AND TESTING

Engine Emission Control

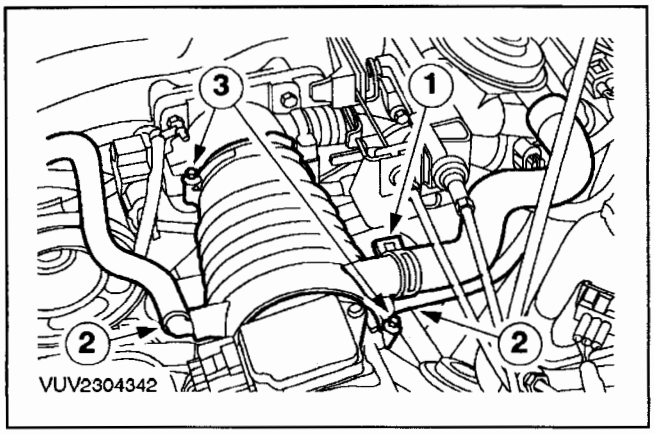
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

1 Can be purchased as a separate item.

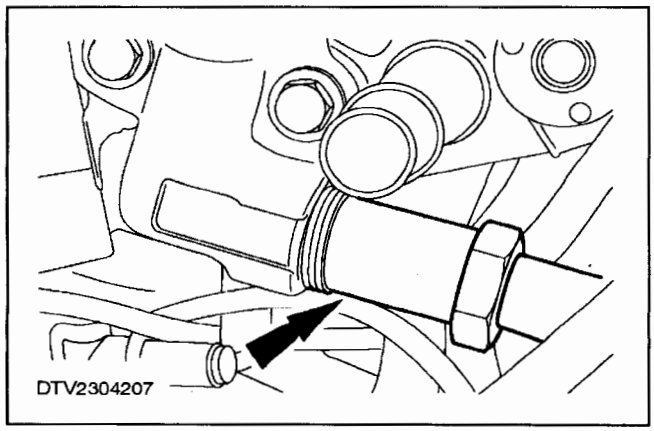
REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) Valve

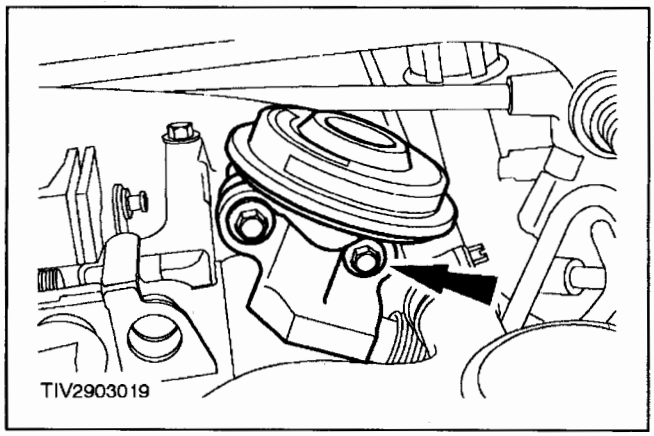
Removal



1. Remove the air cleaner outlet tube.
   1 Disconnect the intake air bypass hose.
   2 Disconnect the positive crankcase ventilation hoses.
   3 Remove the air cleaner outlet tube.



2. Disconnect the tube from the exhaust gas recirculation valve.



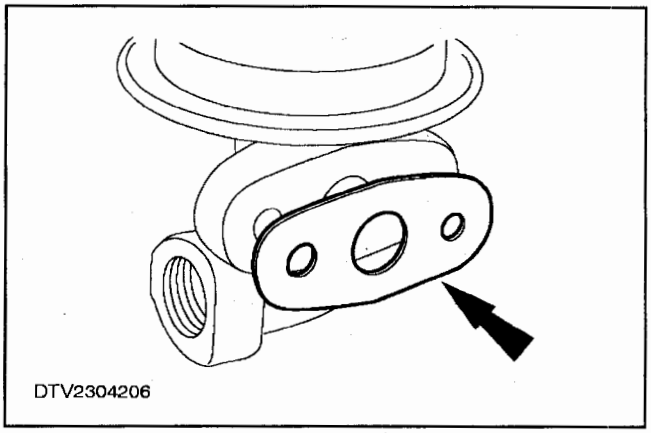
3. Remove the exhaust gas recirculation valve.
   - Disconnect the vacuum hose.

Installation

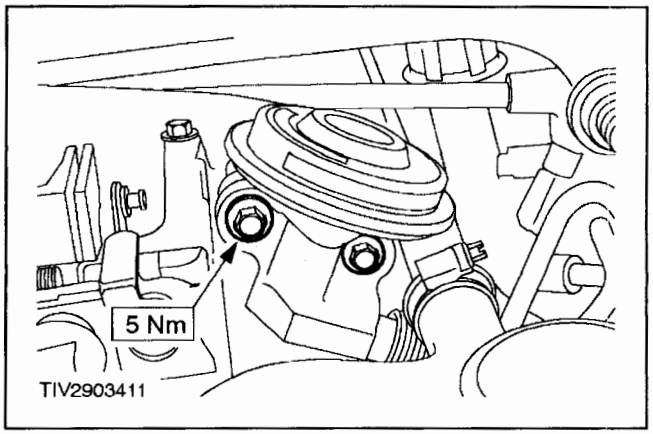
1. **⚠ CAUTION: When cleaning the gasket faces, do not allow debris to enter the intake manifold or exhaust gas recirculation valve.**

   Clean the gasket faces of the intake manifold and exhaust gas recirculation valve.

REMOVAL AND INSTALLATION (Continued)

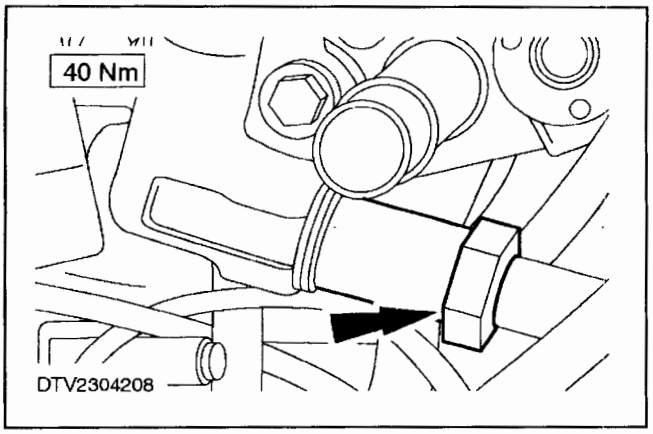

DTV2304206

2. Install a new exhaust gas recirculation valve gasket.



TIV2903411

3. Position the EGR valve and install the bolts.
   - Install the vacuum hose.



DTV2304208

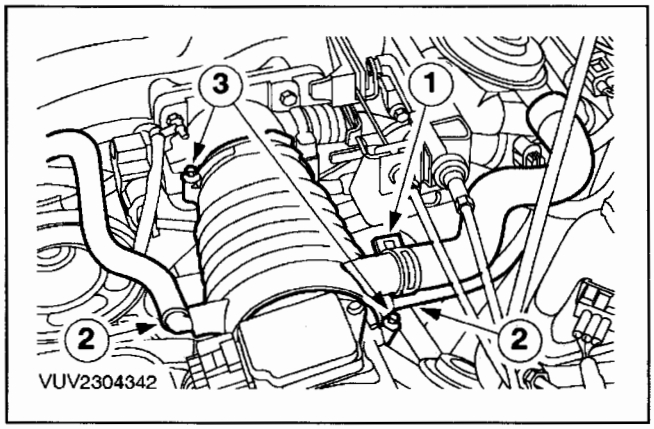
4. Connect the EGR tube.

5. Install the idle air control valve. For additional information, refer to Section 303-14B.

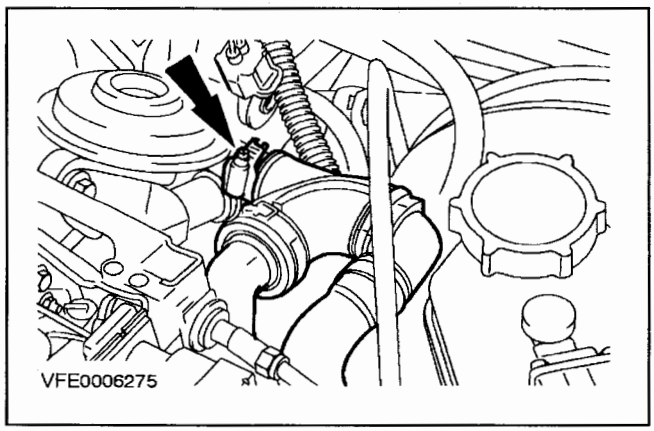
REMOVALANDINSTALLATION (Continued)

Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube

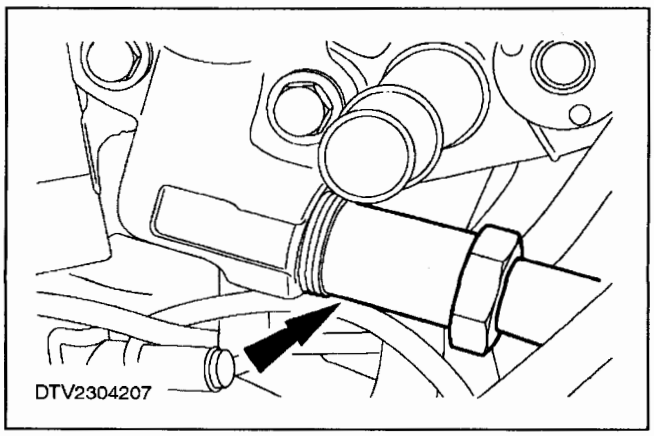
Removal



1. Remove the air cleaner outlet tube.
   1 Disconnect the positive crankcase ventilation hose.
   2 Disconnect the intake air bypass hose.
   3 Remove the air cleaner outlet tube.

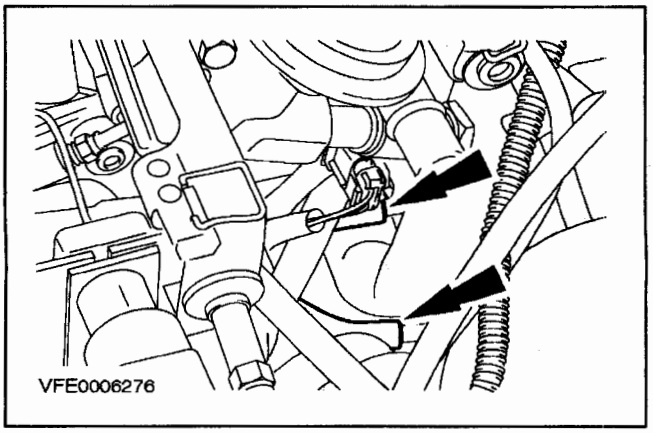


2. Remove the positive crankcase ventilation hoses.



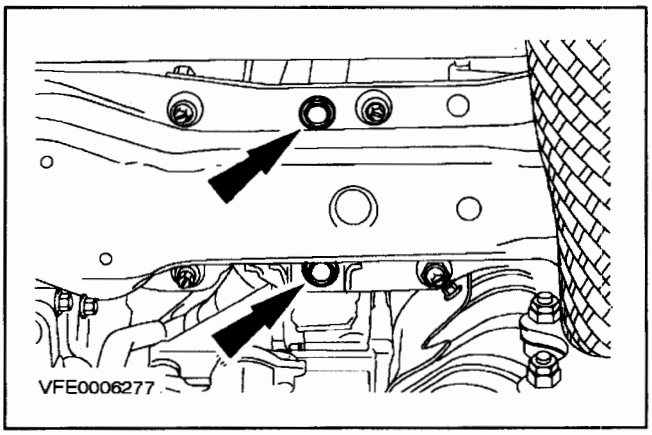
3. Disconnect exhaust gas recirculation (EGR) valve tube.

REMOVAL AND INSTALLATION (Continued)

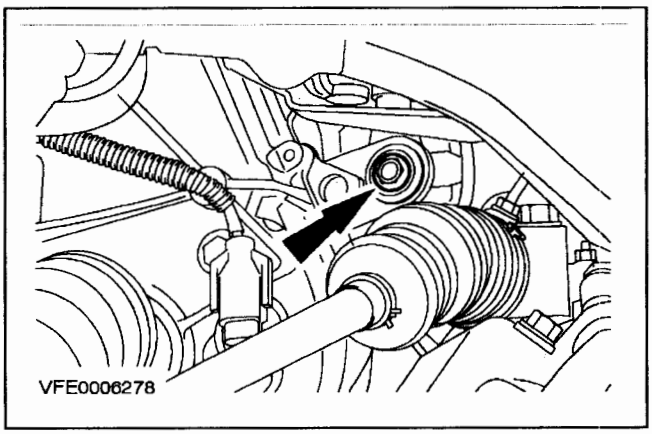


4. Disconnect the differential pressure feedback EGR sensor hoses from the EGR tube.

5. Raise and support the vehicle. For additional information, refer to Section 100-02.

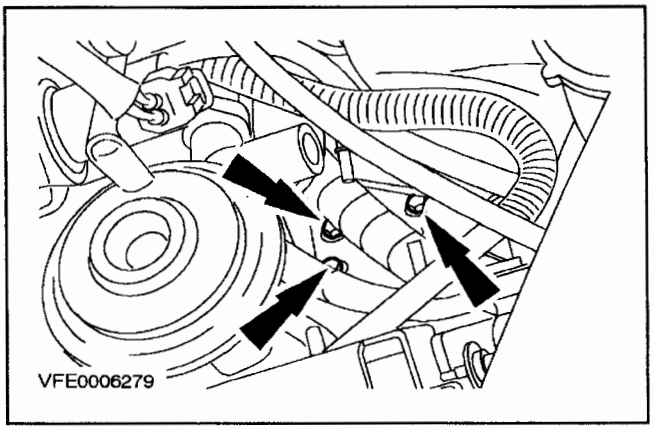


6. Remove the engine roll restrictor bolts.

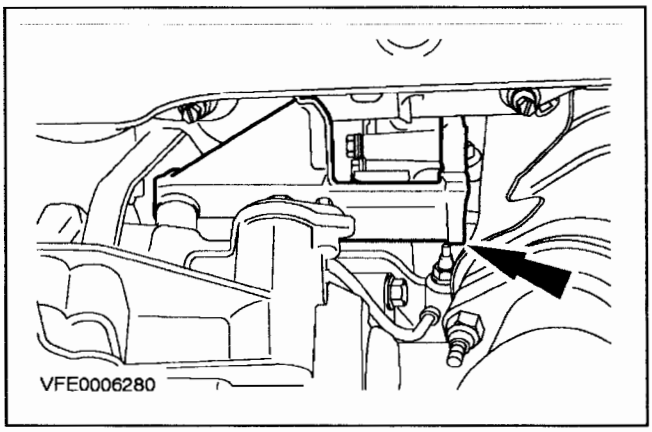


7. Detach the engine roll restrictor and secure to one side.

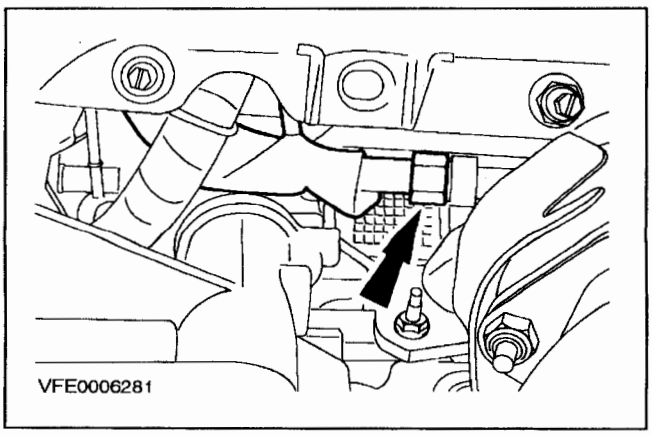
REMOVAL AND INSTALLATION (Continued)



8. Remove the engine roll restrictor bracket bolts.

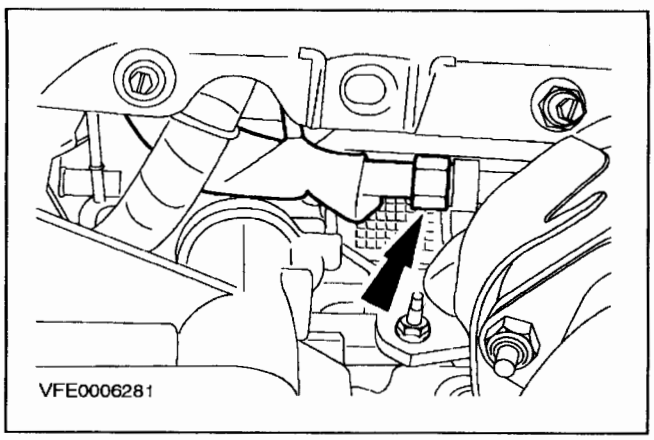


9. Remove the engine roll restrictor bracket.



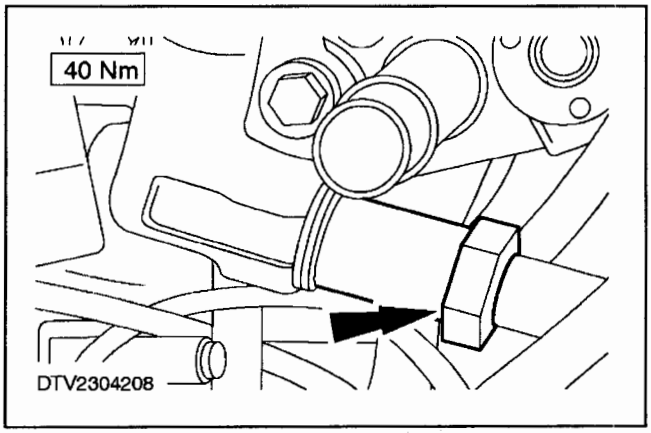
10. Remove the exhaust gas recirculation (EGR) valve tube.

Installation



1. Loosely install the EGR valve tube lower union.

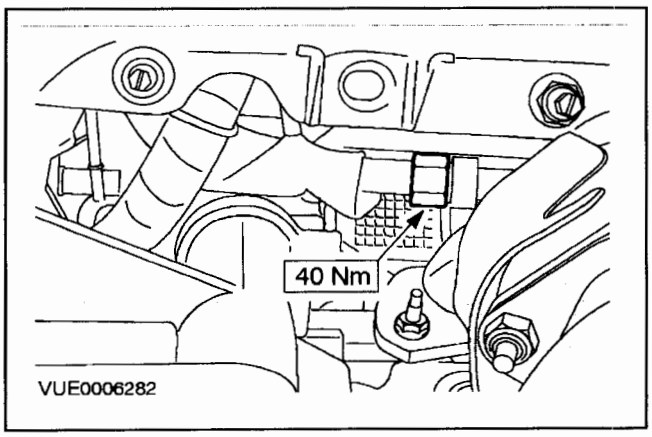
REMOVAL AND INSTALLATION (Continued)



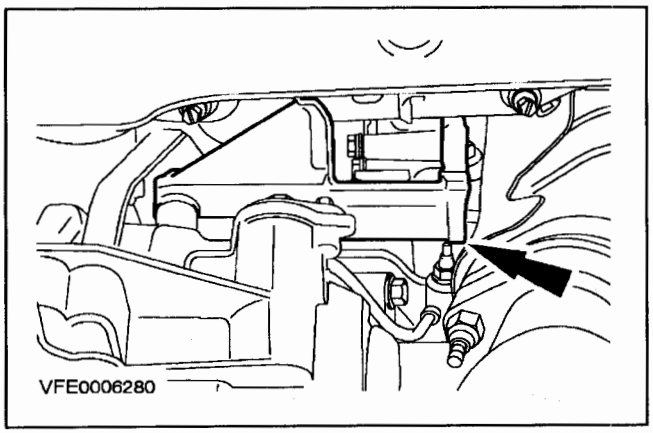
2. Lower the vehicle.

3. Install the EGR valve tube upper union.

4. Raise and support the vehicle. For additional information, refer to Section 100-02.

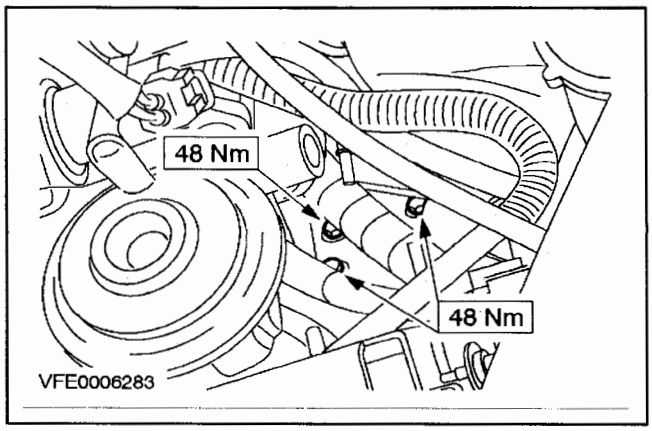


5. Install the EGR valve tube lower union.

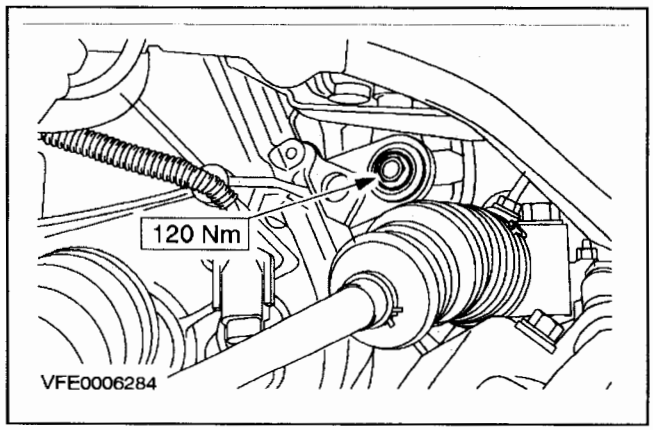


6. Install the engine roll restrictor bracket.

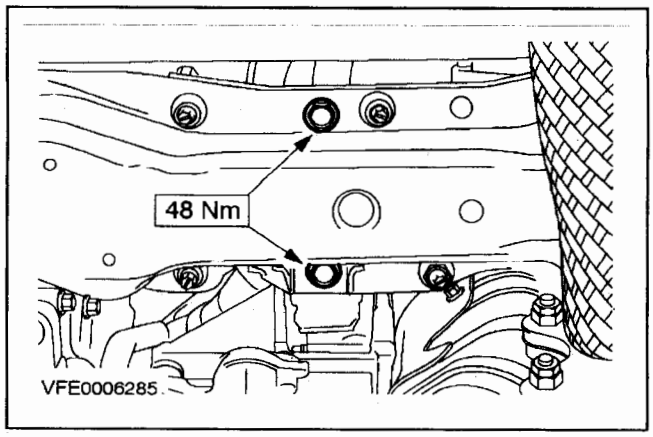
REMOVAL AND INSTALLATION (Continued)



7. Install the engine roll restrictor bracket bolts.

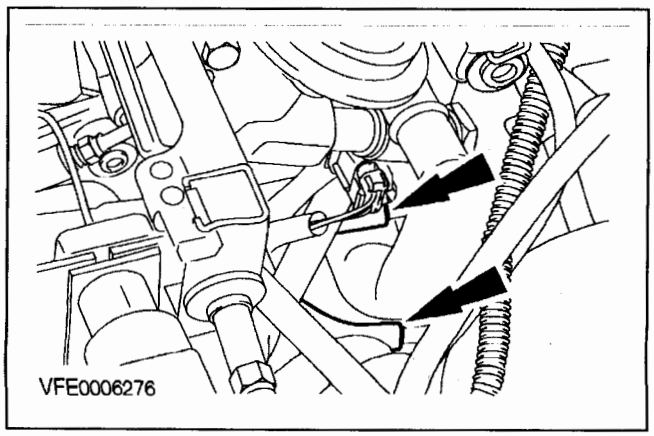


8. Install the engine roll restrictor.



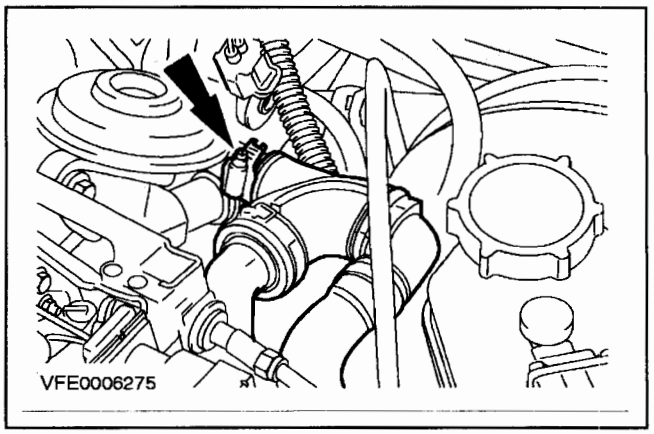
9. Install the engine roll restrictor bolts.

10. Lower the vehicle.

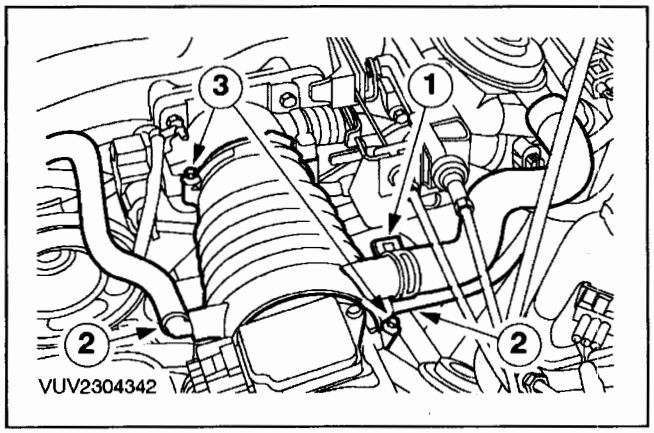


11. Install the differential pressure feedback EGR sensor hoses.

REMOVALANDINSTALLATION (Continued)



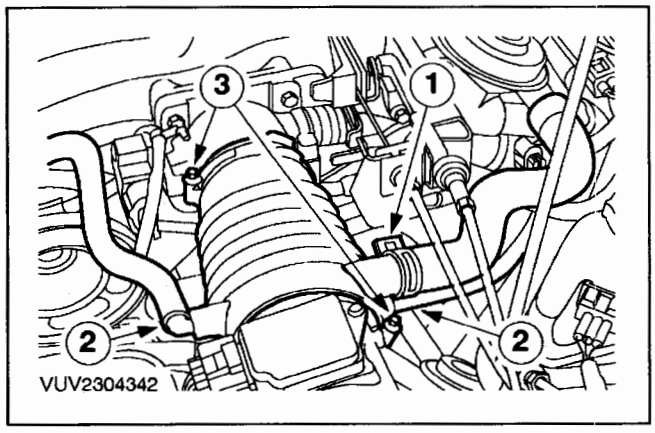
12. Install the positive crankcase ventilation hoses.



13. Install the air cleaner outlet tube.
    1 Install the positive crankcase ventilation hose.
    2 Install the intake air bypass hose.
    3 Install the air cleaner outlet tube.

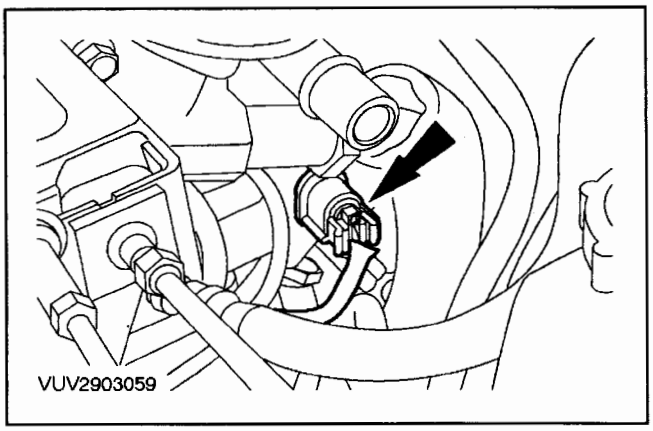
Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System

Removal

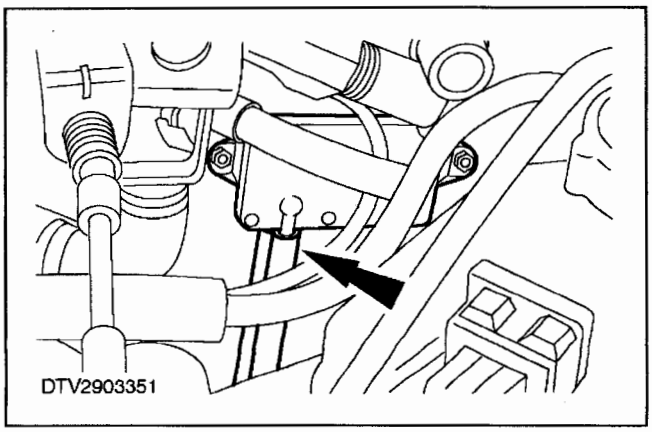


1. Remove the air cleaner outlet tube.
    1 Disconnect the intake air bypass hose.
    2 Disconnect the positive crankcase ventilation hoses.
    3 Remove the air cleaner outlet tube.

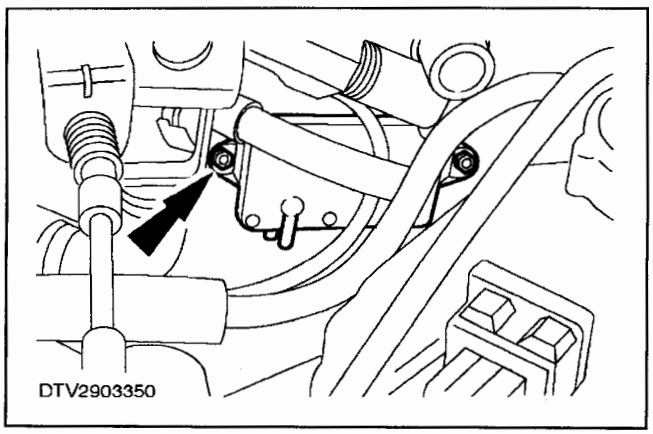
REMOVALANDINSTALLATION (Continued)



2. Disconnect the differential pressure feedback EGR sensor electrical connector.



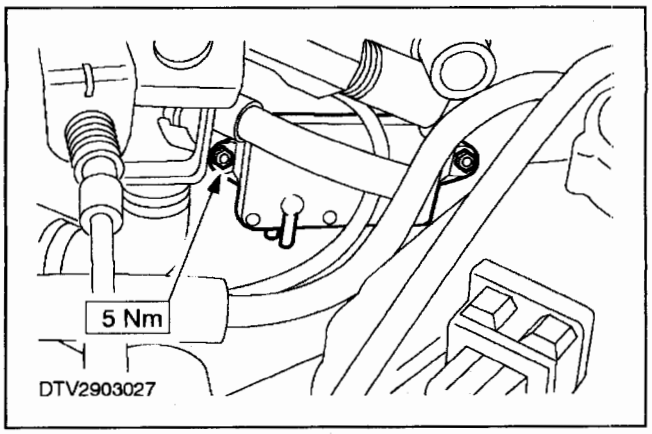
3. Disconnect the hoses from the differential pressure feedback EGR sensor.



4. Remove the differential pressure feedback EGR sensor.

REMOVAL AND INSTALLATION (Continued)

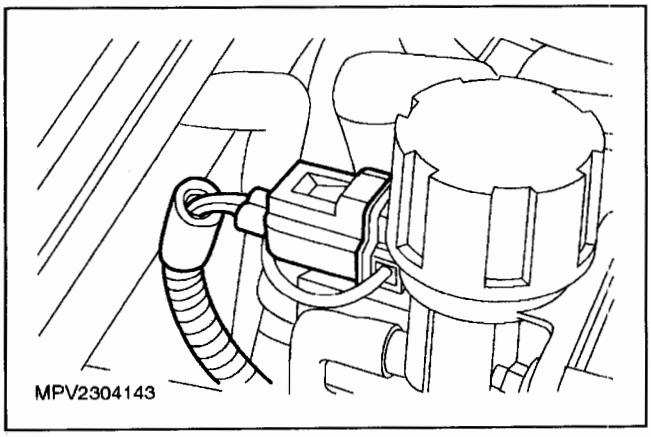
Installation



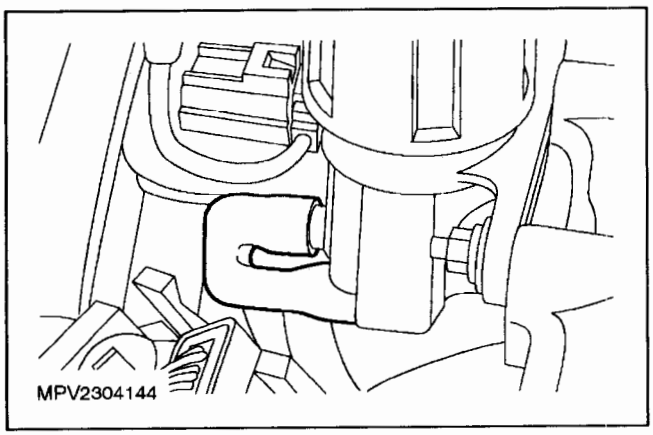
1. To install, reverse the removal procedure.

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid

Removal

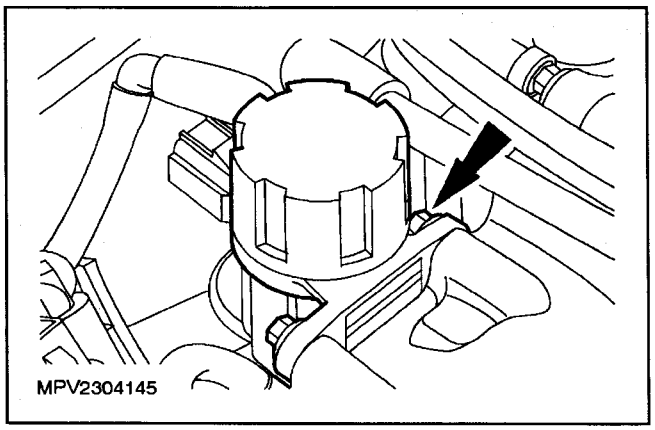


1. Disconnect the EGR vacuum regulator valve electrical connector.



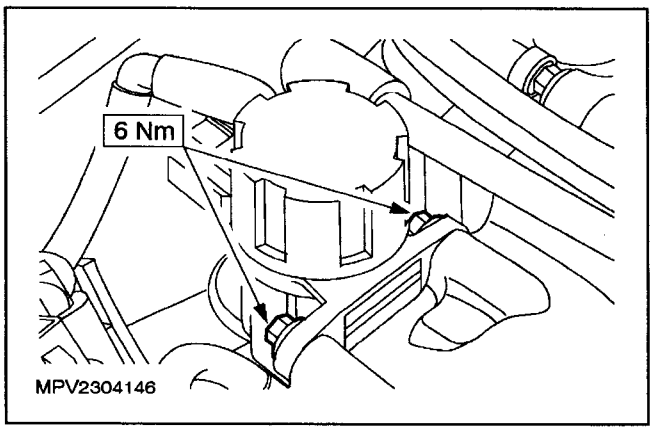
2. Disconnect the vacuum hose connector from the EGR vacuum regulator valve.

REMOVALANDINSTALLATION (Continued)



3. Remove the EGR vacuum regulator valve.

Installation



1. To install, reverse the removal procedure.

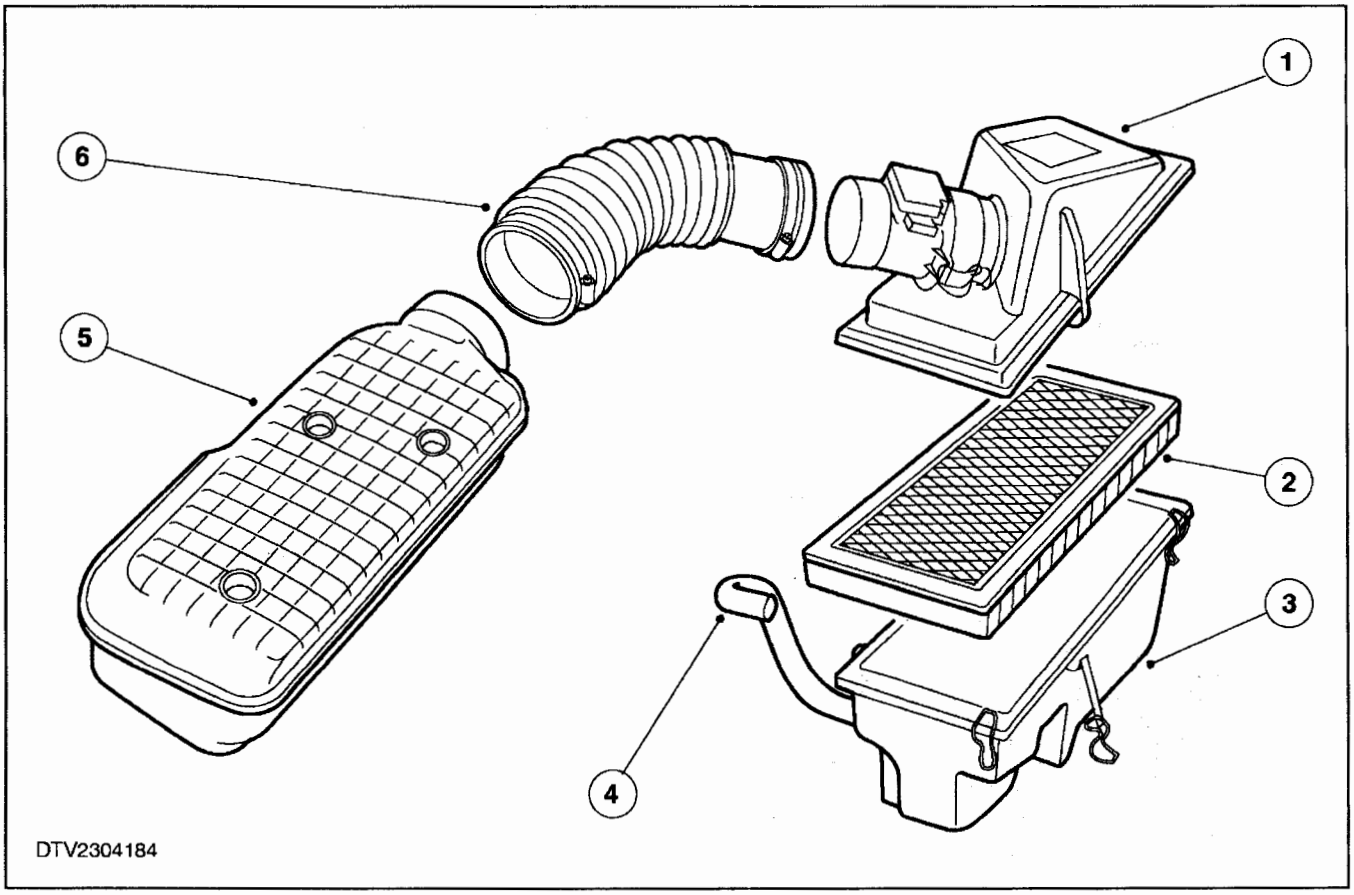
SECTION 303-12A Intake Air Distribution and Filtering — 2.0L Zetec

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Intake Air Distribution And Filtering 303-12A-2
REMOVAL AND INSTALLATION
Air Cleaner Outlet Pipe 303-12A-3
Air Cleaner 303-12A-4
Air Cleaner Element 303-12A-6

DESCRIPTION AND OPERATION

Intake Air Distribution And Filtering



Item	Part Number	Description
1	—	Air cleaner housing cover
2	—	Air cleaner element
3	—	Air cleaner housing

(Continued)

Item	Part Number	Description
4	—	Positive crankcase ventilation hose
5	—	Intake air resonator
6	—	Air cleaner outlet tube

DIAGNOSIS AND TESTING

Intake Air Distribution And Filtering

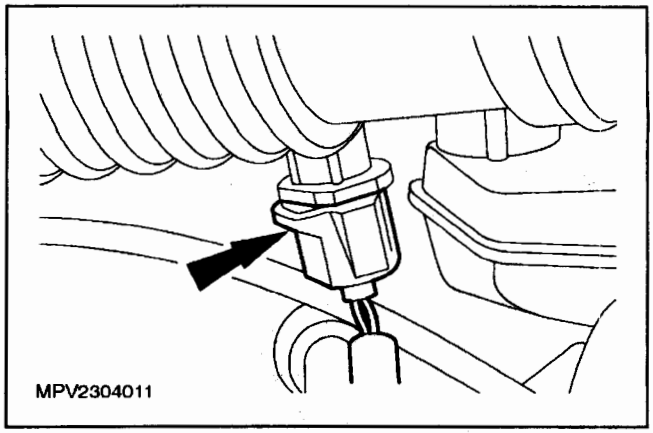
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

1 Can be purchased as a separate item.

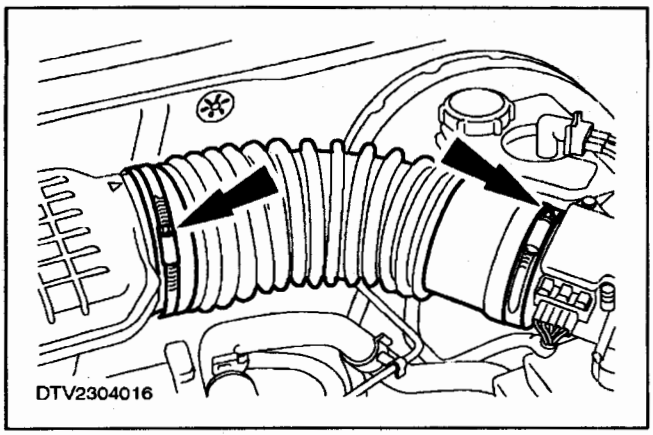
REMOVAL AND INSTALLATION

Air Cleaner Outlet Pipe

Removal



1. Disconnect the intake air temperature sensor electrical connector.



2. Remove the air cleaner outlet tube.

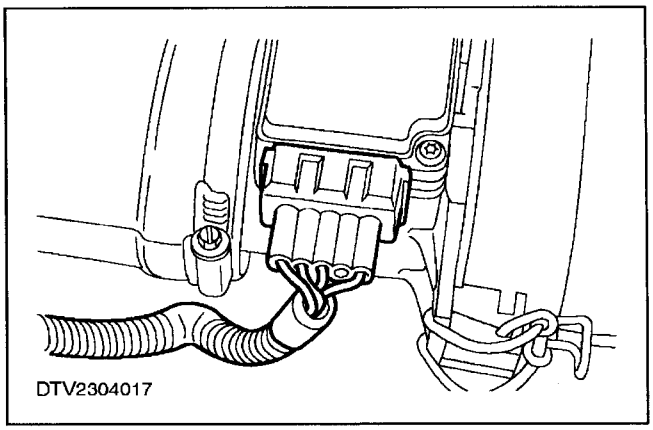
Installation

1. To install, reverse the removal procedure.

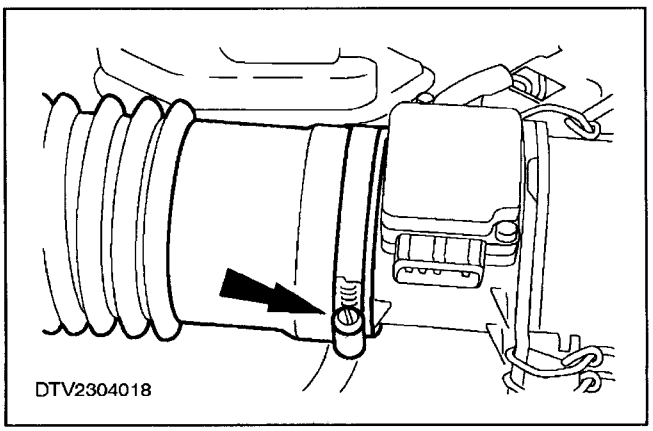
REMOVAL AND INSTALLATION (Continued)

Air Cleaner

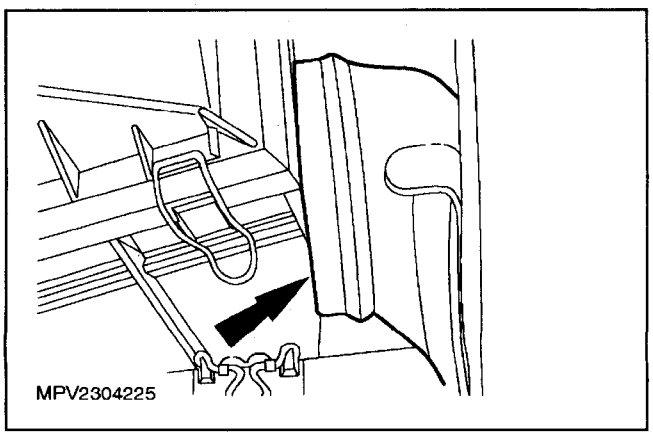
Removal


DTV2304017

1. Disconnect the mass air flow sensor electrical connector.

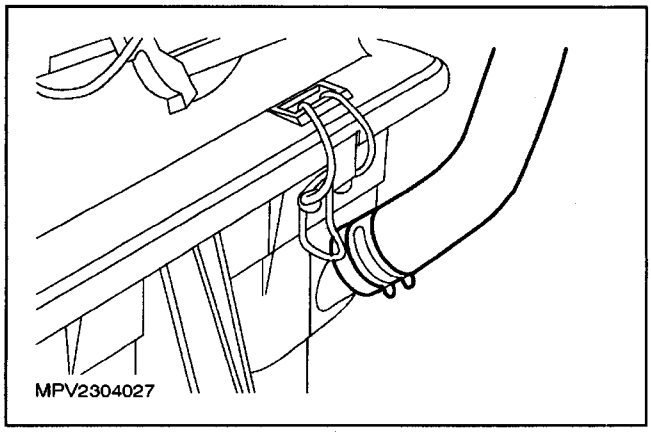

DTV2304018

2. Disconnect the air cleaner outlet tube from the mass air flow sensor.

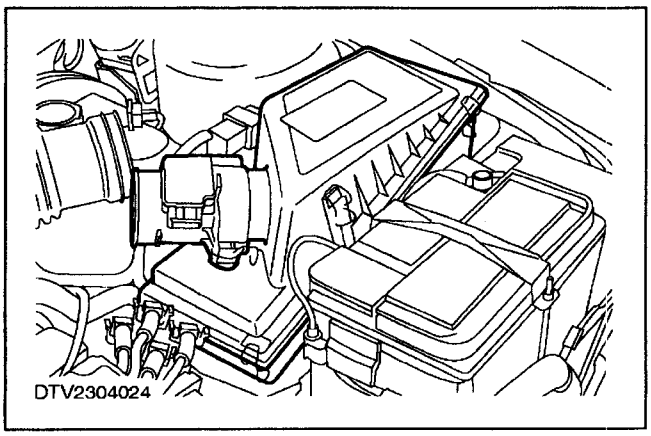

MPV2304225

3. Disconnect the inlet tube from the air cleaner housing.

REMOVAL AND INSTALLATION (Continued)

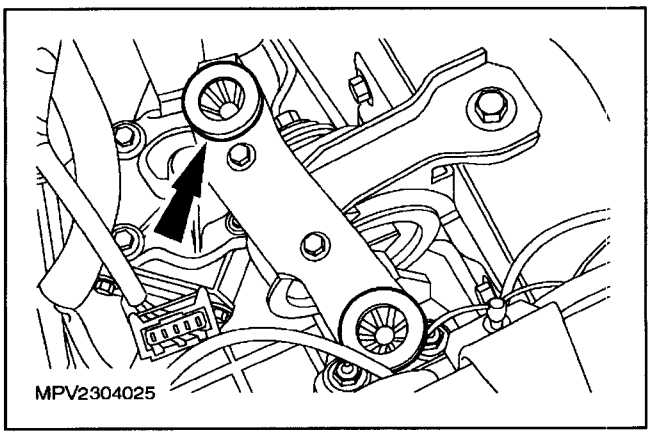


4. Disconnect the positive crankcase ventilation hose from the air cleaner housing.



5. Remove the air cleaner.

Installation



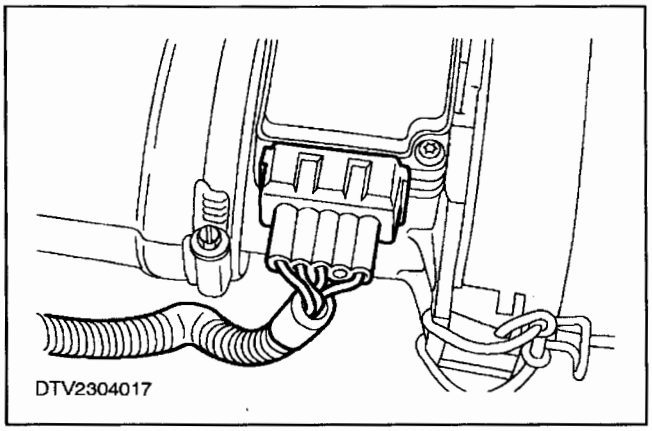
1. **NOTE:** When installing the air cleaner, make sure that the locating pegs fit securely in the grommets located in the retaining bracket.

   To install, reverse the removal procedure.

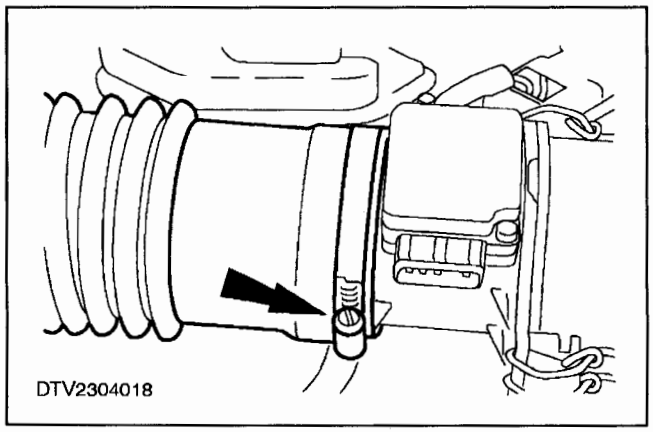
REMOVAL AND INSTALLATION (Continued)

Air Cleaner Element

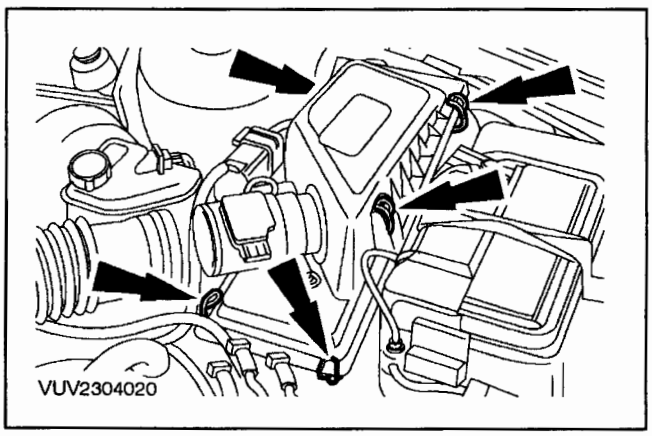
Removal



1. Disconnect the mass air flow sensor electrical connector.

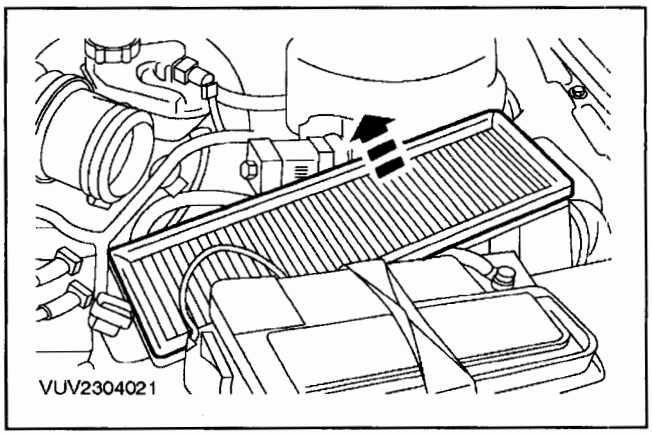


2. Disconnect the air cleaner outlet tube from the mass air flow sensor.



3. Release the retaining clips and remove the air cleaner housing cover.

REMOVAL AND INSTALLATION (Continued)



4. Remove the air cleaner element.

Installation

1. To install, reverse the removal procedure.

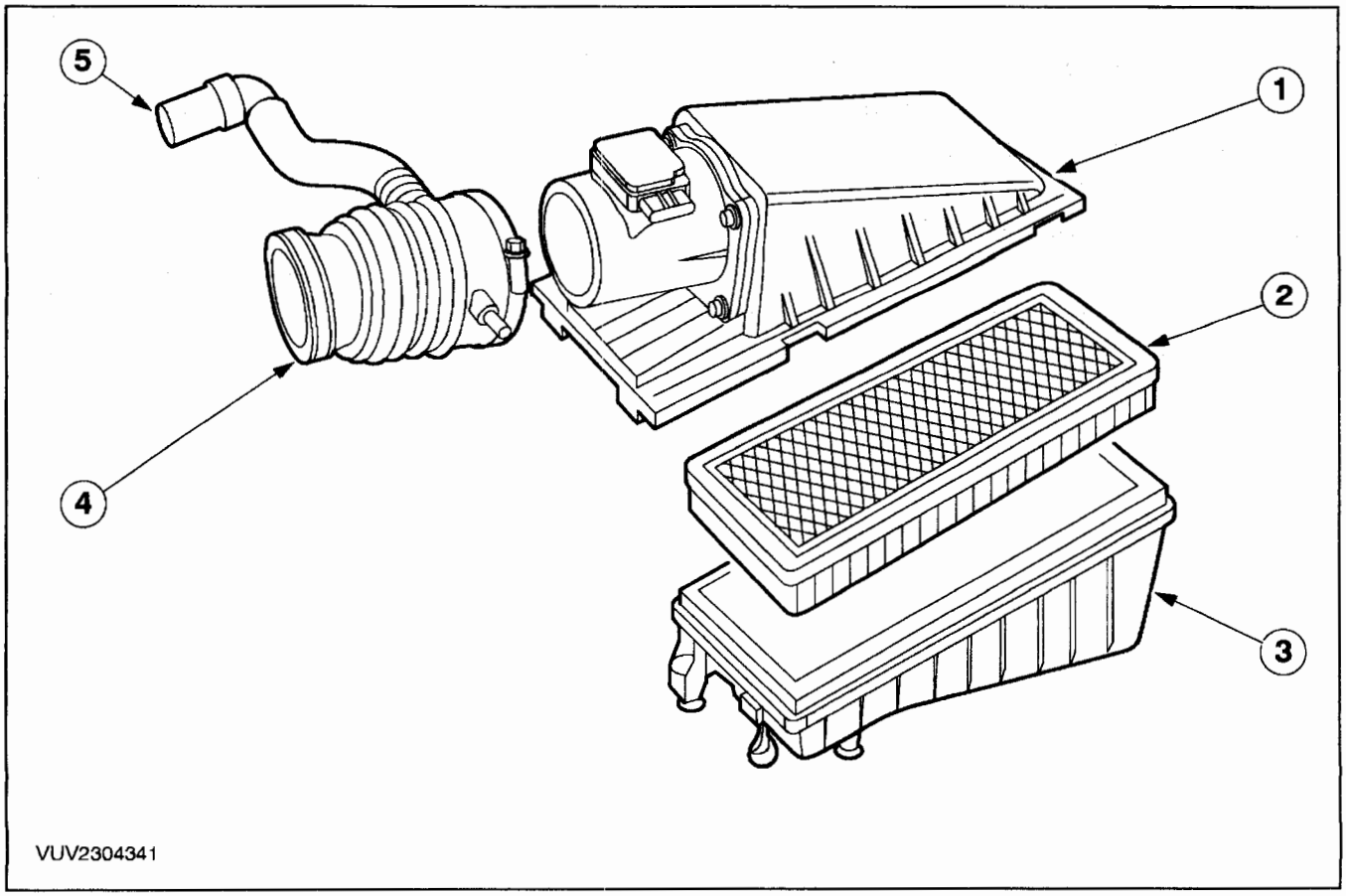
SECTION 303-12B Intake Air Distribution and Filtering — 2.5L

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Intake Air Distribution And Filtering 303-12B-2
REMOVAL AND INSTALLATION
Air Cleaner Outlet Pipe 303-12B-3
Air Cleaner 303-12B-3
Air Cleaner Element 303-12B-5

DESCRIPTION AND OPERATION

Intake Air Distribution And Filtering



Item	Part Number	Description
1	—	Air cleaner housing cover
2	—	Air cleaner element
3	—	Air cleaner housing

Item	Part Number	Description
4	—	Air cleaner outlet tube
5	—	Intake air bypass hose

(Continued)

DIAGNOSIS AND TESTING

Intake Air Distribution And Filtering

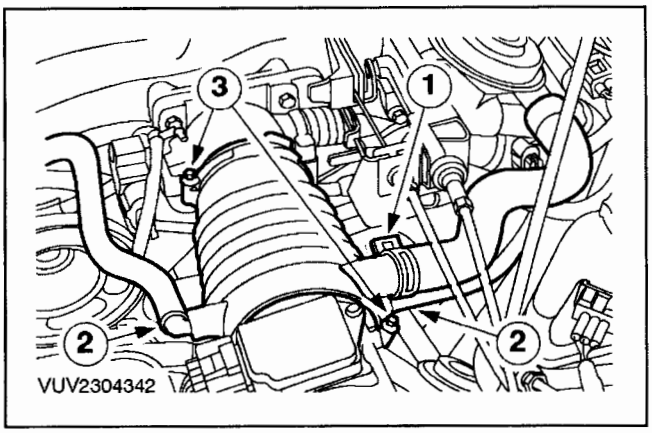
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

1 Can be purchased as a separate item.

REMOVAL AND INSTALLATION

Air Cleaner Outlet Pipe

Removal



1. Remove the air cleaner outlet tube.
   1 Disconnect the intake air bypass hose.
   2 Disconnect the positive crankcase ventilation hoses.
   3 Remove the air cleaner outlet tube.

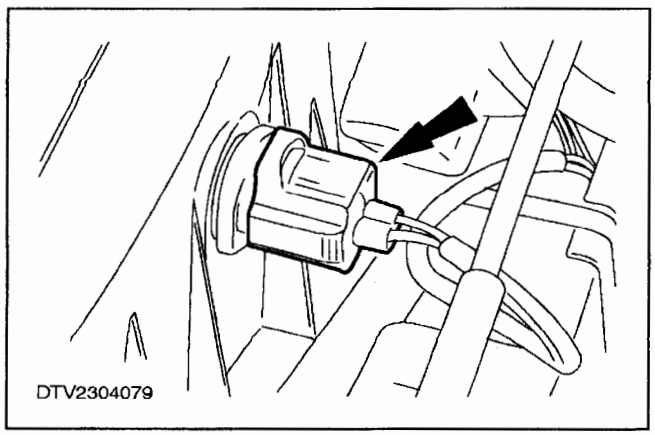
Installation

1. To install, reverse the removal procedure.

Air Cleaner

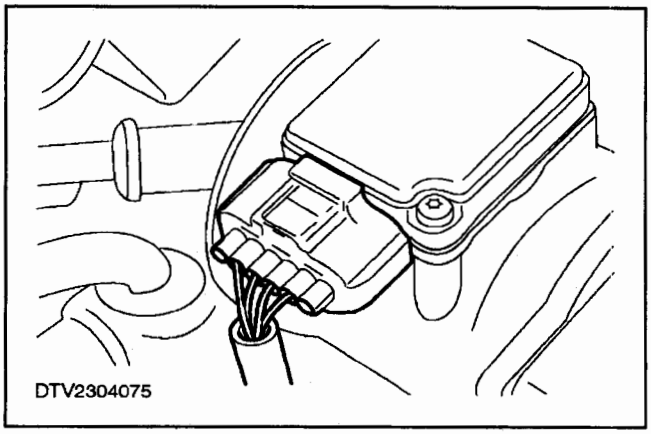
Removal

1. Remove the air cleaner outlet pipe. For additional information, refer to Air Cleaner Outlet Pipe in this section.

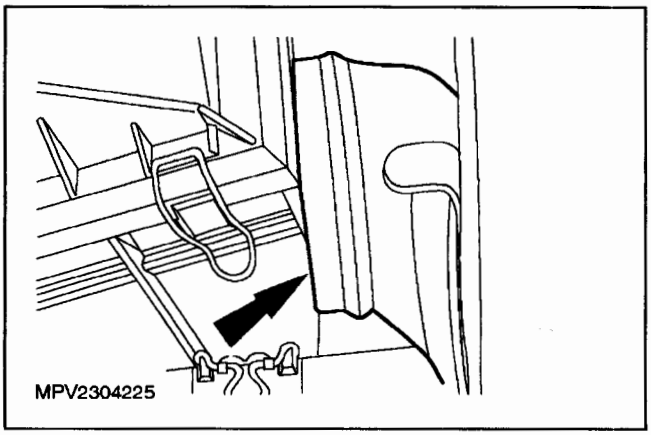


2. Disconnect the intake air temperature (IAT) sensor electrical connector.

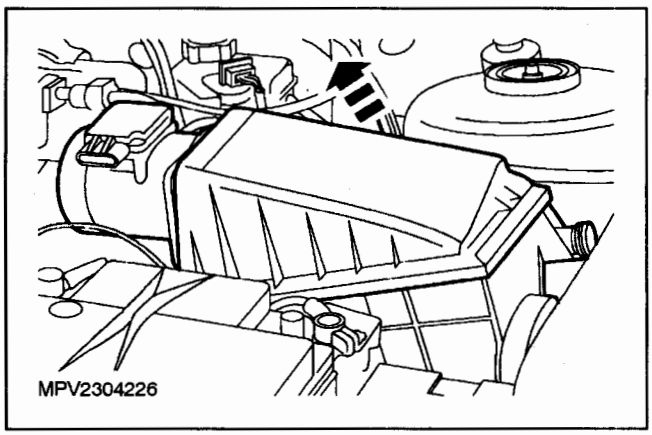
REMOVAL AND INSTALLATION (Continued)


DTV2304075

3. Disconnect the mass airflow sensor electrical connector.


MPV2304225

4. Disconnect the air cleaner inlet tube from the air cleaner housing.


MPV2304226

5. Remove the air cleaner assembly.

Installation

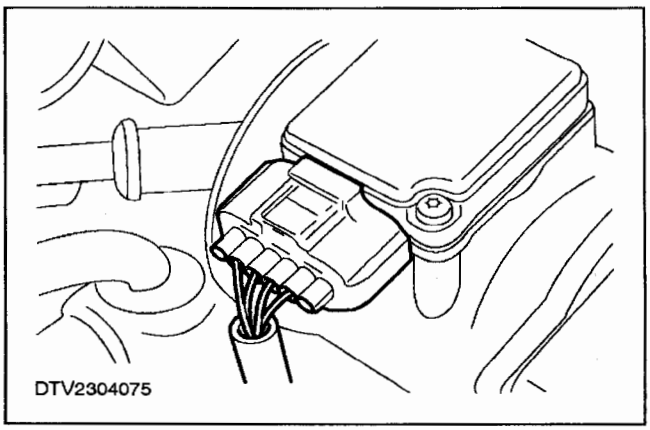
1. **NOTE:** When installing the air cleaner assembly, make sure that the locating pegs fit securely into the grommets located in the retaining bracket.

   To install, reverse the removal procedure.

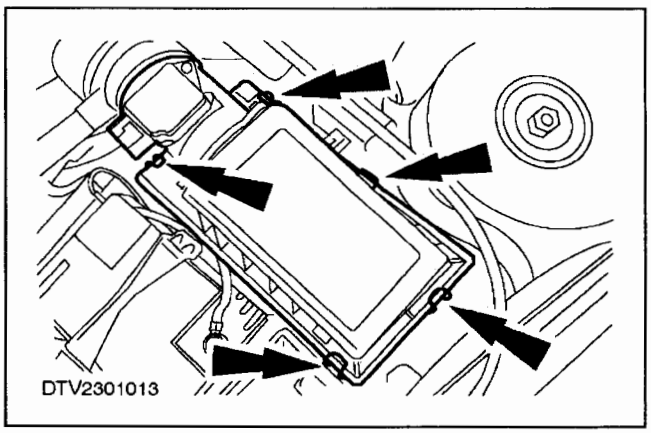
REMOVAL AND INSTALLATION (Continued)

Air Cleaner Element

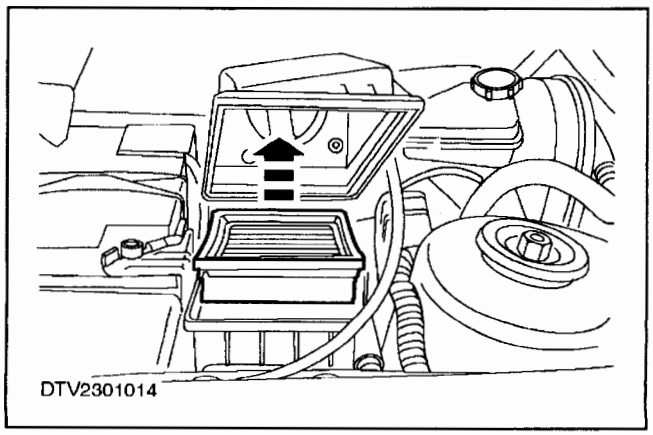
Removal



1. Disconnect the mass airflow sensor electrical connector.



2. Release the air cleaner housing cover retaining clips.



3. Remove the air cleaner element.

Installation

1. To install, reverse the removal procedure.

SECTION 303-13 Evaporative Emissions

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SPECIFICATIONS

General Specifications

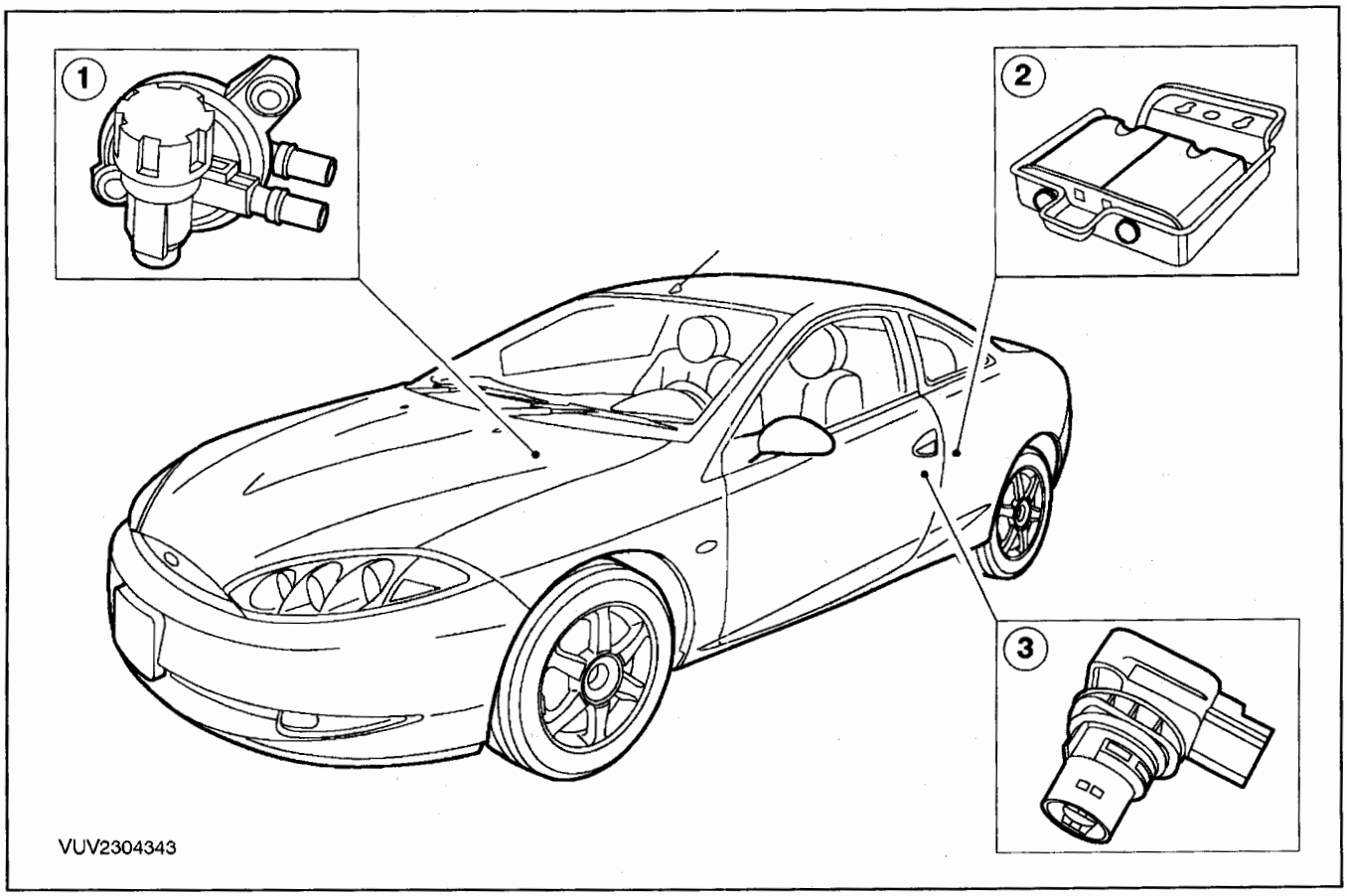
Item	Specification
Engine oil	ESE-M2C-153- H

Torque Specifications

Description	Nm	Lb-In
Evaporative emission canister bolts	6	53

DESCRIPTION AND OPERATION

Evaporative Emissions



Item	Part Number	Description
1	—	Vapor management valve
2	—	Evaporative emission canister
3	—	Fuel tank pressure sensor

The evaporative emission fuel vapor management system consists of an evaporative emission canister and a fuel vapor management valve. A combination of plastic pipes and rubber hoses connect the canister to the fuel tank and the vapor management valve to the intake manifold.

In addition, the fuel vapor management system uses a canister vent solenoid and a fuel tank pressure sensor which are used during the engine management system on board diagnostic routines. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) Manual for further information.

DESCRIPTION AND OPERATION (Continued)

When the vapor management valve is closed, the fuel tank is vented into the canister through the fuel tank roll-over valve. The canister absorbs the fuel vapor and prevents the release of hydrocarbons into the atmosphere. When the vapor management valve is opened, the canister is exposed to the intake manifold vacuum and the fuel vapor deposits are drawn into the manifold where they mix with the incoming air/fuel charge.

The evaporative emission fuel vapor management system is controlled by the powertrain control module according to calibrated data tables.

DIAGNOSIS AND TESTING

Evaporative Emissions

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Fuel vapor hoses • EVAP canister • Vapor management valve (VMV)	• Loose or corroded connector(s)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the NGS tester does not power up, refer to the New Generation STAR tester manual.
5. Carry out the DATA LINK DIAGNOSTIC TEST. If the NGS tester responds with:
   - CKT914, CKT915 or CKT70-ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00.
   - NO RESP/NOT EQUIP for Powertrain Control Module (PCM), refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].
   - System passed, retrieve and record the continuous diagnostic trouble codes (DTCs).
6. If the DTCs retrieved are related to the concern, go to the Diagnostic Trouble Code (DTC) Index.
7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
P0442	Minor leak detected in the EVAP system	PCM	GO to Pinpoint Test A.
P0443	Electrical concern with the EVAP canister purge vale or VMV	PCM	GO to Pinpoint Test B.
P0455	Substantial leak detected in the EVAP system	PCM	GO to Pinpoint Test A.
P1442	Minor leak detected in the EVAP system	PCM	GO to Pinpoint Test A.
P1443	Monitor idle air control duty cycle	PCM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

(Continued)

1 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
P1450	EVAP unable to bleed up fuel tank vacuum	PCM	CHECK all fuel vapor hoses for blockage. CHECK EVAP canister for plugging or blockage. CHECK EVAP canister purge valve for blocked passageway. CHECK VMV for blocked passageway. If the concern persists, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [2].
P1455	Substantial leak detected in the EVAP system	PCM	GO to Pinpoint Test A.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
• Hiss sound when removing fuel cap	• Circuit(s). • Vapor Management Valve (VMV). • EVAP canister purge Valve. • Blocked fuel vapor hose.	• GO to Pinpoint Test B.
• Excessive fuel odor	• Circuit(s). • Vapor Management Valve (VMV). • EVAP canister purge Valve. • EVAP canister. • Fuel vapor hose.	• GO to Pinpoint Test A.

Pinpoint Tests

PINPOINT TEST A: HISS SOUND WHEN REMOVING FUEL CAP

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FOR CORRECT CONNECTION	
	1 Make sure the routing of all EVAP system hoses is correct. Refer to the decal located in the engine compartment 2 Check for loose connection by slightly pulling on the fuel vapor hoses at the manifold, VMV and EVAP canister, as well as the vacuum hose at the VMV. 3 Check all hoses and tubes for cuts, holes, brittleness and any other damage.

(Continued)

2 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: HISS SOUND WHEN REMOVING FUEL CAP (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK FOR CORRECT CONNECTION (Continued)	
	[4] Visually inspect the EVAP canister and the VMV for cracking or any other visual damage. • Are all tubes, hoses and components in good condition? → **Yes** GO to **A2**. → **No** REPAIR or INSTALL new hoses and tubes as necessary. DISCONNECT and PLUG the fuel vapor hose between the VMV and the intake manifold. USE the NGS tester in output test mode to close the EVAP canister vent valve. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test.
A2 CHECK THE EVAP SYSTEM FOR LEAKS	
	[1] Disconnect and plug, at the intake manifold side, the fuel vapor hose between the VMV and intake manifold. [2] Plug the atmospheric vent of the EVAP canister [3] Carry out the EVAP system leak test. Refer to EVAP System Leak Test. • Is the green system passed light ON and no leakage detected? → **Yes** DISCONNECT the leak test equipment. GO to **A5**. → **No** GO to **A3**.
A3 VMV MECHANICAL VACUUM CHECK	
	[1] Disconnect and plug, at the VMV side, the fuel vapor hose between the VMV and EVAP canister

(Continued)

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: HISS SOUND WHEN REMOVING FUEL CAP (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A3 VMV MECHANICAL VACUUM CHECK (Continued)	
	2 Carry out the EVAP system leak test. Refer to EVAP System Leak Test. • Is the green system passed light ON? → **Yes** INSTALL a new VMV. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **A5**. → **No** GO to **A4**.
A4 EVAP CANISTER VENT SOLENOID MECHANICAL VACUUM TEST	
	1 Disconnect and plug, at the EVAP canister, the fuel vapor hose between the fuel tank and the EVAP canister. 2 Carry out the EVAP system leak test. Refer to EVAP System Leak Test. • Is the green system passed light ON? → **Yes** INSTALL a new EVAP canister vent solenoid. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **A5**. → **No** INSTALL a new or REPAIR the component causing a leak in the fuel tank, fuel tank seals, fuel vapor hose, or the fuel filler cap. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **A5**.

(Continued)

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST A: HISS SOUND WHEN REMOVING FUEL CAP (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
A5 CLEAR EVAP SYSTEM DTCS	
1 	2 **NOTE:** Make sure you do not turn the ignition key to the OFF position after clearing the DTCs. Leave the ignition key in the ON position until the drive cycle is completed. Carry out a PCM reset. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [3]. 3 Carry out an OBDII drive cycle. Refer to the PC/ED. • Did the drive cycle clear all DTCs? → **Yes** EVAP system is functioning correctly. If concern persists, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [3]. → **No** If DTC P0442, P0455, P1442, P1443, P1455, or P1450 is retrieved, REFER to the DTC index in this section. Otherwise, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [3].

PINPOINT TEST B: EXCESSIVE FUEL ODOR

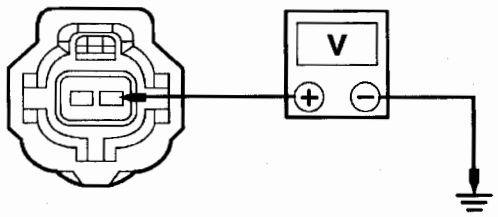
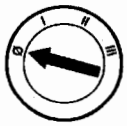
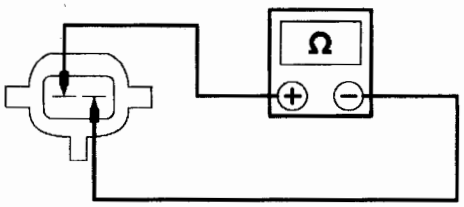
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK VOLTAGE TO VMV	
1 2  VMV C1898	

(Continued)

3 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

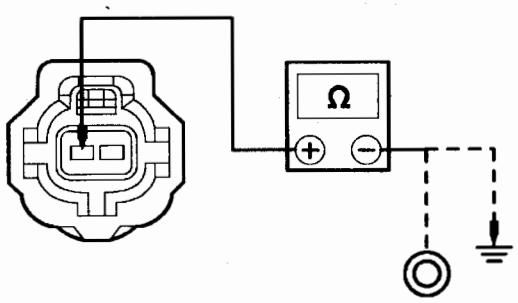
PINPOINT TEST B: EXCESSIVE FUEL ODOR (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK VOLTAGE TO VMV (Continued)	
3  VUV3303487	3 Measure the voltage between the VMV C1898, circuit 95-PB39 (GN/RD), harness side and ground. • Is the voltage greater than 10 volts? → **Yes** GO to **B2**. → **No** REPAIR the circuit. GO to **B10**.
B2 CHECK RESISTANCE OF VMV SOLENOID	
1  2  VUV3303488	2 Measure the resistance between the VMV pin 1 and pin 2. • Is the resistance between 30 and 36 ohms? → **Yes** GO to **B3**. → **No** INSTALL a new VMV. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **B10**.
B3 CHECK FOR VMV INTERNAL SHORT	
	1 Measure the resistance between the VMV pin 1, and the case of the VMV solenoid.

(Continued)

DIAGNOSIS AND TESTING (Continued)

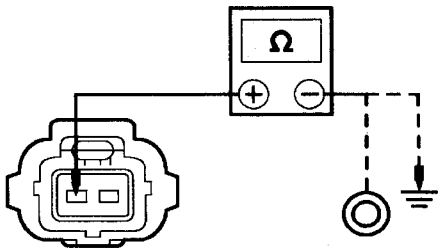
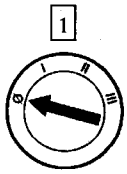
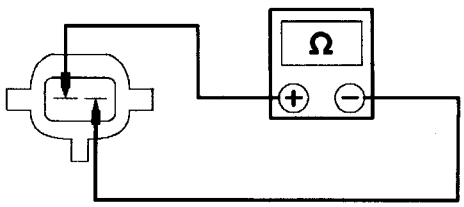
PINPOINT TEST B: EXCESSIVE FUEL ODOR (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B3 CHECK FOR VMV INTERNAL SHORT (Continued)	
	2 Measure the resistance between the VMV pin 2, and case of the VMV solenoid. • Are the resistances greater than 10,000 ohms? → **Yes** GO to **B4**. → **No** INSTALL a new VMV. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **B10**.
B4 CHECK SIGNAL RETURN CIRCUIT FOR VMV	
3  VUV3303489	1 Connect the EEC-V 104 pin breakout box (BOB). Leave the PCM disconnected. 2 Measure the resistance between VMV C1898, circuit 91S-PB39 (BK/OG), harness side and breakout box pin 67. 3 Measure the resistance between VMV C1989, circuit 91S-PB39 (BK/OG), harness side and ground. • Is the resistance less than 5 ohms between the VMV and BOB and greater than 10,000 ohms between the VMV and ground? → **Yes** GO to **B5**. → **No** REPAIR the circuit. GO to **B10**.
B5 CHECK POWER TO EVAP CANISTER PURGE VALVE	
1 2  EVAP Canister Purge Valve	

(Continued)

DIAGNOSIS AND TESTING (Continued)

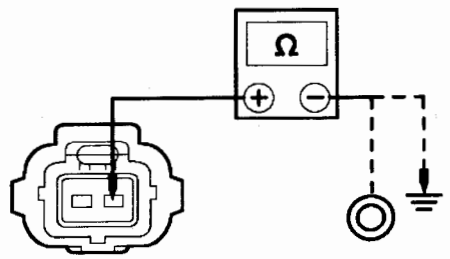
PINPOINT TEST B: EXCESSIVE FUEL ODOR (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B5 CHECK POWER TO EVAP CANISTER PURGE VALVE (Continued)	
3  VUV3303490	3 Measure the voltage between the EVAP canister purge valve C691, circuit 95-PC14 (GN/RD), harness side and ground. • Is the voltage greater than 10 volts? → **Yes** GO to **B6**. → **No** REPAIR the circuit. GO to **B10**.
B6 CHECK EVAP CANISTER VENT VALVE SOLENOID RESISTANCE	
1  2  VUV3303488	2 Measure the resistance between the EVAP canister purge valve pin 1 and pin 2. • Is the resistance between 30 and 90 ohms? → **Yes** GO to **B7**. → **No** INSTALL a new EVAP canister purge valve. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **B10**.
B7 CHECK FOR INTERNAL SHORT	
	1 Measure the resistance between the EVAP canister purge valve pin 1 and the case of the EVAP canister purge valve.

(Continued)

DIAGNOSIS AND TESTING (Continued)

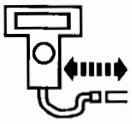
PINPOINT TEST B: EXCESSIVE FUEL ODOR (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B7 CHECK FOR INTERNAL SHORT (Continued)	
	2 Measure the resistance between the EVAP canister purge valve pin 2 and the case of the EVAP canister purge valve. • Is the resistance greater than 10,000 ohms? → **Yes** GO to **B8**. → **No** INSTALL a new EVAP canister purge valve. CARRY OUT the EVAP system leak test. REFER to EVAP System Leak Test. GO to **B10**.
B8 CHECK CIRCUIT 91S-PC14	
2  VUV3303491	1 Measure the resistance between the EVAP canister purge valve C691, circuit 91S-PC14 (BK/OG), harness side and ground. 2 Measure the resistance between the EVAP canister purge valve C691, circuit 91S-PC14 (BK/OG), harness side and breakout box pin 56. • Is the resistance greater than 10,000 ohms when measured to ground and less than 5 ohms when measured to the breakout box? → **Yes** GO to **B9**. → **No** REPAIR the circuit. GO to **B10**.
B9 CHECK FOR SHORT TO POWER	
	1 Measure the resistance between breakout box pin 67 and breakout box pins 71 and 97.

(Continued)

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B: EXCESSIVE FUEL ODOR (Continued)

CONDITIONS	DETAILS/RESULTS/ACTIONS
B9 CHECK FOR SHORT TO POWER (Continued)	
	2 Measure the resistance between breakout box pin 56 and breakout box pins 71 and 97. • Is the resistance greater than 10,000 ohms? → **Yes** The EVAP electrical system is OK If the concern persists, GO to Pinpoint Test A. If the concern still persists, INSTALL a new PCM. → **No** REPAIR the circuit. GO to **B10**.
B10 CLEAR SYSTEM DTCS	
1  2  4 	3 NOTE: Make sure you do not turn the ignition key to the OFF position after clearing the DTCs. Leave the ignition key in the ON position until the drive cycle is completed. Carry out a PCM reset. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [4]. 5 Carry out an OBDII drive cycle. Refer to the PC/ED. • Did the drive cycle clear all DTCs? → **Yes** EVAP system is functioning correctly. If concern persists, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [4]. → **No** If DTC P0442, P0455, P1442, P1443, P1455, or P1450 is retrieved, REFER to the DTC index in this section. Otherwise, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [4].

