Engine Mechanical - 1.8L (LUW, LWE)

Specifications

Fastener Tightening Specifications (1.6L LDE)

Application	Specification	
	Metric	English
AC Compressor Bolt	22 N•m	16 lb ft
AC Compressor and Condenser Hose Nut	19 N•m	14 lb ft
AC Evaporator Hose Assembly Nut	19 N•m	14 lb ft
Air Intake Hose Clamps	3.5 N•m	31 lb in
Automatic Transmission Flex Plate Bolt	60 N•m (2)	44 lb ft (2)
Camshaft Adjuster Bolt		
First Pass	50 N•m (1)	37 lb ft (1)
Second Pass	150 degrees	
Final Pass	15 degrees	
Camshaft Adjuster Closure Plug	30 N•m	22 lb ft
Camshaft Bearing Cap Bolt	8 N•m	71 lb in
Camshaft Closure Bolt	30 N•m	22 lb ft
Camshaft Cover Bolt	8 N•m	71 lb in
Camshaft Position Actuator Solenoid Valve Bolt	6 N•m	53 lb in
Camshaft Position Sensor Bolt	6 N•m	53 lb in
Connecting Rod Bearing Cap Bolt		
First Pass	35 N•m (1)	26 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Coolant Pipe Pump Module Bolt	8 N•m	71 lb in
Coolant Pipe Thermostat Housing Bolt	8 N•m	71 lb in
Crankshaft Balancer Bolt		
First Pass	95 N•m (1)	70 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Crankshaft Bearing Cap Bolt		
First Pass	50 N•m (1)	37 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Crankshaft Position Sensor Bolt	5 N•m	44 lb in
Cylinder Head Bolt		
First Pass	25 N•m (1)	18 lb ft (1)
Second Pass	90 degrees	
Third Pass	90 degrees	
Fourth Pass	90 degrees	
Final Pass	45 degrees	
Drive Belt Tensioner Bolt	50 N•m	37 lb ft
Engine Coolant Thermostat	8 N•m	71 lb in
Engine Coolant Thermostat Housing	8 N•m	71 lb in
Engine Coolant Thermostat Housing Coolant Pipe Bolt	8 N•m	71 lb in

Fastener Tightening Specifications (1.6L LDE) (cont'd)

Application	Specification	
	Metric	English
Engine Coolant Pipe Bolts	9 N•m	80 lb in
Engine Mount Bolt to Engine Mount Bracket– M10		
First Pass	50 N•m (1)	37 lb ft (1)
Final Pass	60–75 degrees	
Engine Flywheel Bolt – Transmission D16/D20/F17		
First Pass	35 N•m	26 lb ft
Second Pass	30 degrees	
Final Pass	15 degrees	
Engine Flywheel Bolt – Transmission M32		
First Pass	60 N•m	44 lb ft
Second Pass	45 degrees	
Final Pass	15 degrees	
Engine Front Cover (Oil Pump Housing)	20 N•m	15 lb ft
Engine Lift Front Bracket	25 N•m	18 lb ft
Engine Mount Bolt	62 N•m	46 lb ft
Engine Mount Bracket to Engine Block/Cylinder Head	62 N•m	46 lb ft
Engine Mount Bracket Bolt to Engine Mount		
First Pass	50 N•m (1)	37 lb ft (1)
Final Pass	60 – 75 degrees	
Engine Mount Nut	62 N•m	46 lb ft
Engine Oil Cooler Bolts	8 N•m	71 lb ft
Engine Oil Cooler Housing Bolt	25 N•m	18 lb ft
Engine Oil Cooler Inlet Pipe Bolt	8 N•m	71 lb in
Engine Oil Cooler Outlet Pipe Bolt	8 N•m	71 lb in
Engine Oil Pressure Indicator Switch	20 N•m	15 lb ft
Engine Oil Level Indicator Bolt	10 N•m	89 lb in
Engine Support Fixture (Front) Bolt	65 N•m	48 lb ft
Engine Support Fixture (Rear Left Side) Bolt	65 N•m	48 lb ft
Engine Support Fixture (Rear Right Side) Bolt	65 N•m	48 lb ft
Evaporative Emission Canister Purge Solenoid Valve Bracket Bolt	7 N•m	62 lb in
Exhaust Manifold Bracket Bolt	20 N•m	15 lb ft
Exhaust Manifold Nut	20 N•m (1)	15 lb ft (1)
Front Compartment Fuse Block Bolt	22 N•m	16 lb ft
Front Exhaust Pipe Bolt	20 N•m	15 lb ft
Generator Bolt	35 N•m	26 lb ft
Heated Oxygen Sensor	40 N•m	30 lb ft
Heat Shield Exhaust Manifold Bolt	8 N•m	71 lb in
Knock Sensor Bolt	20 N•m	15 lb ft
Ignition Module Bolt	8 N•m	71 lb in
Intake Manifold Absolute Pressure Sensor Bolt (LDE, LXV)	2 N•m	18 lb in
Intake Manifold Absolute Pressure Sensor Bolt (2H0)	6 N•m	53 lb in
Intake Manifold Bolt	20 N•m	15 lb ft
Intake Manifold Bracket to Engine Block Bolt	8 N•m	71 lb in
Intake Manifold Bracket Bolt	8 N•m	71 lb in

Fastener Tightening Specifications (1.6L LDE) (cont'd)

Application	Specification	
	Metric	English
Intake Manifold Grommet Bolt	7 N•m	62 lb in
Multiport Fuel Injection Fuel Rail Bolt (LDE, LXV)	8 N•m	71 lb in
Multiport Fuel Injection Fuel Rail Bolt (2H0)	7 N•m	62 lb in
Oil Filter Cap	25 N•m	18 lb ft
Oil Flow Check Valve Bore Plug	21 N•m	15 lb ft
Oil Level Indicator Tube Bolt	15 N•m	11 lb ft
Oil Pan Bolt	10 N•m	89 lb in
Oil Pan Drain Plug	14 N•m	124 lb in
Oil Pan Baffle Bolt	10 N•m	89 lb in
Oil Pan Transmission Housing Bolt M10 (M32, F17)	40 N•m	30 lb ft
Oil Pan Transmission Housing Bolt M12 (M32, F17)	60 N•m	44 lb ft
Oil Pan Transmission Housing Bolt M10 (D16, D20)	45 N•m	33 lb ft
Oil Pan Transmission Housing Bolt M12 (D16, D20)	75 N•m	55 lb ft
Oil Pan Transmission Housing Bolt (GF6)	58 N•m	43 lb ft
Oil Pressure Measurement Closure Bolt Cylinder Head	15 N•m	11 lb ft
Oil Pressure Switch	20 N•m	15 lb ft
Oil Pressure Relief Valve Closure Bolt	21 N•m	15 lb ft
Oil Pump Cover Bolt	8 N•m	71 lb in
Power Steering Fluid Reservoir Bolt	9 N•m	80 lb in
Spark Plugs	25 N•m	18 lb ft
Throttle Body Bolt	8 N•m	71 lb in
Timing Belt Idler Pulley Bolt		
First Pass	20 N•m (1)	15 lb ft (1)
Second Pass	120 degrees	
Final Pass	15 degrees	
Timing Belt Lower Front Cover Bolt	6 N•m	53 lb in
Timing Belt Rear Cover Bolt	6 N•m (2)	53 lb in (2)
Timing Belt Tensioner Bolt		
First Pass	20 N•m (1)	15 lb ft (1)
Second Pass	120 degrees	
Final Pass	15 degrees	
Timing Belt Upper Front Cover Bolt	6 N•m	53 lb in
Transmission to Cylinder Block Bolt (M32, F17)	60 N•m	44 lb ft
Transmission to Cylinder Block Nut (M32, F17)	40 N•m	30 lb ft
Transmission to Cylinder Block Bolt (D16, D20)	75 N•m	55 lb ft
Transmission to Cylinder Block Bolt (GF6)	58 N•m	43 lb ft
Transmission to Cylinder Block Nut (GF6)	58 N•m	43 lb ft
Water Pump Bolt	8 N•m	71 lb in
Water Pump Pulley Bolt	20 N•m (2)	15 lb ft (2)
Wiring Harness Ground Nut	9 N•m	80 lb in

1 = Use NEW Fastener.
2 = Recut threads and insert NEW bolts with screw locking compound.
For screw locking compound, refer to Electronic Parts Catalogue.

Fastener Tightening Specifications (1.8L LUW and LWE)

Application	Specification	
	Metric	English
AC Compressor and Condenser Hose Nut	19 N•m	14 lb ft
AC Compressor Bolt	22 N•m	16 lb ft
AC Evaporator Hose Assembly Nut	19 N•m	14 lb ft
Air Intake Hose Clamps	3.5 N•m	31 lb in
Automatic Transmission Flex Plate Bolt	60 N•m (2)	44 lb ft (2)
Camshaft Adjuster Bolt		
First Pass	50 N•m (1)	37 lb ft (1)
Second Pass	150 degrees	
Final Pass	15 degrees	
Camshaft Adjuster Closure Plug	30 N•m	22 lb ft
Camshaft Bearing Cap Bolt	8 N•m	71 lb in
Camshaft Closure Bolt	30 N•m	22 lb ft
Camshaft Cover Bolt	8 N•m	71 lb in
Camshaft Position Actuator Solenoid Valve Bolt	6 N•m	53 lb in
Camshaft Position Sensor Bolt	6 N•m	53 lb in
Cold Start Rail Bolt	4 N•m	35 lb in
Connecting Rod Bearing Cap Bolt		
First Pass	35 N•m (1)	26 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Coolant Pipe Pump Module Bolt	8 N•m	71 lb in
Coolant Pipe Thermostat Housing Bolt	8 N•m	71 lb in
Crankshaft Balancer Bolt		
First Pass	95 N•m (1)	70 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Crankshaft Bearing Cap Bolt		
First Pass	50 N•m (1)	37 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Crankshaft Position Sensor Bolt	5 N•m	44 lb in
Cylinder Head Bolt		
First Pass	25 N•m (1)	18 lb ft (1)
Second Pass	90 degrees	
Third Pass	90 degrees	
Fourth Pass	90 degrees	
Final Pass	45 degrees	
Drive Belt Tensioner Bolt	55 N•m	41 lb ft
Engine Coolant Pipe Bolts	9 N•m	80 lb in
Engine Coolant Thermostat	8 N•m	71 lb in
Engine Coolant Thermostat Housing	8 N•m	71 lb in
Engine Coolant Thermostat Housing Coolant Pipe Bolt	8 N•m	71 lb in
Engine Flywheel Bolt - Transmission D16/D20/F17		
First Pass	35 N•m (1)	26 lb ft (1)

Fastener Tightening Specifications (1.8L LUW and LWE) (cont'd)

Application	Specification	
	Metric	English
Second Pass	30 degrees	
Final Pass	15 degrees	
Engine Flywheel Bolt - Transmission M32		
First Pass	60 N•m (1)	44 lb ft (1)
Second Pass	45 degrees	
Final Pass	15 degrees	
Engine Front Cover (Oil Pump Housing)	20 N•m	15 lb ft
Engine Lift Front Bracket	25 N•m	18 lb ft
Engine Mount Bolt	62 N•m	46 lb ft
Engine Mount Bolt to Engine Mount Bracket – M10		
First Pass	50 N•m (1)	37 lb ft (1)
Second Pass	60 degrees	
Final Pass	75 degrees	
Engine Mount Bracket Bolt to Engine Mount		
First Pass	50 N•m (1)	37 lb ft (1)
Second Pass	60 degrees	
Final Pass	75 degrees	
Engine Mount Bracket to Engine Block/Cylinder Head		
First Pass	60 N•m (1)	46 lb ft (1)
Second Pass	45 degrees	
Final Pass	60 degrees	
Engine Mount Nut	62 N•m	46 lb ft
Engine Oil Cooler Bolts	8 N•m	71 lb ft
Engine Oil Cooler Housing Bolt	25 N•m	18 lb ft
Engine Oil Cooler Inlet Pipe Bolt	8 N•m	71 lb in
Engine Oil Cooler Outlet Pipe Bolt	8 N•m	71 lb in
Engine Oil Level Indicator Bolt	10 N•m	89 lb in
Engine Oil Pressure Indicator Switch	20 N•m	15 lb ft
Engine Support Fixture (Front) Bolt	65 N•m	48 lb ft
Engine Support Fixture (Rear Left Side) Bolt	65 N•m	48 lb ft
Engine Support Fixture (Rear Right Side) Bolt	65 N•m	48 lb ft
Evaporative Emission Canister Purge Solenoid Valve Bracket Bolt	7 N•m	62 lb in
Exhaust Manifold Bracket Bolt	20 N•m	15 lb ft
Exhaust Manifold Nut	20 N•m (1)	15 lb ft (1)
Front Compartment Fuse Block Bolt	22 N•m	16 lb ft
Front Exhaust Pipe Bolt	20 N•m	15 lb ft
Generator Bolt	35 N•m	26 lb ft
Heat Shield Exhaust Manifold Bolt	8 N•m	71 lb in
Heated Oxygen Sensor	42 N•m	31 lb ft
Ignition Module Bolt	8 N•m	71 lb in
Intake Manifold Absolute Pressure Sensor Bolt	6 N•m	53 lb in
Intake Manifold Bolt	20 N•m	15 lb ft
Intake Manifold Bracket Bolt	8 N•m	71 lb in
Intake Manifold Bracket to Engine Block Bolt	8 N•m	71 lb in

Fastener Tightening Specifications (1.8L LUW and LWE) (cont'd)

Application	Specification	
	Metric	English
Intake Manifold Grommet Bolt	7 N•m	62 lb in
Knock Sensor Bolt	20 N•m	15 lb ft
Multiport Fuel Injection Fuel Rail Bolt	7 N•m	62 lb in
Oil Filter Cap	25 N•m	18 lb ft
Oil Flow Check Valve Bore Plug	21 N•m	15 lb ft
Oil Level Indicator Tube Bolt	15 N•m	11 lb ft
Oil Pan Baffle Bolt	10 N•m	89 lb in
Oil Pan Bolt	10 N•m	89 lb in
Oil Pan Drain Plug	14 N•m	124 lb in
Oil Pan Transmission Housing Bolt M10 (M32, F17)	40 N•m	30 lb ft
Oil Pan Transmission Housing Bolt M12 (M32, F17)	60 N•m	44 lb ft
Oil Pan Transmission Housing Bolt M10 (D16, D20)	45 N•m	33 lb ft
Oil Pan Transmission Housing Bolt M12 (D16, D20)	75 N•m	55 lb ft
Oil Pan Transmission Housing Bolt (GF6)	58 N•m	43 lb ft
Oil Pressure Measurement Closure Bolt Cylinder Head	15 N•m	11 lb ft
Oil Pressure Relief Valve Closure Bolt	21 N•m	15 lb ft
Oil Pressure Switch	20 N•m	15 lb ft
Oil Pump Cover Bolt	8 N•m	71 lb in
Power Steering Fluid Reservoir Bolt	9 N•m	80 lb in
Spark Plugs	25 N•m	18 lb ft
Throttle Body Bolt	8 N•m	71 lb in
Timing Belt Idler Pulley Bolt		
First Pass	20 N•m (1)	15 lb ft (1)
Second Pass	120 degrees	
Final Pass	15 degrees	
Timing Belt Lower Front Cover Bolt	6 N•m	53 lb in
Timing Belt Rear Cover Bolt	6 N•m (2)	53 lb in (2)
Timing Belt Tensioner Bolt		
First Pass	20 N•m (1)	15 lb ft (1)
Second Pass	120 degrees	
Final Pass	15 degrees	
Timing Belt Upper Front Cover Bolt	6 N•m	53 lb in
Transmission to Cylinder Block Bolt (M32, F17)	60 N•m	44 lb ft
Transmission to Cylinder Block Nut (M32, F17)	40 N•m	30 lb ft
Transmission to Cylinder Block Bolt (D16, D20)	75 N•m	55 lb ft
Transmission to Cylinder Block Bolt (GF6)	58 N•m	43 lb ft
Transmission to Cylinder Block Nut (GF6)	58 N•m	43 lb ft
Transmission to Oil Pan Bolt	50 N•m	37 lb ft
Water Pump Bolt	8 N•m	71 lb in
Water Pump Pulley Bolt	20 N•m (2)	15 lb ft (2)
Wiring Harness Ground Nut	9 N•m	80 lb in

1 = Use NEW fastener
2 = Recut threads and insert NEW bolts with screw locking compound.
For screw locking compound, refer to Electronic Parts Catalogue.

Engine Mechanical Specifications (1.6L LDE)

Application	Specification	
	Metric	English
General Data		
Engine Type	4-Cylinder Inline	
Valves	16	
Displacement	1.598 l	97.52 cu in
Bore	79 mm	3.110 in
Bore distance	86 mm	3.386 in
Stroke	81.5 mm	3.209 in
Compression Ratio	10.8:1	
Maximum Power Engine Speed kW/RPM	85 KW/6000	
Maximum Torque Engine Speed N•m/RPM/lbf ft/RPM	155 N•m 4000	114 lbf ft/4000
Idle Speed RPM	780	
Firing Order	1-3-4-2	
Engine Height – Total Dimensions Oil Pan to Cover	708 mm	28 in
Engine Length – RFB to Front of Poly V Belt	513 mm	20 in
Engine Height – Crank Center To Top	420 mm	17 in
Engine Length – RFB to Front of Poly V belt	474.5 mm	19 in
Engine Weight – Opel Format, MT Version	114 kg	251 lb
Block		
Cylinder Block Height	198.5 mm	8 in
Cylinder Bore Diameter – Standard Size Guiding Value 00	78.995–79.005 mm	3.1100–3.1104 in
Cylinder Bore Diameter – Standard Size Guiding Value 05	79.045–79.055 mm	3.1120–3.1124 in
Connecting Rod		
Diameter – Piston Pin	19.012–19.020 mm	0.7485–0.7488 in
Clearance Piston Pin	0.007–0.020 mm	0.0003–0.0008 in
Journal Bearing Clearance	0.018–0.064 mm	0.0007–0.0025 in
Cooling System		
Coolant Specification	Refer to Electronic Parts Catalog	
Water Pump Design	Rotary Pump	
Cooling System Capacity	5,6 l	5.92 quarts
Flow (Engine Outlet 6000 min $^{-1}$, Thermostat Fully Open)	165 l/min	174.35 quarts/min
Thermostat Opening – Electrical	90°C	194°F
Thermostat Opening – Thermic	105°C	221°F
Cylinder Bore Diameter – Oversize Guiding Value 00+05	79.492–79.508 mm	3.1296–3.1302 in
Crankshaft		
Crankshaft Main Bearing Journal 1–5 Diameter – Standard Size (brown/green)	54.980–54.997 mm	2.165–2.166 in
Crankshaft Main Bearing Journal 1–5 Diameter – Undersize 0.25 (brown/green)	54.730–54.747 mm	2.155–2.156 in
Crankshaft Main Bearing Journal 1–5 Diameter – Undersize 0.50 (brown/green)	54.482–54.495 mm	2.145–2.146 in
Crankshaft Main Bearing 3 Width – Standard Size	25.85–25.90 mm	1.018–1.020 in
Crankshaft Main Bearing 3 Width – Undersize 0.25	26.05–26.10 mm	1.026–1.028 in
Crankshaft Main Bearing 3 Width – Undersize 0.50	26.25–26.30 mm	1.034–1.036 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Standard Size (brown)	1.987–1.993 mm	0.0783–0.0785 in

Engine Mechanical Specifications (1.6L LDE) (cont'd)

Application	Specification	
	Metric	English
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Standard Size (green)	1.993–1.999 mm	0.0785–0.0787 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.25 (brown/blue)	2.112–2.118 mm	0.0832–0.0834 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.25 (green/blue)	2.118–2.124 mm	0.0834–0.0836 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.50 (brown/blue)	2.237–2.243 mm	0.0842–0.0844 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.50 (green/blue)	2.243–2.249 mm	0.0884–0.0886 in
Cylinder Head		
Surface Flatness – Block Deck – Longitude	0.05 mm	0.00197 in
	If the deck surface is out of specification, replace the cylinder head. Do not machine the cylinder head.	
Surface Flatness – Block Deck – Transverse	0.03 mm	0.00118 in
	If the deck surface is out of specification, replace the cylinder head. Do not machine the cylinder head.	
Valve Seat Width – Intake	1.000–1.400 mm	0.394–0.552 in
Valve Seat Width – Exhaust	1.400–1.800 mm	0.552–0.709 in
Valve Seat Angle	90° (-30')	
Valve Seat Angle Adjustment – Upper	60° (+/–1°)	
Valve Seat Angle Adjustment – Lower	120° (+/–1°)	
Valve Guide Bore Standard Size	5.000–5.016 mm	1.969–1.975 in
Valve Guide Bore Oversize 0.075	5.075–5.091 mm	1.999–2.005 in
Valve Guide Bore Oversize 0.150	5.150–5.166 mm	2.028–2.034 in
Valve Guide Assembly Height	36.700–37.000 mm	1.445–1.457 in
Valve Guide Longitude	10.700–11.000 mm	4.213–4.331 in
Engine Oil		
Viscosity	SAE 0-W30, 0-W40, 5-W30 and 5-W40	
Quality	Refer to Electronic Parts Catalog	
Quantity		
Oil Change Incl. Filter	4.5 l	4.75 quarts
Oil Consumption Liter/1 000 km (1.057 quarts/621 miles)	max. 0.6 l	max. 0.634 quarts
Piston		
Piston Diameter	78.943–78.957 mm	3.1080–3.1085 in
Piston Clearance	0.035–0.065 mm	0.0014–0.0025 in
Piston Ring		
Groove Clearance – Top Ring	0.04–0.08 mm	0.0016–0.0031 in
Groove Clearance – 2nd Ring	0.03–0.07 mm	0.0012–0.0028 in
Groove Clearance – Oil Ring	0.06–0.15 mm	0.0024–0.0059 in
End Gap – Top Ring	0.15–0.30 mm	0.0059–0.0118 in
End Gap – 2nd Ring	0.30–0.50 mm	0.0118–0.0197 in
End Gap – Oil Ring	0.20–0.70 mm	0.0079–0.0276 in
Piston Pin		
Diameter	19.000–19.005 mm	0.7480–0.7482 in
Length	49.84 mm	1.9622 in
Clearance Connecting Rod	0.007–0.020 mm	0.0003–0.0008 in

Engine Mechanical Specifications (1.6L LDE) (cont'd)

Application	Specification	
	Metric	English
Clearance Piston	0.004–0.015 mm	0.0002–0.0006 in
Valve System		
Valves Standard Longitude – Intake	117.000–117.400 mm	46.063–46.221 in
Valves Standard Longitude – Exhaust	116.160–116.360 mm	45.733–45.812 in
Valves Oversize Longitude 0.075 – Intake	117.000–117.400 mm	46.063–46.221 in
Valves Oversize Longitude 0.075 – Exhaust	116.160–116.360 mm	45.733–45.812 in
Valves Oversize Longitude 0.150 – Intake	117.000–117.400 mm	46.063–46.221 in
Valves Oversize Longitude 0.150 – Exhaust	116.106–116.360 mm	45.733–45.812 in
Valves – Valve Stem Standard Diameter – Intake	4.965–4.980 mm	1.956–1.962 in
Valves – Valve Stem Standard Diameter – Exhaust	4.950–4.965 mm	1.950–1.956 in
Valves – Valve Stem Oversize Diameter 0.075 – Intake	5.030–5.045 mm	1.982–1.988 in
Valves – Valve Stem Oversize Diameter 0.075 – Exhaust	5.025–5.040 mm	1.980–1.986 in
Valves – Valve Stem Oversize Diameter 0.150 – Intake	5.105–5.120 mm	2.011–2.017 in
Valves – Valve Stem Oversize Diameter 0.150 – Exhaust	5.100–5.115 mm	2.009–2.018 in
Valves – Valve Stem to Guide Clearance – Intake	0.020–0.051 mm	0.0008–0.0020 in
Valves – Valve Stem to Guide Clearance – Exhaust	0.035–0.066 mm	0.0014–0.0026 in
Valves – Valve Disk Diameter – Intake	31.100–31.300 mm	12.246–12.324 in
Valves – Valve Disk Diameter – Exhaust	27.400–27.600 mm	10.789–10.868 in
Valves – Valve Clearance – Intake	0.25 (+/- 0,04) mm	0.0098 (+/- 0.0016) in
Valves – Valve Clearance – Exhaust	0.30 (+/- 0,04) mm	0.0118 (+/-0.0016) in
Valve Springs Longitude	41.00 mm	1.616 in
Valve Springs Longitude Under Load – Open	35.00 mm	1.379 in
Valve Springs Longitude Under Load – Close	25.50 mm	1.005 in

Engine Mechanical Specifications (1.8L LUW and LWE)