4 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

Component Tests

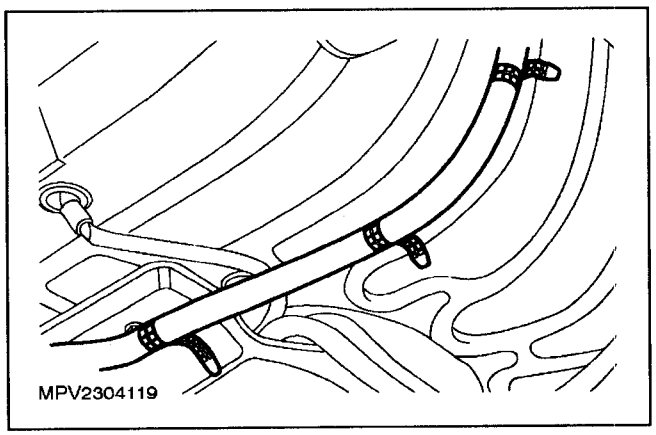
EVAP System Leak Test

1. Install the Rotunda Evaporative Emission System Leak Tester including compressed gas 134-00056 or equivalent, by following the instructions that come with the tester.
2. Turn the ignition key to the ON position.
3. Carry out the evaporative emission system vacuum leak test by allowing the tester to read the amount of vacuum leakage over a predetermined time. The test result displayed by the tester will show the pressure differential as well as a pass (green) or failed (red) light.
4. Carry out the evaporative emission system pressure leak test by pressurizing the evaporative emission system at 3.48 kPa
5. Remove the ultra-sonic leak detector provided with the tester and place the earphones over your ears. Adjust the audio dial on the detector.
6. Closely pass the probe of the detector over all of the fuel vapor hoses and connections. An increase in volume of sound in the earphones indicates a leak.
7. Repair any leaks that have been indicated during this test.
8. If a Pinpoint Test directed you here after changing a component, disconnect the test equipment then unplug and connect all of the hoses, the system is now OK Otherwise, return to the Pinpoint Test that directed you here.

REMOVAL AND INSTALLATION

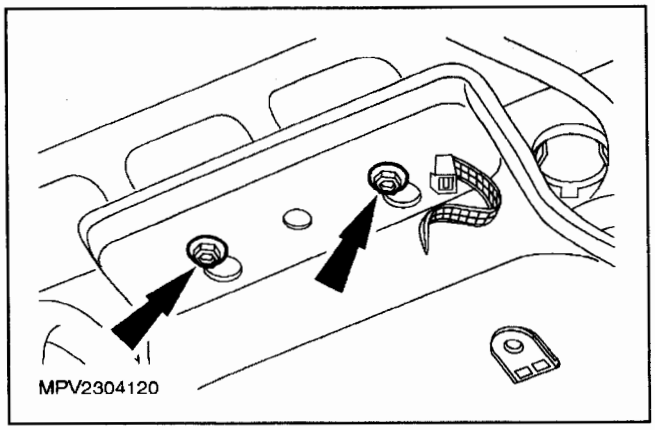
Evaporative Emission Canister

Removal

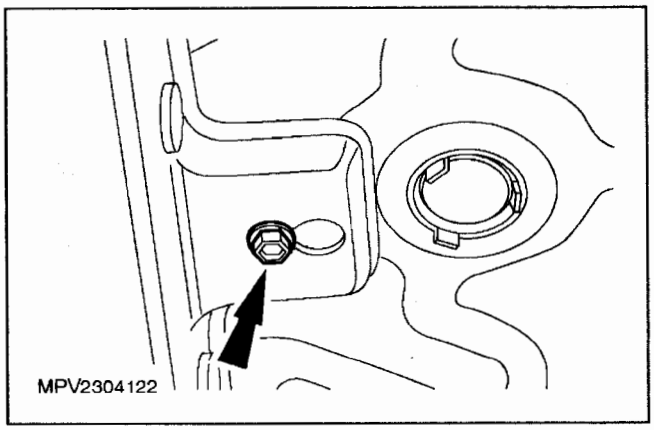


1. Disconnect the battery ground cable.
2. Raise and support the vehicle. For additional information, refer to Section 100-02.
3. Disconnect the ventilation hose from the retaining clips.

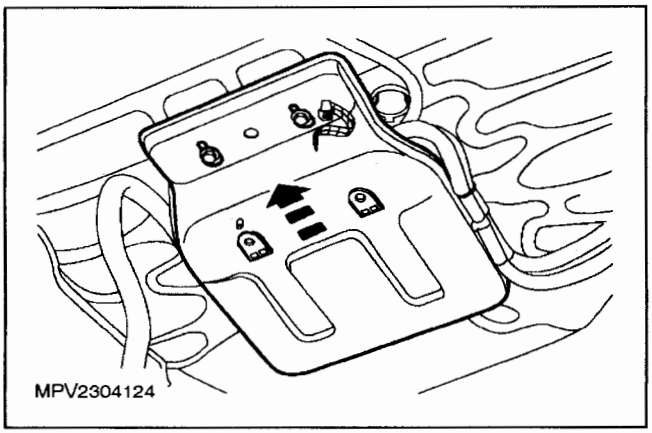
REMOVAL AND INSTALLATION (Continued)



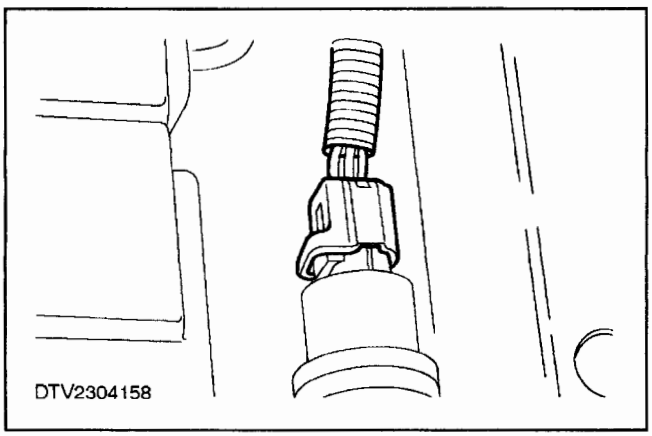
4. Loosen the evaporative emission canister carrier rear bolts.



5. Remove the evaporative emission canister carrier front bolt.

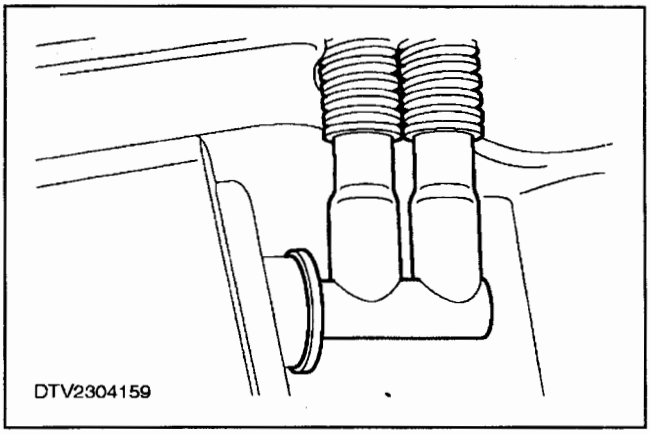


6. Partially lower the evaporative emission canister and carrier assembly.



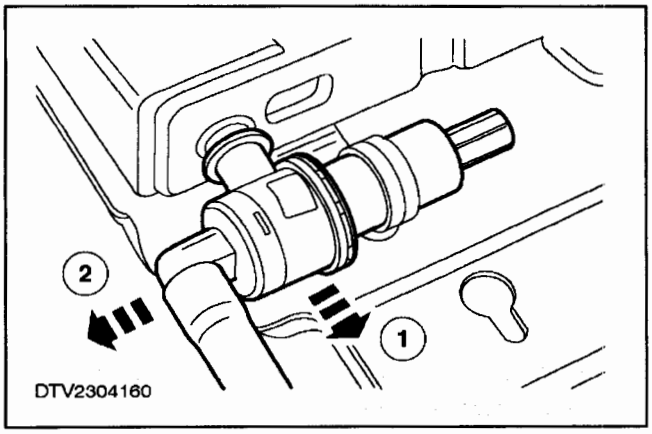
7. Disconnect the evaporative emission canister vent solenoid electrical connector.

REMOVAL AND INSTALLATION (Continued)

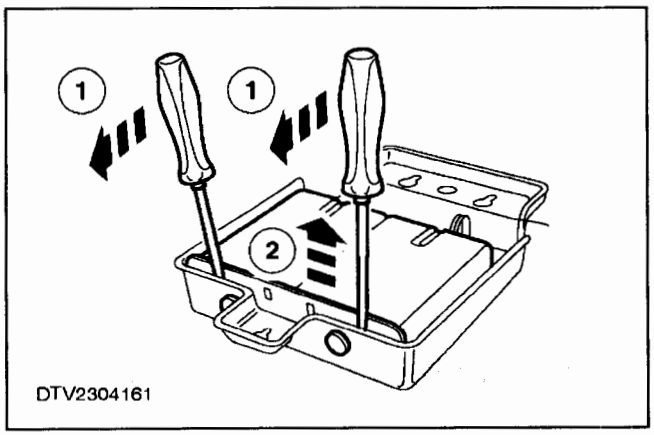


8. Disconnect the vapor tube connector from the evaporative emission canister.

9. Remove the evaporative emission canister and carrier assembly.



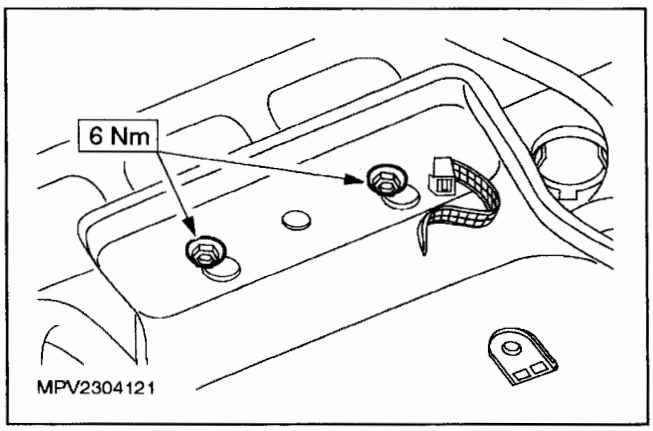
10. Remove the evaporative emission canister vent solenoid.
    1 Disconnect the solenoid from the canister.
    2 Remove the solenoid.

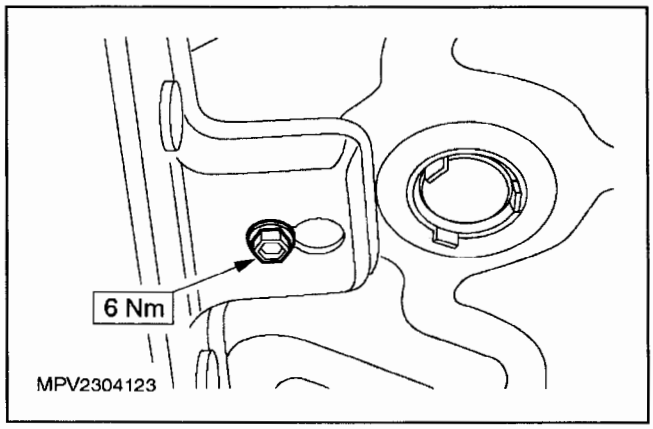


11. Remove the evaporative emission canister.
    1 Remove the carrier away from the canister.
    2 Remove the canister.

REMOVALANDINSTALLATION (Continued)

Installation





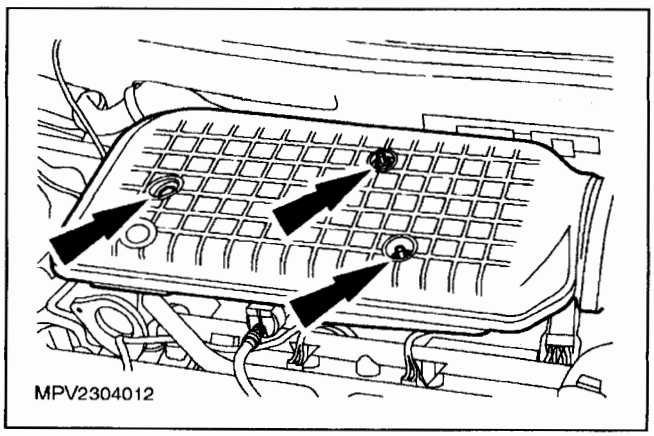
1. To install, reverse the removal procedure.

Evaporative Emission Canister Purge Valve

Removal

Vehicles with 2.0L engine

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12A.



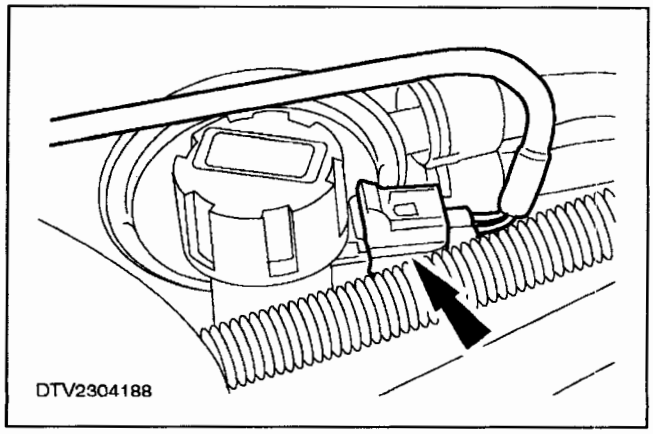
2. Remove the intake air resonator.

REMOVAL AND INSTALLATION (Continued)

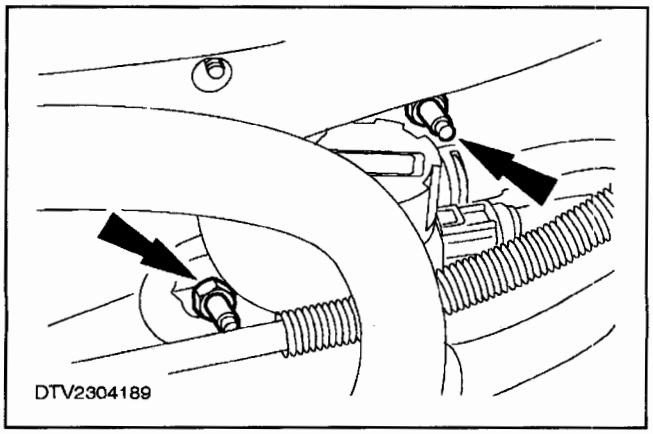
Vehicles with 2.5L engine

3. Remove the ignition coil. For additional information, refer to Section 303-07B.

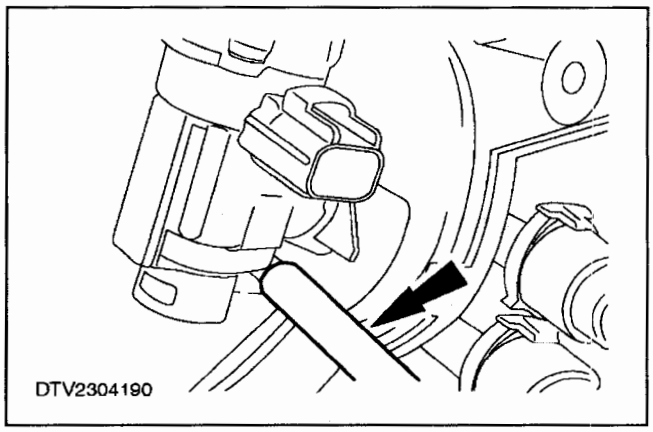
All vehicles



4. Disconnect the vapor management valve electrical connector.

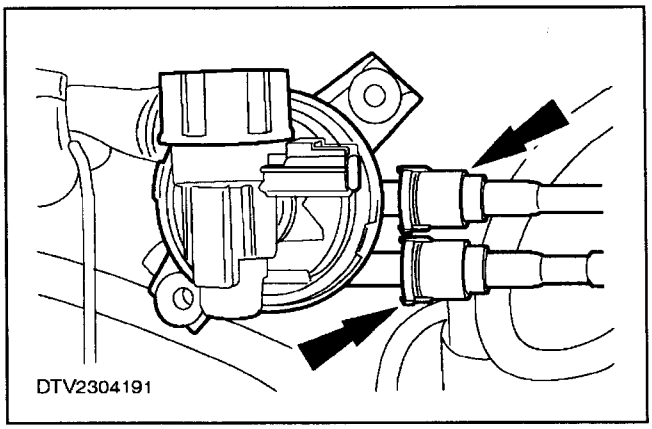


5. Remove the vapor management valve nuts.



6. Disconnect the vacuum hose from the vapor management valve.

REMOVAL AND INSTALLATION (Continued)



7. Disconnect the vapor tubes and remove the vapor management valve.

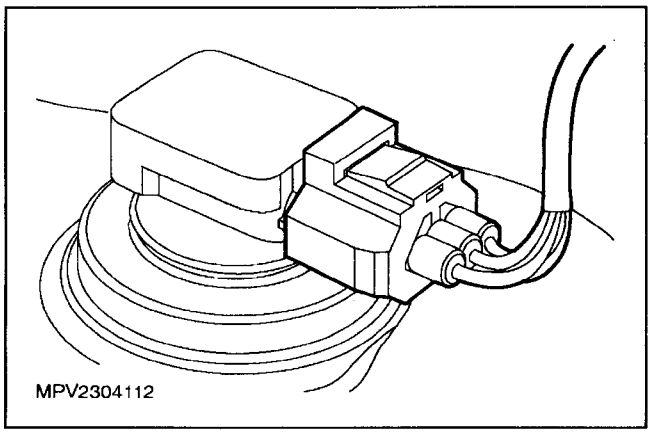
Installation

1. To install, reverse the removal procedure.

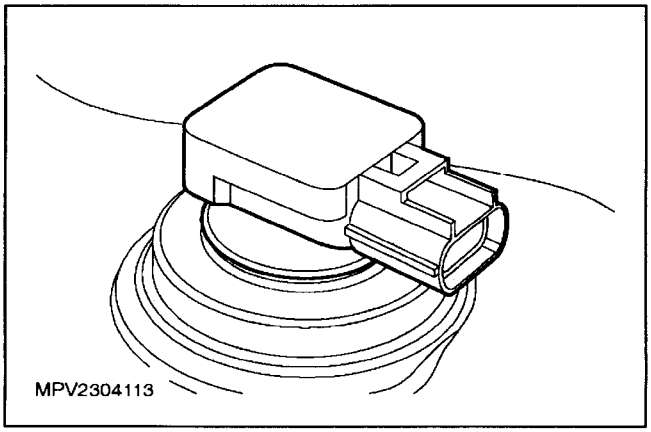
Fuel Tank Pressure Sensor

Removal

1. Remove the fuel tank. For additional information, refer to Section 310-01.



2. Disconnect the fuel tank pressure sensor electrical connector.



3. Remove the fuel tank pressure sensor.

REMOVAL AND INSTALLATION (Continued)

Installation

1. To install, reverse the removal procedure.

SECTION 303-14A Electronic Engine Controls — 2.0L Zetec

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Intake Air Temperature (IAT) Sensor 303-14A-13
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SPECIFICATIONS

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Camshaft position (CMP) sensor bolt	8	—	71
Throttle position sensor bolts	3	—	27
Idle air control (IAC) valve bolts	10	—	89
Engine coolant temperature (ECT) sensor	18	13	—
Heated oxygen sensor (HO2S)	60	44	—

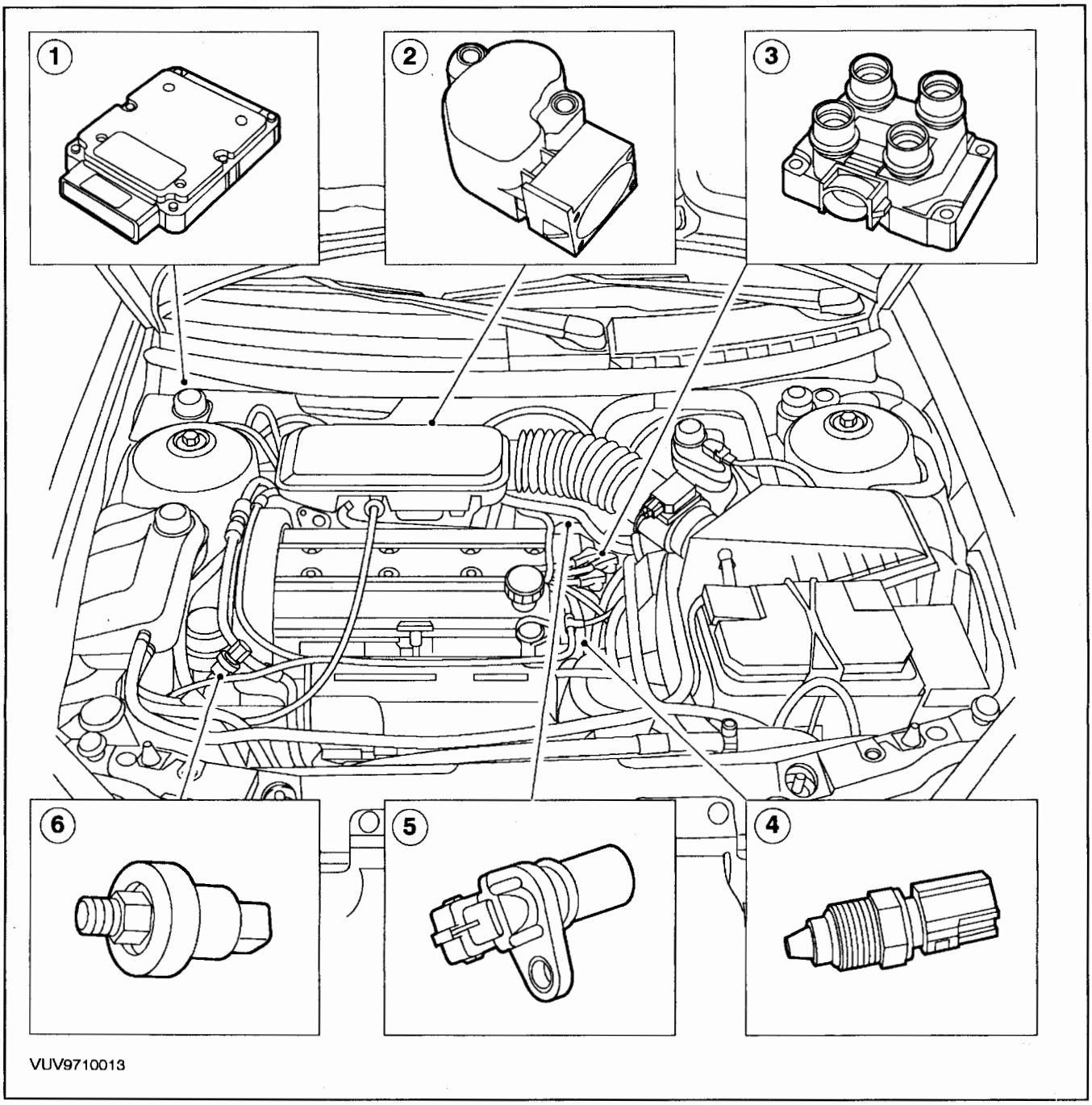
(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Crankshaft position (CKP) sensor bolt	7.5	—	62
Powertrain control module (PCM) electrical connector bolt	4	—	35
PCM bracket nut	4	—	35
Knock sensor (KS) bolt	20	15	—
Power steering pressure (PSP) switch	10	—	89

DESCRIPTION AND OPERATION

Electronic Engine Controls

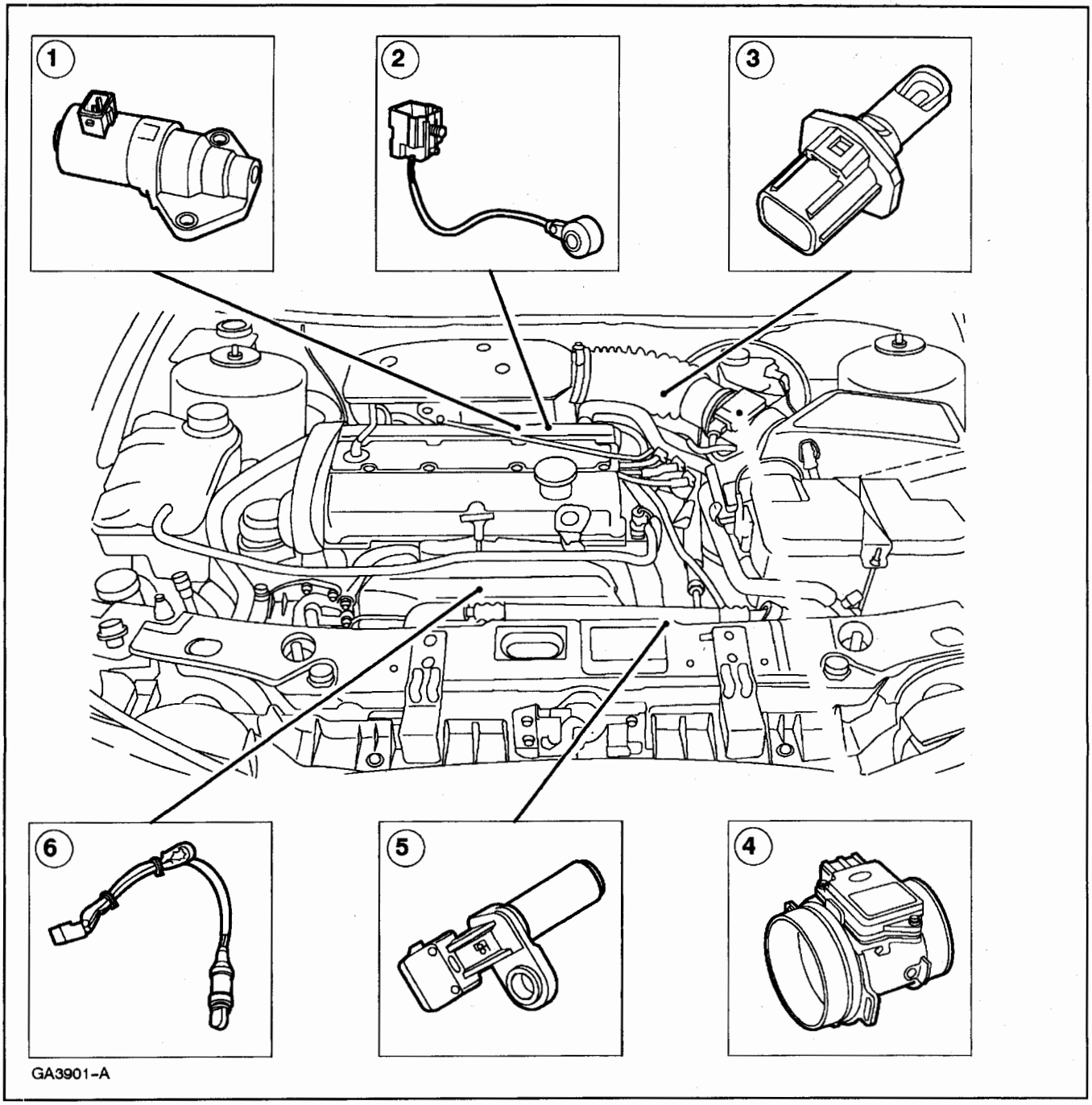


Item	Part Number	Description
1	—	Powertrain control module
2	—	Throttle position sensor
3	—	Ignition coil

(Continued)

Item	Part Number	Description
4	—	Engine coolant temperature sensor
5	—	Camshaft position sensor
6	—	Power steering pressure switch

DESCRIPTION AND OPERATION (Continued)



GA3901-A

Item	Part Number	Description
1	—	Intake air control valve
2	—	Knock sensor
3	—	Intake air temperature sensor

Item	Part Number	Description
4	—	Mass air flow sensor
5	—	Crankshaft position sensor
6	—	Heated oxygen sensor

(Continued)

Comprehensive descriptions of operation are contained in the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

1 Can be purchased as a separate item.

DIAGNOSIS AND TESTING

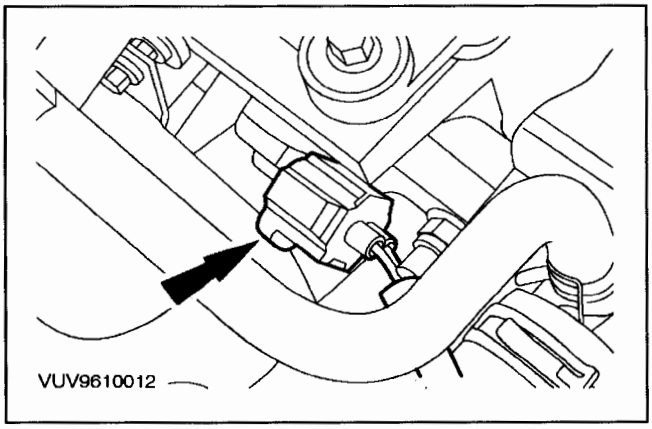
Electronic Engine Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [2].

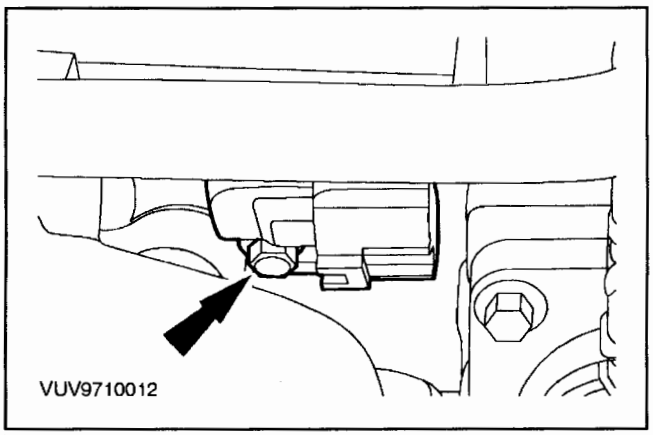
REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor

Removal



1. Disconnect the camshaft position sensor (CMP) electrical connector.

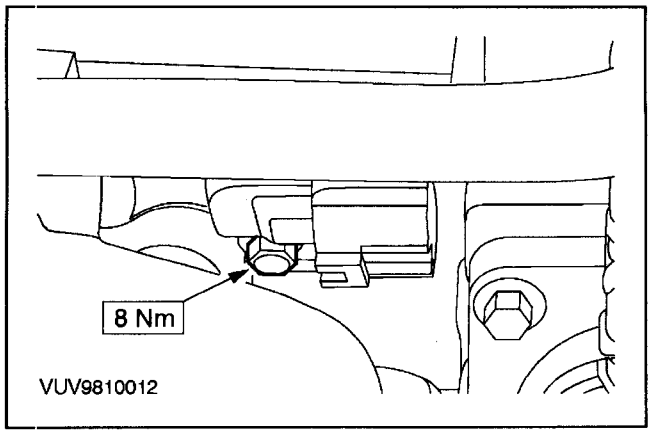


2. Remove the CMP.

2 Can be purchased as a separate item.

REMOVAL AND INSTALLATION (Continued)

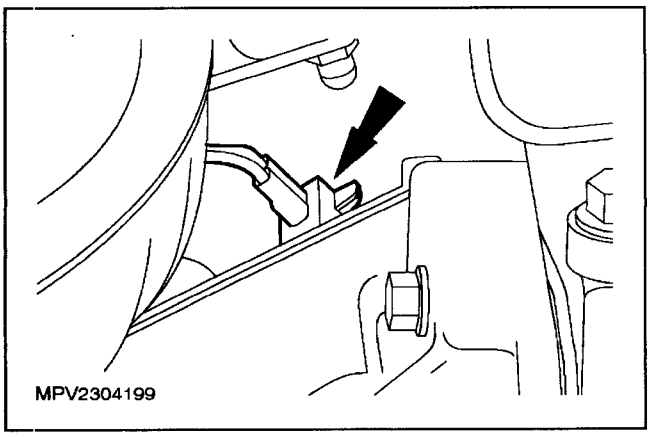
Installation



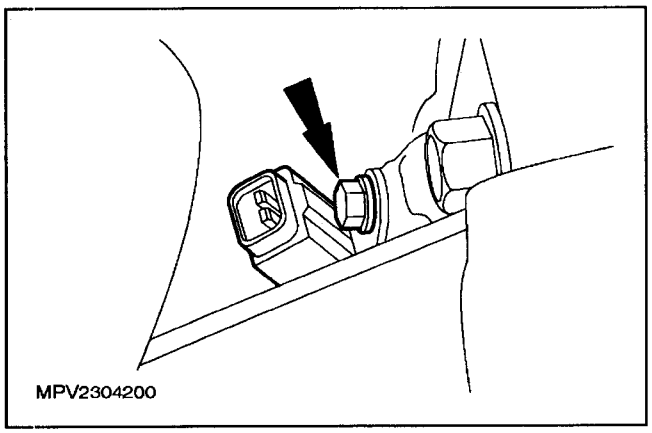
1. To install, reverse the removal procedure.

Crankshaft Position (CKP) Sensor

Removal



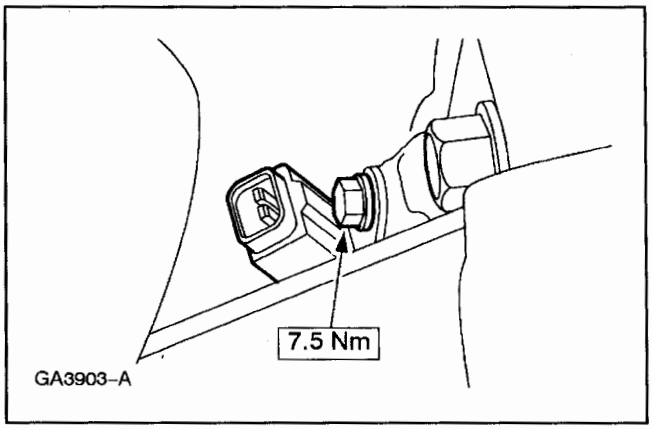
1. Disconnect the crankshaft position (CKP) sensor electrical connector.



2. Remove the CKP.

REMOVAL AND INSTALLATION (Continued)

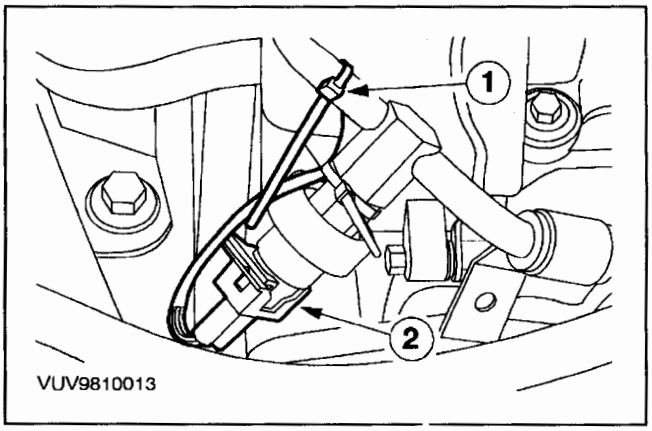
Installation



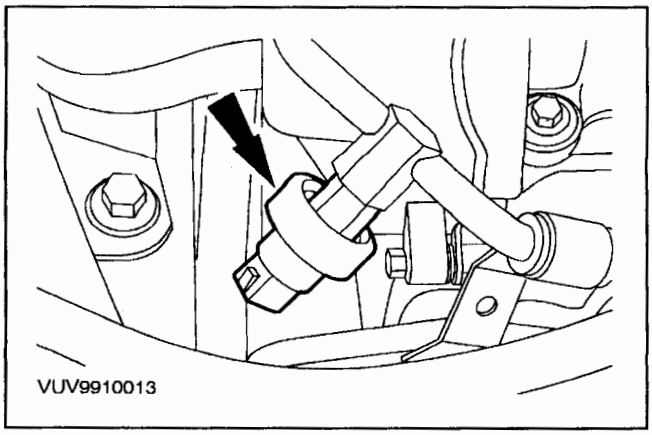
1. To install, reverse the removal procedure.

Power Steering Pressure (PSP) Switch

Removal



1. Disconnect the power steering pressure (PSP) switch electrical connector.
   1 Cut the ties.
   2 Disconnect the electrical connector.

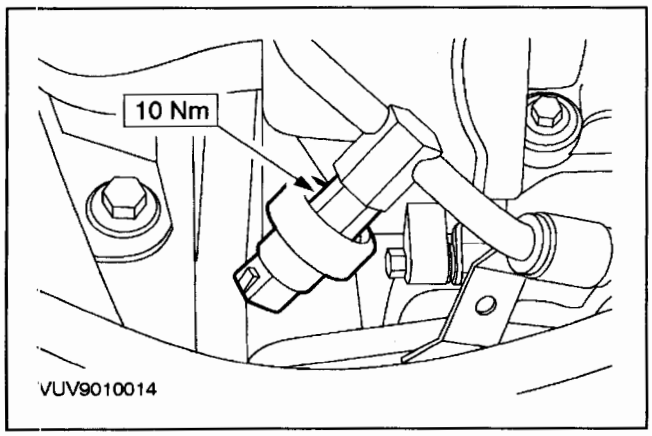


2. **NOTE:** When removing the power steering pressure switch catch any displaced fluid in a suitable container.

   Remove the PSP switch.

REMOVAL AND INSTALLATION (Continued)

Installation

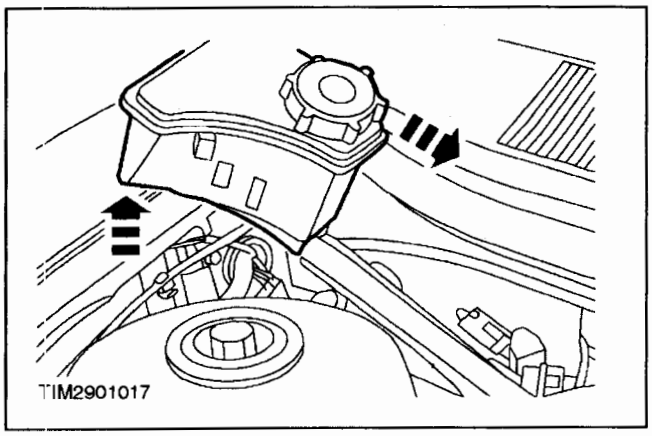


1. **NOTE:** Bleed the power steering system. For additional information, refer to Section 211-00.
   To install, reverse the removal procedure.

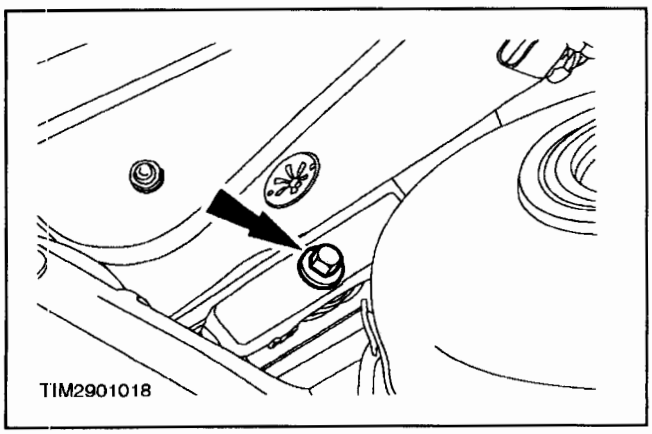
Powertrain Control Module (PCM)

Removal

1. Disconnect the battery ground cable.

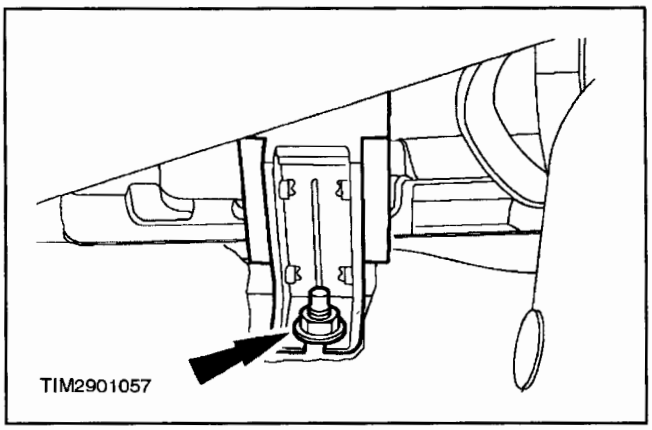


2. Position the power assisted steering fluid reservoir to one side.



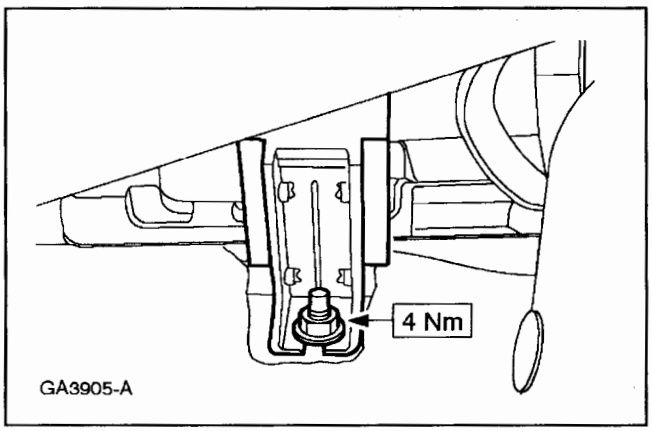
3. Remove the powertrain control module (PCM) electrical connector bolt.

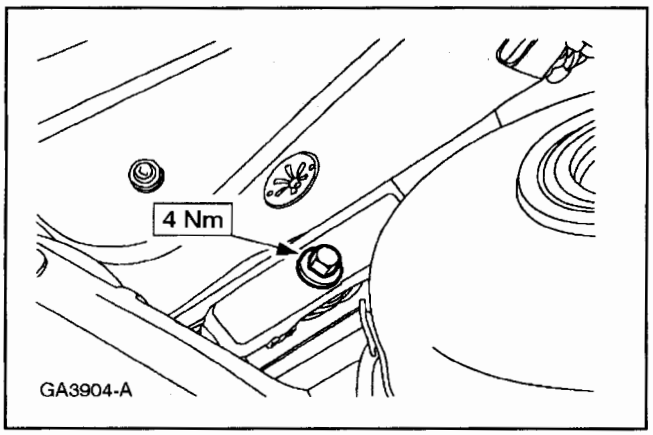
REMOVAL AND INSTALLATION (Continued)



4. Remove the PCM.

Installation





1. **CAUTION: Make sure that the electrical connector locates correctly in the powertrain control module. Do not force or overtighten the electrical connector.**

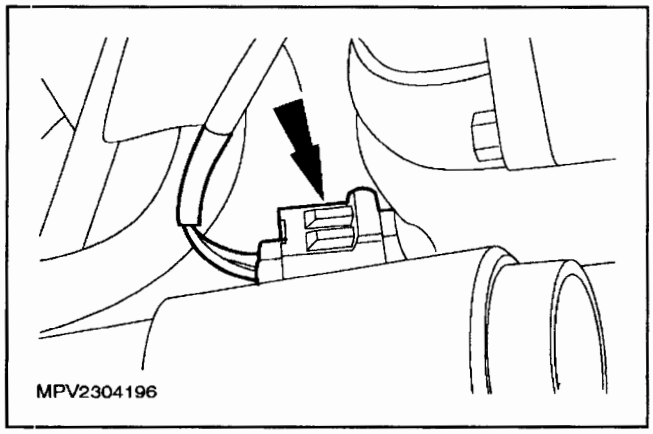
   To install, reverse the removal procedure.

Idle Air Control (IAC) Valve

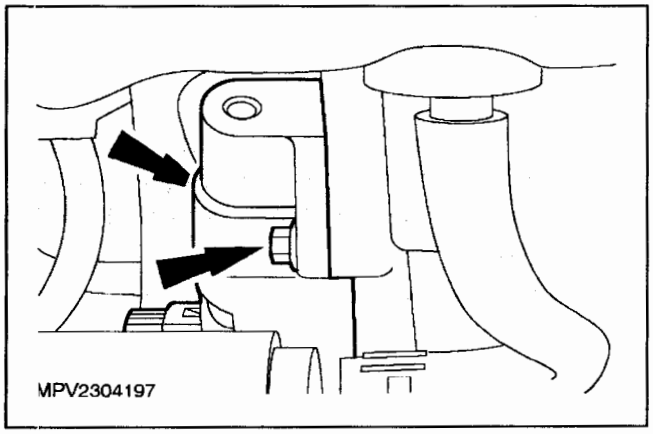
Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02.

REMOVAL AND INSTALLATION (Continued)

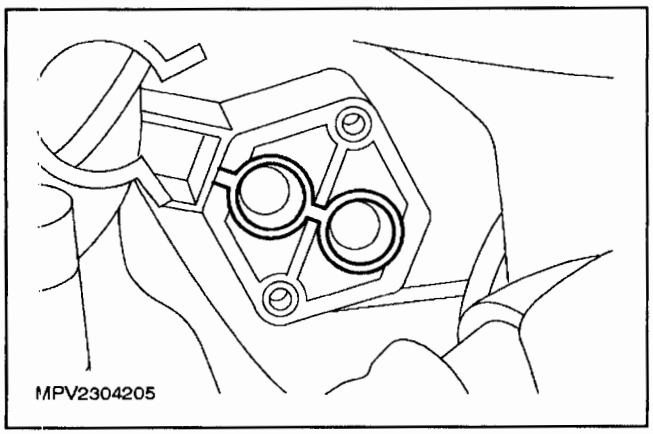


2. Disconnect the idle air control valve (IAC) electrical connector.



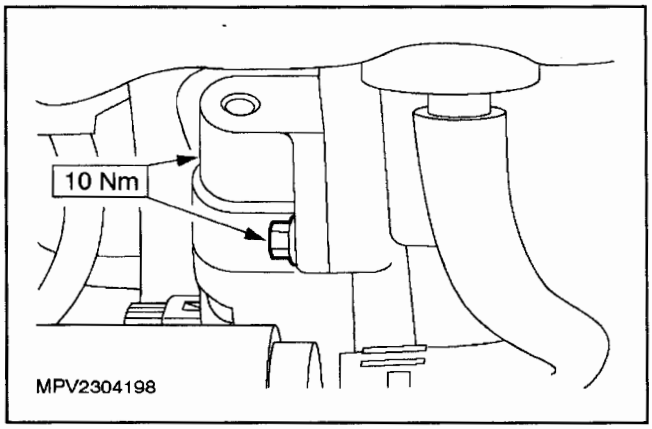
3. Remove the IAC valve.
   - Discard the IAC valve gasket.

Installation



1. To install, reverse the removal procedure.
   - Install a new IAC valve gasket.

REMOVAL AND INSTALLATION (Continued)

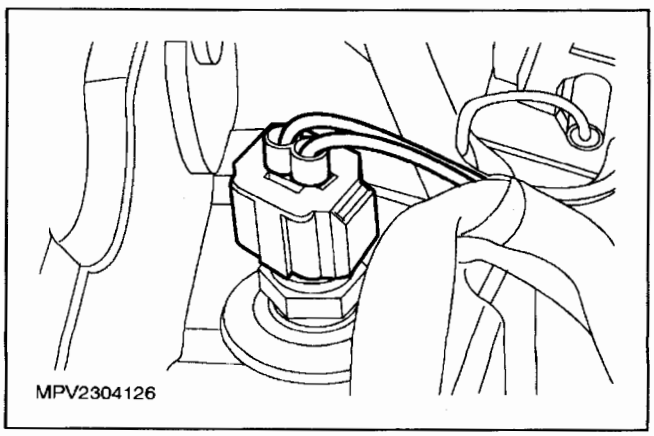


Engine Coolant Temperature (ECT) Sensor

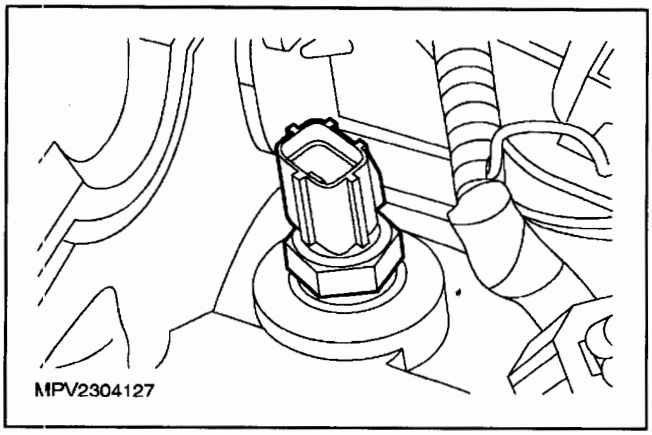
Removal

⚠ **WARNING: When relieving cooling system pressure, cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow these instructions may result in personal injury.**

1. Turn the expansion cap counterclockwise a quarter turn to relieve the cooling system pressure.
2. Retighten the expansion tank cap.
3. Disconnect the engine coolant temperature (ECT) sensor electrical connector.

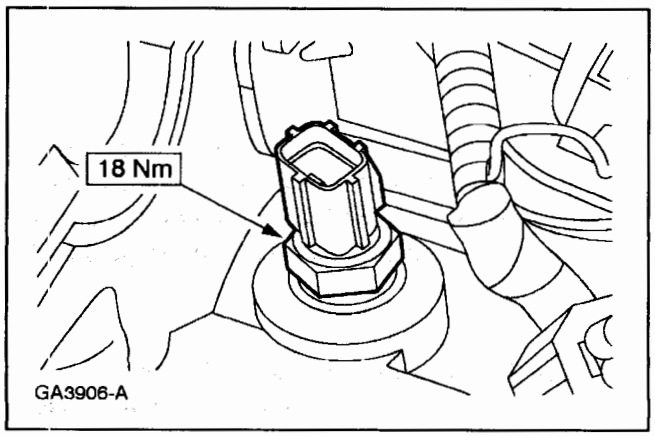


REMOVAL AND INSTALLATION (Continued)



4. Remove the ECT sensor.

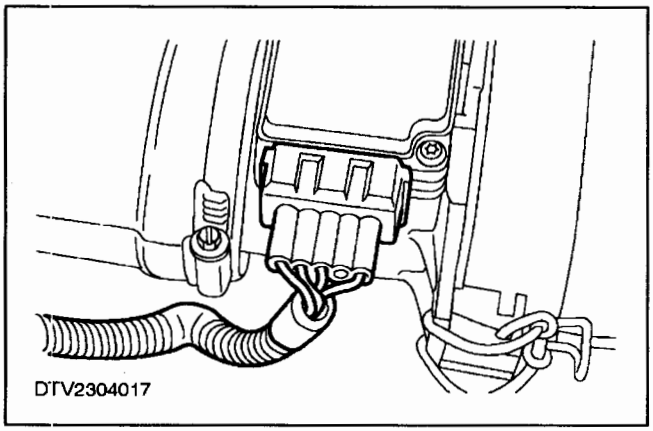
Installation



1. To install, reverse the removal procedure.
   - Fill up the cooling system, as required.

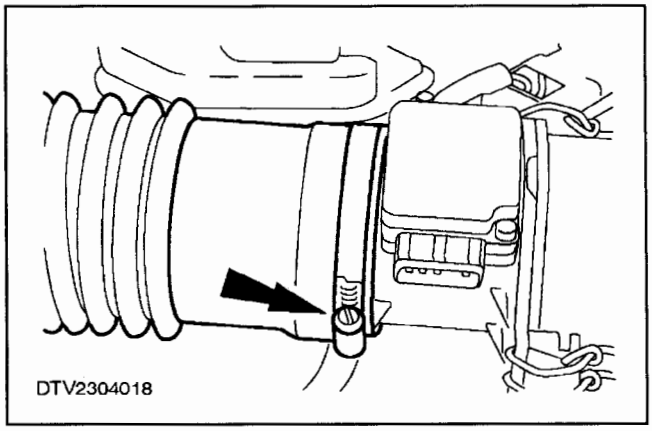
Mass Air Flow (MAF) Sensor

Removal

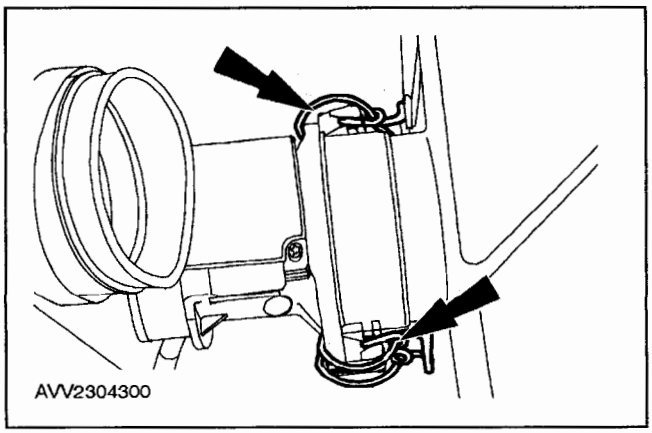


1. Disconnect the mass air flow (MAF) sensor electrical connector.

REMOVAL AND INSTALLATION (Continued)



2. Disconnect the air cleaner outlet tube from the MAF sensor.



3. Remove the MAF sensor.

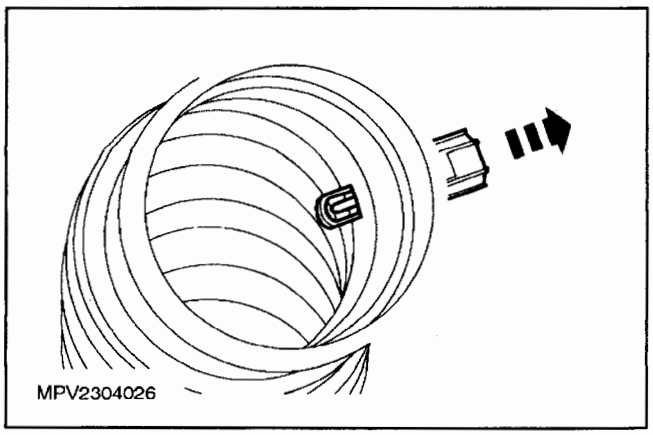
Installation

1. To install, reverse the removal procedure.

Intake Air Temperature (IAT) Sensor

Removal

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12A or Section 303-12B.



2. Remove the intake air temperature sensor.

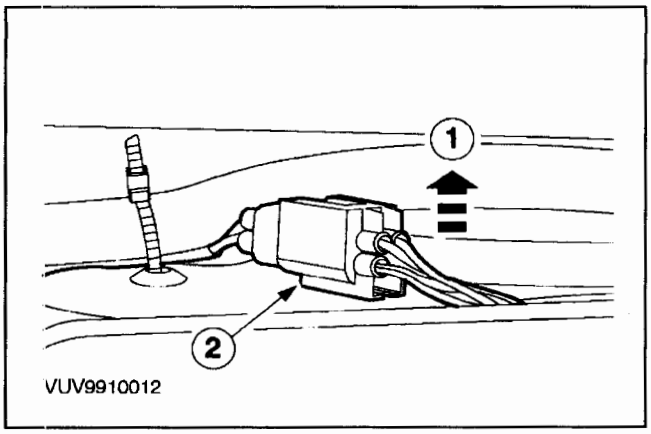
REMOVAL AND INSTALLATION (Continued)

Installation

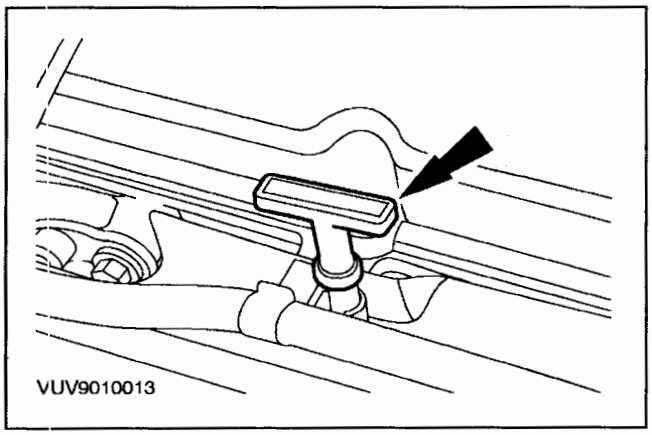
1. To install, reverse the removal procedure.

Heated Oxygen Sensor (HO2S)

Removal

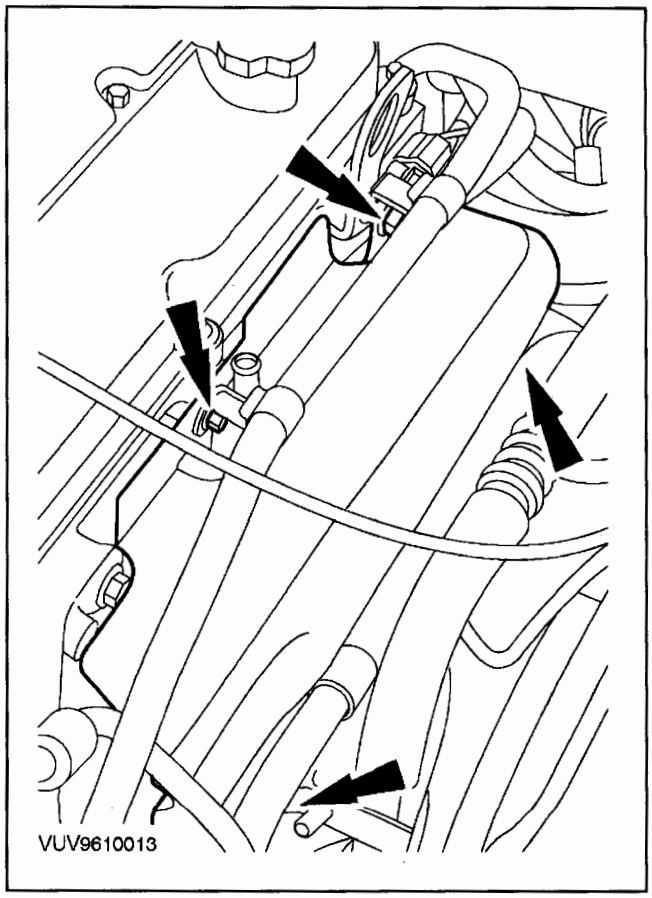


1. Disconnect the heated oxygen sensor (HO2S) electrical connector.
   1 Detach the electrical connector.
   2 Disconnect the electrical connector.

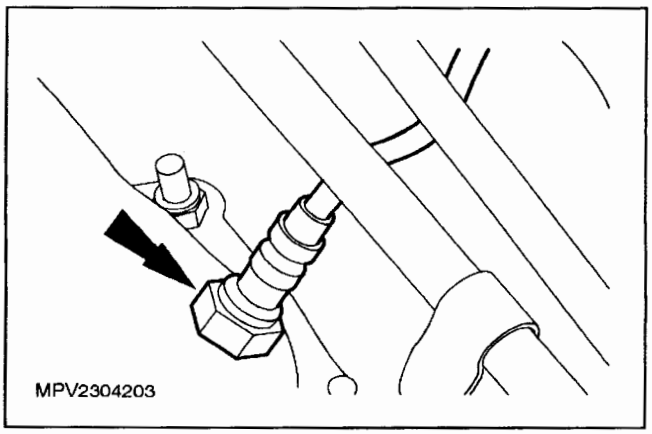


2. Remove the dipstick.

REMOVAL AND INSTALLATION (Continued)



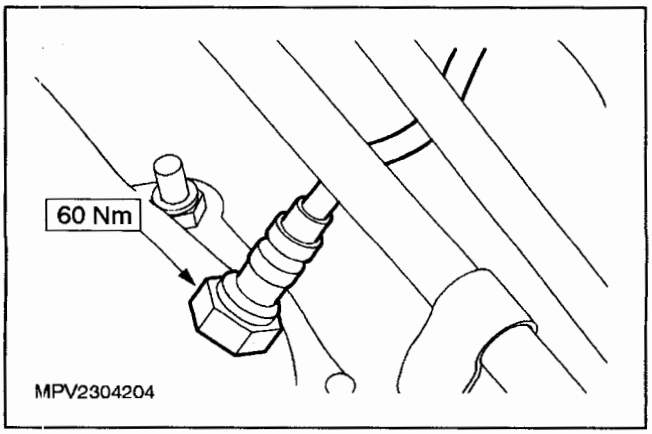
3. Remove the exhaust manifold heat shield.



4. Remove the HO2S.

REMOVAL AND INSTALLATION (Continued)

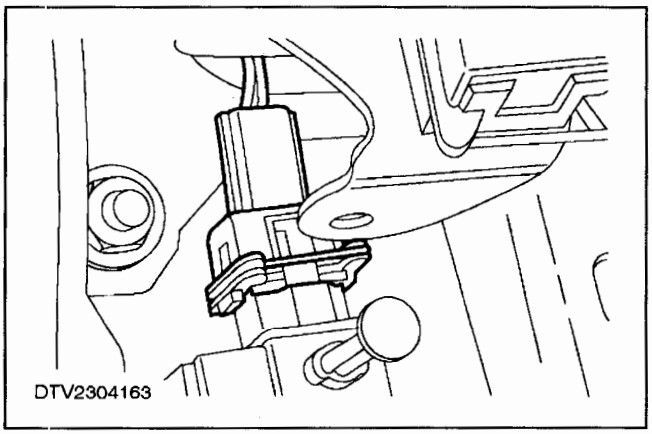
Installation



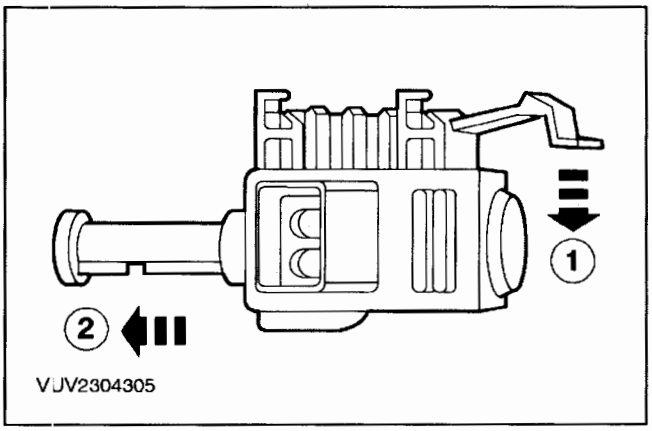
1. To install, reverse the removal procedure.

Clutch Pedal Position (CPP) Switch

Removal



1. Disconnect the clutch pedal position (CPP) switch electrical connector.



2. Remove the CPP switch (removed for clarity).
   1 Release the switch retaining clip.
   2 Remove the switch.

Installation

1. To install, reverse the removal procedure.

SECTION 303-14B Electronic Engine Controls — 2.5L

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Crankshaft Position (CKP) Sensor 303-14B-6
Power Steering Pressure (PSP) Switch 303-14B-7
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Intake Air Temperature (IAT) Sensor 303-14B-16
Heated Oxygen Sensor (HO2S) LH 303-14B-17
Heated Oxygen Sensor (HO2S) RH 303-14B-18
Catalyst Monitor Sensor — LH 303-14B-20
Catalyst Monitor Sensor — RH 303-14B-21
Knock Sensor (KS) 303-14B-23
Clutch Pedal Position (CPP) Switch 303-14B-24
Fuel Pressure Sensor 303-14B-24

SPECIFICATIONS

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Camshaft position (CMP) sensor	10	—	89
Crankshaft position (CKP) sensor	7	—	62
Power steering pressure (PSP) switch	10	—	89
Fuel pressure sensor	3	—	27
Idle air control (IAC) valve bolts	10	—	89

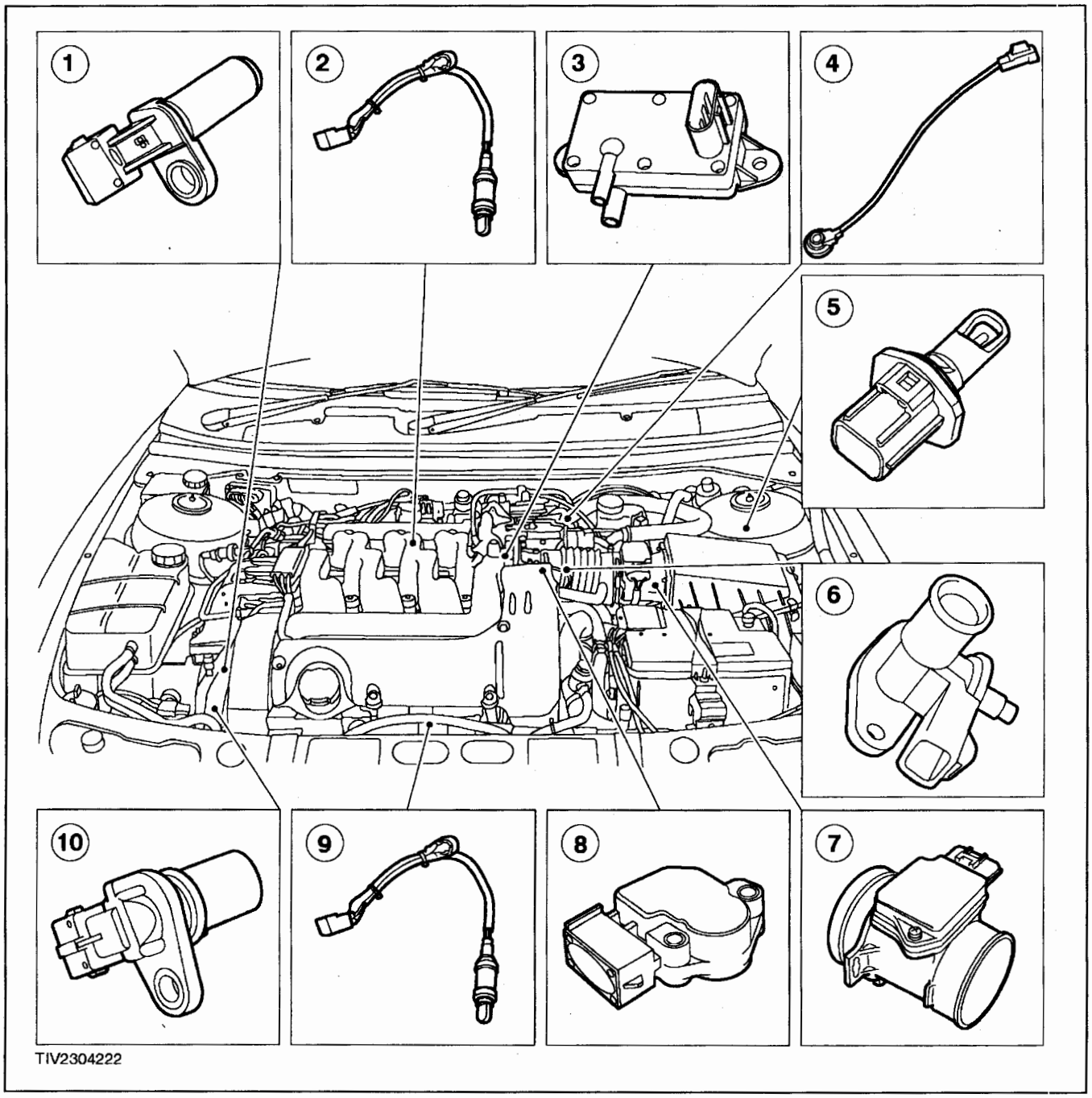
(Continued)

Torque Specifications

Description	Nm	Lb-Ft	Lb-In
Engine coolant temperature (ECT) sensor	23	17	—
Heated oxygen sensors (HO2S)	42	31	—
Catalyst monitor sensors	42	31	—
Powertrain control module (PCM) electrical connector bolt	4	—	35
Knock sensor (KS)	25	18	—

DESCRIPTION AND OPERATION

Electronic Engine Controls



Item	Part Number	Description
1	—	Crankshaft position sensor
2	—	Heated oxygen/catalyst monitor sensors, rear bank
3	—	Differential pressure feedback exhaust gas recirculation sensor

(Continued)

Item	Part Number	Description
4	—	Knock sensor
5	—	Intake air temperature sensor
6	—	Fuel pressure sensor
7	—	Mass air flow sensor
8	—	Throttle position sensor

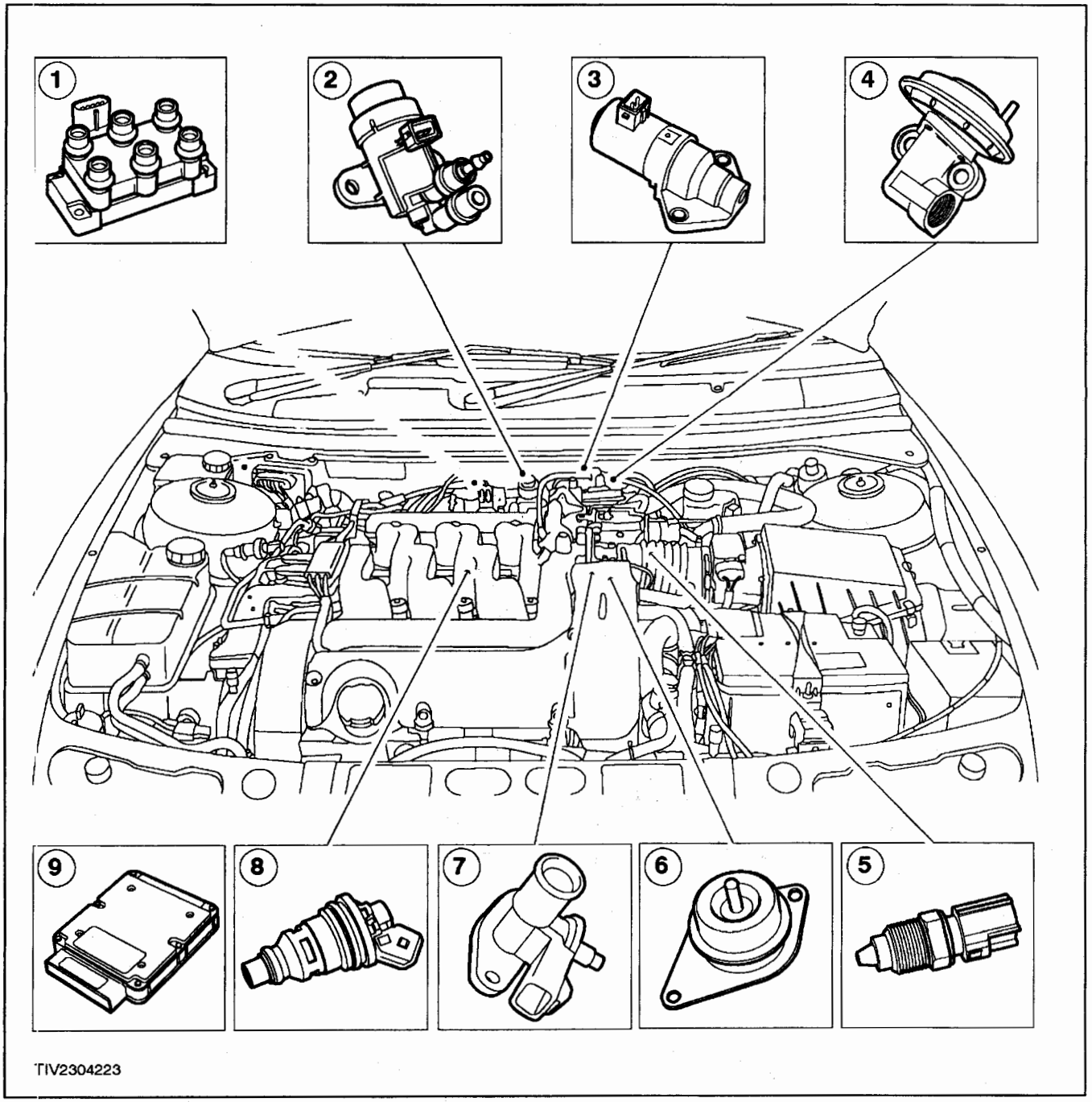
(Continued)

DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
9	—	Heated oxygen/catalyst monitor sensors, front bank

(Continued)

Item	Part Number	Description
10	—	Camshaft position sensor



Item	Part Number	Description
1	—	Ignition coil
2	—	Exhaust gas recirculation vacuum regulator valve
3	—	Idle air control valve

(Continued)

Item	Part Number	Description
4	—	Exhaust gas recirculation valve
5	—	Engine coolant temperature sensor
6	—	Fuel pressure regulator

(Continued)

DESCRIPTION AND OPERATION (Continued)

Item	Part Number	Description
7	—	Fuel pressure sensor
8	—	Fuel injector
9	—	Powertrain control module

(Continued)

DIAGNOSIS AND TESTING

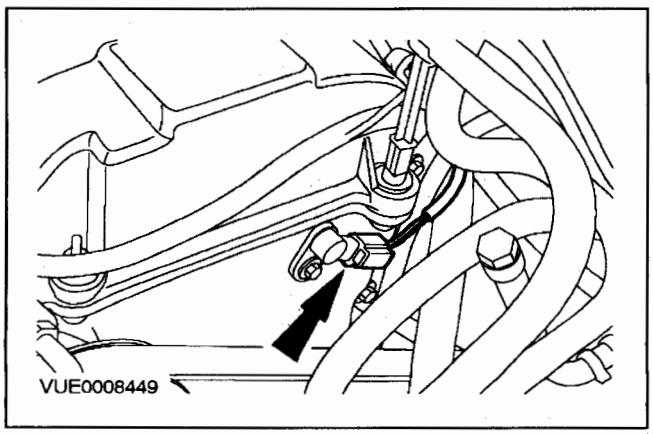
Electronic Engine Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [1].

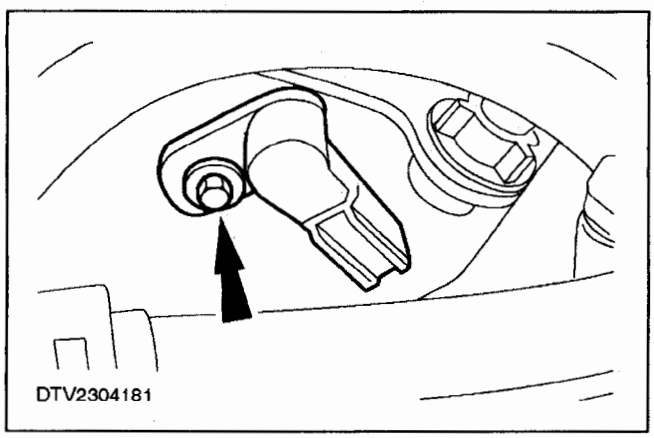
REMOVAL AND INSTALLATION

Camshaft Position (CMP) Sensor

Removal



1. Disconnect the camshaft position (CMP) sensor electrical connector.

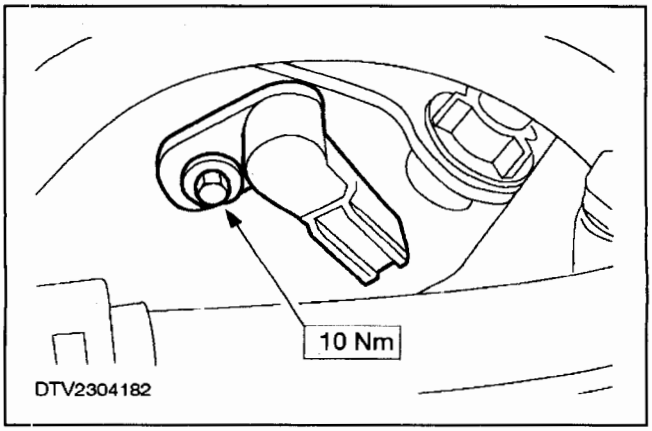


2. Remove the CMP sensor.

1 Can be purchased as a separate item.

REMOVAL AND INSTALLATION (Continued)

Installation

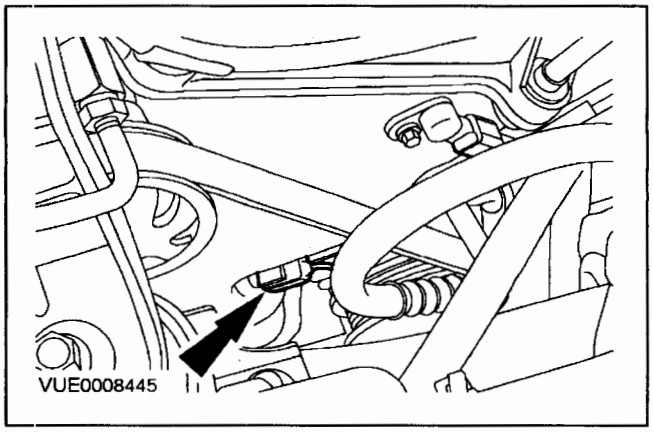


1. To install, reverse the removal procedure.

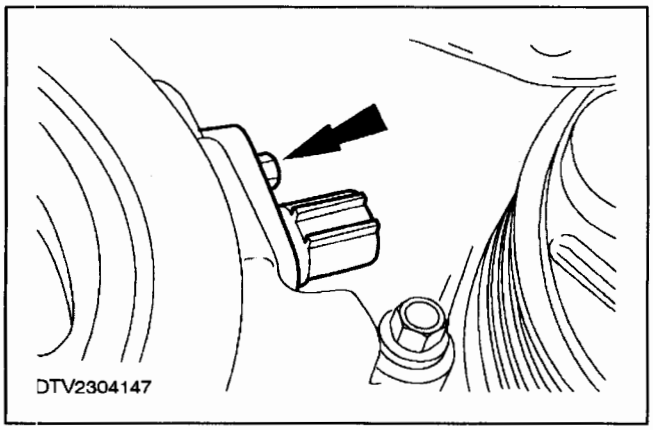
Crankshaft Position (CKP) Sensor

Removal

1. Remove the right-hand lower fender splash shield. For additional information, refer to Section 501-02.



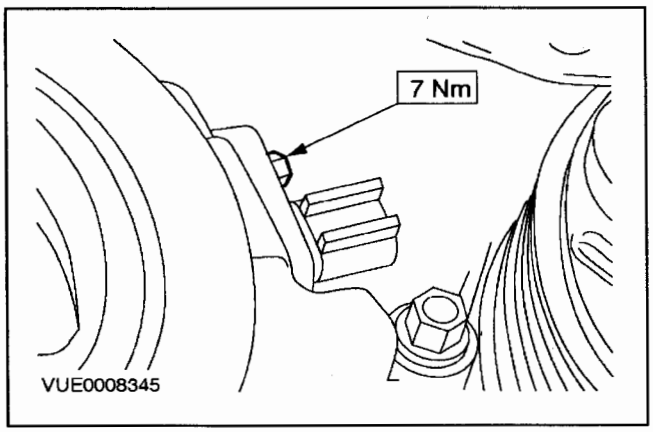
2. Disconnect the crankshaft position (CKP) sensor electrical connector.



3. Remove the CKP sensor.

REMOVALANDINSTALLATION (Continued)

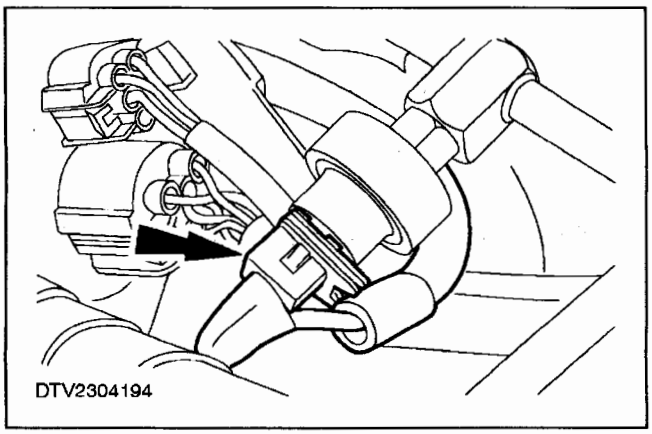
Installation



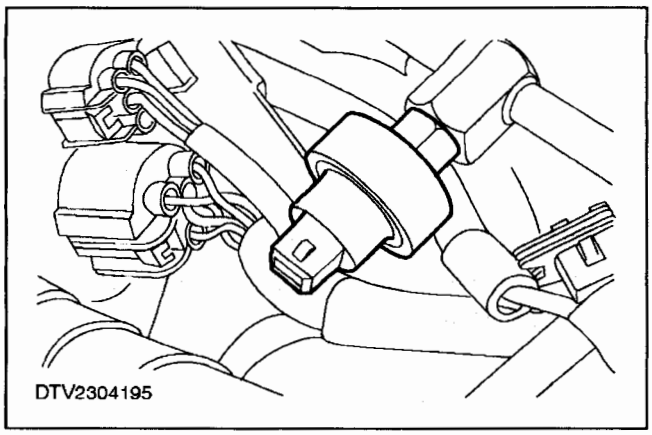
1. To install, reverse the removal procedure.

Power Steering Pressure (PSP) Switch

Removal



1. Disconnect the power steering pressure (PSP) switch electrical connector.

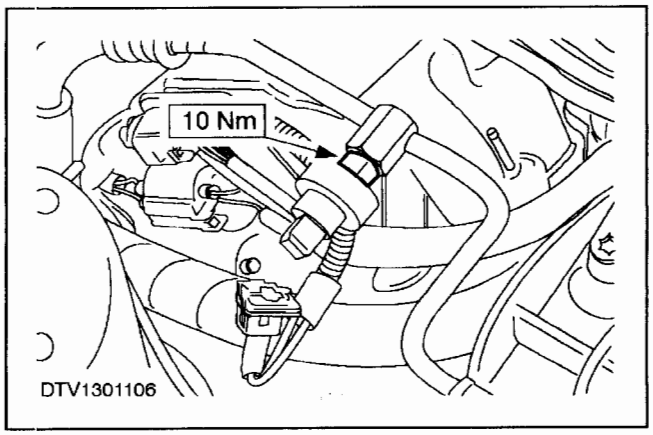


2. **NOTE:** Be prepared for some power steering fluid loss as the switch is removed. Place a small drain tray beneath the switch.

   Remove the PSP switch.

REMOVAL AND INSTALLATION (Continued)

Installation



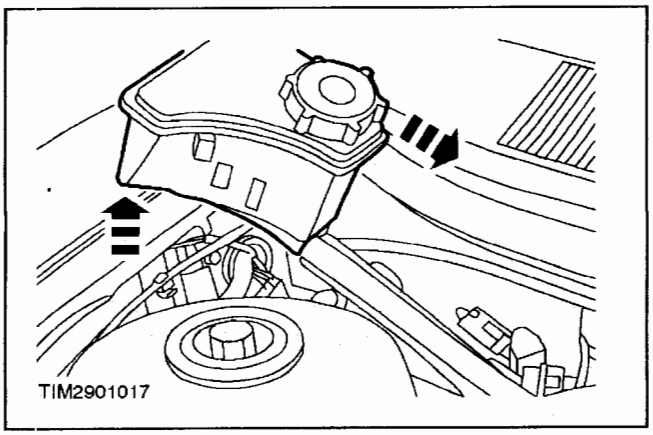
1. To install, reverse the removal procedure.