Application	Specification	
	Metric	English
General Data		
Engine Type	4-Cylinder Inline	
Valves	16	
Displacement	1.796 l	109.59 cu in
Bore	80.5 mm	3.169 in
Bore Distance	86 mm	3.386 in
Stroke	88.2 mm	3.472 in
Compression Ratio	10.5:1	
Maximum Power / Engine Speed kW/RPM – Gasoline Maximum Power / Engine Speed kW/RPM – E85 Ethanol	103 KW/6300 106 KW/6300	
Maximum Torque / Engine Speed – Gasoline N•m/RPM/lb ft/RPM Maximum Torque / Engine Speed – E85 Ethanol N•m/RPM/lb ft/RPM	170 N•m/ 3800 183 N•m/ 3800	125 lb ft/3800 135 lb ft/3800
Idle Speed RPM	700–780	
Overspeed RPM	6500	
Firing Order	1-3-4-2	
Engine Length – RFB to Front of Poly V Belt	513 mm	20 in

Engine Mechanical Specifications (1.8L LUW and LWE) (cont'd)

Application	Specification	
	Metric	English
Engine Height – Crank Center to Top	420 mm	17 in
Engine Weight – MT Version	120.5 kg	266 lb
Block		
Cylinder Block Height	198.5 mm	8 in
Cylinder Bore Diameter – Standard Size Guiding Value 00	80.492–80.508 mm	3.169–3.1694 in
Cylinder Bore Diameter – Standard Size Guiding Value 05	80.542–80.558 mm	3.171–3.1716 in
Cylinder Bore Diameter – Oversize Guiding Value 00+05	80.992–81.008 mm	3.188–3.1893 in
Crankshaft		
Crankshaft Main Bearing Journal 1–5 Diameter – Standard Size (brown/green)	54.980–54.997 mm	2.165–2.166 in
Crankshaft Main Bearing Journal 1–5 Diameter – Undersize 0.25 (brown/green)	54.730–54.747 mm	2.155–2.156 in
Crankshaft Main Bearing Journal 1–5 Diameter – Undersize 0.50 (brown/green)	54.482–54.495 mm	2.145–2.146 in
Crankshaft Main Bearing Journal 3 Width – Standard Size	26.000–26.052 mm	1.024–1.026 in
Crankshaft Main Bearing Journal 3 Width – Undersize 0.25	26.200–26.252 mm	1.032–1.034 in
Crankshaft Main Bearing Journal 3 Width – Undersize 0.50	26.400–26.452 mm	1.040–1.042 in
Con-Rod Bearing Journal – Standard Size	42.971–42.987 mm	1.692–1.693 in
Con-Rod Bearing Journal – Undersize 0.25 (blue)	42.721–42.737 mm	1.682–1.683 in
Con-Rod Bearing Journal – Undersize 0.50 (white)	42.471–42.487 mm	1.672–1.673 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Standard Size (brown)	1.987–1.993 mm	0.0783–0.0785 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Standard Size (green)	1.993–1.999 mm	0.0785–0.0787 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.25 (brown/blue)	2.112–2.118 mm	0.0832–0.0834 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.25 (green/blue)	2.118–2.124 mm	0.0834–0.0836 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.50 (brown/blue)	2.237–2.243 mm	0.0842–0.0844 in
Crankshaft Main Bearing 1–5 – Bearing Shell Thickness – Undersize 0.50 (green/blue)	2.243–2.249 mm	0.0884–0.0886 in
Crankshaft Bearing Allowable Clearance	0.005–0.059 mm	0.0002–0.0024 in
Crankshaft Bearing Allowable End Clearance	0.100–0.202 mm	0.004–0.008 in
Crankshaft Main Bearing 3 Width – Standard Size	25.85–25.90 mm	1.018–1.020 in
Crankshaft Main Bearing 3 Width – Undersize 0.25	26.05–26.10 mm	1.026–1.028 in
Crankshaft Main Bearing 3 Width – Undersize 0.50	26.25–26.30 mm	1.034–1.036 in
Con-Rod Bearing Shell Thickness – Standard Size	1.485–1.497 mm	0.0585–0.0590 in
Con-Rod Bearing Shell Thickness – Undersize 0.25	1.610–1.622 mm	0.0634–0.0639 in
Con-Rod Bearing Shell Thickness – Undersize 0.50	1.735–1.747 mm	0.0684–0.0688 in
Con-Rod Bearing Allowable Clearance	0.019–0.071 mm	0.0007–0.0028 in
Pistons and Pins		
Piston Diameter – Standard Size Guiding Value 00	80.455–80.465 mm	3.1676–3.1680 in
Piston Diameter – Standard Size Guiding Value 00	80–505–80.51 mm	3.1695–3.1697 in
Piston Diameter – Oversize Guiding Value 00+05	80.955–80.965 mm	3.1872–3.1876 in
Piston Clearance	0.027–0.053 mm	0.0011–0.0021 in
Pin Diameter	19 mm	0.748 in
Pin Longitude	49.84 mm	1.962 in

Engine Mechanical Specifications (1.8L LUW and LWE) (cont'd)

Application	Specification	
	Metric	English
Pin to Piston Clearance	0.020–0.060 mm	0.0008–0.0024 in
Pin to Con-Rod Clearance	0.015–0.021 mm	0.0006–0.0009 in
Piston Rings		
Piston Ring Thickness – First Compression Ring	1.170–1.190 mm	0.0461–0.0469 in
Piston Ring Thickness – Second Compression Ring	1.170–1.190 mm	0.0461–0.0469 in
Piston Ring Thickness – Oil Control Ring	1.900–1.980 mm	0.0749–0.0780 in
Piston Ring End Gap – First Compression Ring	0.20–0.40 mm	0.0079–0.0158 in
Piston Ring End Gap – Second Compression Ring	0.40–0.60 mm	0.0158–0.0237 in
Piston Ring End Gap – Oil Control Ring	0.25–0.75 mm	0.0098–0.0295 in
Piston Ring to Groove Clearance – First Compression Ring	0.040–0.080 mm	0.0016–0.0032 in
Piston Ring to groove Clearance – Second Compression Ring	0.030–0.070 mm	0.0012–0.0028 in
Piston Ring to Groove Clearance – Oil Control Ring	0.030–0.130 mm	0.0012–0.051 in
Cylinder Head		
Surface Flatness – Block Deck – Longitude	0.05 mm	0.00197 in
	If the deck surface is out of specification, replace the cylinder head. Do not machine the cylinder head.	
Surface Flatness – Block Deck – Transverse	0.03 mm	0.00118 in
	If the deck surface is out of specification, replace the cylinder head. Do not machine the cylinder head.	
Valve Seat Width – Intake	1.0–1.4 mm	0.040–0.056 in
Valve Seat Width – Exhaust	1.4–1.8 mm	0.056–0.071 in
Valve Seat Angle	45 degrees (– 0.25 degrees)	
Valve Seat Angle Adjustment – Upper	30 degrees (+/– 0.5 degrees)	
Valve Seat Angle Adjustment – Lower	60 degrees (+/– 0.5 degrees)	
Valve Guide Bore Norm Size	5.000–5.016 mm	0.1969–0.1975 in
Valve Guide Bore Oversize 0.075	5.075–5.091 mm	0.1999–0.2005 in
Valve Guide Bore Oversize 0.150	5.150–5.166 mm	0.2028–0.2034 in
Valve Guide Assembly Height	10.70–11.00 mm	0.422–0.434 in
Valve Guide Longitude	36.70–37.30 mm	1.445–1.468 in
Valve Assembly Height – Intake	36.33 mm	1.430 in
Valve Assembly Height – Exhaust	36.33 mm	1.430 in
Camshaft		
Cam Stroke Intake	10 mm	0.394 in
Cam Stroke Exhaust	9 mm	0.354 in
Valve System		
Valves Norm Longitude – Intake	101.10–101.30 mm	3.980–3.988 in
Valves Norm Longitude – Exhaust	100.40–100.60 mm	3.953–3.961 in
Valves Oversize Longitude 0.075 – Intake	100.70–100.90 mm	3.965–3.972 in
Valves Oversize Longitude 0.075 – Exhaust	100.00–100.20 mm	3.937–3.945 in
Valves – Valve Stem Norm Diameter – Intake	4.965–4.980 mm	0.1955–0.1961 in
Valves – Valve Stem Norm Diameter – Exhaust	4.950–4.965 mm	0.1949–0.1955 in
Valves – Valve Stem Oversize Diameter 0.075 – Intake	5.040–5.055 mm	0.1985–0.1991 in
Valves – Valve Stem Oversize Diameter 0.075 – Exhaust	5.025–5.050 mm	0.1979–0.1989 in
Valves – Valve Stem to Guide Clearance – Intake	0.020–0.051 mm	0.0008–0.0021 in
Valves – Valve Stem to Guide Clearance – Exhaust	0.035–0.066 mm	0.0014–0.0026 in

Engine Mechanical Specifications (1.8L LUW and LWE) (cont'd)

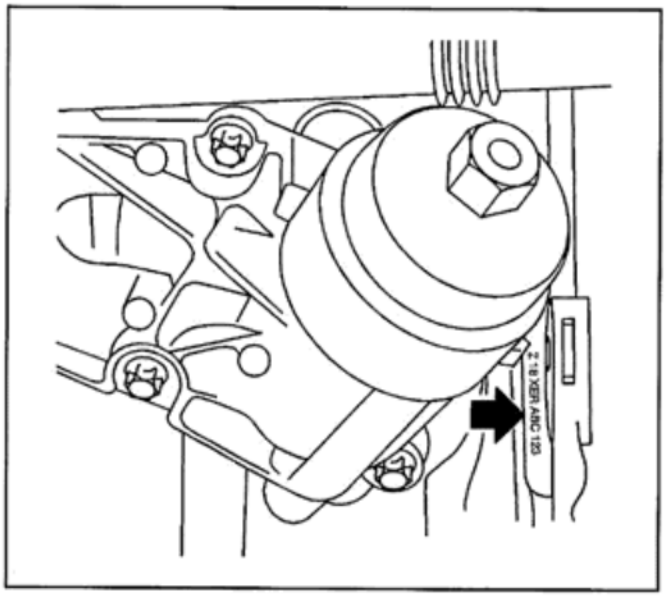
Application	Specification	
	Metric	English
Valves – Valve Stem allowable Run-Out	0.05 mm	0.0019 in
Valves – Valve Disk Diameter – Intake	31.1–31.3 mm	1.225–1.233 in
Valves – Valve Disk Diameter – Exhaust	27.4–27.6 mm	1.079–1.087 in
Valves – Valve Seat Angle on Valve Disk	90°40' (+/-15')	
Valve Springs Longitude	42 mm	1.65 in
Valve Springs Longitude Under Load – Open	35.0 mm	1.38 in
Valve Springs Longitude Under Load – Close	25.0 mm	0.98 in
Engine Oil		
Viscosity	SAE 0-W30, 0-W40, 5-W30 and 5-W40	
Quality	Dexos 1	
Quantity		
Oil Change Incl. Filter	4.5 l	4.76 quarts
Oil Consumption Liter/1 000 km (1.057 quarts/621 miles)	max. 0.6 l	max. 0.634 quarts
Cooling System		
Coolant Specification	Refer to Electronic Parts Catalog	
Water Pump Design	Rotary Pump	
Cooling System Capacity	5,6 l	5.92 quarts
Flow (Engine Outlet 6000 min $^{-1}$, Thermostat Fully Open)	160 l/min	42.27 US gal/min
Flow (Radiator 6000 min $^{-1}$, Thermostat Fully Open)	165 l/min	174.4 quarts/min
Thermostat Opening – Electrical	90°C	194°F
Thermostat Opening – Thermic	105°C	221°F

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material	GM Part Number	
		United States	Canada
Bolt Connections	Screw Locking Compound	12345382	10953489
Camshaft Bearings	Dexos1 Engine Oil	19293000	19286321
Camshaft Cover Bolt	Pipe Sealant	12346004	10953480
Camshaft Front Oil Seal	Sealant	1052943	10953491
Camshafts	Dexos1 Engine Oil	19293000	19286321
Crankshaft Bearing Lubricant	Dexos1 Engine Oil	19293000	19286321
Engine Block Oil Gallery Plugs	Sealant	1052943	10953491
Engine Oil	Dexos1 Engine Oil	19293000	19286321
Intake and Exhaust Valves	Dexos1 Engine Oil	19293000	19286321
Oil Pan	Sealant	12378521	88901148
Oxygen Sensor	Assembly Paste - White	88862477	88862478
Oxygen Sensor Threads	Anti-seize	12397953	NA
Rear Crankshaft Main Bearing Cap	Sealant	12378521	88901148
Rear Crankshaft Oil Seal	Dexos1 Engine Oil	19293000	19286321
Rod Bearing - Rod Pins of Crankshaft	Dexos1 Engine Oil	19293000	19286321
Seal Rings	Silicone Grease - White	12345579	10953481
Turbo Heat Shield Fastener	Lubricant	12345996	10953501
Water Pump Bearing	Sealant	1052943	10953491

Component Locator

Engine Identification



1945826

Important: When a short block engine is installed, the engine number must be marked on the cylinder block before installing the engine.

The engine identification code is embossed on the flattened area of the cylinder block, arrow, at the transmission side.

Diagnostic Information and Procedures

Symptoms - Engine Mechanical

Strategy Based Diagnostics

Perform the *Diagnostic System Check - Vehicle on page 6-66*.

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system condition. The diagnostic flow is the place to start when repairs are necessary.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the engine.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds, if applicable, to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- *Base Engine Misfire without Internal Engine Noises on page 9-949*
- *Base Engine Misfire with Abnormal Internal Lower Engine Noises on page 9-950*
- *Base Engine Misfire with Abnormal Valve Train Noise on page 9-950*
- *Base Engine Misfire with Coolant Consumption on page 9-951*
- *Base Engine Misfire with Excessive Oil Consumption on page 9-951*
- *Engine Noise on Start-Up, but Only Lasting a Few Seconds on page 9-948*
- *Upper Engine Noise, Regardless of Engine Speed on page 9-951*
- *Lower Engine Noise, Regardless of Engine Speed on page 9-952*
- *Engine Noise Under Load on page 9-948*
- *Engine Will Not Crank - Crankshaft Will Not Rotate on page 9-952*
- *Coolant in Engine Oil on page 9-948*
- *Engine Compression Test on page 9-953*
- *Cylinder Leakage Test on page 9-957*
- *Oil Consumption Diagnosis on page 9-947*
- *Oil Pressure Diagnosis and Testing on page 9-945*
- *Oil Leak Diagnosis on page 9-945*
- *Crankcase Ventilation System Inspection/ Diagnosis on page 9-959*
- *Drive Belt Chirping, Squeal, and Whine Diagnosis on page 9-953*
- *Drive Belt Rumbling and Vibration Diagnosis on page 9-955*
- *Drive Belt Falls Off and Excessive Wear Diagnosis on page 9-959*
- *Drive Belt Tensioner Diagnosis on page 9-961*

Oil Pressure Diagnosis and Testing

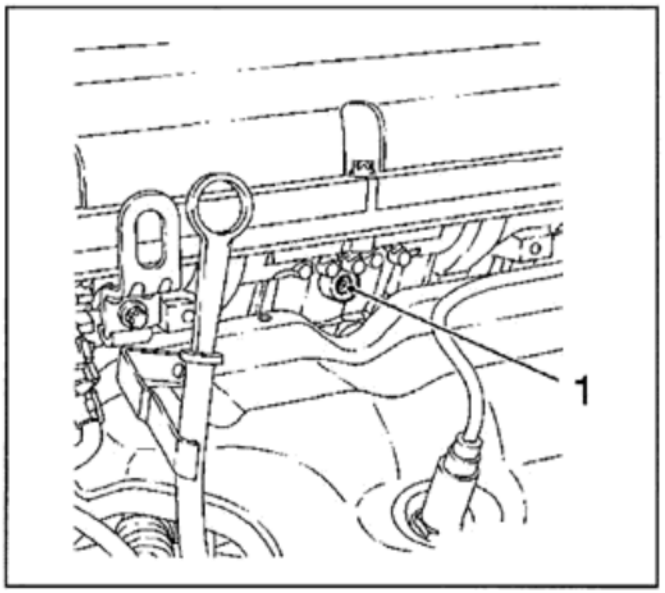
Special Tools

- *EN-498-B* Oil Pressure Gauge
- *EN-232* Adapter Oil Pressure Check

For equivalent regional tools, refer to *Special Tools on page 9-1135.*

Removal Procedure

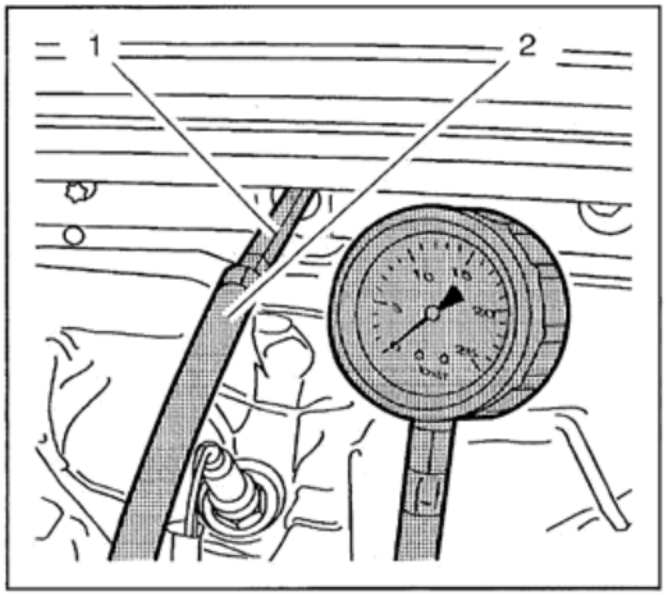
1. If necessary, remove the exhaust manifold heat shield. Refer to *Exhaust Manifold Heat Shield Replacement (LUV) on page 9-749* or *Exhaust Manifold Heat Shield Replacement (LUW) on page 9-750.*



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2. Remove the closure bolt (1).
3. Clean the thread.

Measurement Procedure



2501435

1. Install the *EN-498-B* gauge (2).
2. Install the *EN-232* adapter (1).
3. Start the engine.
4. Check oil pressure.

   At idling speed, the oil pressure must be at least **130 kPa (18.85 psi)** and the oil temperature must be **80°C (170°F)** or more.

Installation Procedure

1. Switch off the engine.
2. Remove the *EN-232* adapter.
3. Remove the *EN-498-B* gauge.
4. Install new closure bolt in the cylinder head.

Caution: Refer to *Fastener Caution on page 0-8.*

5. Tighten the closure bolt to **15 N•m (11 lb ft)**.
6. If necessary, install the exhaust manifold heat shield. Refer to *Exhaust Manifold Heat Shield Replacement (LUV) on page 9-749* or *Exhaust Manifold Heat Shield Replacement (LUW) on page 9-750.*
7. Check the engine oil level.

Oil Leak Diagnosis

Step	Action	Yes	No
DEFINITION: You can repair most fluid leaks by first, visually locating the leak, repairing or replacing the component, or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the leak and the cause of the leak.			
1	1. Operate the vehicle until it reaches normal operating temperature. Refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938.* 2. Park the vehicle on a level surface over a large sheet of paper or other clean surface. 3. Wait 15 minutes. 4. Inspect for drippings. Are drippings present?	Go to *Step 2*	System OK

Oil Leak Diagnosis (cont'd)

Step	Action	Yes	No
2	Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 3*
3	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 4*
4	1. Completely clean the entire engine and surrounding components. 2. Operate the vehicle for several miles at normal operating temperature and at varying speeds. 3. Park the vehicle on a level surface over a large sheet of paper or other clean surface. 4. Wait 15 minutes. 5. Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 5*
5	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 6*
6	1. Completely clean the entire engine and surrounding components. 2. Apply an aerosol-type powder, for example, baby powder or foot powder, to the suspected area. 3. Operate the vehicle for several miles at normal operating temperature and at varying speeds. 4. Identify the type of fluid and the approximate location of the leak from the discolorations in the powder surface. Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 7*
7	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 8*
8	Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	Go to *Step 9*
9	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to *Step 10*	System OK

Oil Leak Diagnosis (cont'd)

Step	Action	Yes	No
10	1. Inspect the engine for mechanical damage. Special interest should be shown to the following areas: • Higher than recommended fluid levels • Higher than recommended fluid pressures • Plugged or malfunctioning fluid filters or pressure bypass valves • Plugged or malfunctioning engine ventilation system • Improperly tightened or damaged fasteners • Cracked or porous components • Improper sealants or gaskets, where required • Improper sealant or gasket installation • Damaged or worn gaskets or seals • Damaged or worn sealing surfaces 2. Inspect the engine for customer modifications. Is there mechanical damage or customer modifications to the engine?	Go to *Step 11*	System OK
11	Repair or replace all damaged or modified components. Did you complete the repair?	Go to *Step 1*	—

Oil Consumption Diagnosis

Excessive oil consumption, not due to leaks, is the use of 0.6 L (0.14 gallon) engine oil within 1000 kilometers (622 miles). The causes of excessive oil consumption include the following conditions:

- External oil leaks

  Tighten bolts and/or replace gaskets and oil seals as necessary.
- Incorrect oil level or improper reading of oil level indicator

  With the vehicle on a level surface, allow adequate drain down time and inspect for the correct oil level.
- Improper oil viscosity

  Use recommended SAE viscosity for the prevailing temperatures.
- Continuous high speed driving and/or severe usage
- Crankcase ventilation system restrictions or malfunctioning components
- Valve guides and/or valve stem oil seals worn, or the seal omitted

  Ream guides and install oversize service valves and/or new valve stem oil seals.
- Piston rings broken, improperly installed, worn, or not seated properly

  Allow adequate time for rings to seat. Replace broken or worn rings, as necessary.
- Piston improperly installed or mis-fitted.

Coolant in Combustion Chamber

Cause	Correction
DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an overtemperature condition which may cause engine component damage. 1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to *Engine Will Not Crank - Crankshaft Will Not Rotate on page 9-952*. 2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore. 3. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component. 4. Inspect by performing a cylinder compression test. Two cylinders side-by-side on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to *Engine Compression Test on page 9-953*.	
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to *Cylinder Head Cleaning and Inspection on page 9-1096* and *Cylinder Head Replacement on page 9-990*.
Warped cylinder head	Replace the cylinder head and gasket. Refer to *Cylinder Head Replacement on page 9-990*.
Cracked cylinder head	Replace the cylinder head and gasket. *Cylinder Head Replacement on page 9-990*
Cracked cylinder liner	Replace the components as required.
Cylinder head or block porosity	Replace the components as required.

Coolant in Engine Oil

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an overtemperature condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed. 1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to *Lower Engine Noise, Regardless of Engine Speed on page 9-952.* 2. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. Two cylinders side-by-side on the engine block with low compression may indicate a failed cylinder head gasket. Refer to *Engine Compression Test on page 9-953.*	
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to *Cylinder Head Replacement on page 9-990.*
Warped cylinder head	Replace the cylinder head and gasket. Refer to *Cylinder Head Replacement on page 9-990.*
Cracked cylinder head	Replace the cylinder head and gasket. *Cylinder Head Replacement on page 9-990*
Cracked cylinder liner	Replace the components as required.
Cylinder head or block porosity	Replace the components as required.

Engine Noise Under Load

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to *Oil Pressure Diagnosis and Testing on page 9-945.* 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition. Refer to *Symptoms - Engine Controls on page 9-511.*
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair as required.
Cracked flywheel– automatic transmission	1. Inspect the flywheel bolts and flywheel. 2. Repair as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components and repair as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore

Engine Noise on Start-Up, but Only Lasting a Few Seconds

Cause	Correction
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
High valve lash adjuster leak down rate	Replace the lash adjusters as required.
Worn crankshaft thrust bearing	1. Inspect the thrust bearing and crankshaft. 2. Repair or replace as required.
Damaged or faulty oil filter by-pass valve	1. Inspect the oil filter by-pass valve for proper operation. 2. Repair or replace as required.

Engine Noise on Start-Up, but Only Lasting a Few Seconds (cont'd)

Cause	Correction
Malfunctioning camshaft position actuators - improper oil viscosity or contamination. The result is camshaft actuator locking pin does not lock	1. Verify correct engine oil viscosity by changing the engine oil and filter. Reevaluate the concern. 2. Isolate the noise to a specific camshaft position actuator. 3. Replace the camshaft actuator, oil and filter.

Base Engine Misfire without Internal Engine Noises

Cause	Correction
Abnormalities, severe cracking, bumps, or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine revolutions per minute (RPM) variations and lead to a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components, and repair or replace as required.
A loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	Repair or replace as required.
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder heads or throttle body	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body as required.
Improperly installed or damaged manifold absolute pressure (MAP) sensor The sealing grommet of the MAP sensor should not be torn or damaged.	Repair or replace the MAP sensor as required.
Damage to the MAP sensor housing	Replace the intake manifold.
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should be intact and in the proper position.	Replace the valve rocker arms as required.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump up and loss of compression.	• Perform an oil pressure test. Refer to *Oil Pressure Diagnosis and Testing on page 9-945.* • Repair or replace the oil pump as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. • Inspect the cylinder heads, engine block, and/or head gaskets. • Repair or replace as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to *Engine Compression Test on page 9-953.*

Base Engine Misfire without Internal Engine Noises (cont'd)

Cause	Correction
	• Perform cylinder leak down and compression testing to identify the cause. • Repair or replace as required.
A damaged crankshaft reluctor wheel A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. • Systems with electronic communications, DIS or coil per cylinder, and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then re-sync the crankshaft position. • Systems with electronic communication, DIS or coil per cylinder, and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a DTC P0300 may be set. • Systems with mechanical communications, high voltage switch, and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery to the point of generating a DTC P0300 or P0336.	Replace the sensor and/or crankshaft as required.

Base Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine revolutions per minute (RPM) variations, noises similar to a faulty lower engine, and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to *Engine Compression Test on page 9-953*. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.
Worn crankshaft thrust bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft, and create a diagnostic trouble code (DTC) without an actual misfire condition.	Replace the crankshaft and bearings as required.

Base Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Worn or loose rocker arms The rocker arm bearing end caps and/or needle bearings should intact within the rocker arm assembly.	Replace the valve rocker arms as required.
Stuck valves	Repair or replace as required.

Base Engine Misfire with Abnormal Valve Train Noise (cont'd)

Cause	Correction
Carbon buildup on the valve stem can cause the valve to not close properly.	
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lash adjusters.
Sticking lifters	Replace as required.

Base Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gasket and/or cracking, or other damage to the cylinder head and engine block cooling system passages. Coolant consumption may or may not cause the engine to overheat.	• Inspect for spark plugs saturated by coolant. • Perform a cylinder leak down test. • Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.

Base Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides, and/or valve stem oil seals	• Inspect the spark plugs for oil deposits. • Repair or replace as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to *Engine Compression Test on page 9-953*. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.

Upper Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	• Perform an oil pressure test. Refer to *Oil Pressure Diagnosis and Testing on page 9-945*. • Repair or replace as required.
Loose and/or worn valve rocker arm attachments	• Inspect the valve rocker arm stud, nut, or bolt. • Repair or replace as required.
Worn valve rocker arm	Replace the valve rocker arm.
Improper lubrication to the valve rocker arms	Inspect the following components and repair or replace as required: • The valve rocker arm • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn or dirty valve lifters	Replace the valve lifters.
Stretched or broken timing belt and/or damaged sprocket teeth	Replace the timing belt and sprockets.
Worn, damaged, or faulty timing belt tensioners	Replace tensioners
Worn engine camshaft lobes	• Inspect the engine camshaft lobes. • Replace the camshaft and valve lifters as required.
Worn valve guides or valve stems	Inspect the following components, and repair as required: • The valves • The valve guides

Upper Engine Noise, Regardless of Engine Speed (cont'd)

Cause	Correction
Stuck valves Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the following components and repair as required: • The valves • The valve guides

Lower Engine Noise, Regardless of Engine Speed

Cause	Correction
Low oil pressure	• Perform an oil pressure test. Refer to *Oil Pressure Diagnosis and Testing on page 9-945*. • Repair or replace damaged components as required.
Worn accessory drive components– abnormalities, such as severe cracking, bumps, or missing areas in the accessory drive belt and/or misalignment of system components	1. Inspect the accessory drive system. 2. Repair or replace as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition system. Refer to *Symptoms - Engine Controls on page 9-511*.
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair or replace as required.
Loose or damaged flywheel	Repair or replace the flywheel.
Damaged oil pan, contacting the oil pump screen An oil pan that has been damaged, may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	1. Inspect the oil pan. 2. Inspect the oil pump screen. 3. Repair or replace as required.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, piston pin, and the connecting rod. 2. Repair or replace as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft • The crankshaft journals
Excessive crankshaft bearing clearance	Inspect the following components and repair as required: • The crankshaft bearings • The crankshaft journals
Incorrect piston, piston pin, and connecting rod installation Pistons must be installed with the mark, or dimple, on the top of the piston, facing the front of the engine. Piston pins must be centered in the connecting rod pin bore.	1. Verify the pistons, piston pins and connecting rods are installed correctly. 2. Repair as required.

Engine Will Not Crank - Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head.

Engine Will Not Crank - Crankshaft Will Not Rotate (cont'd)

Cause	Correction
	4. Inspect for a sticking fuel injector. 5. Inspect for cracked cylinder wall,
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Seized manual transmission	1. Disengage the clutch. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or gears	• Inspect timing chain and gears. • Repair as required.
Seized balance shaft	• Inspect balance shaft. • Repair as required.
Material in cylinder • Broken valve • Piston material • Foreign material • Cracked cylinder wall	• Inspect cylinder for damaged components and/or foreign materials. • Inspect for fallen cylinder wall. • Repair or replace as required.
Seized crankshaft or connecting rod bearings	• Inspect crankshaft and connecting rod bearings. • Inspect for fallen cylinder wall. • Repair as required.
Bent or broken connecting rod	• Inspect connecting rods. • Repair as required.
Broken crankshaft	• Inspect crankshaft. • Repair as required.

Engine Compression Test

Removal Procedure

1. Remove the throttle body. Refer to *Throttle Body Assembly Replacement on page 9-542*.
2. Remove the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.
3. Remove the relay holder cover.
4. Remove the fuel pump relay.

Measurement Procedure

Check Compression for all cylinders:

Note: Engine revs at least 300/min.

1. Start the engine (approx. 4 seconds).
2. Compare the compression values.
   Maximum pressure differential 100 kPa (14.5 psi)

Installation Procedure

1. Install the fuel pump relay.
   - Place into the socket.
   - Ensure the plug contacts are sound.
2. Install the relay carrier cover.
3. Install the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.
4. Install the throttle body. Refer to *Throttle Body Assembly Replacement on page 9-542*.

Drive Belt Chirping, Squeal, and Whine Diagnosis

Diagnostic Aids

- A chirping or squeal noise may be intermittent due to moisture on the drive belts or the pulleys. It may be necessary to spray a small amount of water on the drive belts in order to duplicate the customers concern. If spraying water on the drive belt duplicates the symptom, cleaning the belt pulleys may be the probable solution.
- If the noise is intermittent, verify the accessory drive components by varying their loads making sure they are operated to their maximum capacity. An overcharged A/C system, power steering system with a pinched hose or wrong fluid, or a generator failing are suggested items to inspect.
- A chirping, squeal or whine noise may be caused by a loose or improper installation of a body or suspension component. Other items of the vehicle may also cause the noise.
- The drive belts will not cause a whine noise.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. The noise may not be engine related. This step is to verify that the engine is making the noise. If the engine is not making the noise do not proceed further with this table.

3. The noise may be an internal engine noise. Removing the drive belts one at a time and operating the engine for a brief period will verify the noise is related to the drive belt. When removing the drive belt the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.
4. Inspect all drive belt pulleys for pilling. Pilling is the small balls or pills or it can be strings in the drive belt grooves from the accumulation of rubber dust.
6. Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.
10. Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed.
12. Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.
14. This test is to verify that the drive belt tensioner operates properly. If the drive belt tensioner is not operating properly, proper belt tension may not be achieved to keep the drive belt from slipping which could cause a squeal noise.
15. This test is to verify that the drive belt is not too long, which would prevent the drive belt tensioner from working properly. Also if an incorrect length drive belt was installed, it may not be routed properly and may be turning an accessory drive component in the wrong direction.
16. Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure for that pulley.
17. This test is to verify that the pulleys are the correct diameter or width. Using a known good vehicle compare the pulley sizes.
19. Replacing the drive belt when it is not damaged or there is not excessive pilling will only be a temporary repair.

Drive Belt Chirping, Squeal, and Whine Diagnosis

Step	Action	Yes	No
Caution: Refer to *Belt Dressing Caution on page 0-7.* DEFINITION: The following items are indications of chirping: • A high pitched noise that is heard once per revolution of the drive belt or a pulley. • Chirping may occur on cold damp start-ups and will subside once the vehicle reaches normal operating temp. DEFINITION: The following items are indications of drive belt squeal: • A loud screeching noise that is caused by a slipping drive belt. This is unusual for a drive belt with multiple ribs. • The noise occurs when a heavy load is applied to the drive belt, such as an air conditioning compressor engagement snapping the throttle, or slipping on a seized pulley or a faulty accessory drive component. DEFINITION: The following items are indications of drive belt whine: • A high pitched continuous noise. • The noise may be caused by an accessory drive component failed bearing.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to *Step 2*	Go to *Symptoms - Engine Mechanical on page 9-944*
2	Verify that there is a chirping, squeal or whine noise. Does the engine make the chirping squeal or whine noise?	Go to *Step 3*	Go to Diagnostic Aids
3	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed. 2. Operate the engine for no longer than 30–40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the chirping, squeal or whine noise still exist?	Go to *Symptoms - Engine Mechanical on page 9-944*	Go to *Step 4*
4	If diagnosing a chirping noise, inspect for severe pilling exceeding 1/3 of the belt groove depth. If diagnosing a squeal or whine noise, proceed to step 13. Do the belt grooves have pilling?	Go to *Step 5*	Go to *Step 6*

Drive Belt Chirping, Squeal, and Whine Diagnosis (cont'd)

Step	Action	Yes	No
5	Clean the drive belt pulleys with a suitable wire brush. Did you complete the repair?	Go to *Step 20*	Go to *Step 6*
6	Inspect for misalignment of the pulleys. Are any of the pulleys misaligned?	Go to *Step 7*	Go to *Step 8*
7	Replace or repair any misaligned pulleys. Did you complete the repair?	Go to *Step 20*	Go to *Step 8*
8	Inspect for bent or cracked brackets. Did you find any bent or cracked brackets?	Go to *Step 9*	Go to *Step 10*
9	Replace any bent or cracked brackets. Did you complete the repair?	Go to *Step 20*	Go to *Step 10*
10	Inspect for improper, loose or missing fasteners. Did you find the condition?	Go to *Step 11*	Go to *Step 12*
11	**Caution:** Refer to *Fastener Caution on page 0-8.* 1. Tighten any loose fasteners. Refer to *Fastener Tightening Specifications (1.8L LUW and LWE) on page 9-935* or *Fastener Tightening Specifications (1.6L LDE) on page 9-932.* 2. Replace any improper or missing fasteners. Did you complete the repair?	Go to *Step 20*	Go to *Step 12*
12	Inspect for a bent pulley. Did you find the condition?	Go to *Step 18*	Go to *Step 19*
13	Inspect for an accessory drive component seized bearing or a faulty accessory drive component. Did you find and correct the condition? If diagnosing a whine noise and the condition still exist, proceed to Diagnostic Aids.	Go to *Step 20*	Go to *Step 14*
14	Test the drive belt tensioner for proper operation. Did you find and correct the condition?	Go to *Step 20*	Go to *Step 15*
15	Inspect for the correct drive belt length. Did you find and correct the condition?	Go to *Step 20*	Go to *Step 16*
16	Inspect for misalignment of a pulley. Did you find and correct the condition?	Go to *Step 20*	Go to *Step 17*
17	Inspect for the correct pulley size. Did you find and correct the condition?	Go to *Step 20*	Go to Diagnostic Aids
18	Replace the bent pulley. Did you complete the repair?	Go to *Step 20*	Go to *Step 19*
19	Replace the drive belt. Refer to *Drive Belt Replacement on page 9-964.* Did you complete the repair?	Go to *Step 20*	Go to Diagnostic Aids
20	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to *Step 3*

Drive Belt Rumbling and Vibration Diagnosis

Diagnostic Aids

The accessory drive components can have an affect on engine vibration. Vibration from the engine operating may cause a body component or another part of the vehicle to make rumbling noise. Vibration can be caused by, but not limited to the A/C system over charged, the power steering system restricted or the incorrect fluid, or an extra load on the generator. To help identify an intermittent or an improper condition, vary the loads on the accessory drive components.

The drive belt may have a rumbling condition that can not be seen or felt. Sometimes replacing the drive belt may be the only repair for the symptom.

If replacing the drive belt, completing the diagnostic table, and the noise is only heard when the drive belts are installed, there might be an accessory drive component with a failure. Varying the load on the different accessory drive components may aid in identifying which component is causing the rumbling noise.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. This test is to verify that the symptom is present during diagnosing. Other vehicle components may cause a similar symptom.
3. This test is to verify that one of the drive belts is causing the rumbling noise or vibration. Rumbling noise may be confused with an internal engine noise due to the similarity in the description. Remove only one drive belt at a time if the vehicle has multiple drive belts. When removing the drive belts the water pump may not be operating and the engine may overheat. Also DTCs may set when the engine is operating with the drive belts removed.
4. Inspecting the drive belts is to ensure that they are not causing the noise. Small cracks across the ribs of the drive belt will not cause the noise. Belt separation is identified by the plys of the belt separating and may be seen at the edge of the belt our felt as a lump in the belt.
5. Small amounts of pilling is normal condition and acceptable. When the pilling is severe the drive belt does not have a smooth surface for proper operation.
9. Inspecting of the fasteners can eliminate the possibility that the wrong bolt, nut, spacer, or washer was installed.
11. This step should only be performed if the water pump is driven by the drive belt. Inspect the water pump shaft for being bent. Also inspect the water pump bearings for smooth operation and excessive play. Compare the water pump with a known good water pump.
12. Accessory drive component brackets that are bent, cracked, or loose may put extra strain on that accessory component causing it to vibrate.

Drive Belt Rumbling and Vibration Diagnosis

Step	Action	Yes	No
Caution: Refer to *Belt Dressing Caution on page 0-7*. DEFINITION: The following items are indications of drive belt rumbling: • A low pitch tapping, knocking, or thumping noise heard at or just above idle. • Heard once per revolution of the drive belt or a pulley. • Rumbling may be caused from: – Pilling, the accumulation of rubber dust that forms small balls (pills) or strings in the drive belt pulley groove – The separation of the drive belt – A damaged drive belt – A worn drive belt idler pulley DEFINITION: The following items are indications of drive belt vibration: • The vibration is engine-speed related. • The vibration may be sensitive to accessory load.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to *Step 2*	Go to *Symptoms - Engine Mechanical on page 9-944*
2	Verify that there is a rumbling noise or that the vibration is engine related. Does the engine make the rumbling noise or vibration?	Go to *Step 3*	Go to Diagnostic Aids
3	1. Remove the drive belt. If the engine has multiple drive belts, remove the belts one at a time and perform the test below each time a belt is removed. 2. Operate the engine for no longer than 30–40 seconds. 3. Repeat this test if necessary by removing the remaining belt(s). Does the rumbling or vibration still exist?	Go to *Symptoms - Engine Mechanical on page 9-944*	Go to *Step 4*
4	Inspect the drive belts for wear, damage, separation, sections of missing ribs, and debris build-up. Did you find any of these conditions?	Go to *Step 7*	Go to *Step 5*
5	Inspect for severe pilling of more than 1/3 of the drive belt pulley grooves. Did you find severe pilling?	Go to *Step 6*	Go to *Step 7*

Drive Belt Rumbling and Vibration Diagnosis (cont'd)

Step	Action	Yes	No
6	1. Clean the drive belt pulleys using a suitable wire brush. 2. Reinstall the drive belts. Refer to *Drive Belt Replacement on page 9-964*. Did you correct the condition?	Go to *Step 8*	Go to *Step 7*
7	Install a new drive belt. Refer to *Drive Belt Replacement on page 9-964*. Did you complete the replacement?	Go to *Step 8*	Go to *Step 9*
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to *Step 9*
9	Inspect for improper, loose or missing fasteners. Did you find any of these conditions?	Go to *Step 10*	Go to *Step 11*
10	**Caution:** Refer to *Fastener Caution on page 0-8*. 1. Tighten any loose fasteners. Refer to *Fastener Tightening Specifications (1.8L LUW and LWE) on page 9-935* or *Fastener Tightening Specifications (1.6L LDE) on page 9-932*. 2. Replace improper or missing fasteners. Did you complete the repair?	Go to *Step 13*	Go to *Step 11*
11	Inspect for a bent water pump shaft. Did you find and correct the condition?	Go to *Step 13*	Go to *Step 12*
12	Inspect for bent or cracked brackets. Did you find and correct the condition?	Go to *Step 13*	Go to Diagnostic Aids
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to *Step 3*

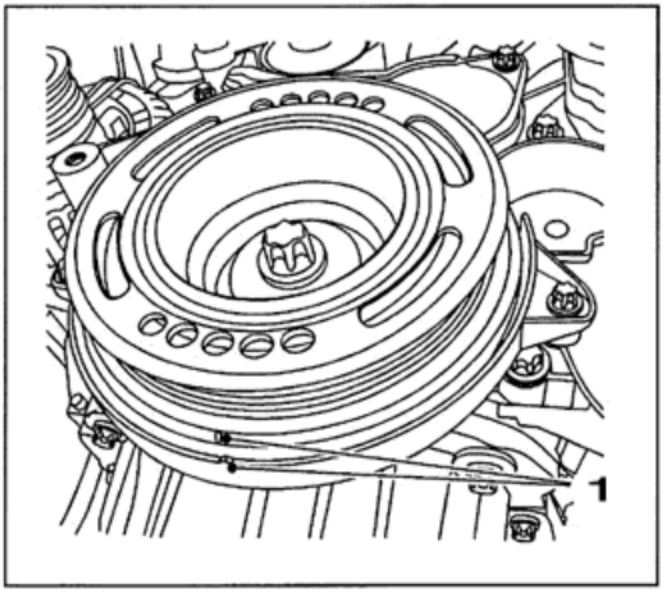
Cylinder Leakage Test

Removal Procedure

Note: A leakage test may be performed in order to measure cylinder/combustion chamber leakage. High leakage may indicate one or more of the following:

- Worn or burnt valves
- Broken valve springs
- Stuck valve lash adjusters
- Damaged piston
- Worn piston rings
- Worn or scored cylinder bore
- Damaged cylinder head gasket
- Cracked or damaged cylinder head
- Cracked or damaged engine block

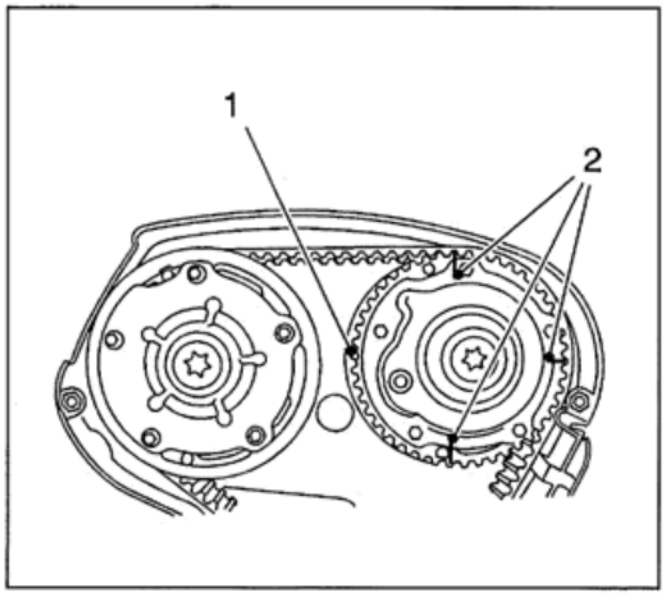
1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
2. Remove the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left SIde) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right SIde, LWE, LUW) on page 3-149*.



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3. Set up the crankshaft.
4. Move the crankshaft in the direction of the engine rotation to the first cylinder TDC position (mark 1).
5. Lower the vehicle.
6. Remove the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Replacement on page 9-984*.
7. Remove the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.

8. Detach the engine wiring harness from intake manifold, cylinder head cover and engine wiring harness bracket.
9. Remove the coolant expansion tank closure cap.
10. Remove the oil dipstick.



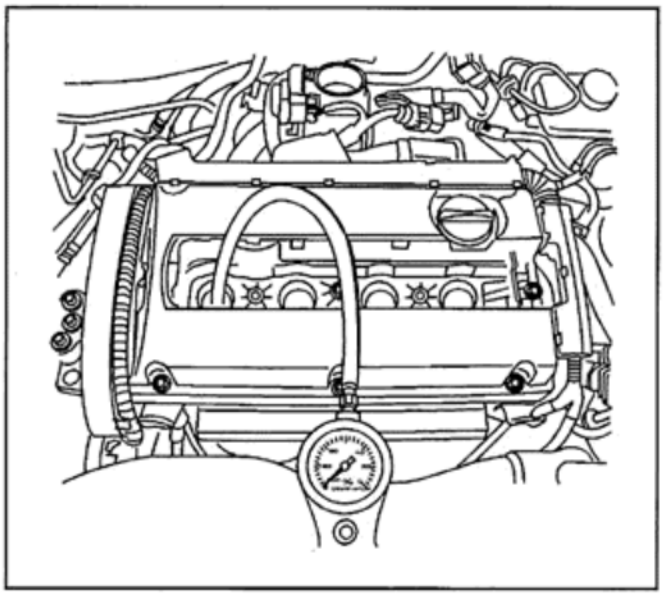
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11. Apply guidance marks.
12. Attach 3 markings (2) as an aid to one of the camshaft adjusters, each one offset by 90° to the marking applied (1).

Test Procedure

Note: Follow manufacturer instructions.

1. Calibrate the pressure loss tester and connect to the compressed air system.



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2. Install the pressure loss tester.

Note: Wheels must be in contact with the ground.

- Engage first gear and apply the parking brake.
- Install the connecting piece into the spark plug thread of cylinder number 1.
- Apply compressed air to cylinder number 1.

3. Inspect for Pressure Loss
   - Take pressure loss reading.
   - The maximum permissible pressure differential between cylinders is approximately 10 percent.
   - Maximum pressure loss of a cylinder is 25 percent.
4. Take note of any visible escape of compressed air. In excessive leakage situations, inspect for the following conditions:
   - Air leakage sounds at the throttle body, intake manifold or air inlet hose that may indicate a worn or burnt intake valve or a broken valve spring.
   - Air leakage sounds at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve or a broken valve spring.
   - Air leakage sounds from the crankcase, oil level indicator tube, or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head.
   - Air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.
5. Perform pressure loss test by analogy on cylinders 3, 4 and 2.

Installation Procedure

1. Remove the pressure loss tester.
2. Remove the connection piece from the spark plug thread.
3. Put the vehicle in neutral.
4. Insert the oil dipstick.
5. Install the coolant expansion tank closure cap.
6. Install the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.
7. Install the engine management wiring harness to the intake manifold, cylinder head cover and engine wiring harness bracket.
8. Install the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Replacement on page 9-984*.
9. Raise the vehicle.
10. Install the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left Side) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LWE, LUW) on page 3-149*.
11. Lower the vehicle.

Crankcase Ventilation System Inspection/Diagnosis

Results of Incorrect Operation

A plugged positive crankcase ventilation (PCV) orifice or hose may cause the following conditions:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Oil in the throttle body
- Sludge in the engine

Functional Check

With these systems, any blow-by in excess of the system capacity, from a badly worn engine, sustained heavy load, etc., is exhausted into the throttle body and is drawn into the engine.

Proper operation of the crankcase ventilation system depends upon a sealed engine. If oil slugging or dilution is noted and the crankcase ventilation system is functioning properly, check the engine for a possible cause. Correct any problems.

If an engine is idling rough, inspect for a clogged PCV orifice, a dirty vent filter, air cleaner element, or plugged hose. Replace as required. Use the following procedure:

1. Remove the PCV hose from the cylinder head cover.
2. Operate the engine at idle.
3. Place your thumb over the end of the hose in order to check for a vacuum. If there is no vacuum at the hose, inspect for the following items:
   - Plugged hoses
   - The manifold port
4. Turn OFF the engine.
5. Inspect the PCV orifice in the cylinder head cover for debris or blockage.

Drive Belt Falls Off and Excessive Wear Diagnosis

Diagnostic Aids

If the drive belt repeatedly falls off the drive belt pulleys, this is because of pulley misalignment.

An extra load that is quickly applied on released by an accessory drive component may cause the drive belt to fall off the pulleys. Verify the accessory drive components operate properly.

If the drive belt is the incorrect length, the drive belt tensioner may not keep the proper tension on the drive belt.

Excessive wear on a drive belt is usually caused by an incorrect installation or the wrong drive belt for the application.

Minor misalignment of the drive belt pulleys will not cause excessive wear, but will probably cause the drive belt to make a noise or to fall off.