2. Bleed the power steering system. For additional information, refer to Section 211-00.

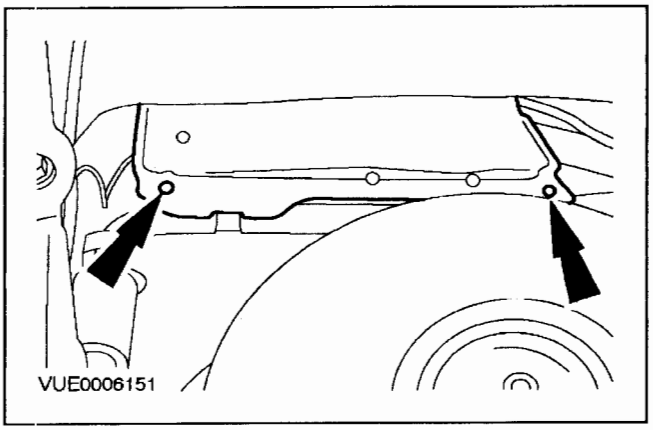
Powertrain Control Module (PCM)

Removal

1. Disconnect the battery ground cable.



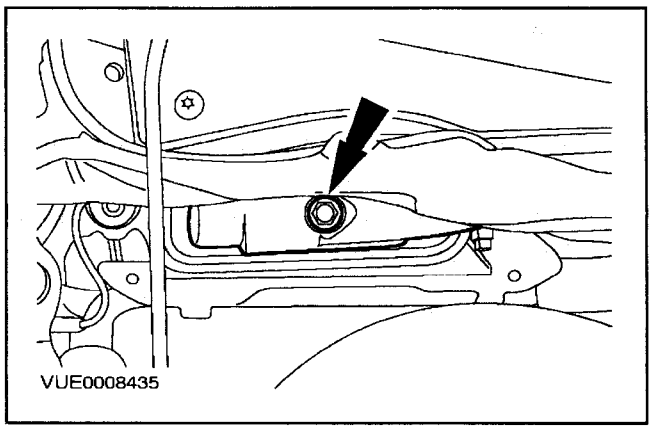
2. Position the power steering fluid reservoir to one side.



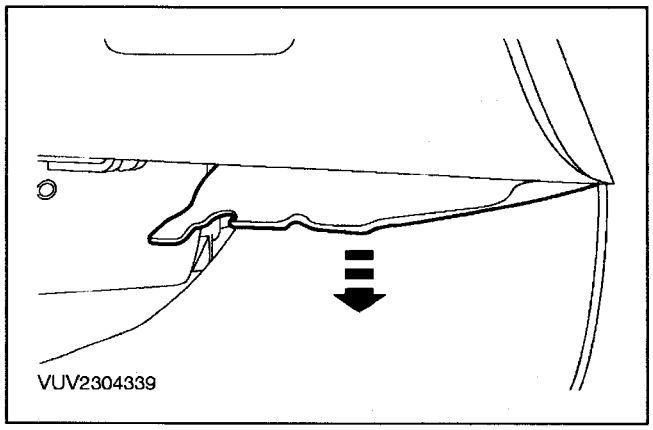
3. **NOTE:** Drill out the steel rivets.

   Remove the powertrain control module (PCM) security shield.

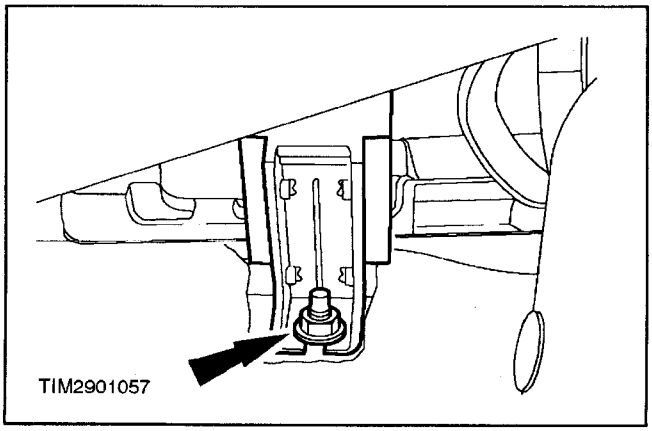
REMOVAL AND INSTALLATION (Continued)



4. Disconnect the PCM electrical connector.



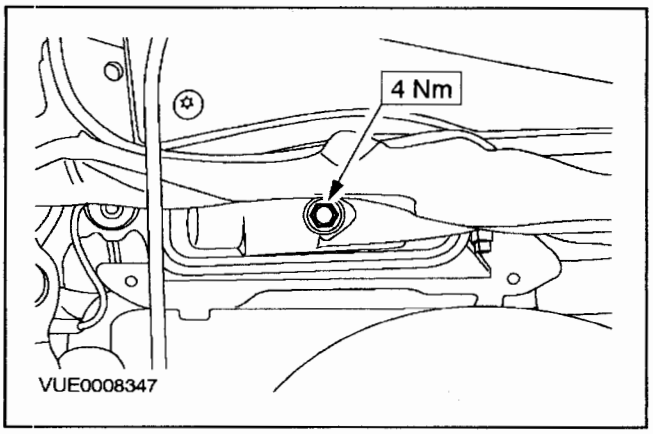
5. Remove the trim panel.



6. Remove the PCM.

REMOVAL AND INSTALLATION (Continued)

Installation

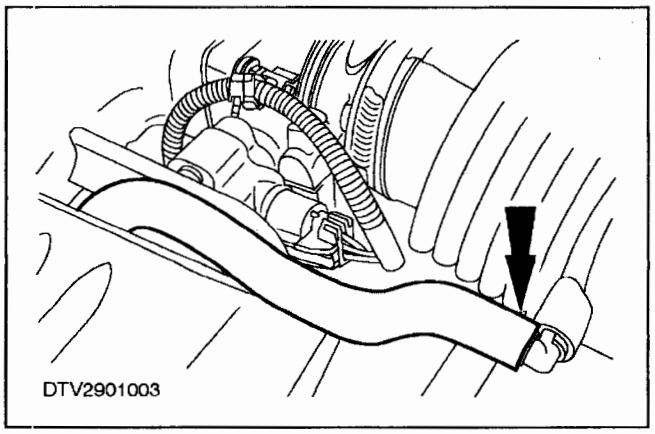


1. ⚠ **CAUTION: Make sure that the electrical connector locates correctly in the powertrain control module. Do not force or overtighten the electrical connector.**

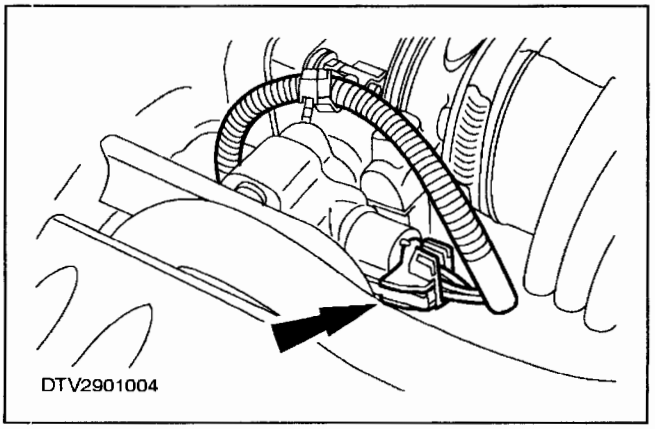
   To install, reverse the removal procedure.

Throttle Position (TP) Sensor

Removal

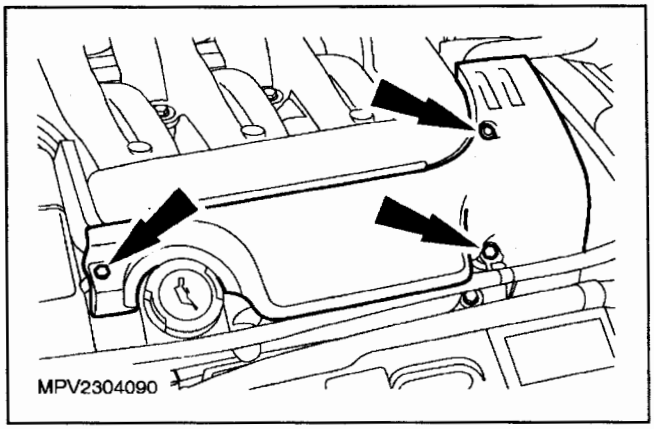


1. Disconnect the positive crankcase ventilation (PCV) hose from the air cleaner outlet tube.

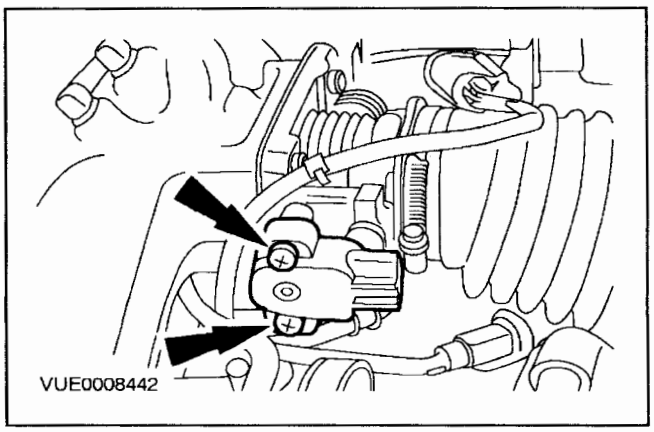


2. Disconnect the throttle position (TP) sensor electrical connector.

REMOVAL AND INSTALLATION (Continued)



3. Remove the engine cover.



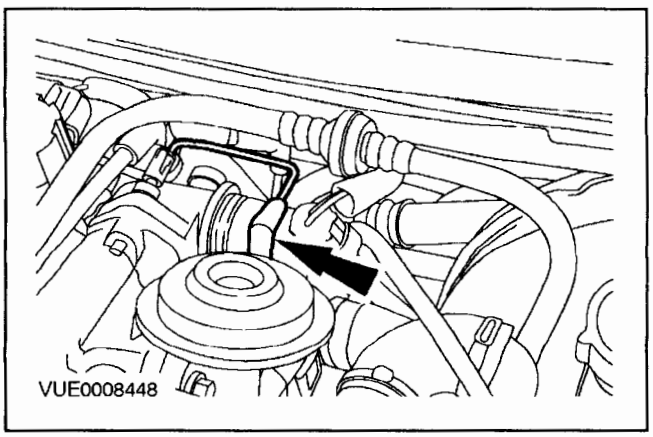
4. Remove the TP sensor.

Installation

1. To install, reverse the removal procedure.

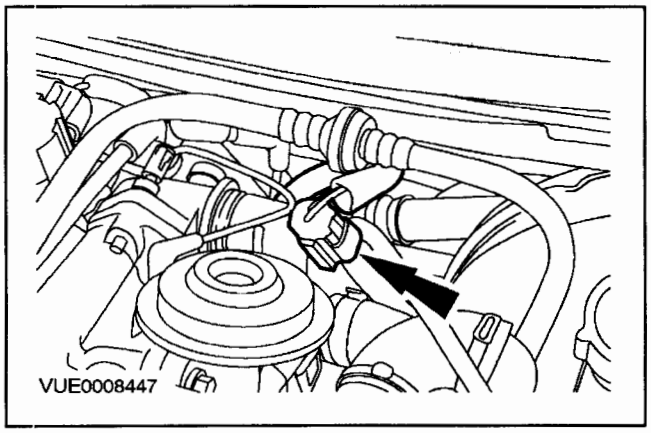
Idle Air Control (IAC) Valve

Removal

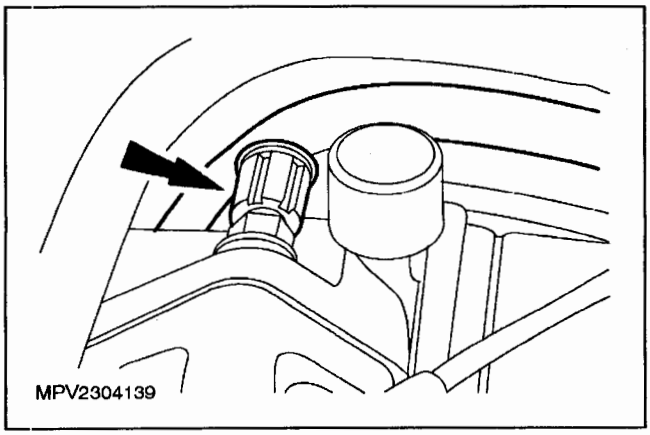


1. Disconnect the vacuum line from the exhaust gas recirculation valve.

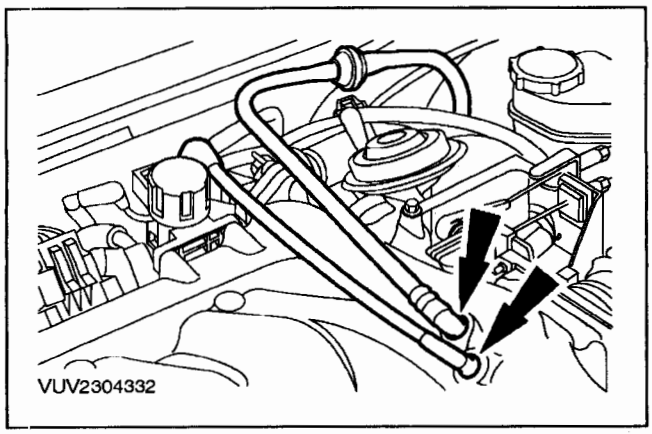
REMOVAL AND INSTALLATION (Continued)



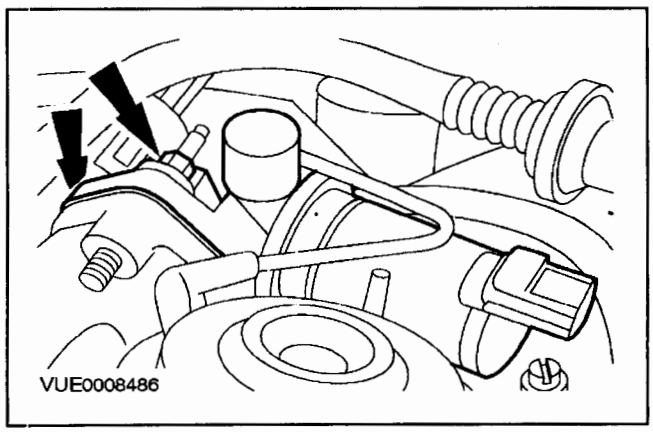
2. Disconnect the idle air control (IAC) valve electrical connector.



3. Detach the wiring harness from the IAC valve stud.

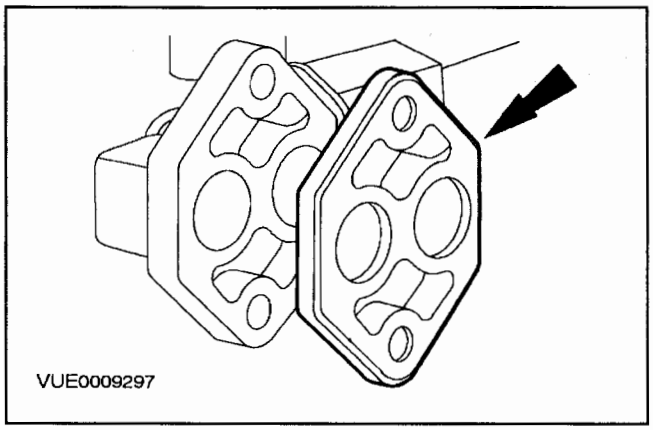


4. Disconnect the vacuum supply lines from the upper intake manifold.



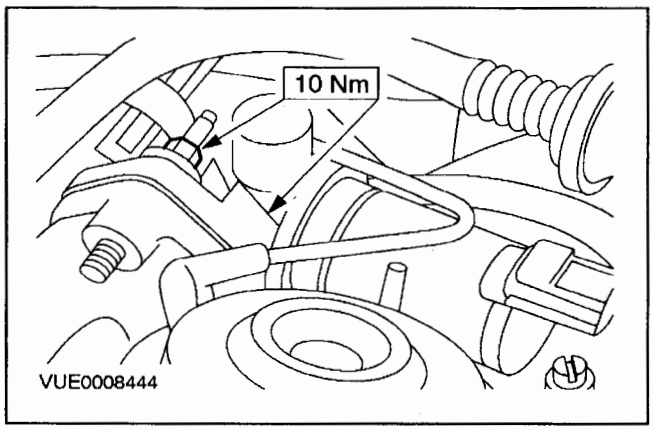
5. Remove the IAC valve.

REMOVALANDINSTALLATION (Continued)



6. Remove and discard the IAC valve gasket.

Installation

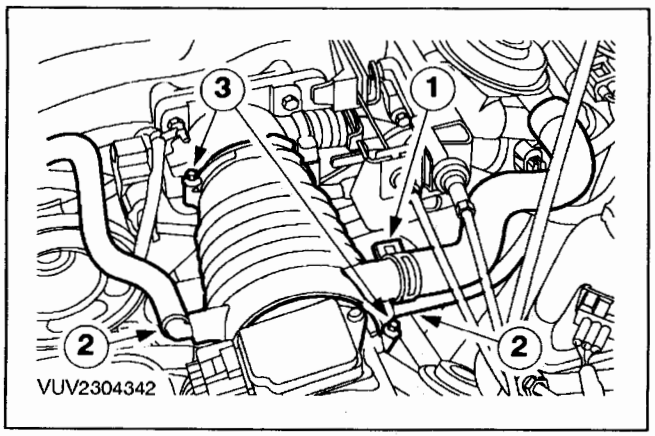


1. **NOTE:** Install a new IAC valve gasket.
   To install, reverse the removal procedure.

Engine Coolant Temperature (ECT) Sensor

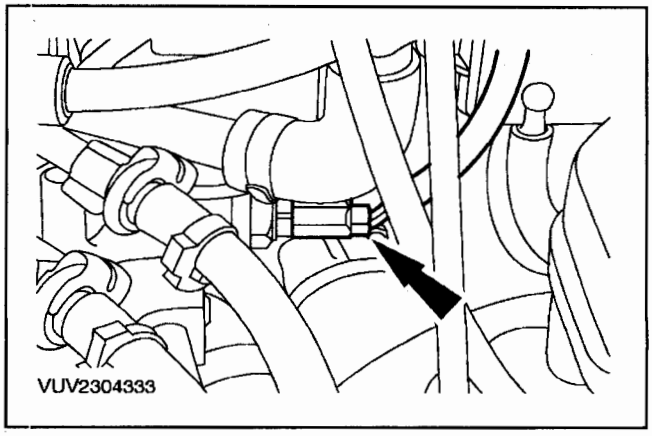
Removal

1. Drain the cooling system. For additional information, refer to Section 303-03.

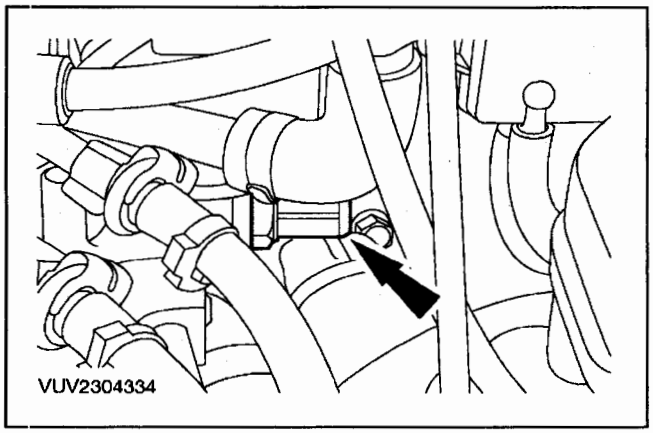


2. Remove the air cleaner outlet tube.
   1 Disconnect the intake air bypass hose.
   2 Disconnect the positive crankcase ventilation hose.
   3 Remove the air cleaner outlet tube.

REMOVAL AND INSTALLATION (Continued)

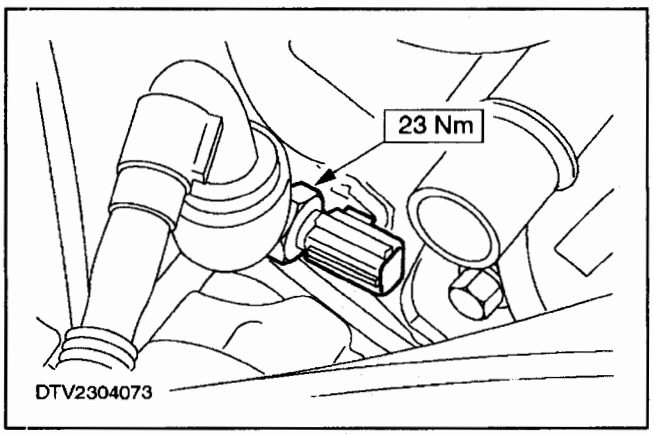


3. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



4. Remove the ECT sensor.

Installation



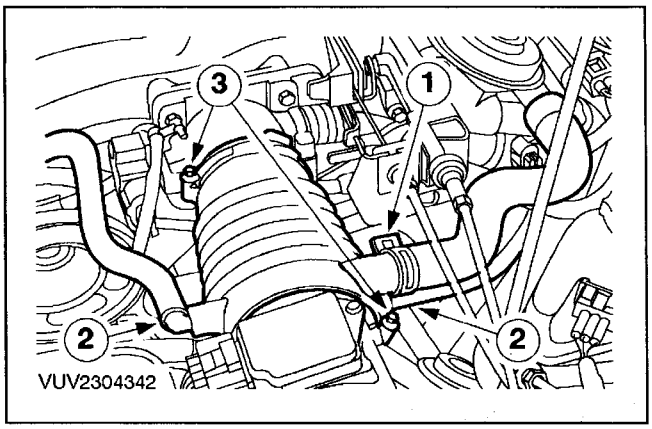
1. To install, reverse the removal procedure.

2. Fill the cooling system, as required. For additional information, refer to Section 303-03.

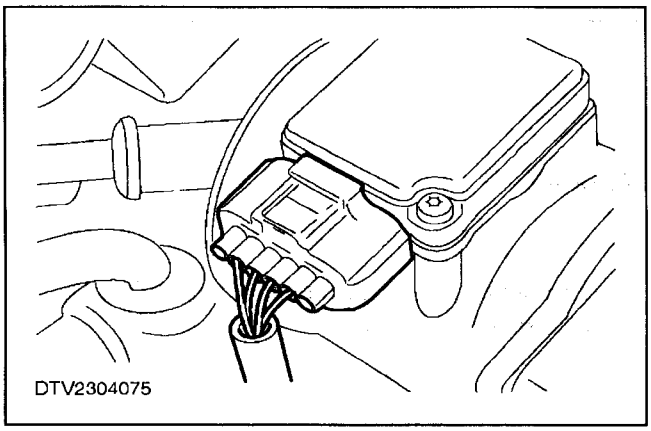
REMOVAL AND INSTALLATION (Continued)

Mass Air Flow (MAF) Sensor

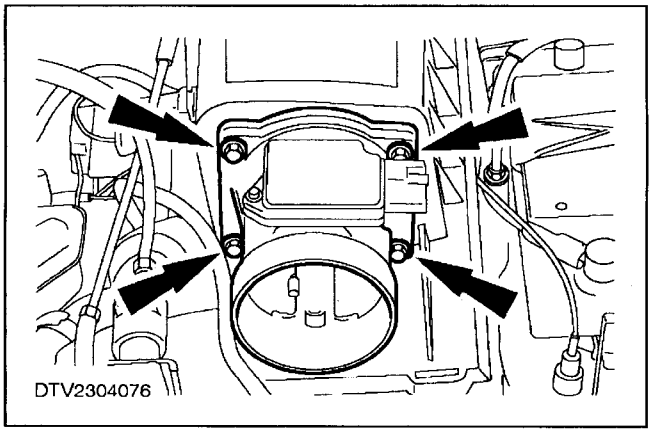
Removal



1. Remove the air cleaner outlet tube.
   1 Disconnect the intake air bypass tube.
   2 Disconnect the positive crankcase ventilation hose.
   3 Remove the air cleaner outlet tube.



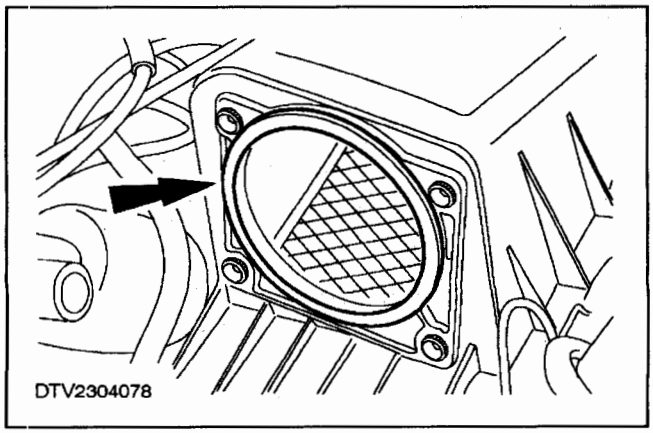
2. Disconnect the mass air flow sensor electrical connector.



3. Remove the mass air flow sensor.
   - Discard the mass air flow sensor gasket.

REMOVAL AND INSTALLATION (Continued)

Installation

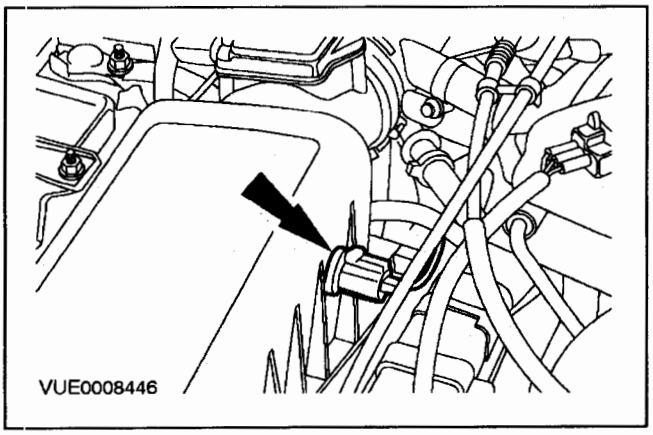


1. Install a new mass air flow sensor gasket.

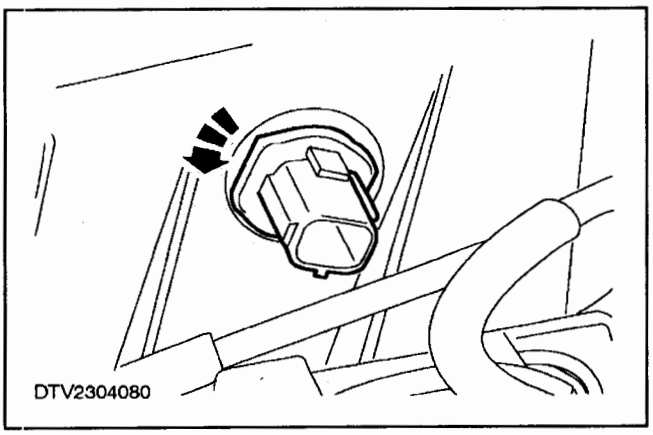
2. To install, reverse the removal procedure.

Intake Air Temperature (IAT) Sensor

Removal



1. Disconnect the intake air temperature (IAT) sensor electrical connector.



2. Remove the IAT sensor.

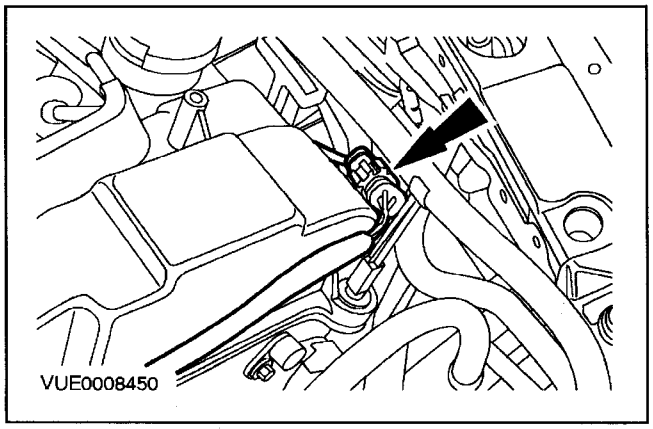
REMOVAL AND INSTALLATION (Continued)

Installation

1. To install, reverse the removal procedure.

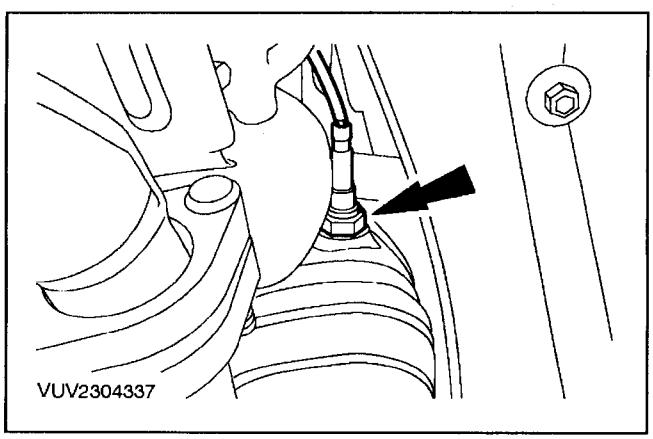
Heated Oxygen Sensor (HO2S) LH

Removal



1. Disconnect the heated oxygen sensor (HO2S) electrical connector.

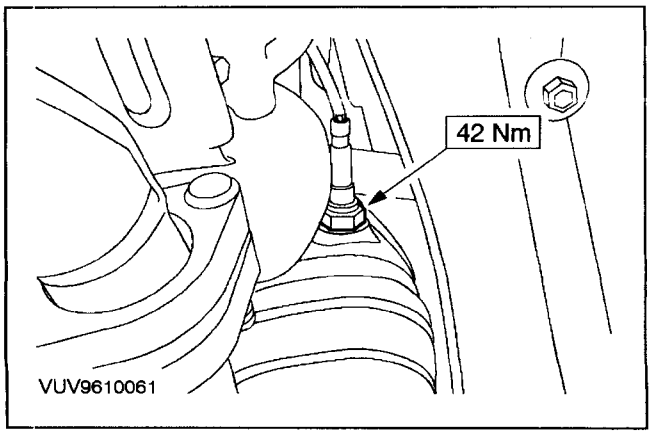
2. Raise and support the vehicle. For additional information, refer to Section 100-02.



3. Remove the HO2S.

REMOVAL AND INSTALLATION (Continued)

Installation

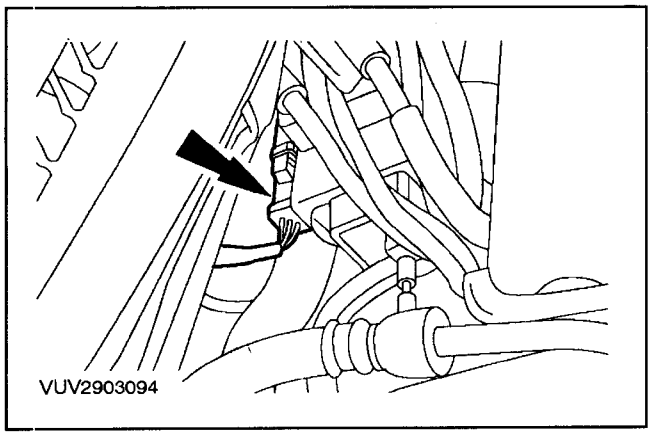


1. To install, reverse the removal procedure.

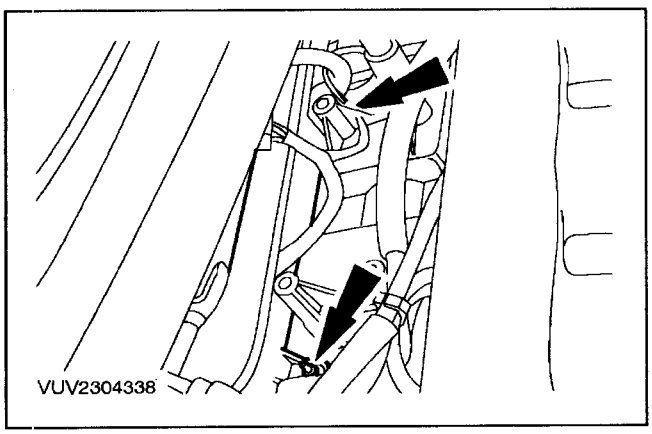
Heated Oxygen Sensor (HO2S) RH

Removal

1. Remove the ignition coil. For additional information, refer to Section 303-07B.

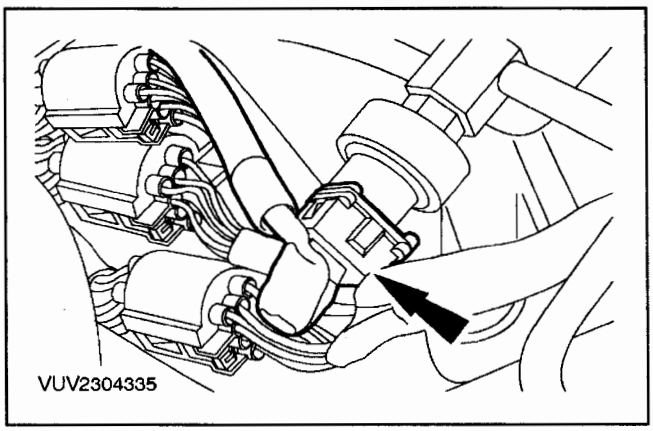


2. Disconnect the right-hand heated oxygen sensor (HO2S) electrical connector.

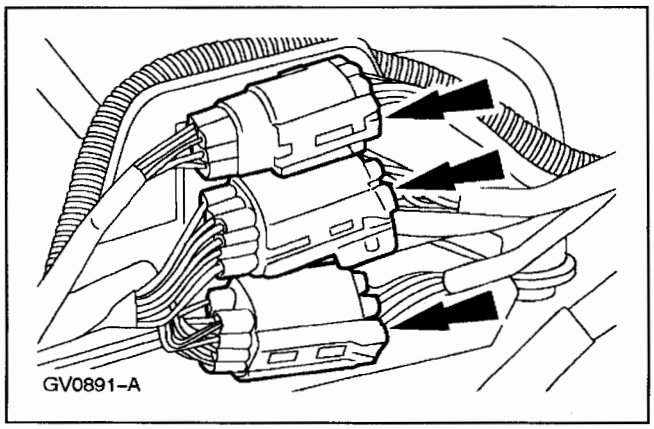


3. Detach the wiring harness.

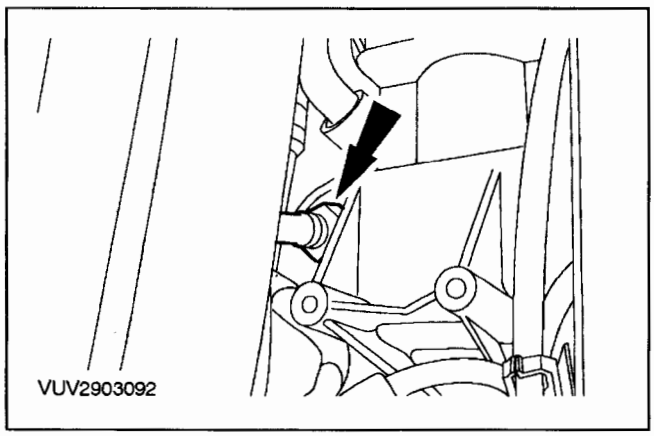
REMOVAL AND INSTALLATION (Continued)



4. Disconnect the power steering pressure switch electrical connector.



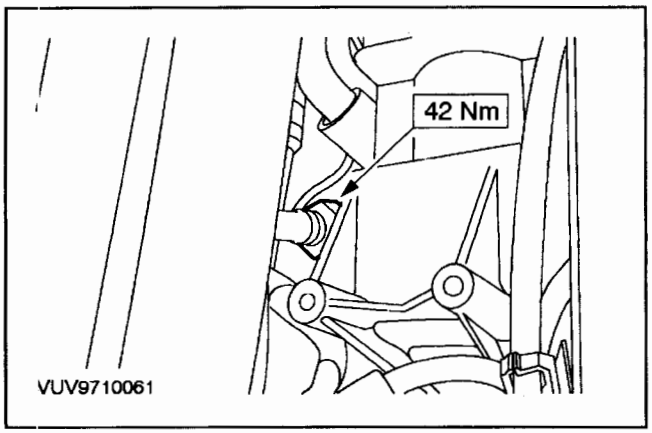
5. Disconnect the fuel injector wiring harness main in-line electrical connectors.



6. Remove the HO2S.

REMOVAL AND INSTALLATION (Continued)

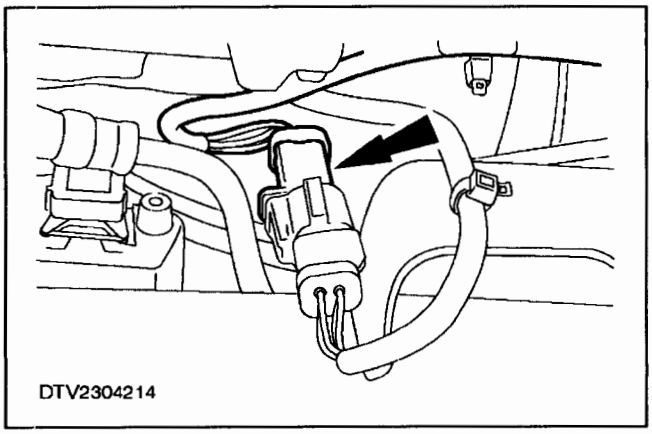
Installation



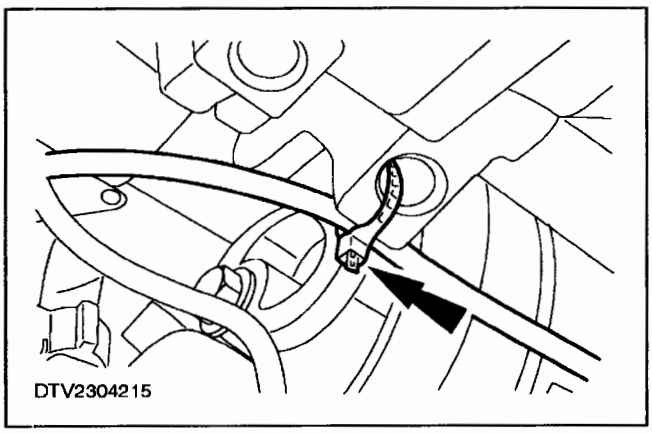
1. To install, reverse the removal procedure.

Catalyst Monitor Sensor — LH

Removal

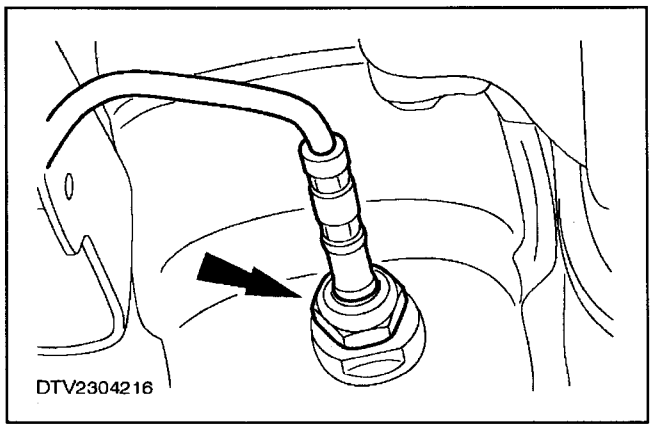


1. Disconnect the catalyst monitor sensor (CMS) electrical connector.



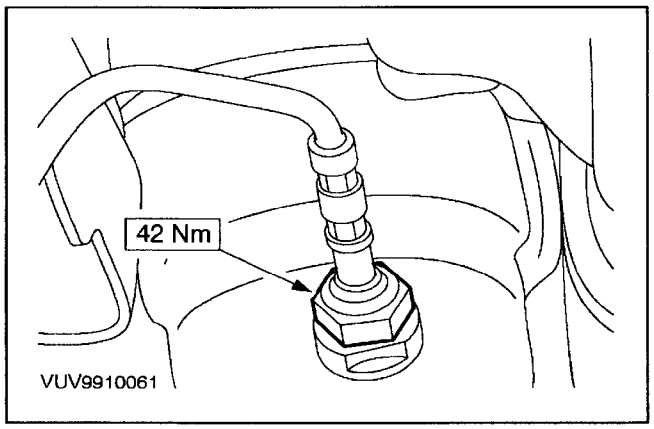
2. Detach the CMS wiring harness from the engine block.
   - Cut the cable tie.

REMOVAL AND INSTALLATION (Continued)



3. Remove the CMS.

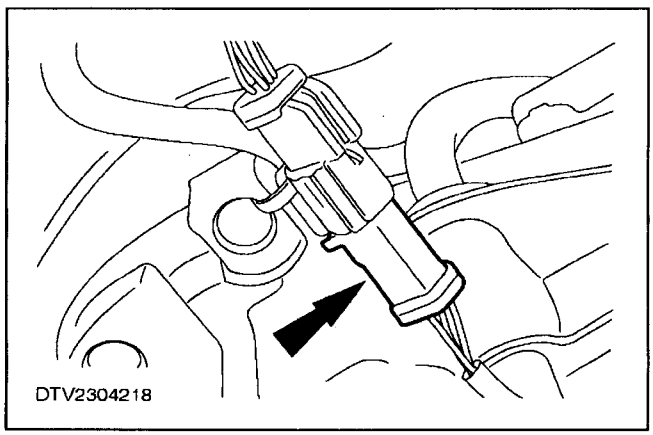
Installation



1. To install, reverse the removal procedure.
   - Install a new cable tie.

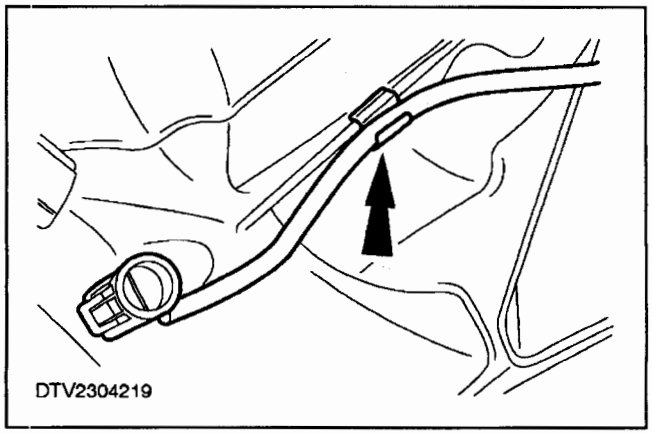
Catalyst Monitor Sensor — RH

Removal

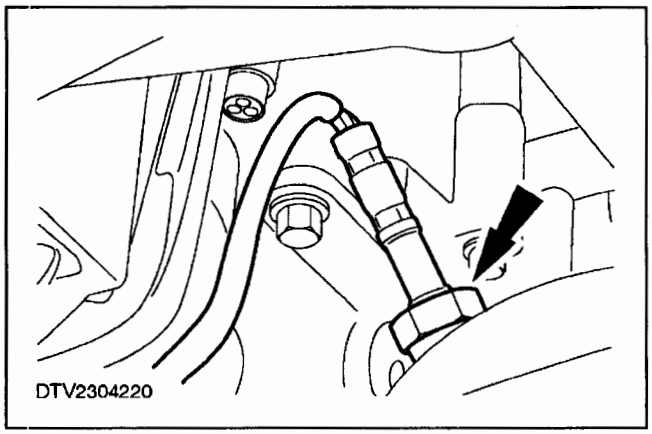


1. Disconnect the catalyst monitor sensor (CMS) electrical connector.

REMOVAL AND INSTALLATION (Continued)

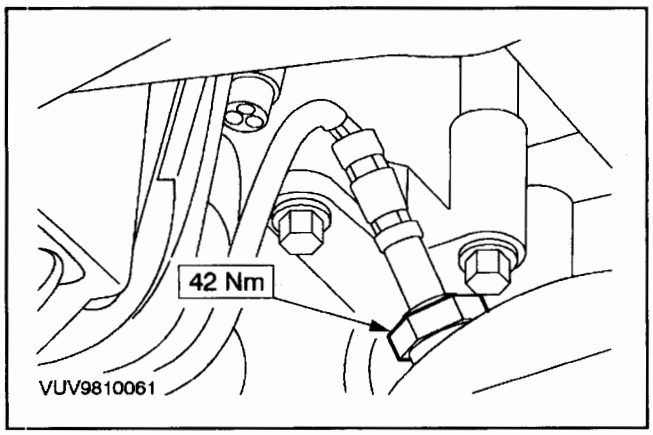


2. Detach the CMS wiring harness from the retaining clip on the transaxle housing.



3. Remove the CMS.

Installation

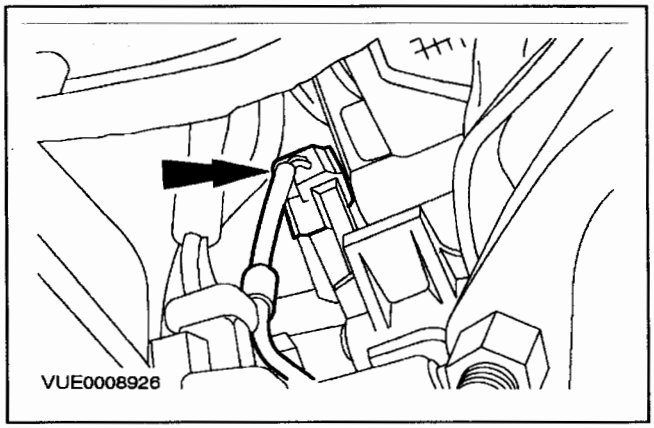


1. To install, reverse the removal procedure.

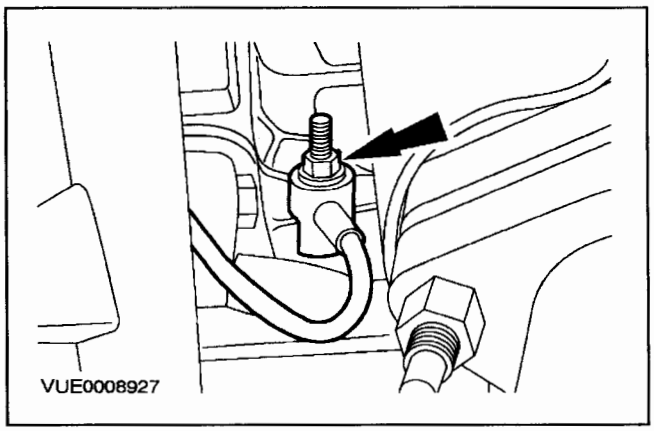
REMOVAL AND INSTALLATION (Continued)

Knock Sensor (KS)

Removal

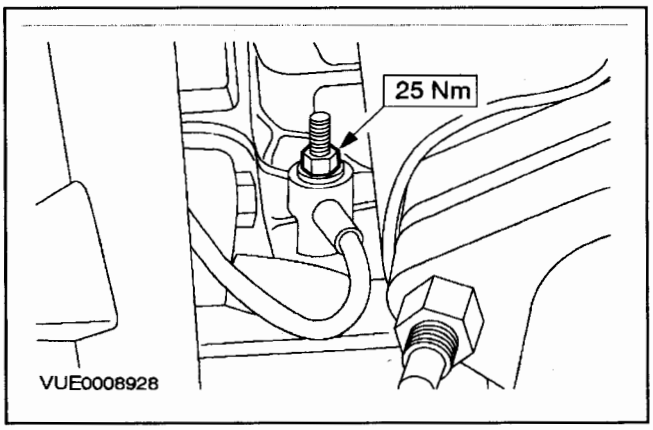


1. Disconnect and detach the knock sensor (KS) electrical connector.



2. Remove the KS.

Installation

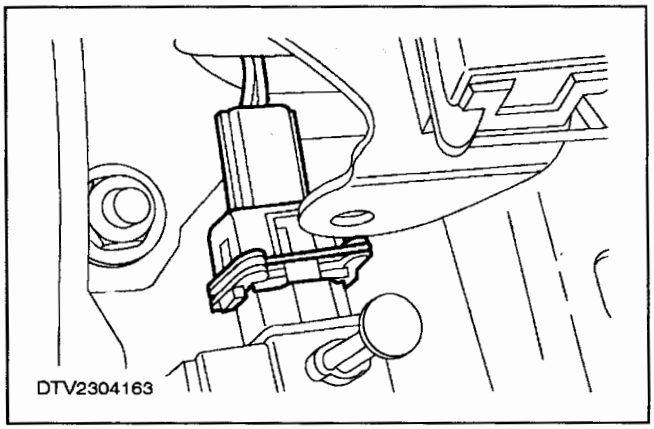


1. To install, reverse the removal procedure.

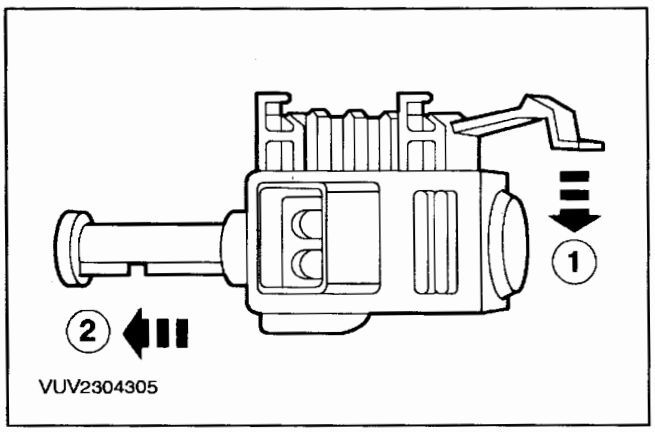
REMOVAL AND INSTALLATION (Continued)

Clutch Pedal Position (CPP) Switch

Removal



1. Disconnect the clutch pedal position (CPP) switch electrical connector.



2. Remove the CPP switch (shown removed for clarity).
   1 Release the switch retaining clip.
   2 Remove the switch.

Installation

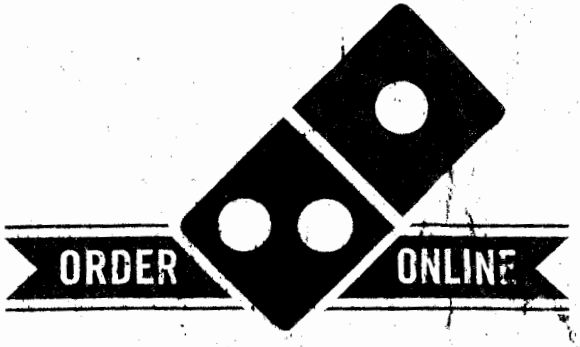
1. To install, reverse the removal procedure.

Fuel Pressure Sensor

Removal

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12B.

2. Disconnect the fuel line. For additional information, refer to Section 310-00.



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DIAGNOSIS AND TESTING (Continued)

SHIFT CONCERNS: SOFT/SLIP 2-1 SHIFT ONLY (AUTOMATIC OR KICKDOWN)

Possible Component	Reference/Action
231 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, EPC solenoid, transmission fluid temperature (TFT) sensor, throttle position sensor, mass air flow sensor	• Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [33] for diagnosis. Carry out Pinpoint Tests B and E using Transmission Tester with CD4E Cable and Overlay. Repair as necessary. Clear codes, road test and rerun OBD Tests.
331 — HYDRAULIC/MECHANICAL ROUTINE	
• Pump Assembly	
• Gaskets damaged	• Inspect for damage. Install new as necessary.
• Porosity/cross — leaks	• Inspect for leaks/porosity. Install new as necessary.
• Pump support seals No.3 or No.4 leaking, misassembled, damaged	• Inspect for damage. Repair as necessary.
• Intermediate OD Servo and Band Assembly	
• Servo piston damaged	• Inspect for damage. Repair as necessary
• Servo piston return spring damaged	• Inspect for damage. Repair as necessary
• Forward Clutch Assembly	
• Carry out Air Pressure Test.	
• Piston or seals damaged	• Inspect for damage. Repair as necessary.
• Friction elements damaged	• Inspect for damage. Repair as necessary.
• Low OWC	
• Damaged, not holding	• Inspect for damage. Repair as necessary.

SHIFT CONCERNS: HARSH 1-2 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
232 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, EPC solenoids, transmission fluid temperature (TFT) sensor, TSS, throttle position sensor, mass air flow sensor, TCC solenoid, Gearshift Position Sensor	• Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [33] for diagnosis. Carry out Pinpoint Tests B, C, D, E and F with Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as necessary. Clear codes, road test and rerun OBD tests. Carry out Stall Speed Tests.
332 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket leaks	• Inspect for damage. Repair as necessary.
• 2-4 accumulator valve, 3-2 control valve (also harsh 3-4 shift) stuck, damaged or misassembled	• Inspect for damage. Repair as necessary.
• Separator plates damaged	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket damaged	• Inspect for damage. Repair as necessary.
• Pump support seal rings No.3 or No.4 damaged	• Inspect for damage. Repair as necessary.

(Continued)

33 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

SHIFT CONCERNS: HARSH 1-2 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
• Porosity/cross leaks	• Inspect for damage. Repair as necessary.
• INT/OD Band and Servo Assembly	
• Cushion return springs damaged	• Inspect for damage. Repair as necessary.
• INT/OD band damaged, worn	• Inspect for damage. Repair as necessary.
• INT/OD band or reverse clutch drum assembly worn, damaged or misassembled	• Inspect for damage. Repair as necessary.
• Forward Clutch Assembly	
• Carry out Air Pressure Test.	
• Seals damaged	• Inspect for damage. Repair as necessary.
• Return spring damaged	• Inspect for damage. Repair as necessary.
• Friction elements damaged	• Inspect for damage. Repair as necessary.
• Case	
• Band anchor area damaged	• Inspect for damage. If damaged, install a new case.

SHIFT CONCERNS: HARSH 2-3 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
233 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, EPC solenoid, transmission range (TR) sensor, transmission fluid temperature (TFT) sensor, mass air flow sensor, TCC solenoid, turbine shaft speed (TSS) sensor	• Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [34] for diagnosis. Carry out Pinpoint Tests B, C, D, E and F with Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as necessary. Clear codes, road test and rerun OBD tests.
333 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket leaks	• Inspect for damage. Repair as necessary.
• Line modulator valve (also 1-2 and 3-4 harsh shift), servo release shuttle valve stuck, damaged or misassembled	• Inspect for damage. Repair as necessary.
• Separator plates damaged	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket damaged	• Inspect for damage. Repair as necessary.
• Porosity/cross — leaks	• Inspect for damage. Repair as necessary.
• Pump support seal rings No.4 or No.5 damaged	• Inspect for damage. Repair as necessary.
• Direct Clutch Assembly	
• Carry out Air Pressure Test.	
• Piston or piston bore damaged	• Inspect for damage. Repair as necessary.
• Friction elements damaged, worn	• Inspect for damage. Repair as necessary.
• Ball check not seating correctly	• Inspect for damage. Repair as necessary.
• Return spring damaged	• Inspect for damage. Repair as necessary.
• Clutch cylinder splines damaged	• Inspect for damage. Repair as necessary.

(Continued)

34 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

SHIFT CONCERNS: HARSH 2-3 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
• INT/OD Servo	
• Servo piston or piston bore damaged	• Inspect for damage. Repair as necessary.
• Servo rod damaged	• Inspect for damage. Repair as necessary.
• Case	
• Leakage in the servo apply, servo release or direct clutch circuits	• Inspect case for damage. Carry out Air Pressure Test. Repair or install a new case as necessary.
• Servo rod bore damaged	• Inspect for damage. Repair as necessary.

SHIFT CONCERNS: HARSH 3-4 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
234 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, EPC solenoid, 3-2T/CCS, transmission range (TR) sensor, transmission fluid temperature (TFT) sensor, TSS, throttle position sensor, mass air flow sensor, TCC solenoid	• Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [35] for diagnosis. Carry out Pinpoint Tests B, C, D, E, F and G with Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as necessary. Clear codes, road test and rerun OBD tests.
334 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket leaks	• Inspect for damage. Repair as necessary.
• Line modulator valve (also 1-2 and 2-3 harsh shift), 3-2 control valve, 2-4 accumulator valve, coast clutch valve, stuck, damaged or misassembled	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Separator plates damaged, blocked	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gaskets damaged	• Inspect for damage. Repair as necessary.
• Porosity/cross — leaks	• Inspect for damage. Repair as necessary.
• Coast clutch Teflon seals damaged	• Inspect for damage. Repair as necessary.
• INT/OD Band and Servo Assembly	
• INT/OD band and reverse clutch drum assembly, damaged, worn, misassembled	• Inspect for damage. Repair as necessary.
• Servo piston or cover damaged or leaking	• Inspect for damage. Repair as necessary.
• Springs damaged	• Inspect for damage. Repair as necessary.
• Coast Clutch Assembly	
• Piston or seals damaged, missing	• Inspect for damage. Repair as necessary.
• Friction elements damaged, worn	• Inspect for damage. Repair as necessary.
• Check ball not functioning	• Inspect for damage. Repair as necessary.
• Direct Clutch Assembly	
• Carry out Air Pressure Test.	
• Piston or seals damaged, missing	• Inspect for damage. Repair as necessary.
• Check ball damaged, missing or leaking	• Inspect for damage. Repair as necessary.

(Continued)

35 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

SHIFT CONCERNS: HARSH 3-4 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
• Return spring damaged	• Inspect for damage. Repair as necessary.
• Friction elements damaged	• Inspect for damage. Repair as necessary.
• Clutch cylinder splines damaged	• Inspect for damage. Repair as necessary.
• Case	
• Band anchor damaged	• Inspect for damage. Repair as necessary.

SHIFT CONCERNS: HARSH 4-3 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
235 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, electronic pressure control (EPC) solenoid, transmission range (TR) sensor, 3-2T/CCS, transmission fluid temperature (TFT) sensor, TSS, throttle position sensor, mass air flow sensor, TCC solenoid	• Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [36] for diagnosis. Carry out Pinpoint Tests B, C, D, E, F and G with Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as necessary. Clear codes, road test and rerun OBD tests.
335 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• -Adjust bolts to specification.
• Gasket leaks	• Inspect for damage. Repair as necessary.
• Servo release shuttle valve, 3-2 timing/coast valve stuck, damaged or misassembled	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Separator plates damaged, blocked	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Bolts out of torque specification	• -Adjust bolts to specification.
• Porosity/cross — leaks, seal rings damaged, missing or leaking ball plug	• Inspect for damage. Repair as necessary.
• Gasket damaged	• Inspect for damage. Repair as necessary.
• Pump support seal rings No.2, No.3, No.4 or No.5 (coast and direct clutch circuits) damaged	• Inspect for damage. Repair as necessary.
• INT/OD Band and Servo Assembly	
• Servo rod bent, damaged	• Inspect for damage. Repair as necessary.
• Servo return spring broken	• Inspect for damage. Repair as necessary.
• Coast Clutch Assembly	
• Seals damaged, missing	• Inspect for damage. Repair as necessary.
• Piston damaged	• Inspect for damage. Repair as necessary.
• Friction elements worn, damaged	• Inspect for damage. Repair as necessary.
• Check ball not functioning	• Inspect for damage. Repair as necessary.
• Forward clutch piston and return spring damaged	• Inspect for damage. Repair as necessary.
• Case	
• Porosity/cross — leaks in servo apply, servo release, direct clutch, coast clutch circuits	• Inspect for damage. Carry out Air Pressure Test. Repair as necessary.

36 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

SHIFT CONCERNS: HARSH 3-2 SHIFT ONLY (AUTOMATIC)

Possible Component	Reference/Action
236 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, electronic pressure control (EPC) solenoid, transmission range (TR) sensor, 3-2T/CCS, transmission fluid temperature (TFT) sensor, TSS, throttle position sensor, mass air flow sensor, TCC solenoid	• Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [37] for diagnosis. Carry out Pinpoint Tests B, C, D, E, F and G with Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as necessary. Clear codes, road test and rerun OBD tests.
336 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket damaged	• Inspect for damage. Repair as necessary.
• 3-2 timing valve, solenoid regulator valve, 3-2 control valve stuck, damaged, misassembled	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Separator plates damaged or blocked	• Inspect for damage. Repair as necessary.
• 3-2T/CCS solenoid not functioning correctly	• Activate solenoid using Transmission Tester. If coast clutch operation is OK, proceed to direct clutch assembly.
• Direct Clutch Assembly	
• Carry out Air Pressure Test.	
• Return spring damaged, broken	• Inspect for damage. Repair as necessary.
• Friction elements damaged, worn	• Inspect for damage. Repair as necessary.
• Check ball not exhausting	• Inspect for damage. Repair as necessary.
• INT/OD Band and Servo Assembly	
• INT/OD band or reverse clutch drum assembly damaged, worn or misassembled	• Inspect for damage. Repair as necessary.
• Servo piston damaged	• Inspect for damage. Repair as necessary .
• Servo return and cushion springs damaged, misassembled	• Inspect for damage. Repair as necessary.
• Springs damaged, misassembled	• Inspect for damage. Repair as necessary.
• Servo rod bent or damaged	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gaskets damaged	• Inspect for damage. Install new as necessary.
• Porosity/cross leaks	• Inspect for porosity, leaks. Repair as necessary.
• Pump support seal rings damaged or misassembled	• Inspect for damage. Repair as necessary.
• Case	
• Band anchor damaged	• Inspect for damage. Repair as necessary.
• Servo rod bore damaged	• Inspect for damage. Repair as necessary.

TORQUE CONVERTER OPERATION CONCERNS: NO APPLY

Possible Component	Reference/Action
240 — ELECTRICAL ROUTINE	
• Powertrain Control System	

(Continued)

37 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

TORQUE CONVERTER OPERATION CONCERNS: NO APPLY

Possible Component	Reference/Action
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, transmission fluid temperature (TFT) sensor, TCC solenoid, stoplight switch, TSS	• Carry out Torque Converter Clutch Operation. Refer to Road Testing the Vehicle procedure in this section. Run OBD tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [38] for diagnosis. Carry out Pinpoint Tests B, C and F with Transmission Tester with CD4E Cable and Overlay. Repair as necessary. Clear codes, road test and rerun OBD tests.
340 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket damaged	• Inspect for damage. Repair as necessary.
• Solenoid pressure regulator valve, bypass clutch control valve and plunger, converter regulator valve stuck, damaged, misassembled	• Inspect for damage. Repair as necessary.
• TCC solenoid not functioning correctly	• Activate solenoid using Transmission Tester. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Separator plates damaged or blocked	• Inspect for damage. Repair as necessary.
• Torque Converter Assembly	
• Leakage, internal damage	• Inspect for damage and leakage. Carry out Torque Converter Clutch Operation Checks. Refer to Preliminary Inspection in this section. Install new as necessary.

TORQUE CONVERTER OPERATION CONCERNS: ALWAYS APPLIED/MAY STALL ENGINE

Possible Component	Reference/Action
241 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module (PCM), transmission fluid temperature (TFT) sensor, TCC solenoid	• Carry out Torque Converter Clutch Operation Tests. Refer to Road Testing the Vehicle procedure in this section. Run OBD Tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [38] for diagnosis. Carry out Pinpoint Tests B and C using Transmission Tester with CD4E Cable and Overlay. Repair as necessary. Clear codes, road test and rerun OBD Tests.
341 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Gasket damaged	• Inspect for damage. Repair as necessary.
• Bypass clutch control valve and plunger (always applied), converter regulator valve stuck, damaged, misassembled	• Inspect for damage. Repair as necessary.
• Separator plates damaged, blocked	• Inspect for damage. Repair as necessary.
• TCC solenoid not functioning correctly. NOTE: Converter clutch not applied in 1st gear or reverse gear	• Activate solenoid using Transmission Tester. Repair as necessary.
• Pressure tap plate/gasket damaged	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Bolts out of torque specification	• Adjust bolts to specification.

(Continued)

38 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

TORQUE CONVERTER OPERATION CONCERNS: ALWAYS APPLIED/MAY STALL ENGINE

Possible Component	Reference/Action
• Gaskets damaged	• Inspect for damage. Repair as necessary.
• Pump support No.1 seal ring damaged, missing, misassembled	• Inspect for damage. Repair as necessary.
• Torque Converter Assembly	
• Internal seals damaged	• Inspect for damage. Repair as necessary.
• Piston plate damaged/stuck to cover	• If cover is heat stained, install a new torque converter.
• Case	
• Porosity/cross — leaks from the clutch bypass circuit	• Inspect for porosity/leaks. Repair or install new as necessary.

OTHER CONCERNS: SHIFT LEVER EFFORT IS HIGH

Possible Component	Reference/Action
251 — ELECTRICAL ROUTINE	
• No Electrical Concerns	
351 — HYDRAULIC/MECHANICAL ROUTINE	
• Park Interlock Solenoid	• Refer to Section 307-05 for diagnostic procedure.
• Internal and External Shift Linkages	
• Damaged, out of adjustment or misassembled	• Inspect and repair as required. Verify linkage adjustment. Refer to Section 307-05. After repairing linkage, verify that the transmission range (TR) sensor is correctly adjusted. Refer to Transmission Range (TR) Sensor in this section.
• Manual control lever damaged, park mechanism damaged, shaft bent, detent lever shaft bore (in case) damaged, detent spring bent/damaged, nut loose	• Inspect for damage. Repair as required.
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Manual valve stuck, damaged	• Inspect for damage. Repair as necessary.

OTHER CONCERNS: EXTERNAL LEAKS

Possible Component	Reference/Action
252 — ELECTRICAL ROUTINE	
• No Electrical Concerns	
352 — HYDRAULIC/MECHANICAL ROUTINE	
• Fluid	
• Incorrect level	• Fill to correct level.
• Seals/Gaskets	
• Differential seals, speedometer gear, retainer seal, pump assembly, main control cover, servo cover, split flange gasket, converter impeller hub, manual lever shaft seal, fluid level indicator tube	• Locate source of leak. Repair as required. If differential seal or converter impeller hub is leaking, inspect drain back holes in case/converter housing, inspect surface of linkshaft or front wheel driveshaft and joint for a rough surface. Rough surface may cause seal leakage. Repair as necessary.
• Other	
• Fluid tube fitting, line pressure tap, pressure port plugs, drain plug, cooler tubes, case porosity, cracked case	• Locate source of leak. Repair as necessary.
• Vent blocked or damaged	• Check vent for damage or blockage. Repair as necessary.

(Continued)

DIAGNOSIS AND TESTING (Continued)

OTHER CONCERNS: EXTERNAL LEAKS

Possible Component	Reference/Action
• Bolts at split flange or main control cover leaking	• Inspect for leaks. Repair as necessary.
• Sensors/Connectors	
• Transmission connectors, transmission range (TR) sensor. TSS sensor or seal	• -Locate source of leak. Repair as necessary.

OTHER CONCERNS: POOR VEHICLE PERFORMANCE

Possible Component	Reference/Action
253 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Base engine concerns	• Refer to Section 303-00 for repair procedure.
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, transmission fluid temperature (TFT) sensor, TCC solenoid, transmission range (TR) sensor, throttle position sensor	• Carry out Torque Converter Clutch Operation Test. Refer to Road Testing the Vehicle procedure in this section. Run OBD Tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [39] for diagnosis. Carry out Pinpoint Tests B, C, D using Rotunda Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as necessary. Clear codes, road test and rerun OBD Tests.
353 — HYDRAULIC/MECHANICAL ROUTINE	
• Internal and External Shift Linkages or Gearshift Position Sensor	
• Damaged, out of adjustment or misassembled	• Inspect and repair as required. Verify linkage adjustment. Refer to Section 307-05. After repairing linkage, verify that the transmission range (TR) sensor is correctly adjusted. Refer to Transmission Range (TR) Sensor in this section.
• Verify Correct Shift Points and Engagements	• Refer to Road Testing the Vehicle.
• Go to the appropriate diagnostic routines in the index	
• Torque Converter Clutch Always Applied	• Go to Routine 341.
• Torque Converter One-Way Clutch	• Inspect torque converter. Repair or install new as necessary.
• Damaged	• Inspect torque converter. Repair or install new as necessary.

OTHER CONCERNS: NOISE/VIBRATION-FORWARD/REVERSE

Possible Component	Reference/Action
254 — ELECTRICAL ROUTINE	
• No Electrical Concerns	
354 — HYDRAULIC/MECHANICAL ROUTINE	
• For Noises/Vibrations That Change With Engine Speed:	
• Torque converter components	• Locate source of disturbance. Repair as necessary.
• Fluid level (low) pump cavitation	
• Pump assembly	
• Engine drive accessories	
• Cooler tubes grounding out	
• Flexplate	
• Inspection cover	
• For Noises/Vibrations that Change with Vehicle Speed:	

(Continued)

39 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

OTHER CONCERNS: NOISE/VIBRATION-FORWARD/REVERSE

Possible Component	Reference/Action
• Powertrain mounts loose, damaged	• Locate source of disturbance. Repair as necessary. For specific shifts or torque converter concerns, refer to appropriate routines as listed in the index.
• Tires	
• Driveline concerns: front wheel driveshaft and joint or linkshaft, differential: final drive/chain, suspension, modifications	
• Planetary gear sets	
• Chain grounding to chain pan	• Inspect chain pan for signs of damage or misinstallation. Repair as necessary.
• Forward one-way clutch	
• Torque converter assembly	
• LH and RH front wheel driveshaft and joint splines worn, damaged	• Inspect for damage. Repair as necessary.
• Speedometer cable or gears	
• Other Noises/Vibrations:	
• Shift cable and bracket vibration, grounding	• Locate source of disturbance. Repair as necessary.
• Cooler lines grounding	

OTHER CONCERNS: ENGINE WILL NOT CRANK

Possible Component	Reference/Action
255 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Base engine concerns	• Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [40] or to diagnostic procedure in the Workshop Manual.
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, transmission range (TR) sensor damaged, misadjusted	• Run OBD Tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [40] for diagnosis. Carry out Pinpoint Test D using the Transmission Tester with CD4E Cable and Overlay and MLP-D Cable. Repair as required. Clear codes, road test and rerun OBD Tests.
355 — HYDRAULIC/MECHANICAL ROUTINE	
• Starter/Flexplate	
• Damaged or misassembled	• Inspect for damage, misassembly. Repair as necessary.
• Internal and External Shift Linkages or Transmission Range (TR) Sensor	
• Damaged, out of adjustment or misassembled	• Verify linkage adjustment. Refer to Section 307-05. After repairing linkage, verify that the transmission range (TR) sensor is correctly adjusted. Refer to Transmission Range (TR) Sensor in this section.

40 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

OTHER CONCERNS: NO PARK RANGE

Possible Component	Reference/Action
256 — ELECTRICAL ROUTINE	
• No Electrical Concerns	
356 — HYDRAULIC/MECHANICAL ROUTINE	
• Internal or External Shift Linkages	
• Damaged, misadjusted or misassembled	• Inspect and repair as required. Verify linkage adjustment. Refer to Section 307-05. After repairing linkage, verify that the transmission range (TR) sensor is correctly adjusted. Refer to Transmission Range (TR) Sensor in this section.
• Park Mechanism	
• Park gear on driven sprocket assembly, parking pawl return spring, park pawl ratcheting springs, parking pawl shaft, manual control lever, cam apply lever, manual lever detent spring, transmission range (TR) sensor, parking pawl apply cam, manual shaft nut damaged, missing or misassembled	• Inspect for damage. Repair as necessary.

OTHER CONCERNS: TRANSAXLE OVERHEATING

Possible Component	Reference/Action
257 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, TCC solenoid, transmission fluid temperature (TFT) sensor, TSS	• Run OBD Tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [41] for diagnosis. Carry out Pinpoint Tests B, C and F using Transmission Tester with CD4E Cable and Overlay. Repair as required. Clear codes, road test and rerun OBD Tests.
357 — HYDRAULIC/MECHANICAL ROUTINE	
• Vehicle Concerns Causing Engine Overheating	• Refer to Section 303-00 for diagnostic procedure.
• Fluid	
• Incorrect level	• Adjust to correct level.
• Condition	• Inspect. Refer to Check Fluid Level and Condition procedure in this section. If fluid is aerated, check thermo valve and filter seals. Repair as necessary.
• Cooler Tubes	
• Damaged, blocked, reversed	• Inspect for damage. Repair as necessary.
• Intake Cooler	
• Damaged, blocked, restricted or leaking	• Inspect for damage. Repair as necessary.
• Auxiliary Cooler (if equipped)	
• Damaged, blocked, restricted or leaking	• Inspect for damage or incorrect installation. Repair as necessary.
• Main Control	
• Bolts out of torque specification	• Adjust bolts to specification.
• Main regulator valve, bypass clutch control valve, converter regulator valve stuck, damaged, misassembled	• Inspect for damage. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Separator plates/gaskets damaged	• Inspect for damage. Repair as necessary.
• TCC solenoid not functioning correctly (off)	• Activate solenoid using Transmission Tester. Repair as necessary.

(Continued)

41 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

OTHER CONCERNS: TRANSAXLE OVERHEATING

Possible Component	Reference/Action
• Torque Converter Clutch — No Apply	• Go to Routine 240/340.
• Pump Assembly	
• Gasket damaged	• Inspect for damage. Repair as necessary.
• Rear lube passage blocked	• Inspect for damage. Repair as necessary.
• Chain Pan	
• Missing	• Inspect for missing pan. Install pan if missing.
• Thermostatic Fluid Level Control Valve	
• Stuck open or damaged	• Inspect for damage. Repair as necessary.
• Gasket damaged or missing	• Inspect for damage. Repair as necessary.
• Bolt or bracket damaged, missing, or incorrect installed	• Inspect for damage. Repair as necessary.
• Case/Converter Housing/Stator Support	
• Front lube passage blocked or restricted	• Inspect passages. Refer to Air Pressure Tests and Air Pressure Test Port Locations for identification of passages. Repair as necessary.
• Torque converter clutch, clutch timing passages blocked or restricted	

OTHER CONCERNS: NO ENGINE BRAKING IN MANUAL 1ST POSITION

Possible Component	Reference/Action
258 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, 3-2 timing/coast clutch solenoid	• Run OBD Tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [42] for diagnosis. Carry out Pinpoint Test G using Transmission Tester with CD4E Cable and Overlay. Repair as necessary. Clear codes, road test and rerun OBD Tests. Carry out Stall Speed Tests.
358 — HYDRAULIC/MECHANICAL ROUTINE	
• Main Controls	
• Bolts out of specification	• Adjust bolts to specification.
• Gaskets damaged	• Inspect for damage. Repair as necessary.
• Low/reverse modulator valve, coast clutch valve stuck, damaged or misassembled	• Inspect for damage. Repair as necessary.
• 3-2 timing/coast clutch solenoid stuck or damaged	• Inspect for damage, contamination. Activate solenoid using Transmission Tester. Repair as necessary.
• Hydraulic passages damaged	• Inspect for damage. Repair as necessary.
• Pressure tap plate/gasket damaged	• Inspect for damage. Repair as necessary.
• Separator plate/gasket damaged	• Inspect for damage. Repair as necessary.
• Coast Clutch Assembly	
• Assembly misassembled, damaged	• Inspect for damage. Repair as necessary.
• Forward clutch hub seal damaged	• Inspect for damage. Repair as necessary.
• Piston or seals damaged	• Inspect for damage. Repair as necessary.
• Check ball damaged, missing	• Inspect for damage. Repair as necessary.
• Low/Reverse Clutch Assembly	
• Carry out Air Pressure Test.	

(Continued)

42 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

OTHER CONCERNS: NO ENGINE BRAKING IN MANUAL 1ST POSITION

Possible Component	Reference/Action
• Assembly misassembled, damaged	• Inspect for damage. Repair as necessary.
• Piston or seals damaged	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Pump support No.2 or No.3 seal rings for the coast clutch circuit damaged, missing	• Inspect for damage. Repair as necessary.

OTHER CONCERNS: NO ENGINE BRAKING IN DRIVE (TCS ON) OR MANUAL 2ND POSITION

Possible Component	Reference/Action
259 — ELECTRICAL ROUTINE	
• Powertrain Control System	
• Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, 3-2 timing/coast clutch solenoid	• Run OBD Tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual [43] for diagnosis. Carry out Pinpoint Test G using Rotunda Transmission Tester with CD4E Cable and Overlay. Repair as necessary. Clear codes, road test and rerun OBD Tests. Carry out Stall Speed Tests.
359 — HYDRAULIC/MECHANICAL ROUTINE	
• Internal or External Shift Linkages	
• Damaged, out of adjustment or misassembled	• Inspect and repair as necessary. Verify linkage adjustment. Refer to Section 307-05. After repairing linkage, verify that the transmission range (TR) sensor is correctly adjusted. Refer to Transmission Range (TR) Sensor in this section.
• Main Controls	
• 3-4 shift valve, 1-2 shift valve, pull-in valve, coast clutch control valve stuck, damaged	• Inspect for damage. Repair as necessary.
• 3-2 timing/coast clutch solenoid stuck or damaged	• Inspect for damage, contamination. Activate solenoid using Transmission Tester. Repair as necessary.
• Forward One-Way Clutch Assembly	
• Damaged, misassembled	• Inspect for damage. Repair as necessary.
• Coast Clutch Assembly	
• Assembly misassembled	• Inspect for damage. Repair as necessary.
• Forward clutch hub seal assembled	• Inspect for damage. Repair as necessary.
• Piston or seals damaged	• Inspect for damage. Repair as necessary.
• Check ball damaged, missing	• Inspect for damage. Repair as necessary.
• Pump Assembly	
• Pump support No.2 or No.3 seal rings for the coast clutch circuit damaged, missing	• Inspect for damage. Repair as necessary.

OTHER CONCERNS: VEHICLE MOVEMENT WITH GEAR SELECTOR IN THE "N" POSITION

Possible Component	Reference/Action
262 — ELECTRICAL ROUTINE	
• No Electrical Concerns	
362 — HYDRAULIC/MECHANICAL ROUTINE	
• Internal or External Shift Linkages	

(Continued)

43 Can be purchased as a separate item.

DIAGNOSIS AND TESTING (Continued)

OTHER CONCERNS: VEHICLE MOVEMENT WITH GEAR SELECTOR IN THE "N" POSITION

Possible Component	Reference/Action
• Damaged, out of adjustment or misassembled	• Inspect and repair as required. Verify linkage adjustment. Refer to Section 307-05. After repairing linkage, verify that the transmission range (TR) sensor is correctly adjusted. Refer to Transmission Range (TR) Sensor in this section.
• Pump Assembly	
• Gaskets severely damaged	• Inspect for damage. Install new as necessary.
• Pump support seal ring No.2, leakage from lube circuit into FC circuit	• Inspect for damage. Install new as necessary.
• Forward/Coast Clutch Assembly	
• Friction plates severely damaged	• Inspect for damage. Install new as necessary.
• Return spring damaged	• Inspect for damage. Install new as necessary.
• Check ball damaged, missing	• Inspect for damage. Install new as necessary.

Reference: Clutch/Band Application Chart

Gear	INT/OD (2/4) Band	Reverse Clutch	Direct Clutch	Forward Clutch	Coast Clutch	Low/Reverse Clutch
REV	X	X				
1ST	X					
2ND	X	X				
3RD	X	X				
4TH	X	X	X/I			
M-3RD	X	X	X			
M-2ND	X	X	X			
M-1ST	X	X	X			

X-Transmits torque, OR-Overrunning, I-Ineffective

Reference: One-way Clutch Application Chart

Gear	Forward One-way Clutch Drive	Forward One-way Clutch Coast	Low One-way Clutch Drive	Low One-way Clutch Coast	Engine Braking
REV	X/I	Yes			
1st	X	OR	X	OR	NO
2ND	X	OR	OR	OR	NO
3RD	X	OR	OR	OR	NO
4TH	OR	OR	OR	OR	YES
M-3RD	X	OR	OR	YES	
M-2ND	X	OR	OR	YES	
M-1ST	X	X	YES		

X-Transmits torque, OR-Overrunning, I-Ineffective

GENERAL PROCEDURES

Transmission Fluid Cooler Tubes — Backflushing and Cleaning

Backflushing and Cleaning

1. Remove the fluid cooler tubes. For additional information, refer to Section 307-02.

2. **CAUTION: If the automatic transmission fluid is very dirty or it contains metallic particles, then install new tubes and a new automatic transmission fluid cooler.**

   Flush the fluid cooler and pipes using a suitable torque converter/fluid cooler cleaner. Follow all the manufacturer's instructions for correct use.

3. Install the fluid cooler tubes. For additional information, refer to Section 307-02.

IN-VEHICLE REPAIR

Transmission Fluid Drain And Refill

Materials

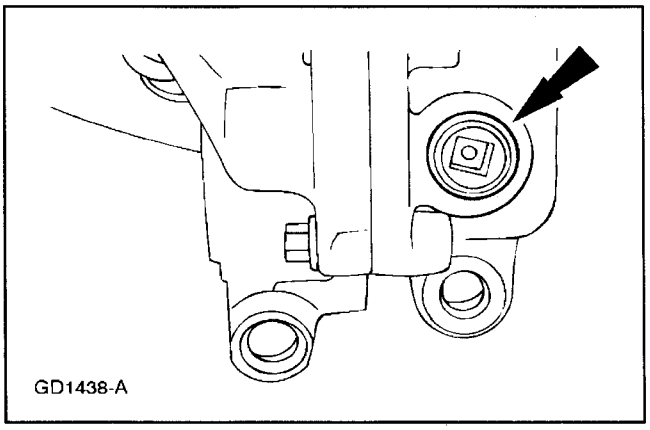
Item	Specification
Pipe Sealant with Teflon® D8Z-19554-A	WSK-M2G350-A2
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02.

2. Place a suitable container under the transaxle drain plug.

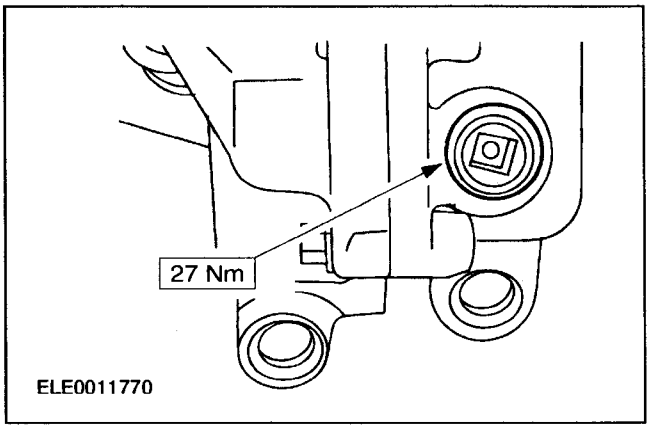
IN-VEHICLE REPAIR (Continued)



3. **NOTE:** If an integral problem is suspected, drain the fluid through a paper filter. A small amount of metal or friction particles may be found from normal wear. However, if excessive metal and friction particles are present, internal service will be required.

   Remove the transaxle drain plug and drain transmission fluid.

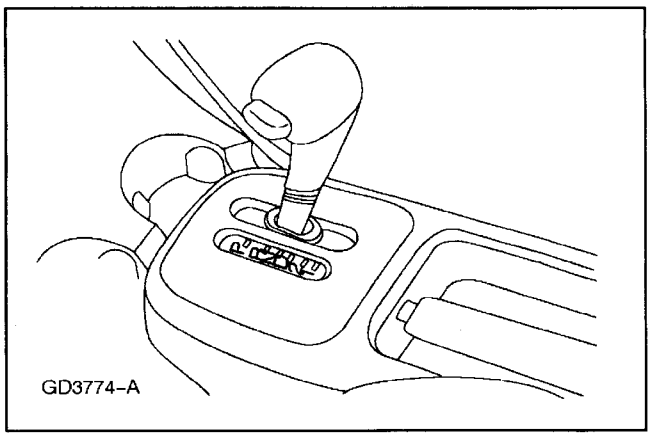
Installation



1. Install the transaxle drain plug.
   - After the fluid has been drained, clean the drain plug threads and apply a small amount of pipe sealant.

2. Lower the vehicle

3. Add 3.7 liters (3.9 quarts) of automatic transmission fluid.



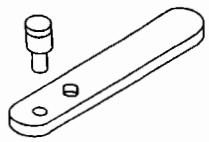
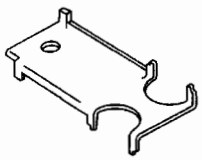
4. Start the engine and run through all gears for a total of five minutes at idle. Turn off the engine.

5. Repeat steps 1 through 5 to help flush fluid from the torque converter.

IN-VEHICLE REPAIR (Continued)

Main Control

Special Tool(s)

 ST1968-A	Aligner, Selector Shaft 307-S290 (T94P-77000-H)
 307-351	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Materials

Item	Specification
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

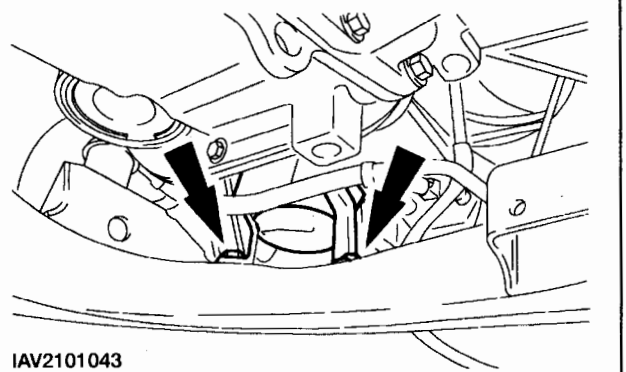
Removal

All vehicles

1. Disconnect the battery ground cable.

2. Remove the battery tray. For additional information, refer to Section 414-01.

Vehicles with air conditioning


IAV2101043

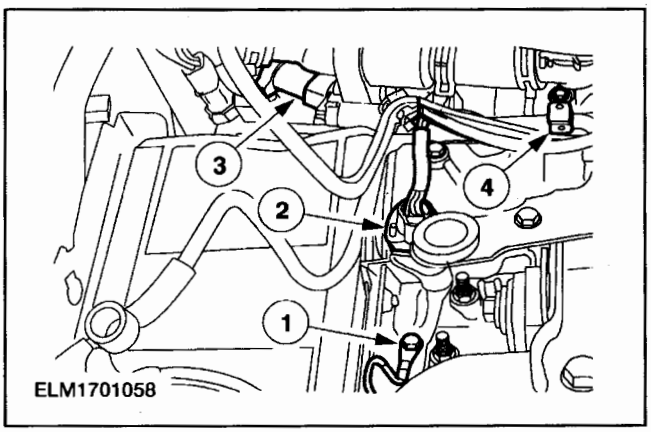
3. **⚠ CAUTION: Do not place excessive pressure on tubes/hoses (A/C) and fittings when disconnecting and reconnecting A/C components. Excessive pressure may cause component damage and A/C system leaks.**

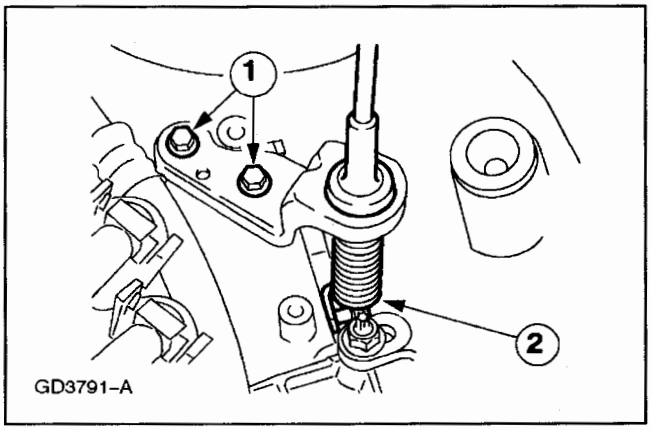
   NOTE: On some vehicles, it may be necessary to disconnect and position the A/C suction accumulator out of the way to allow enough room for main control cover removal.

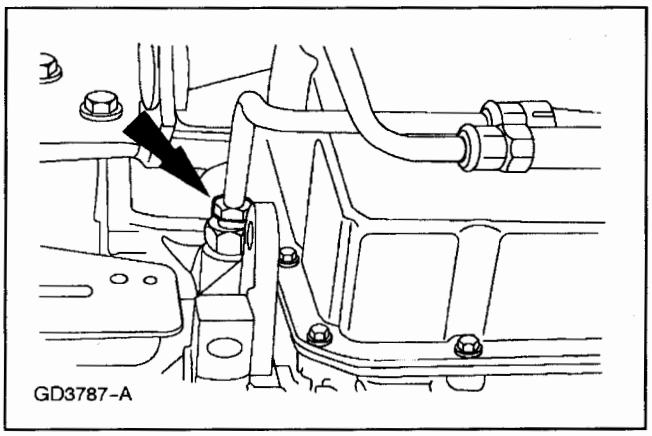
   Remove the suction accumulator bracket and position the suction accumulator to one side.

   - Loosen the suction accumulator canister holding screw, and remove the suction accumulator from the bracket.

IN-VEHICLE REPAIR (Continued)







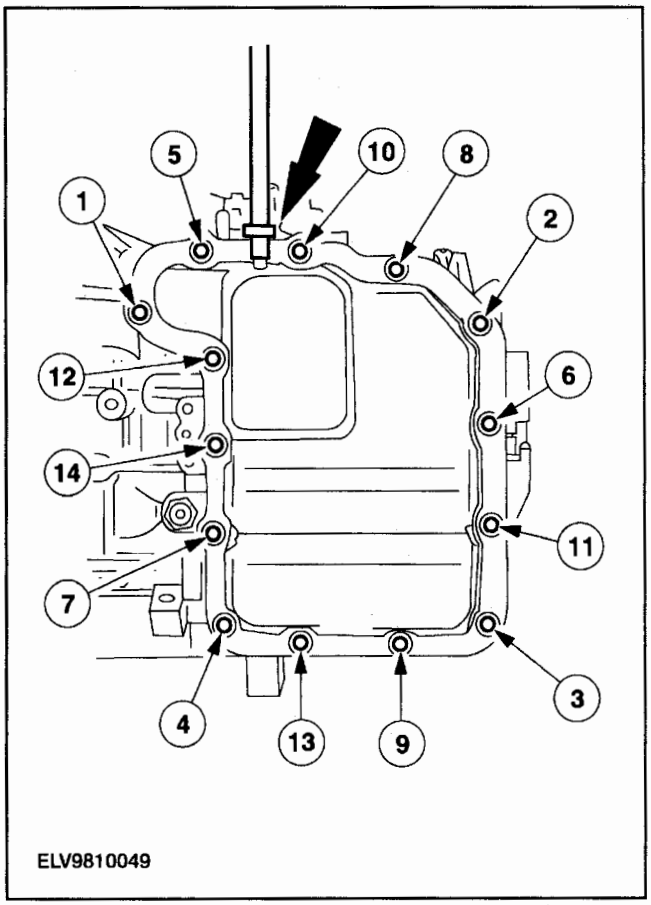
All vehicles

4. Disconnect the transaxle wiring harness electrical connector.
   1 Remove the ground cable, if fitted.
   2 Remove the solenoid body electrical connector.
   3 Remove the transmission range (TR) sensor electrical connector.
   4 Remove the wiring harness retaining clip.

5. Disconnect the transmission shift cable and bracket.
   1 Remove the bracket bolts.
   2 Remove the cable.

6. **NOTE:** Position a suitable drain pan under the main control cover.
   Disconnect the transaxle cooler inlet line.

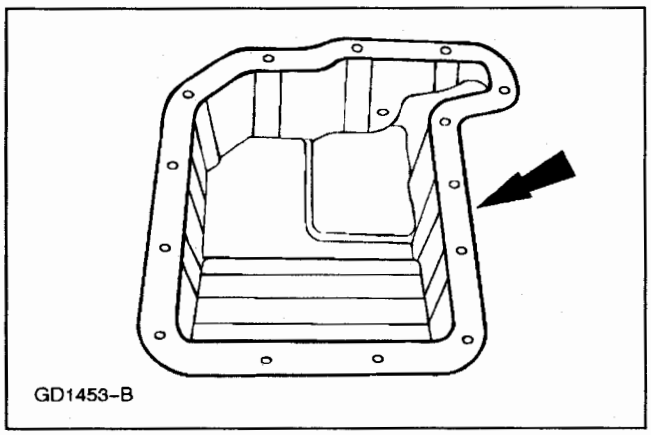
IN-VEHICLE REPAIR (Continued)



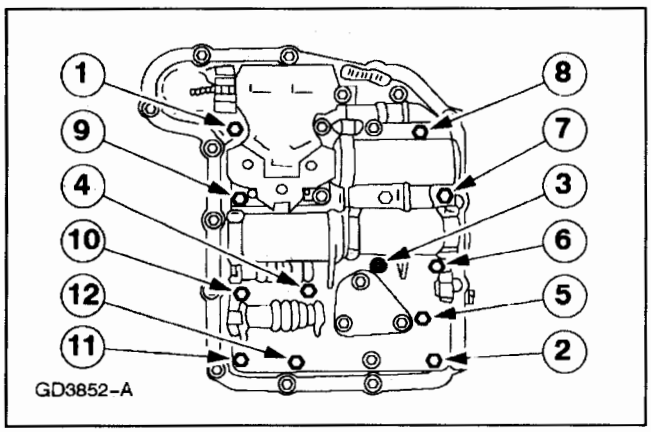
7. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the main control cover.

   - Open clamp and disconnect the main control cover vent tube.
   - Remove the main control bolts and main control cover.



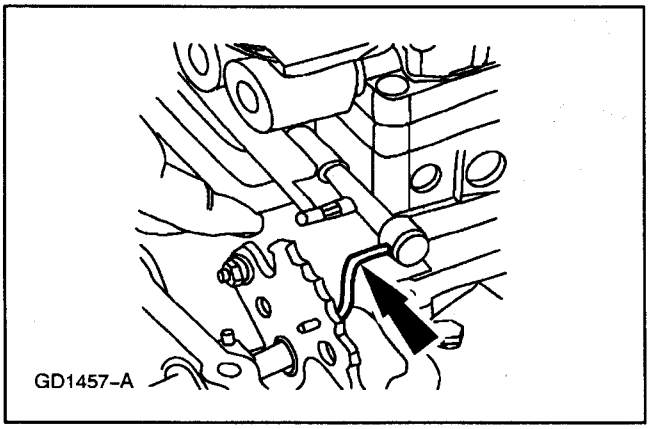
8. Remove the main control cover gasket.



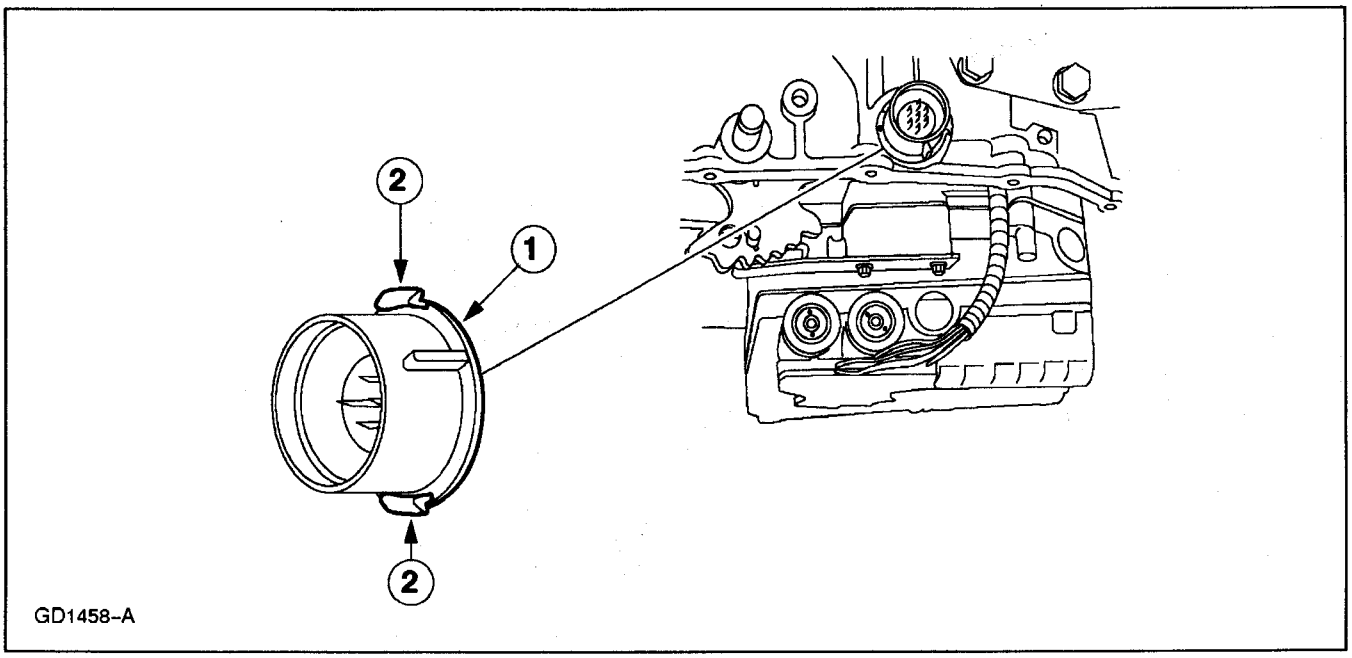
9. **NOTE:** Remove the bolts in the indicated sequence.

   Remove the main control valve body bolts.

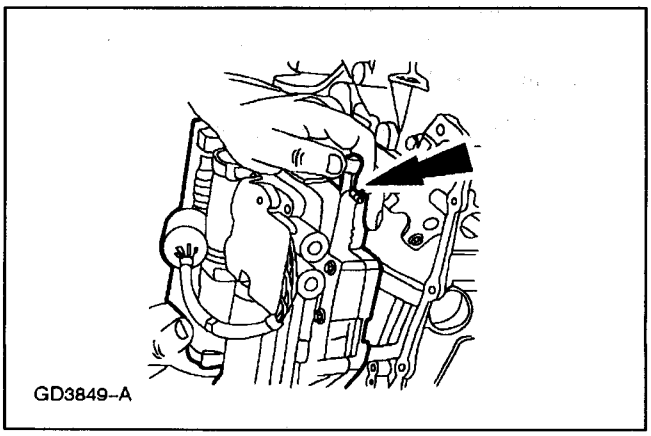
IN-VEHICLE REPAIR (Continued)



10. **NOTE:** Do not damage the manual valve.
    Lift the main control valve body while disconnecting the manual valve link.



11. Remove the solenoid body harness connector.
    1 Depress the retaining tabs.
    2 Push the solenoid valve body electrical connector down through the transaxle case.

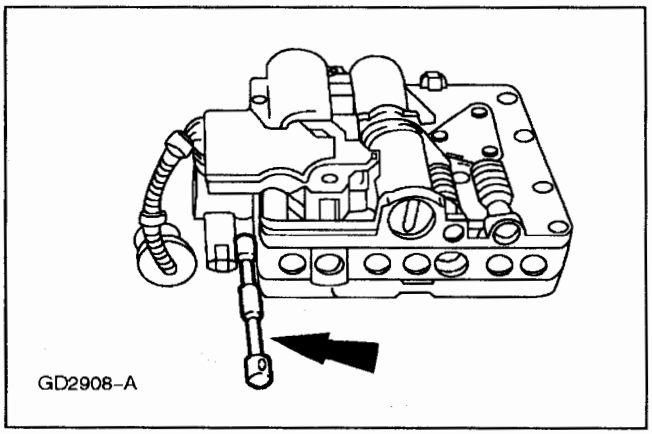


12. Make sure the manual valve control lever does not fall out while removing from the vehicle.

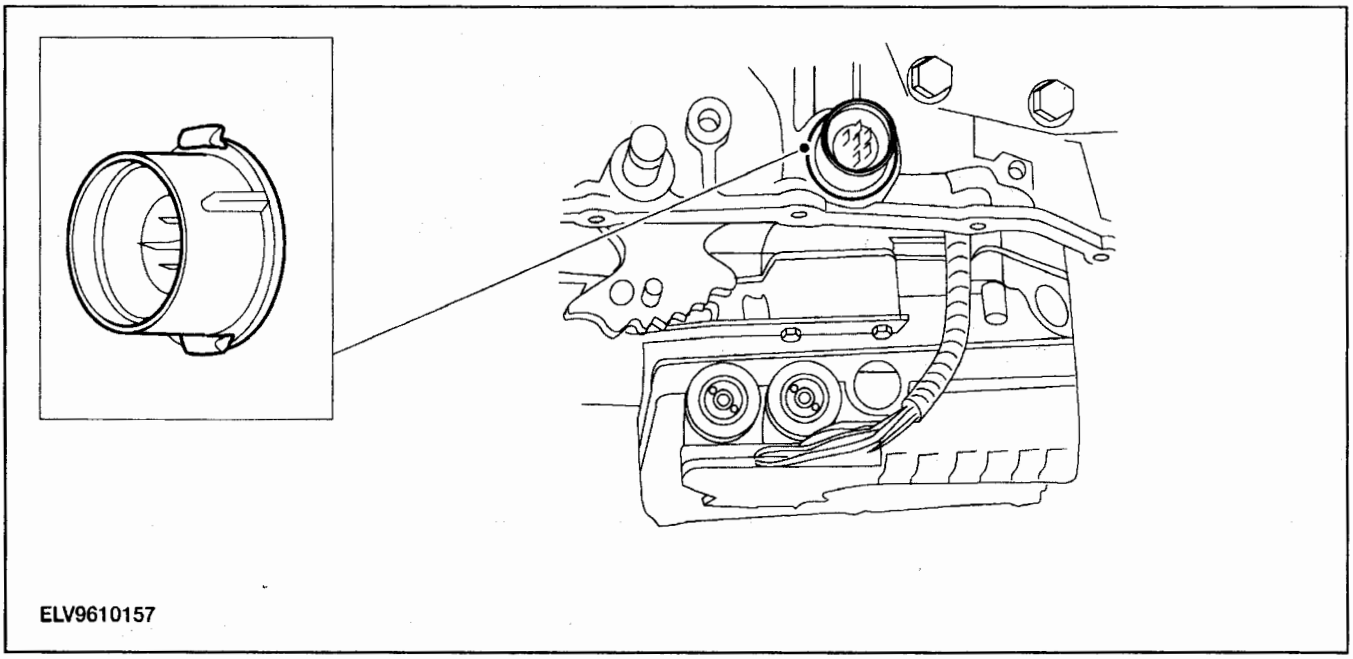
IN-VEHICLE REPAIR (Continued)

Installation

All vehicles



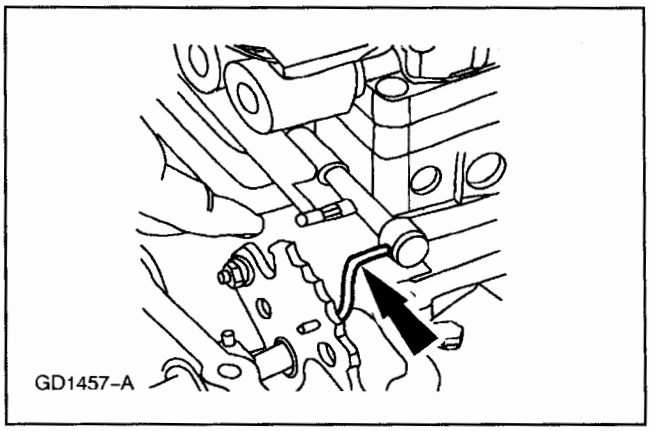
1. Install the manual valve.



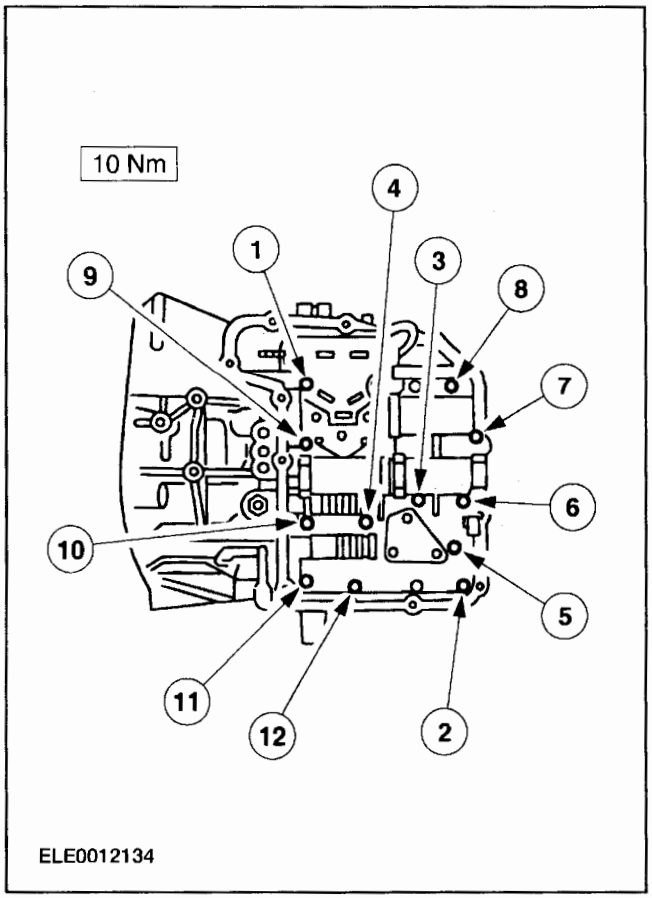
2. **NOTE:** Inspect solenoid valve body harness connector O-ring seal and install new as necessary before installing solenoid valve body harness connector in transaxle case.

   Push the solenoid valve body harness connector up through the transaxle case.

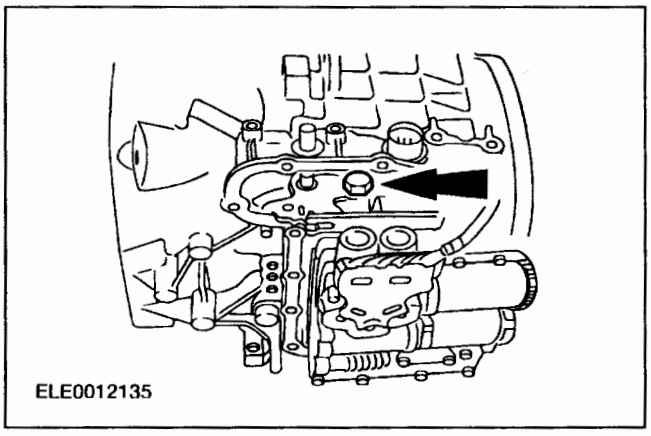
IN-VEHICLE REPAIR (Continued)



3. Connect the manual valve link to the manual valve.

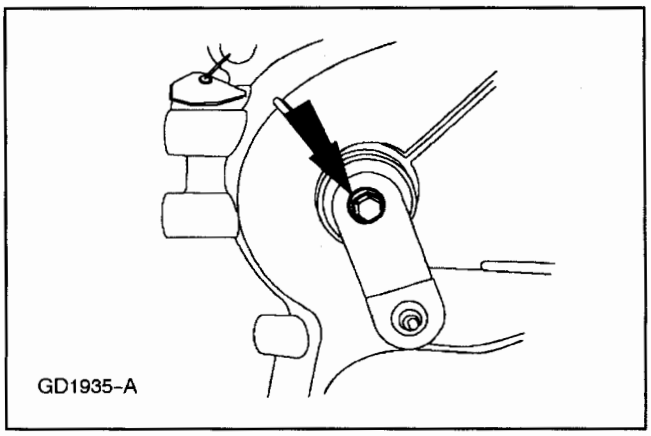


4. **NOTE:** Install the bolts in the indicated sequence.
   Position the main control valve body and install the mounting bolts.

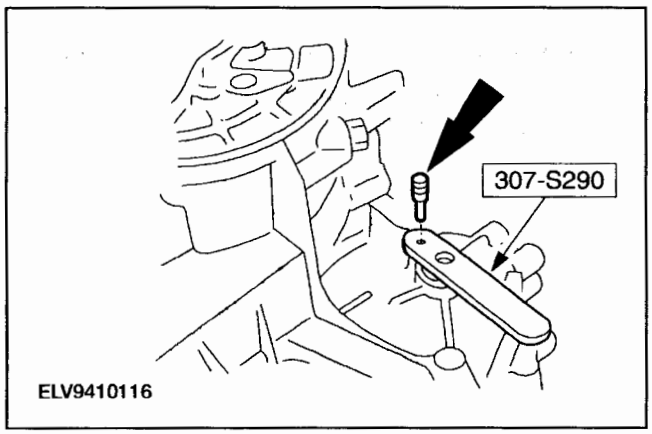


5. Loosen the nut on the ball stud for the manual valve detent lever actuating rod assembly.

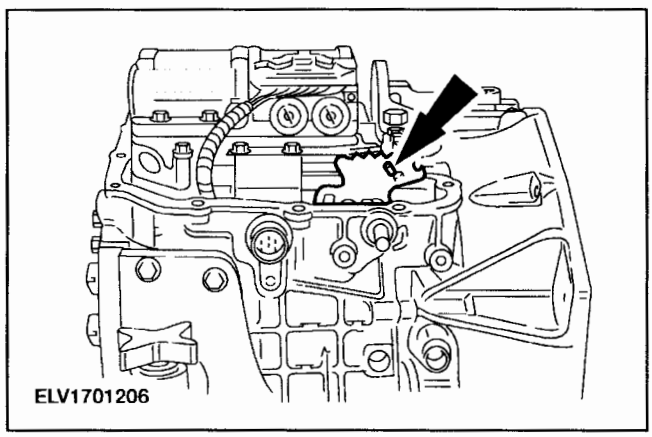
IN-VEHICLE REPAIR (Continued)



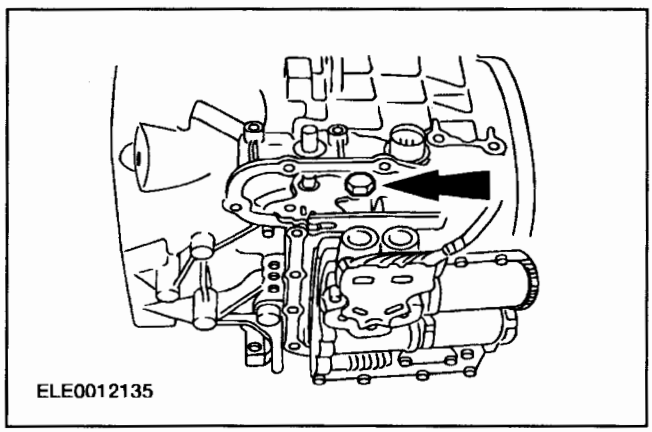
6. Remove the manual control lever bolt.



7. Using the special tool and pin, align the shifter shaft.

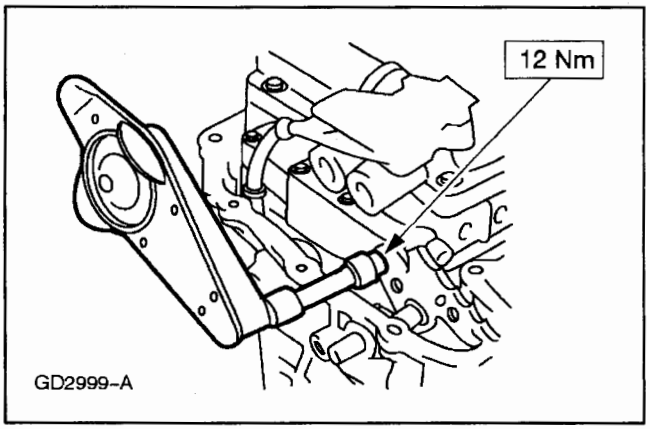


8. Move the manual valve detent lever assembly to the D position.

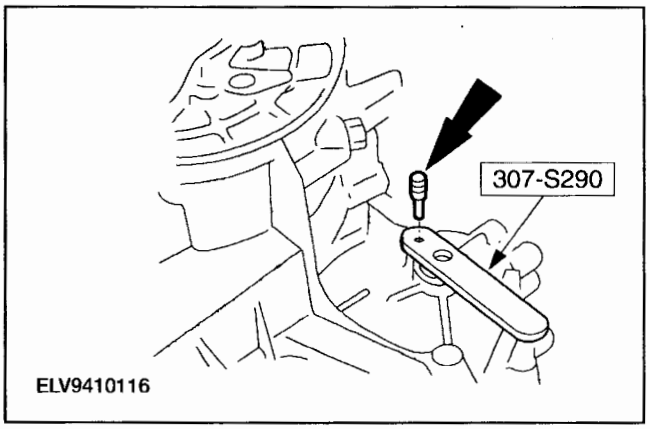


9. Tighten the nut on the ball.
   - Remove the shifter pin from the special tool.

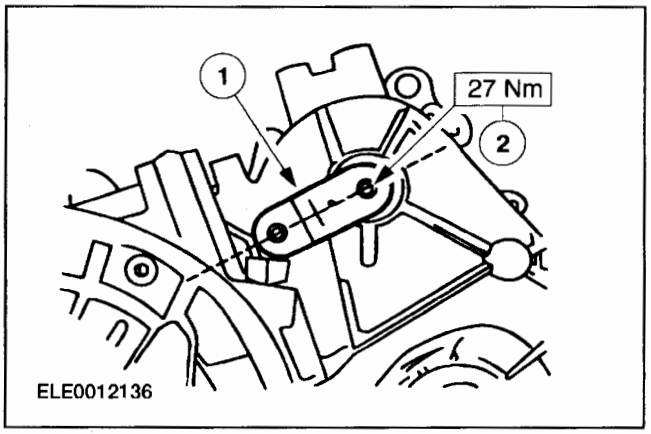
IN-VEHICLE REPAIR (Continued)



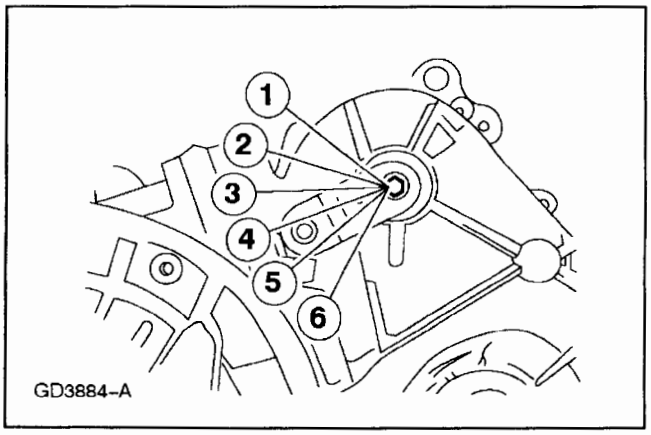
10. Rotate the special tool until the socket can be fitted on nut.
    - Tighten the detent nut.
    - Rotate back to the D position and check the adjustment.



11. Using the special tool, check the manual control lever assembly settings.

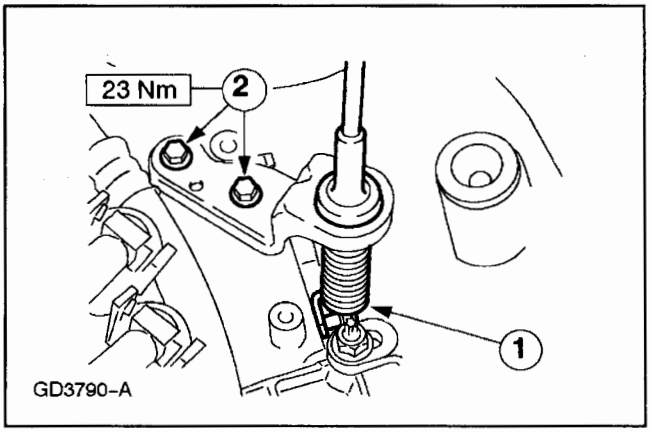


12. Install the manual control lever.
    1 Position the manual control lever.
    2 Tighten the bolt.

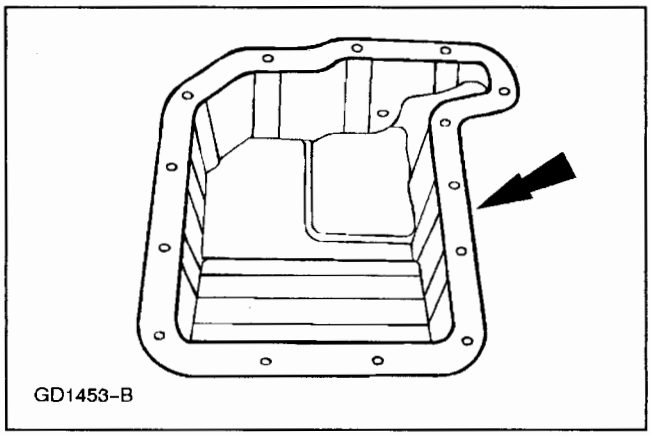


13. Install and rotate the manual valve detent lever assembly to the NEUTRAL position.
    1 Low 1
    2 Low 2
    3 Drive
    4 Neutral
    5 Reverse
    6 Park

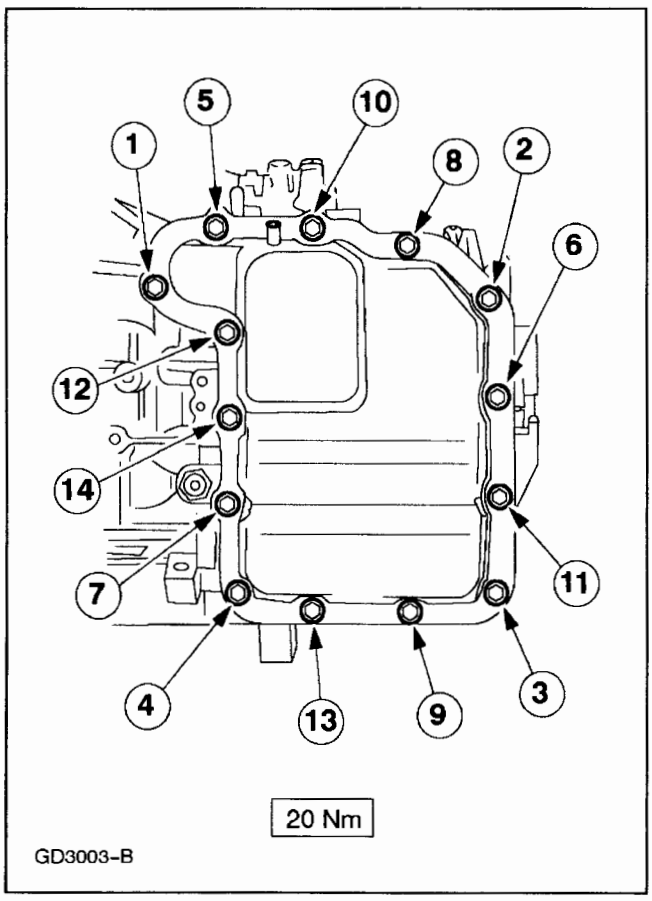
IN-VEHICLE REPAIR (Continued)



14. Connect the shift cable to the control lever.
    1 Install the shift cable.
    2 Install the bolts.



15. Install new gasket on the main control cover before positioning.

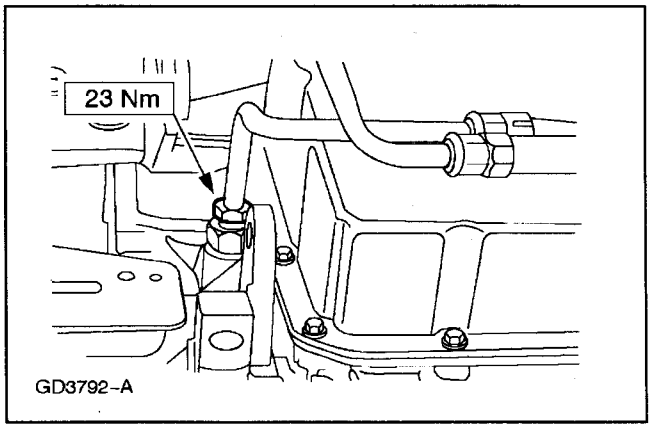


16. **NOTE:** Tighten the bolts in the indicated sequence.

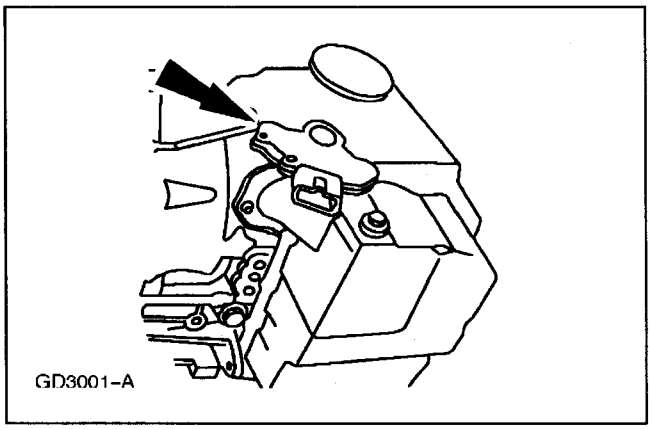
    Install the main control cover.

    - Connect the main control cover vent tube and close clamp.
    - Position main control cover and tighten bolts.

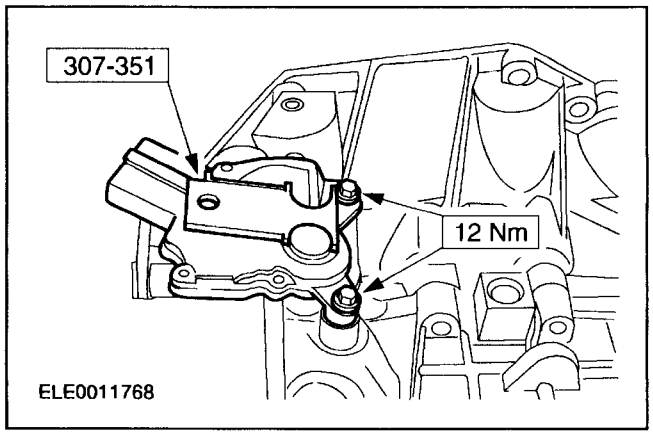
IN-VEHICLE REPAIR (Continued)



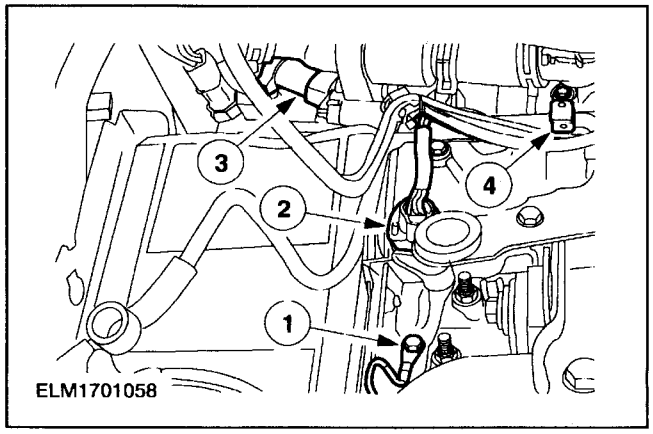
17. **NOTE:** Remove the drain pan.
    Connect the transaxle cooler inlet line.



18. **NOTE:** Do not tighten the TR sensor bolts.
    Install the transmission range (TR) sensor and install the bolts loosely.

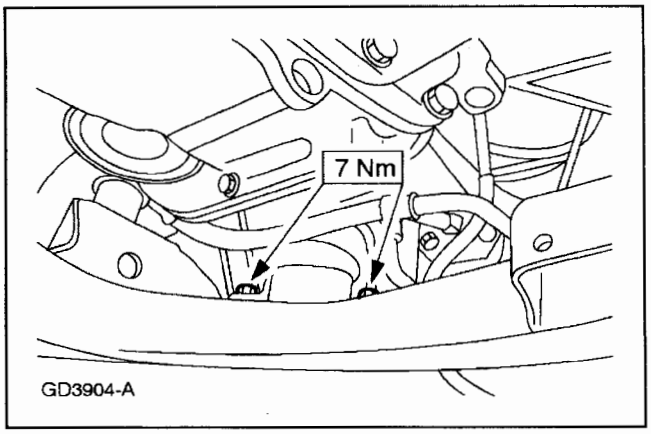


19. Tighten the TR sensor bolts. For additional information, refer to Transmission Range (TR) Sensor.



20. Connect the transaxle harness electrical connector.
    1 Install the ground cable.
    2 Install the solenoid body electrical connector.
    3 Install the TR sensor electrical connector.
    4 Install the wiring harness clip.

IN-VEHICLE REPAIR (Continued)



Vehicles with air conditioning

21. ⚠ **CAUTION: Do not place excessive pressure on tubes/hoses (A/C) and fittings when disconnecting and reconnecting A/C components. Excessive pressure may cause component damage and A/C system leaks.**

    NOTE: On some vehicles, it may be necessary to disconnect and position the suction accumulator out of the way to allow enough room for main control cover removal.

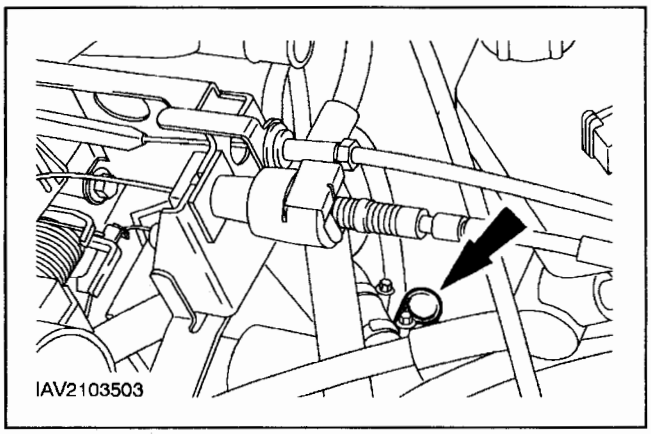
    Position the suction accumulator and install the screws.

All Vehicles

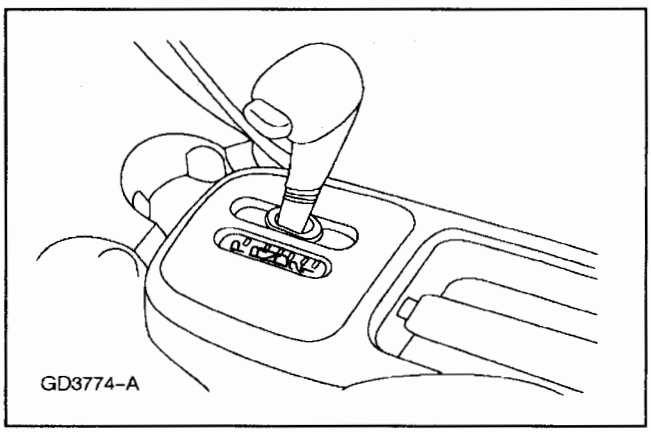
22. Install the battery tray. For additional information, refer to Section 414-01.

23. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 160 km (100 miles) or more to relearn the strategy.

    Connect the battery ground cable.



24. Check the transmission fluid. Add as necessary using clean automatic transmission fluid.



25. Start the engine and move the transaxle range selector lever through all gear positions. Refill as necessary.

IN-VEHICLE REPAIR (Continued)

Turbine Shaft Speed (TSS) Sensor

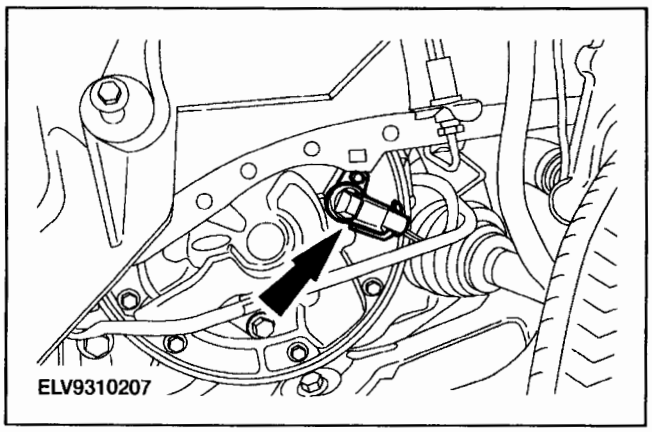
Materials

Item	Specification
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

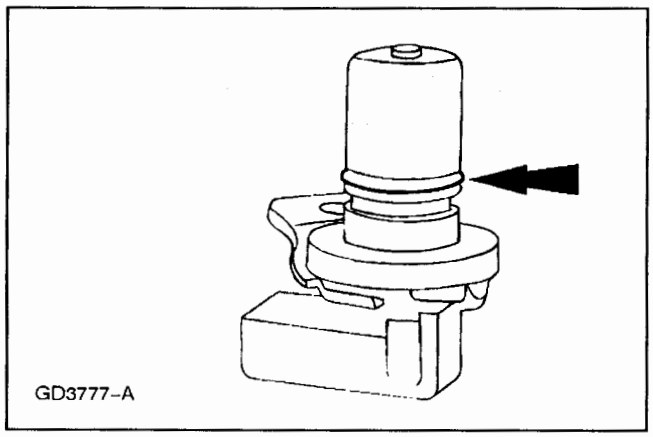
Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02.

2. Place a drain pan beneath the turbine shaft speed (TSS) sensor.



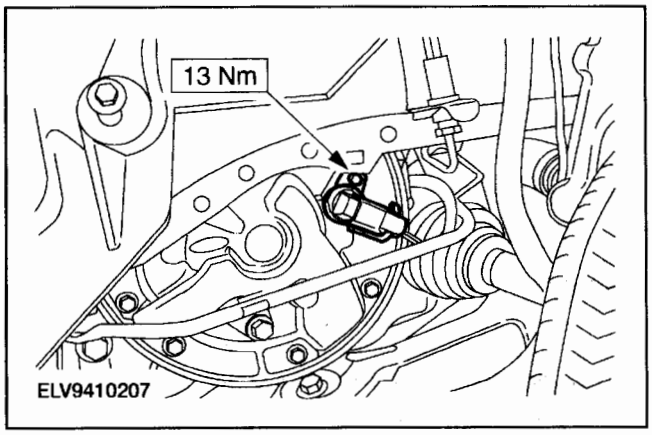
3. Remove the TSS sensor.
   - Disconnect the TSS sensor electrical connector (white plastic).
   - Remove the bolt.
   - Inspect the TSS sensor bore.



4. Inspect the O-ring seal for nicks or cuts; install new as necessary.

IN-VEHICLE REPAIR (Continued)

Installation



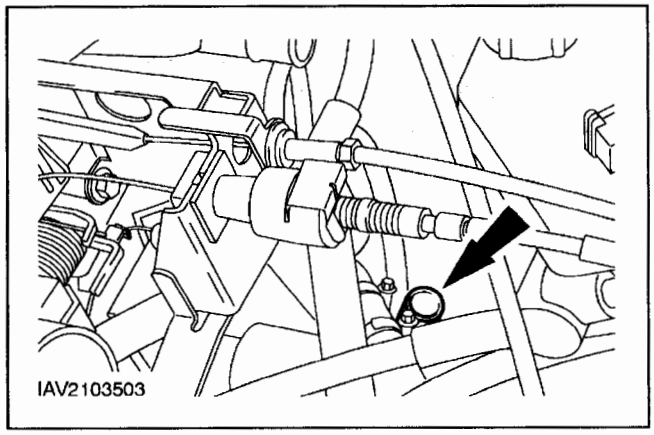
1. **NOTE:** Apply a light coat of petroleum jelly to the O-ring seal before installation.

   Install the TSS sensor.

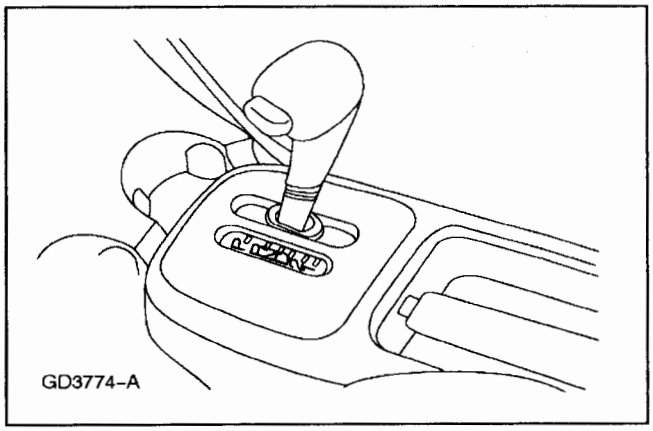
   - Connect the TSS electrical connector (white plastic).

2. Remove the drain pan.

3. Lower the vehicle.



4. Check the transmission fluid level, add automatic transmission fluid.



5. Start the engine and move the transaxle range selector lever through all gear positions.

IN-VEHICLE REPAIR (Continued)

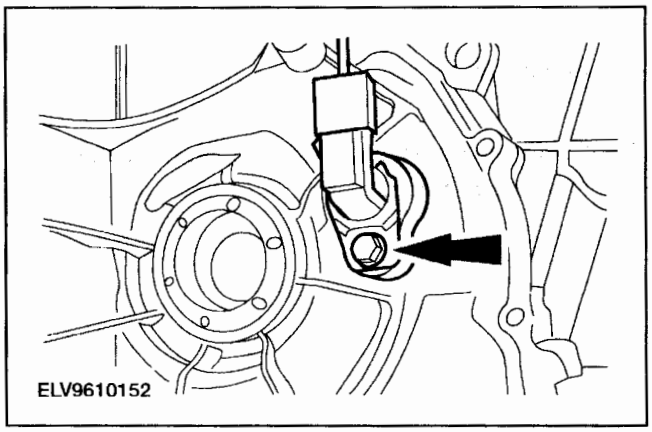
Output Shaft Speed (OSS) Sensor

Materials

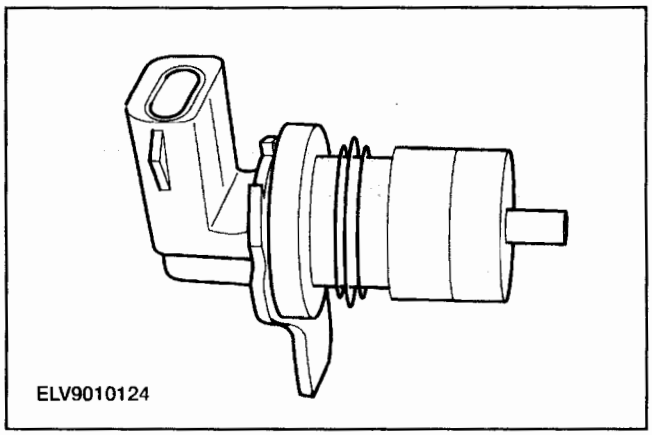
Item	Specification
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02.



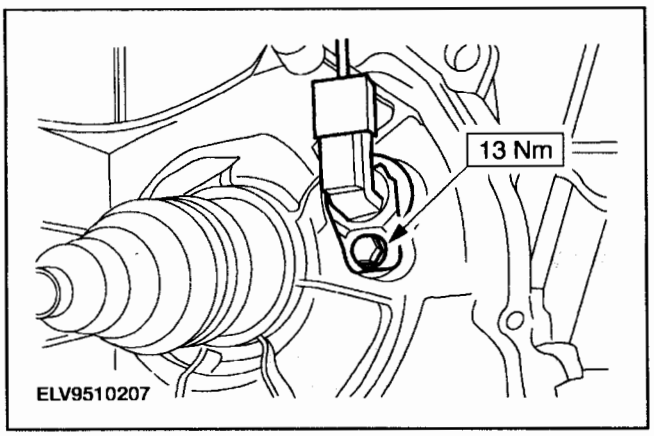
2. Remove the output shaft speed (OSS) sensor.
   - Disconnect the OSS sensor electrical connector.
   - Remove the bolt.
   - Inspect the OSS bore.



3. Inspect the O-ring seal for nicks or cuts. Install a new seal as necessary.

IN-VEHICLE REPAIR (Continued)

Installation

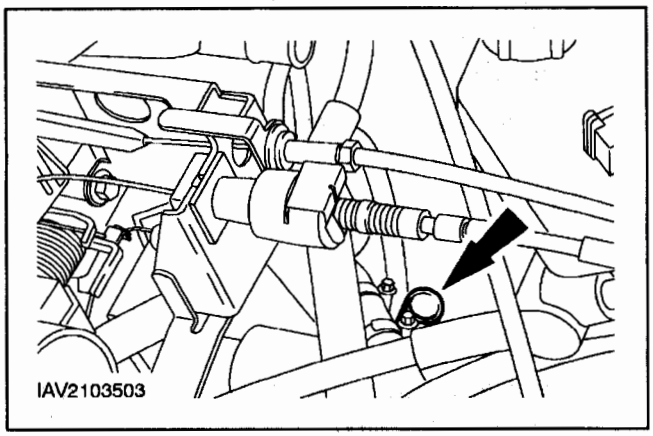


1. **NOTE:** Apply a light coat of petroleum jelly to the O-ring before installation.

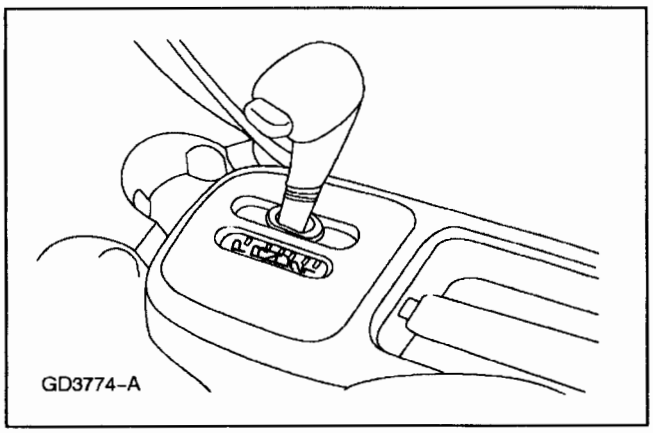
   Install the OSS sensor.

   - Connect the OSS sensor electrical connector.

2. Lower vehicle.



3. Check the transmission fluid level, add automatic transmission fluid.

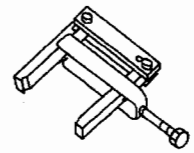
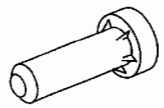


4. Start the engine and move the transaxle range selector lever through all gear positions.

IN-VEHICLE REPAIR (Continued)

Differential Fluid Seals

Special Tool(s)

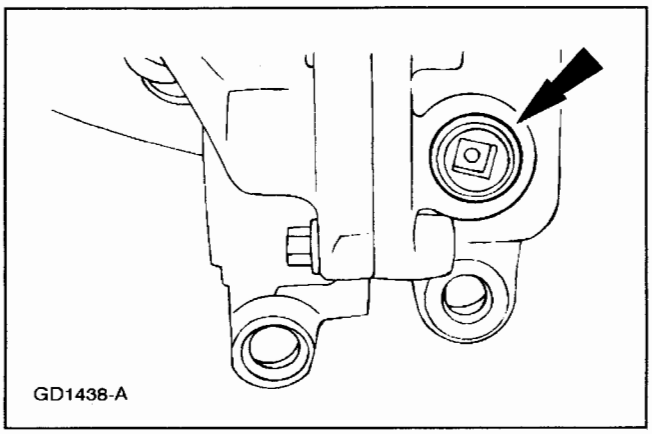
 ST1846-A	Remover, Oil Seal, Converter 307-309 (T94P-77001-BH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1957-A	Installer, Output, Oil Seal, Halfshaft 307-157 (86P-1177-B)

Materials

Item	Specification
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

Removal

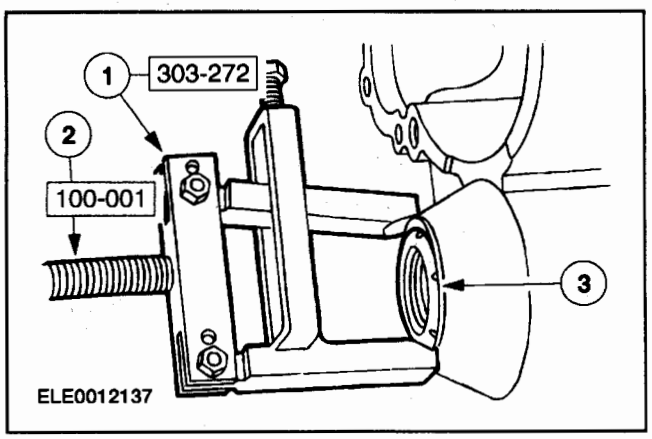
1. Remove LH/RH halfshafts. For additional information, refer to Section 205-04.


GD1438-A

2. **NOTE:** Place a suitable drain pan under the vehicle.

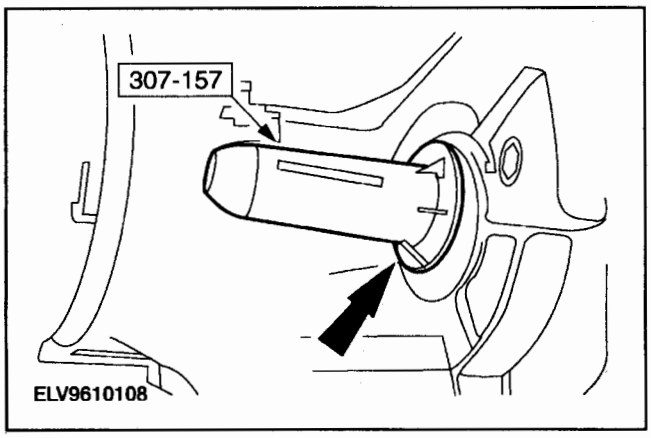
   Remove the transaxle drain plug and drain the fluid.

IN-VEHICLE REPAIR (Continued)



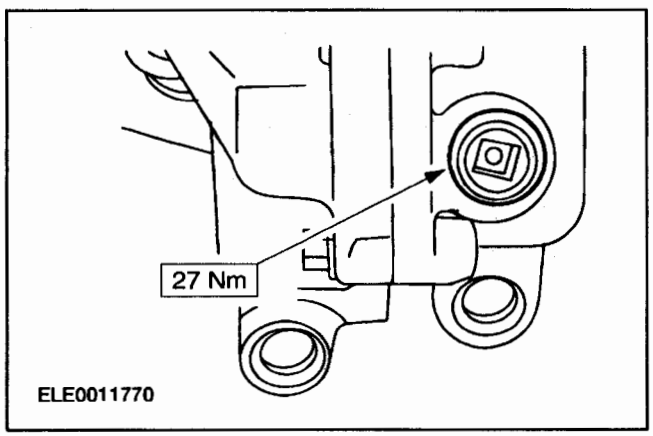
3. Remove and discard the differential seal(s).
   1 Install the special tool.
   2 Install the special tool.
   3 Remove and discard the differential seal(s).

Installation



1. Using the special tool, install the differential seal.

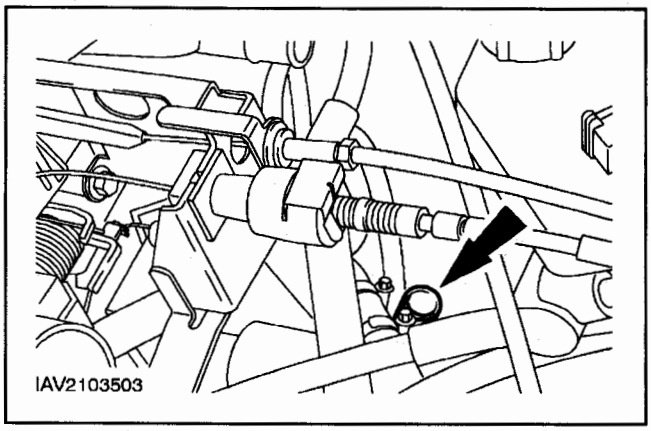
2. Install LH/RH halfshafts. For additional information, refer to Section 205-04.



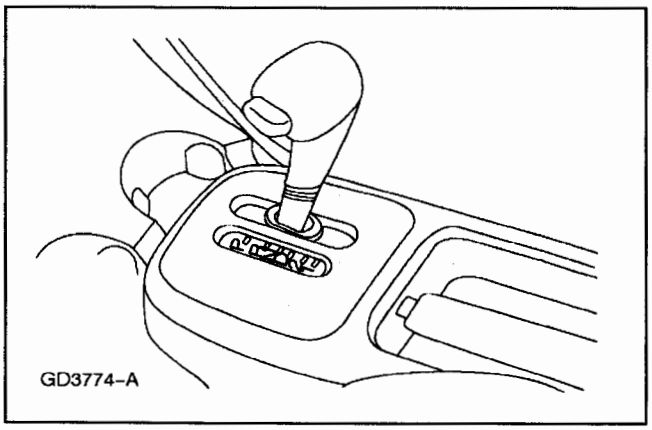
3. Install the transaxle drain plug.

4. Remove the drain pan and lower the vehicle.

IN-VEHICLE REPAIR (Continued)



5. Add automatic transmission fluid.



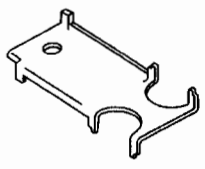
6. Start the engine and move the transaxle range selector lever through all gear positions. Refill as necessary.

7. Allow the transmission fluid to reach operating temperature and fill as necessary.

8. Test drive the vehicle.

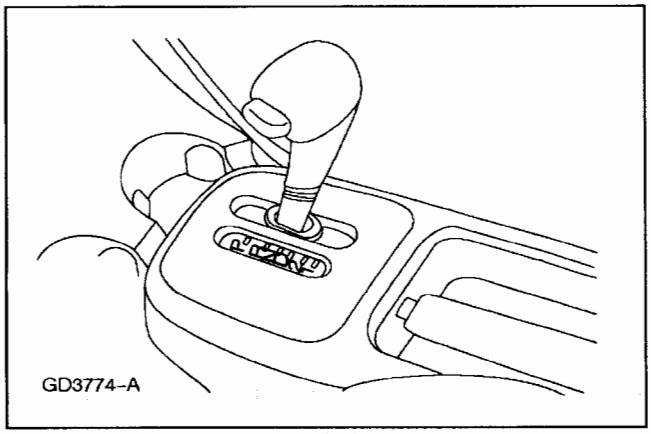
Transmission Range (TR) Sensor

Special Tool(s)

 307-351	TRS Alignment Tool 307-351 (T97L-70010-A)

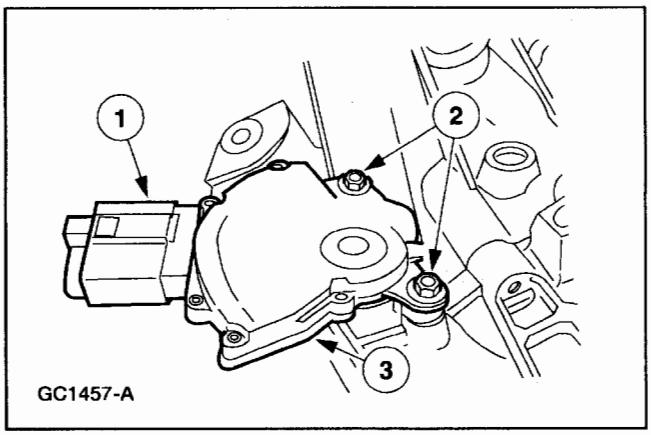
IN-VEHICLE REPAIR (Continued)

Removal



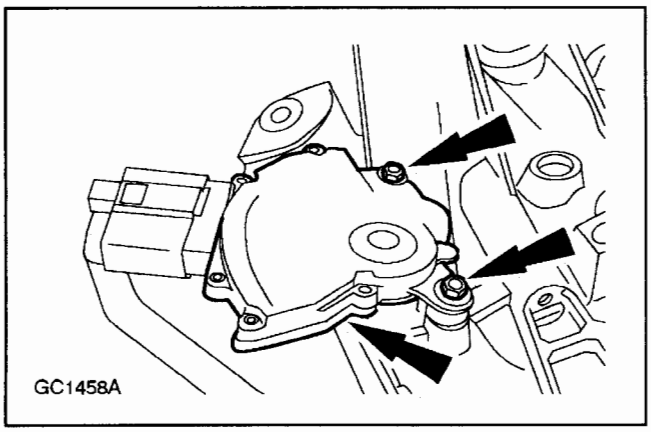
1. Disconnect the battery ground cable. Place the vehicle in NEUTRAL.

2. Remove the battery tray. For additional information, refer to Section 414-01.



3. Remove the transmission range (TR) sensor.
   1 Disconnect the TR electrical connector.
   2 Remove the bolts.
   3 Remove the TR sensor.

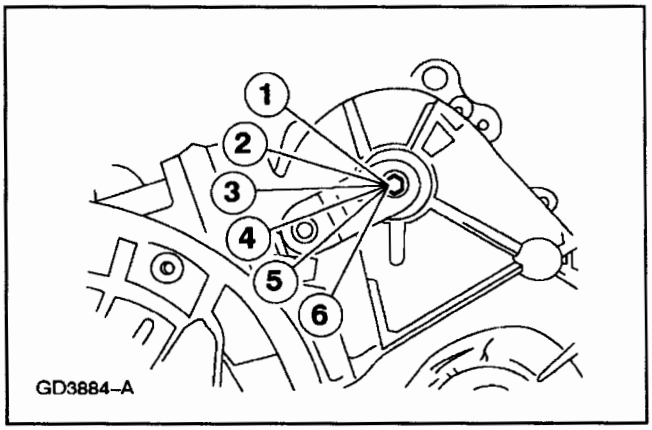
Installation



1. **NOTE:** Make sure the transaxle is in the NEUTRAL position.

   Position the transmission range (TR) sensor and loosely install the bolts.

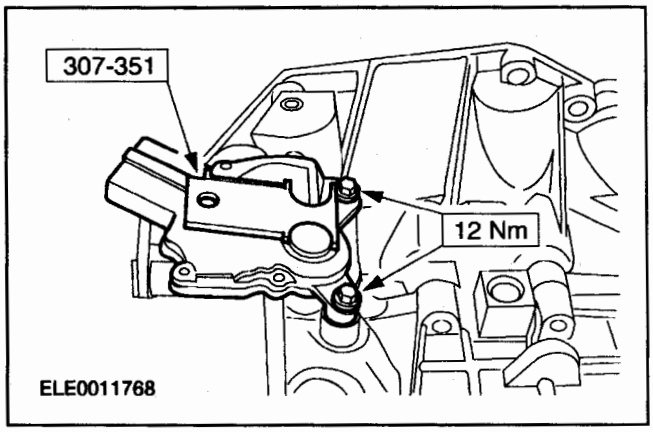
IN-VEHICLE REPAIR (Continued)



2. **NOTE:** As necessary, move the manual control lever to N position for TR sensor adjustment.

   Rotate the manual valve detent lever assembly to the NEUTRAL position.

   1 Low 1
   2 Low 2
   3 Drive
   4 Neutral
   5 Reverse
   6 Park



3. Install the TR sensor.
   - Using the special tool, align the TR sensor.
   - Tighten the bolts and remove the special tool.
   - Connect the electrical connector.

4. Install the battery tray. For additional information, refer to Section 414-01.

5. **NOTE:** When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 Km (10 miles) or more to relearn the strategy.

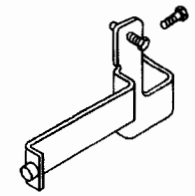
   Connect the battery ground cable.

6. Check the correct operation with the parking brake control engaged. The engine should start only in PARK or NEUTRAL. Backup lamps should be active only in the REVERSE position.

IN-VEHICLE REPAIR (Continued)

Overdrive Servo

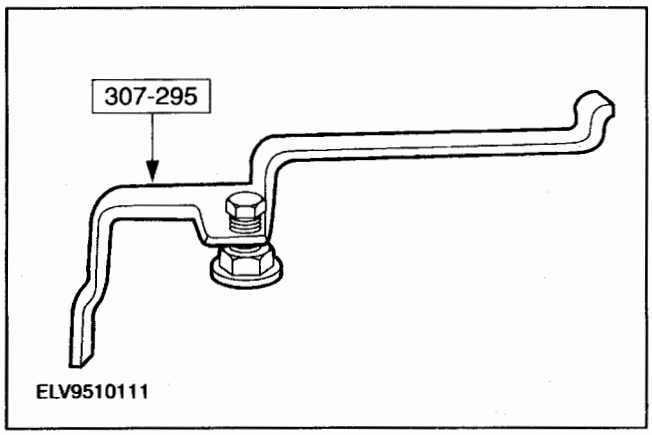
Special Tool(s)

 ST1845-A	Remover/Installer, Servo Cover 307-295 (T94P-77000-L)

Removal

NOTE: Servicing the intermediate and overdrive servo in the vehicle is only recommended in the event of a leak. If servicing is required due to a servo condition, it is necessary to remove and disassemble the transaxle to inspect the intermediate and overdrive band assembly and direct clutch for damage.

1. Raise and support the vehicle. For additional information, refer to Section 100-02.

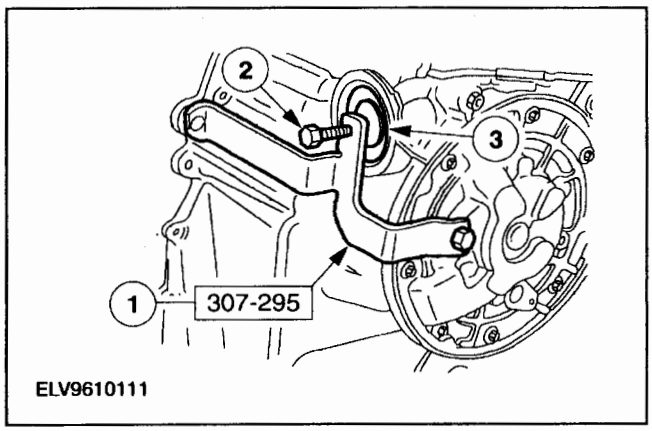


ELV9510111

2. ⚠ **WARNING: The servo is under pressure.**

   ⚠ **WARNING: The servo and servo cover are under high spring force. Use caution when removing the servo cover. Failure to follow these instructions may result in personal injury.**

   Assemble the special tool.



ELV9610111

3. ⚠ **CAUTION: Use only snap ring pliers to install the retaining ring. Failure to follow this instruction may result in damage to the case.**

   Using the special tool, remove the servo assembly.

   1 Install the special tool.

   2 Compress the servo assembly by tightening the bolt.

   3 Remove the retaining ring.

4. Remove the servo cover assembly.

IN-VEHICLE REPAIR (Continued)

5. Remove the intermediate and overdrive servo piston and return spring.

6. Using a lint free cloth wipe the servo piston and servo cap cover.

7. ⚠ **CAUTION: Do not use cleaning solvent to clean the rubber sealing surfaces of the servo piston or servo cover cap. Failure to follow this instruction may result in damage to the sealing surfaces.**

   NOTE: Check for damage in the area where the servo piston connects to the servo rod.

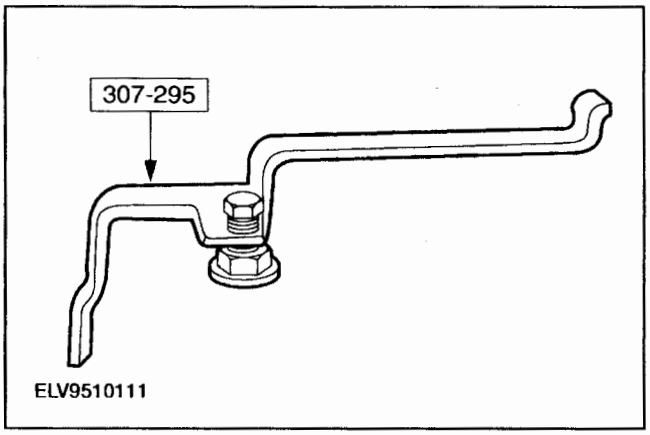
   Inspect the servo piston for cracks to the pressure and sealing surfaces.

8. **NOTE:** If the lip of the servo piston is brittle install a new servo piston.

   Check the servo piston lip.

9. Inspect the servo retainer spring for cracks, breaks or deformation.

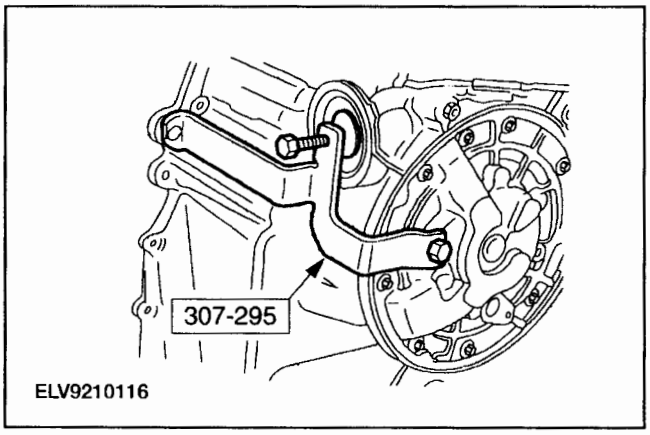
Installation



ELV9510111

1. ⚠ **WARNING: Servo return spring force is very high. Failure to follow these instructions may result in personal injury.**

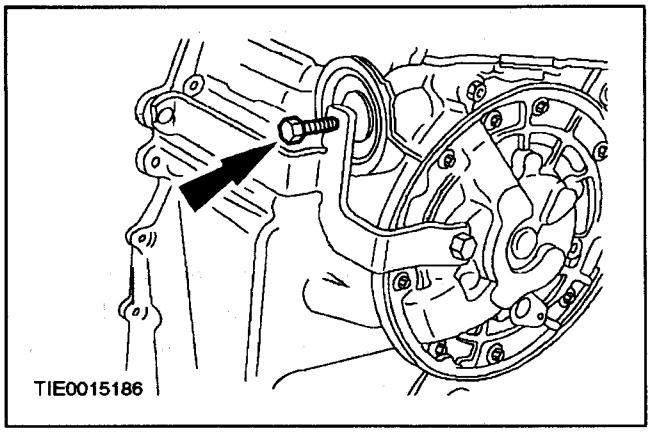
   Assemble the special tool.



ELV9210116

2. Install the special tool.

IN-VEHICLE REPAIR (Continued)



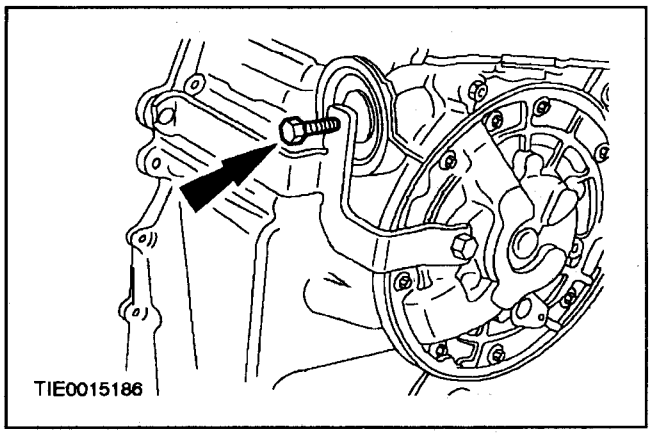
3. **⚠ CAUTION: If the case is stamped with a WG, install a wide groove snap ring. Failure to follow this instruction may result in damage to the servo.**

   ⚠ CAUTION: Use only snap ring pliers to install the retaining ring. Failure to follow this instruction may result in damage to the case.

   NOTE: If the servo cover will not seat deep enough in the bore to install the servo cover retaining ring, use a blunt punch or small hammer and gently tap the cover around the outer edge until the servo cover retaining ring can be installed.

   Tighten the special tool bolt.

   - Install the retaining ring.



4. Loosen the special tool bolt.
   - When spring tension is released remove the special tool.

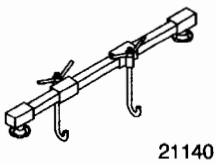
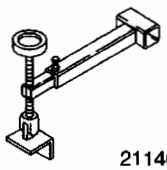
5. Lower the vehicle.

6. Check the fluid level prior to road testing.

REMOVAL

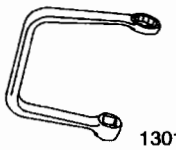
Transaxle

Special Tool(s)

 21140	Support Bar, Engine 303-290A
 2114003	Adapter for 303-290A 303-290A-03A
 ST1636-A	Remover, Torque Converter 307-346 (T97T-7902-A)
 T70P-6000	Lifting Bracket, Engine 303-050 (T70P-6000)

(Continued)

Special Tool(s)

 13013	Wrench, Steering Gear 211-202 (T97P-3504-A)
 ST1185-A	Slide Hammer 100-010 (T50T-100-A)
 ST1582-A	Remover, Halfshaft 205-241 (T86P-3514-A)

General Equipment

Auxiliary plugs
Securing straps
Transmission Jack
CD4E Transaxle Adapter
Rotunda Powertrain Lift

Materials

Item	Specification
Cable ties	—

Removal

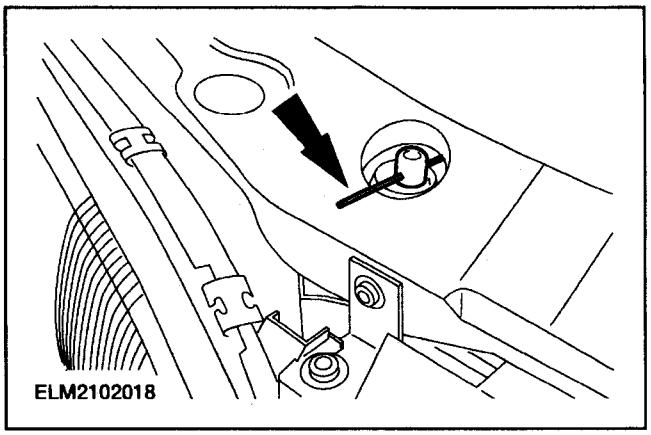
All vehicles

1. General instructions
   - The locations of engine mountings and engine support insulators are described looking from the automatic transaxle to the engine.

REMOVAL (Continued)

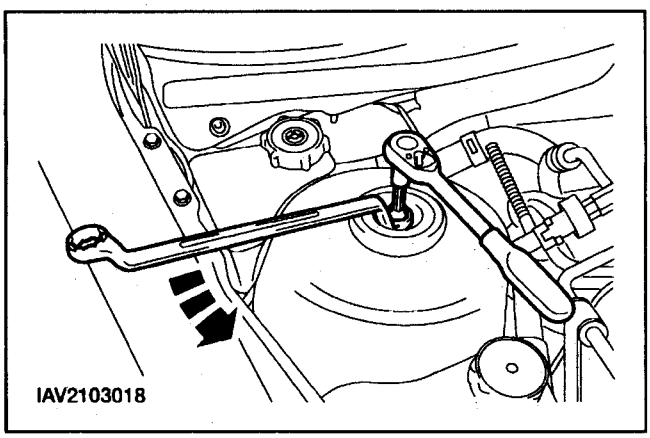
2. Standard preparatory measures
   - Move the selector lever to Ⓓ position.
   - Make a note of the radio keycode.
   - Make a note of the preset radio stations.

3. Remove the battery tray. For additional information, refer to Section 414-01.



4. Fix the radiator in position on both sides (left-hand side shown).

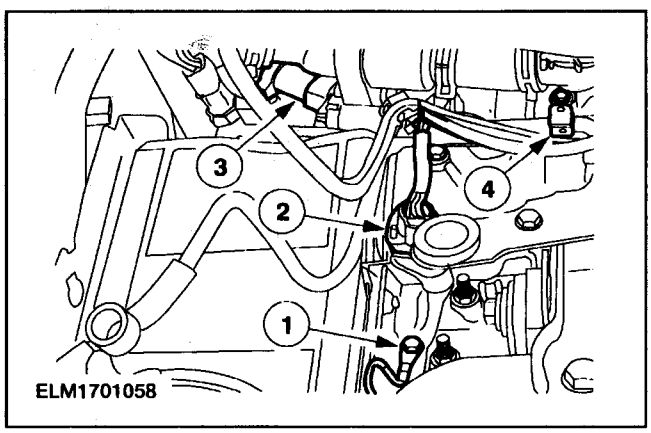
5. Remove the air cleaner. For additional information, refer to Section 303-12B.



6. **NOTE:** Use an Allen key to prevent the piston rod from turning.

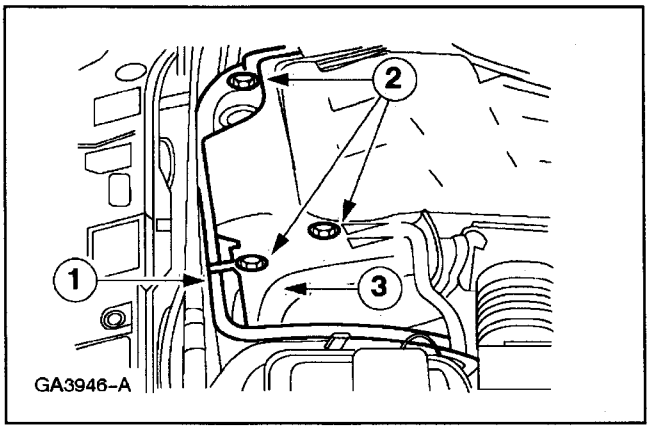
   Loosen the suspension strut locknuts five turns on both sides (right-hand side shown).