Excessive misalignment of the drive belt pulleys will cause excessive wear but may also make the drive belt fall off.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. This inspection is to verify the condition of the drive belt. Damage may of occurred to the drive belt when the drive belt fell off. The drive belt may of been damaged, which caused the drive belt to fall off. Inspect the belt for cuts, tears, sections of ribs missing, or damaged belt plys.
4. Misalignment of the pulleys may be caused from improper mounting of the accessory drive component, incorrect installation of the accessory drive component pulley, or the pulley bent inward or outward from a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found refer to that accessory drive component for the proper installation procedure of that pulley.
5. Inspecting the pulleys for being bent should include inspecting for a dent or other damage to the pulleys that would prevent the drive belt from not seating properly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used to drive the pulley.
6. Accessory drive component brackets that are bent or cracked will let the drive belt fall off.
7. Inspecting of the fasteners can eliminate the possibility that a wrong bolt, nut, spacer, or washer was installed. Missing, loose, or the wrong fasteners may cause pulley misalignment from the bracket moving under load. Over tightening of the fasteners may cause misalignment of the accessory component bracket.
13. The inspection is to verify the drive belt is correctly installed on all of the drive belt pulleys. Wear on the drive belt may be caused by mis-positioning the drive belt by one groove on a pulley.
14. The installation of a drive belt that is too wide or too narrow will cause wear on the drive belt. The drive belt ribs should match all of the grooves on all of the pulleys.
15. This inspection is to verify the drive belt is not contacting any parts of the engine or body while the engine is operating. There should be sufficient clearance when the drive belt accessory drive components load varies. The drive belt should not come in contact with an engine or a body component when snapping the throttle.

Drive Belt Falls Off and Excessive Wear Diagnosis

Step	Action	Yes	No
Caution: Refer to *Belt Dressing Caution on page 0-7.* DEFINITION: The drive belt falls off the pulleys or may not ride correctly on the pulleys. DEFINITION: Wear at the outside ribs of the drive belt due to an incorrectly installed drive belt.			
1	Did you review the Drive Belt Symptom operation and perform the necessary inspections?	Go to *Step 2*	Go to *Symptoms - Engine Mechanical on page 9-944*
2	If diagnosing excessive wear, proceed to step 13. If diagnosing a drive belt that falls off, inspect for a damaged drive belt. Did you find the condition?	Go to *Step 3*	Go to *Step 4*
3	Install a new drive belt. Refer to *Drive Belt Replacement on page 9-964.* Does the drive belt continue to fall off?	Go to *Step 4*	System OK
4	Inspect for misalignment of the pulleys. Did you find and repair the condition?	Go to *Step 12*	Go to *Step 5*
5	Inspect for a bent or dented pulley. Did you find and repair the condition?	Go to *Step 12*	Go to *Step 6*
6	Inspect for a bent or a cracked bracket. Did you find and repair the condition?	Go to *Step 12*	Go to *Step 7*
7	Inspect for improper, loose or missing fasteners. Did you find loose or missing fasteners?	Go to *Step 8*	Go to *Step 9*
8	**Caution:** Refer to *Fastener Caution on page 0-8.* 1. Tighten any loose fasteners. Refer to *Fastener Tightening Specifications (1.8L LUW and LWE) on page 9-935* or *Fastener Tightening Specifications (1.6L LDE) on page 9-932.* 2. Replace improper or missing fasteners. Does the drive belt continue to fall off?	Go to *Step 9*	System OK
9	Test the drive belt tensioner for operating correctly. Refer to *Drive Belt Tensioner Diagnosis on page 9-961.* Does the drive belt tensioner operate correctly?	Go to *Step 11*	Go to *Step 10*
10	Replace the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966.* Does the drive belt continue to fall off?	Go to *Step 11*	System OK
11	Inspect for failed drive belt idler and drive belt tensioner pulley bearings. Did you find and repair the condition?	Go to *Step 12*	Go to Diagnostic Aids
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to *Step 2*
13	Inspect the drive belt for the proper installation. Refer to *Drive Belt Replacement on page 9-964.* Did you find this condition?	Go to *Step 16*	Go to *Step 14*
14	Inspect for the proper drive belt. Did you find this condition?	Go to *Step 16*	Go to *Step 15*
15	Inspect for the drive belt rubbing against a bracket, hose, or wiring harness. Did you find and repair the condition?	Go to *Step 17*	Go to Diagnostic Aids
16	Replace the drive belt. Refer to *Drive Belt Replacement on page 9-964.* Did you complete the replacement?	Go to *Step 17*	—
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	—

Drive Belt Tensioner Diagnosis

Step	Action	Yes	No
1	Remove the drive belt and inspect the drive belt tensioner pulley. Refer to *Drive Belt Replacement on page 9-964*. Is the drive belt tensioner pulley loose or misaligned?	Go to *Step 4*	Go to *Step 2*
2	Rotate the drive belt tensioner. Does the tensioner rotate without any unusual resistance or binding?	Go to *Step 3*	Go to *Step 4*
3	1. Use a torque wrench in order to measure the torque required to move the tensioner off of the stop. 2. Use a torque wrench on a known good tensioner in order to measure the torque required to move the tensioner off of the stop. Is the first torque reading within 10 percent of the second torque reading?	System OK	Go to *Step 4*
4	Replace the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966*. Is the repair complete?	System OK	—

Dual Mass Flywheel Diagnosis

Check for Thermal Overload

Note: These quick information shall help to carry out a correct diagnosis in case of a customer complaint.

Through friction of clutch plate on the friction surface of the dual mass flywheel temperatures up to 200 °C can arise during normal driving. At sliding clutch or through operating errors much higher temperatures can arise. These temperatures must not cause mandatory a reduced lifetime of the dual mass flywheel.

Possible indications for a high thermal load are:

- Tarnish (bluish) as well as local hotspots on friction surface
- Tarnish (bluish) near of mounting area and riveting area of clutch

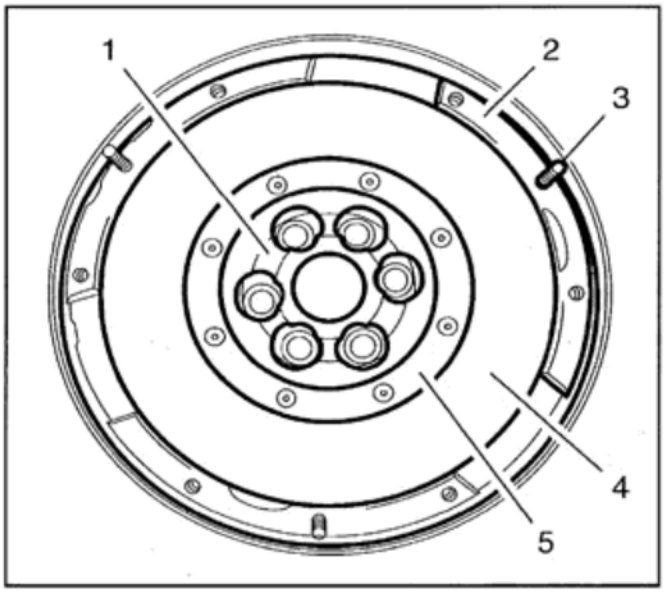
If all other checkable features are well, the dual mass flywheel can stay in the vehicle.

Possible indications for a too high thermal load are:

- Cracks
- Fusion zones on friction surface (material smear)
- Scores in friction surface (for example through clutch lining riveting at destroyed or worn clutch plate)
- Tarnish (bluish) which reaches up to bearing area of dual mass flywheel
- Bluish discoloration of locating pins (3 locating pins in outer zone of dual mass flywheel)

In these cases the dual mass flywheel has to be replaced.

Overview Dual Mass Flywheel

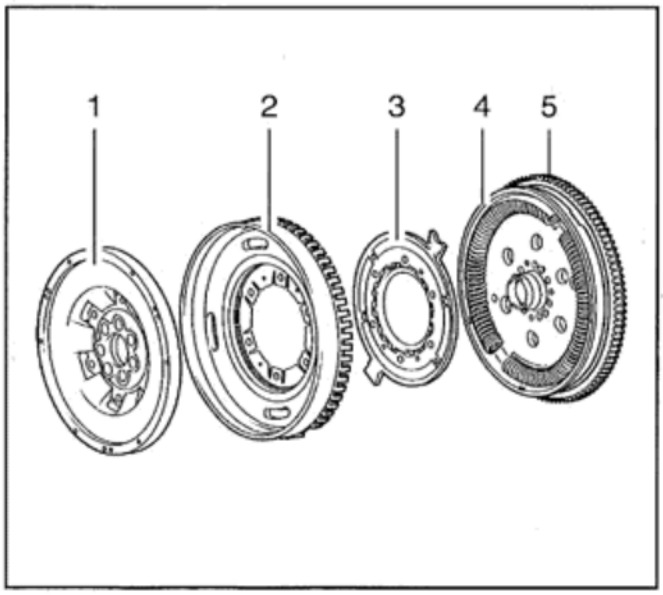


2371711

Legend

(1) Bearing Area
(2) Mounting Area Pressure Plate
(3) Locating Pins
(4) Friction Surface
(5) Riveting Area

Exploded View Dual Mass Flywheel with Additional Mass



2371713

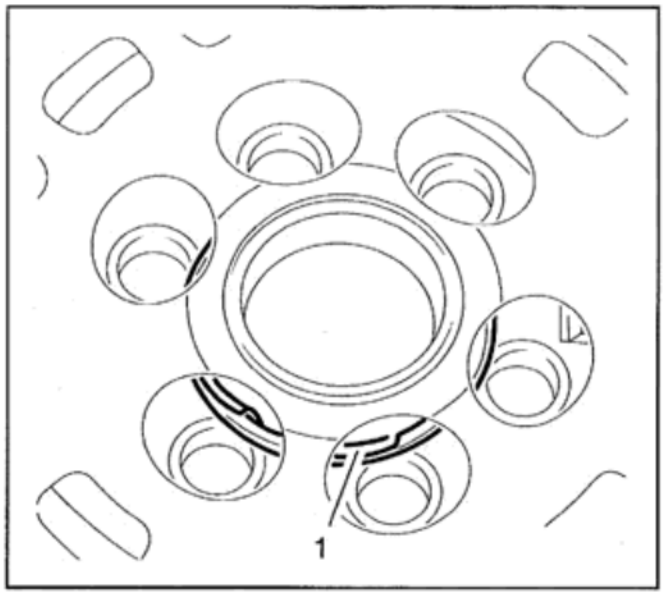
Legend

(1) Secondary Flywheel Mass
(2) Additional Mass, Coupled with Cover and Pulse-Generator Ring
(3) Flange
(4) Primary Flywheel Mass with Bowed Springs and Plain Bearing/Bearing Bolt
(5) Toothed Ring

Check for Damaged Components

All following checking procedures have to be carried out at installed dual mass flywheel. For visual check at vehicle very bright light and a additional bright and small pocket lamp is necessary. Damages like grease on primary flywheel and loose ore missing balance weights cannot be checked at installed condition. During visual check material alteration can be stated which eliminate a further operating suitability.

For comparison different damages at dual mass flywheel with the corresponding further procedure are presented here.

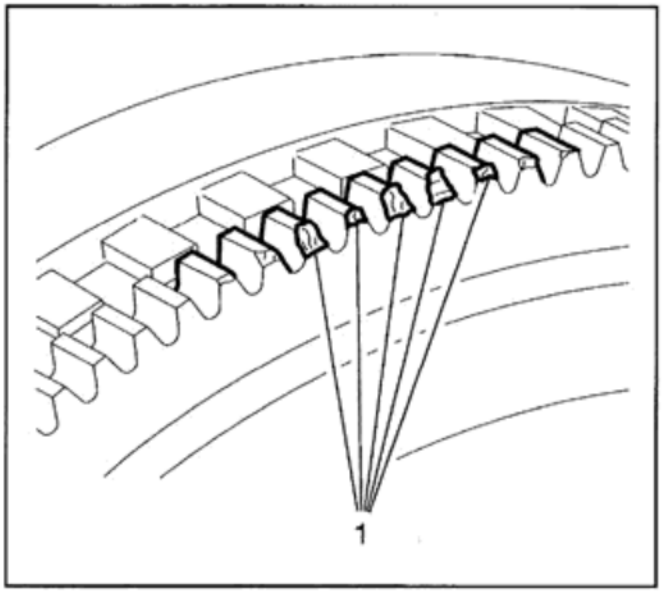


2371714

Note: In case of mechanical damages at plain bearing the dual mass flywheel has to be replaced.

1. Inspect plain bearing (1) for damages.

   Dependent of the manufacturer damages can be detected through ventilation openings of secondary flywheel. Parts of the bearing (1) are detached or lie loose around the bearing bolt.



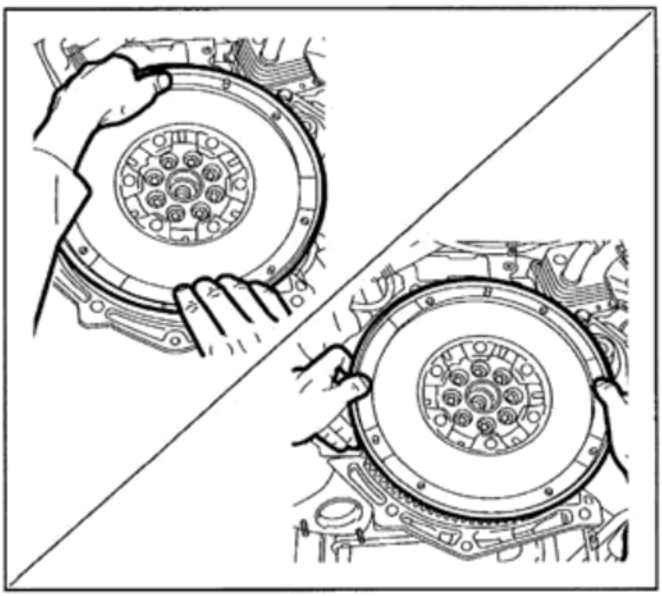
2371715

Note: Light abrasion on frontal areas of teeth is allowed. If problems occur during starting the engine the dual mass flywheel has to be replaced.

2. Inspect toothed ring (1) for damages.

   The toothed ring is needed to start the engine. Through a lot of starting procedures and/or an incorrect engaging starter signs of abrasion can occur on teeth of the toothed ring. The profile of damages can reach from only low signs of abrasion up to heavy material removal. The installation of a pulse-generator ring depends on the manufacturer.

The image shows signs of abrasion and mechanical damages at toothed ring (1), they occur through abrasion due to a lot of starting procedures. In this case the dual mass flywheel has to be replaced.

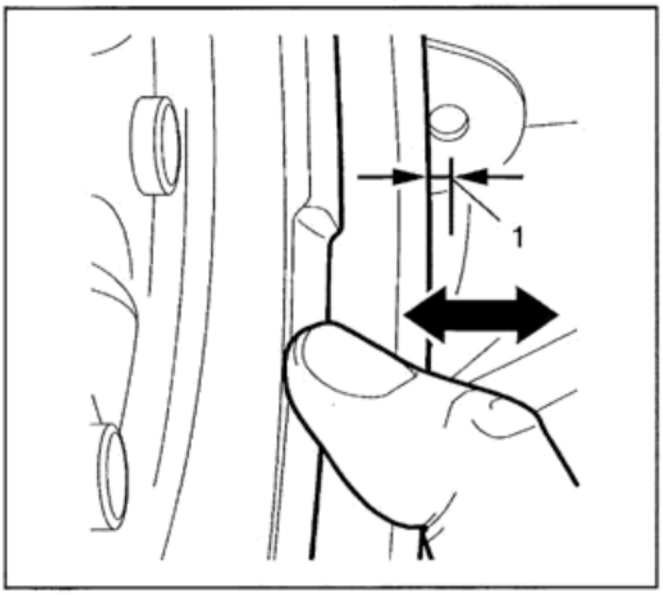


2371716

Note: The check must be carried out only by hand without any tools.

3. Inspect tilt clearance.

   At dual mass flywheel the additional-mass ring looms over the gap between primary and secondary flywheel. It is not possible to carry out just a visual check.



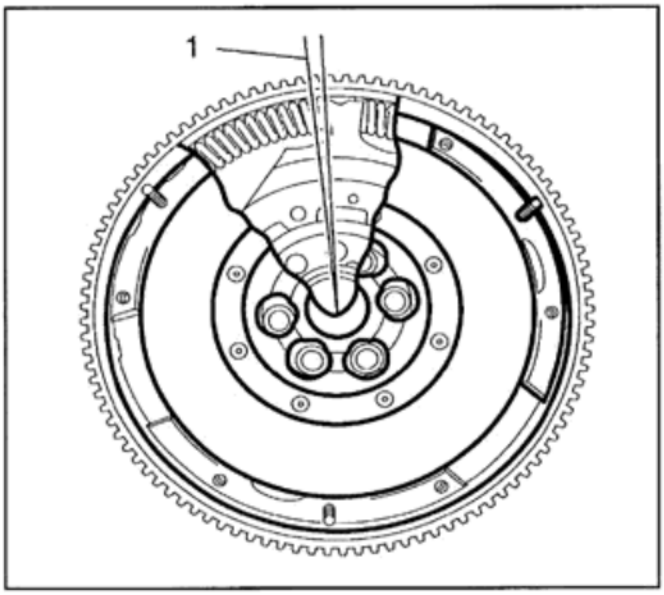
2371717

Note: An absolute clear measurement is not possible with this check due to the different applied forces of the several workshop employees during the check.

4. Embrace dual mass flywheel and apply thumbs onto the outer radius of secondary flywheel.
5. Apply pressure onto the secondary flywheel alternating on upper, lower, left and right side

   During the tilt clearance check a functional metal rattling noise may occur.

   If tilt clearance is higher than 3 mm (MUST be measured, DO NOT make an estimation) (1) the dual mass flywheel has to be replaced.



2371719

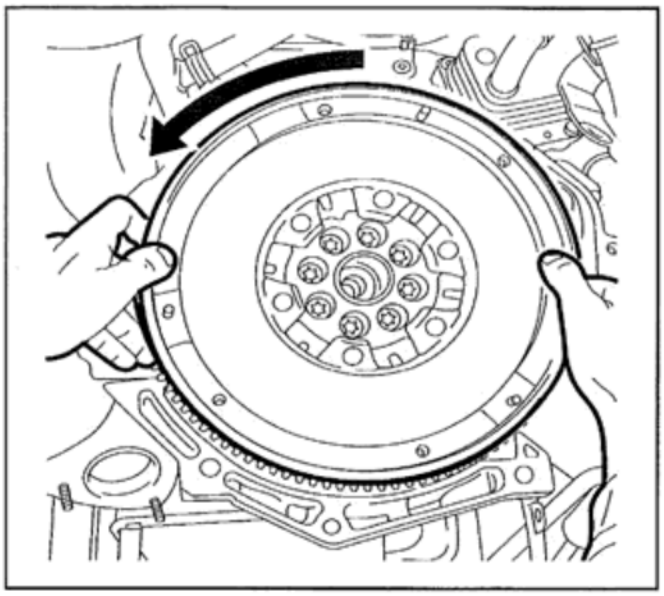
6. Inspect clearance angle (1).

   Before the inspection of the clearance angle the dual mass flywheel should be rotated several times clockwise and anticlockwise to receive a feeling for the resistance of the springs. In addition unusual loud clicking noise or possible rattle, crunch, grinding noise can be sounded out during rotating the dual mass flywheel.

   If the rotation of the flywheel is impossible the flywheel is defective and has to be replaced.

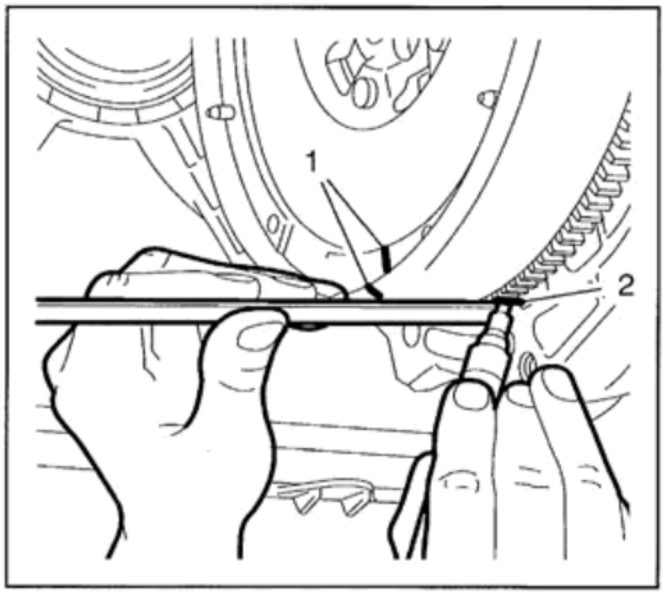
   The clearance angle is the angle (1) about the secondary and the primary flywheel can be turned light against each other. Thereby the flange wings are moved in the duct of the bowed springs without adjoining the bowed springs. Dictated by functional factors the clearance angle is up to 8 teeth.

   Is the secondary flywheel rotated beyond this point the bowed springs in the duct are moved to spring arrestor in the primary flywheel/cover. Now the both spring are tensioned.



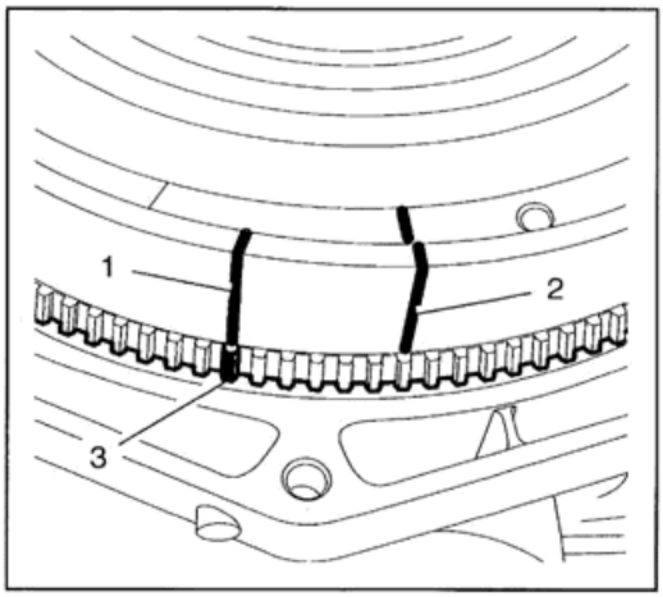
2371720

- Rotate secondary flywheel anticlockwise (arrow) until the elastic counterforce (spring force) is clear noticeable.
- Release secondary flywheel slowly until the bowed springs are relaxed, so no counterforce acts onto the springs.



2371721

- Mark position with a vertical line by a white pencil on secondary flywheel (1) and on toothed ring for starter (2).
- Rotate secondary flywheel clockwise until the elastic counterforce is clear noticeable.
- Release secondary flywheel slowly until the bowed springs are relaxed.



2371722

- Apply new marking on secondary flywheel (1) on the height of the marking on the toothed ring for starter (3).
- Count amount of teeth on toothed ring for starter from marked tooth up to the height of the first marking on secondary flywheel (2). Dictated by functional factors up to 8 teeth are allowed.

7. ALWAYS replace the engine flywheel if following conditions are given:
   - The difference exceeds the amount of 8 teeth.
   - The dual mass flywheel cannot be rotated.
   - During rotating the dual mass flywheel a hard metallic arrestor is audible or noticeable.

Repair Instructions - On Vehicle

Drive Belt Replacement

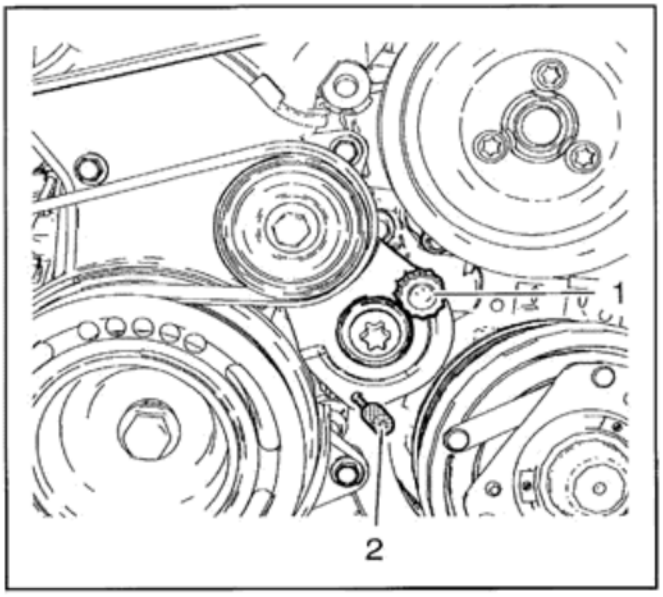
Special Tools

EN 6349 Locking Pin

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

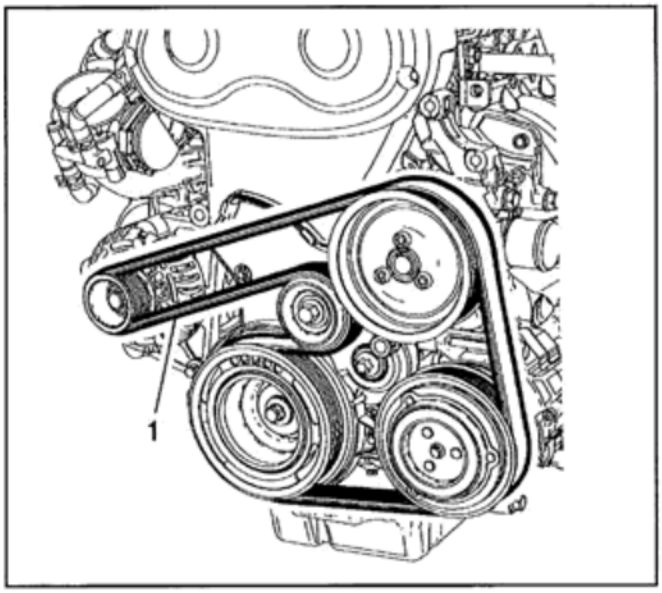
Removal Procedure

1. Remove the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left Side) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LWE, LUW) on page 3-149*.