7. Loosen the wheel nuts on both front wheels.

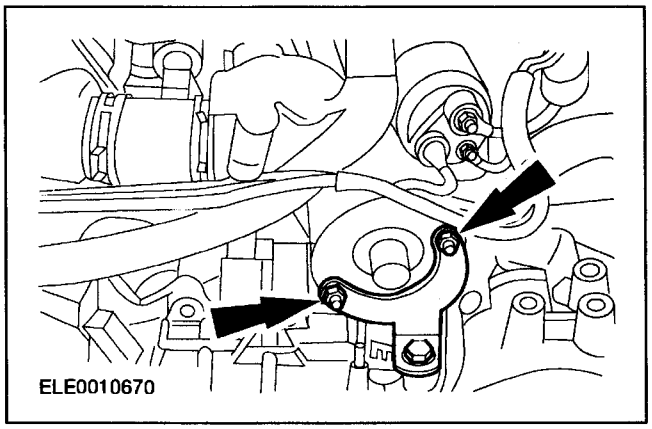


8. Disconnect the electrical connections.
   1 Ground cable
   2 Automatic transaxle control
   3 Transmission range (TR) switch
   4 Wiring harness retaining clip

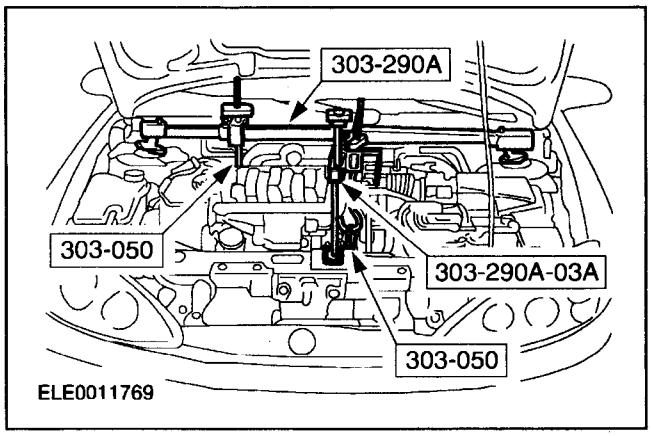
REMOVAL (Continued)



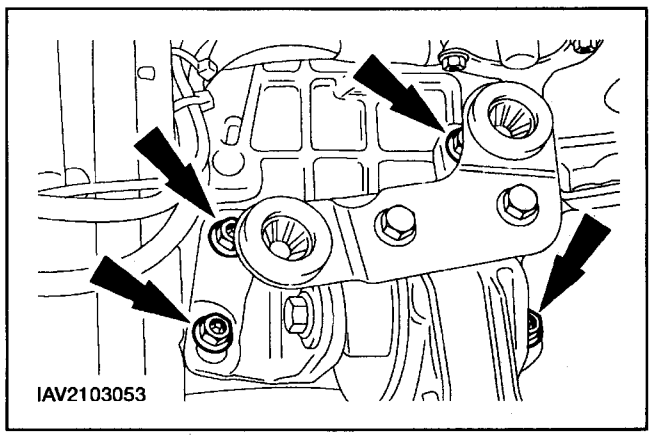
9. Remove the water pump cover.
   1 Disconnect the engine coolant hose.
   2 Remove the bolts.
   3 Remove the water pump cover.



10. **NOTE:** Starter motor to remain in vehicle temporarily.
    Remove the starter motor bolts.

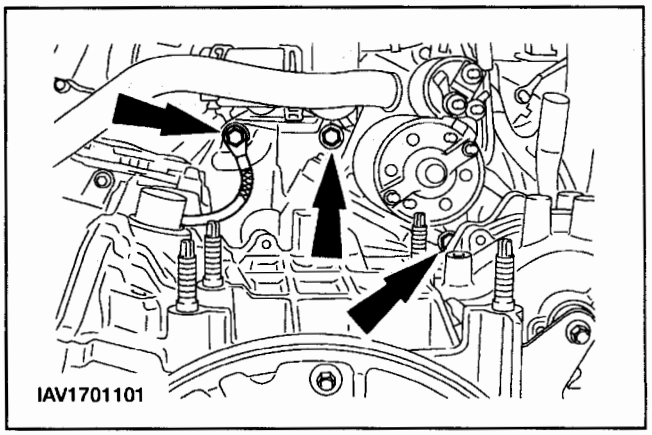


11. Install the special tools.

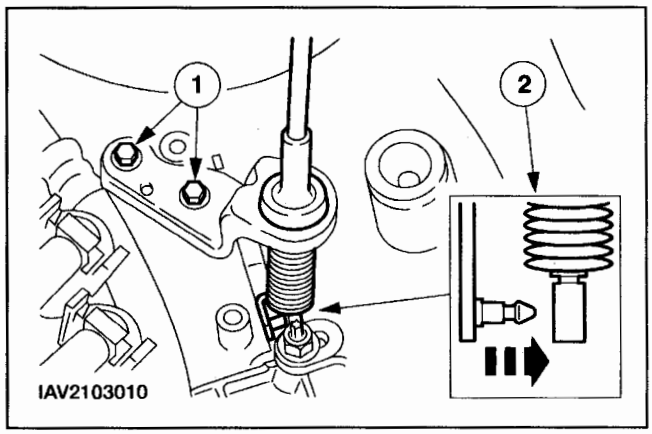


12. Remove the transaxle rear support insulator bracket.

REMOVAL (Continued)



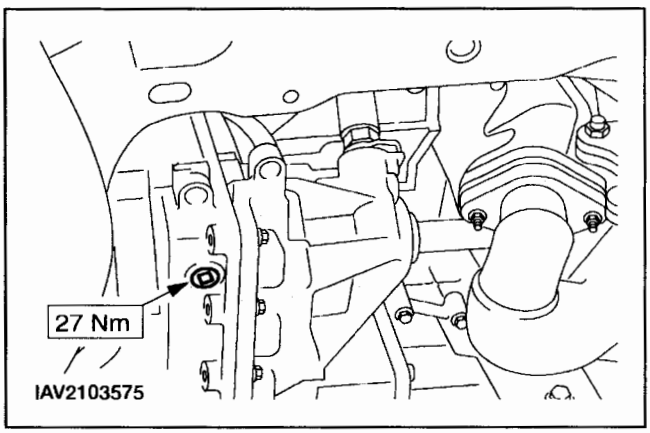
13. **NOTE:** Engine ground cable.
    Remove the upper bellhousing bolts.



14. Disconnect the selector cable from the transaxle.
    1 Bracket
    2 Selector lever selector cable

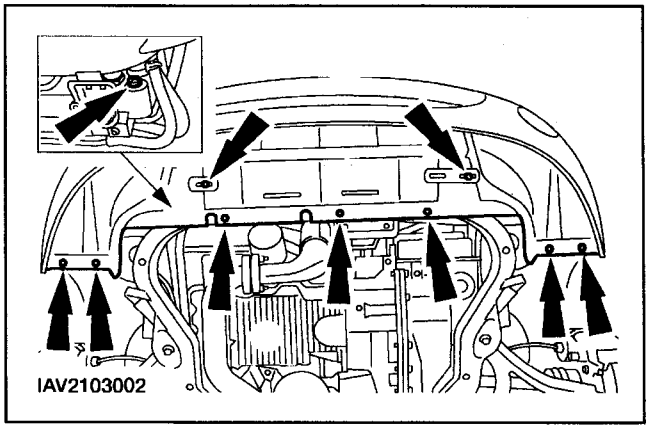
15. Raise and support the vehicle. For additional information, refer to Section 100-02.

16. Remove both front wheels.

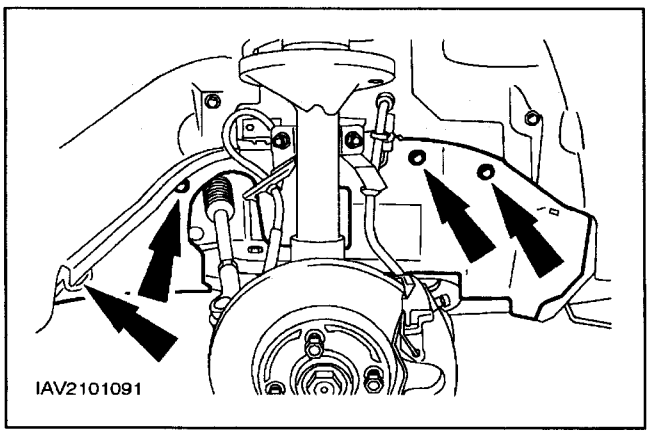


17. Drain the automatic transmission fluid.
    - Place suitable pan under the transaxle.
    - Retighten the drain plug.

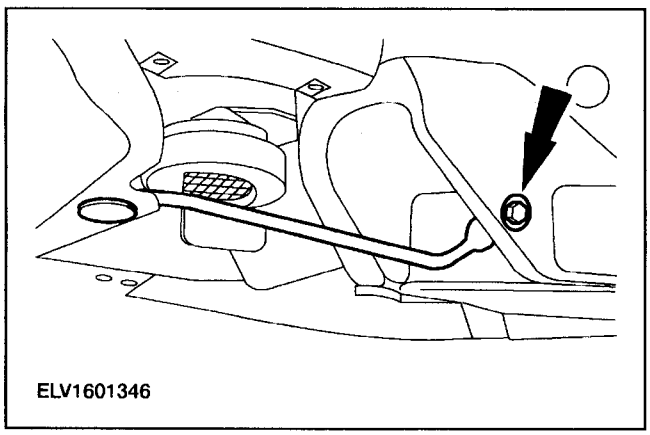
REMOVAL (Continued)


IAV2103002

18. Remove the radiator splash shield.
    - Remove the bolts and clips.

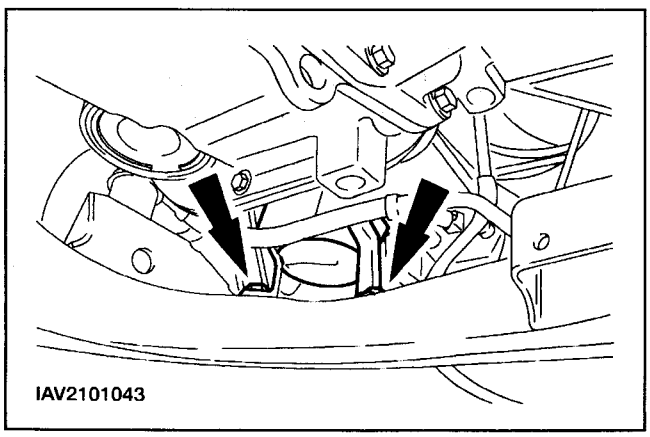

IAV2101091

19. Remove the right-hand fender splash shields.


ELV1601346

20. **NOTE:** Rotate the bumper bracket forward.
    Remove the bumper bracket on both sides from the sub-frame (left-hand side shown).

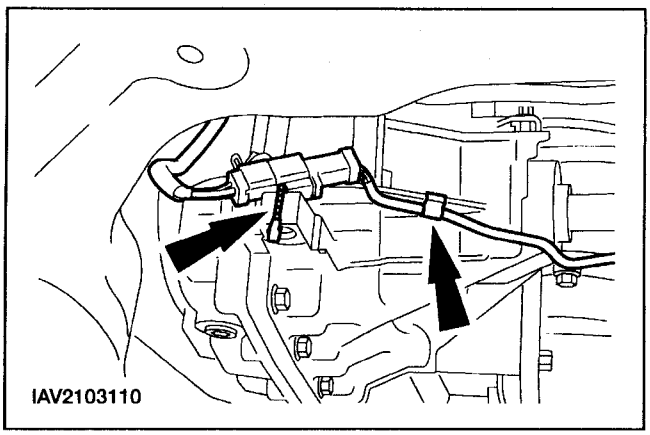
Vehicles with air conditioning


IAV2101043

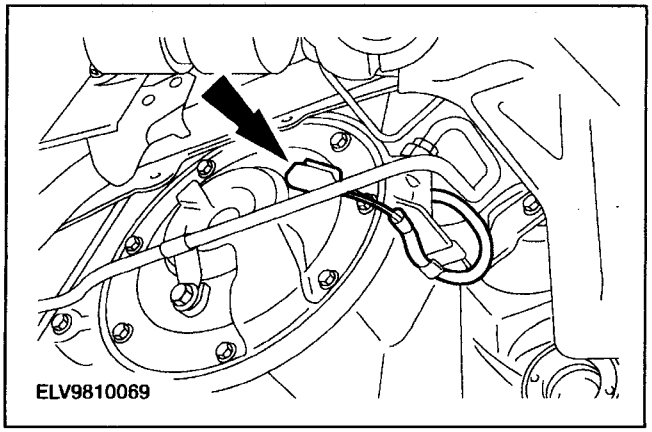
21. Remove the suction accumulator bracket bolts.

REMOVAL (Continued)

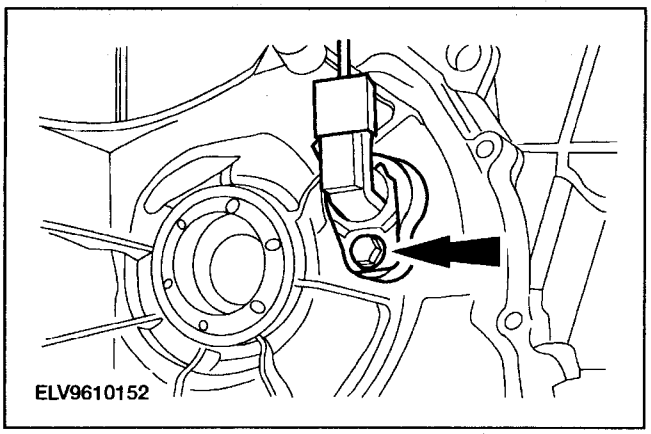
All vehicles



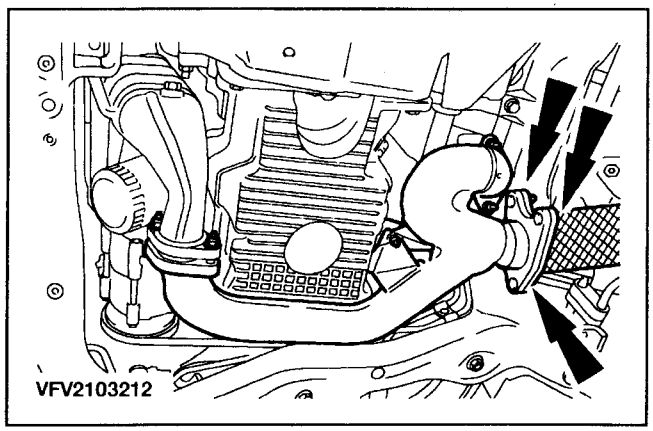
22. Disconnect the heated oxygen sensor (HO2S) electrical connector.
    - Separate the cable ties.



23. Disconnect the turbine shaft speed (TSS) sensor electrical connector (shown from below).
    - Unclip the cable.

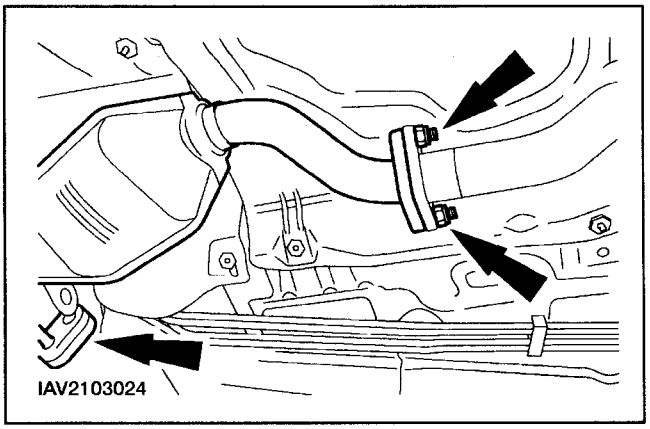


24. Disconnect the output shaft speed (OSS) sensor electrical connector.

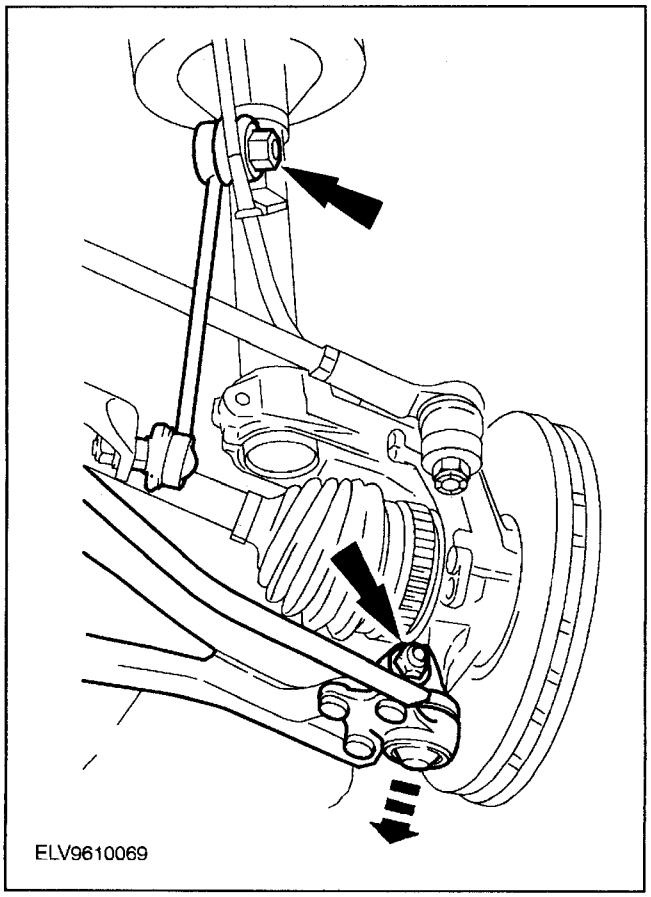


25. **⚠ CAUTION: Overbending of the flexible pipe may cause damage resulting in failure.**
    Remove the flexible pipe from the exhaust manifold.
    - Remove the gaskets.

REMOVAL (Continued)



26. Remove the flexible pipe and the TWC continuation.
    - Discard the gaskets.

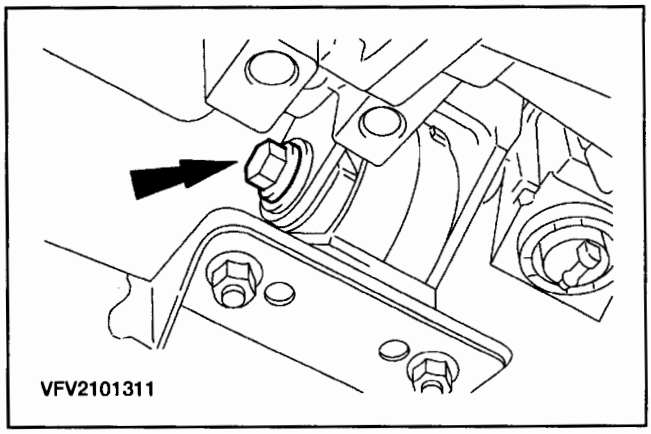


27. ⚠ **CAUTION: Do not damage the boot or the ABS sensor ring.**

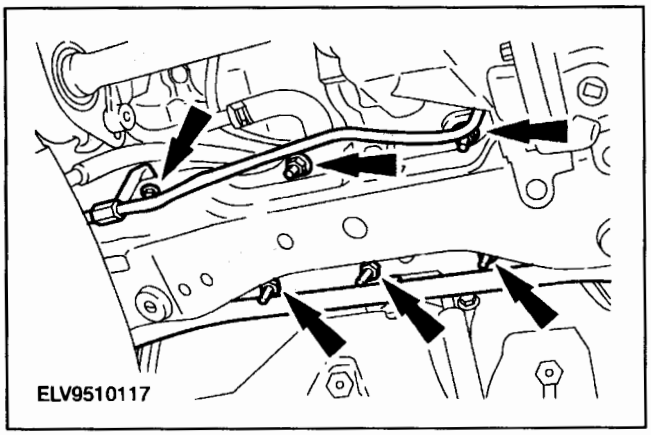
    Disconnect the lower suspension arm ball joints and the stabilizer link rods (right-hand side shown).
    - Disconnect the ABS wiring harness bracket from the suspension strut.

28. Raise the automatic transaxle assembly slightly using the transmission jack.

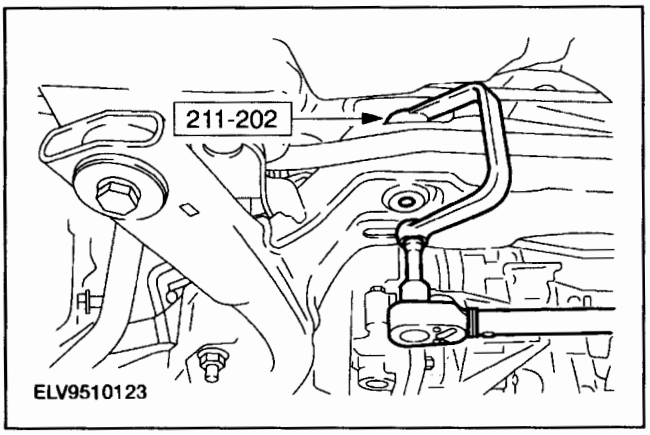
REMOVAL (Continued)


VFV2101311

29. Remove the engine left-hand support insulator center bolt.

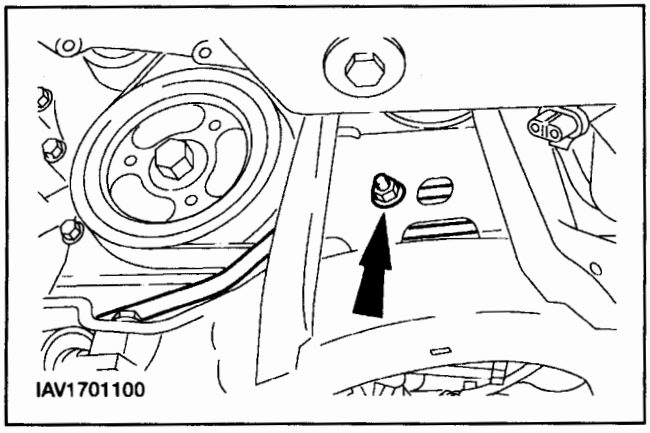

ELV9510117

30. Remove the steering gear heat shield.



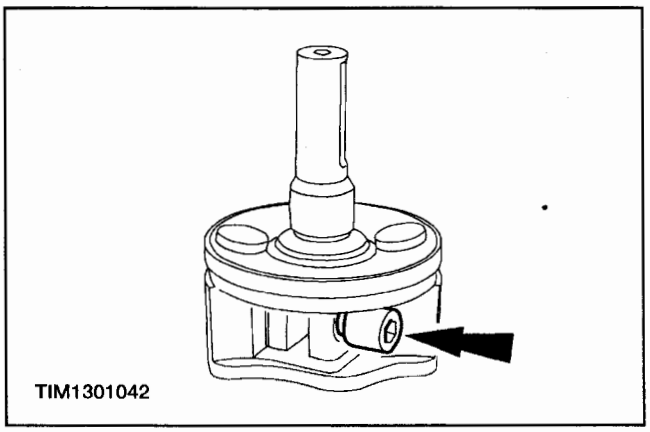
ELV9510123

31. Using the special tool, remove the steering gear (two bolts) and tie it up (left-hand side shown).

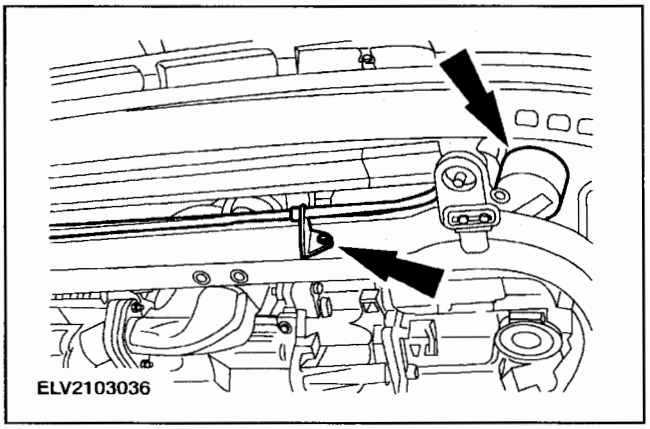

IAV1701100

32. Disconnect the power steering hoses from the subframe (one nut and two bolts).

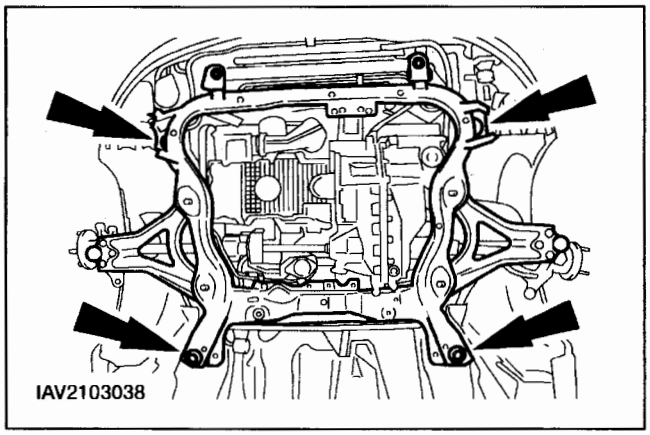
REMOVAL (Continued)


TIM1301042

33. Remove the steering intermediate shaft from the steering gear.

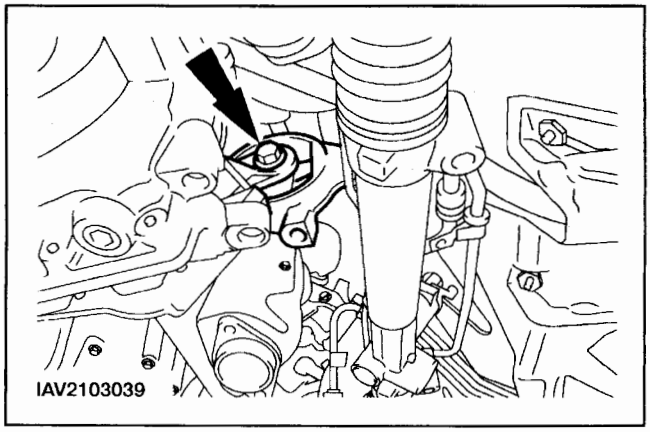

ELV2103036

34. Remove the transaxle cooler line brackets.
    - Reposition the suction accumulator (A/C), if equipped.


IAV2103038

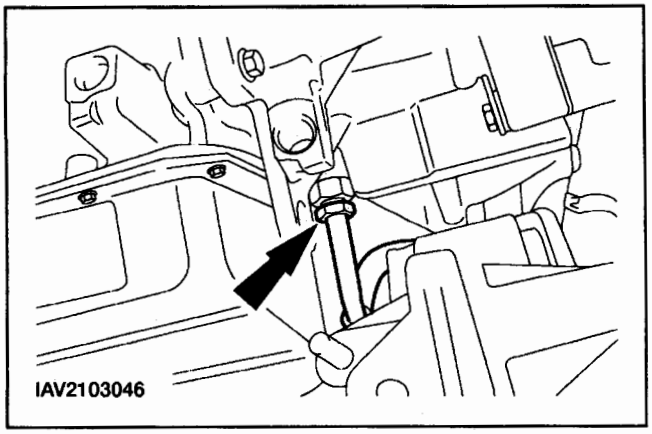
35. **⚠ CAUTION: Support the subframe using Rotunda Powertrain Lift. Place a wooden block approximately one meter (40 inches) in length secured to the lift under the subframe.**

    Remove the sub-frame.


IAV2103039

36. Remove the right-hand roll restrictor center bolt.

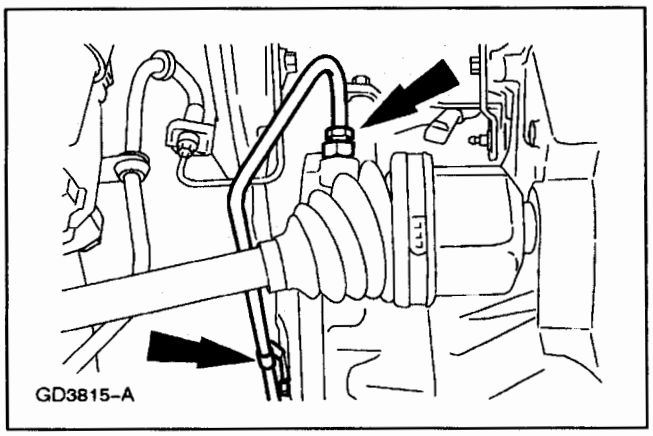
REMOVAL (Continued)



37. **CAUTION: Do not loosen the connector cooler inlet to the transaxle.**

Remove the lower transaxle cooling tube.

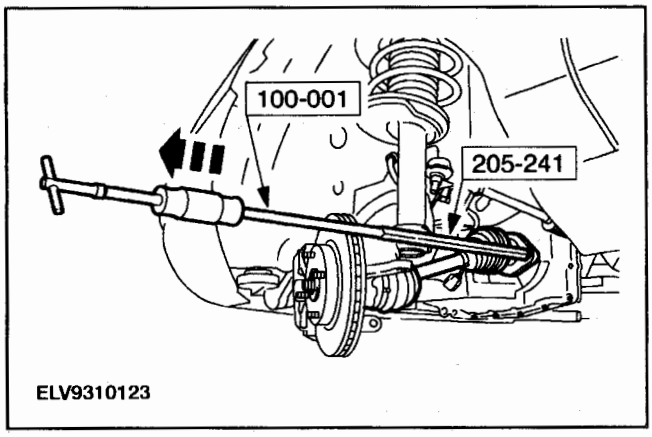
- Close the hole with suitable stuffing.



38. **CAUTION: Do not loosen the connector cooler inlet to the transaxle.**

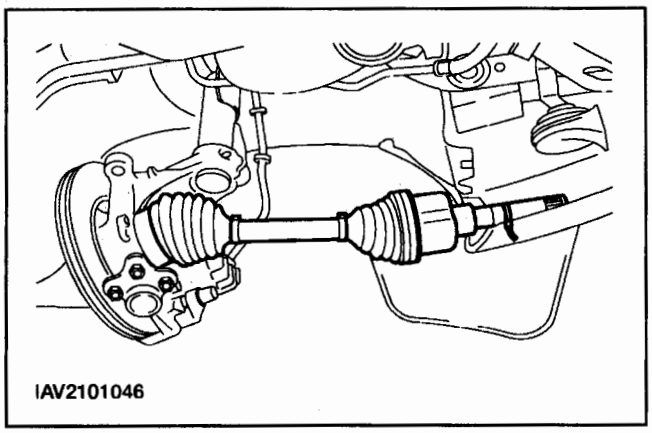
Remove the upper transaxle cooling lines.

- Unclip the transaxle cooling line from hold down.
- Close the hole with a suitable stuffing.



39. **CAUTION: To avoid damage to joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by more than 45 degrees.**

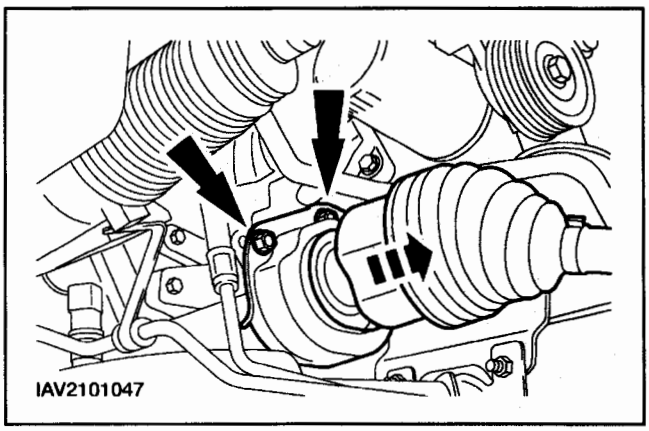
Using the special tools, disconnect the left-hand halfshaft.



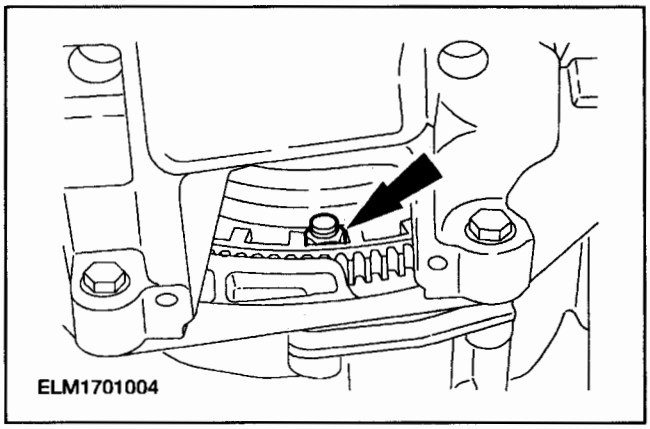
40. **CAUTION: To avoid damage to joints and boots, do not bend the inner halfshaft joint by more than 18 degrees, the outer one by more than 45 degrees.**

Pull out the left-hand halfshaft and tie it up.

REMOVAL (Continued)

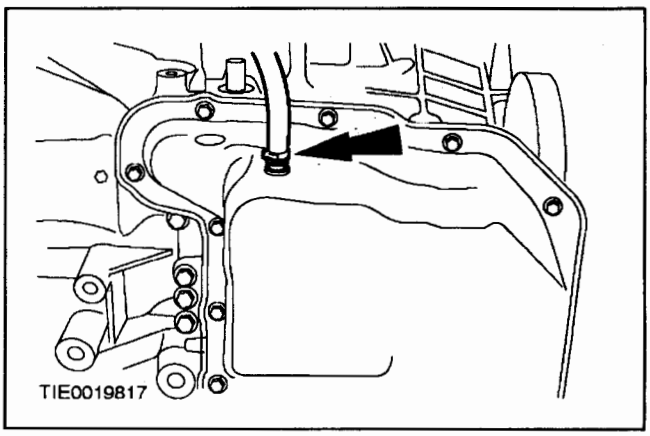

IAV2101047

41. Remove the right-hand halfshaft and intermediate shaft.
    - Secure the right-hand halfshaft out of the way with mechanics wire.


ELM1701004

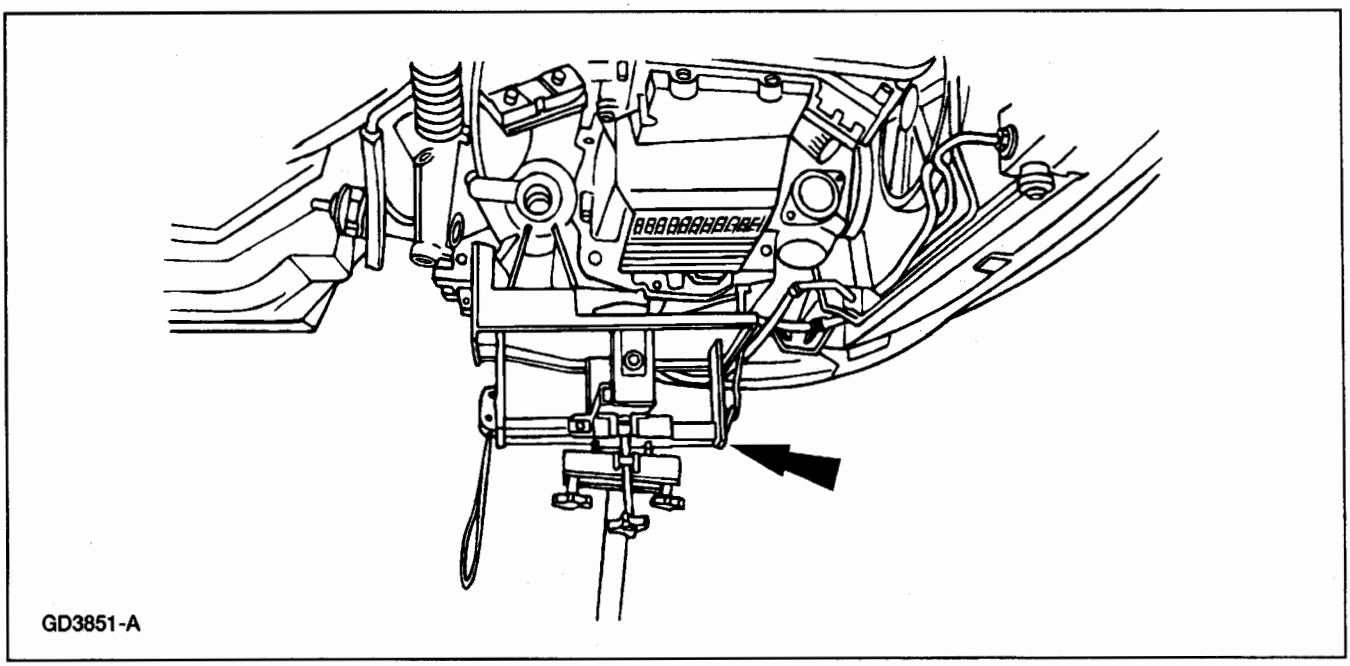
42. **NOTE:** Discard the nuts.

    Remove the torque converter rubber and the four torque converter nuts.
    - Remove rubber cover to gain access to the torque converter nuts.
    - Rotate the torque converter to gain access to remaining nuts.

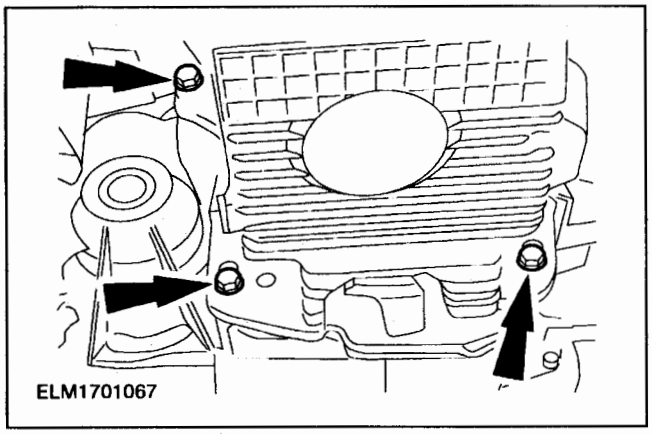

TIE0019817

43. Remove the vent tube.

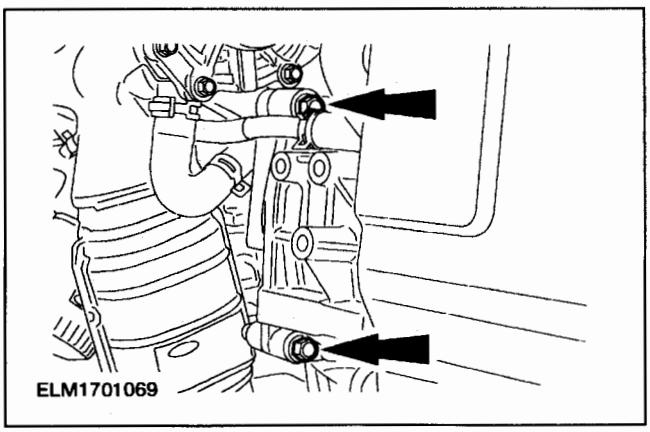
REMOVAL (Continued)


GD3851-A

44. Install the Hi-Lift transmission jack and CD4E transaxle adapter.
    - Secure with the retaining straps.

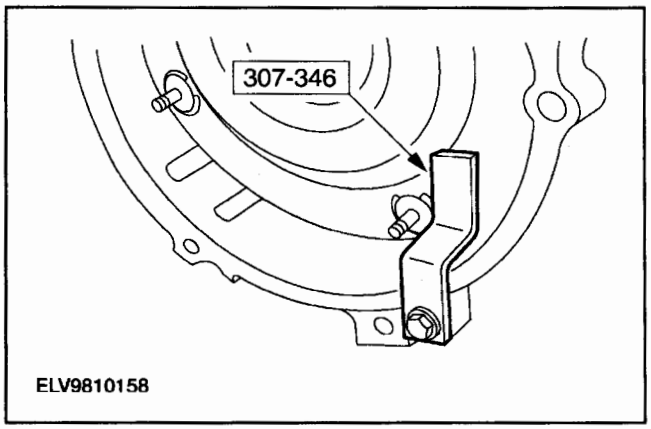

ELM1701067

45. Remove the lower bellhousing bolts.

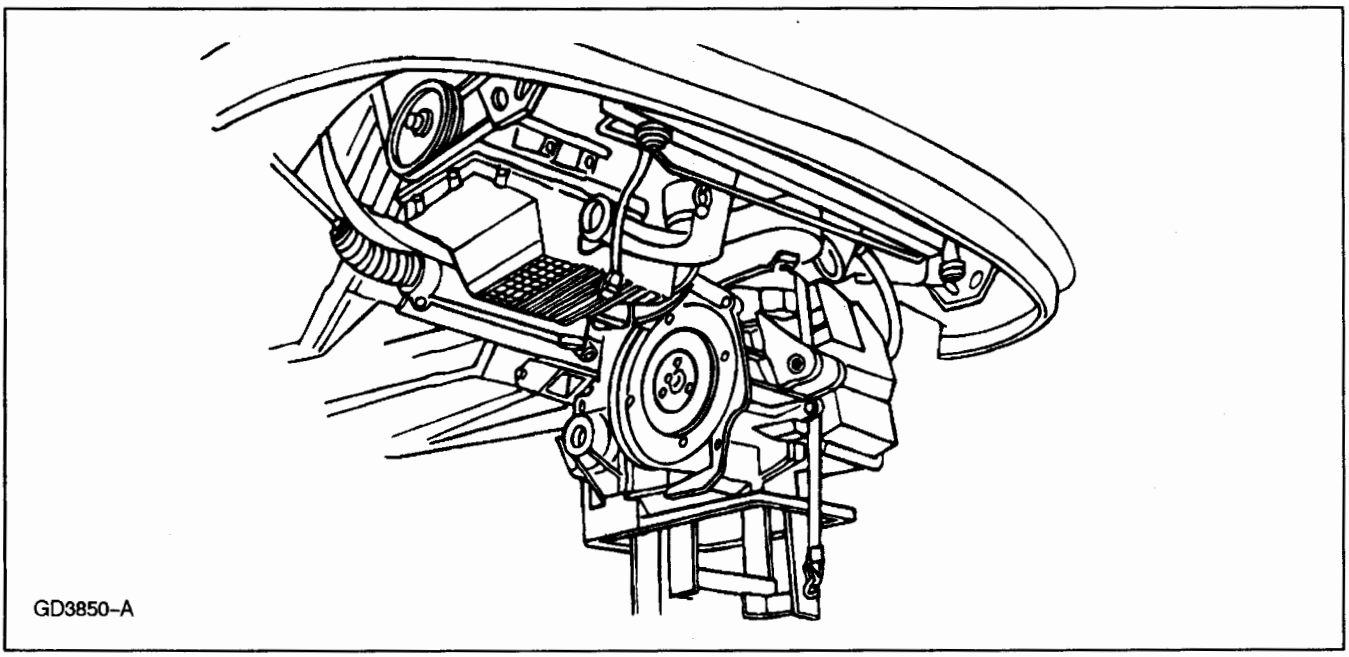

ELM1701069

46. Remove the front bellhousing bolts.

REMOVAL (Continued)



47. ⚠ **CAUTION: The torque converter is heavy. Install the special tool before lowering the transaxle.**
Install the special tool.

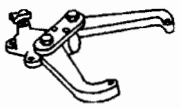
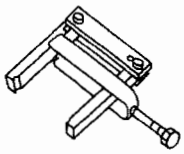
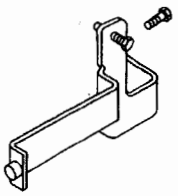
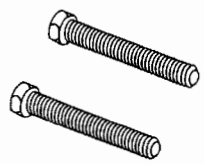


48. Lower the transaxle.

DISASSEMBLY

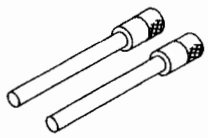
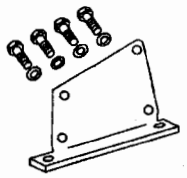
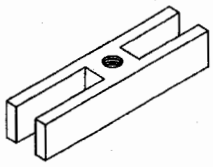
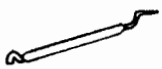
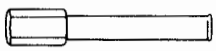
Transaxle

Special Tool(s)

 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1987-A	Actuator Pin, Dia 3/16" 303-D011 (D80L-100-G)
 ST1846-A	Remover, Torque Converter Fluid Seal 307-309 (T94P-77001-BH)
 ST1845-A	Remover/Installer, Servo Cover 307-295 (T94P-77000-L)
 ST1990-A	Remover, Transmission Oil Pump 307-289 (T94P-77000-G)
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

(Continued)

Special Tool(s)

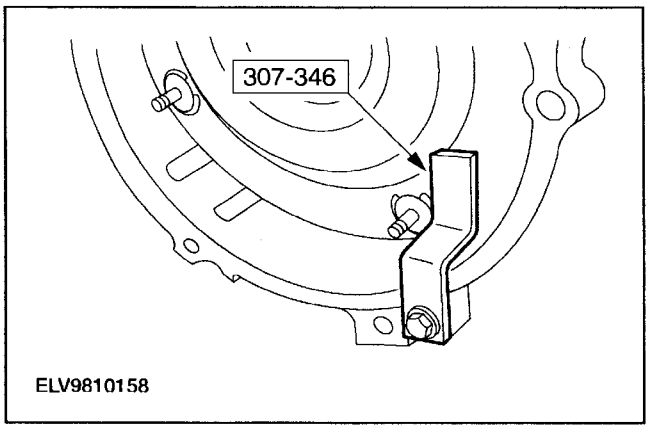
 ST1956-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 7700-A	Holding Fixture, Transmission 307-288 (T94P-77000-F)
 ST2066-A	Cross Block 307-109 (T81P-78103-A)
 ST1219-A	Remover, O-Ring Seal 100-010 (T71P-19703-C)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1988-A	Collet, 3/4" to 7/8" 303-D019 (D80L-100-Q)

DISASSEMBLY (Continued)

Disassembly

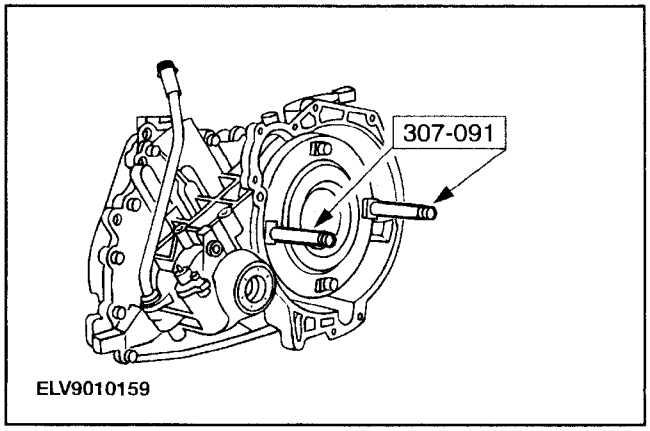
1. **NOTE:** Clean the transaxle assembly to prevent the entry of dirt when reassembling.

   Inspect transaxle during disassembly.



ELV9810158

2. Remove the special tool.

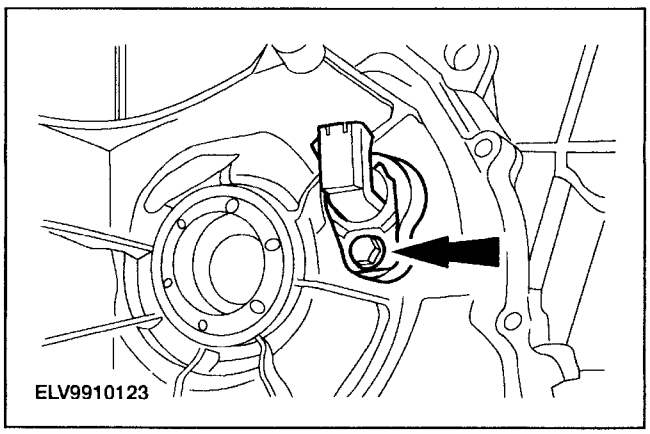


ELV9010159

3. ⚠ **CAUTION: Do not tilt the torque converter when removing it to avoid damaging the torque converter hub.**

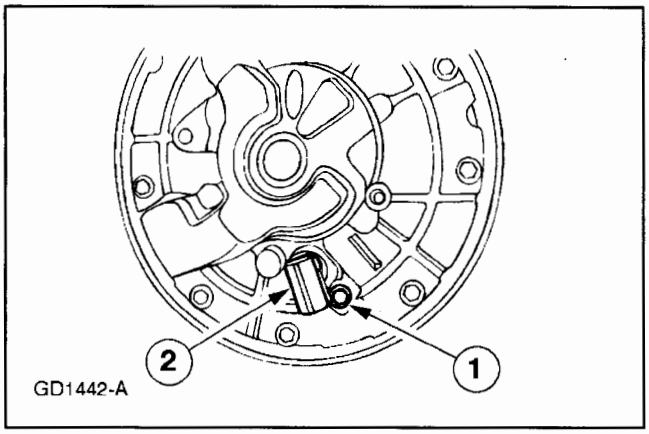
   NOTE: The torque converter is filled with fluid. Position it on a table so that fluid will drain out of the torque converter into a drain pan.

   Using the special tool, remove the torque converter.

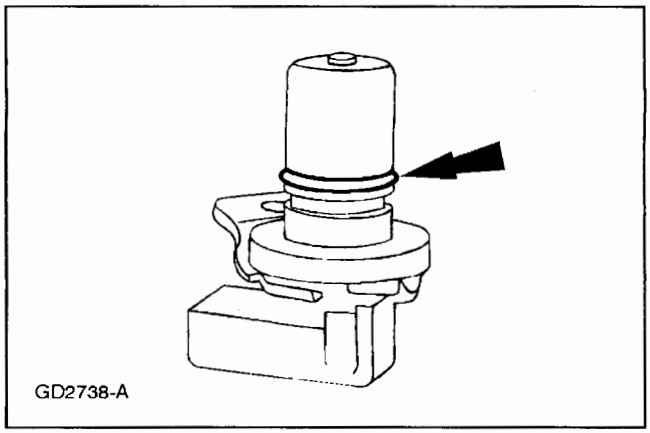

ELV9910123

4. Remove the output shaft speed (OSS) sensor (if equipped).

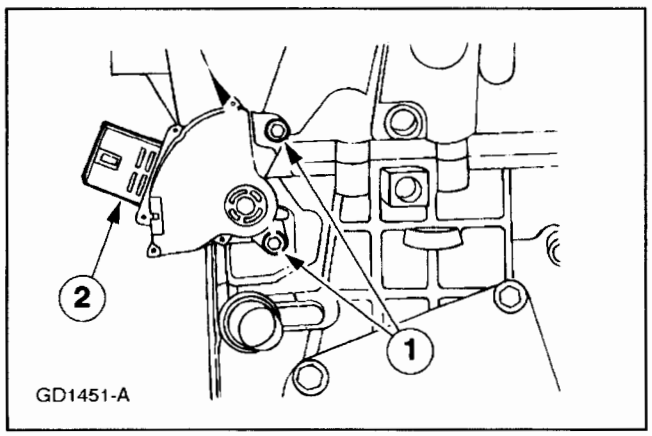
DISASSEMBLY (Continued)



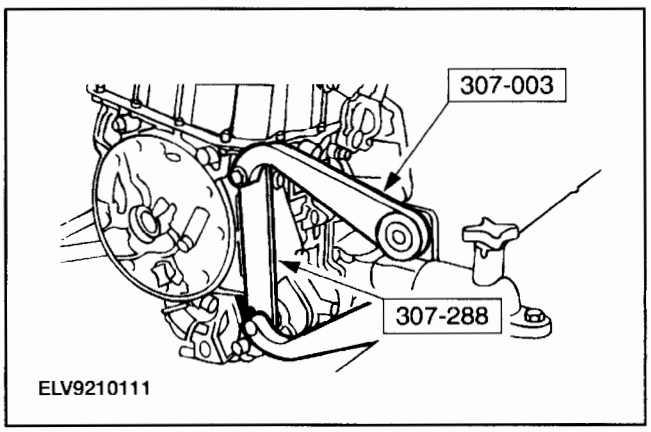
5. Remove the turbine shaft speed (TSS) sensor (if equipped).
   1 Remove the bolt.
   2 Remove the TSS sensor.



6. Remove and discard the TSS and OSS sensor O-ring seals.

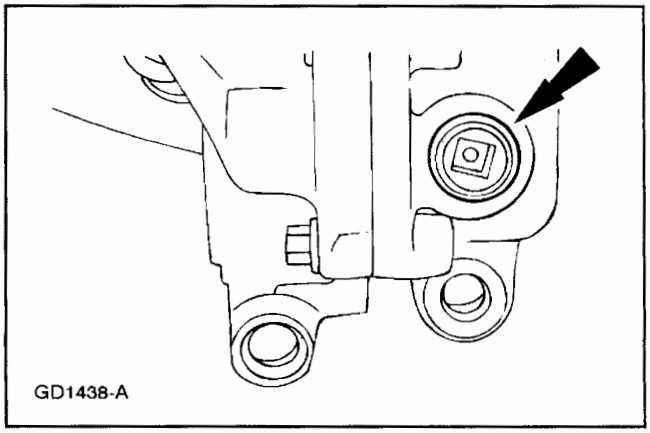


7. Remove the transmission range (TR) sensor.
   1 Remove the bolts.
   2 Remove the TR sensor from the manual valve detent lever shaft.

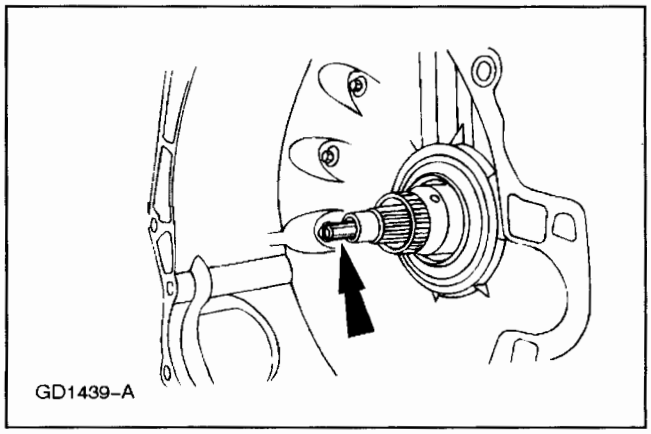


8. Using the special tool, secure the transaxle.

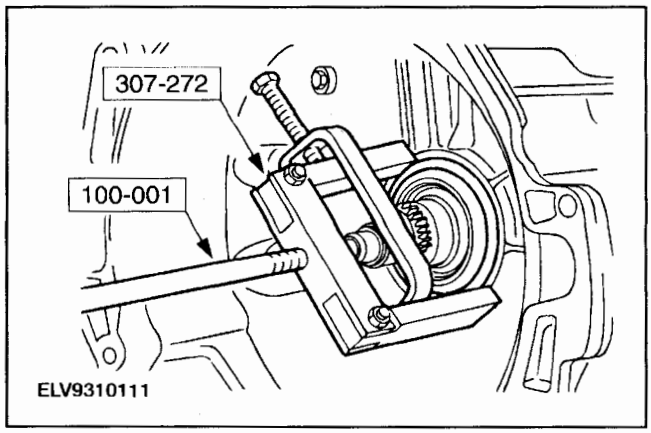
DISASSEMBLY (Continued)



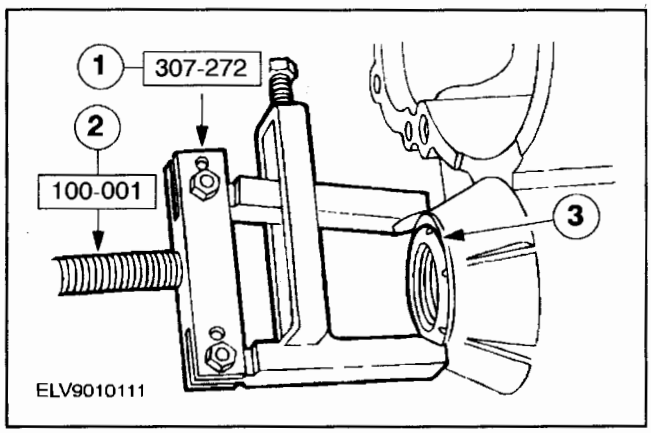
9. Position the drain pan under the transaxle, remove the drain plug, and drain the transmission fluid.



10. Remove the pump assembly driveshaft.

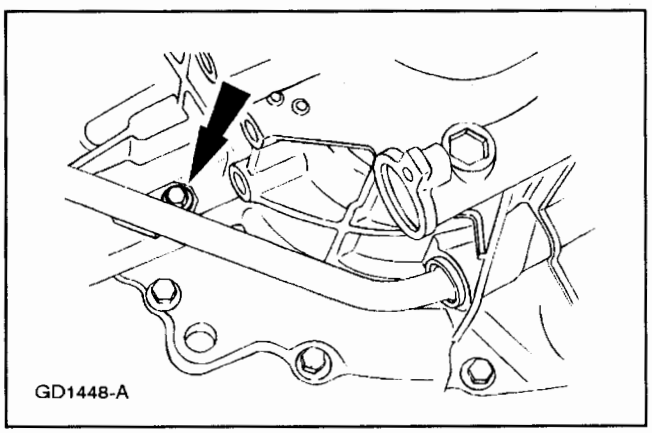


11. Using the special tools, remove and discard the torque converter impeller hub seal.

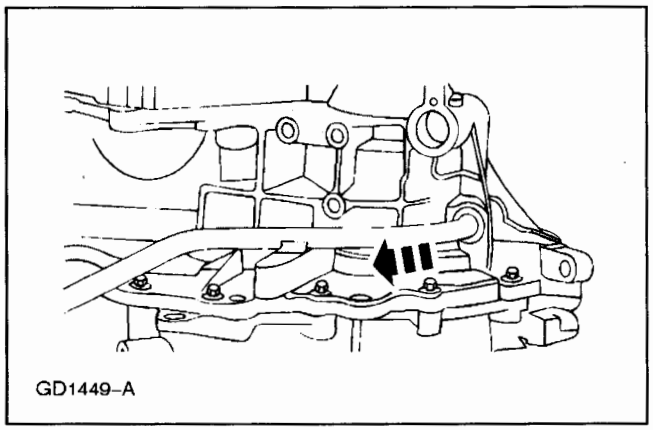


12. Using the special tools, remove the left-hand and right-hand differential seals.
    1 Install the special tool.
    2 Install the special tool.
    3 Remove and discard the differential seals.

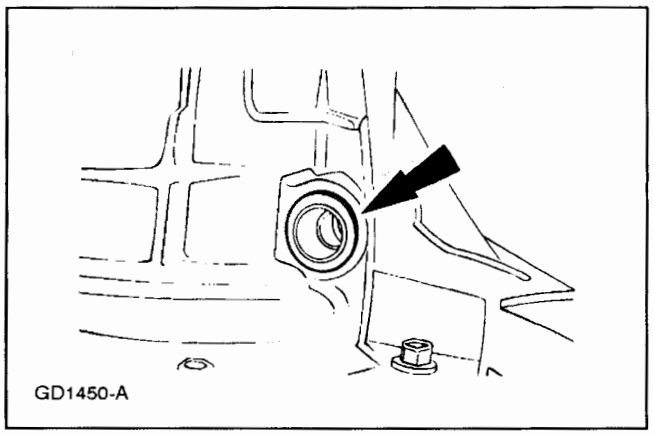
DISASSEMBLY (Continued)


GD1448-A

13. Remove the transaxle fluid filler tube bolt.

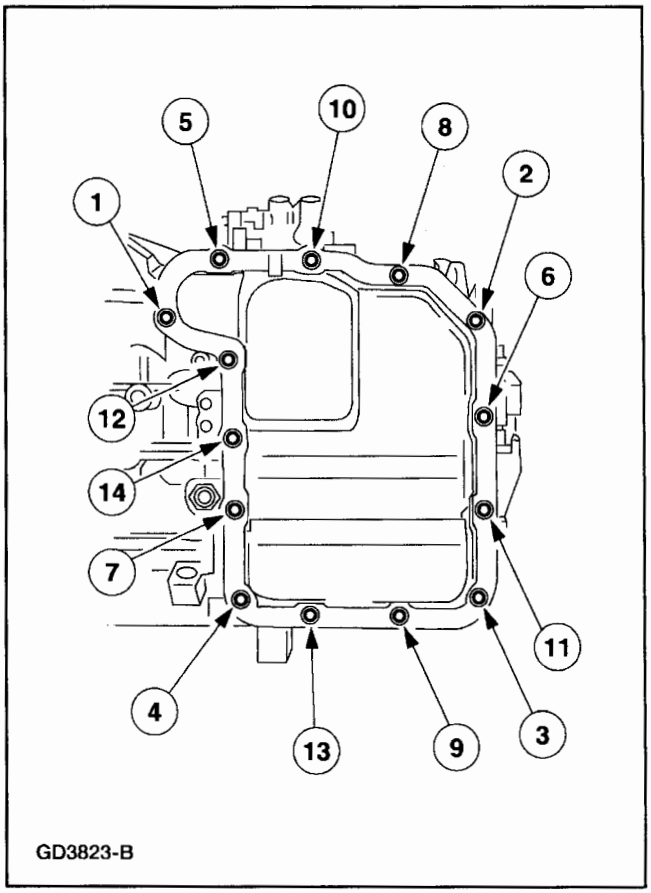

GD1449-A

14. Remove the transaxle fluid filler tube.


GD1450-A

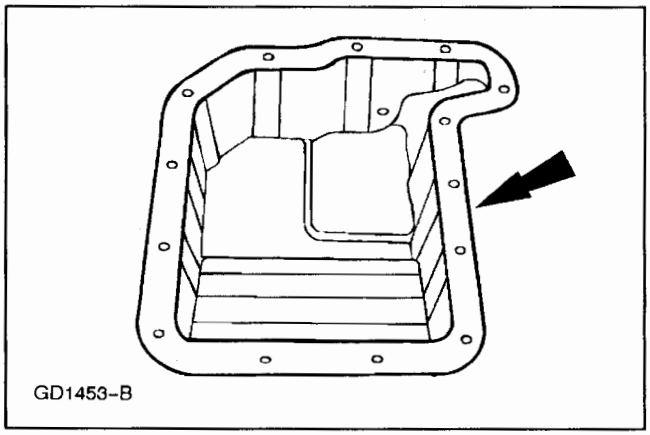
15. Remove and discard the transaxle filler tube grommet.

DISASSEMBLY (Continued)



16. **NOTE:** Remove the bolts in the indicated sequence.

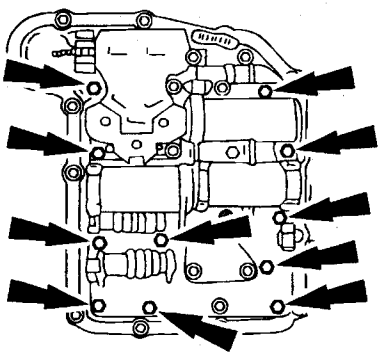
    Remove the main control cover bolts, and cover.



17. Remove and discard the gasket.

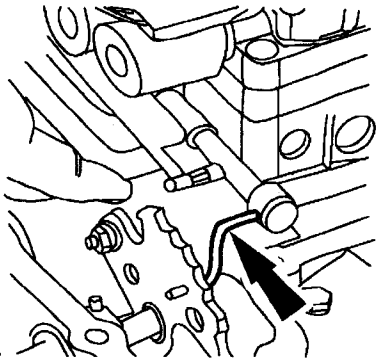
18. Inspect the fitting of the main control cover vent tube for blockage.

DISASSEMBLY (Continued)


ELE0012138

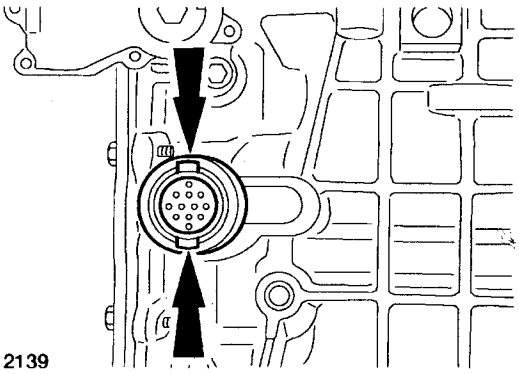
19. **NOTE:** Remove the bolts in the indicated sequence.

    Remove the main control valve body bolts.


GD1457-A

20. ⚠ **CAUTION: Do not allow loose manual valve to become damaged.**

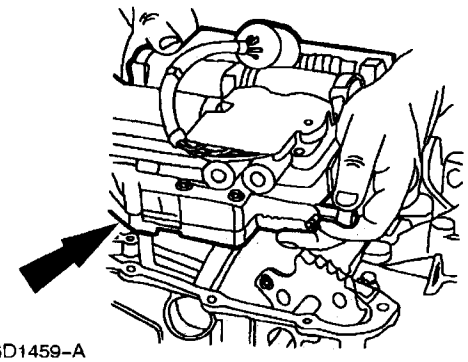
    Disconnect the manual valve link from the manual valve when lifting the main control valve body from the case.


ELE0012139

21. ⚠ **CAUTION: Do not pull on solenoid body electrical connector wires, or use a hammer on the electrical connector.**

    Remove the solenoid body electrical connector.

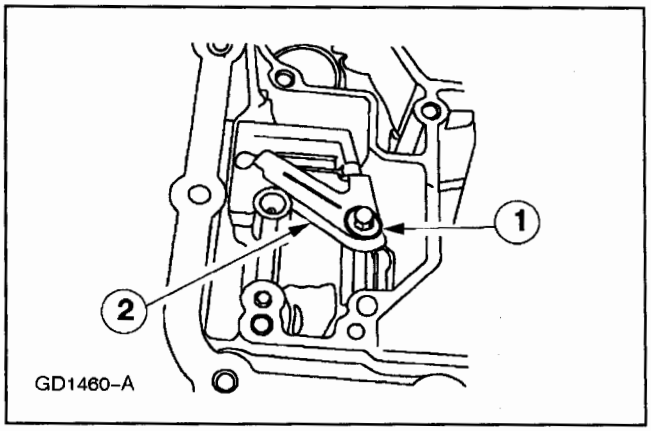
    - Release the retaining tabs and push the connector through the transaxle case.


GD1459-A

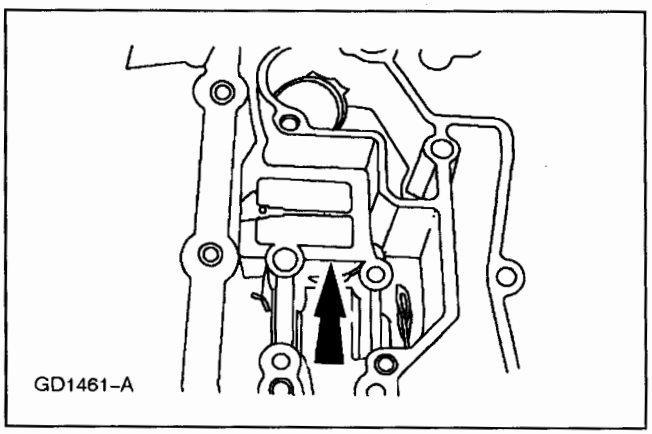
22. Support the manual valve and remove the main control.

    - Store the main control in a clean, dry location.

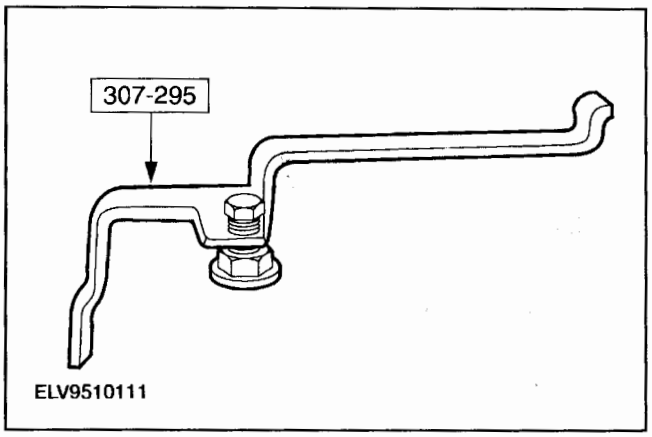
DISASSEMBLY (Continued)



23. Remove the thermostatic fluid level control valve bracket.
    1 Remove the bolt.
    2 Remove the bracket.



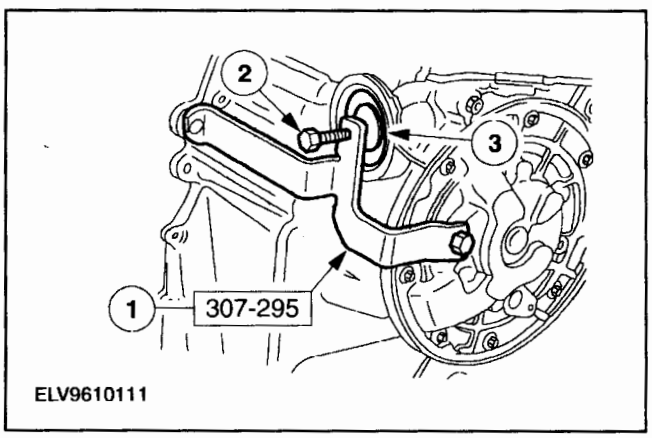
24. Remove the thermostatic fluid level control valve.



25. ⚠ **WARNING: The servo is under pressure.**

    ⚠ **WARNING: Servo and servo cover are under high spring force. Use caution when removing servo cover. Failure to follow these instructions may result in personal injury.**

    Assemble the special tool.



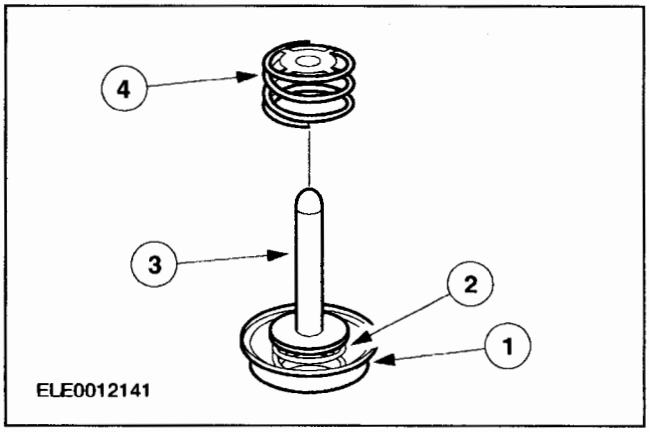
26. ⚠ **CAUTION: Use snap ring pliers to remove the retaining ring. Failure to follow this instruction may result in damage to the case.**

    Using the special tool, remove the servo assembly.
    1 Install the special tool.
    2 Compress the servo assembly by tightening the bolt.
    3 Remove the retaining ring.

27. Remove the servo cover assembly.

DISASSEMBLY (Continued)

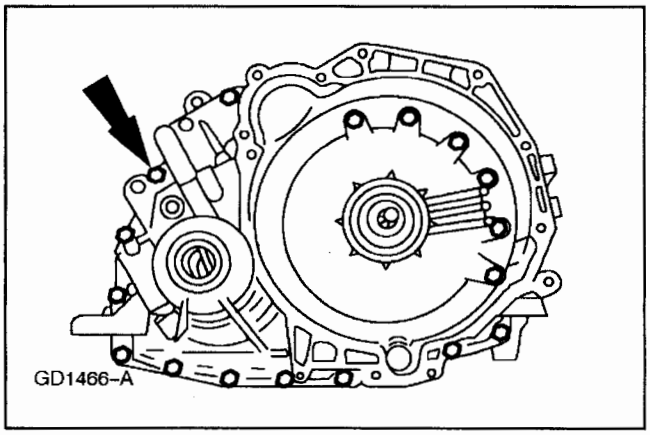
28. Remove the intermediate and overdrive servo piston and return spring.



29. **NOTE:** If the bonded seal is damaged, install a new servo assembly.

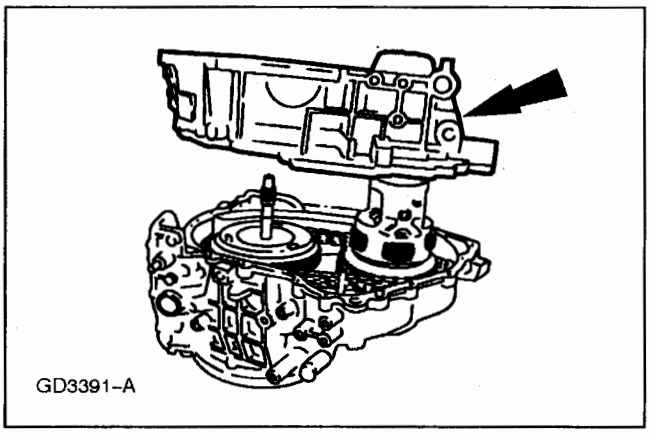
    Inspect the intermediate and overdrive servo assembly and bore for damage or wear.

    1 Servo cover with bonded seal.
    2 Cushion spring.
    3 Servo apply rod.
    4 Servo return spring.



30. **NOTE:** Position the transaxle with the torque converter housing facing upward.

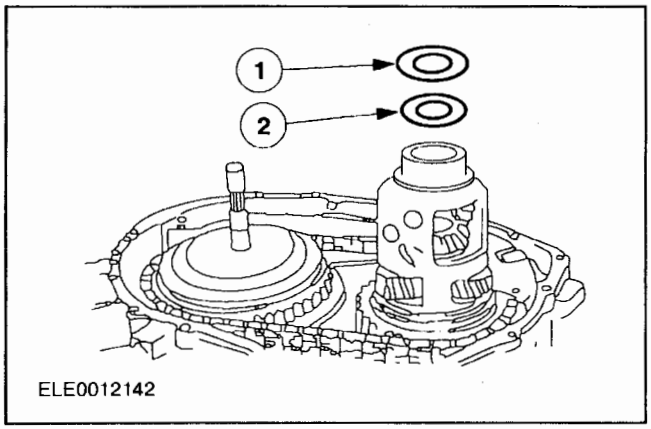
    Remove the 20 bolts.



31. **NOTE:** Place the torque converter housing on the engine flange side after removal to prevent damage to the lube tube.

    Separate the torque converter housing from the transaxle case.

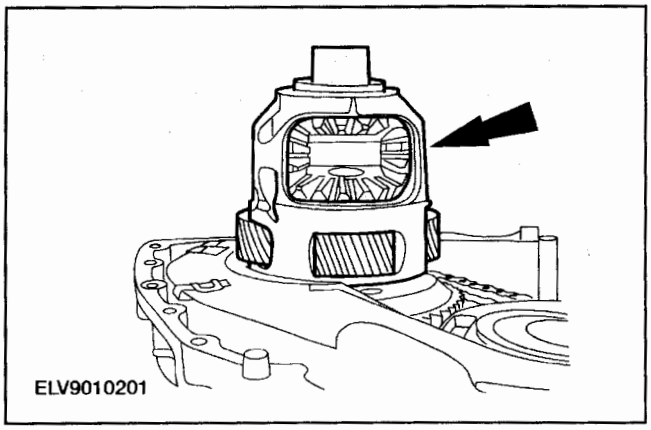
    - Remove and discard the transaxle split flange gasket.



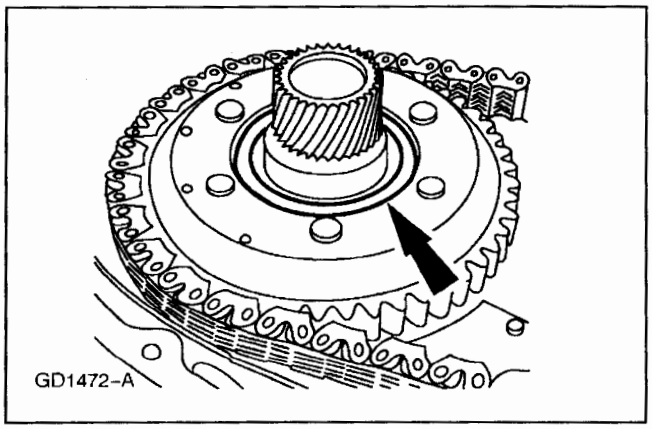
32. Remove the differential bearing and shim.

    1 Remove the No. 15 differential bearing.
    2 Remove the No. 14 differential bearing shim.

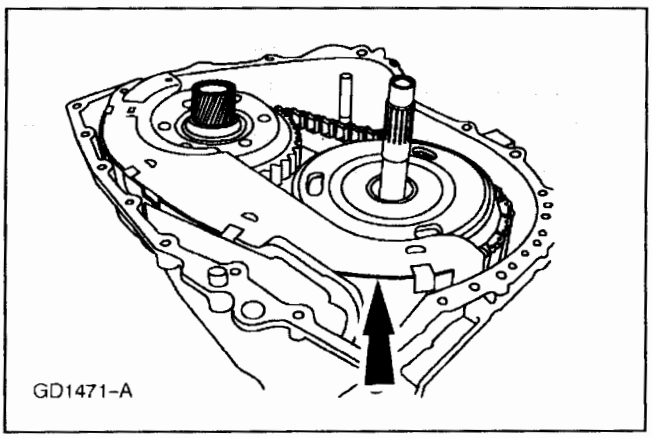
DISASSEMBLY (Continued)



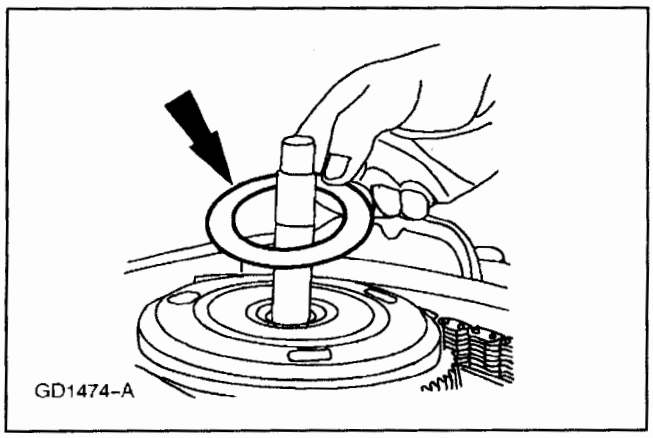
33. Remove the final drive carrier and differential assembly.



34. Remove the No. 13 driven sprocket thrust bearing.



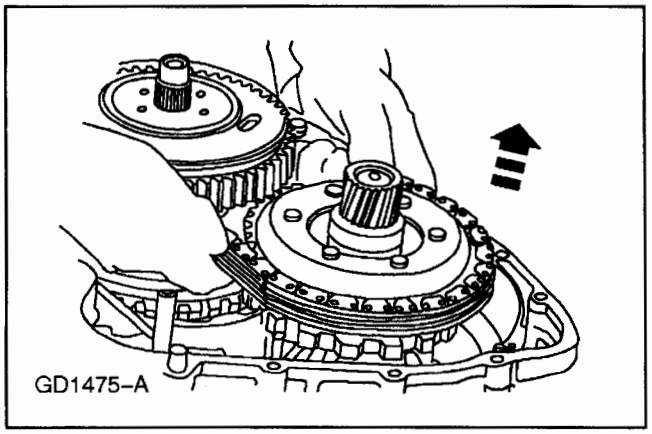
35. Unclip and remove the chain pan cover.



36. **NOTE:** The driven sprocket thrust washer may adhere to the converter housing.

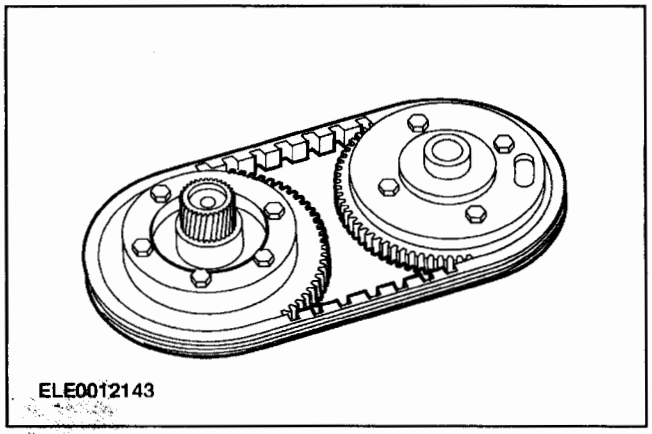
    Remove the No. 10 driven sprocket thrust washer from the reverse/overdrive ring gear assembly.

DISASSEMBLY (Continued)

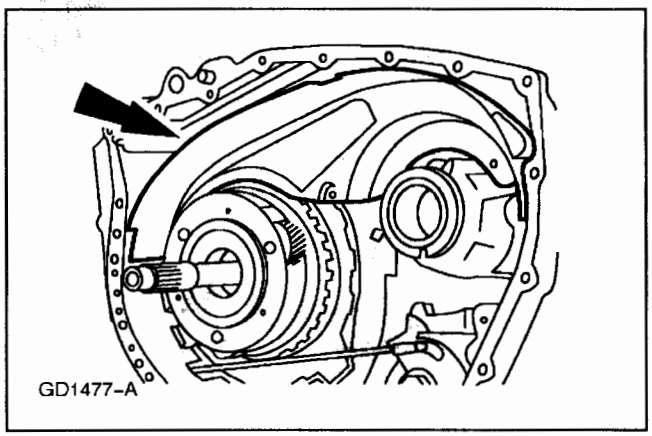


37. ⚠ **WARNING: Wear gloves as protection from sharp chain and sprocket teeth. Failure to follow these instructions will result in personal injury.**

    Remove the chain drive, reverse/overdrive ring gear, and driven sprocket assembly.

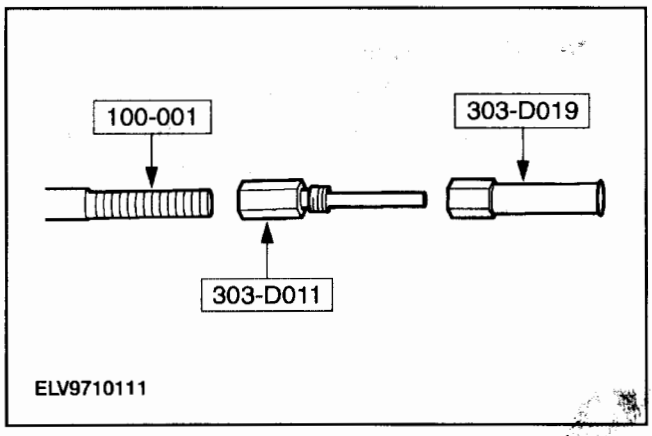


38. Separate the drive chain assembly from the driven sprocket assembly and reverse/overdrive ring gear assembly.



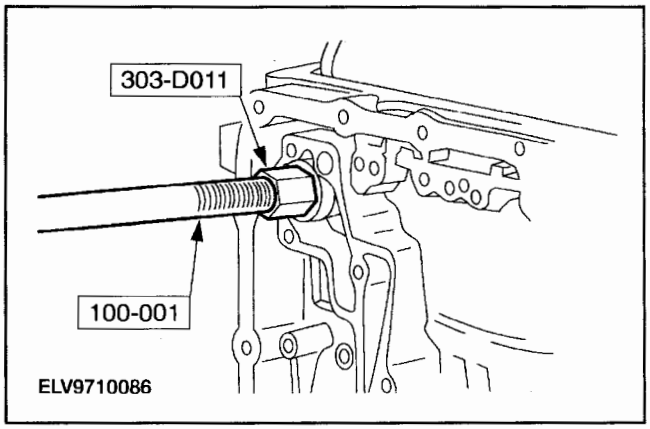
39. **NOTE:** Inspect the magnet located on the chain pan for excessive metal particles.

    Remove the chain pan (with the magnet retained) from the transaxle case.