2189264

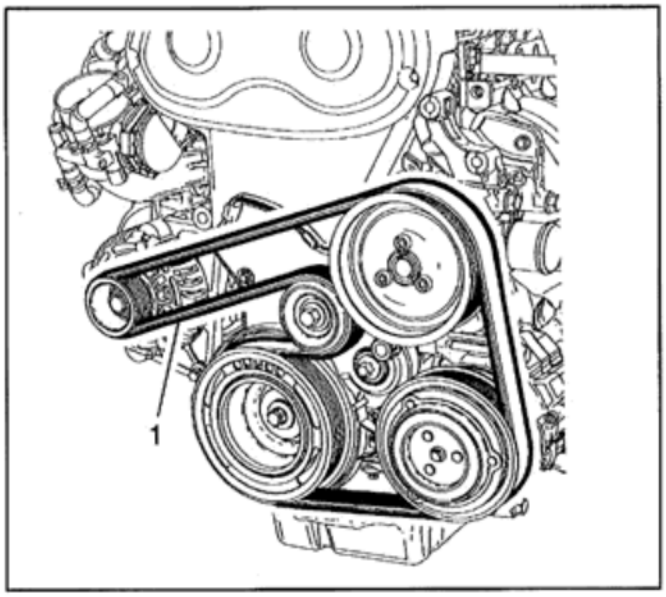
2. Release tension to the drive belt tensioner by rotating counterclockwise (1) and lock with *EN 6349* pin (2).



2512912

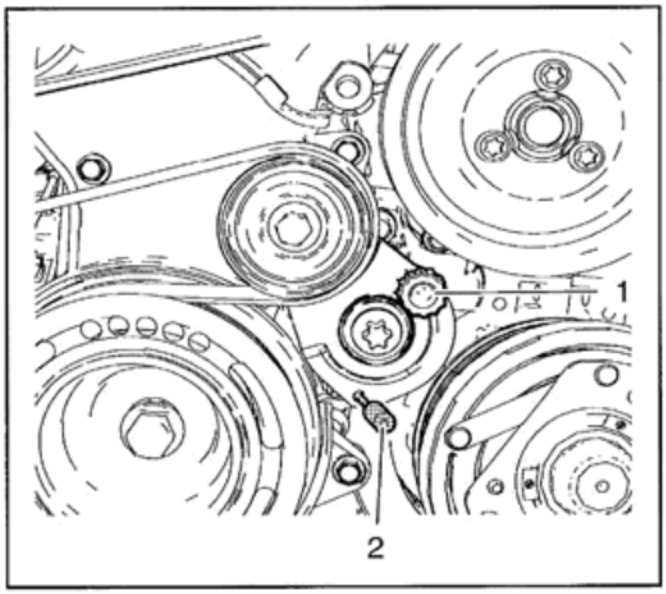
3. Remove the drive belt (1).

Installation Procedure



2512912

1. Install the drive belt (1).



2189264

2. Release tension to the tensioner by rotating counterclockwise (1).

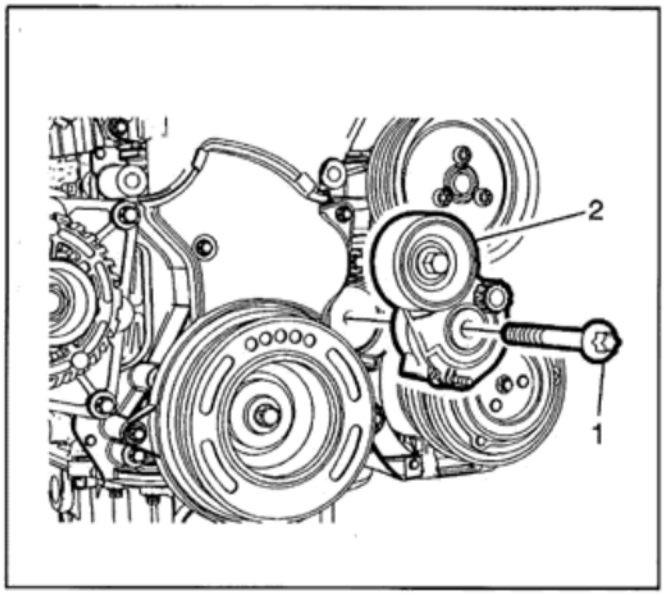
Note: Allow tensioner to slide back slowly.

3. Remove *EN 6349* pin (2).
4. Apply tension to the tensioner clockwise (1).
5. Install the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left SIde) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right SIde, LWE, LUW) on page 3-149*.

Drive Belt Tensioner Replacement

Removal Procedure

1. Remove the drive belt. Refer to *Drive Belt Replacement on page 9-964*.

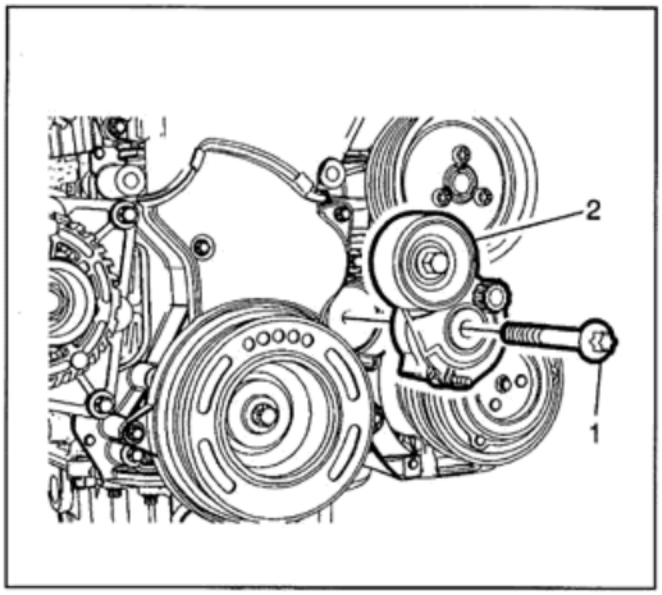


2495148

2. Remove the drive belt tensioner bolt (1).
3. Remove the drive belt tensioner (2).

Installation Procedure

1. Clean the drive belt tensioner thread.



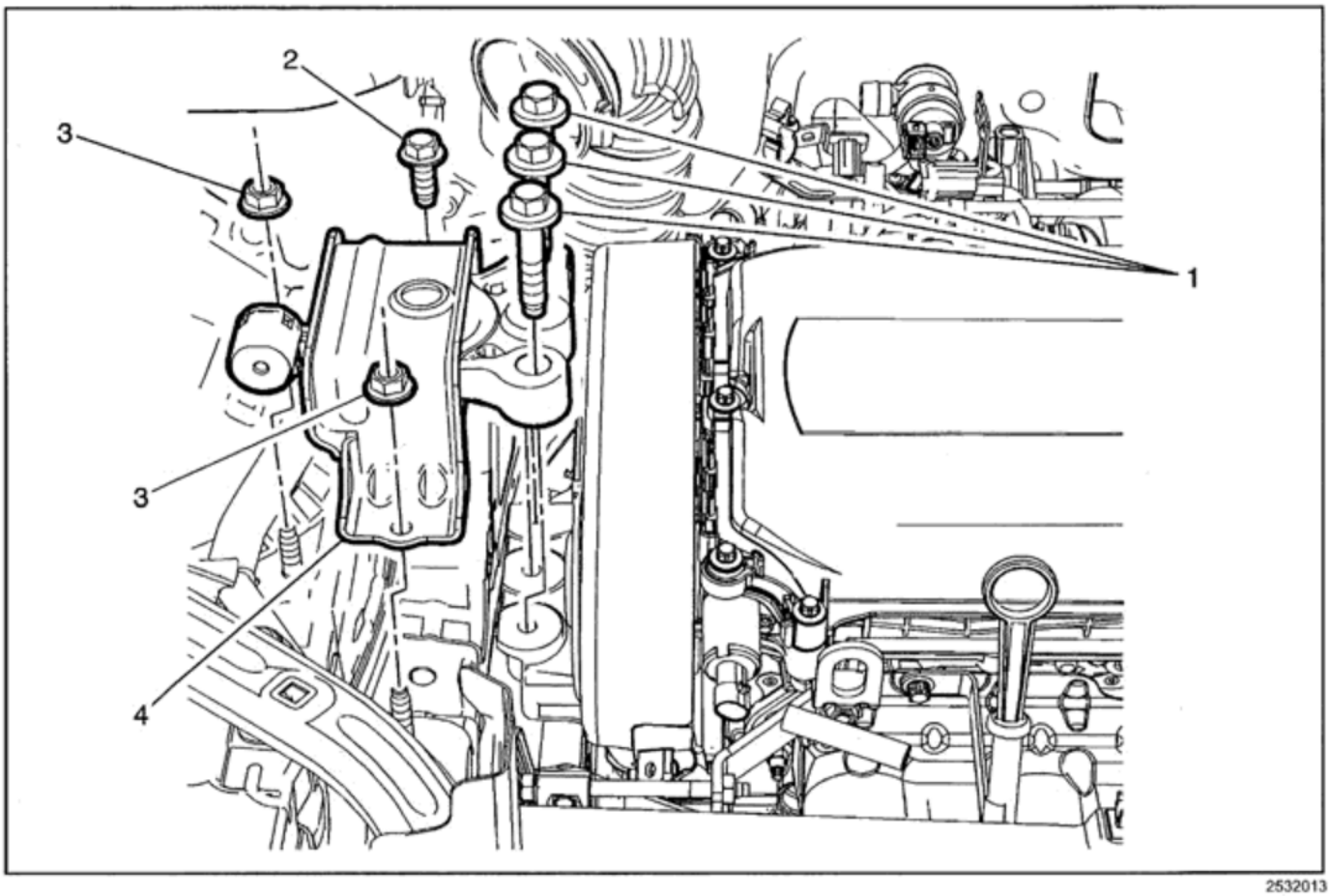
2495148

2. Install drive belt tensioner (2).

Caution: Refer to *Fastener Caution on page 0-8*.

3. Install drive belt tensioner bolt (1) and tighten to **55** N•m **(41 lb ft)**.
4. Install the drive belt. Refer to *Drive Belt Replacement on page 9-964*.

Engine Mount Replacement

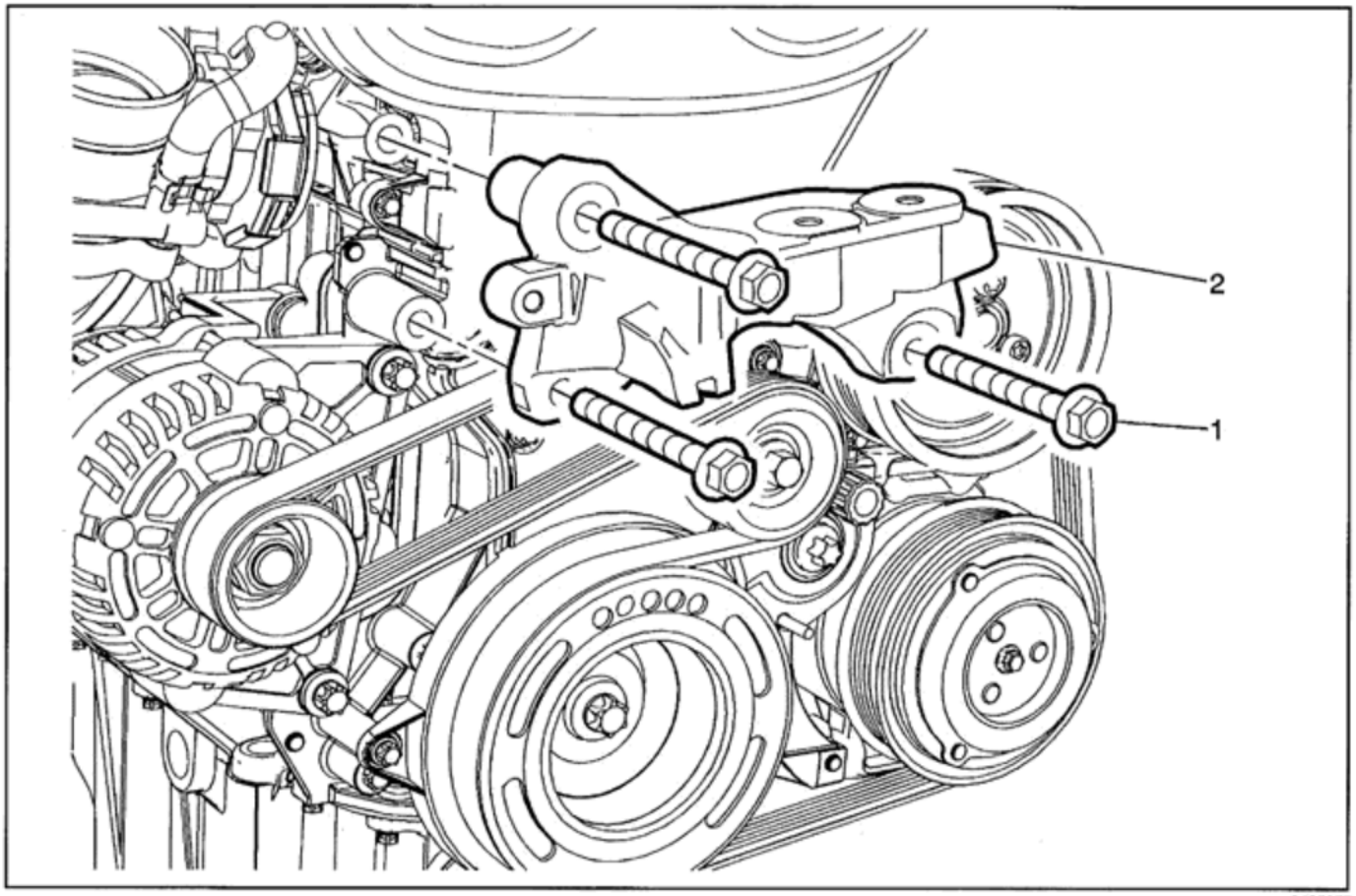


2532013

Engine Mount Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the air cleaner assembly. Refer to *Air Cleaner Assembly Replacement on page 9-582*. 2. Install the engine support fixture. Refer to *Engine Support Fixture on page 9-1060*. 3. Prior to removing the mount, mark the mount location using spray paint or a marker for correct positioning during installation.	
1	Engine Mount Bracket to Mount Bolt (Qty; 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Note:** Use NEW bolts whenever mount is removed. **Tighten** **58 N•m (43 lb ft)** **Special Tools** *EN-45059* Torque Angle Sensor Kit. For equivalent regional tools, refer to *Special Tools on page 9-1135*
2	Engine Mount Bracket Bolt (Qty; 1) **Note:** Ensure to use a NEW bolt whenever the mount is removed. **Tighten** **58 N•m (43 lb ft)**
3	Engine Mount Nut (Qty; 2) **Tighten** **58 N•m (43 lb ft)**
4	Engine Mount

Engine Mount Bracket Replacement



2495277

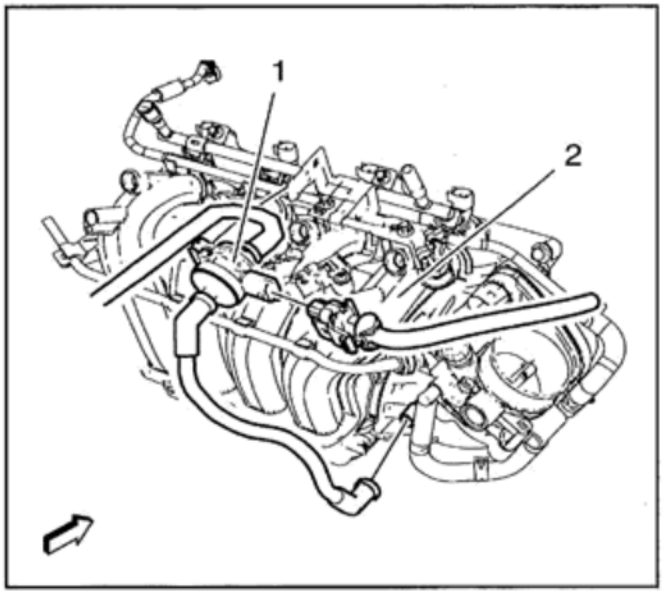
Engine Mount Bracket Replacement

Callout	Component Name
Preliminary Procedure Remove the engine mount. Refer to *Engine Mount Replacement on page 9-967*.	
1	Engine Mount Bracket Bolt (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** **50 N·m (37 lb ft)**
2	Engine Mount Bracket

Intake Manifold Replacement (LDE)

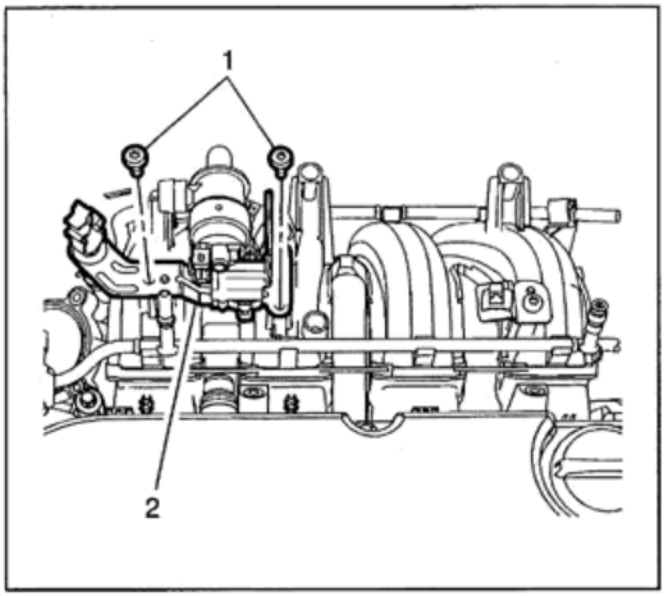
Removal Procedure

1. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-713*.
2. Remove the throttle body assembly. Refer to *Throttle Body Assembly Replacement on page 9-542*.



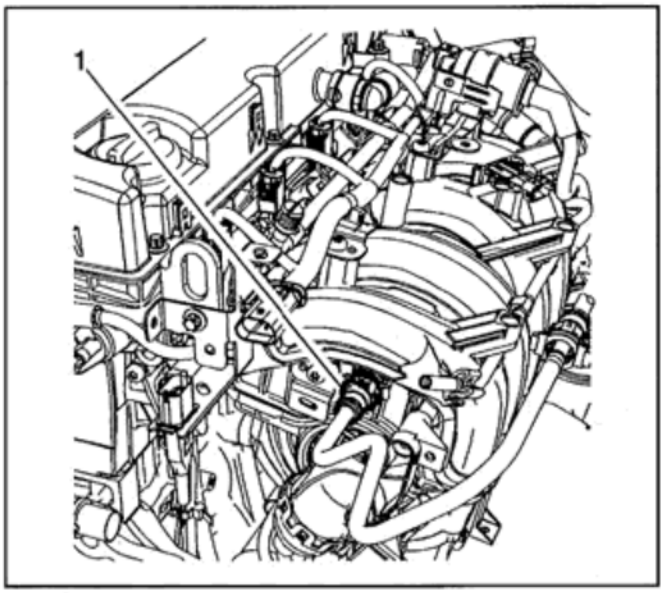
2028169

3. Disconnect wiring harness plug.
4. Disconnect the pipes from the evaporative emission canister purge solenoid valve (1).
5. Remove the evaporative emission canister purge solenoid valve (1) and the rubber mounting from the intake manifold (2).
6. Disconnect and reposition the electrical connectors as necessary.
7. Remove the fuel injector rail. Refer to *Fuel Injector Replacement on page 9-562*.
8. Remove the manifold absolute pressure sensor. Refer to *Manifold Absolute Pressure Sensor Replacement on page 9-537*.



2502356

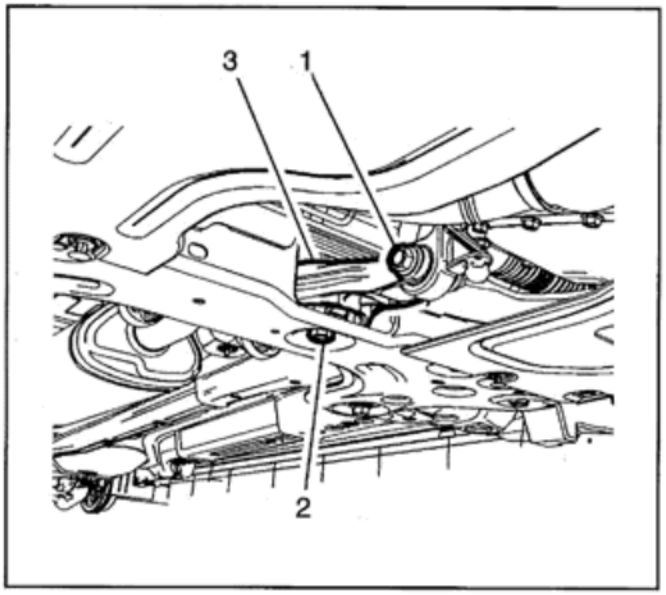
9. Remove the evaporative emission canister purge solenoid valve bracket bolts (1).
10. Remove the evaporative emission canister purge solenoid valve bracket (2).



2502359

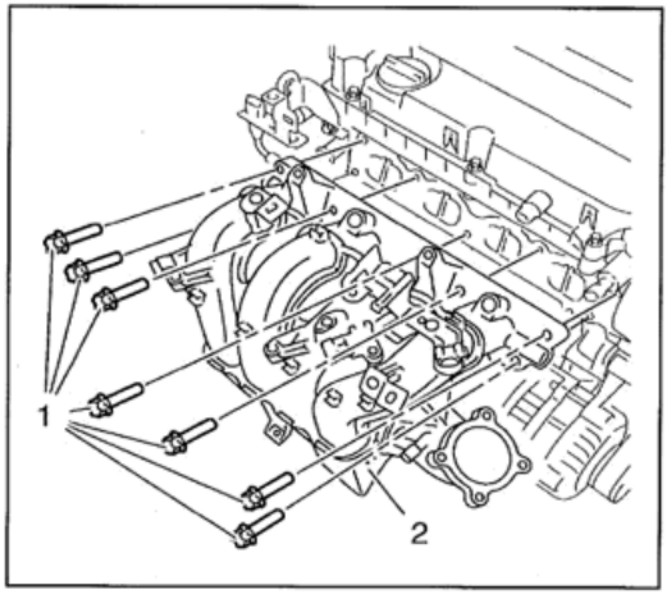
11. Disconnect the booster vacuum pipe (1) from the intake manifold.
12. Remove the front wheel drive shaft right side. Refer to *Front Wheel Drive Shaft Replacement on page 7-5*.

13. Remove the starter. Refer to *Starter Replacement (LUW) on page 9-722* or *Starter Replacement (LUV) on page 9-724*.
14. Remove the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.