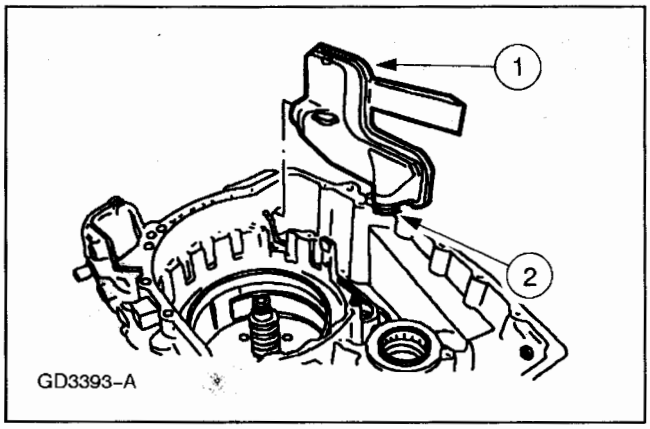


40. Assemble the special tools.

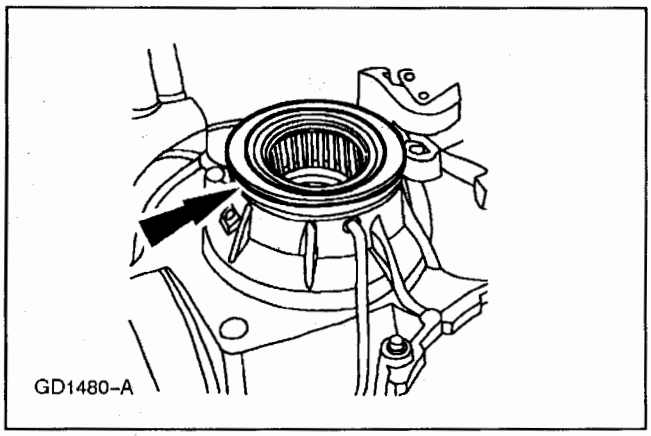
DISASSEMBLY (Continued)



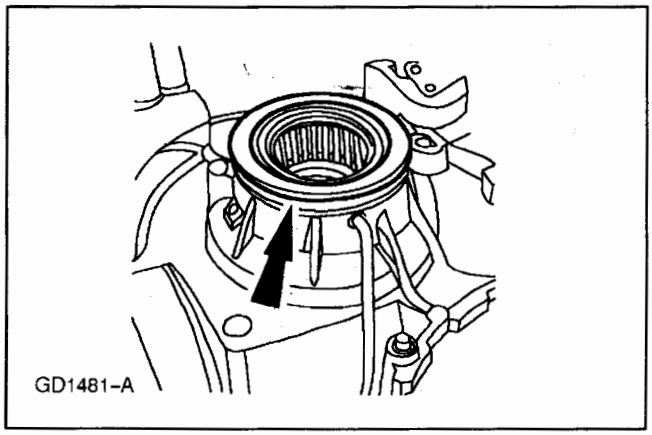
41. **NOTE:** Install the special tools.
    Using the special tools, remove and discard fluid filter recirculating regulator exhaust seal.



42. Remove the fluid filter and seal assembly.
    1 Discard the fluid filter.
    2 Discard the fluid filter seal.

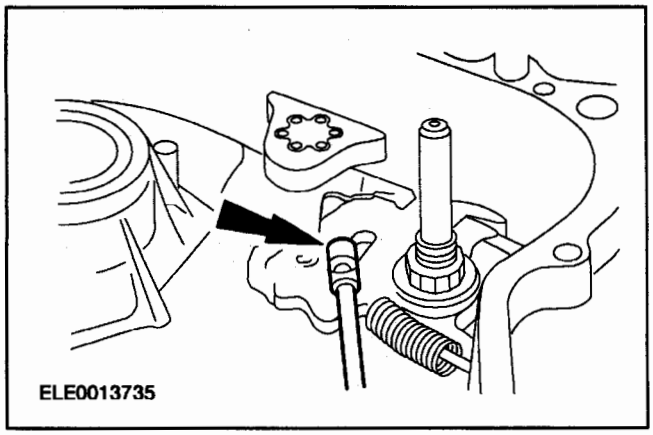


43. Remove the No. 12 driven sprocket bearing.

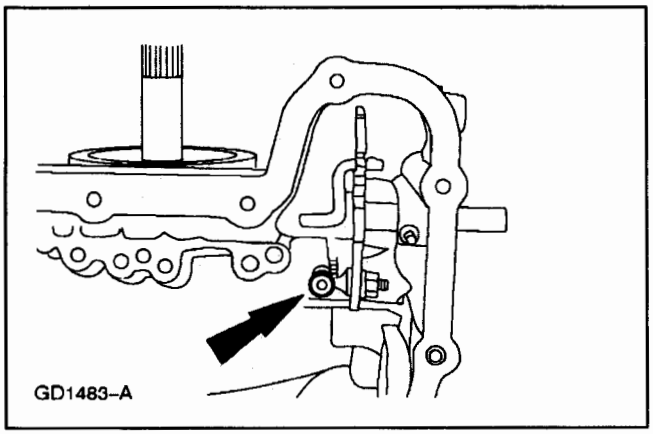


44. Remove the No. 11 driven sprocket shim (selective fit).

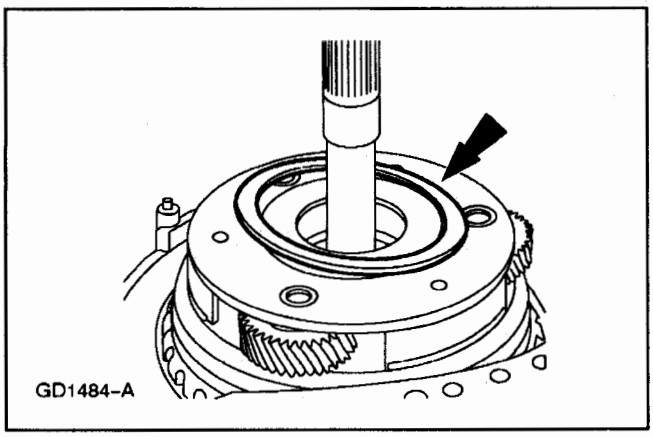
DISASSEMBLY (Continued)



45. Disconnect the parking lever actuating rod from the parking cam actuator lever assembly.

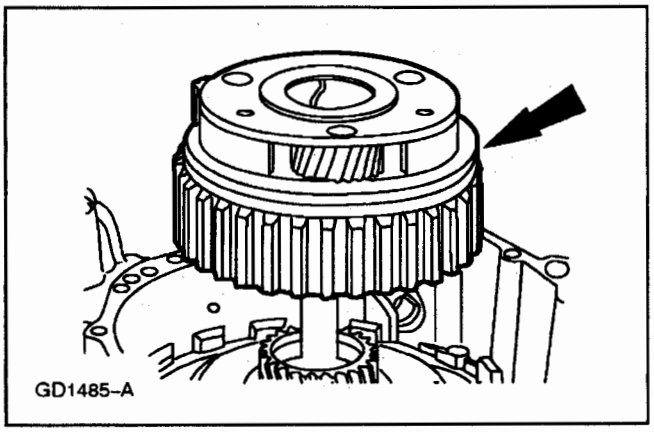


46. Disconnect the parking lever actuation rod from the manual valve detent lever, and remove the parking lever actuation rod.



47. **NOTE:** The thrust bearing may adhere to the reverse/overdrive sprocket.

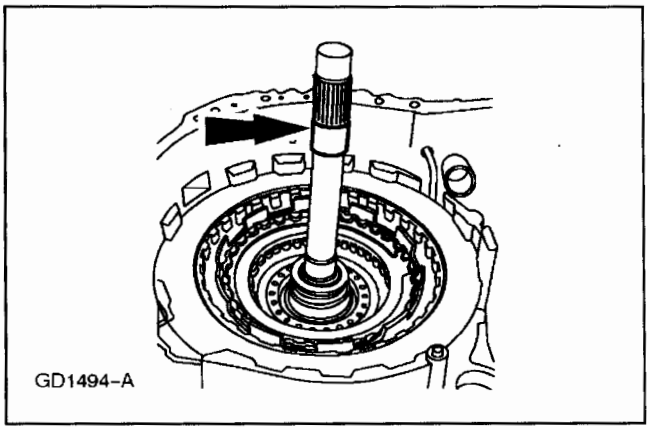
    Remove the No. 9 reverse/overdrive ring gear thrust bearing.



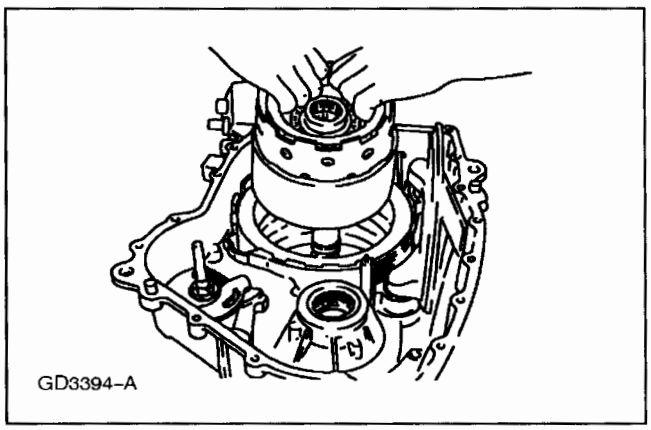
48. **NOTE:** The thrust bearing is part of the reverse/overdrive carrier assembly.

    Remove the reverse/overdrive carrier assembly with captured No. 8 thrust bearing.

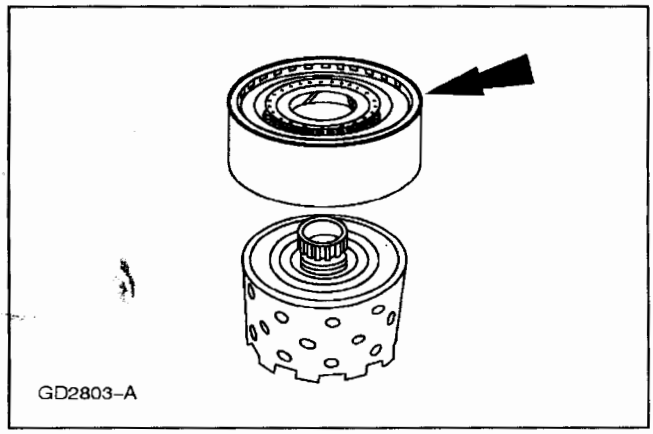
DISASSEMBLY (Continued)



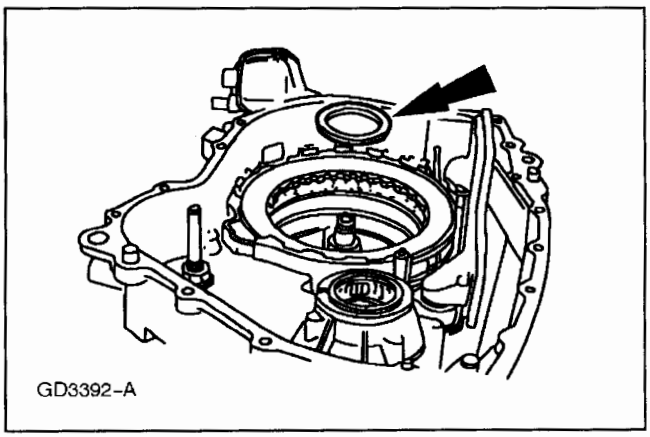
57. Remove the turbine shaft assembly.



58. Remove the forward/coast/direct cylinder assembly and reverse clutch drum assembly from the transaxle.



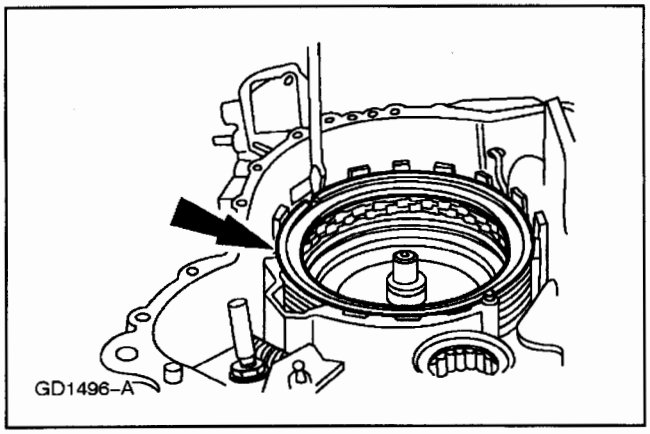
59. Remove the forward/coast/direct clutch cylinder from the reverse clutch drum assembly.



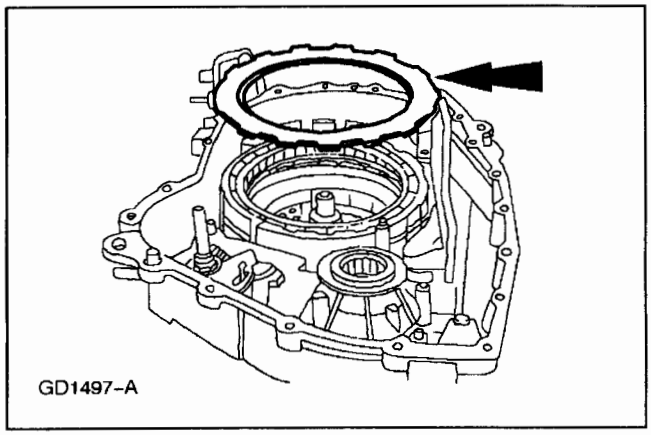
60. **NOTE:** The pump support thrust bearing assembly may adhere to the reverse clutch drum assembly.

    Remove the No. 1 pump support thrust bearing and tag for installation.

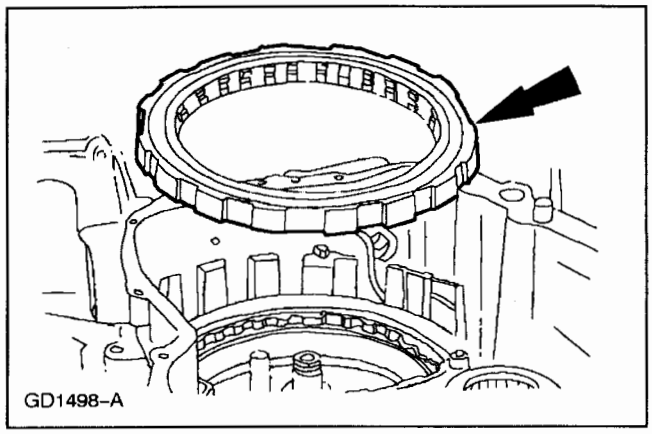
DISASSEMBLY (Continued)



61. Remove the low one-way clutch retaining ring.

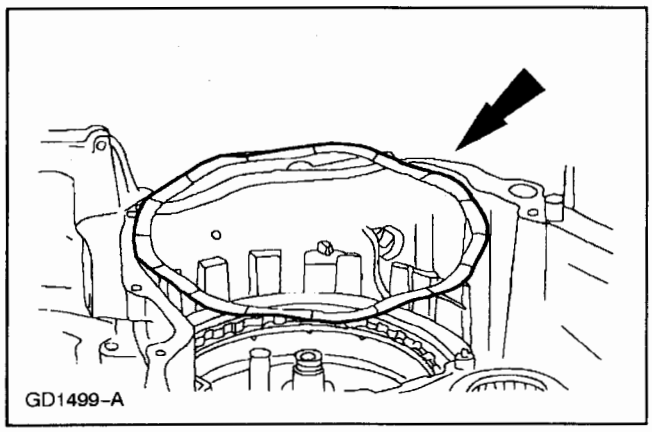


62. Remove the low one-way clutch thrust plate.



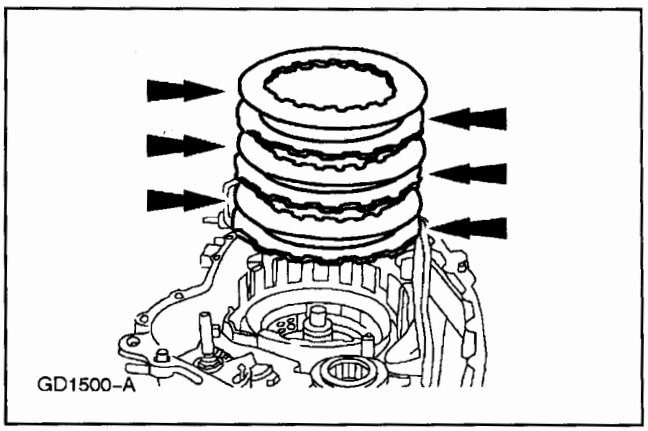
63. **NOTE:** The low one-way clutch assembly should be removed as an assembly.

    Remove the low one-way clutch assembly.

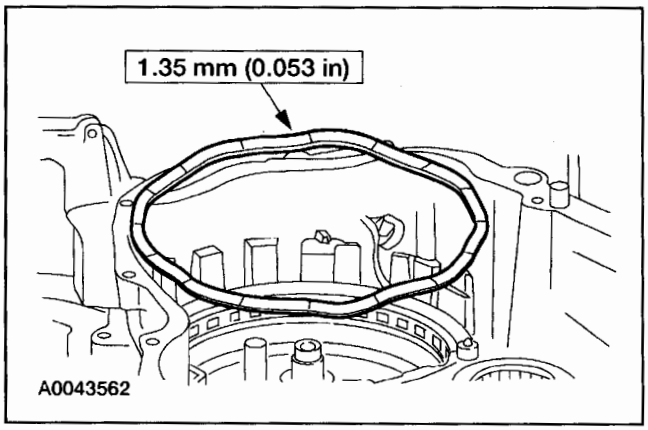


64. Remove the thin, eight-wave low/reverse clutch wave spring.

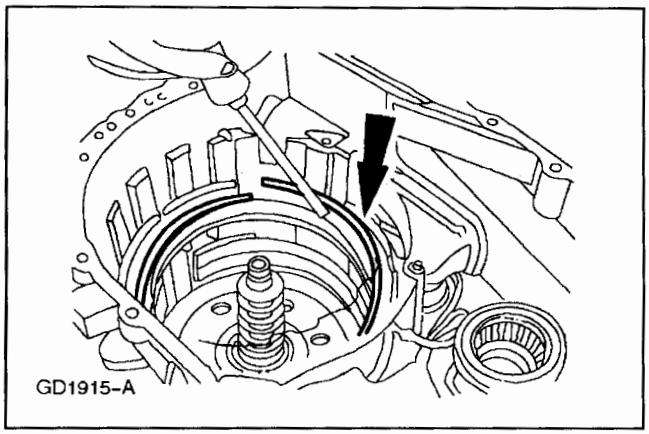
DISASSEMBLY (Continued)



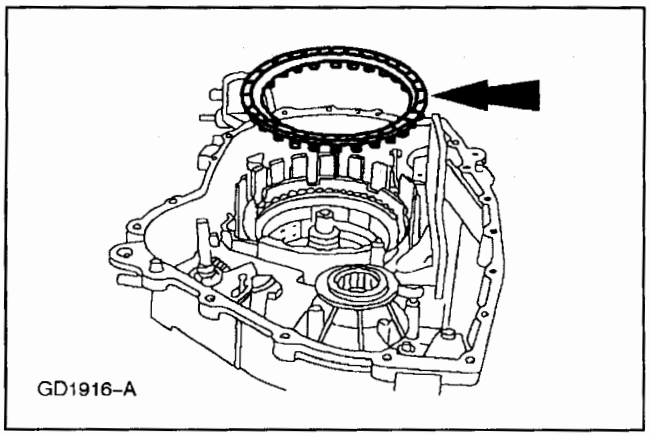
65. Remove the low/reverse clutch plates.
    - Inspect the friction plates for partially stripped, broken or bent spline teeth, burnt, worn or flaked off friction material, and warped or bent friction discs.
    - Inspect the steel plates for heat discoloration or distortion.



66. Remove the thick, ten-wave low/reverse clutch wave spring.

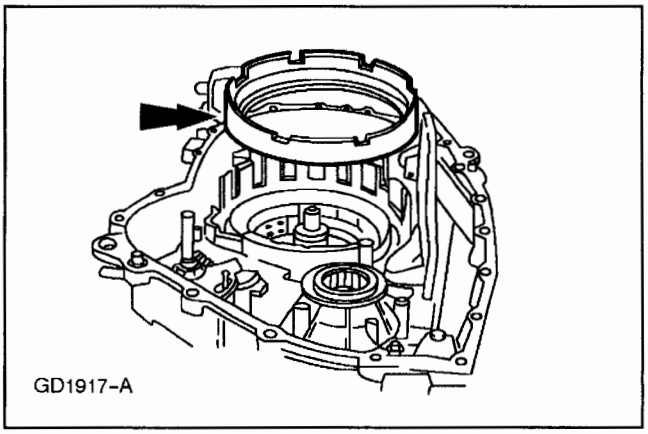


67. Remove the low/reverse clutch return spring retaining ring.



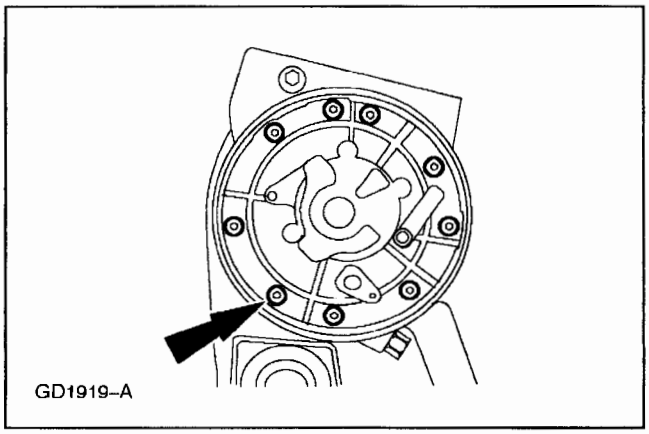
68. Remove the low/reverse clutch return spring assembly.

DISASSEMBLY (Continued)


GD1917-A

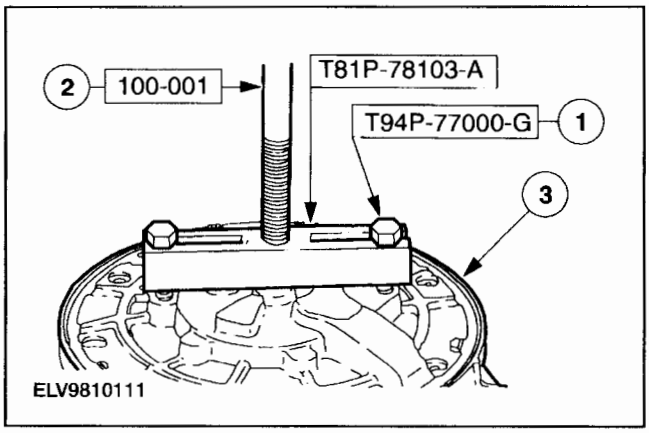
69. **NOTE:** Rotate the low/reverse clutch piston while pulling upward.

    Remove the low/reverse clutch piston.


GD1919-A

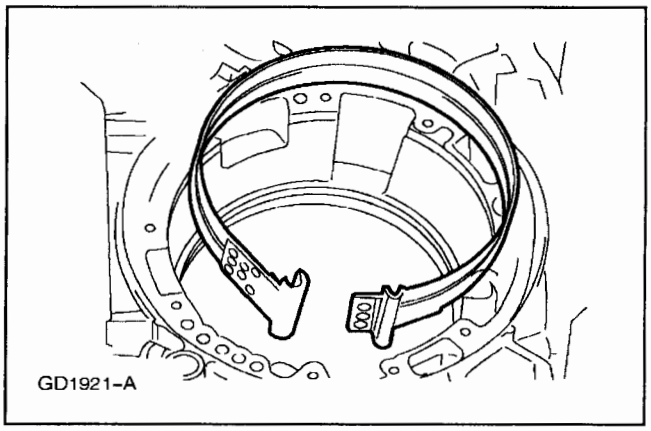
70. **NOTE:** Position the transaxle so the pump assembly is facing upward.

    Remove the pump assembly bolts.



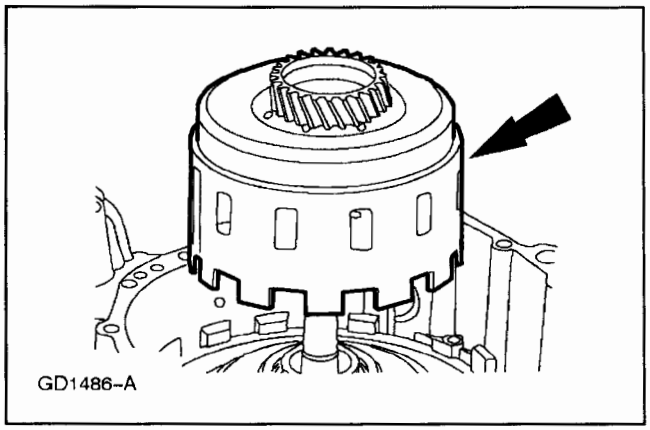
ELV9810111

71. Using the special tools, remove the pump assembly.
    1 Install the special tool.
    2 Assemble the special tools.
    3 Using the special tools, remove the pump assembly.

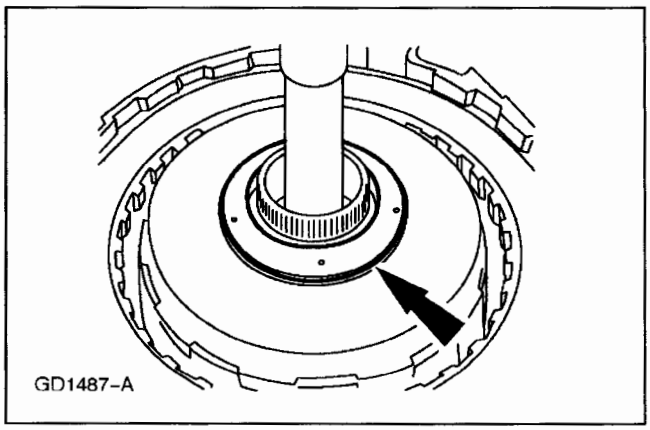

GD1921-A

72. Remove the intermediate and overdrive band assembly from the case.
    - Inspect the intermediate and overdrive band assembly for damage and wear.

DISASSEMBLY (Continued)

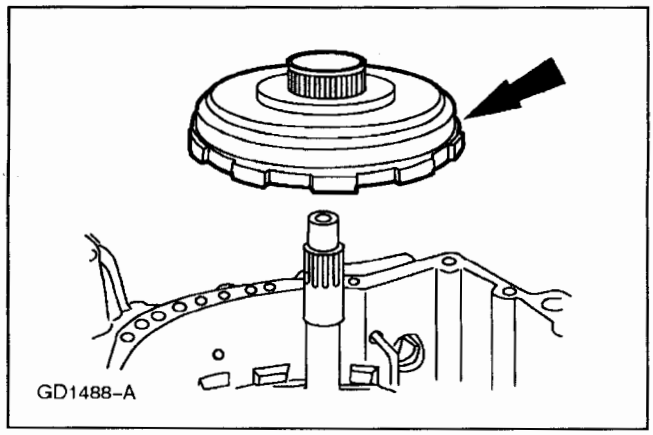


49. Remove the reverse/overdrive sun gear and shell assembly.

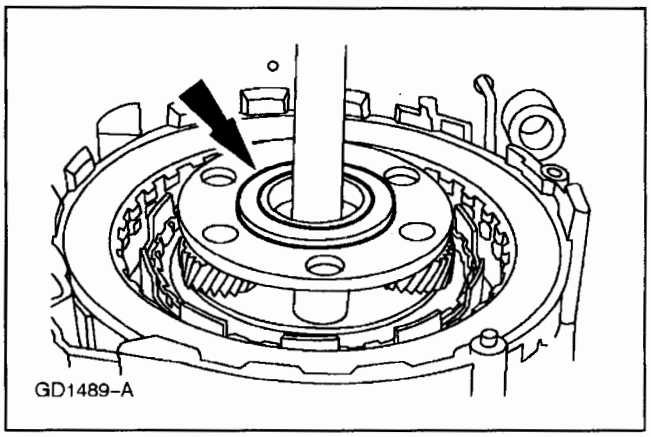


50. **NOTE:** The thrust bearing may adhere to the reverse/overdrive sun gear and shell.

    Remove the reverse/overdrive sun gear and No. 7 shell thrust bearing.



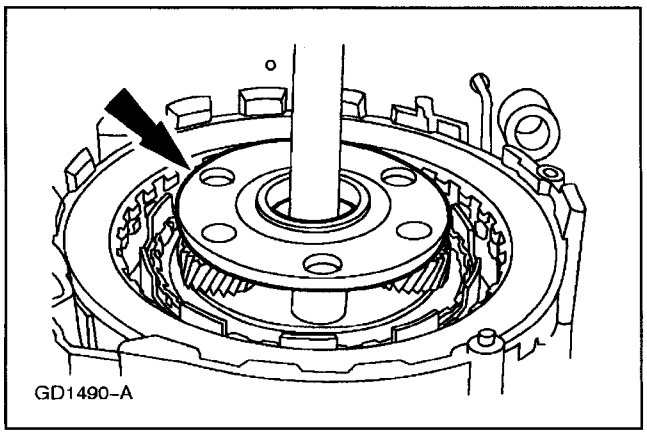
51. Remove the low-intermediate ring gear assembly.



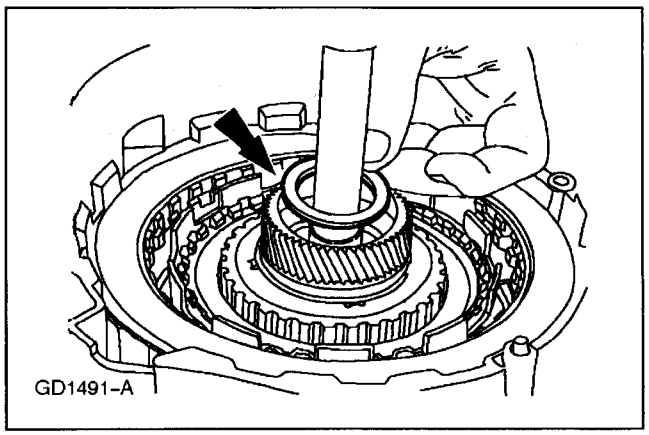
52. **NOTE:** The low-intermediate carrier thrust bearing may adhere to the low-intermediate ring gear.

    Remove the No. 6 low-intermediate carrier thrust bearing.

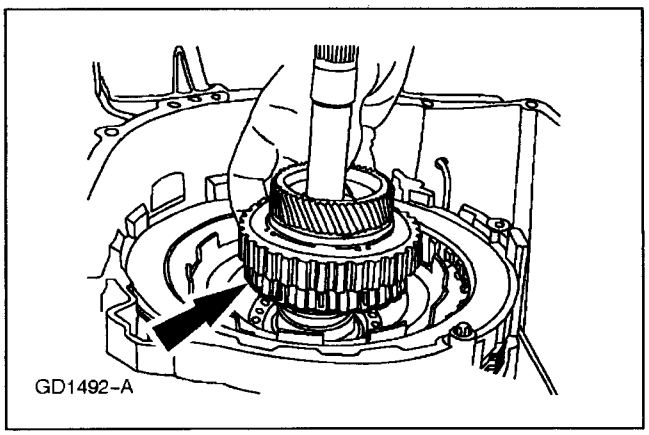
DISASSEMBLY (Continued)


GD1490-A

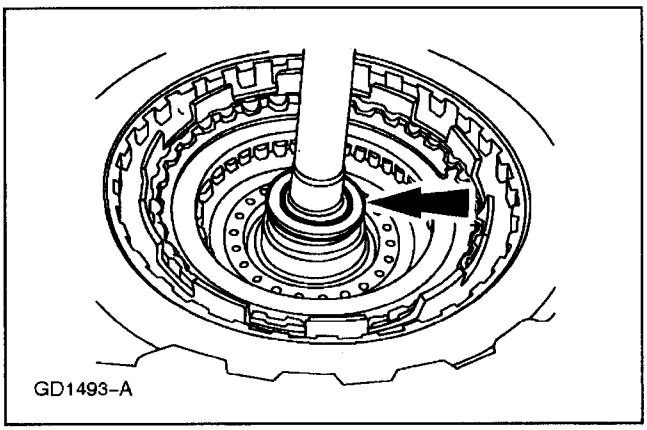
53. Remove the low-intermediate carrier assembly.


GD1491-A

54. Remove the No. 5 low-intermediate sun gear thrust bearing and tag for installation.


GD1492-A

55. Remove the forward one-way clutch and low/intermediate sun gear.


GD1493-A

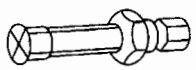
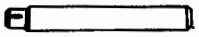
56. **NOTE:** The turbine shaft thrust bearing may adhere to the forward one-way clutch and low/intermediate sun gear.

    Remove the No. 4 turbine shaft thrust bearing.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

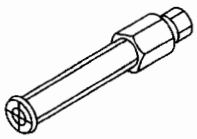
Chain Sprockets

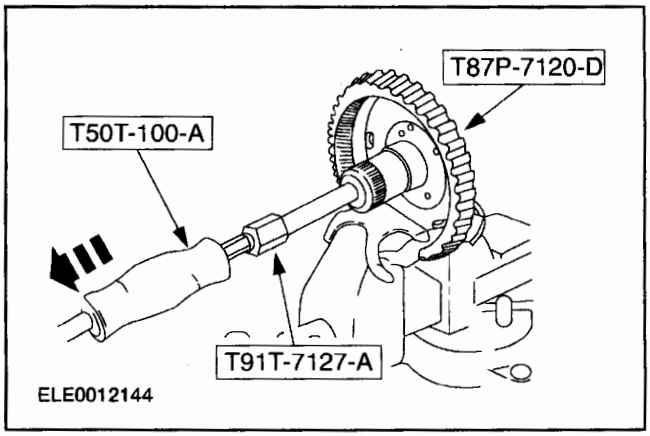
Special Tool(s)

 ST2059-A	Remover, Transfer Case Bearing Cup 308-125 (T87P-7120-D)
 ST1955-A	Installer, Needle Bearing 307-294 (T94P-77000-K)
 ST1255-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)

(Continued)

Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2058-A	Remover, Input Shaft Bearing 308-201 (T91T-7127-A)

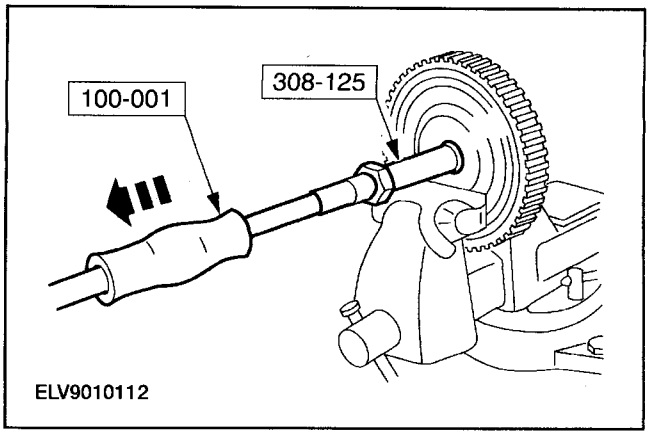


Disassembly

1. ⚠ **CAUTION: Clamp the sprocket in a soft-jawed vise.**

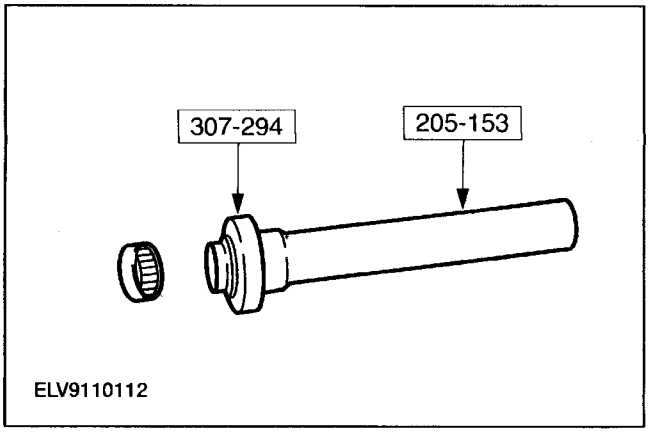
   Using the special tools, remove the No. 16 reverse/overdrive ring gear bearing, as necessary.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

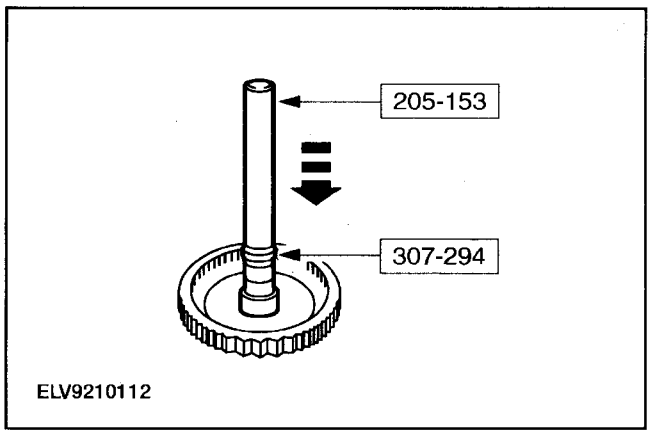


2. Using the special tools, remove the No. 17 stator support bearing, as necessary.

Assembly

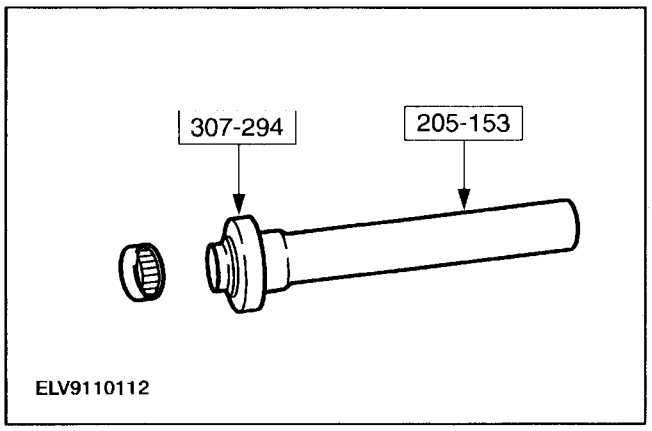


1. Position the No. 16 reverse/overdrive ring gear bearing on the special tools.
   - Position the bearing with the part number facing toward the handle of the special tool.



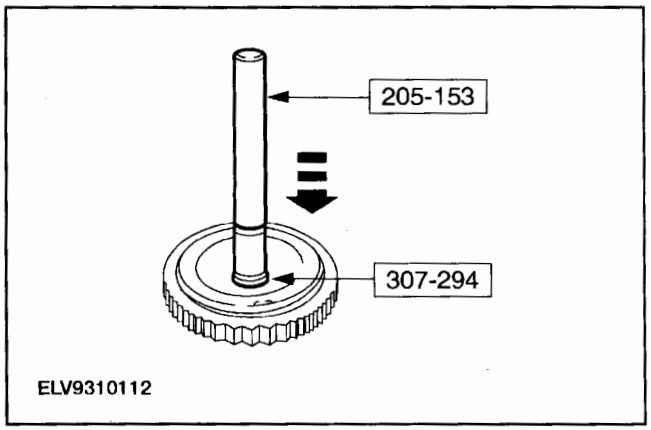
2. **NOTE:** The identification stamping of the bearing goes to the outboard side of the reverse/overdrive ring gear.

   Using the special tools, install the No. 16 reverse/overdrive ring gear bearing.



3. Position the No. 17 stator support bearing on the special tools.
   - Position the bearing with the part number facing toward the handle of the special tool.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

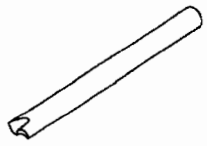


4. **NOTE:** The identification stamping of the bearing goes to the outboard side of the reverse/overdrive ring gear.

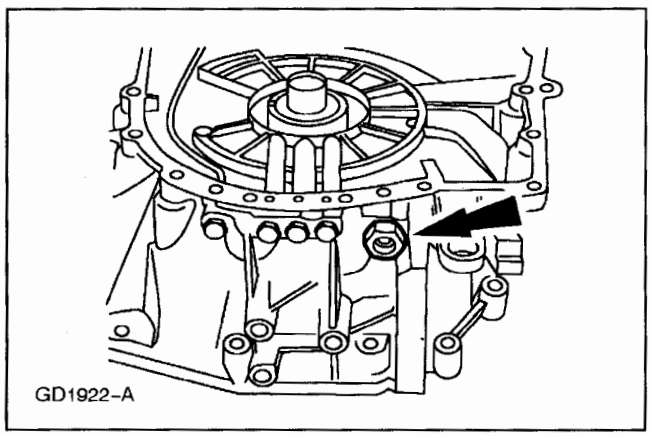
   Using the special tools, install the No. 17 stator support bearing into the stator support sprocket.

Torque Converter Housing

Special Tool(s)

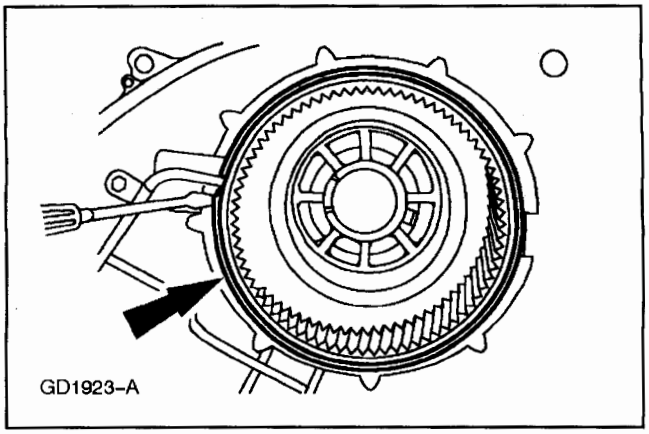
 ST1848-A	Installer, Lube Tube 307-306 (T94P-77000-U1)

Disassembly

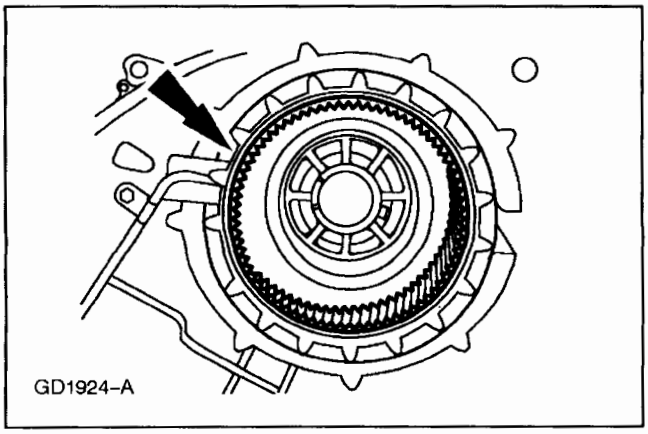


1. Remove and discard the cooler tube fitting.

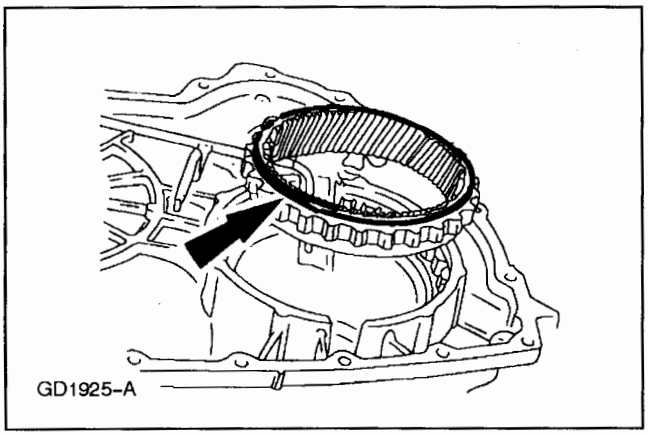
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD1923-A

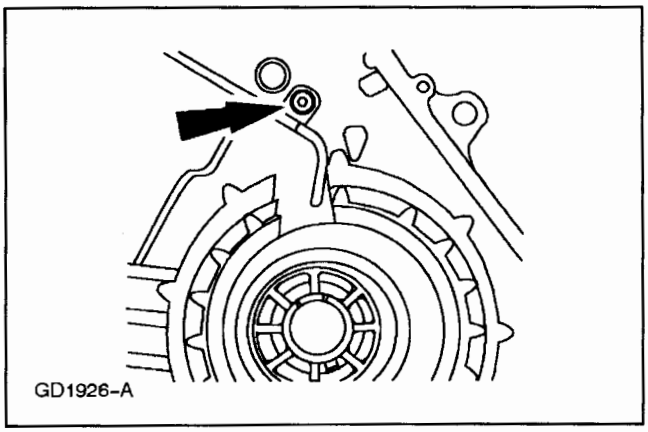
2. Remove the final drive ring gear retaining ring.


GD1924-A

3. Remove the final drive ring gear.

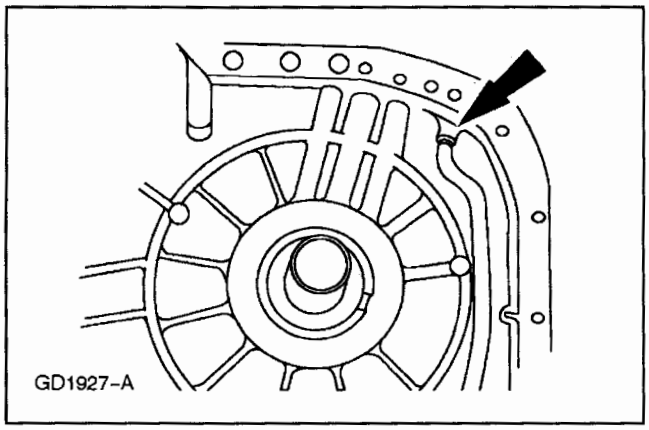

GD1925-A

4. Inspect the final drive ring gear, housing lug teeth, and final drive ring gear teeth for damage or wear.


GD1926-A

5. Remove the differential lube tube bolt.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



6. Pull the differential lube tube from the housing.

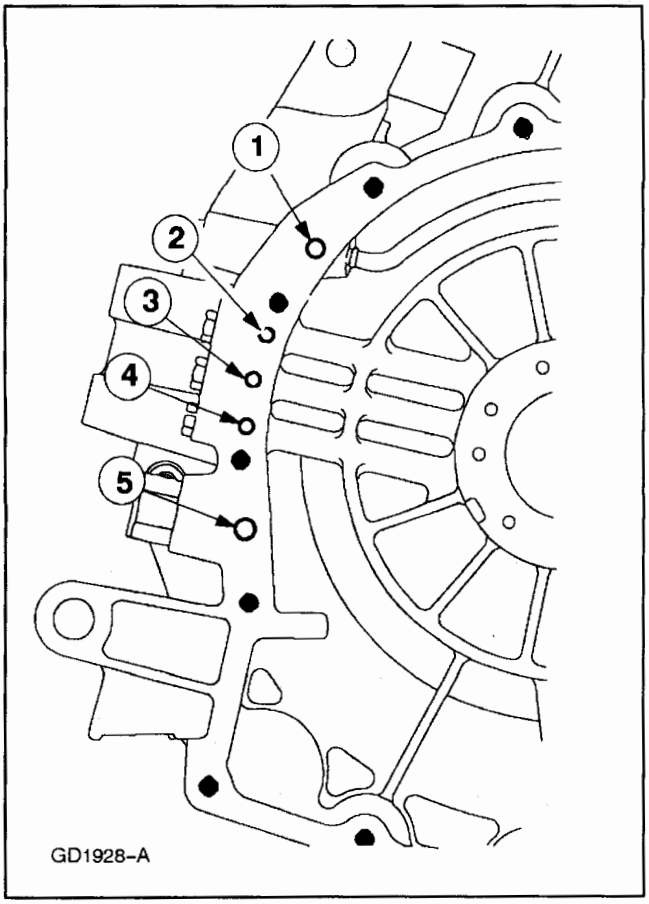
7. ⚠ **WARNING: In order to avoid injury, eye protection should be worn when cleaning components with compressed air. Failure to follow these instructions can result in personal injury.**

   NOTE: Clean all components with a suitable solvent and use moisture-free compressed air to dry all parts and clean fluid passages.

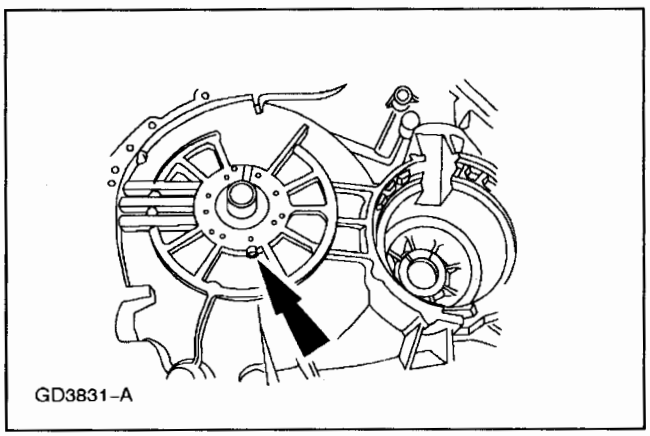
   Inspect the converter housing for:

   - stator support area wear.
   - case mating surfaces for nicks or deformation.
   - differential bushing wear.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



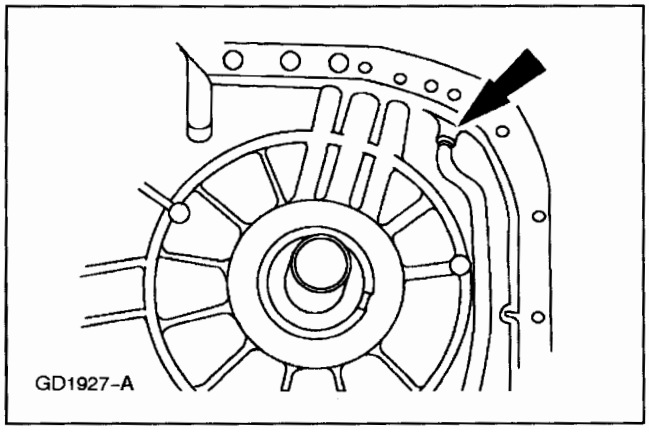
8. Check the converter housing hydraulic passages for blockage.
   1 Differential lubrication passage
   2 Front lubrication passage
   3 Converter turbine passage
   4 Converter impeller passage
   5 Cooler passage



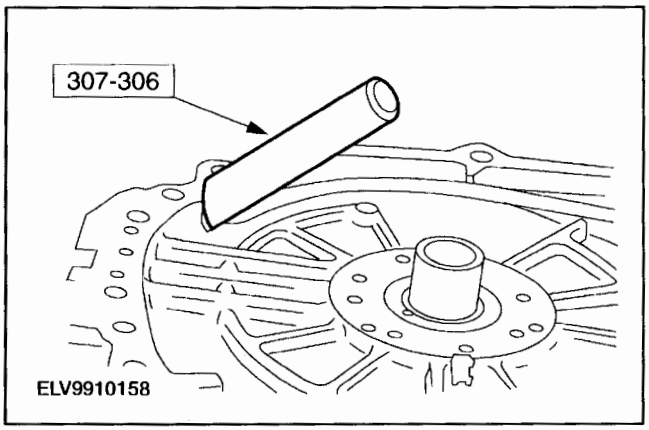
9. Check for blockage at the converter seal return hole.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

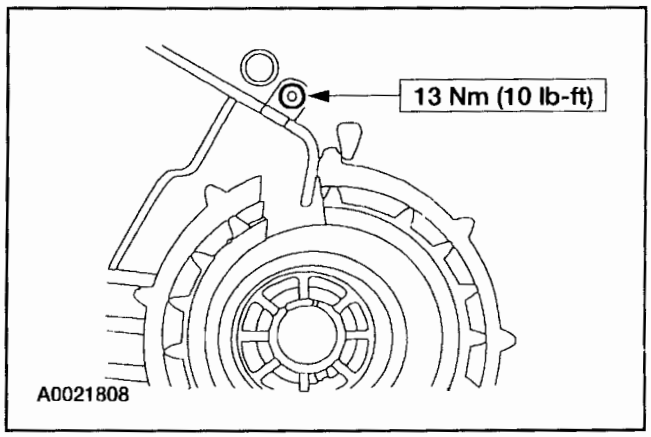
Assembly



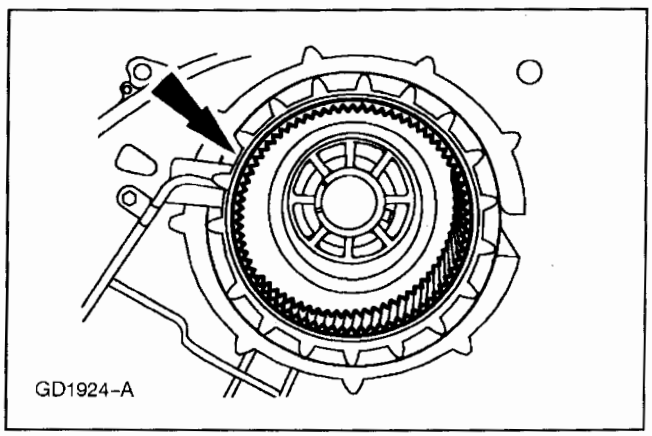
1. Position a new differential lube tube in the torque converter housing.



2. Using the special tool, install the differential lube tube.



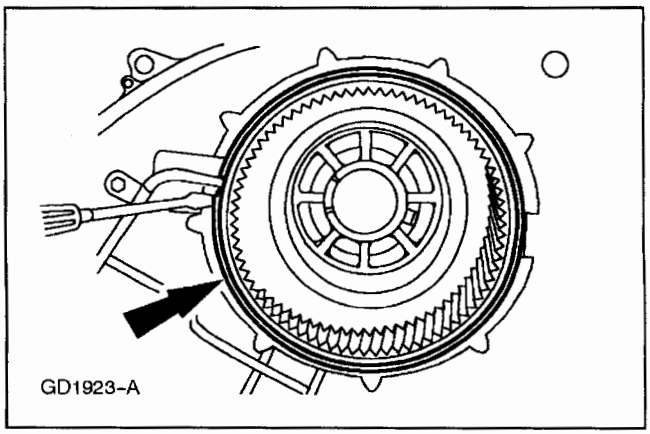
3. Install the differential lube tube bolt.



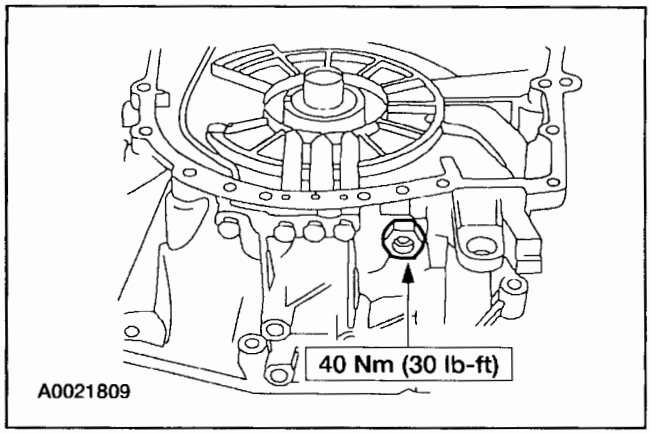
4. **NOTE:** The final drive ring gear is installed with the lug end uppermost.

   Install the final drive ring gear.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



5. Install the final drive ring gear retaining ring.

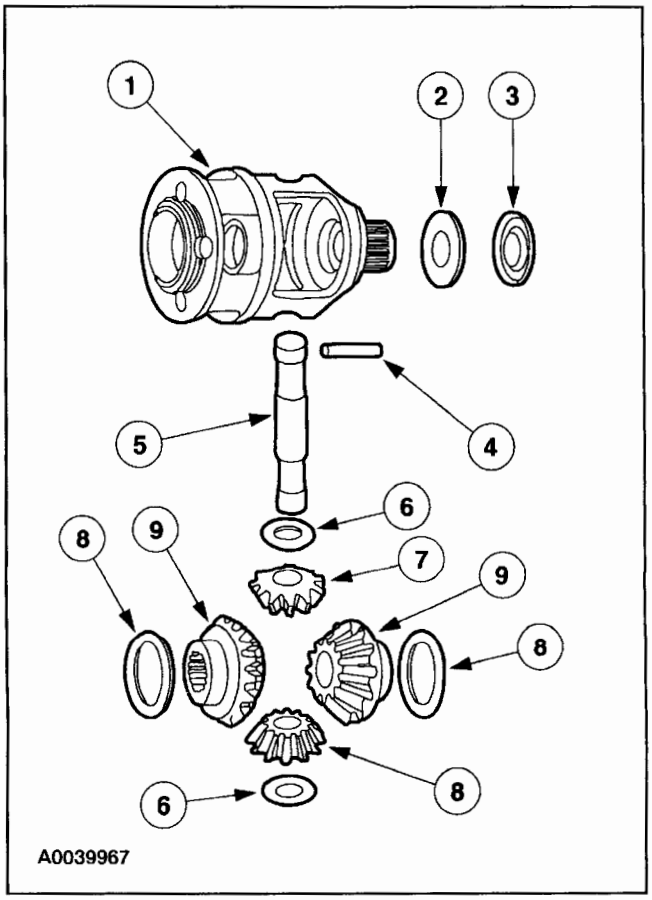


6. Install the cooler tube fitting.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Final Drive Carrier And Differential Assembly

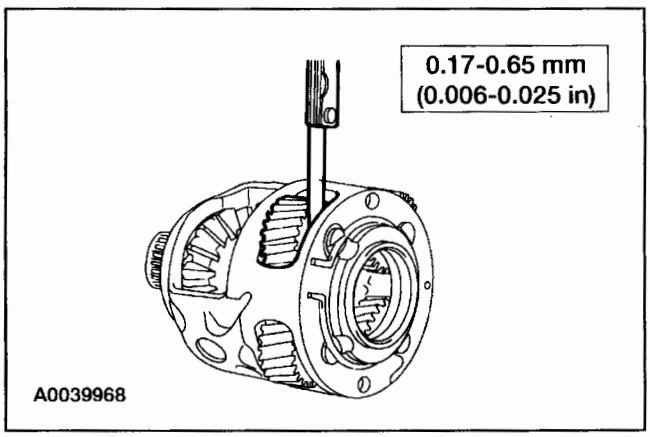
Disassembly



1. **NOTE:** If damage is detected during the checking procedure, a new differential should be installed.

   Inspect the differential:

   1 Differential housing
   2 Differential bearing shim
   3 Differential housing bearing
   4 Pinion shaft roll pin
   5 Pinion shaft
   6 Pinion thrust washer
   7 Pinion gear
   8 Side gear thrust washer
   9 Differential side gear

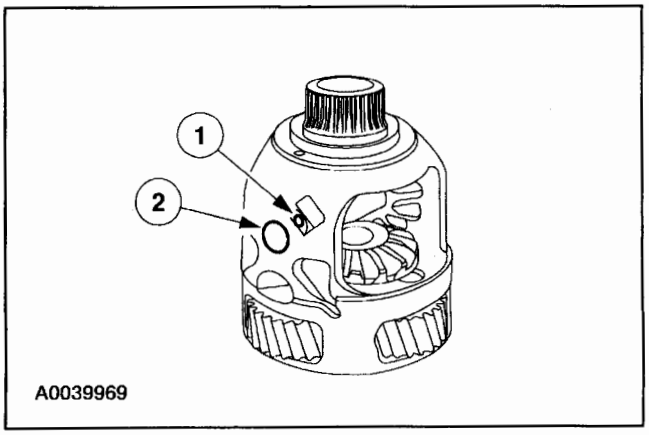


2. **⚠ CAUTION: Do not disassemble the planet carrier.**

   NOTE: If the measurement exceeds specification, install a new complete final drive carrier. If the measurement is within specification, continue with the diagnostic procedure.

   Measure the final drive planet gear end play with a feeler gauge.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

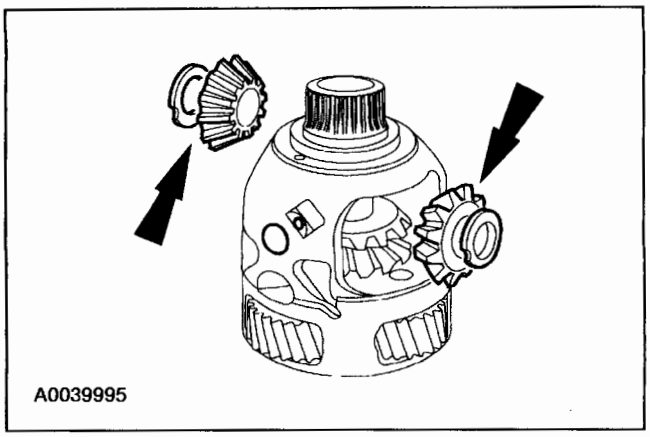


3. **NOTE:** Do not remove the final drive pinion shaft retaining ring.

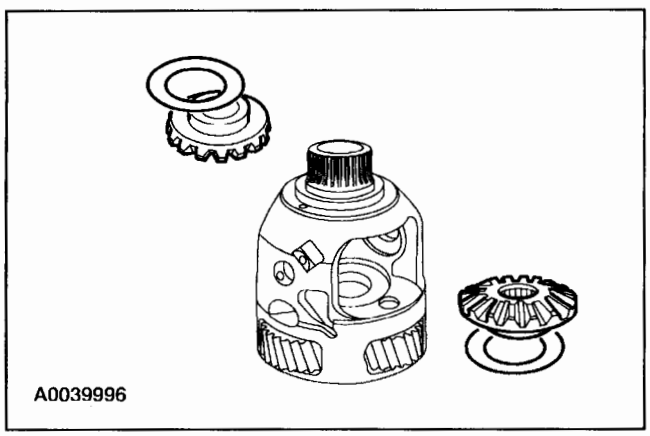
   Remove the differential pinion shaft.

   1 Remove the pinion shaft roll pin.

   2 Remove the differential pinion shaft.



4. Remove the pinion gears and thrust washers.
   - Turn the differential pinion gears 90 degrees and remove.

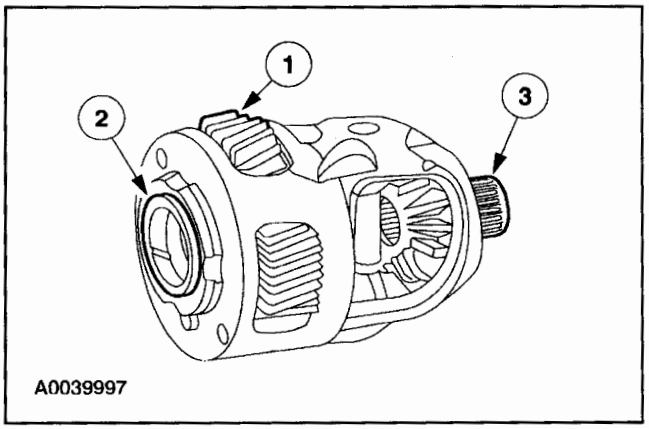


5. Remove the differential side gears and differential side gear thrust washers.

6. Clean all parts thoroughly in clean solvent and blow dry with moisture-free regulated compressed air.

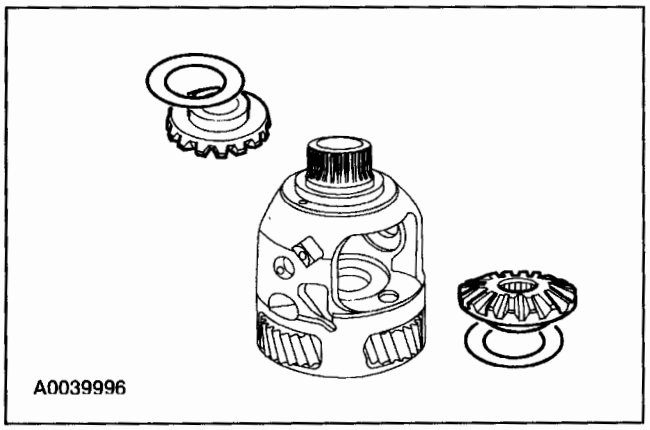
7. Inspect the differential parts for damage and wear.
   - Gear teeth.
   - Thrust washer surface.
   - Thrust bearing surface.
   - Pinion shaft.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

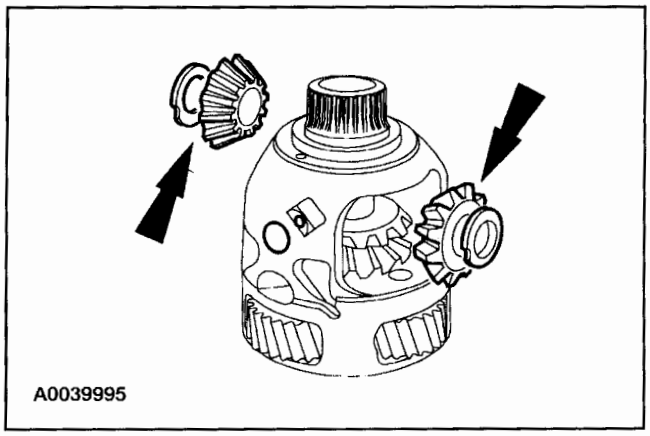


8. Inspect the final drive planet and carrier.
   1 Pinion gear teeth.
   2 Thrust bearing surfaces.
   3 Bushing surfaces.

Assembly

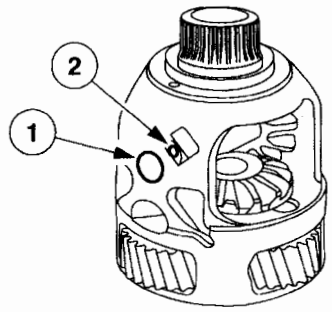


1. Install the differential side gears and thrust washers.



2. Install the differential pinion gears and thrust washers.
   - Rotate the differential pinion gears 90 degrees.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

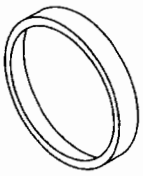


A0040000

3. Install the differential pinion shaft.
   1 Push the pinion shaft in place.
   2 Install the roll pin.

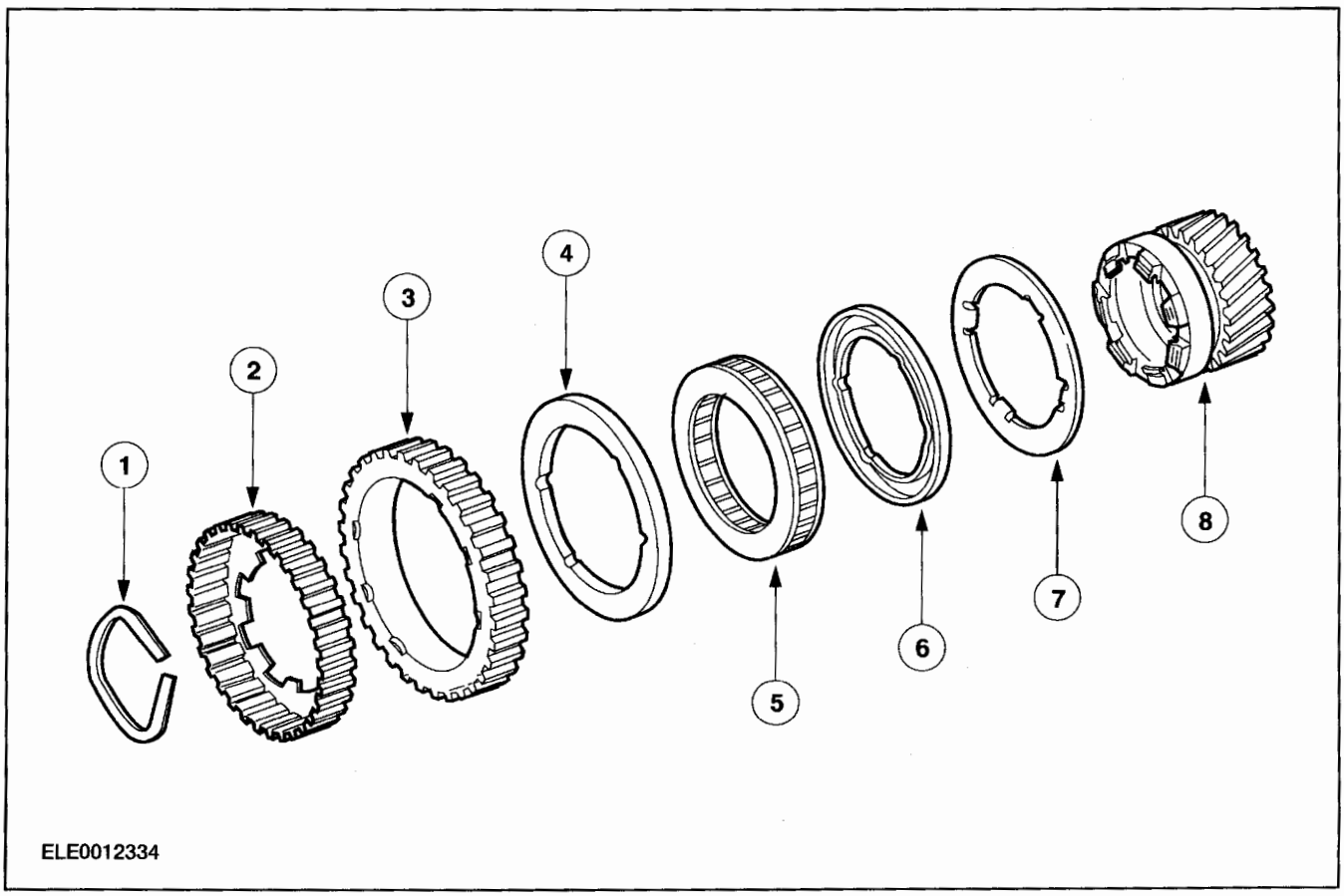
Forward One-Way Clutch

Special Tool(s)

 ST1967-A	Installer, Transmission Sprag 307-293 (T94P-77000-J)

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

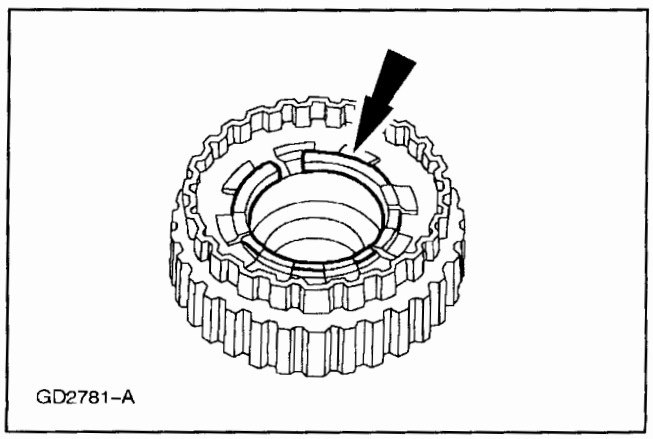
Disassembly



ELE0012334

Item	Part Number	Description
1	—	Coast clutch hub retaining ring
2	—	Coast clutch hub
3	—	Forward one-way clutch outer race
4	—	Forward one-way clutch end cap
5	—	Forward one-way clutch sprag assembly
6	—	Forward one-way clutch end cap
7	—	Forward one-way clutch retainer
8	—	Low and intermediate sun gear, race and bushing assembly

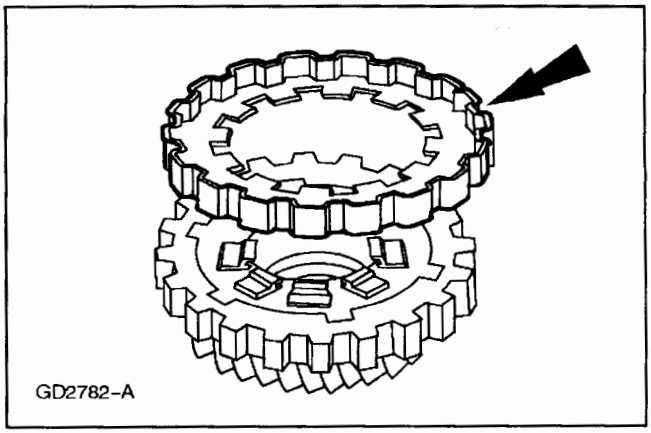
(Continued)



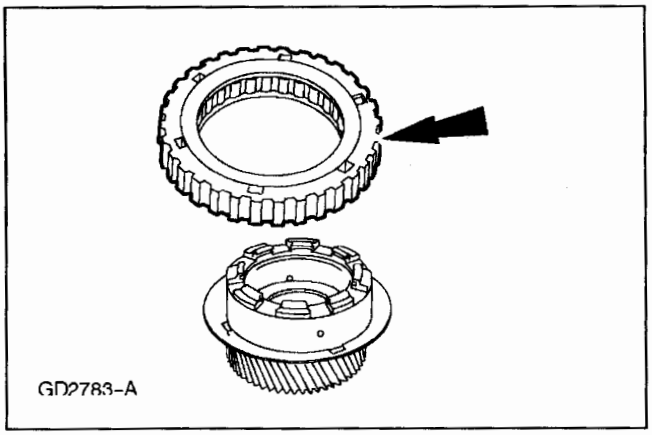
GD2781-A

1. Remove the coast clutch hub retaining ring.

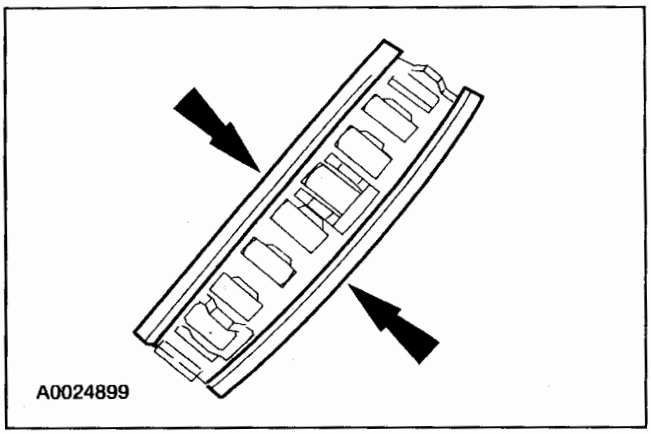
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2782-A

2. Remove the coast clutch hub.

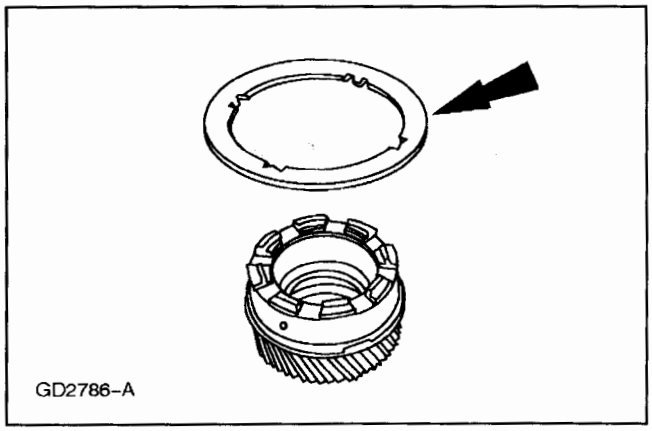

GD2783-A

3. Remove the forward one-way clutch outer race and sprag assembly with end caps.


A0024899

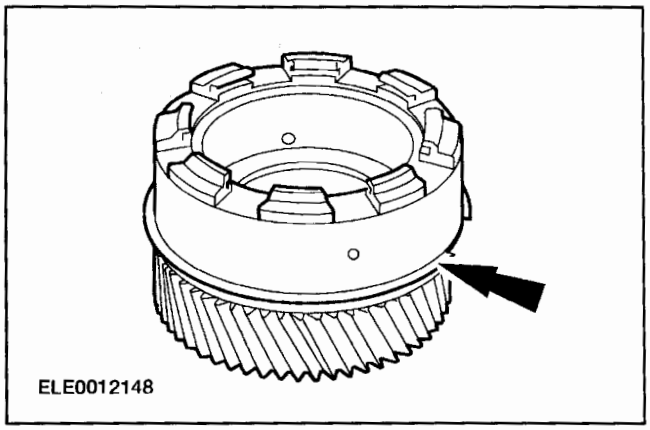
4. **NOTE:** Orientation of end caps to sprag assembly. New design end caps are the same thickness and interchangeable (but not reversible).

   Remove the forward one-way clutch end caps from the sprag assembly.


GD2786-A

5. Remove the forward one-way clutch retainer.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



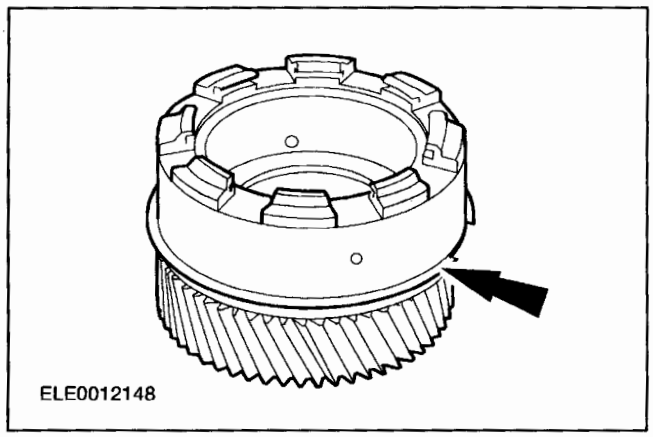
6. Remove the retaining ring down over the gear.

7. **⚠ WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Failure to follow these instructions can result in personal injury.**

   Clean all parts thoroughly in clean solvent and blow dry with moisture-free compressed air.

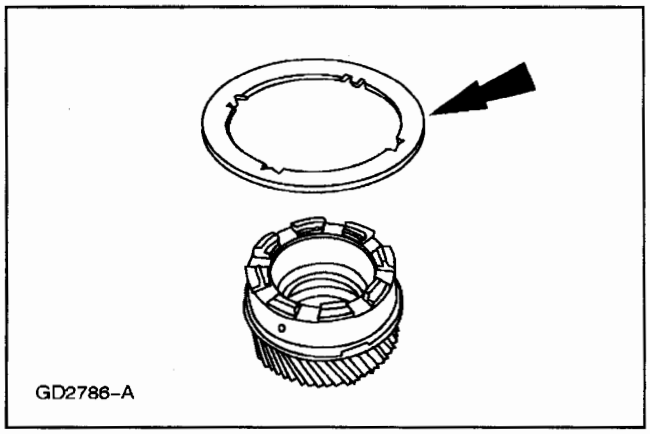
8. Inspect the forward one-way clutch parts for damage and wear.
   - Outer race.
   - Sprag assembly and end caps.
   - Inner race and low-intermediate sun gear assembly.
   - Lube holes.
   - Coast clutch hub.

Assembly

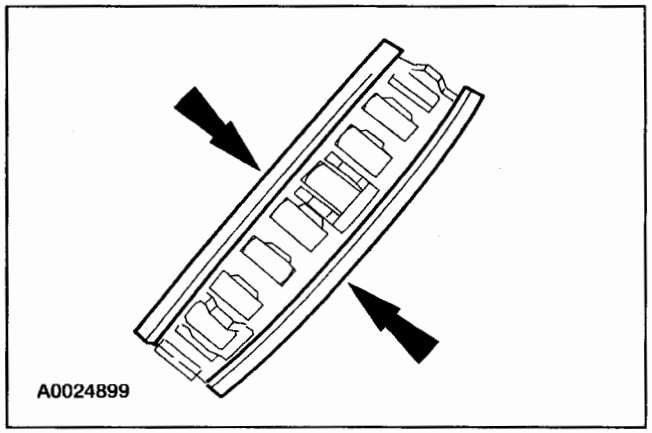


1. Install the retaining ring.

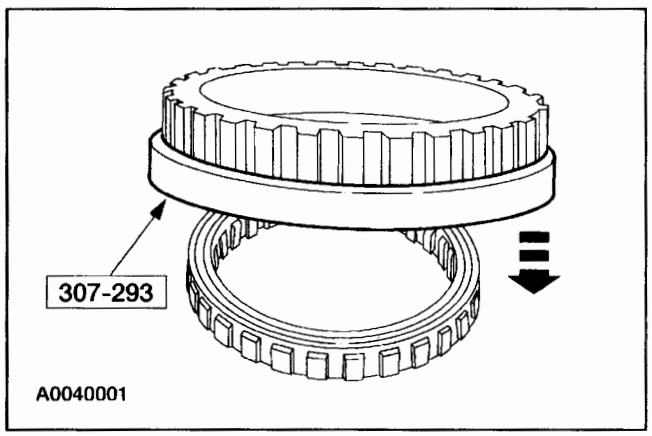
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



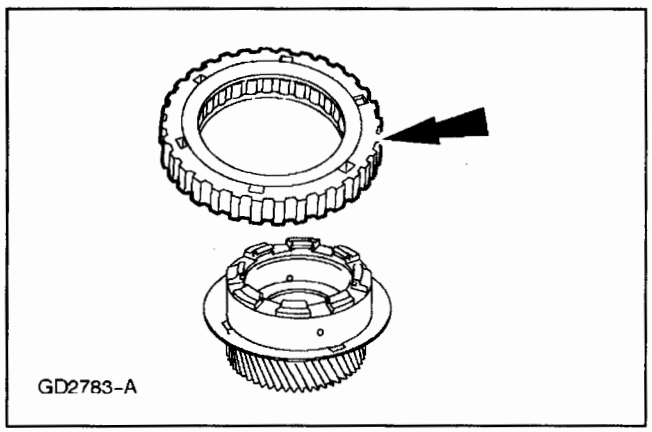
2. **NOTE:** The tabs on the retainer face downward.
   Install the forward one-way clutch retainer.



3. Install the forward one-way clutch end caps onto the sprag assembly.

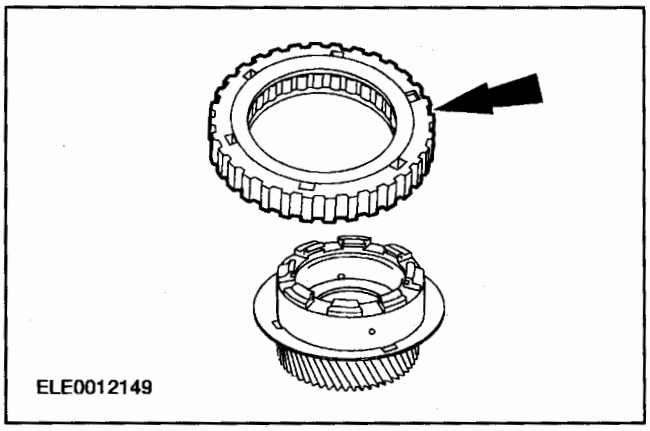


4. Using the special tool, install the one-way clutch bearing into the one-way outer race.



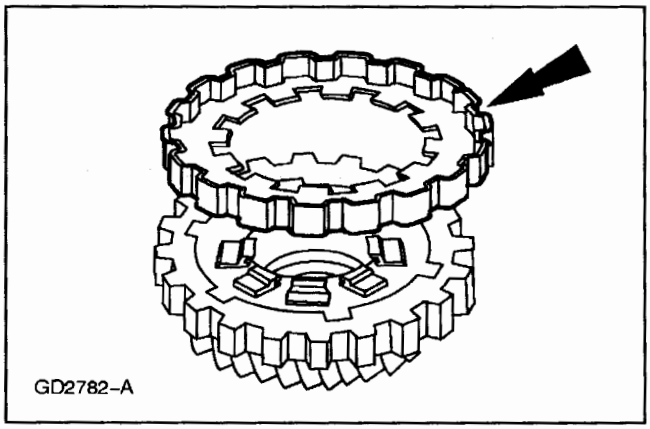
5. Install the sprag assembly and end caps in the outer race.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

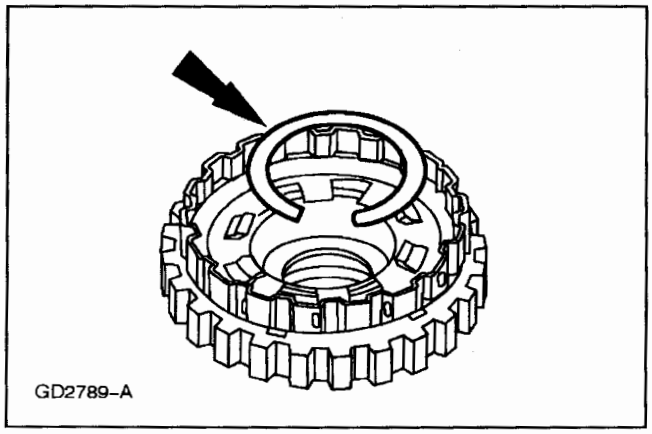

ELE0012149

6. **NOTE:** Lube grooves face upward (away from the sun gear).