2503662

15. Remove and DISCARD the transmission rear mount to bracket through bolt (1).

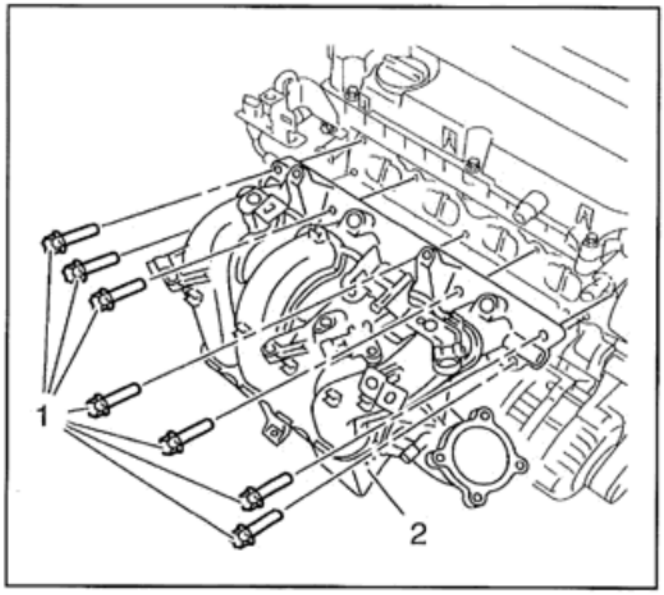


2026837

16. Remove the intake manifold bolts (1).
17. Remove the intake manifold (2).
18. Clean and inspect the intake manifold. Refer to *Intake Manifold Cleaning and Inspection on page 9-1095*.

Installation Procedure

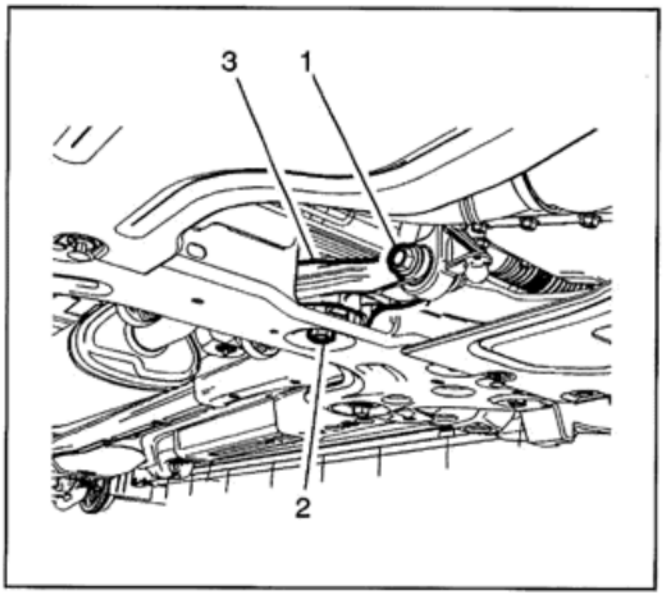
1. Clean the sealing surfaces.
2. Install the NEW gasket.



2026837

Caution: Refer to *Fastener Caution on page 0-8*.

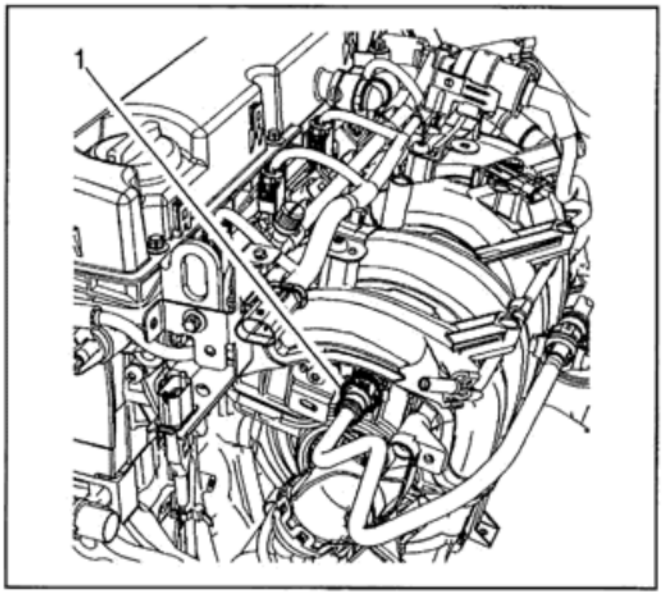
3. Install the intake manifold (2) and the 7 intake manifold bolts (1) and tighten to **20 N·m (15 lb ft)**.



2503662

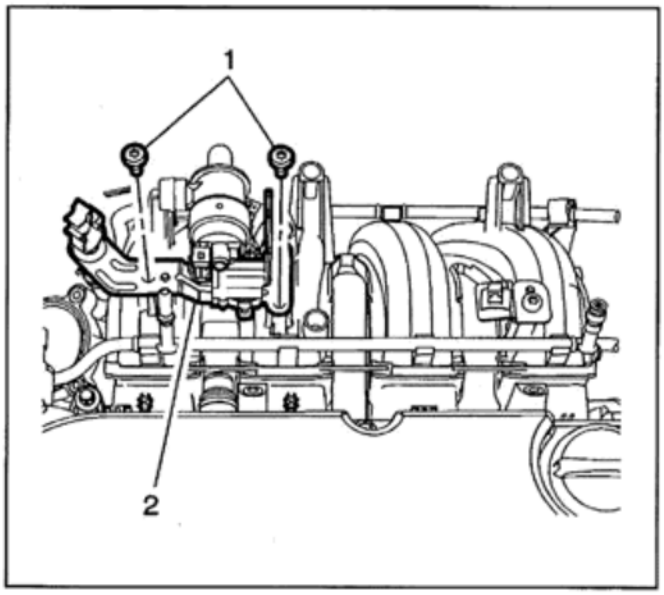
4. Install the NEW transmission rear mount to bracket through bolt (1) and tighten to **80 N·m (59 lb ft) plus 45-60 degrees**.
5. Install the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.
6. Install the starter. Refer to *Starter Replacement (LUW) on page 9-722* or *Starter Replacement (LUV) on page 9-724*.

7. Install the front wheel drive shaft right side. Refer to *Front Wheel Drive Shaft Replacement on page 7-5.*



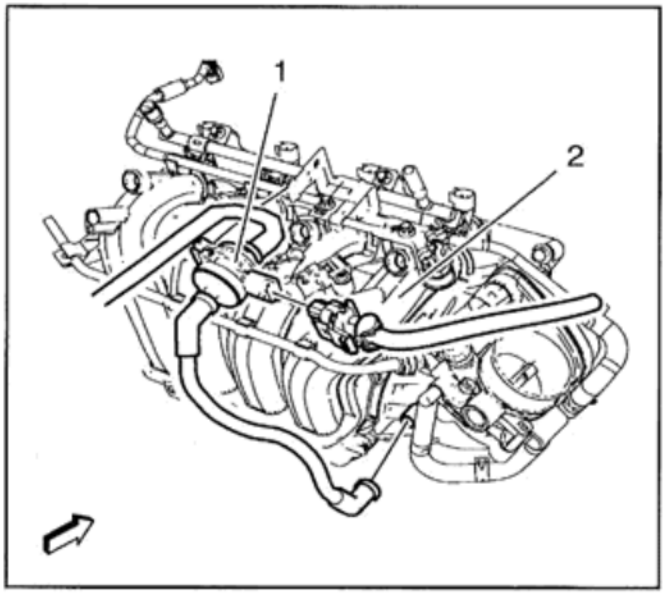
2502359

8. Connect the booster vacuum pipe (1) to the intake manifold.
9. Install the manifold absolute pressure sensor. Refer to *Manifold Absolute Pressure Sensor Replacement on page 9-537.*



2502356

10. Install the evaporative emission canister purge solenoid valve bracket (2).
11. Install the evaporative emission canister purge solenoid valve bracket bolts (1) and tighten to **8 N•m (71 lb in)**.
12. Connect the electrical connectors as necessary.
13. Install the fuel injector rail. Refer to *Fuel Injector Replacement on page 9-562.*



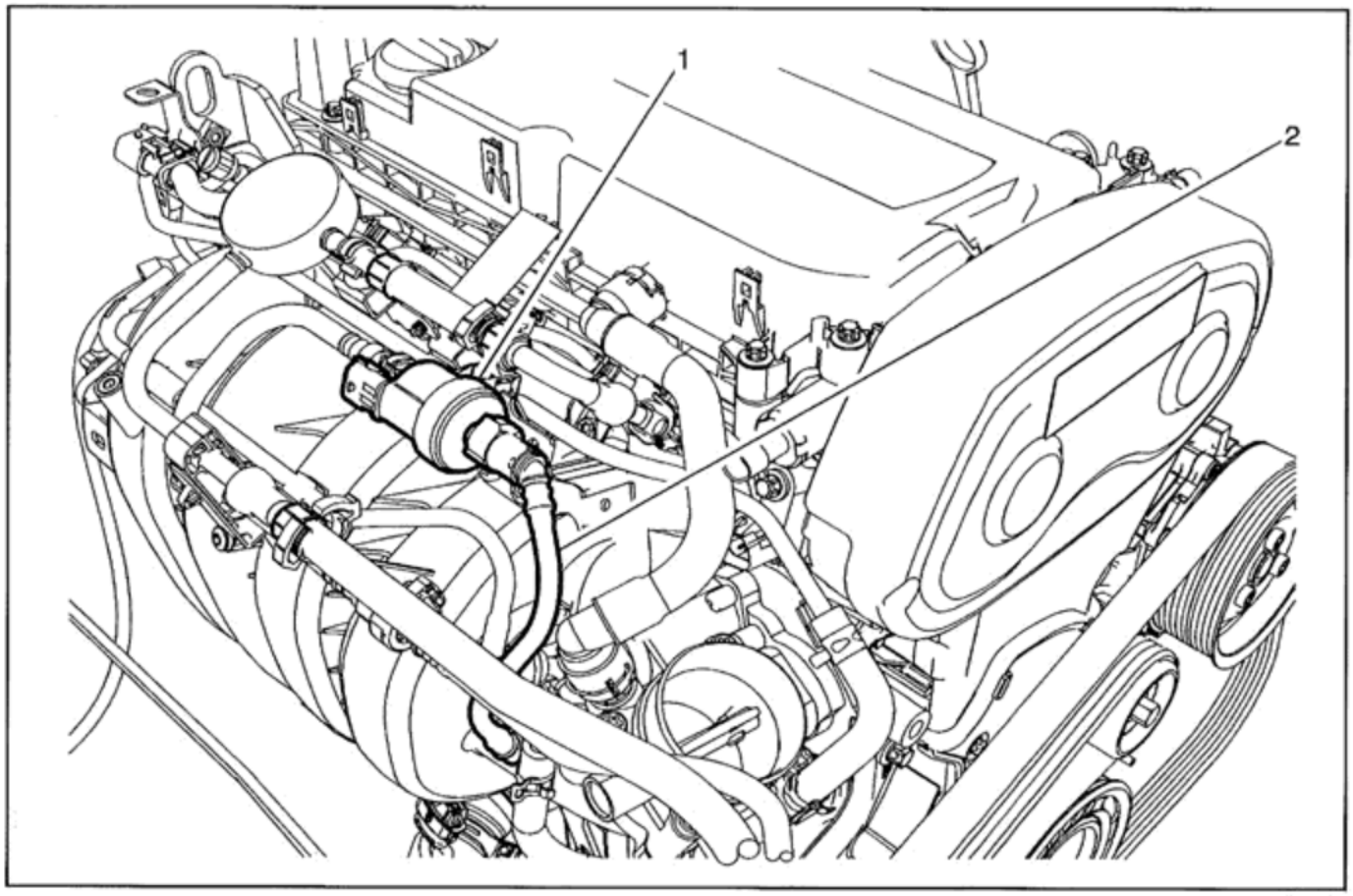
2028169

14. Install the evaporative emission canister purge solenoid valve (1) and the rubber mounting to the intake manifold (2).
15. Connect the pipes to the evaporative emission canister purge solenoid valve (1).
16. Connect wiring harness as necessary.
17. Install the throttle body assembly. Refer to *Throttle Body Assembly Replacement on page 9-542.*
18. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-713.*

Intake Manifold Replacement (LUW)

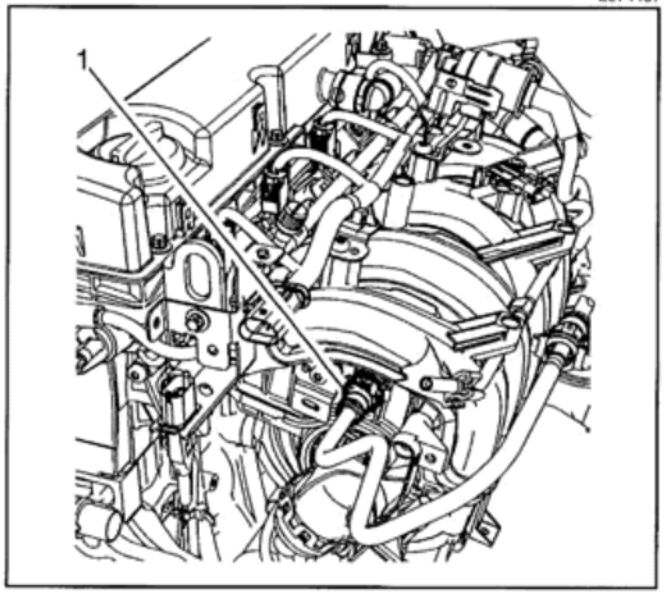
Removal Procedure

1. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-713.*
2. Remove the throttle body assembly. Refer to *Throttle Body Assembly Replacement on page 9-542.*



2874437

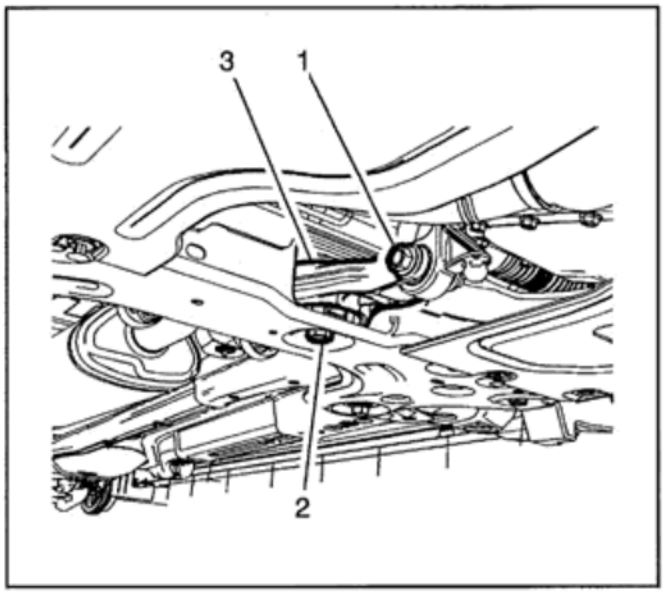
3. Disconnect wiring harness plug.
4. Disconnect the pipes from the evaporative emission canister purge solenoid valve (1).
5. Remove the evaporative emission canister purge solenoid valve (1) and the rubber mounting from the intake manifold (2).
6. Disconnect and reposition the electrical connectors as necessary.
7. Remove the fuel injector rail. Refer to *Fuel Injector Replacement on page 9-562*.
8. Remove the manifold absolute pressure sensor. Refer to *Manifold Absolute Pressure Sensor Replacement on page 9-537*.



2502359

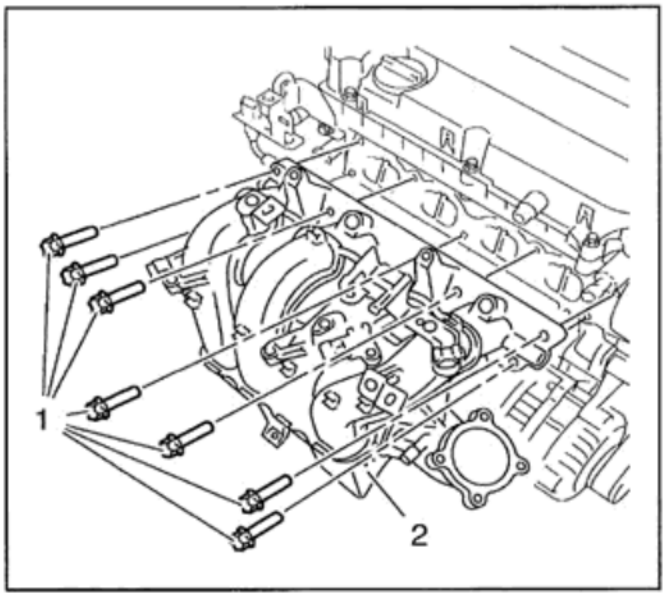
9. Disconnect the booster vacuum pipe (1) from the intake manifold.

10. Remove the front wheel drive shaft right side. Refer to *Front Wheel Drive Shaft Replacement on page 7-5*.
11. Remove the starter. Refer to *Starter Replacement (LUW) on page 9-722* or *Starter Replacement (LUV) on page 9-724*.
12. Remove the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.
13. Remove the front exhaust pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*.



2503662

14. Remove and DISCARD the transmission rear mount to bracket through bolt (1).

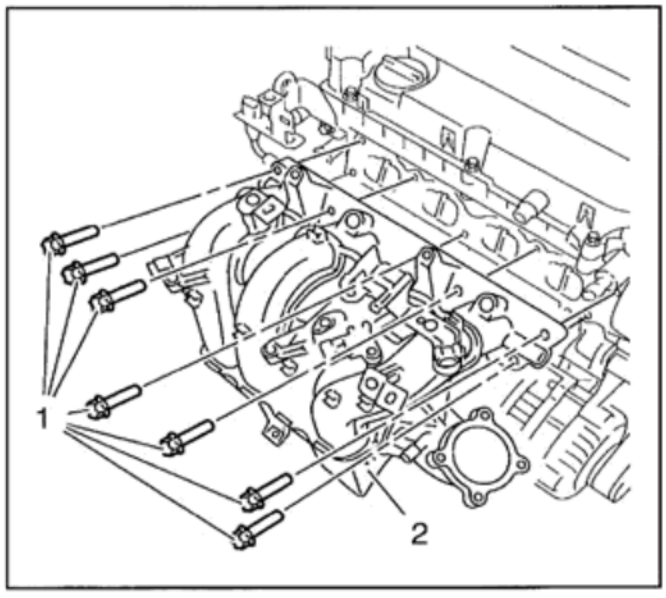


2026837

15. Remove the intake manifold bolts (1).
16. Remove the intake manifold (2).
17. Clean and inspect the intake manifold. Refer to *Intake Manifold Cleaning and Inspection on page 9-1095*.

Installation Procedure

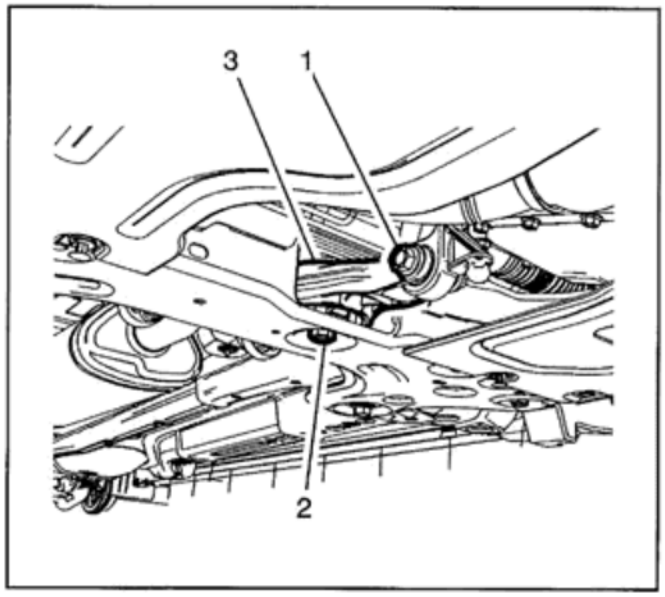
1. Clean the sealing surfaces.
2. Install the NEW gasket.



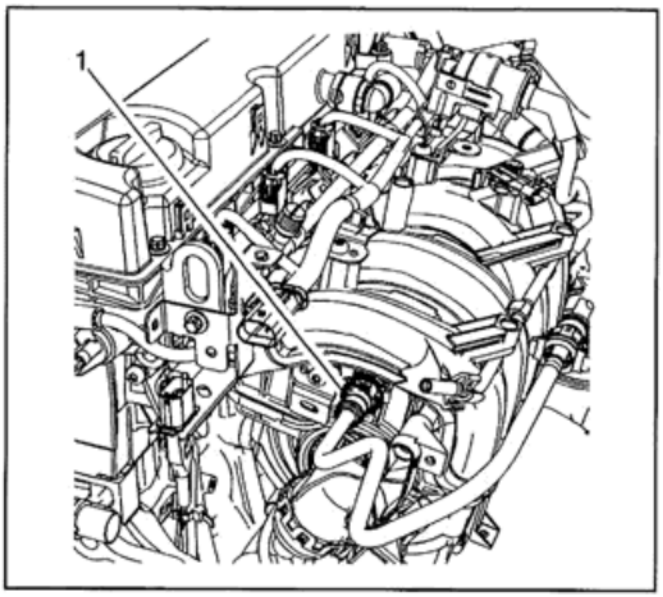
2026837

Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the intake manifold (2) and the 7 intake manifold bolts (1) and tighten to **20 N•m (15 lb ft)**.

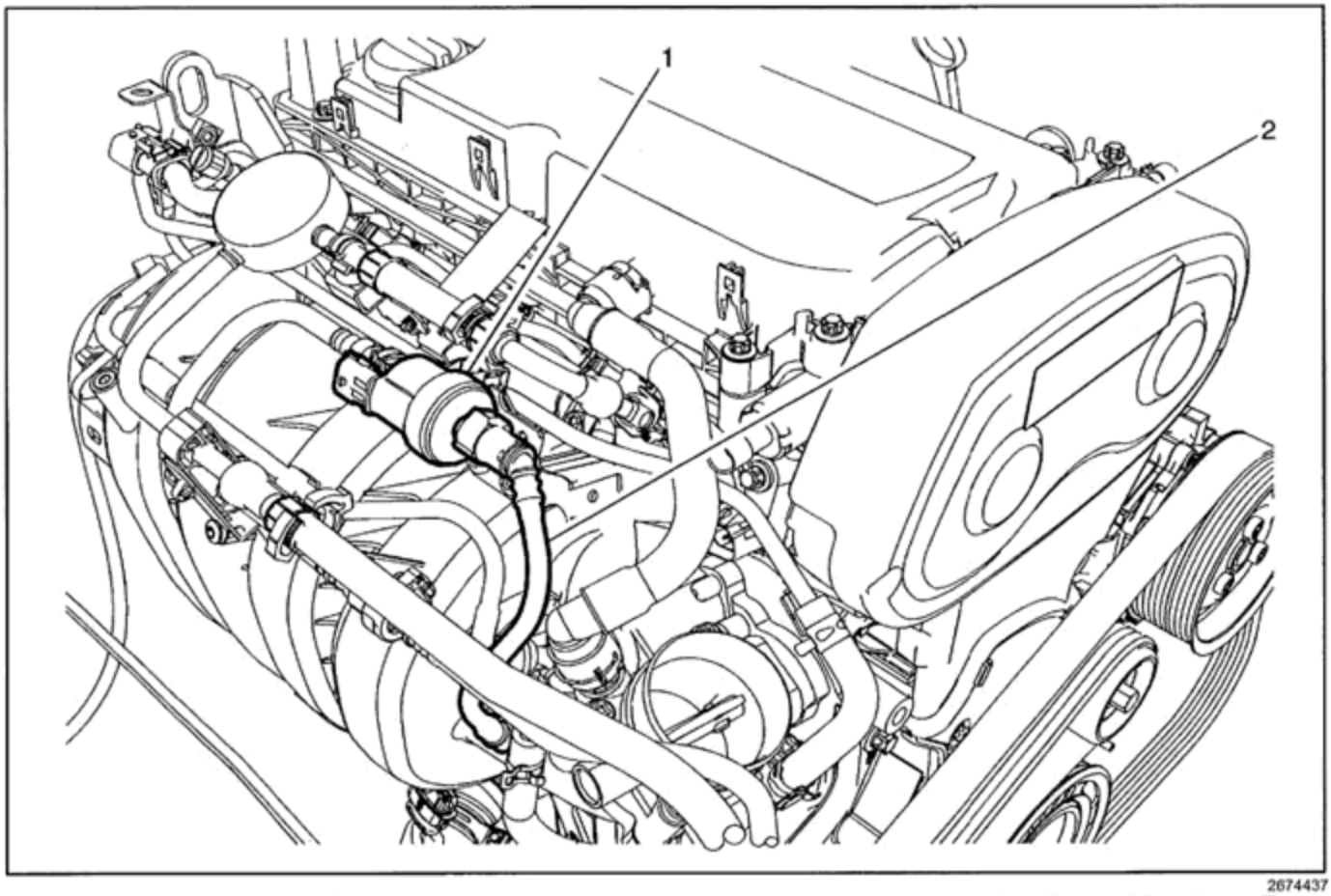


2503662



2502359

4. Install the NEW transmission rear mount to bracket through bolt (1) and tighten to **80 N•m (59 lb ft) plus 45-60 degrees**.
5. Install the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.
6. Install the starter. Refer to *Starter Replacement (LUW) on page 9-722* or *Starter Replacement (LUV) on page 9-724*.
7. Install the front exhaust pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*.
8. Install the front wheel drive shaft right side. Refer to *Front Wheel Drive Shaft Replacement on page 7-5*.
9. Connect the booster vacuum pipe (1) to the intake manifold.
10. Install the manifold absolute pressure sensor. Refer to *Manifold Absolute Pressure Sensor Replacement on page 9-537*.
11. Connect the electrical connectors as necessary.
12. Install the fuel injector rail. Refer to *Fuel Injector Replacement on page 9-562*.



2674437

13. Install the evaporative emission canister purge solenoid valve (1) and the rubber mounting to the intake manifold (2).
14. Connect the pipes to the evaporative emission canister purge solenoid valve (1).
15. Connect wiring harness as necessary.
16. Install the throttle body assembly. Refer to *Throttle Body Assembly Replacement on page 9-542*.
17. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-713*.

Timing Belt Replacement

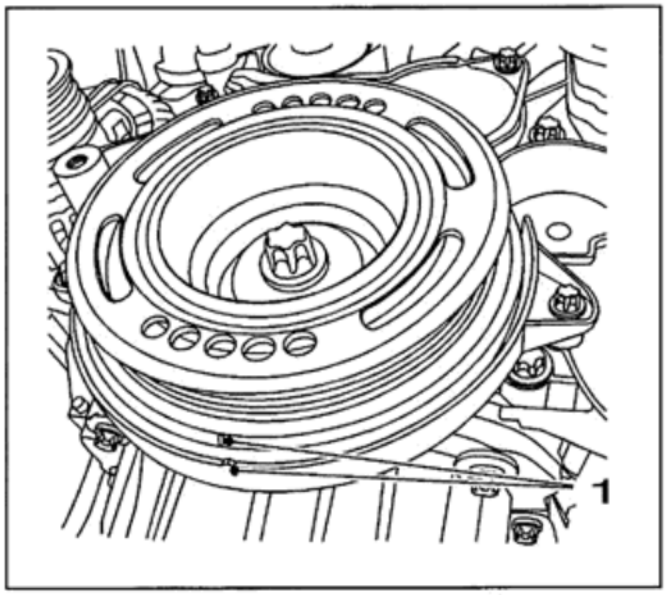
Special Tools

- *EN-6333* Timing Belt Tensioner Locking Pin
- *EN-6340* Camshaft Locking Tool

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

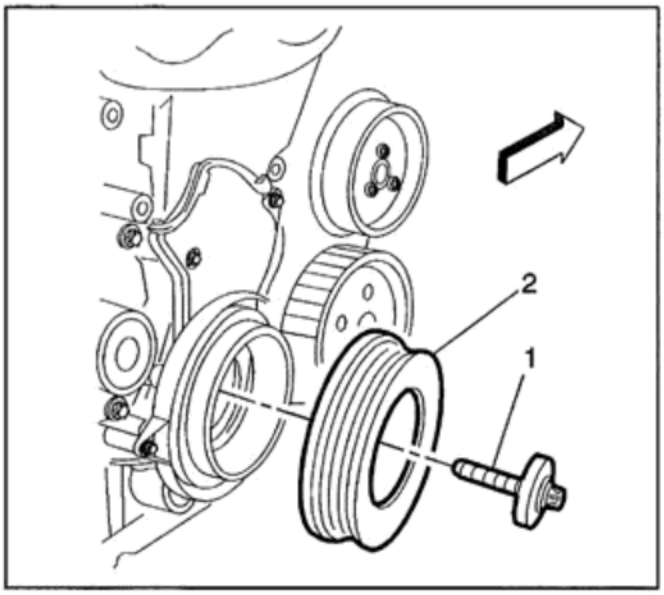
Removal Procedure

1. Remove the air cleaner assembly. Refer to *Air Cleaner Assembly Replacement on page 9-582*.
2. Remove the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Replacement on page 9-984*.
3. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
4. Remove the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left Side) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right SIde, LWE, LUW) on page 3-149*.
5. Remove the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966*.



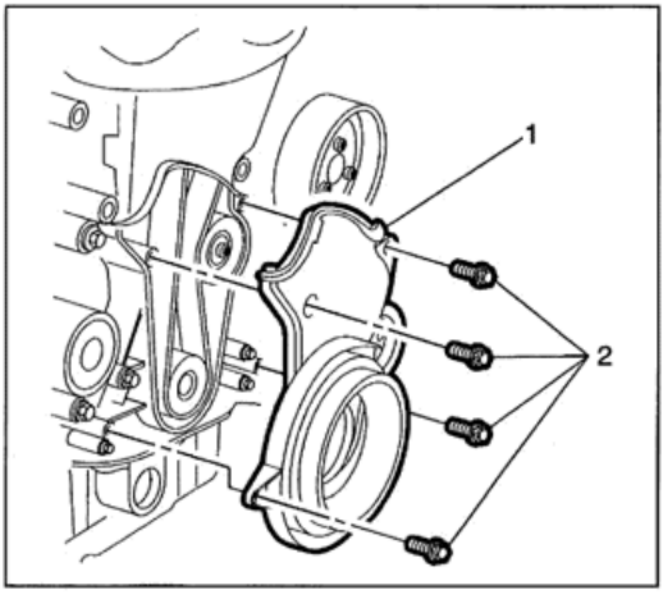
1936993

6. Set crankshaft balancer in direction of engine rotation to cylinder 1 TDC of combustion stroke (1).



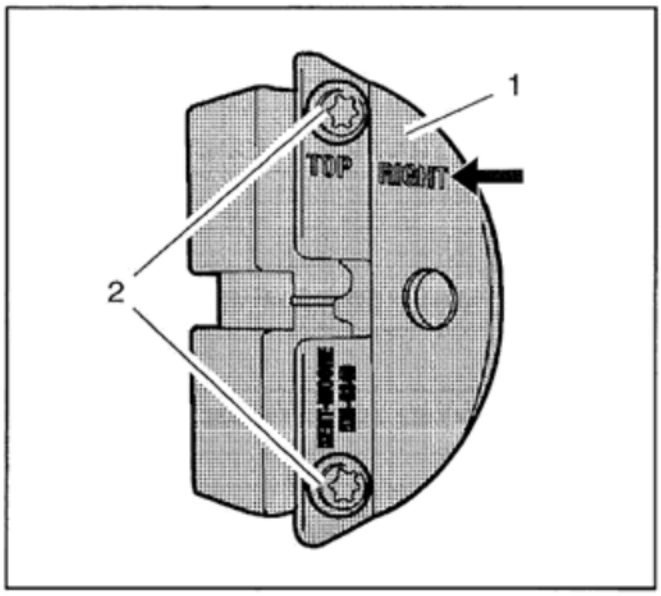
2504713

7. Remove the crankshaft balancer bolt (1).
8. Remove the crankshaft balancer (2). Refer to *Crankshaft Balancer Replacement on page 9-1004*.



2504712

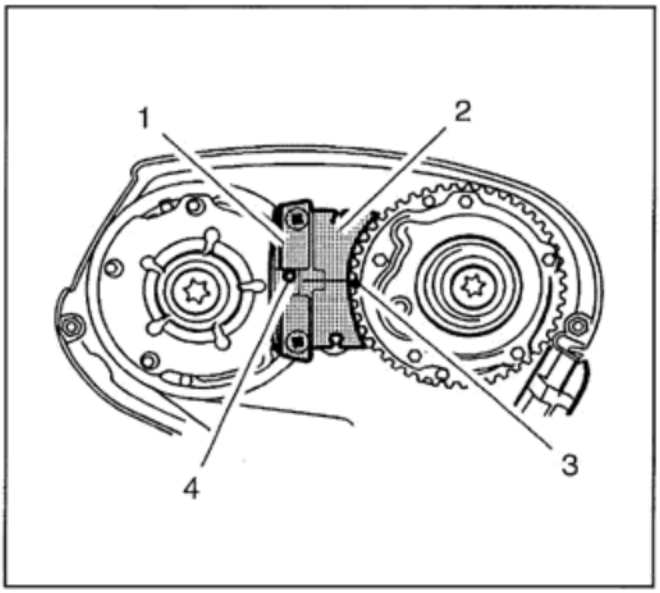
9. Remove the 4 lower timing belt cover bolts (2).
10. Remove the lower timing belt cover (1).



2373397

Note: The right half of the *EN-6340* locking tool can be recognized by the lettering "right", arrow, on the tool.

11. Prepare the right half of the *EN-6340* locking tool.
    11.1. Remove the 2 bolts (2).
    11.2. Remove the front panel (1) from the *EN-6340-right* locking tool.



2373398

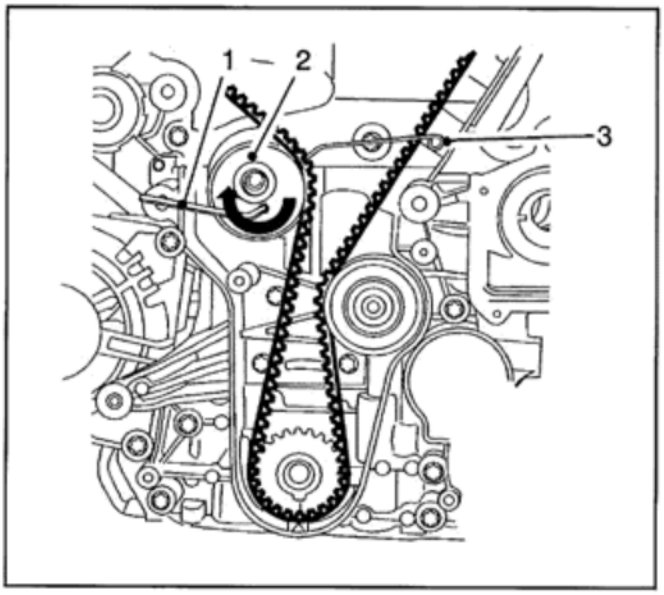
12. Install *EN-6340* locking tool into the camshaft position actuator adjusters.

Note: The spot type marking (4) on the intake camshaft adjuster does not correspond to the groove of EN-6340-left during this process but must be somewhat above as shown.

12.1. Install *EN-6340-left* locking tool (1) in the camshaft position actuator adjusters as shown.

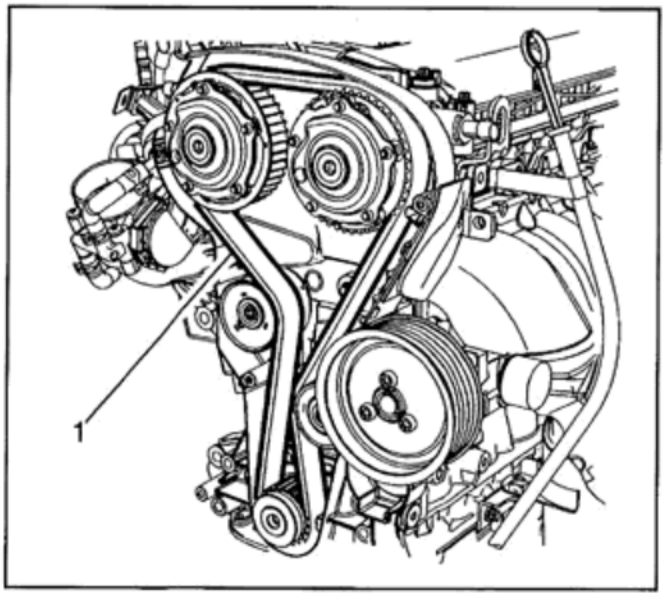
Note: The spot type marking (3) on the exhaust camshaft adjuster must correspond to the groove on EN-6340-right.

12.2. Install *EN-6340-right* locking tool (2) in the camshaft position actuator adjusters as shown.



2504691

13. Apply tension to the timing belt tensioner (2) in the direction of the arrow, using an Allen key (1).
14. Install the *EN-6333* locking pin (3).

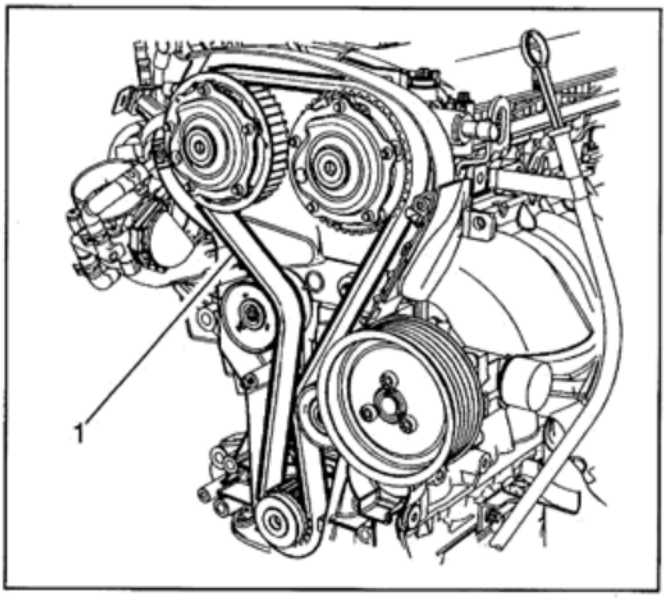


2506526

Note: Note the direction of the belt.

15. Remove the timing belt (1).

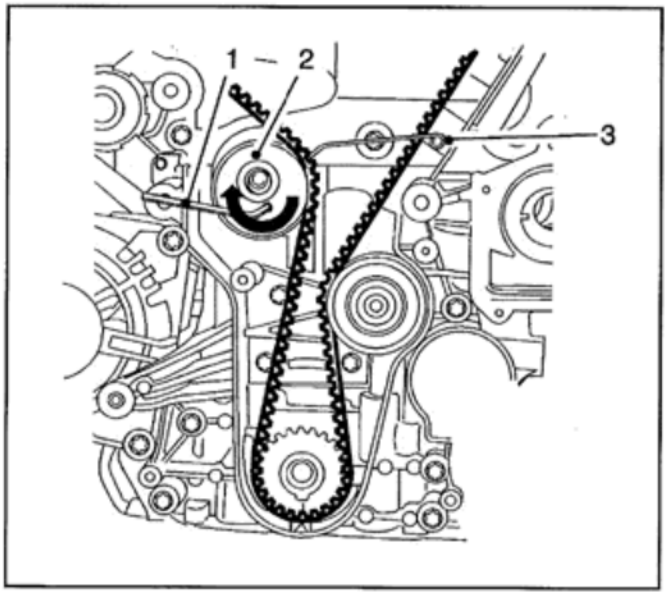
Installation Procedure



2506526

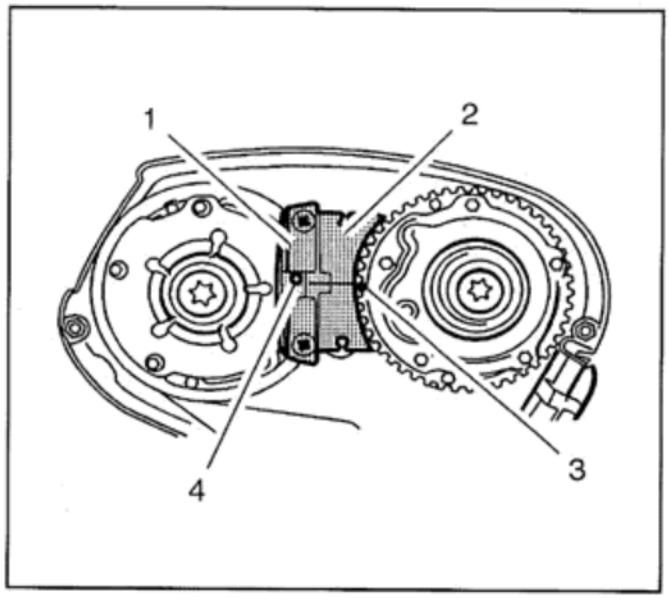
Note: Threading the timing belt through the engine mount bracket is only permissible in conjunction with the assembly tool supplied with NEW timing belts or otherwise it is possible to damage the toothed belt at this stage by kinking it.

1. Install the timing belt (1).
2. Guide the timing belt past the tensioner and place it on the crankshaft sprocket wheel.
3. Place the timing belt on the exhaust and intake camshaft position actuator adjusters.



2504691

4. Apply tension to the timing belt tensioner (2) in the direction of the arrow, using an Allen key (1).
5. Remove the *EN-6333* locking pin (3).



2373398

Note: The timing belt tensioner moves automatically to the correct position.

6. Check the timing.

Note: Note the marking at the camshaft sprockets.

6.1. Turn the crankshaft 720 degrees in the direction of engine rotation by the bolt on the crankshaft balancer.

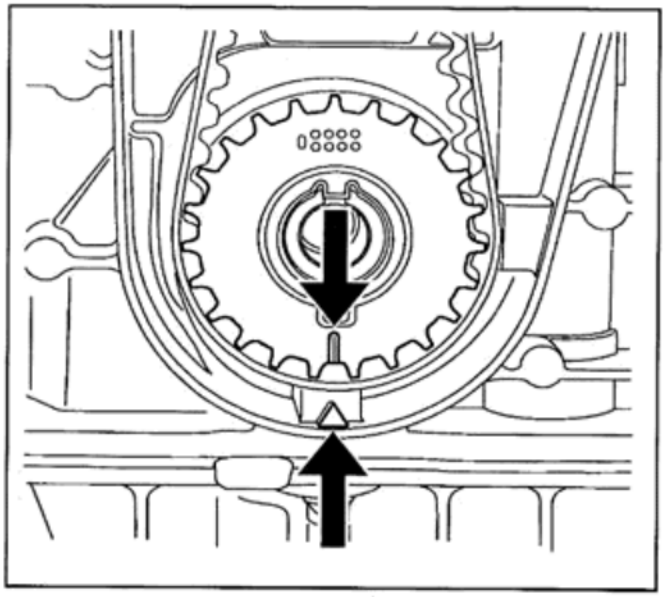
Note: The spot type marking (4) on the intake camshaft position actuator adjuster does not correspond to the groove of EN-6340-left during this process but must be slightly above as shown.

6.2. Install *EN-6340-left* locking tool (1) into the camshaft position actuator adjusters as shown.

Note: The spot type marking (3) on the exhaust camshaft position actuator adjuster must correspond to the groove on EN-6340-right.

6.3. Install *EN-6340-right* locking tool (2) into the camshaft position actuator adjusters as shown.

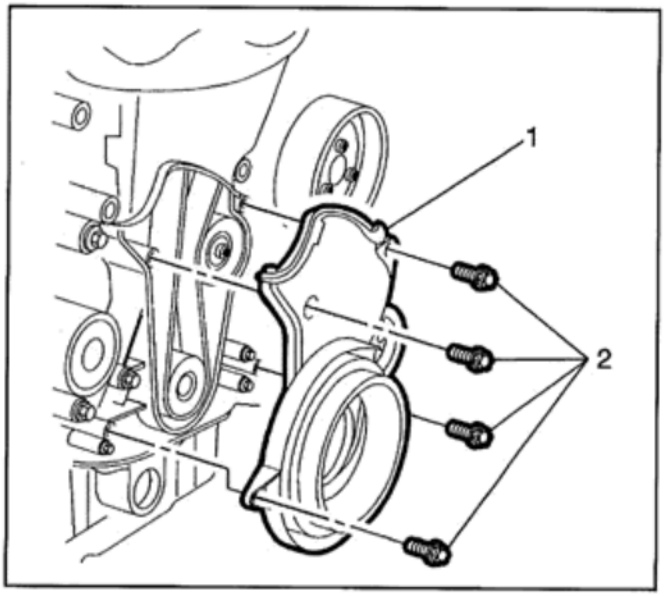
7. Remove the *EN-6340* locking tool.



2027014

Note: The timing belt drive gear and oil pump housing must align.

8. Control the crankshaft balancer position.

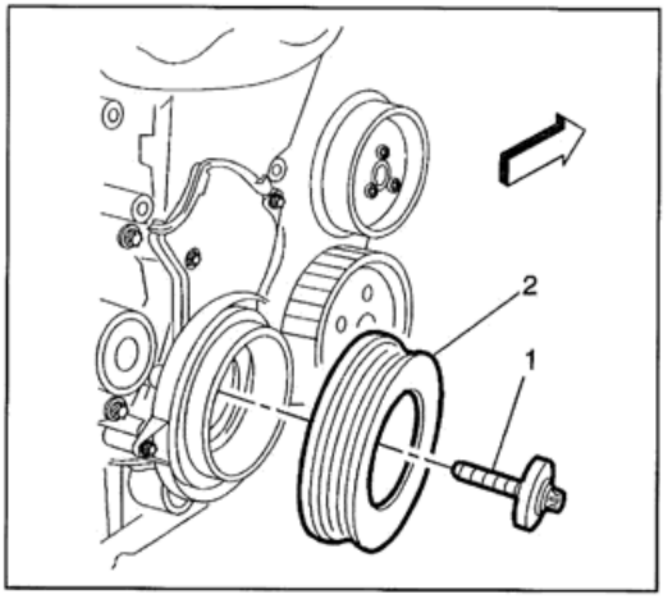


2504712

9. Install the lower timing belt cover (1).

Caution: Refer to *Fastener Caution on page 0-8.*

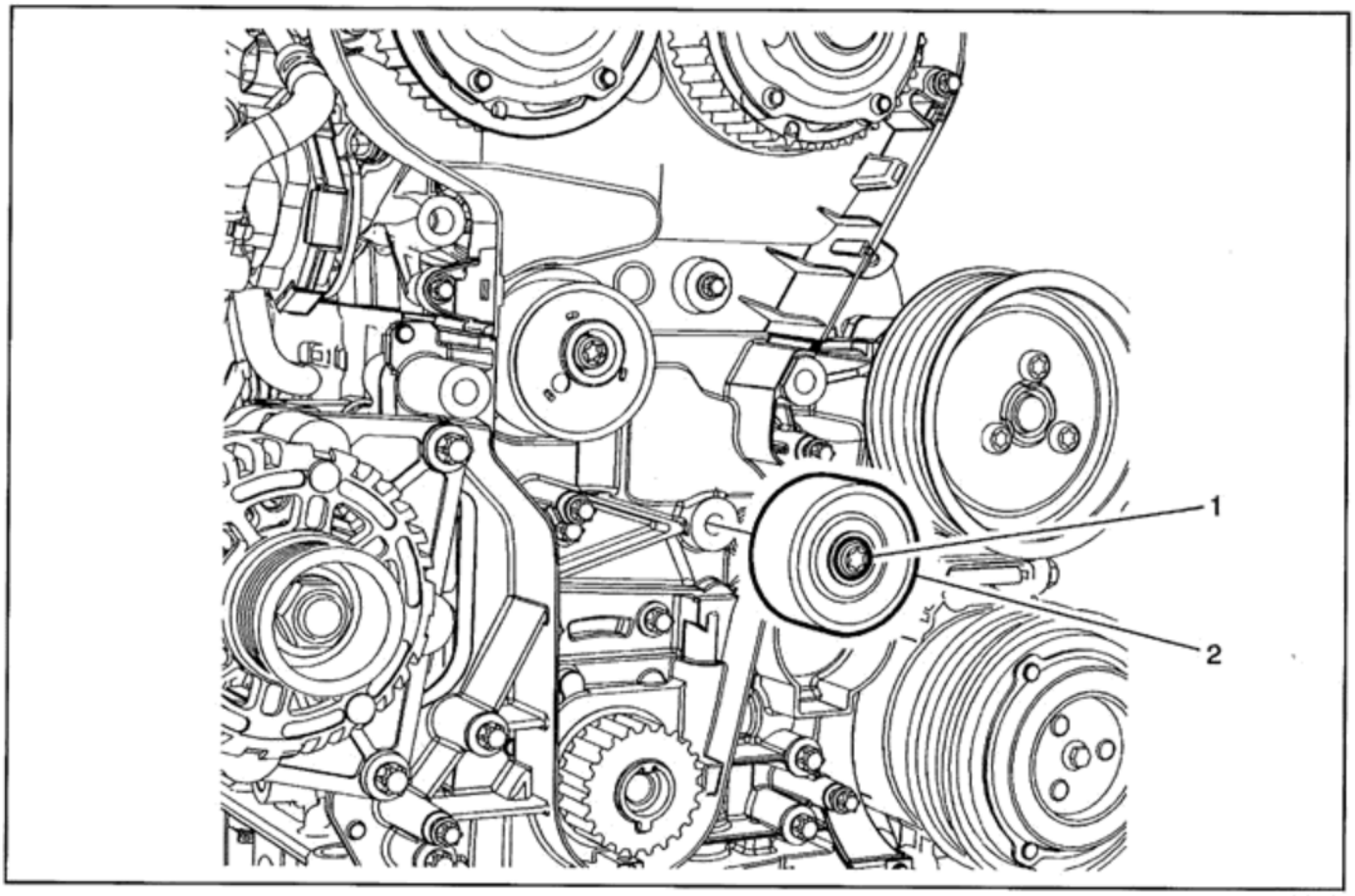
10. Install the 4 lower timing belt cover bolts (2) and tighten to **6 N•m (53 lb in)**.