   Rotate the outer race and sprag assembly (with end caps) over and install it on the forward one-way clutch inner race.


GD2782-A

7. Install the coast clutch hub.

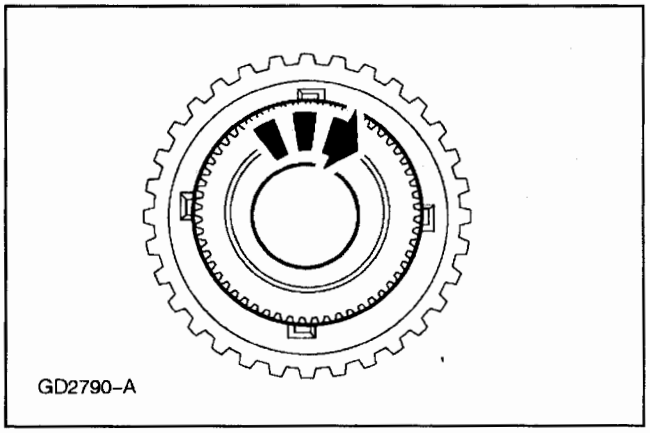

GD2789-A

8. **NOTE:** The ends of the retaining ring should point toward the coast clutch hub.

   NOTE: Make sure the retaining ring is fully seated upon installation.

   Install the coast clutch hub retaining ring.

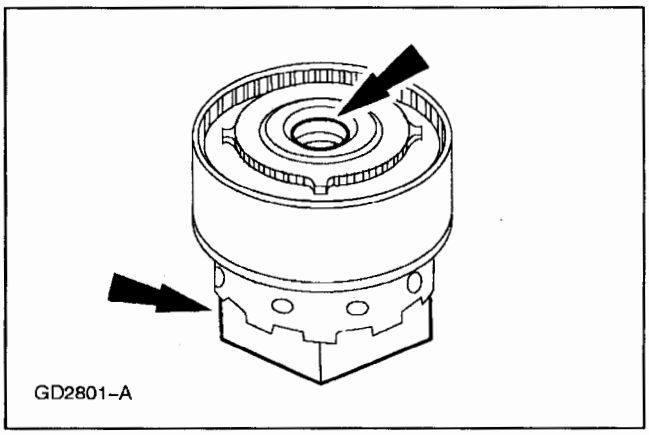
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2790-A

9. Check the operation of the forward one-way clutch with the low/intermediate sun gear facing upward.
   - Hold the outer race firmly.
   - Rotate the low/intermediate sun gear clockwise.
   - The low/intermediate sun gear should rotate with a slight drag without attempting to rotate the outer race.
   - Rotate the low/intermediate sun gear counterclockwise. The low/intermediate sun gear should rotate the outer race.

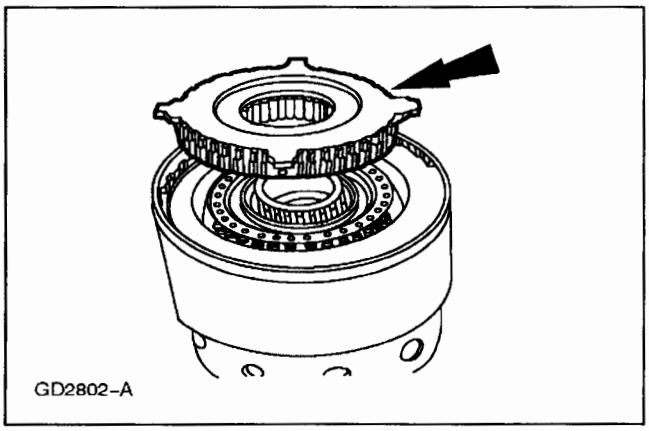
Forward/Coast/Direct Clutch Cylinder and Reverse Clutch Drum — Disassembly

Disassembly


GD2801-A

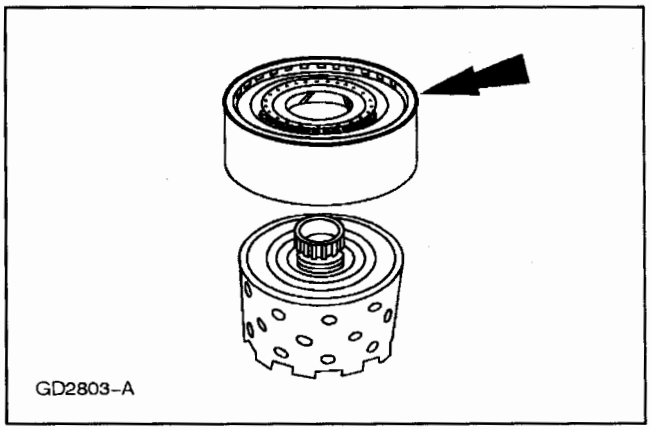
1. **NOTE:** Support the assembly of the forward/coast/direct clutch cylinder assembly and reverse clutch drum assembly on a block of wood so that the reverse clutch hub faces upward. This will ease the reverse clutch hub retaining ring removal.

   Remove the reverse clutch hub retaining ring.

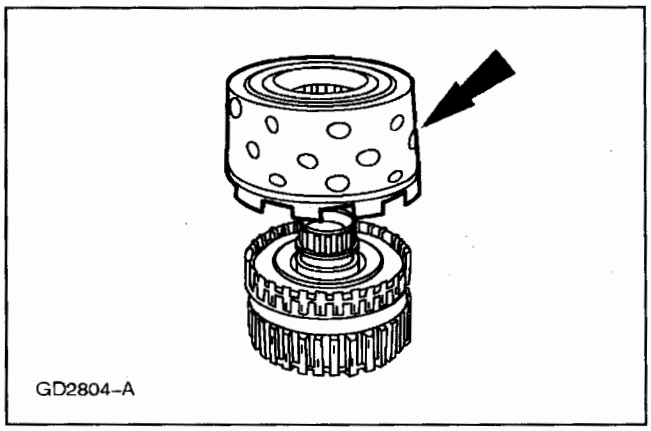

GD2802-A

2. Remove the reverse clutch hub.

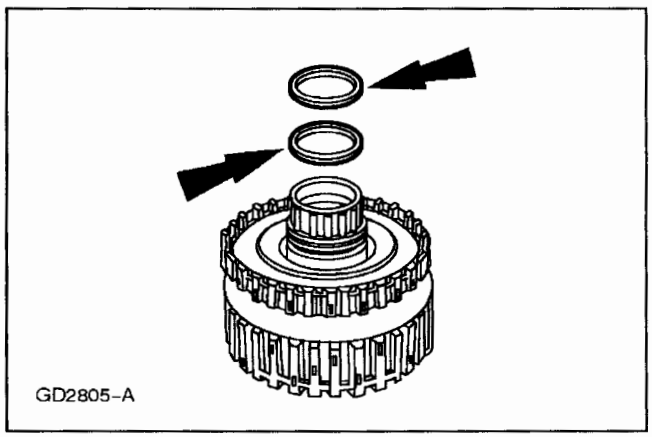
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2803-A

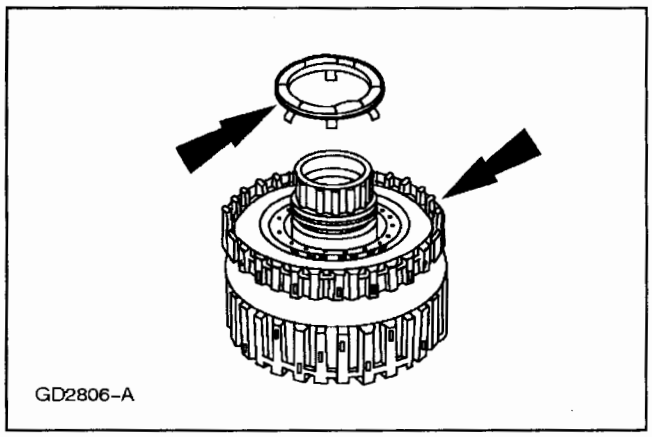
3. Remove the reverse clutch drum assembly.


GD2804-A

4. Remove the direct clutch hub and shell from the forward/coast/direct clutch cylinder.


GD2805-A

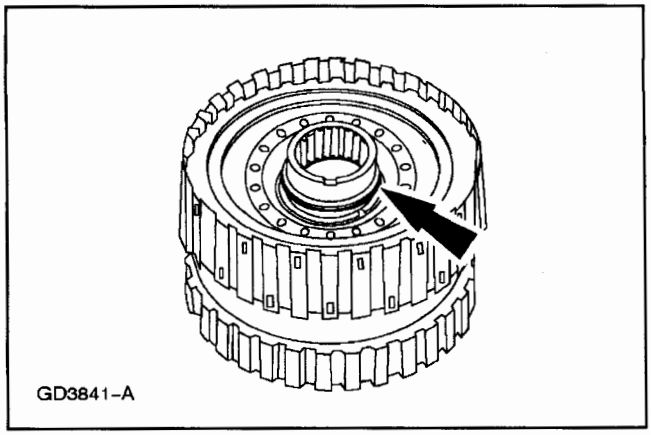
5. Remove and discard the two reverse clutch cylinder seals from the forward/coast/direct clutch cylinder assembly.


GD2806-A

6. **NOTE:** Observe the tab orientation of the No. 2 direct clutch thrust washer during disassembly for correct installation.

   Remove the No. 2 direct clutch thrust washer from the forward/coast/direct clutch cylinder.

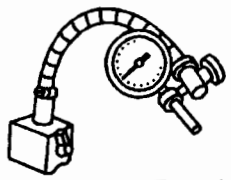
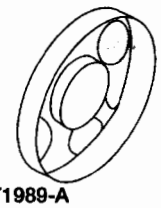
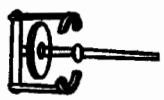
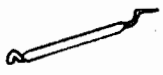
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



7. Remove and discard the forward/coast/direct clutch cylinder hub seal ring.

Forward/Coast/Direct Clutches

Special Tool(s)

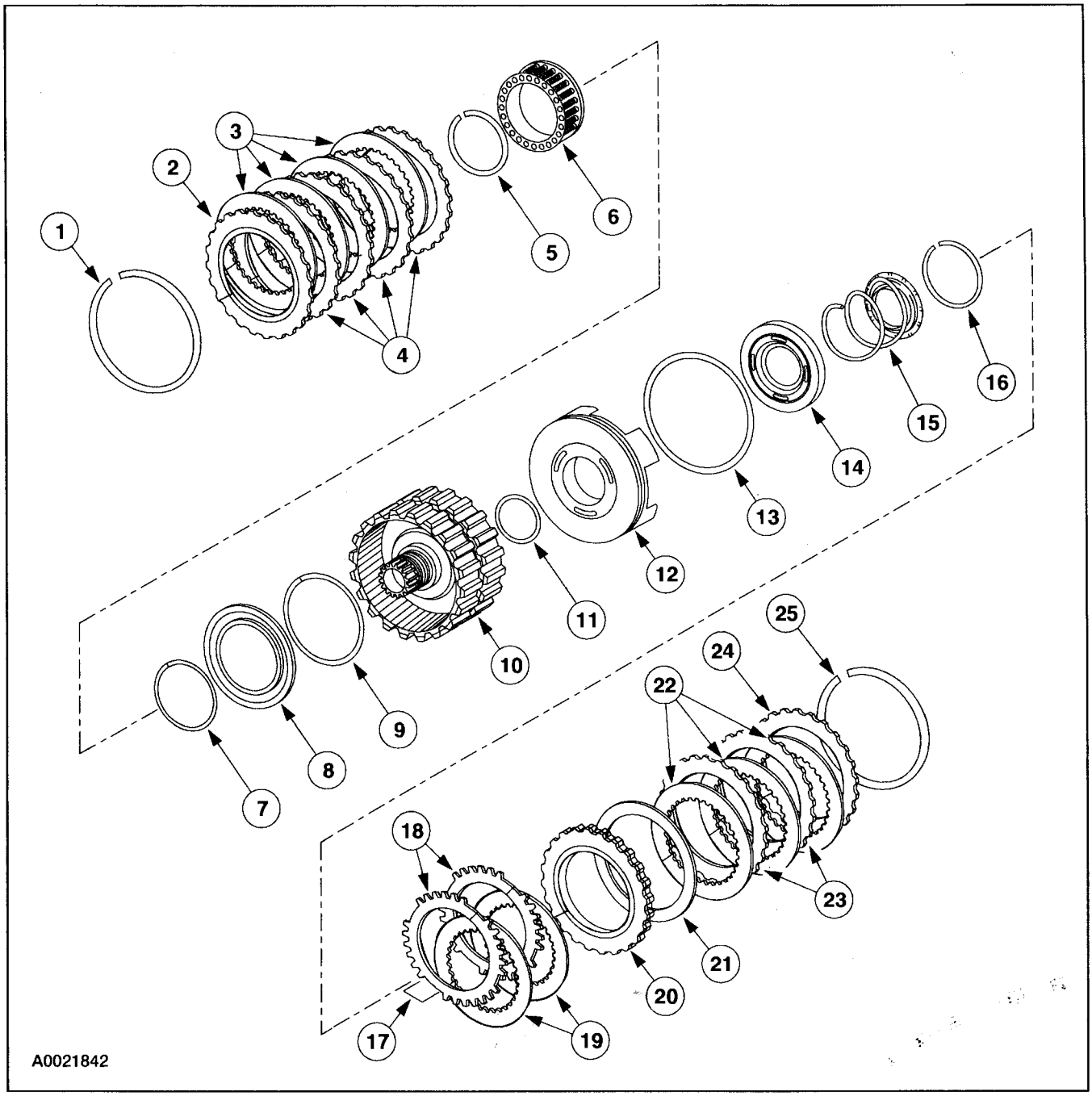
 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B)
 ST1989-A	Protector, Piston Seal 307-282 (T94P-77000-D3)
 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1219-A	Remover, O-Ring Seal 100-010 (T71P-19703-C)

Materials

Item	Specification
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Disassembly



Item	Part Number	Description
1	7D483	Retaining ring — direct clutch pressure plate
2	7B477	Pressure plate — direct clutch
3	7B164	Clutch plates — direct clutch internal spline (friction)
4	7B442	Clutch plates — direct clutch external spline (steel)

(Continued)

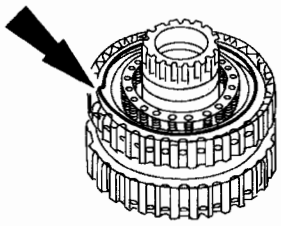
Item	Part Number	Description
5	7C122	Retaining ring — direct clutch spring
6	7F235	Return spring — direct clutch
7	7F225	Piston inner lip seal — direct clutch
8	7A262	Piston assembly — direct clutch

(Continued)

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Item	Part Number	Description
9	7A548	Piston outer lip seal — direct clutch
10	7G120	Cylinder assembly — forward/coast/direct clutch
11	7A548	Piston inner lip seal — forward clutch
12	7A262	Piston assembly — forward clutch
13	7A548	Piston outer lip seal — forward clutch
14	7A262	Piston and seal assembly — coast clutch
15	7G299	Return spring — forward/coast clutch
16	7N169	Retaining ring — forward clutch spring
17	—	Clearance for fingers on the forward clutch piston
18	7B442	Clutch plates — coast clutch external spline (steel)
19	7B164	Clutch plates — coast clutch internal spline (friction)
20	7B066	Pressure plate — coast clutch
21	74159	Wave spring — forward clutch
22	7B164	Internal spline clutch plates — forward clutch (friction)
23	7B442	External spline clutch plates — forward clutch (steel)
24	7B066	Pressure plate — forward clutch
25	7D483	Retaining ring — forward clutch pressure plate

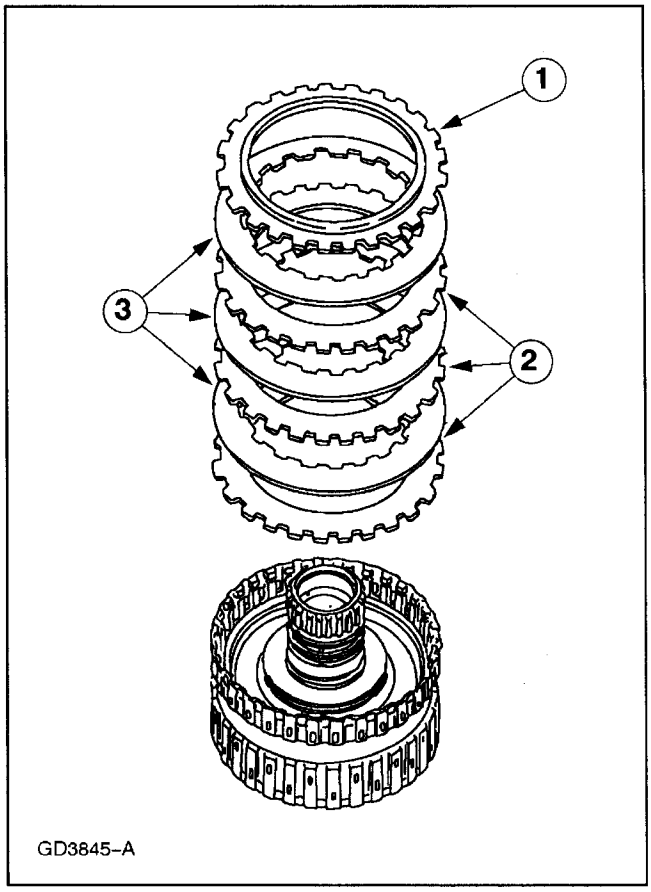
(Continued)



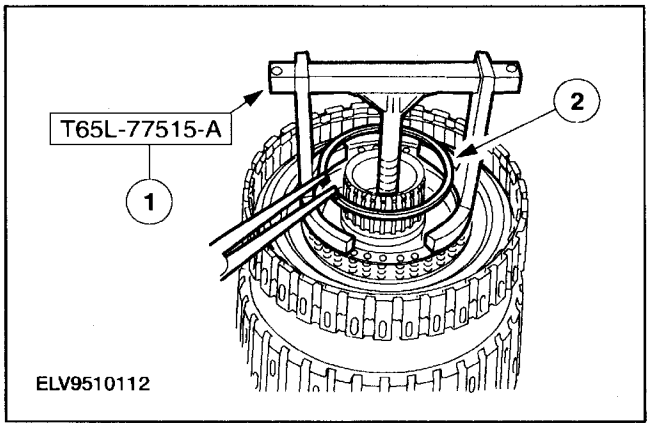
GD2832-A

1. Remove the direct clutch pressure plate retaining ring.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



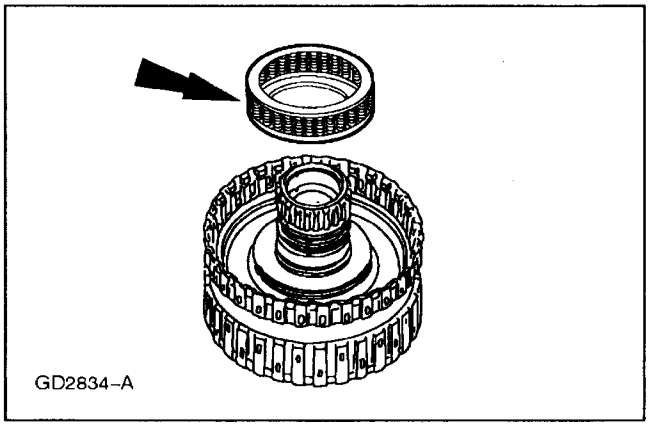
2. Disassemble the direct clutch pack.
   1 Remove the direct clutch pressure plate.
   2 Remove the direct clutch steel plates.
   3 Remove the direct clutch friction plates.



3. **⚠ WARNING: Use caution when releasing tool pressure on the clutch piston springs. Failure to follow these instructions may result in personal injury.**

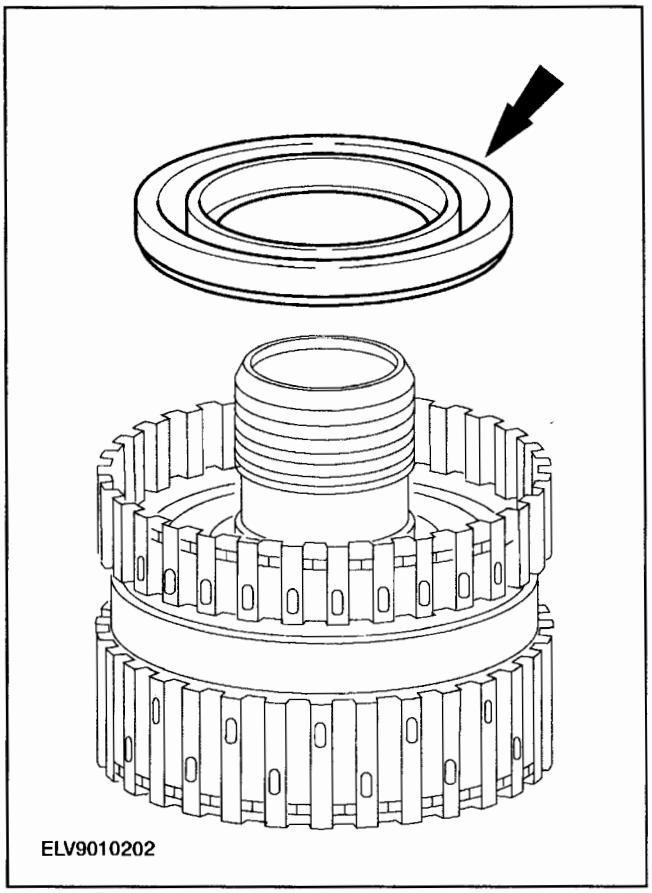
   ⚠ CAUTION: Do not compress the direct clutch return springs completely.

   Remove the direct clutch spring retaining ring.
   1 Using the special tool, compress the direct clutch return springs.
   2 Remove the direct clutch return spring retaining ring.

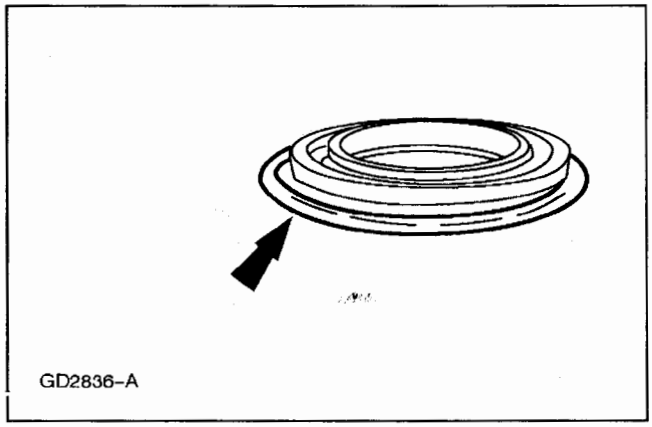


4. Remove the direct clutch return spring assembly.

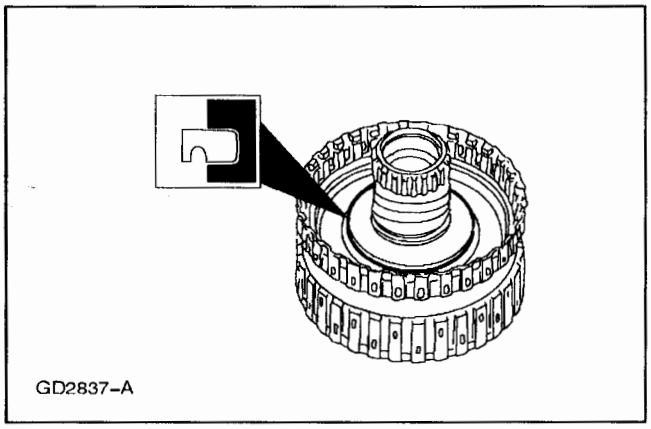
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


ELV9010202

5. Remove the direct clutch piston assembly.

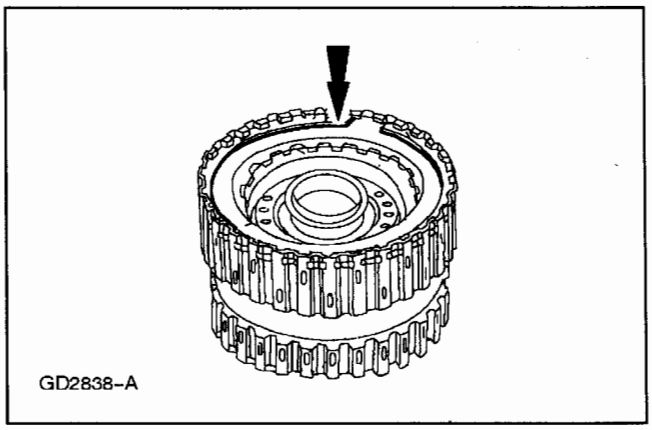

GD2836-A

6. Remove and discard the direct clutch piston outer lip seal.

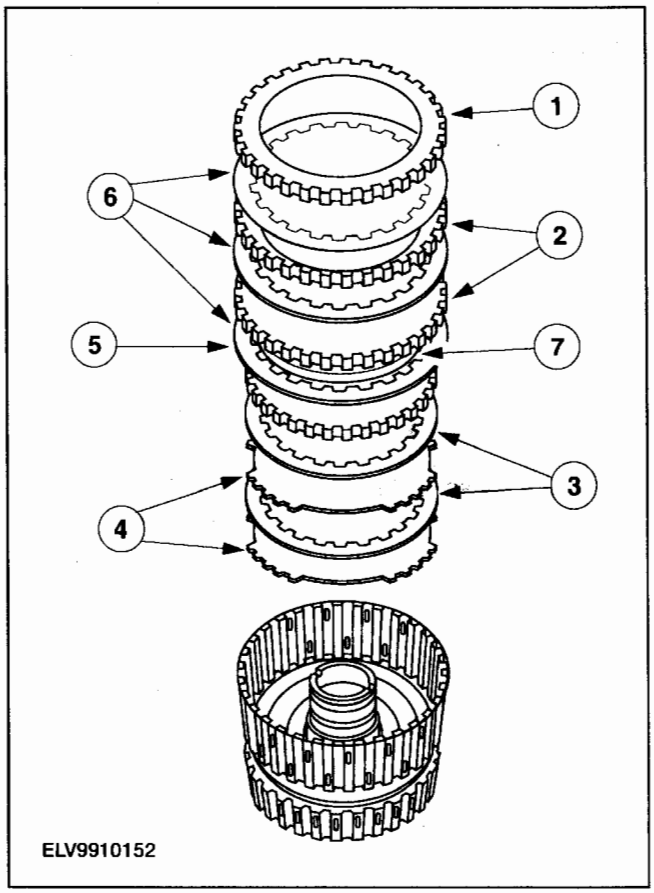

GD2837-A

7. Remove and discard the direct clutch piston inner lip seal from the forward/coast/direct clutch cylinder assembly.

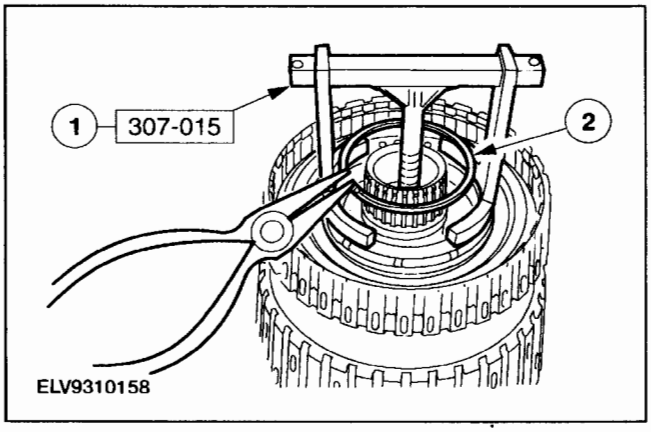
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



8. Remove the forward clutch pressure plate retaining ring.



9. Remove the forward and coast clutch plates.
   1 Forward clutch pressure plate.
   2 Forward clutch external spline clutch plates (steel).
   3 Coast clutch internal spline clutch plates (friction).
   4 Coast clutch external spline clutch plates (steel).
   5 Coast clutch pressure plate.
   6 Forward clutch internal spline clutch plates (friction).
   7 Forward clutch wave spring.

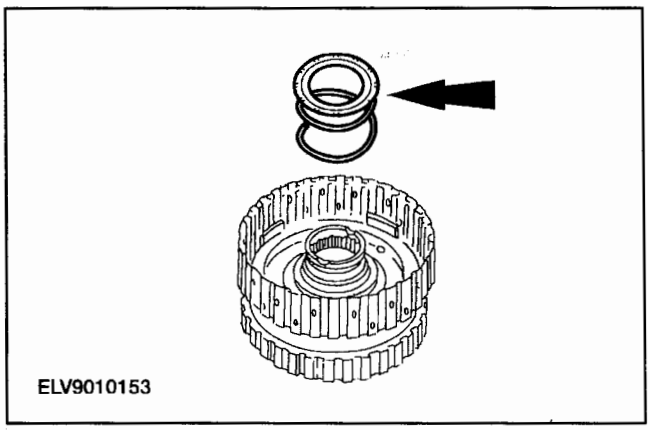


10. **⚠ WARNING: Use caution when releasing tool pressure on the clutch piston springs. Failure to follow these instructions can result in personal injury.**

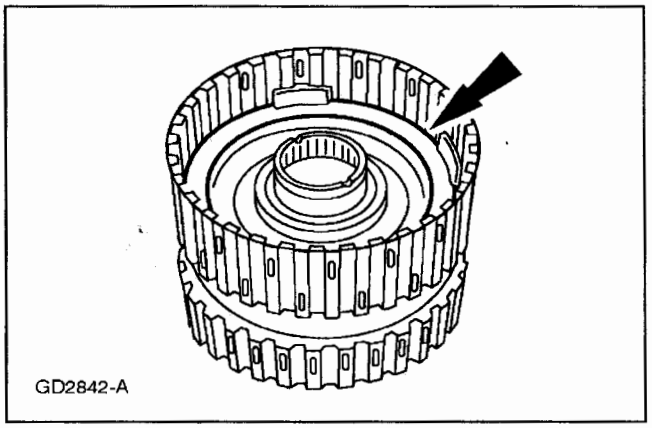
    ⚠ CAUTION: Do not compress the return springs completely.

    Remove the forward/coast clutch return spring retaining ring.
    1 Using the special tool, compress the return spring.
    2 Remove the retaining ring.

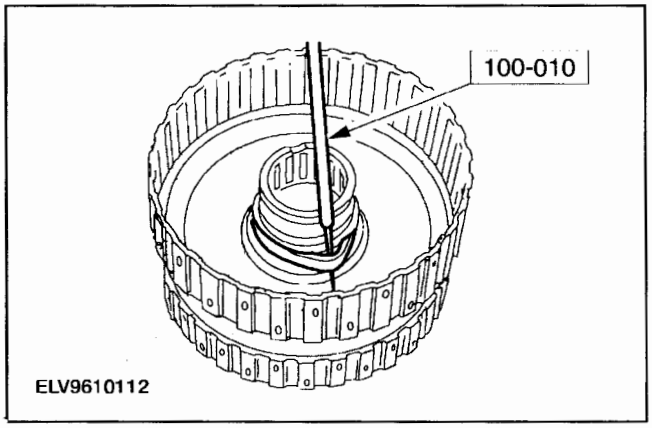
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


ELV9010153

11. Remove the forward/coast clutch return spring assembly.

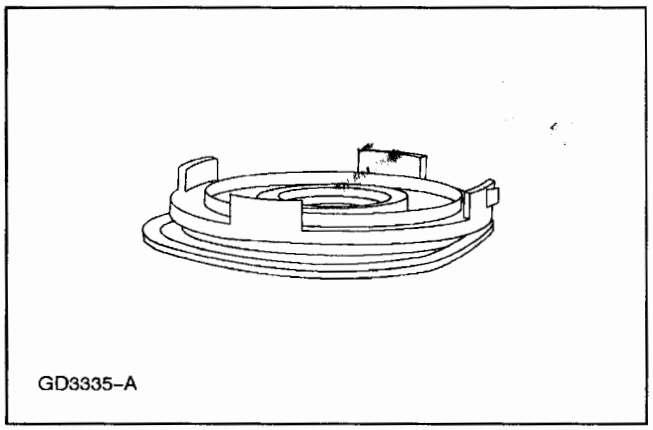

GD2842-A

12. Remove the forward and coast clutch pistons.



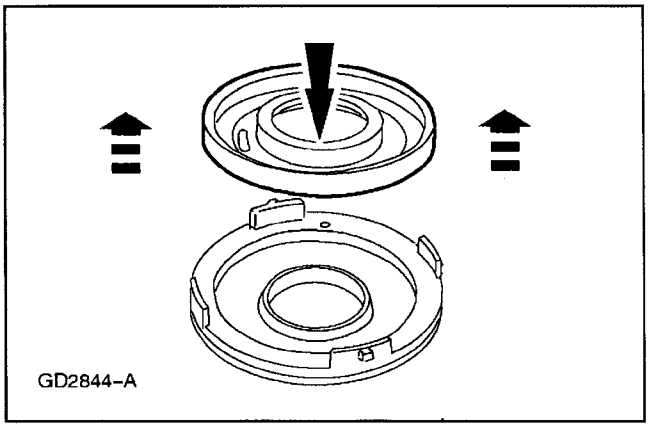
ELV9610112

13. Using the special tool, remove and discard the forward clutch piston inner seal from the forward/coast/direct clutch cylinder assembly.


GD3335-A

14. Remove and discard the forward clutch piston outer lip seal.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



15. Separate the coast clutch piston assembly from the forward clutch piston assembly.

16. ⚠ **WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Failure to follow these instructions can result in personal injury.**

    NOTE: Do not clean the clutch plates in a vapor degreaser or in any other type of detergent solution.

    Clean all parts thoroughly in a clean solvent and blow dry with moisture-free regulated compressed air.

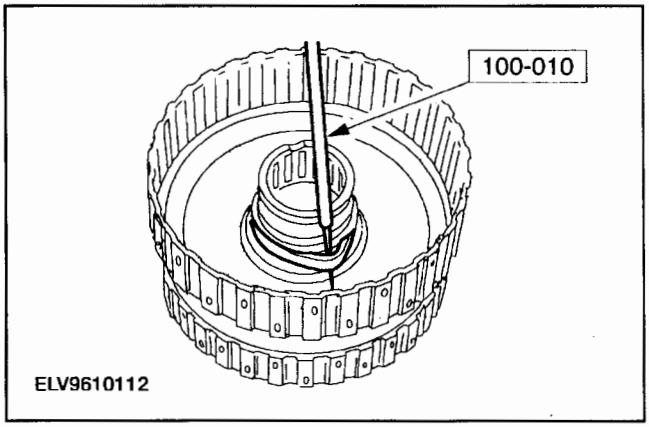
    - Clean the steel clutch plates with a lint-free cloth.
    - Soak the new clutch plates in the specified transmission fluid for 30 minutes before assembly.

17. Inspect the parts for damage or wear.
    - Spline teeth
    - Clutch plates
    - Seals
    - Bushing
    - Check balls in pistons
    - Piston bore
    - Passages and lubrication holes in the forward/coast/direct clutch cylinder

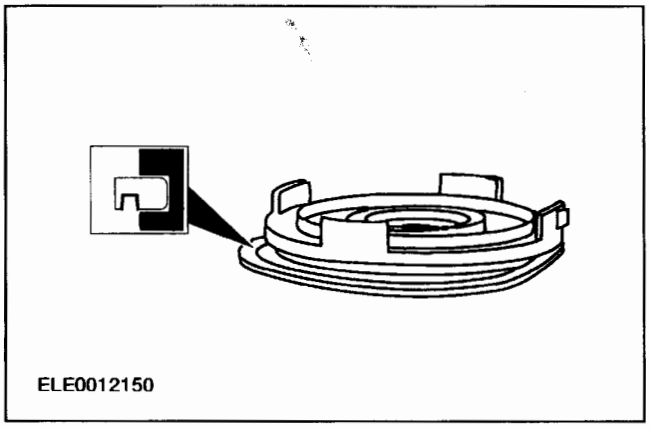
Assembly

1. Soak the internal spline clutch plates in clean automatic transmission fluid.

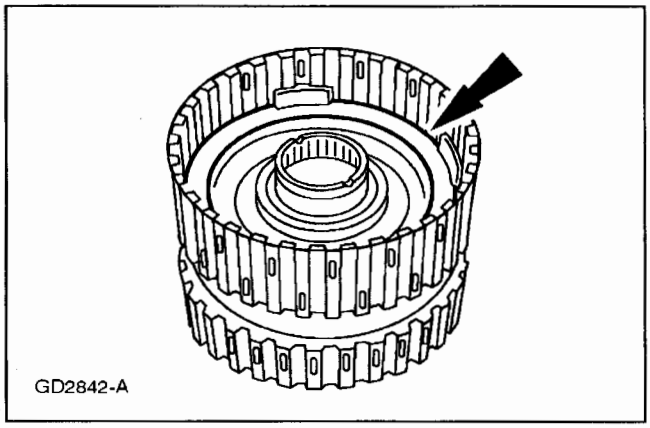
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



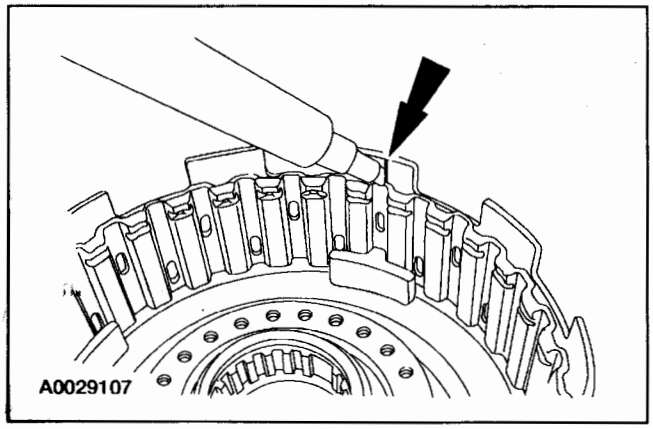
2. Install the forward clutch piston inner seal on the forward/coast/direct clutch cylinder assembly.



3. Install the forward clutch piston outer lip seal on the forward clutch piston assembly.

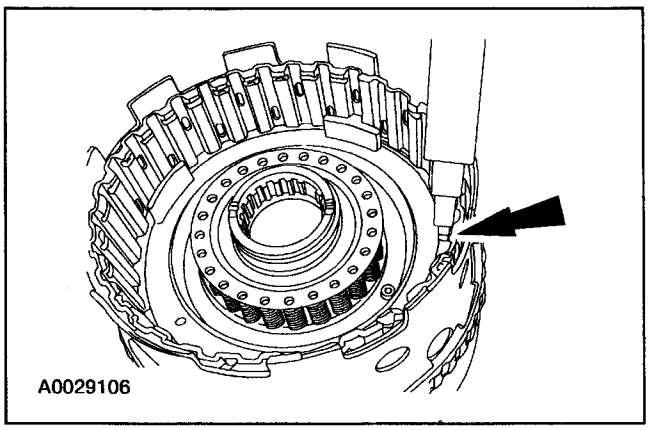


4. Install the forward clutch piston assembly in the forward/coast/direct clutch cylinder assembly.

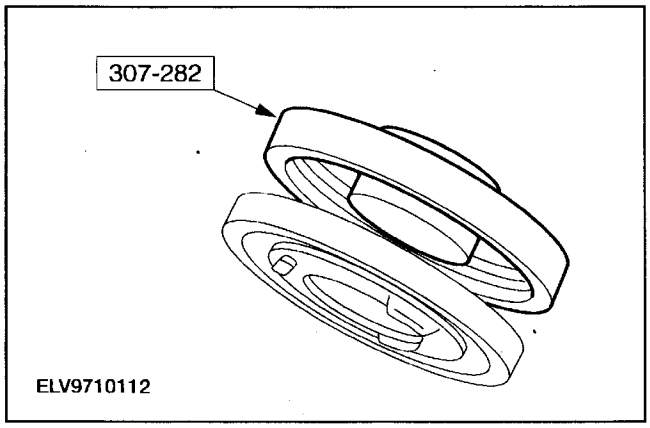


5. Mark the center of two adjacent legs on the top of the cylinder.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

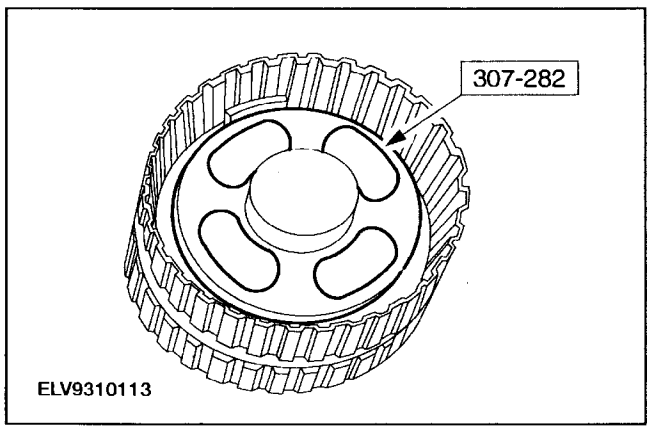

A0029106

6. Find the center between the marks (45 degrees from either leg) and mark the cylinder.



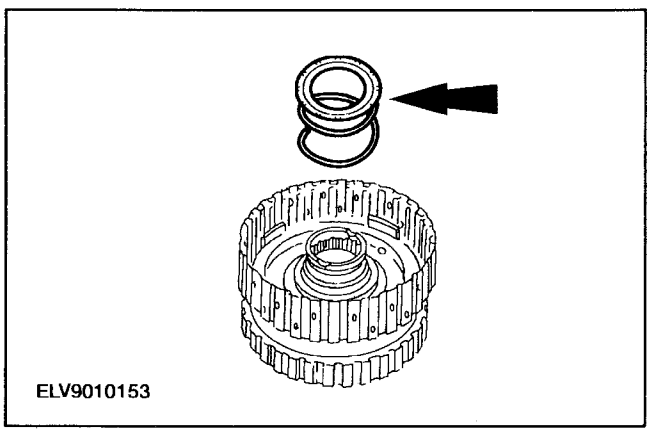
ELV9710112

7. Install the coast clutch piston assembly onto the special tool.



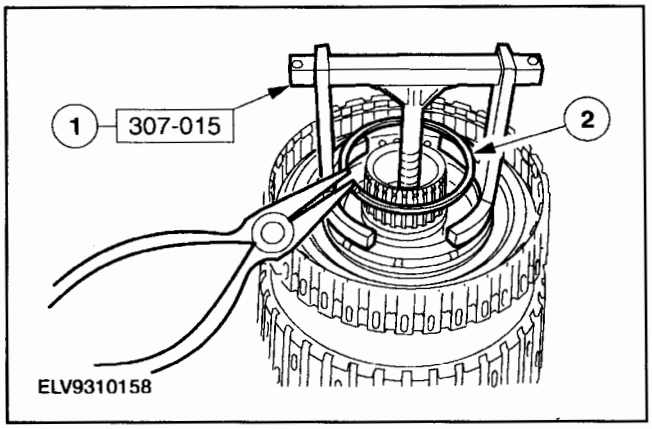
ELV9310113

8. Using the special tool, install the coast clutch piston into the forward clutch piston assembly.


ELV9010153

9. Install the forward/coast clutch return spring assembly.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



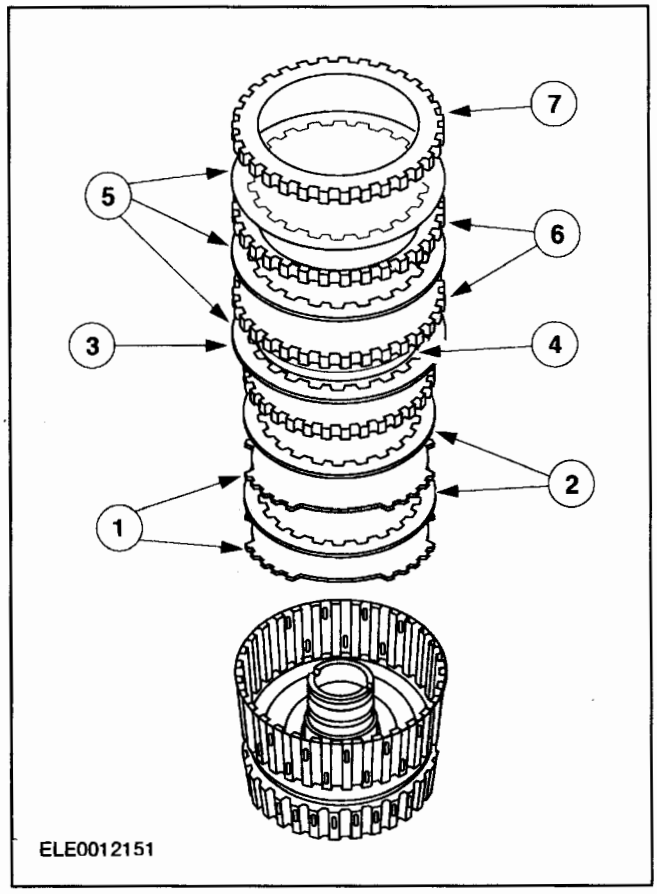
10. ⚠ **WARNING: Use caution when releasing tool pressure on the clutch piston springs. Failure to follow these instructions can result in personal injury.**

    Install the forward/coast clutch return spring retaining ring.

    1 Using the special tool, compress the return spring.

    2 Install the forward/coast clutch retaining ring.

    - Orient the gap between the piston legs.



11. Install the forward and coast clutch plates in the sequence shown.

    1 Coast clutch external spline clutch plates (steel).

    2 Coast clutch internal spline clutch plates (friction).

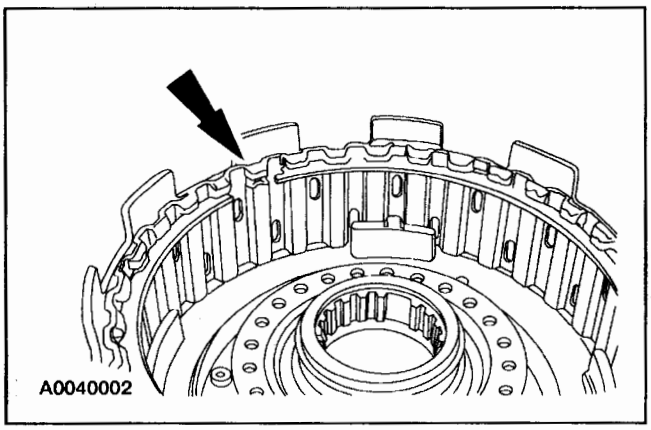
    3 Coast clutch pressure plate.

    4 Forward clutch wave spring.

    5 Forward clutch internal spline clutch plates (friction).

    6 Forward clutch external spline clutch plates (steel).

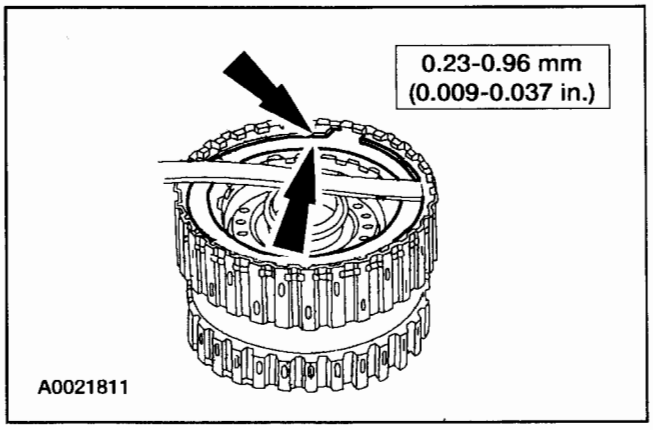
    7 Forward clutch pressure plate.



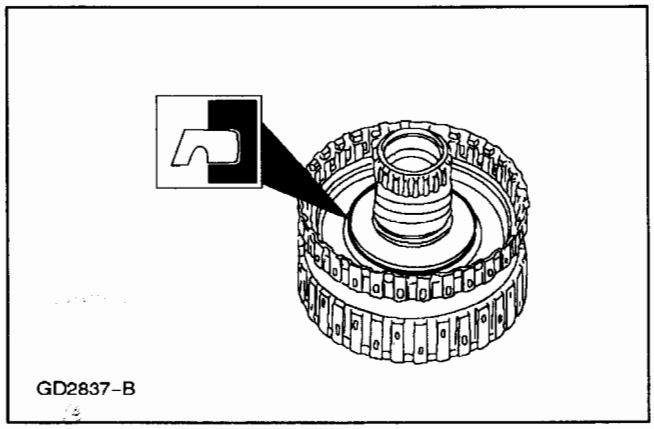
12. Install the forward clutch pressure plate retaining ring.

    - Center the select fit retaining ring on the 45-degree mark between the two adjacent legs.

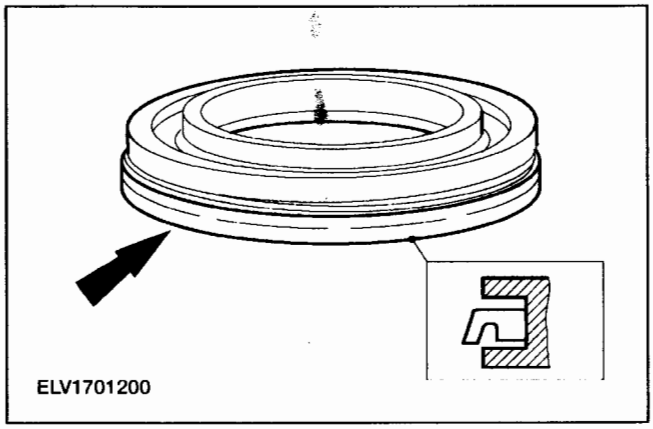
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



13. Using a feeler gauge, measure the clearance between the forward clutch pressure plate and the forward clutch pressure plate retaining ring.
    - Take a second measurement on the opposite side.
    - Average the two measurements to get the clearance.
    - If the clearance is not within specification, select and install the correct thickness retaining ring to obtain the standard clearance.
    - Retaining ring sizes:
      - 1.43-1.53 mm (0.056-0.060 in)
      - 1.59-1.69 mm (0.062-0.066 in)
      - 1.75-1.85 mm (0.069-0.073 in)
      - 1.92-2.02 mm (0.075-0.079 in)

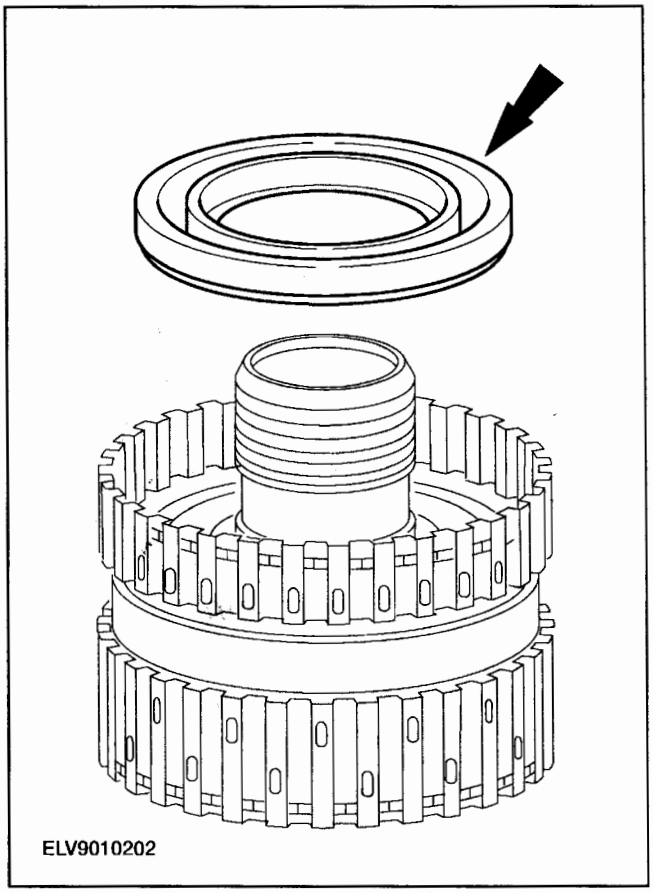


14. Install the direct clutch piston inner lip seal on the direct clutch cylinder assembly.

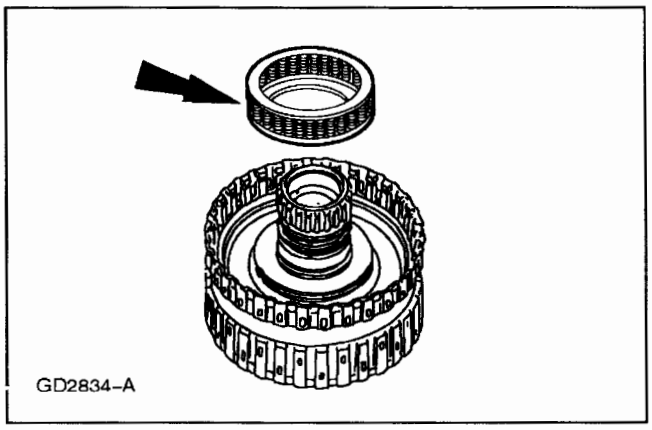


15. Install the direct clutch piston outer seal on the direct clutch piston assembly.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

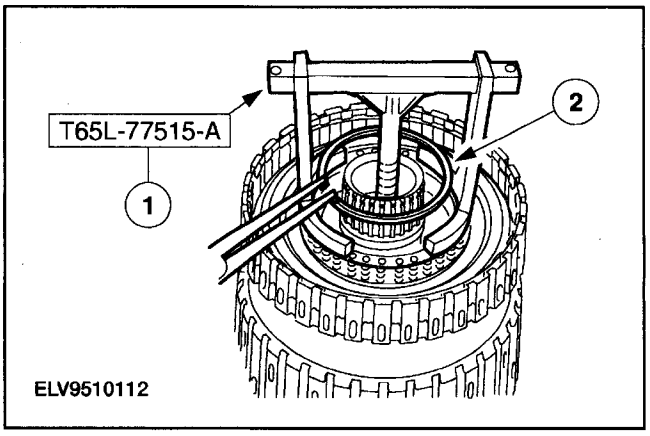

ELV9010202

16. **NOTE:** Position the lip seal facing down.
    Install the direct clutch piston assembly in the forward/coast/direct clutch cylinder assembly.


GD2834-A

17. Install the direct clutch return spring assembly.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



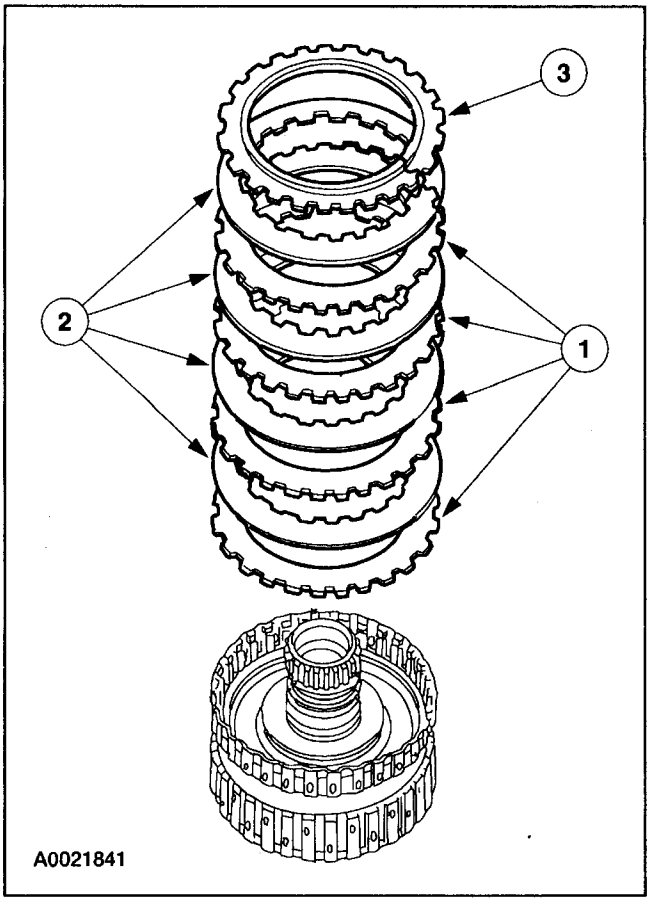
18. **⚠ WARNING: Use caution when releasing tool pressure on the clutch piston springs. Failure to follow these instructions can result in personal injury.**

    ⚠ CAUTION: Do not compress the direct clutch return springs completely.

    Install the direct clutch return spring retaining ring.

    1 Using the special tool, compress the direct clutch return springs.

    2 Install the direct clutch return spring retaining ring.



19. **NOTE:** Quantity of plates are model dependent.

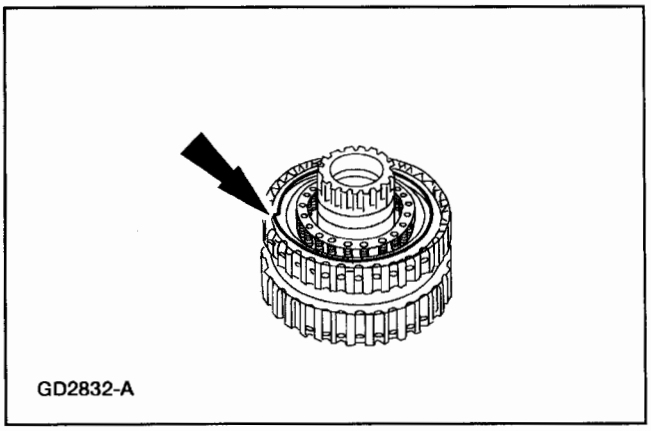
    Install the direct clutch plates.

    1 Install the direct clutch external spline (steel) clutch plates.

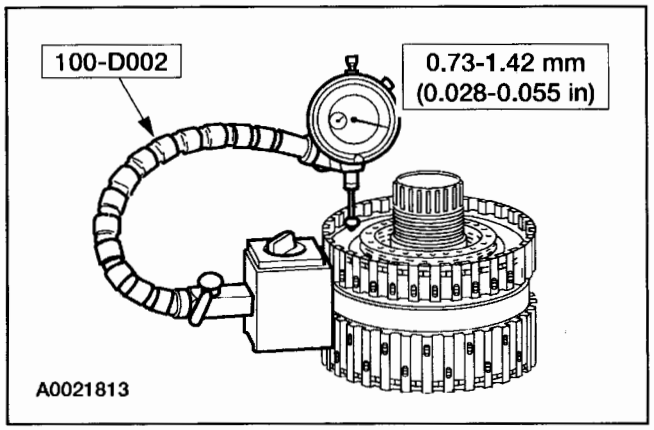
    2 Install the direct clutch internal spline (friction) clutch plates.

    3 Install the direct clutch pressure plate.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

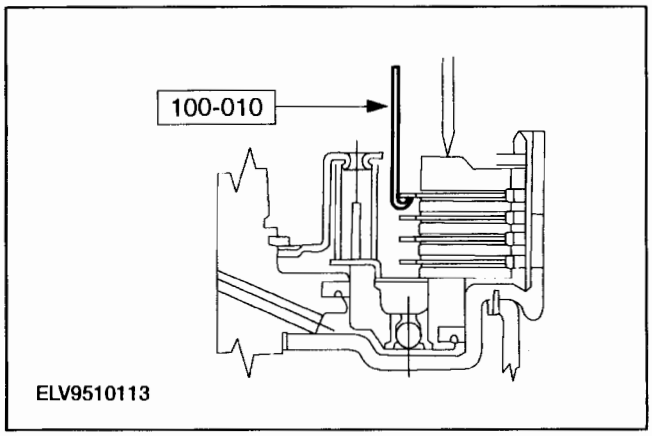

GD2832-A

20. Install the direct clutch pressure plate retaining ring.



A0021813

21. Measure the direct clutch clearance as follows:
    - Install the special tool.
    - Zero the dial on the direct clutch pressure plate.
    - Pull the direct clutch pressure plate upward, and record the reading.



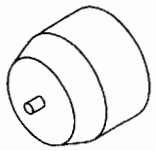
ELV9510113

22. Make a second measurement on the opposite side. Average the two measurements to get the clearance. If the clearance is not within the specification, select and install, using the special tool, the correct thickness direct clutch pressure plate retainer snap ring to obtain the standard clearance.
    - Retaining ring sizes:
        - 1.28-1.38 mm (0.050-0.054 in)
        - 1.39-1.49 mm (0.054-0.058 in)
        - 1.52-1.62 mm (0.059-0.063 in)
        - 1.65-1.75 mm (0.064-0.069 in)

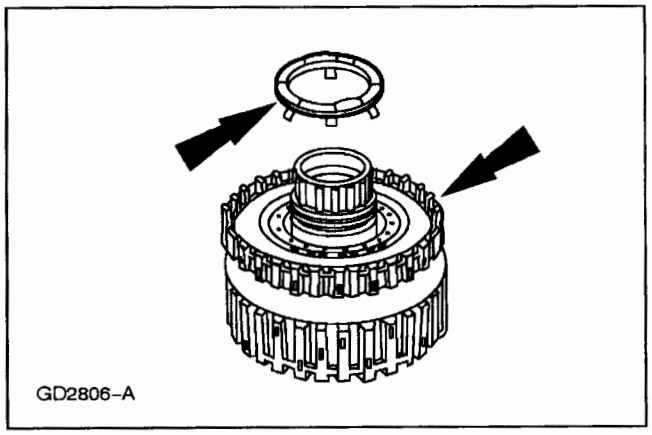
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Forward/Coast/Direct Clutch Cylinder and Reverse Clutch Drum — Assembly

Special Tool(s)

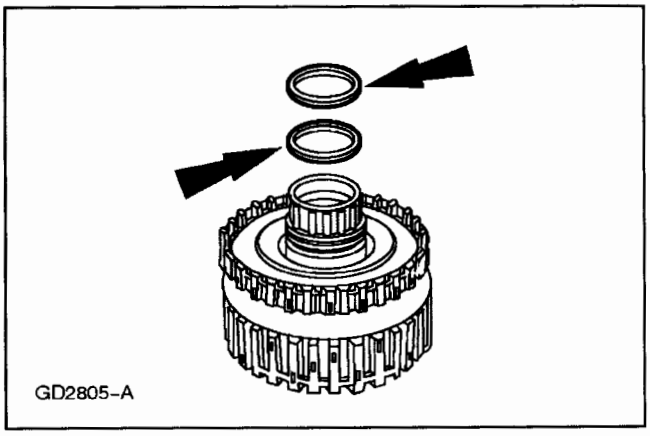
 ST1952-A	Sizer, Hub Seal 307-283 (T94P-77000-D4)

Assembly

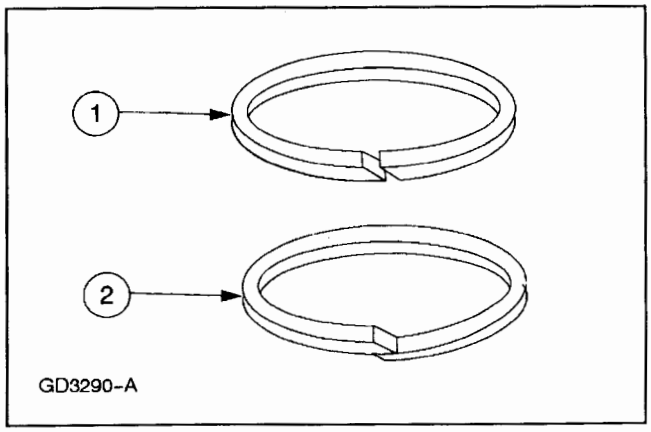

GD2806-A

1. ⚠ **CAUTION: The tabs on the No. 2 direct clutch thrust washer must be seated in the direct clutch support and spring.**

   Install the No. 2 direct clutch thrust washer on the forward/coast/direct clutch cylinder with the tabs facing downward.


GD2805-A

2. Install the two reverse clutch cylinder seals.



GD3290-A

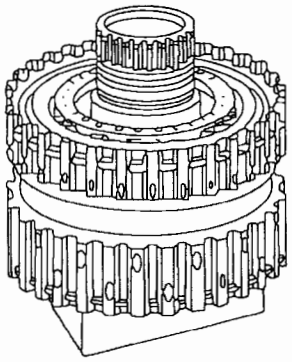
3. **NOTE:** Make sure that the reverse clutch cylinder seals are overlapped correctly.

   Position the reverse clutch cylinder seals.

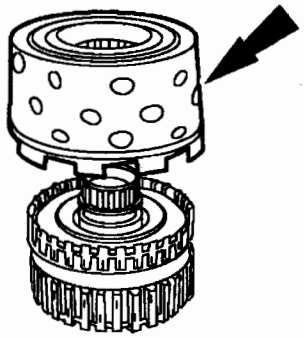
   1 Correct installation.

   2 Incorrect installation.

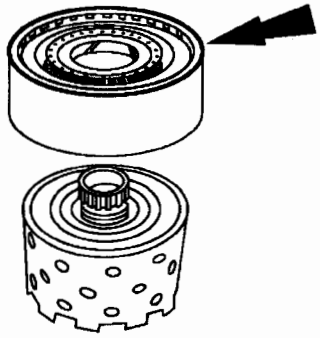
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


ELE0012152

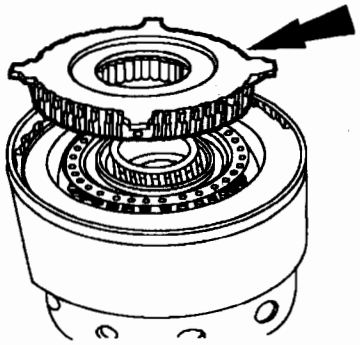
4. Support the forward/coast/direct clutch cylinder assembly on a block of wood so that the direct clutch faces upward.


GD2804-A

5. Install the direct clutch hub and shell on the forward/coast/direct clutch cylinder.

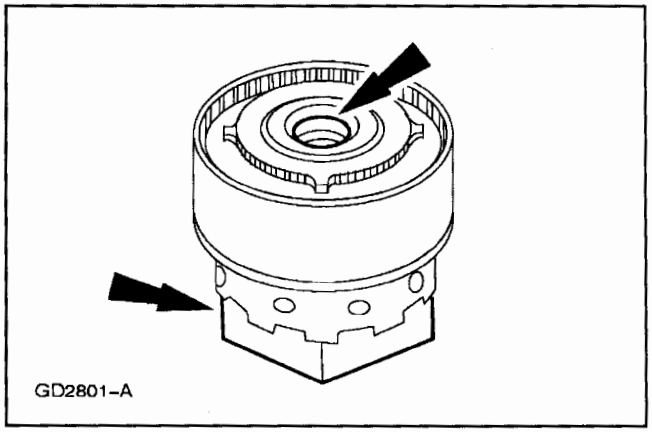

GD2803-A

6. Install the reverse clutch drum assembly.

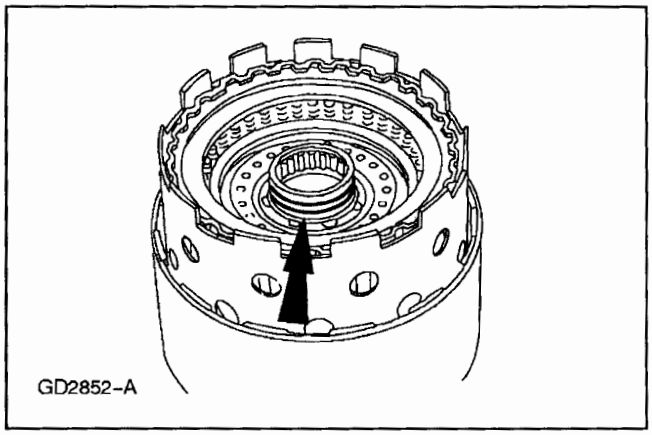

GD2802-A

7. Install the reverse clutch hub.

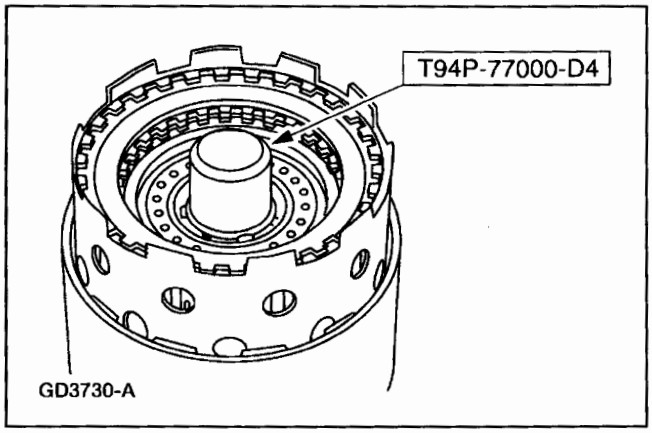
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2801-A

8. Support the reverse clutch drum on a block of wood while installing the reverse clutch hub retaining ring.


GD2852-A

9. Install the forward/coast/direct clutch cylinder hub seal.



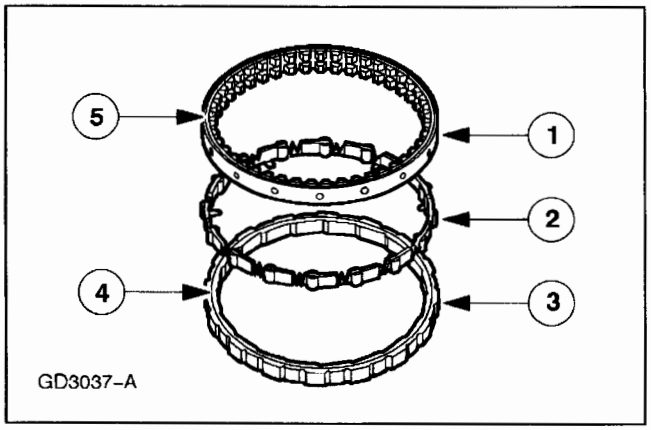
GD3730-A

10. Leave special tool attached until the forward/coast/direct clutch cylinder is installed into the transaxle housing.

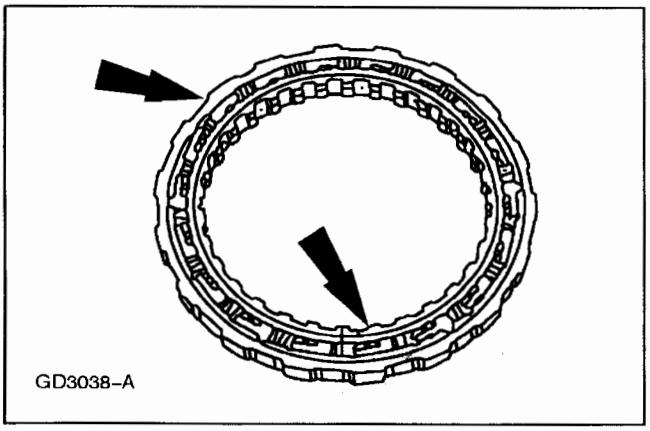
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Low One-Way Clutch Assembly

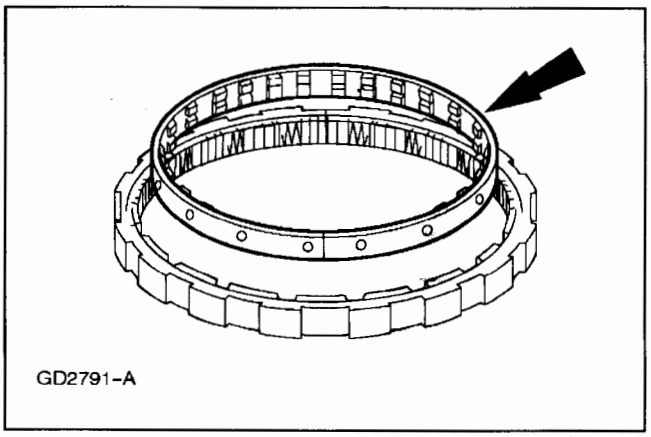
Disassembly



1. Inspect the low one-way clutch components:
   1 Low one-way clutch inner race.
   2 Roller assembly.
   3 Low one-way clutch outer race.
   4 Outer race groove.
   5 Inner race groove.

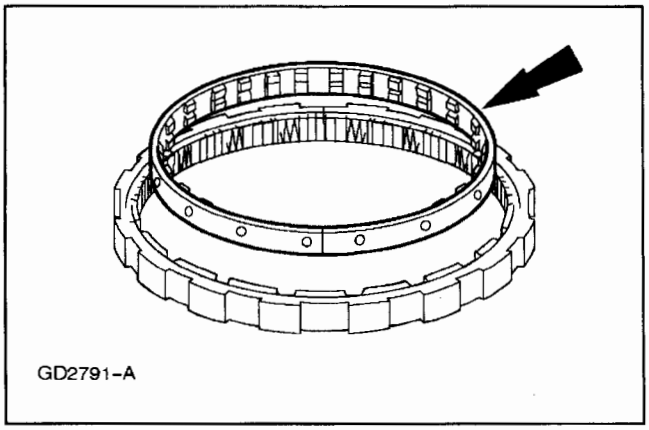


2. Position the low one-way clutch so the inner and outer race grooves are facing upward.



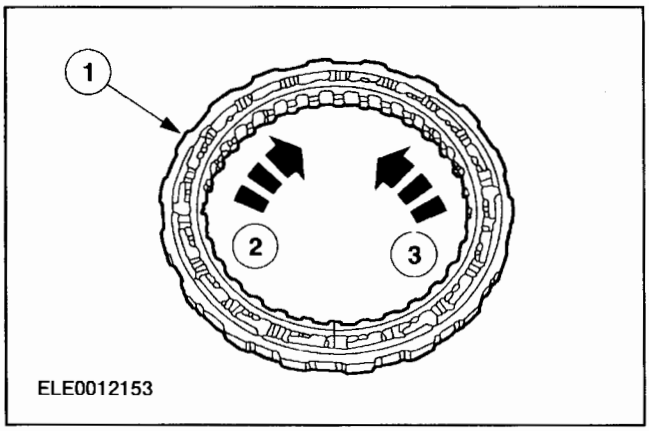
3. Remove the inner race.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2791-A

2. **NOTE:** To aid in inner race installation, rotate the inner race clockwise during installation.

   Install the inner race with the grooves facing up.

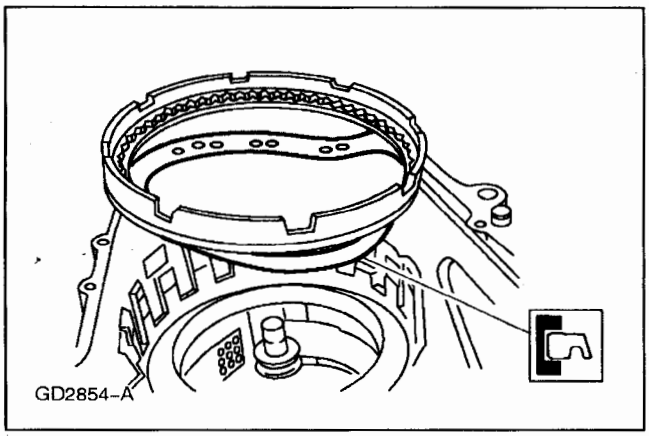


ELE0012153

3. Check the operation of the one-way clutch as follows:
   1 Hold the outer race.
   2 Rotate the inner race clockwise. It should rotate with a slight drag without attempting to rotate the outer race.
   3 Rotate the inner race counterclockwise. The inner race should rotate the outer race.

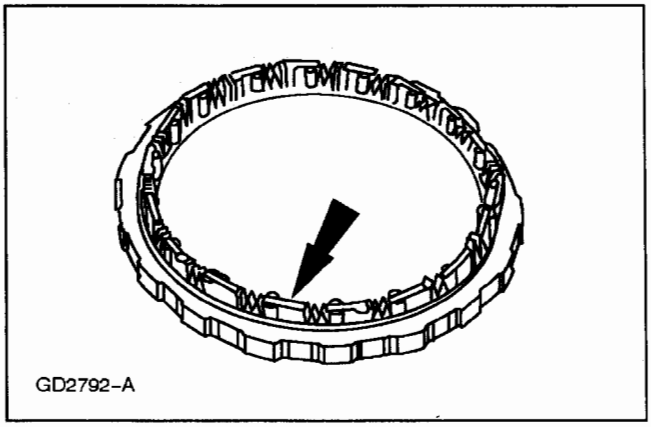
Low/Reverse Piston

Disassembly


GD2854-A

1. Remove and discard the low/reverse clutch piston outer seal on the low/reverse clutch piston.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2792-A

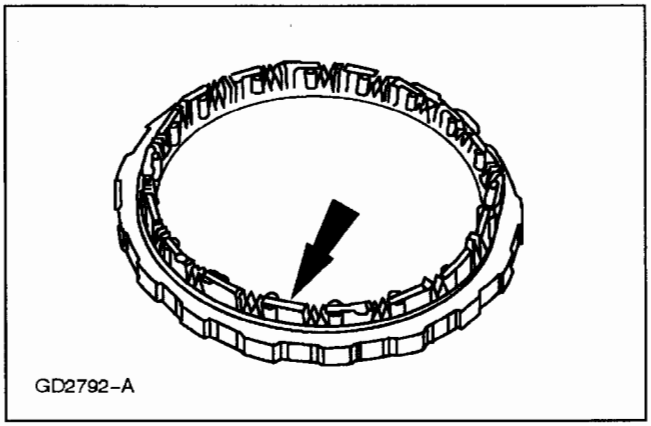
4. Remove the roller assembly.

5. ⚠ **WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Failure to follow these instructions can result in personal injury.**

   Clean all parts thoroughly in clean solvent and blow dry with moisture-free regulated compressed air.

6. Inspect the low one-way clutch parts for damage and wear.
   - Outer race
   - Sprag assembly
   - Inner race
   - Lubrication holes

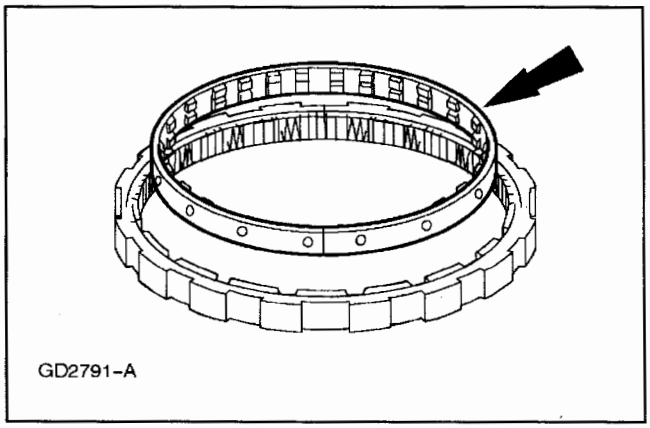
Assembly


GD2792-A

1. **NOTE:** Outer tabs of the roller assembly must face up.

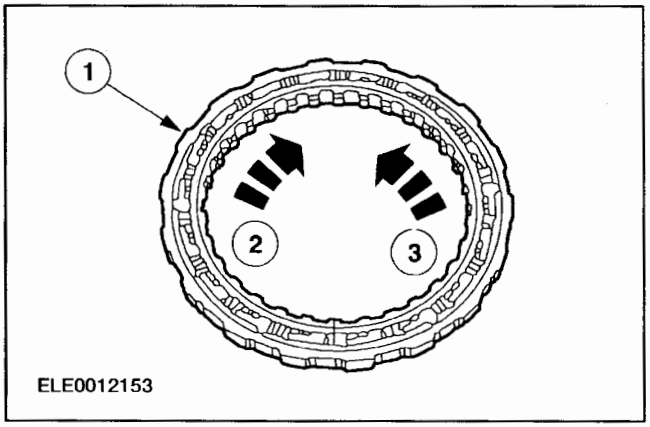
   Install the roller assembly into the outer race with the groove facing up.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2791-A

2. **NOTE:** To aid in inner race installation, rotate the inner race clockwise during installation.

   Install the inner race with the grooves facing up.

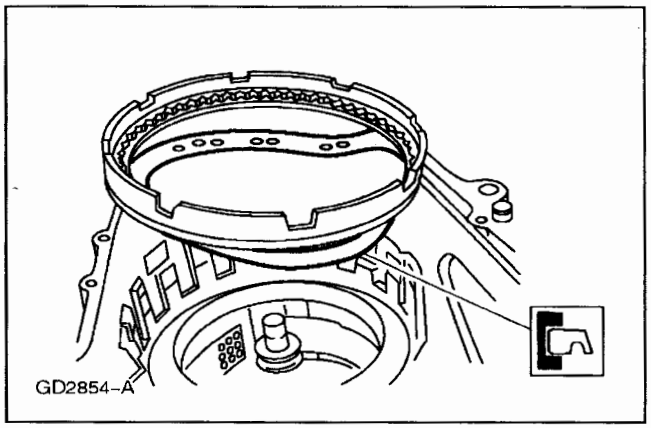


ELE0012153

3. Check the operation of the one-way clutch as follows:
   1 Hold the outer race.
   2 Rotate the inner race clockwise. It should rotate with a slight drag without attempting to rotate the outer race.
   3 Rotate the inner race counterclockwise. The inner race should rotate the outer race.

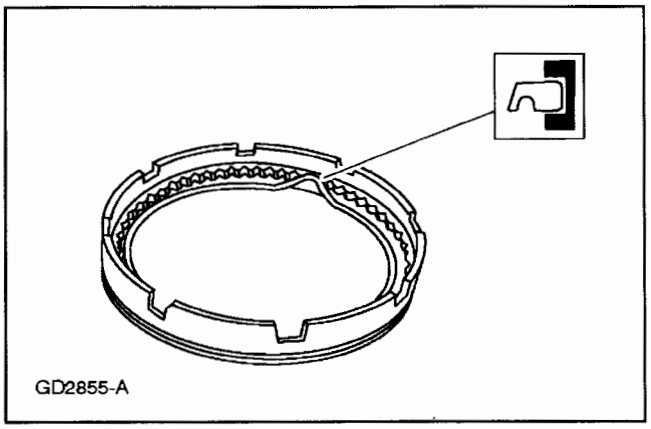
Low/Reverse Piston

Disassembly


GD2854-A

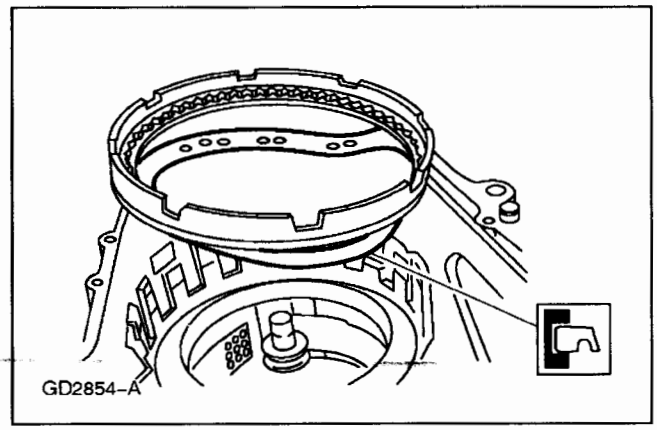
1. Remove and discard the low/reverse clutch piston outer seal on the low/reverse clutch piston.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

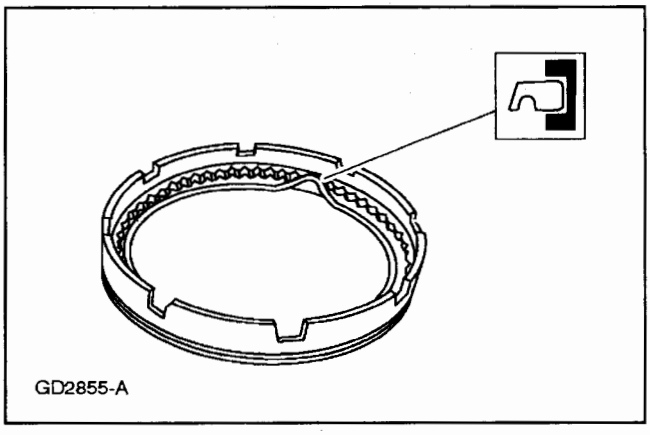

GD2855-A

2. Remove and discard the low/reverse clutch piston inner seal on the low/reverse clutch piston.

Assembly


GD2854-A

1. Install the low/reverse clutch piston outer seal on the low/reverse clutch piston.

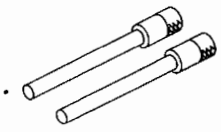

GD2855-A

2. Install the low/reverse clutch piston inner seal on the low/reverse clutch piston.

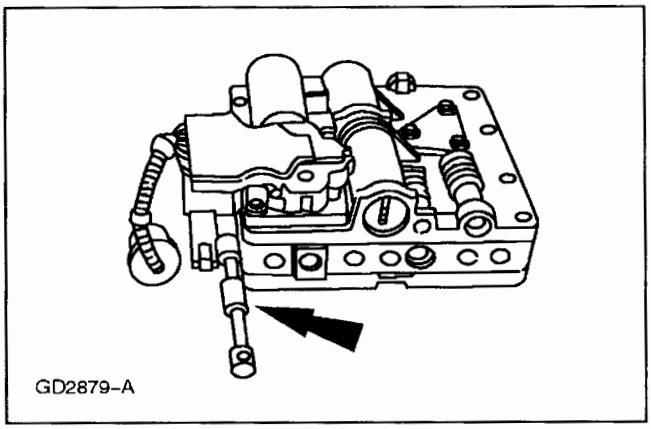
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Main Control Valve Body

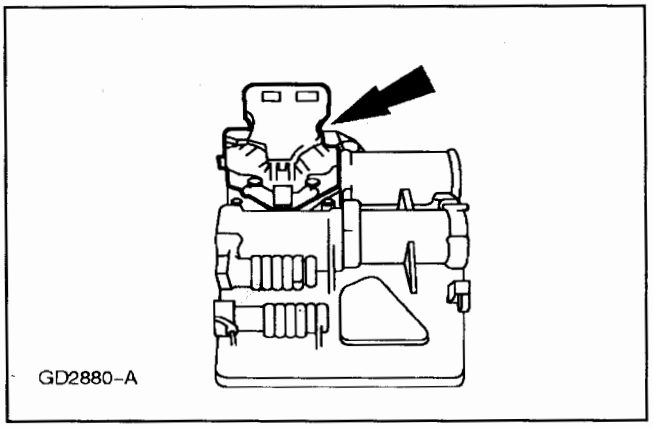
Special Tool(s)

 ST2535-A	Alignment Pins, Valve Body 307-299 (T94P-77000-N)

Disassembly

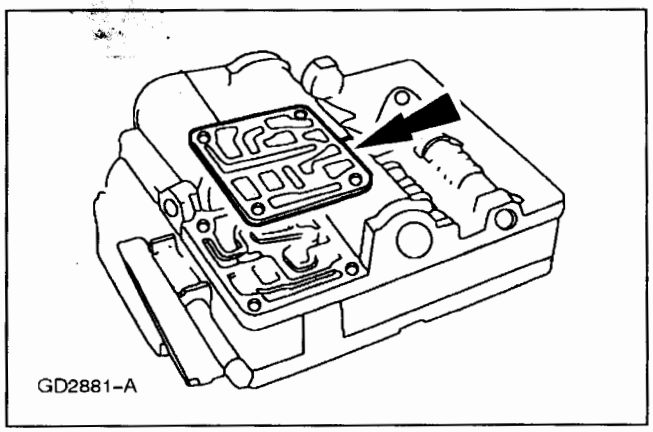

GD2879-A

1. Remove the manual valve.


GD2880-A

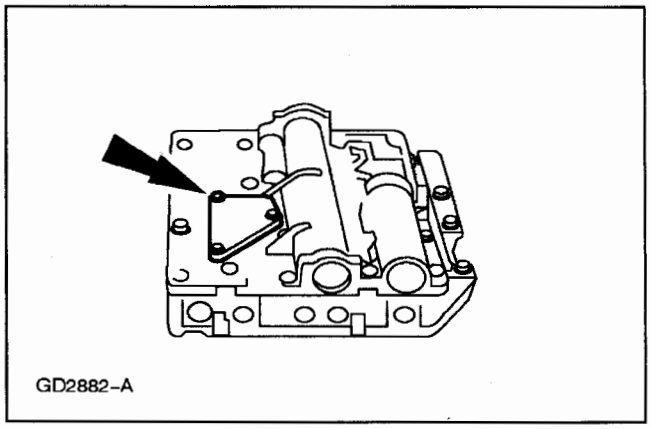
2. ⚠ **CAUTION: Do not attempt to remove the solenoid valve body wiring cover.**

   Remove the two solenoid valve body bolts and the solenoid valve body.

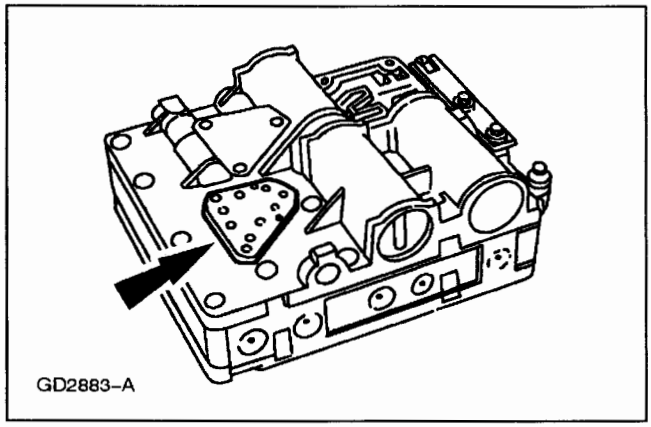

GD2881-A

3. Remove and discard the solenoid valve body gasket.

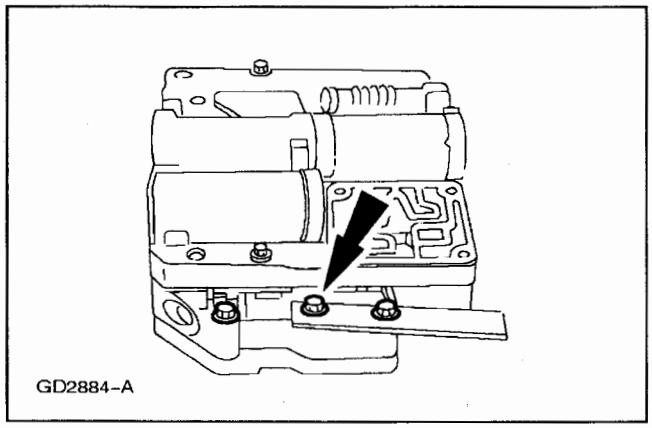
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD2882-A

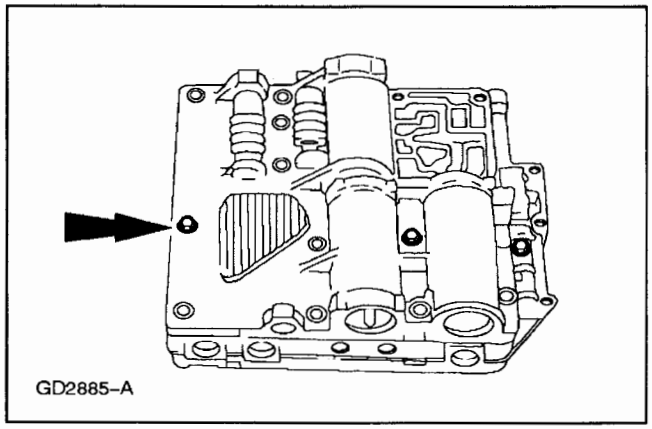
4. Remove the three pressure tap plate bolts and the pressure tap plate.


GD2883-A

5. Remove and discard the pressure plate tap gasket.

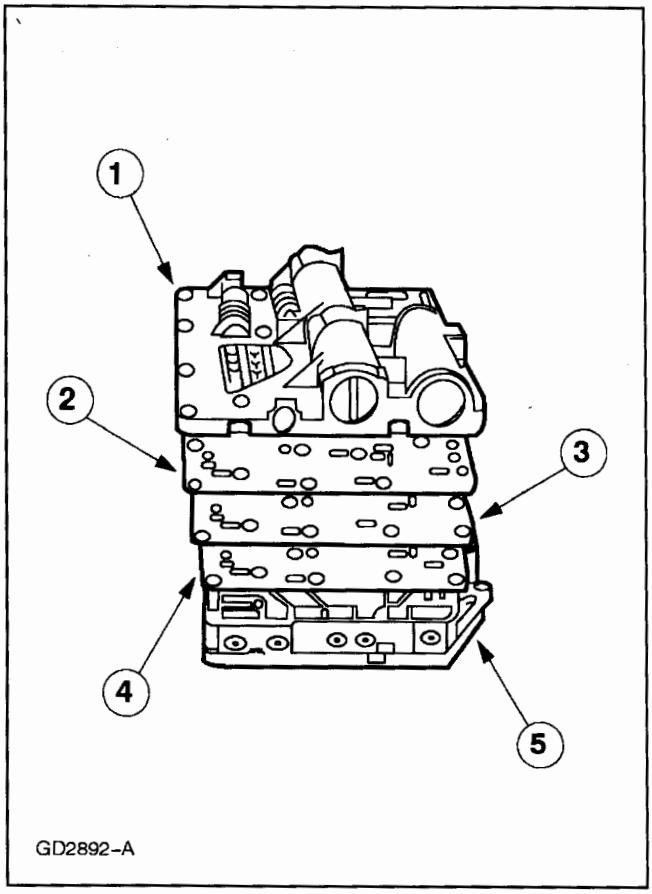

GD2884-A

6. Remove the control valve body to transfer plate bolts, and remove the manual valve detent spring assembly.

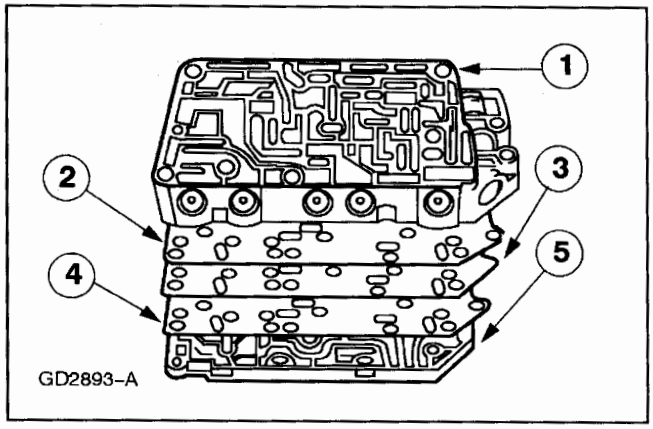

GD2885-A

7. Remove the accumulator body-to-transfer plate bolts.

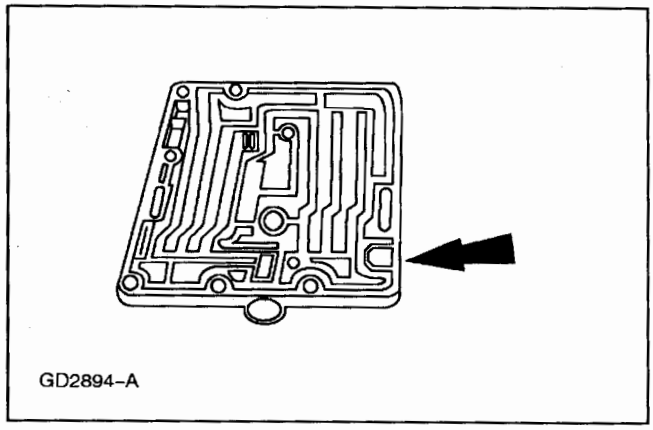
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



8. Separate the accumulator body from the main control valve body.
   1 Remove the accumulator body assembly.
   2 Remove and discard the accumulator body separator gasket.
   3 Remove the accumulator body separator plate.
   4 Remove and discard the accumulator body separator gasket.
   5 Remove the main control valve body.

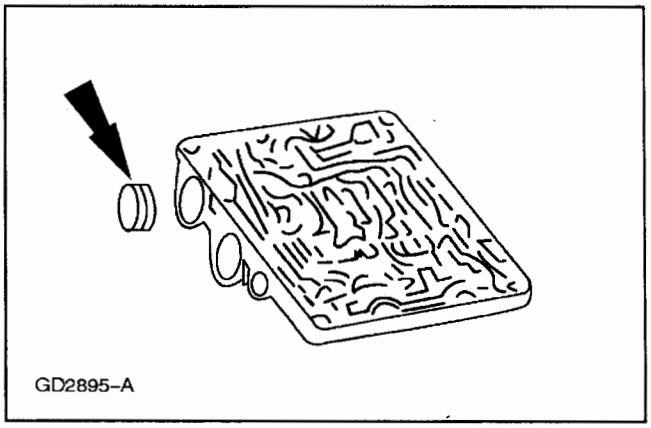


9. Separate the transfer plate from the main control valve body.
   1 Remove the main control valve body.
   2 Remove and discard the valve body separator plate gasket.
   3 Remove the valve body separator plate.
   4 Remove and discard the valve body separator plate gasket.
   5 Remove the transfer plate.



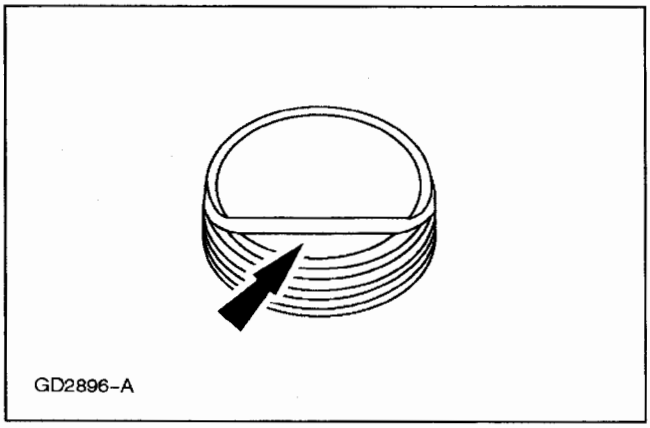
10. Remove the intermediate and overdrive accumulator valve plug retaining plate from the accumulator body assembly.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



GD2895-A

11. Remove the intermediate and overdrive accumulator valve plug.



GD2896-A

12. Remove and discard the intermediate and overdrive accumulator plug seal.

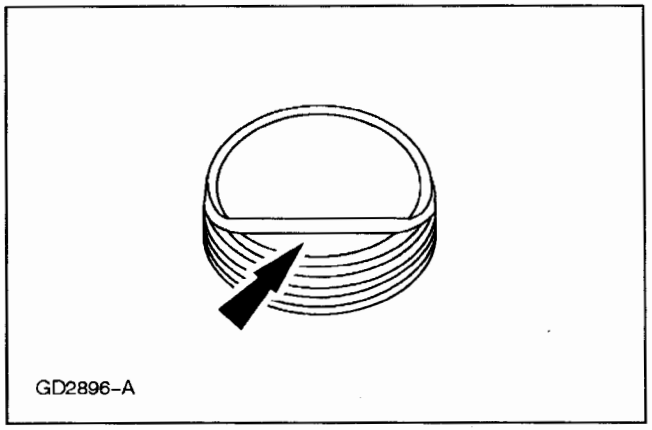
13. ⚠ **CAUTION: Remove, note location and clean one valve at a time to avoid incorrect installation.**

    As necessary, disassemble the parts of the accumulator body and main control valve body assemblies.

    - Lubricate and reassemble the parts as soon as possible to avoid accidental damage or incorrect installation.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Assembly

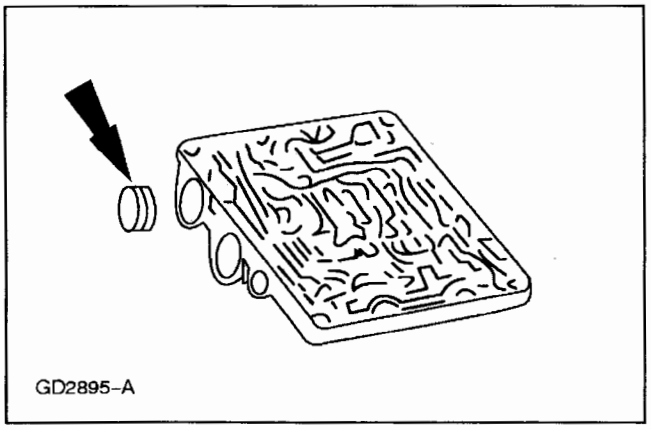

GD2896-A

1. **⚠ WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Failure to follow these instructions can result in personal injury.**

   ⚠ CAUTION: If the valve sticks in its bore and cannot be freed, install a new main control valve body.

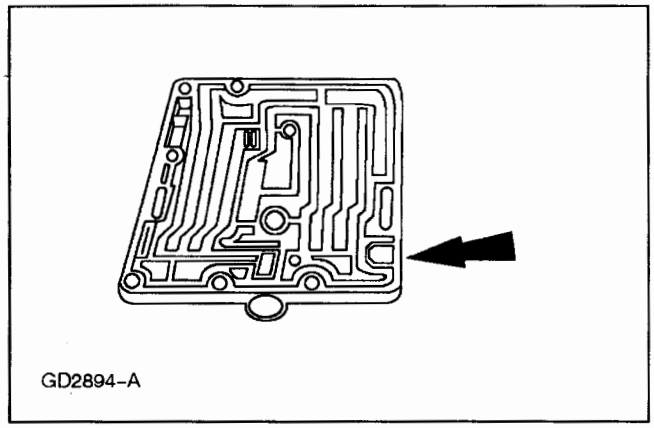
   NOTE: Clean the main control valve body and accumulator body assembly of the main control in cleaning solvent. Blow dry with moisture-free regulated compressed air. The solenoid valve body should not be cleaned in cleaning solvent. It may be blown clean with compressed air or wiped clean with a lint-free cloth.

   Install a new intermediate and overdrive accumulator plug seal and coat with petroleum jelly.


GD2895-A

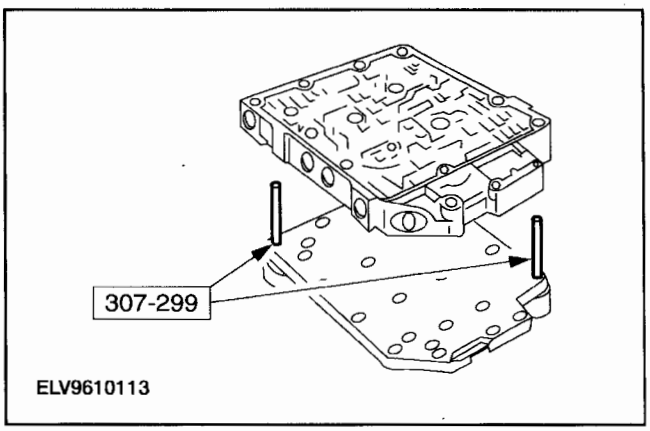
2. **⚠ CAUTION: Do not install the intermediate and overdrive accumulator valve plug and seal too far into the bore and damage the seal. Only push the intermediate and overdrive accumulator valve plug until it is flush with the accumulator body assembly.**

   Install the intermediate and overdrive accumulator valve plug.

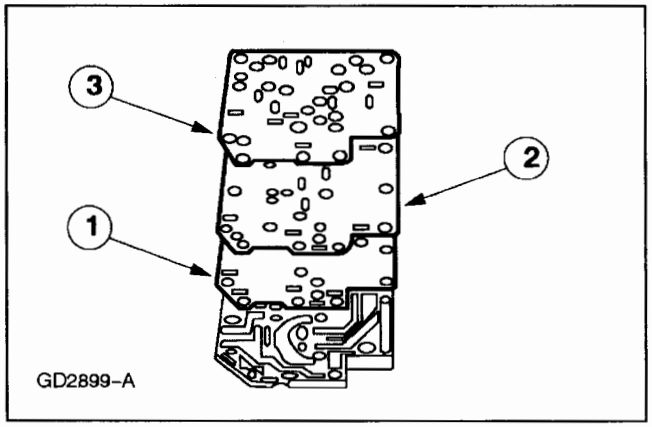

GD2894-A

3. Install the intermediate and overdrive accumulator valve plug retaining plate.

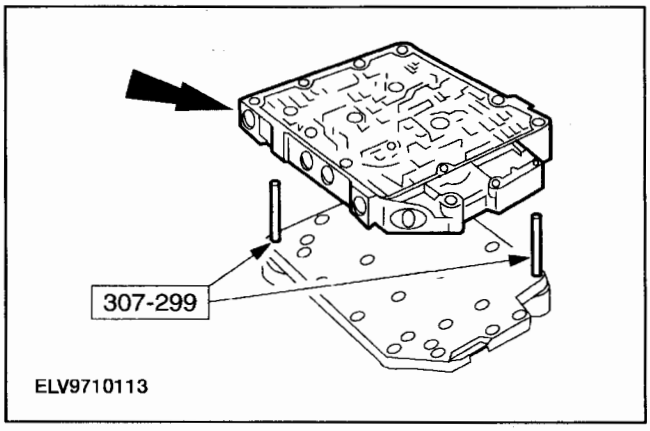
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



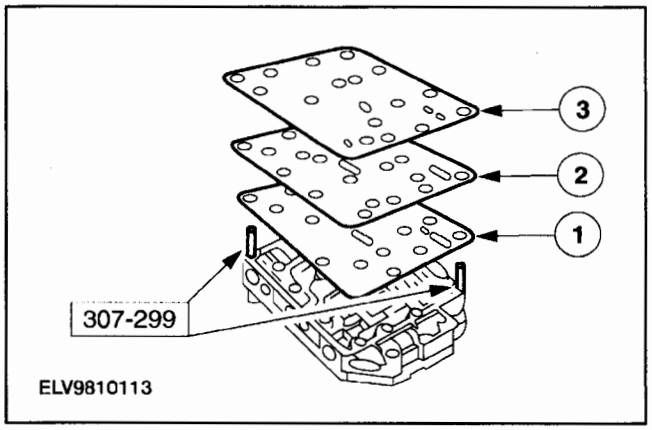
4. Install the special tool.



5. Using the special tool, install the valve body separator plate gaskets and valve body separator plate.
   1 Install a new valve body separator plate gasket.
   2 Install the valve body separator plate.
   3 Install a new valve body separator plate gasket.

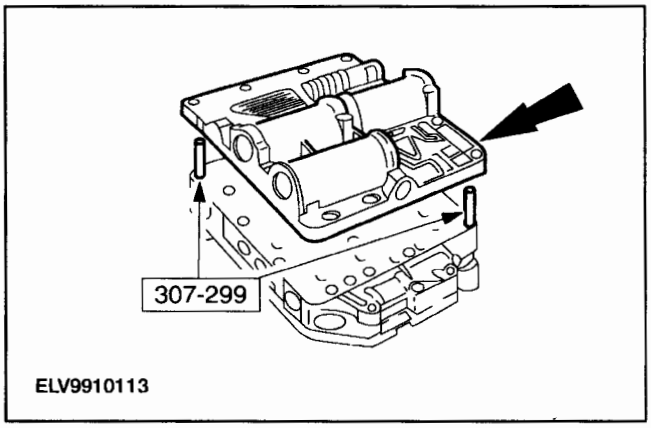


6. Using the special tool, install the main control valve body.

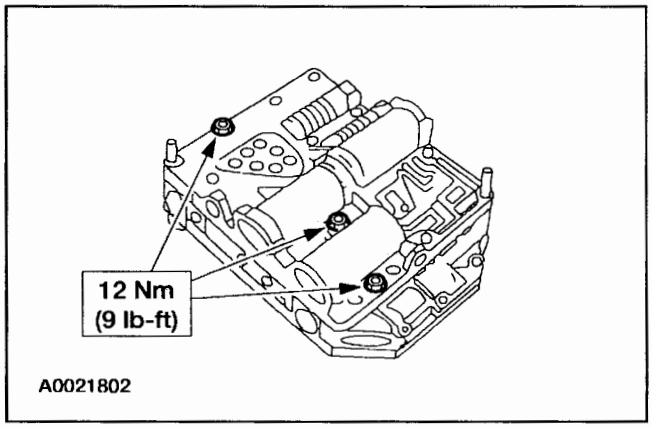


7. Using the special tool, install the accumulator body separator plate and gaskets.
   1 Install a new accumulator body separator plate gasket.
   2 Install the accumulator body separator plate.
   3 Install a new accumulator body separator plate gasket.

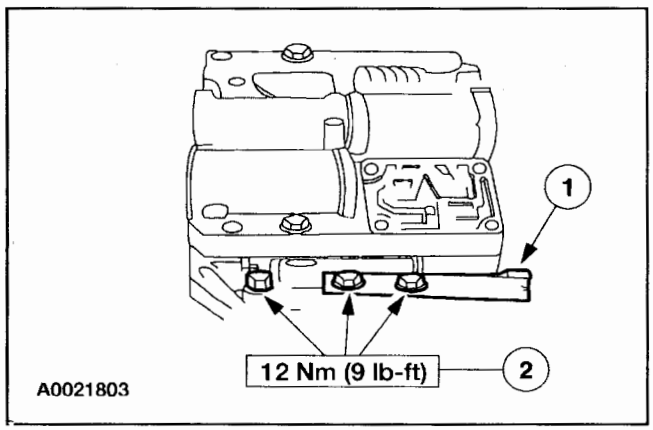
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



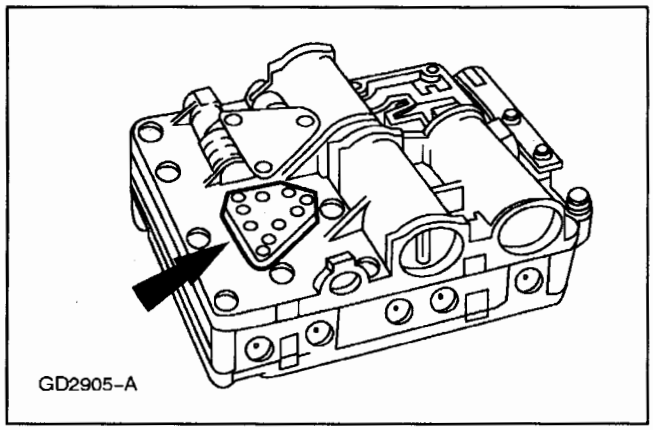
8. Using the special tool, install the accumulator body assembly.



9. Starting with the bolts in the middle and working outward, install the accumulator body transfer plate.

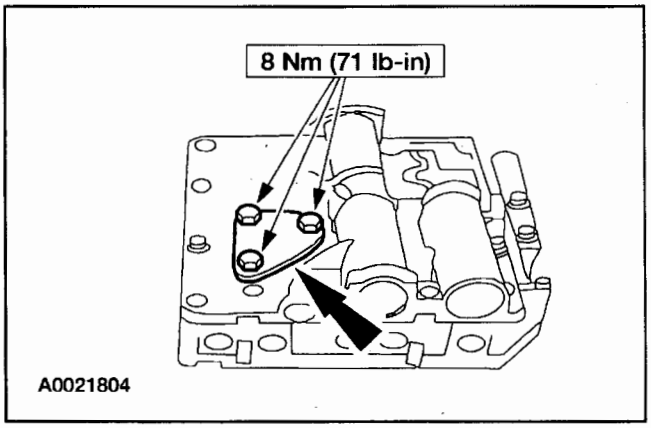


10. Starting with the bolts in the middle and working outward, install the main control valve body to transfer plate.
    1 Install the manual valve detent spring.
    2 Install the control valve body to transfer plate bolts.

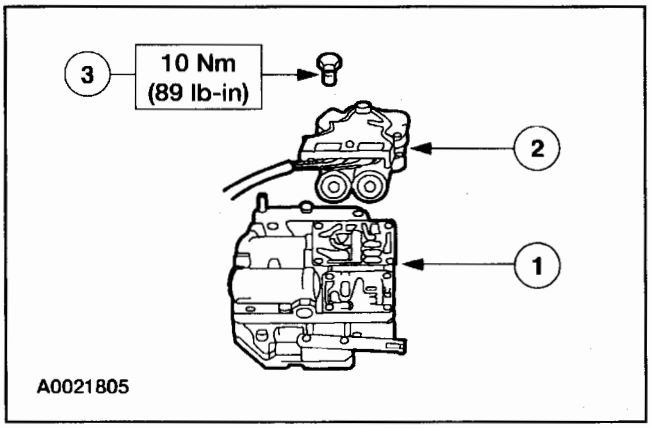


11. Install a new pressure tap plate gasket.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



12. Install the pressure tap plate and bolts.



13. **NOTE:** Match the solenoid valve body gasket to passages.

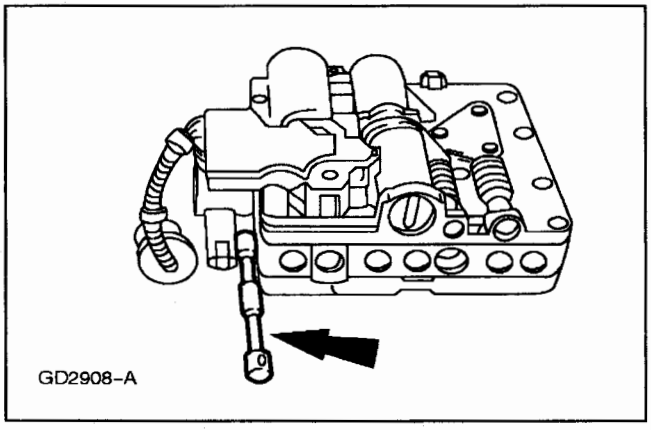
    Install the solenoid valve body.

    1 Install the solenoid valve body gasket.

    2 Install the solenoid valve body.

    3 Install the two solenoid valve body bolts.

    - Remove the special tool.

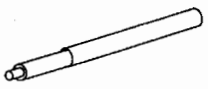
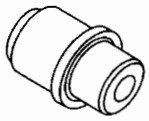
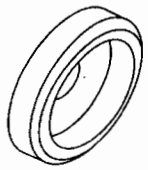
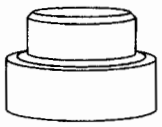


14. Install the manual valve.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

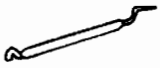
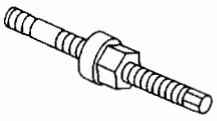
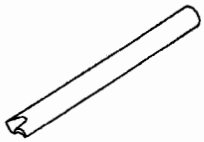
Transaxle Case

Special Tool(s)

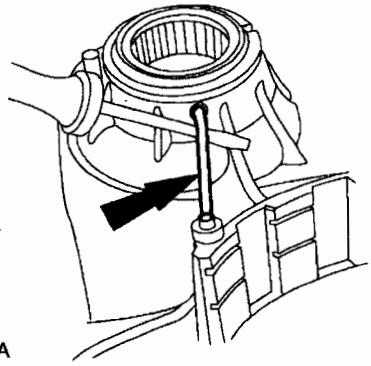
 ST2056-A	Installer, Lube Tube Fluid Seal 307-240 (T91P-76085-A)
 ST2053-A	Remover/Installer, Needle Bearing 307-286 (T94P-77000-E1)
 ST2054-A	Installer/Remover Servo Plug 307-287 (T94P-77000-ER2)
 ST2536-A	Installer, Throttle Shaft Fluid Seal 307-097 (T81P-70337-A)

(Continued)

Special Tool(s)

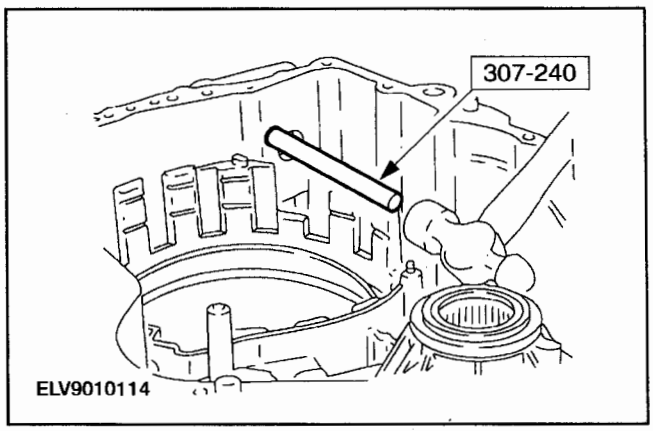
 ST1219-A	Remover, O-Ring Seal 100-010 (T71P-19703-C)
 ST1287-A	Drawbar, Rear Axle 205-098 (T75T-1176-A)
 ST1848-A	Installer, Lube Tube 307-307 (T94P-77000-U2)

Disassembly

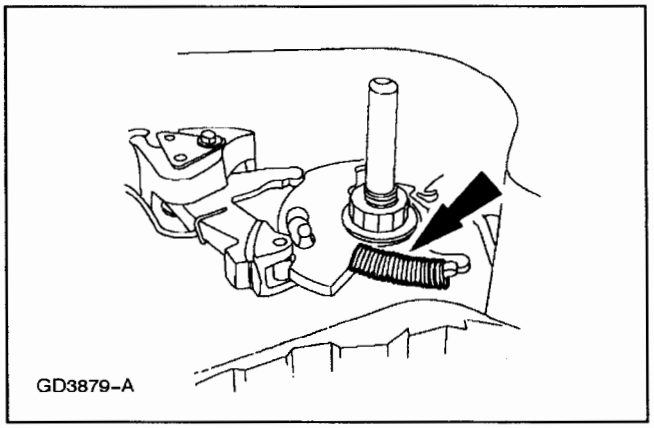

GD1932-A

1. Remove and discard the final drive lube tube.

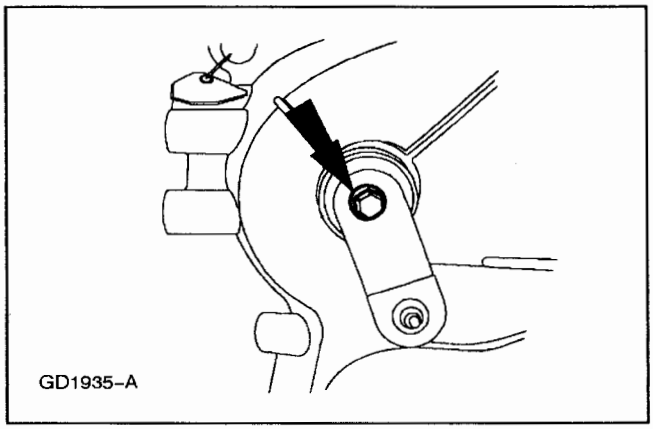
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



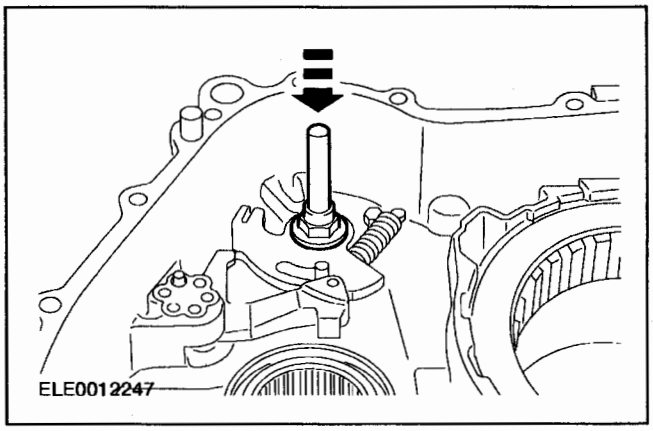
2. Using the special tool, remove and discard the final drive lube tube seal.



3. Remove the parking pawl ratcheting spring.

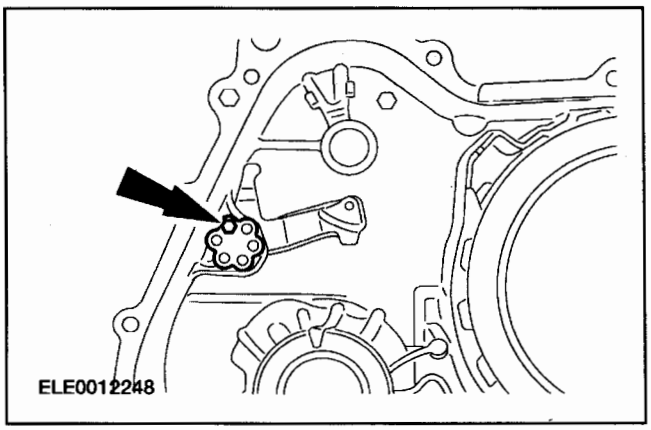


4. Remove the manual control lever outer assembly.

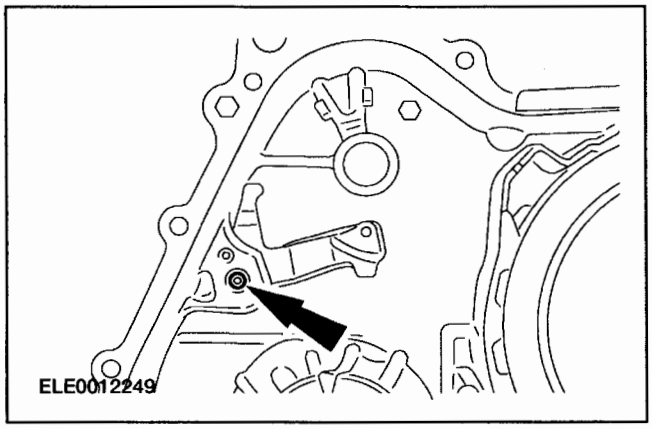


5. Remove the manual control lever shaft assembly.

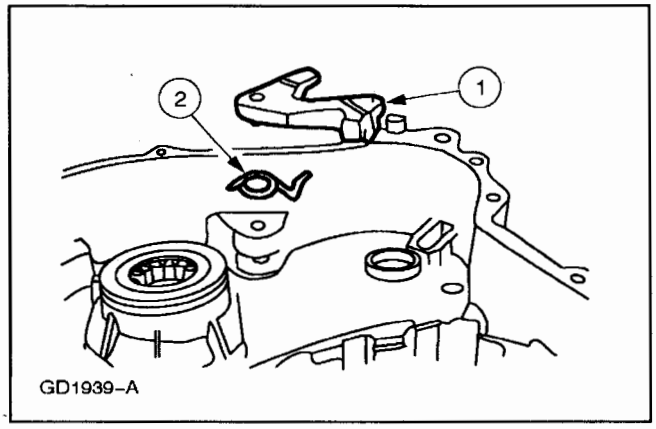
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



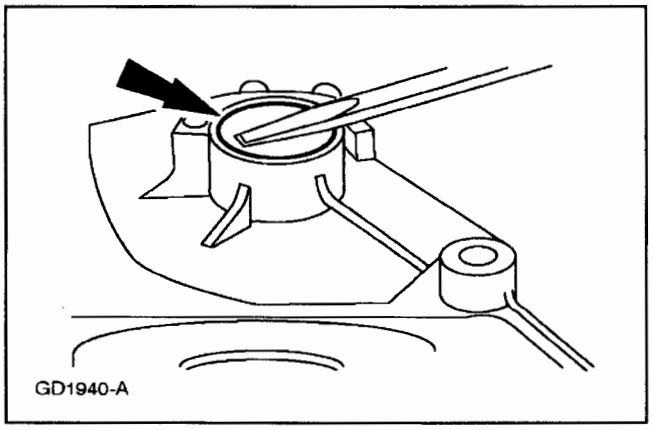
6. Remove the parking pawl shaft retainer and bolt.



7. Remove the parking pawl shaft.

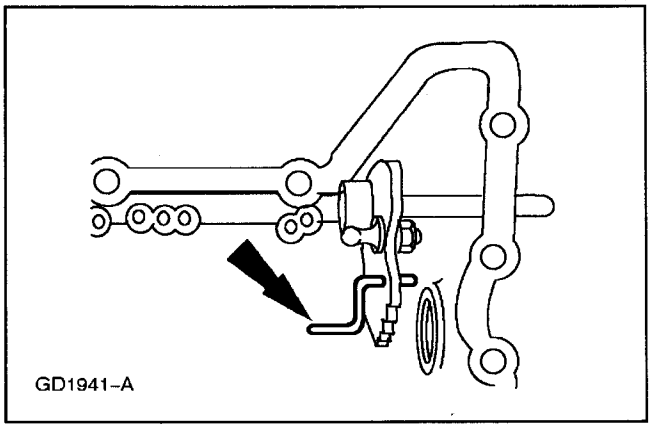


8. Remove the parking pawl assembly.
   1 Remove the parking pawl.
   2 Remove the parking pawl return spring.

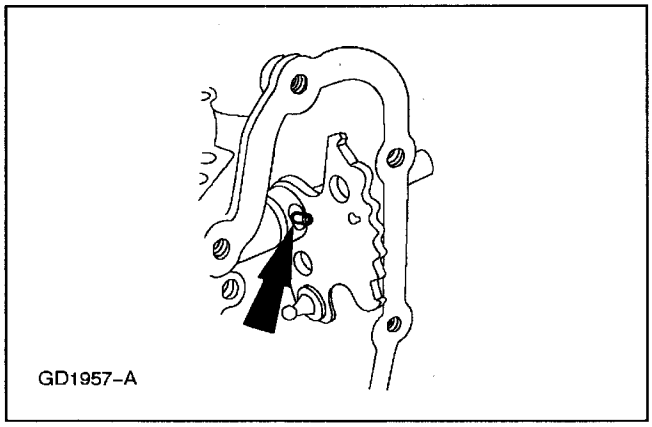


9. ⚠ **CAUTION: Do not damage the transaxle case bore during seal removal.**
   Remove and discard the manual control lever seal.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

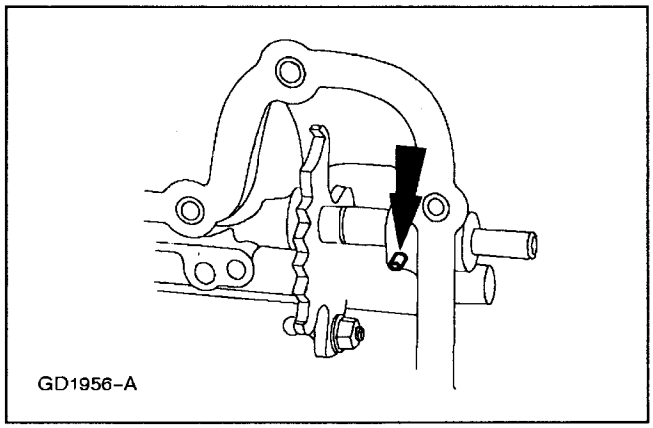


10. Remove the manual valve actuator rod (manual valve link).



11. ⚠ **CAUTION: Do not damage the transaxle case sealing surface.**

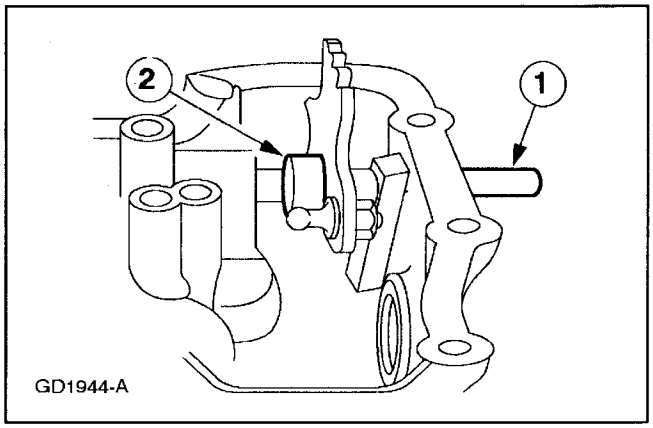
    Remove and discard the manual valve detent lever shaft retaining pin.



12. ⚠ **CAUTION: Do not damage the transaxle case sealing surface.**

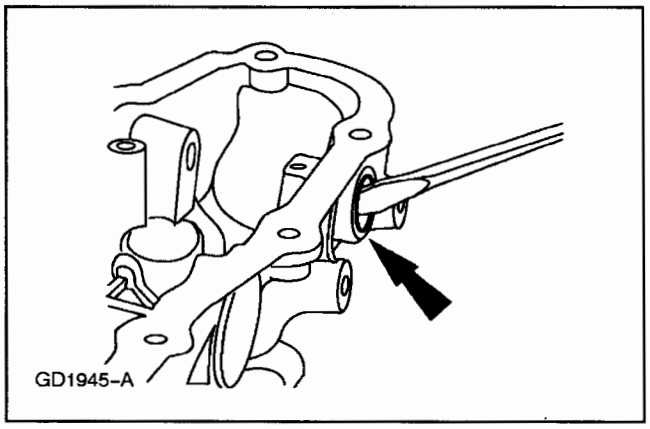
    NOTE: There are two retaining pins, one on either side of the manual valve detent lever.

    Remove the manual valve detent lever shaft retaining pin.



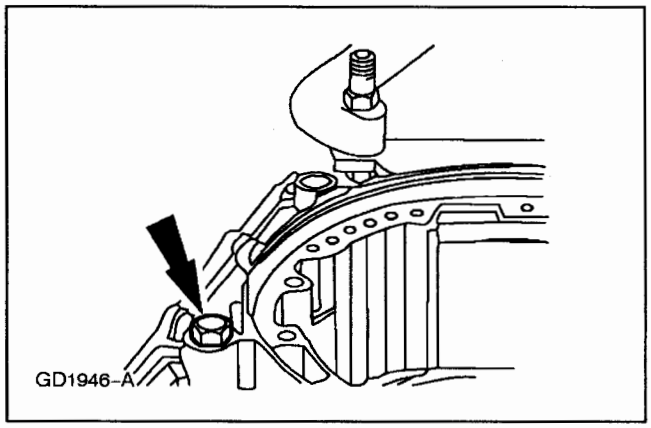
13. Remove the manual valve detent lever and shaft assembly.
    1. Pull the manual valve detent lever and manual valve detent lever shaft from the transaxle case.
    2. Lift the manual valve detent lever from the transaxle case.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

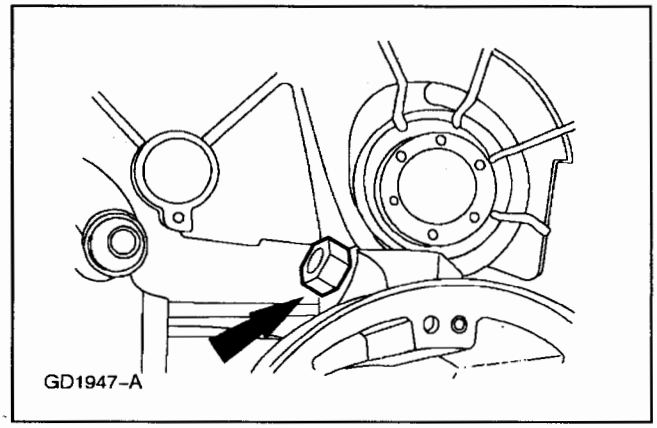


14. ⚠ **CAUTION: Do not damage the seal bore in the case during seal removal.**

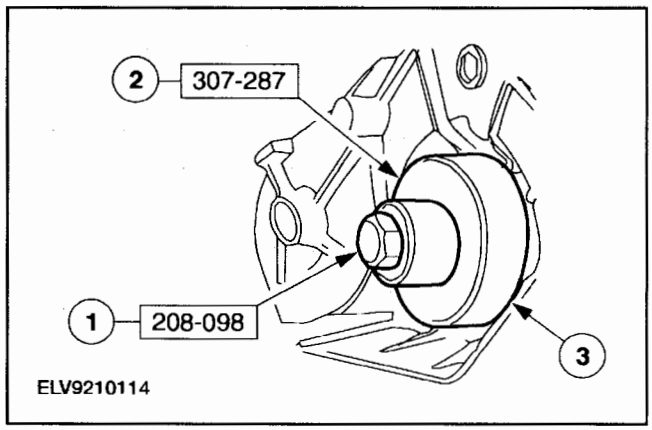
    Remove and discard the manual control seal.



15. If a new case is being installed, remove the line pressure port plug.



16. If a new case is being installed, remove and discard the cooler tube fitting.

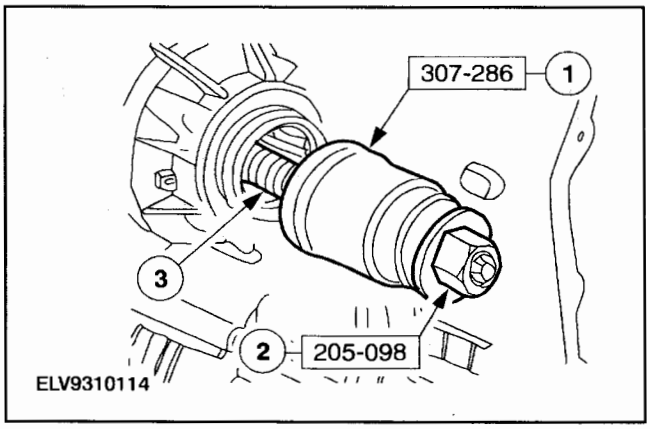


17. **NOTE:** A new driven sprocket bearing No. 18 can be installed once before an installation of the transaxle case becomes necessary. If a new No. 18 driven sprocket bearing was installed previously and a second installation is required, a new transaxle case must be installed.

    As necessary, remove the No. 18 driven sprocket bearing assembly from transaxle case.

    1 Install the special tool into the transaxle.
    2 Position the special tool.
    3 Remove the bearing.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



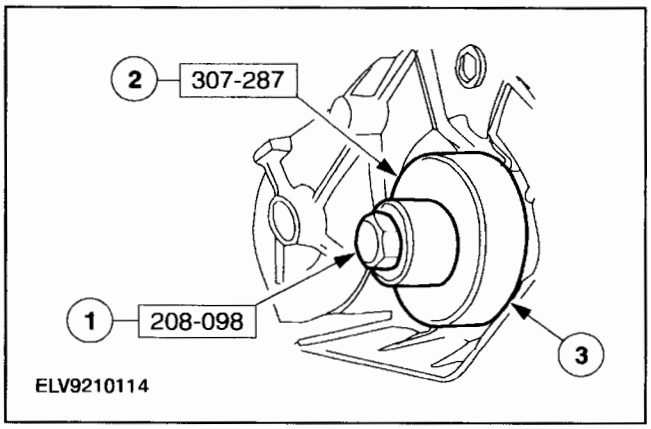
18. Using the special tools, remove the No. 18 driven sprocket bearing assembly.
    1 Position the special tool.
    2 Position the special tool.
    3 Remove the No. 18 driven sprocket bearing.

19. ⚠ **WARNING: In order to avoid injury, eye protection should be worn when cleaning components with compressed air. Failure to follow these instructions can result in personal injury.**

    Clean all components with a suitable solvent and use moisture-free compressed air to dry all parts and clean fluid passages. Check the following before assembling:

    - final drive lubrication tube for damage
    - manual control linkage for damage or wear
    - case mating surfaces for nicks or deformation
    - bearing wear
    - support area wear

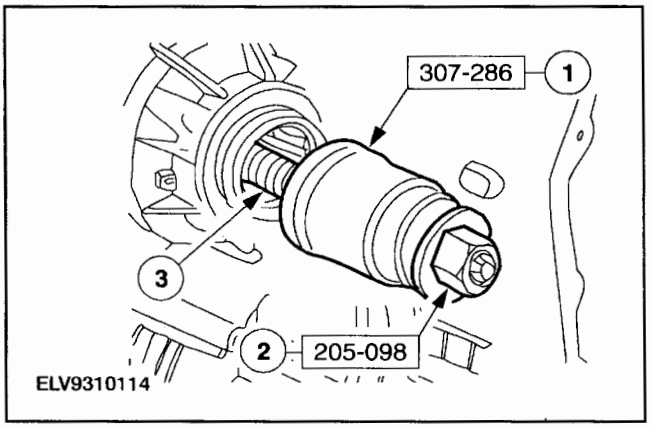
Assembly



1. **NOTE:** A new driven sprocket bearing No. 18 can be installed once before an installation of the transaxle case becomes necessary. If the No. 18 driven sprocket bearing was installed previously and a second installation is required, a new transaxle case must be installed.

   As necessary, install the No. 18 driven sprocket bearing into the transaxle case.
   1 Position the special tool.
   2 Position the special tool.
   3 Install new bearing.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

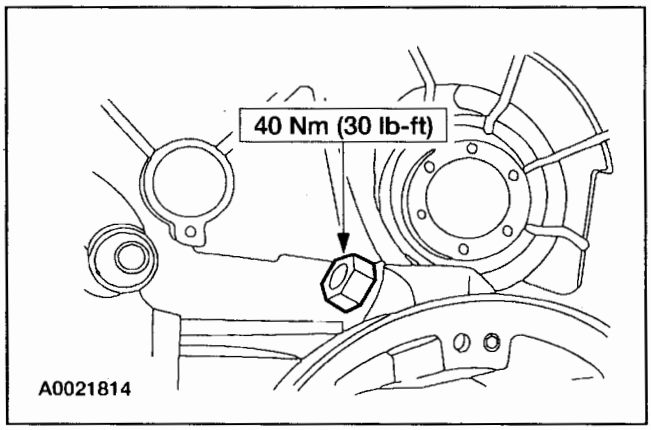


2. **⚠ CAUTION: Do not lubricate the outer surface of the No. 18 driven sprocket bearing assembly.**

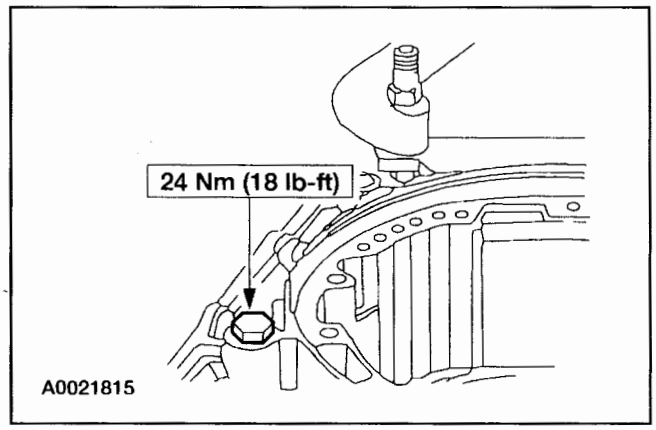
   NOTE: The No. 18 driven sprocket bearing must be installed with the lettering on the needle bearing surface facing toward the needle bearing replacer.

   Using the special tools, install the No. 18 driven sprocket bearing assembly by pressing it into the transaxle case.

   1 Install the bearing on the special tool.
   2 Position the special tool.
   3 Install the No. 18 driven sprocket bearing.

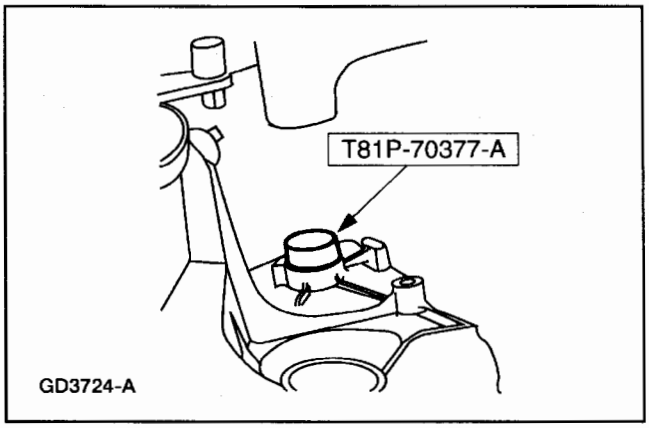


3. Install the cooler tube fitting.

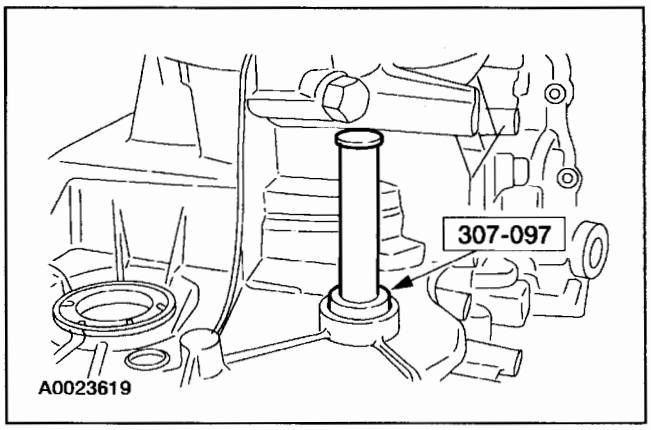


4. Install the line pressure port plug.

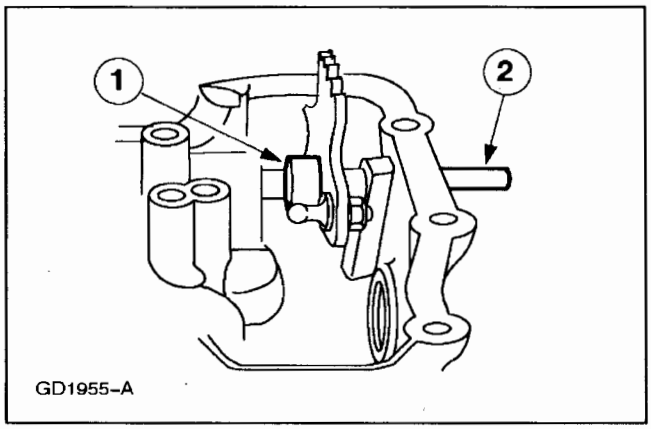
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



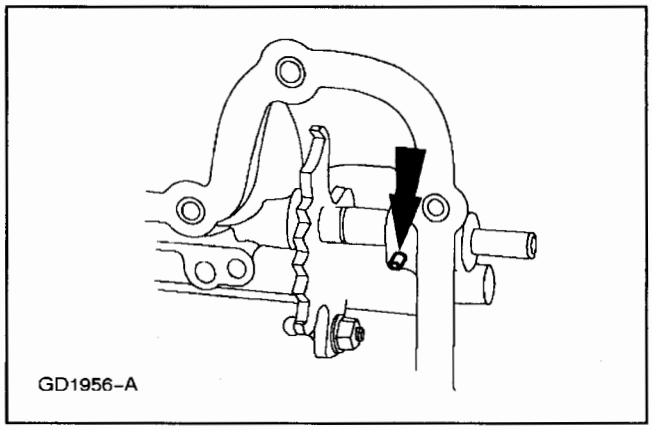
5. Using the special tool, install a new manual control lever seal.



6. Using the special tool, install a new manual control seal.

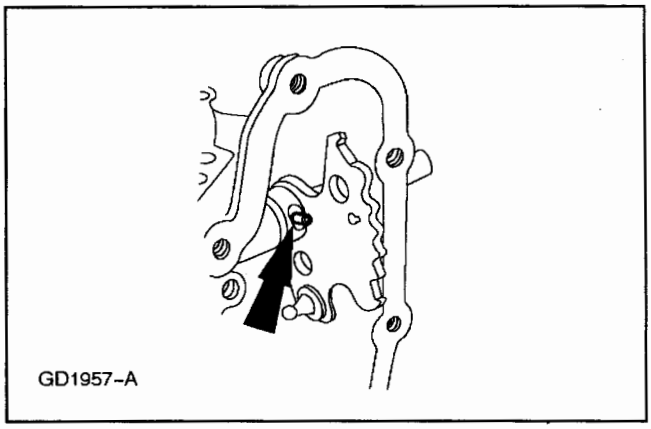


7. Install the manual valve detent lever assembly and the manual valve detent lever shaft assembly.
   1 Position the manual valve detent lever into the transaxle case.
   2 Install the manual valve detent lever shaft into the transaxle case and lever.



8. Install a new manual shaft retaining pin.

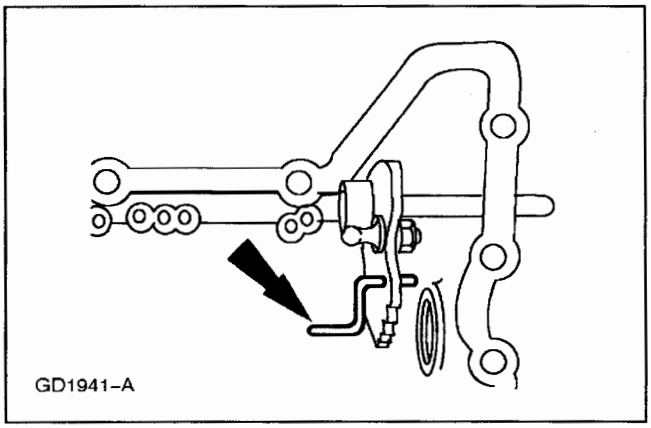
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)


GD1957-A

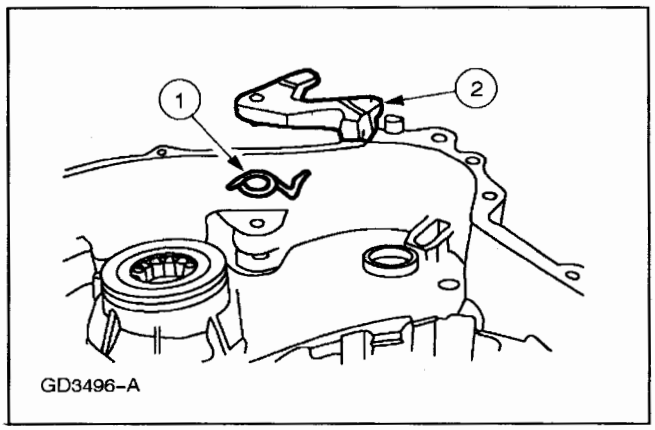
9. ⚠ **CAUTION: Do not allow the manual shaft retaining pin to contact the transaxle case.**

   Install a new manual valve detent lever shaft retaining pin.

   - Verify that the manual valve detent lever shaft rotates without binding.

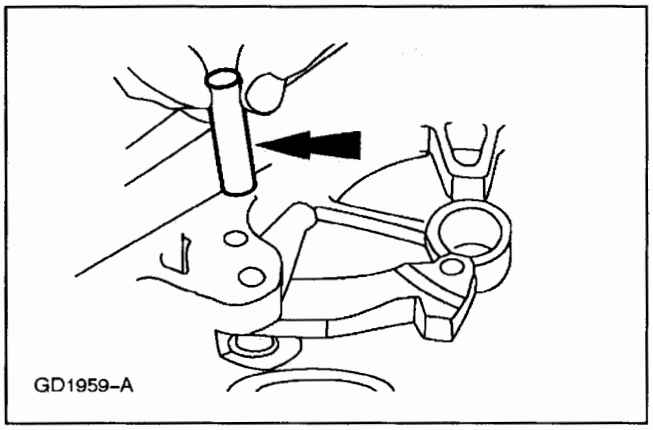

GD1941-A

10. Install the manual valve actuator rod (manual valve link).



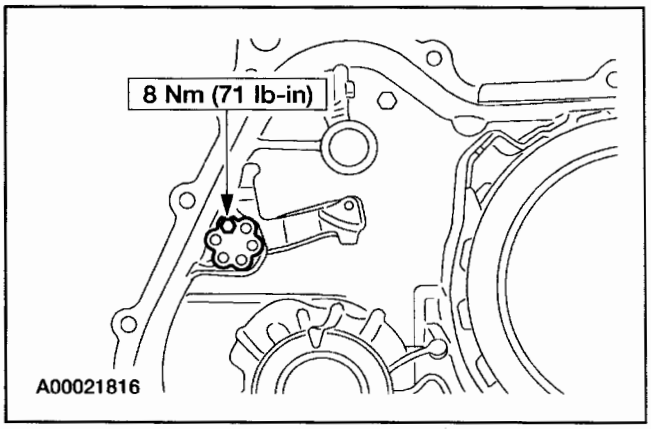
GD3496-A

11. Install the parking pawl assembly.
    1 Install the parking pawl return spring.
    2 Install the parking pawl.

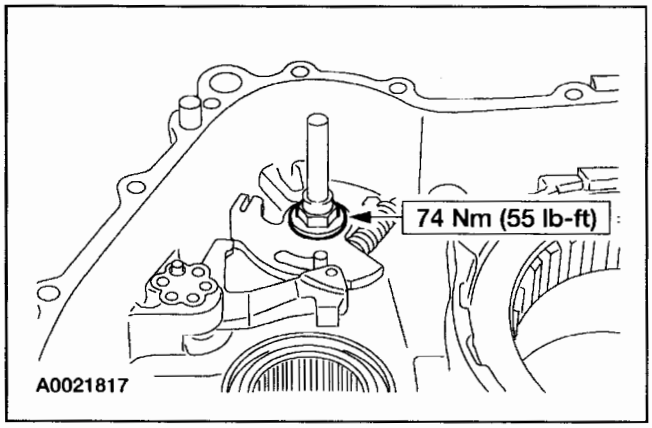

GD1959-A

12. Install the parking pawl shaft.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



13. Install the parking pawl shaft retainer and bolt.

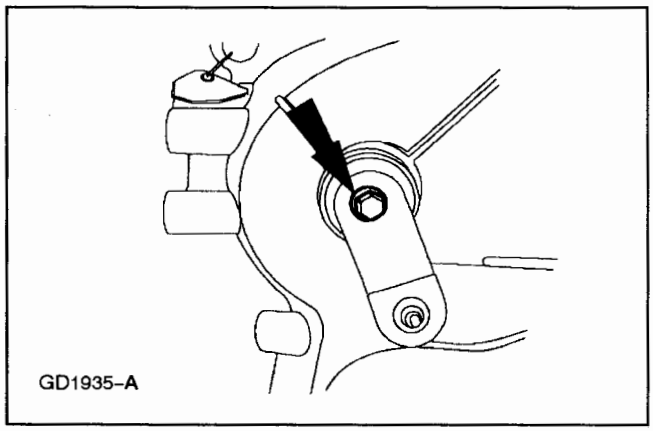


14. **NOTE:** Lubricate the manual control lever inner shaft prior to installation.

    Install the manual control lever shaft assembly.

15. **NOTE:** Verify that the actuating cam rotates freely.

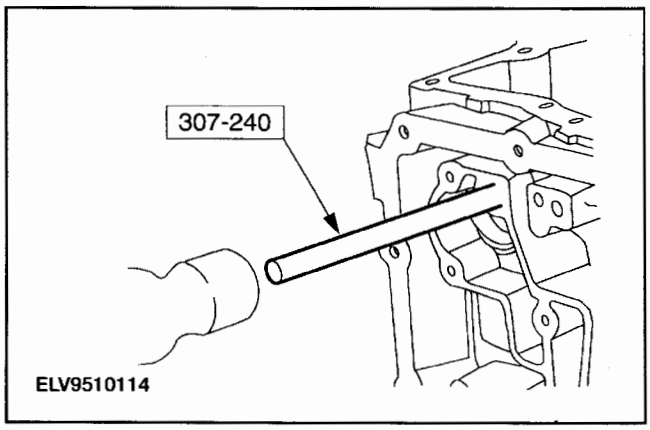
    Install the parking pawl ratcheting spring.



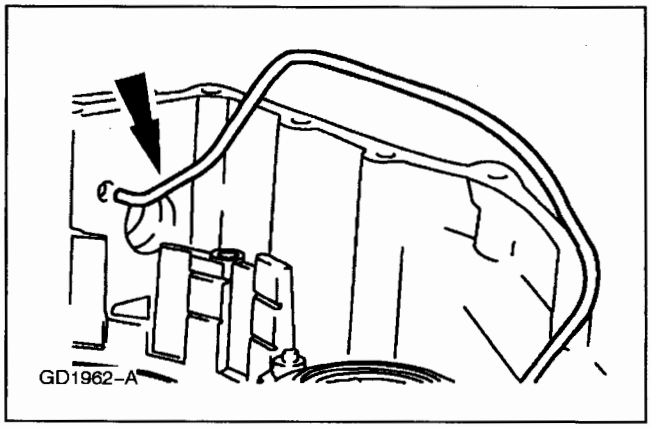
16. **NOTE:** Hand-tighten the manual control lever bolt; it will be torqued after linkage adjustment.

    Install the manual control lever outer assembly and bolt.

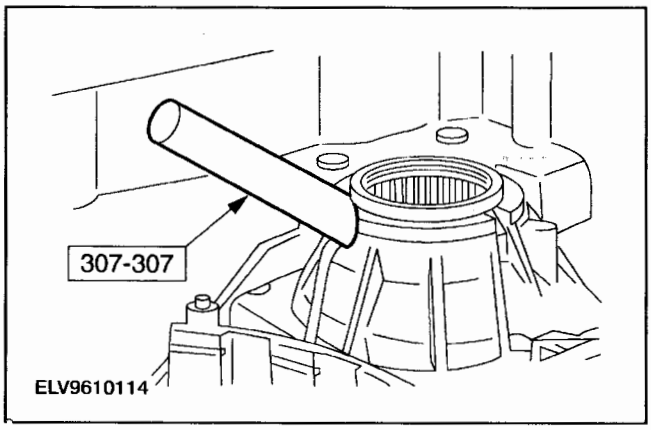
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



17. Using the special tool, install a new final drive lube tube seal.



18. Install the final drive lube tube into the seal.

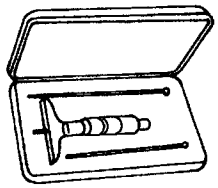
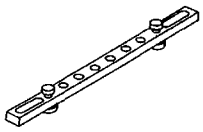
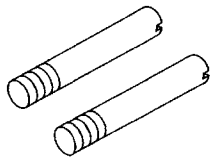


19. Using the special tool, install the final drive lube tube into the case.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Pump Assembly

Special Tool(s)

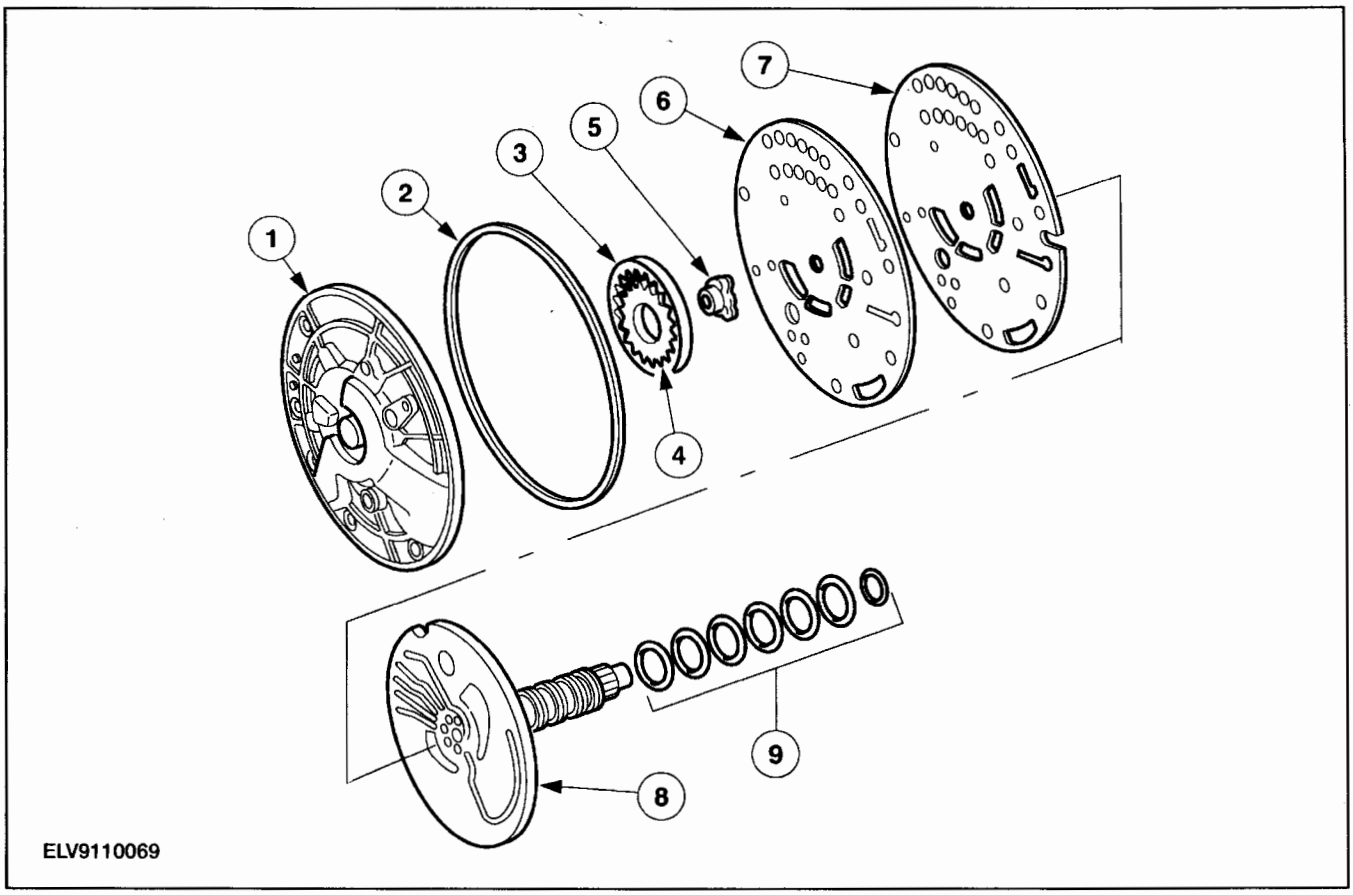
 ST1274-A	Depth Micrometer 303-D026 (D80P-4201-A)
 ST1954-A	Shim Selection Gauge 307-300 (T94P-77000-Q)
 ST1953-A	Alignment Pins, Transmission Main Control Body 307-127 (T94P-77000-P)

Materials

Item	Specification
MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX	MERCON®

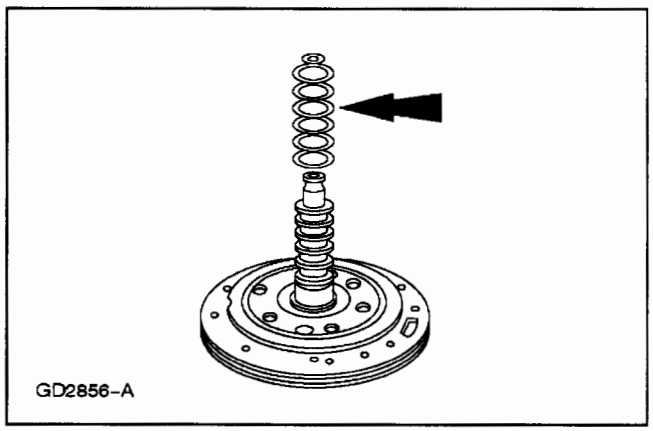
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Disassembly



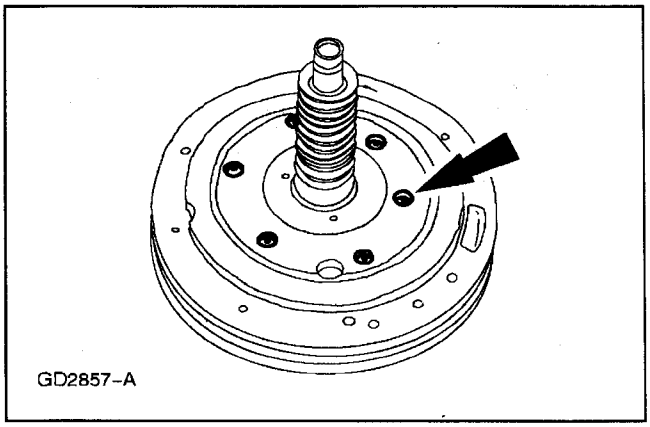
Item	Part Number	Description
1	7F370	Pump body — front
2	7A248	O-ring — pump seal
3	7C011	Driven gear — pump
4	7C009	Drive gear — pump
5	7F402	Drive gear insert — pump
6	7A142-AA	Separator plate — pump body
7	7G331-AA	Separator plate gasket — pump body
8	7A108	Pump support — front
9	—	Pump seals — front

(Continued)

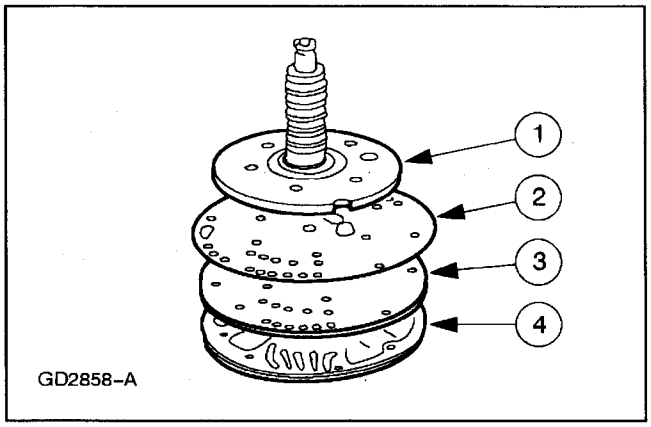


1. Remove and discard the seven pump support seal rings from the pump support.

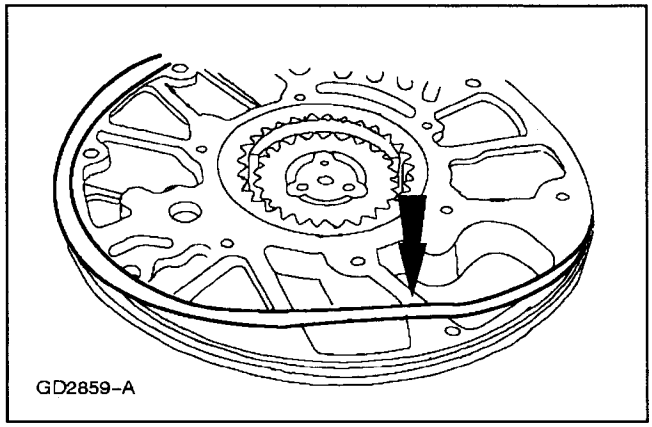
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)



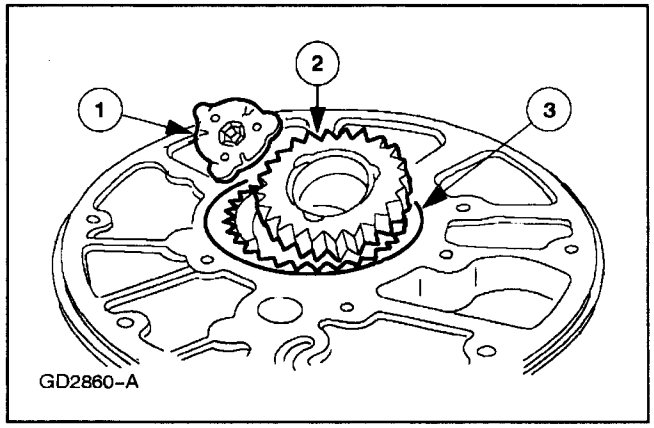
2. Remove the six pump support bolts.



3. Separate the pump support and body assembly.
   1 Remove the pump support.
   2 Remove the pump body separator plate gasket.
   3 Remove the pump body separator plate.
   4 Remove the pump body.



4. Remove and discard the pump seal.



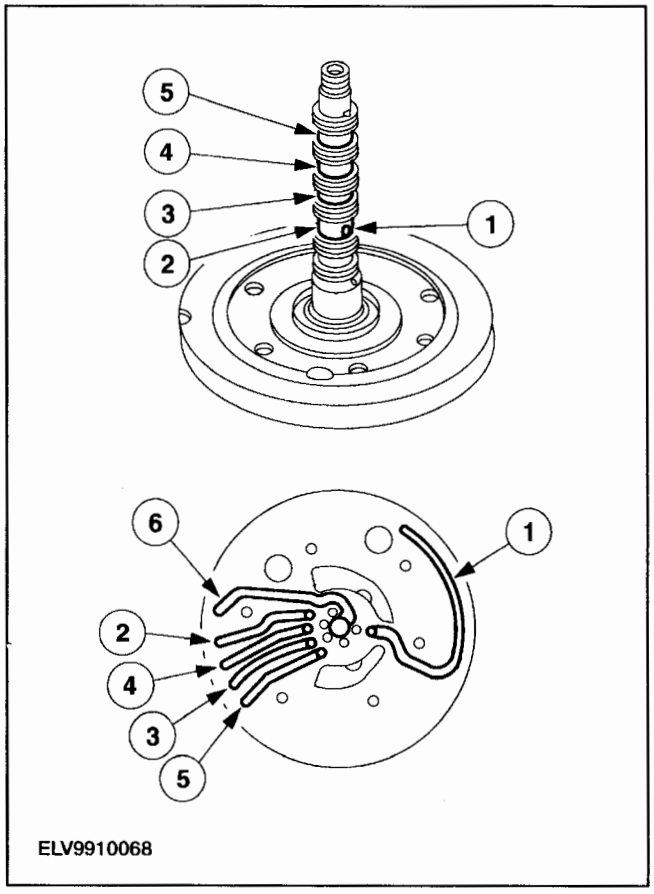
5. Remove the pump drive gear assembly.
   1 Pump drive gear insert.
   2 Pump drive gear.
   3 Pump driven gear.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

6. **⚠ WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Failure to follow these instructions can result in personal injury.**

   Clean all parts thoroughly in clean solvent and blow dry with moisture-free regulated compressed air.

7. Inspect the pump body and gears for damage and wear.
   - Driven gear teeth
   - Drive gear teeth
   - Gear bore
   - Crescent
   - Lubrication passages and holes



ELV9910068

8. Inspect the pump support apply circuit passages and lubrication passages.
   1 Rear lube (from cooler TC circuit)
   2 Reverse clutch (RC)
   3 Direct clutch (DC)
   4 Forward clutch (FC)
   5 Coast clutch (CC)
   6 Converter clutch bypass (CBY)