2504713

11. Install the crankshaft balancer (2). Refer to *Crankshaft Balancer Replacement on page 9-1004* if necessary.
12. Install the crankshaft balancer bolt (1) and tighten to **95 N·m (70 lb ft) plus 30 degrees plus 15 degrees**.
13. Install the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966*.
14. Install the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left SIde) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right SIde, LWE, LUW) on page 3-149*.
15. Install the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Replacement on page 9-984*.
16. Install the air cleaner assembly. Refer to *Air Cleaner Assembly Replacement on page 9-582*.

Timing Belt Idler Pulley Replacement



2495298

Timing Belt Idler Pulley Replacement

Callout	Component Name
Preliminary Procedure Remove the timing belt. Refer to *Timing Belt Replacement on page 9-975*.	
1	Timing Belt Idler Pulley Bolt **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 25 N•m (18 lb ft)
2	Timing Belt Idler Pulley **Procedure** Ensure to use a NEW BOLT whenever the timing belt idler pulley is removed.

Timing Belt Tensioner Replacement

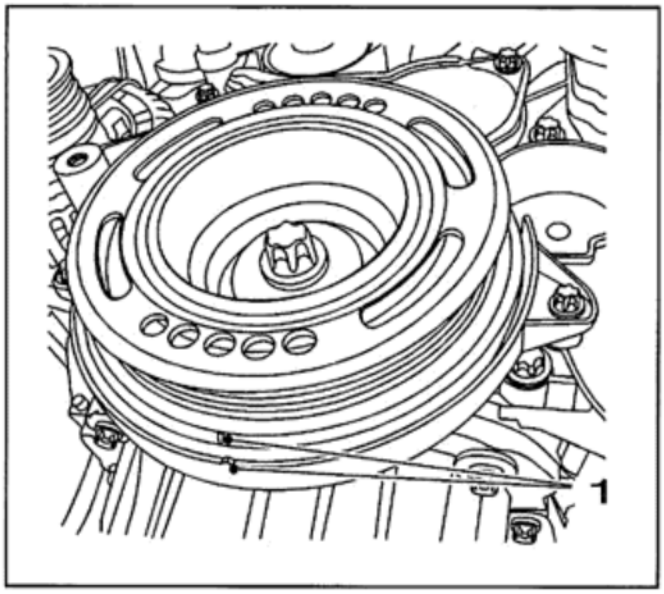
Special Tools

- *EN-6333* Timing Belt Tensioner Locking Pin
- *EN-6340* Camshaft Locking Tool

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

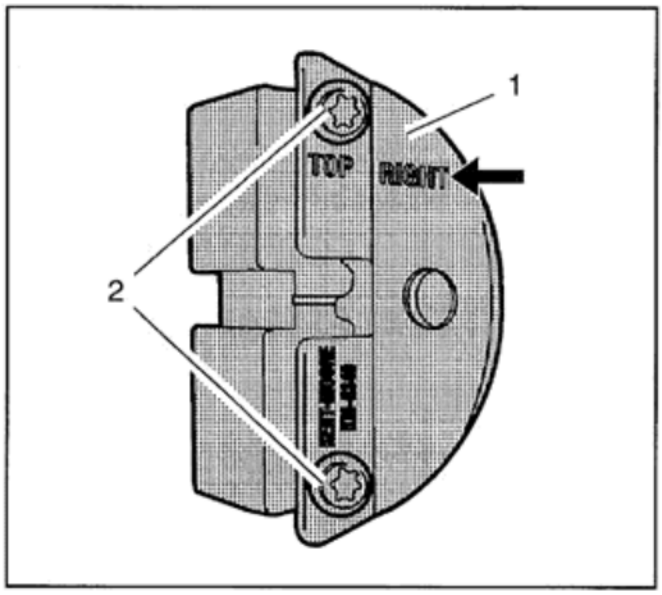
Removal Procedure

1. Remove the air cleaner assembly. Refer to *Air Cleaner Assembly Replacement on page 9-582*.
2. Remove the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966*.
3. Remove the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Removal on page 9-1074*.



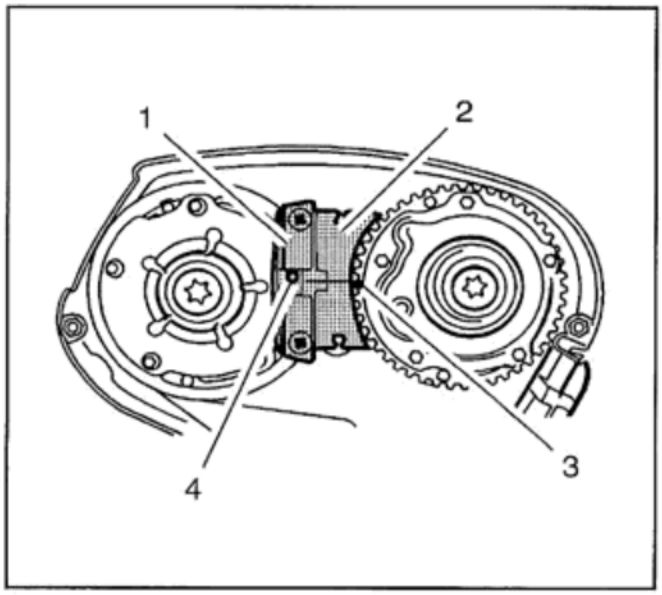
1936993

4. Set crankshaft balancer in direction of engine rotation to cylinder 1 TDC of combustion stroke (1).



2373397

5. Prepare the right half of the *EN-6340* locking tool.
   5.1. Remove the 2 bolts (2).
   5.2. Remove the front panel (1).



2373398

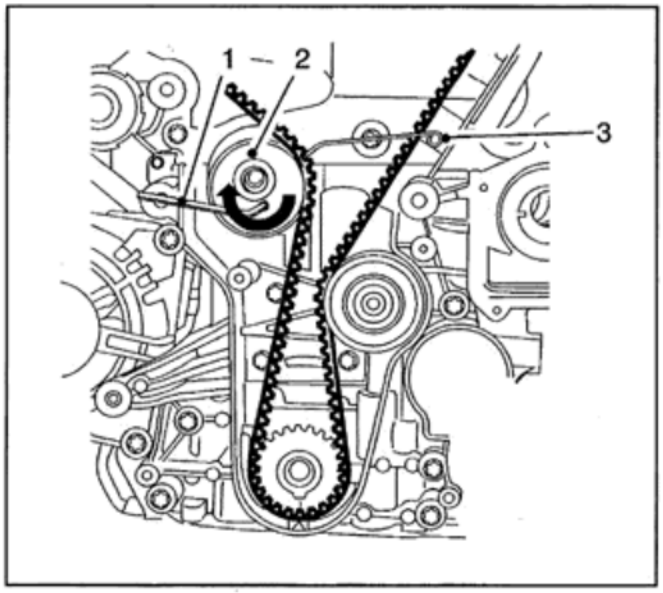
6. Install the *EN-6340* locking tool into the camshaft adjusters.

Note: The spot type marking (4) on the intake camshaft adjuster does not correspond to the groove of EN-6340-left during this process but must be somewhat above as shown.

7. Install the *EN-6340-left* locking tool (1) in the camshaft adjusters as shown.

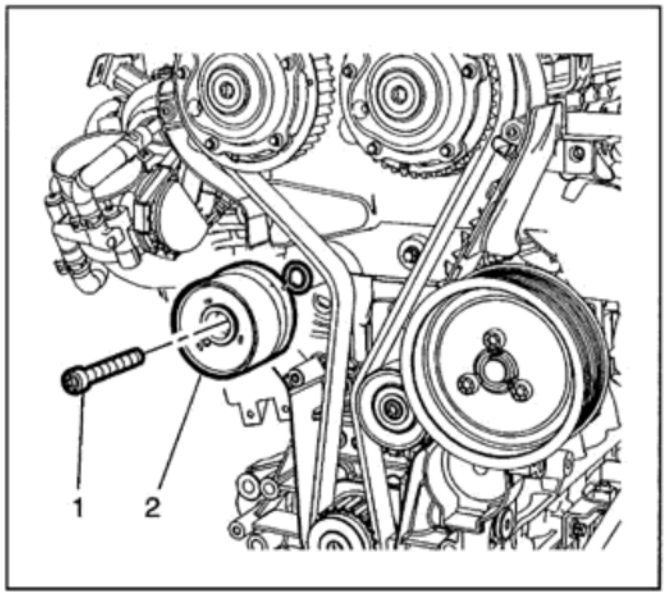
Note: The spot type marking (3) on the exhaust camshaft adjuster must correspond to the groove on EN-6340-right.

8. Install *EN-6340-right* locking tool (2) in the camshaft adjusters as shown.
9. Remove *EN-6340* locking tool.
10. Remove the crankshaft balancer. Refer to *Crankshaft Balancer Replacement on page 9-1004*.
11. Remove the engine mount bracket. Refer to *Engine Mount Bracket Replacement on page 9-968*.
12. Remove the timing belt center front cover. Refer to *Timing Belt Center Front Cover Removal on page 9-1074*.
13. Remove the timing belt lower front cover. Refer to *Timing Belt Lower Front Cover Removal on page 9-1075*.



2504691

14. Loosen the timing belt tensioner bolt.
15. Apply tension to the drive belt tensioner (2) in the direction of the arrow, using an allen key (1).
16. Install the *EN-6333* locking pin (3).

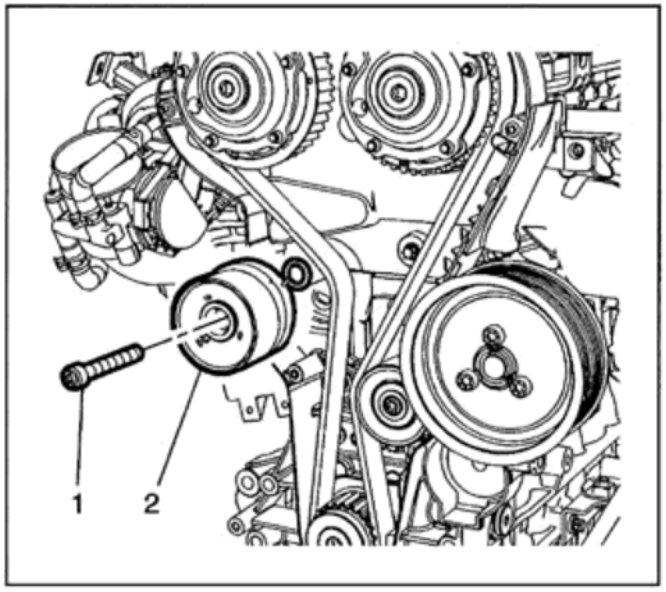


2504687

17. Remove the timing belt tensioner bolt (1) and the timing belt tensioner (2).

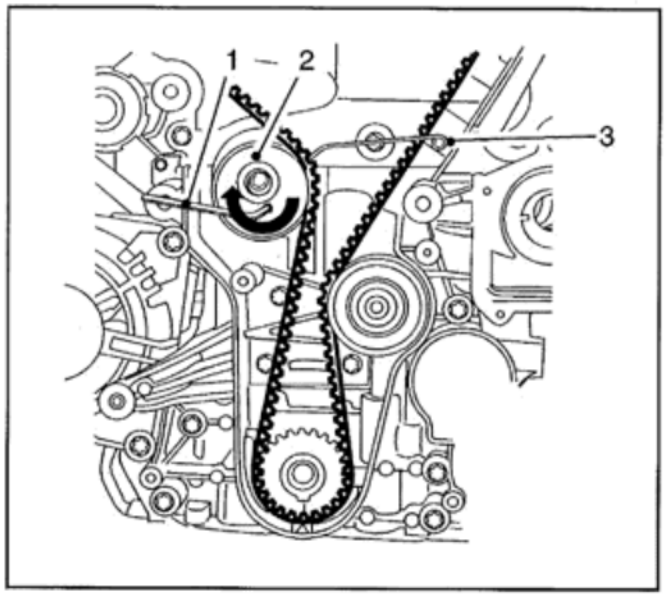
Installation Procedure

1. Clean the timing belt tensioner thread.



2504687

2. Install the timing belt tensioner (2).
3. Install the timing belt tensioner bolt (1).



2504691

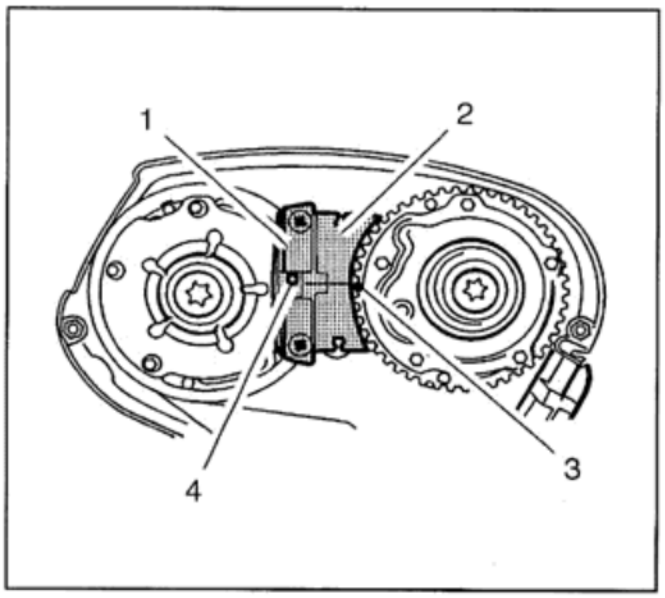
4. Apply tension to the drive belt tensioner (2) in the direction of the arrow, using an allen key (1).
5. Remove the *EN-6333* locking pin (3).

Note: The timing belt tensioner moves automatically to the correct position.

6. Release tension on timing belt tensioner.

Caution: Refer to *Fastener Caution on page 0-8*.

7. Tighten the timing belt tensioner bolt to **20 N•m (15 lb ft)**.
8. Install the timing belt lower front cover. Refer to *Timing Belt Lower Front Cover Installation on page 9-1125*.
9. Install the timing belt center front cover. Refer to *Timing Belt Center Front Cover Installation on page 9-1125*.
10. Install the engine mount bracket. Refer to *Engine Mount Bracket Replacement on page 9-968*.
11. Install the crankshaft balancer. Refer to *Crankshaft Balancer Replacement on page 9-1004*.



2373398

12. Check the timing.

Note: Note the marking at the camshaft sprockets.

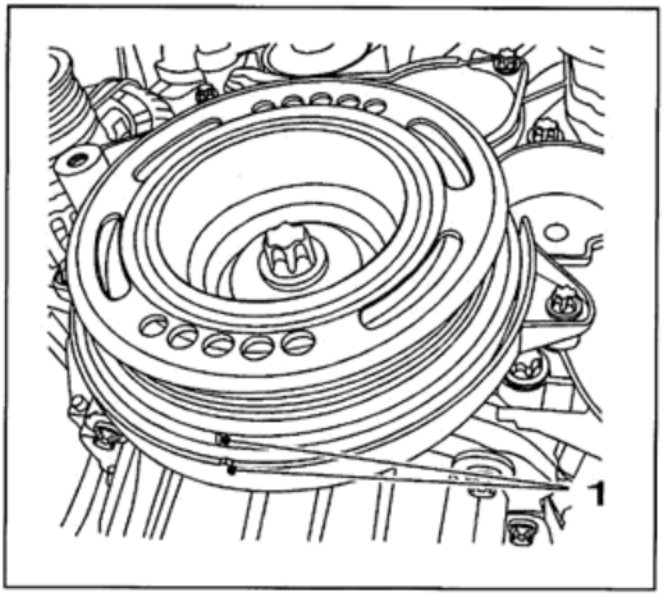
12.1. Turn the crankshaft 720 degrees in the direction of engine rotation by the bolt on the crankshaft balancer.

Note: The spot type marking (4) on the intake camshaft adjuster does not correspond to the groove of EN-6340-left during this process but must be somewhat above as shown.

12.2. Install *EN-6340-left* locking tool (1) into the camshaft adjusters as shown.

Note: The spot type marking (3) on the exhaust camshaft adjuster must correspond to the groove on EN-6340-right.

12.3. Install *EN-6340-right* locking tool (2) into the camshaft adjusters as shown.

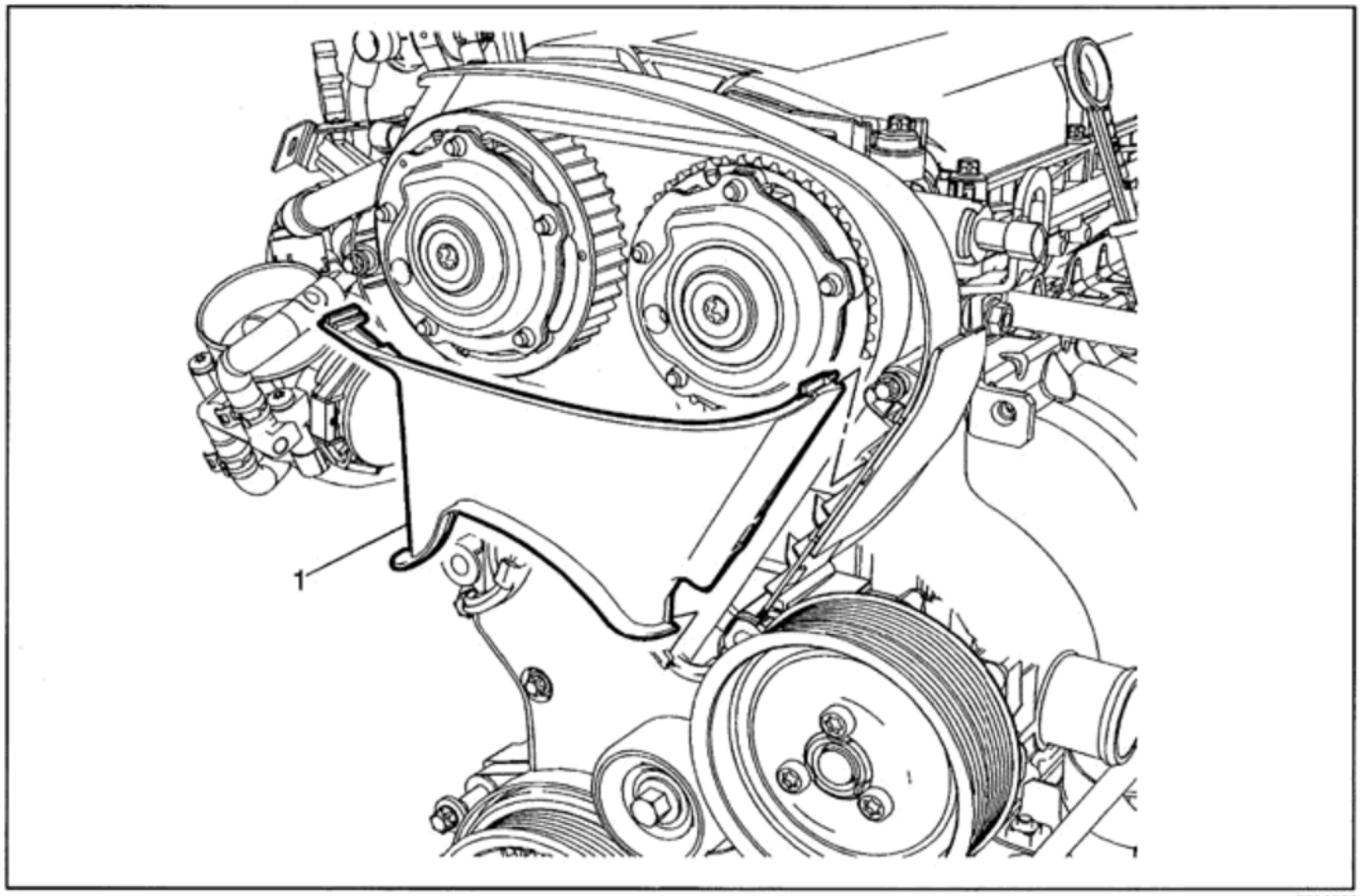


1936993

Note: Note the marking at the crankshaft balancer and the cover (1) must align before installing the drive belt.

13. Install the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966.*
14. Remove the *EN-6340* locking tool.
15. Install the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Installation on page 9-1126.*
16. Install the air cleaner assembly. Refer to *Air Cleaner Assembly Replacement on page 9-582.*

Timing Belt Center Front Cover Replacement

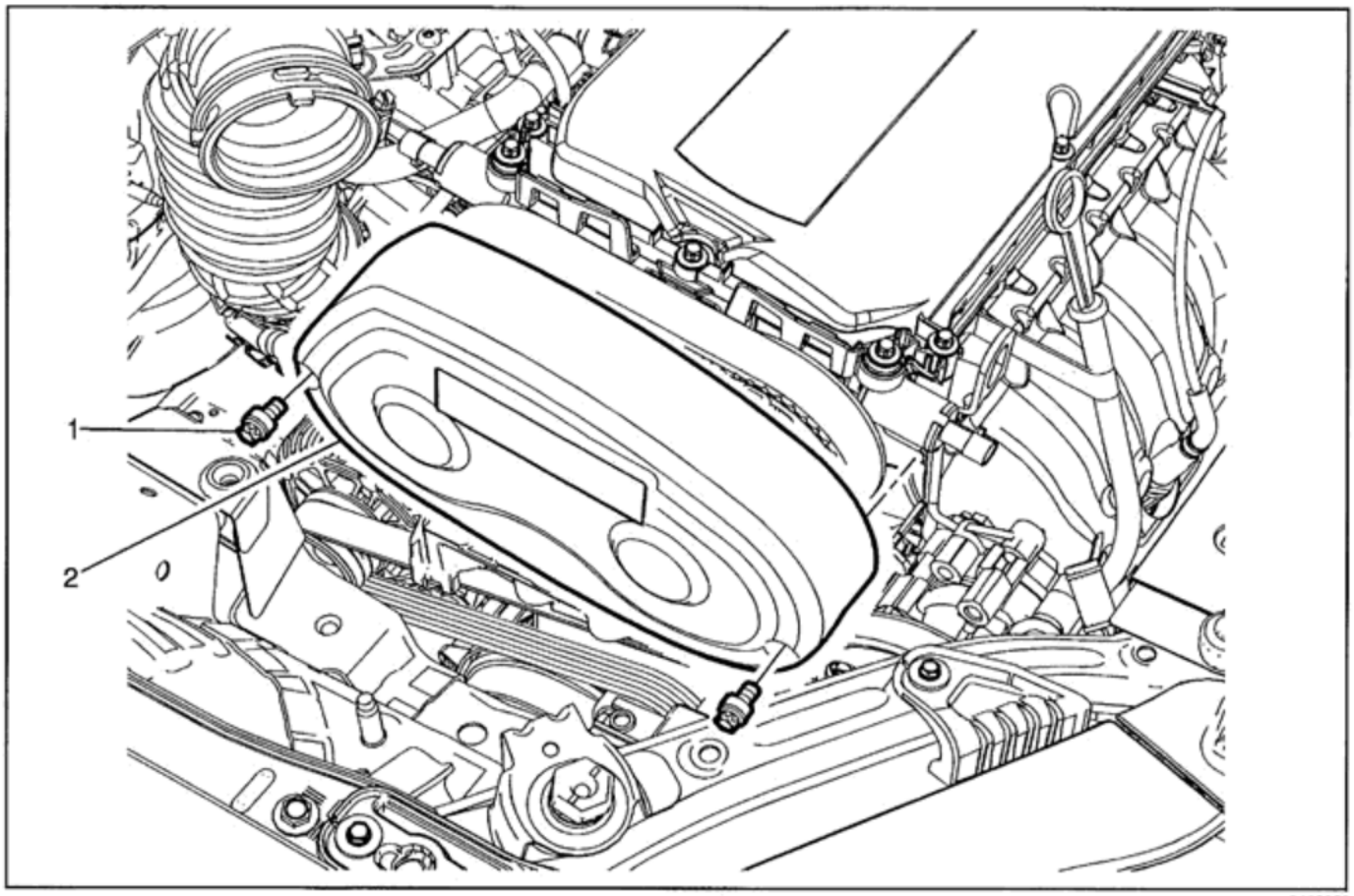


2501256

Timing Belt Center Front Cover Replacement

Callout	Component Name
Preliminary Procedure 1. Remove the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Replacement on page 9-984.* 2. Remove the engine mount bracket. Refer to *Engine Mount Bracket Replacement on page 9-968.*	
1	Timing Belt Center Front Cover **Procedure** Transfer Parts as necessary.

Timing Belt Upper Front Cover Replacement

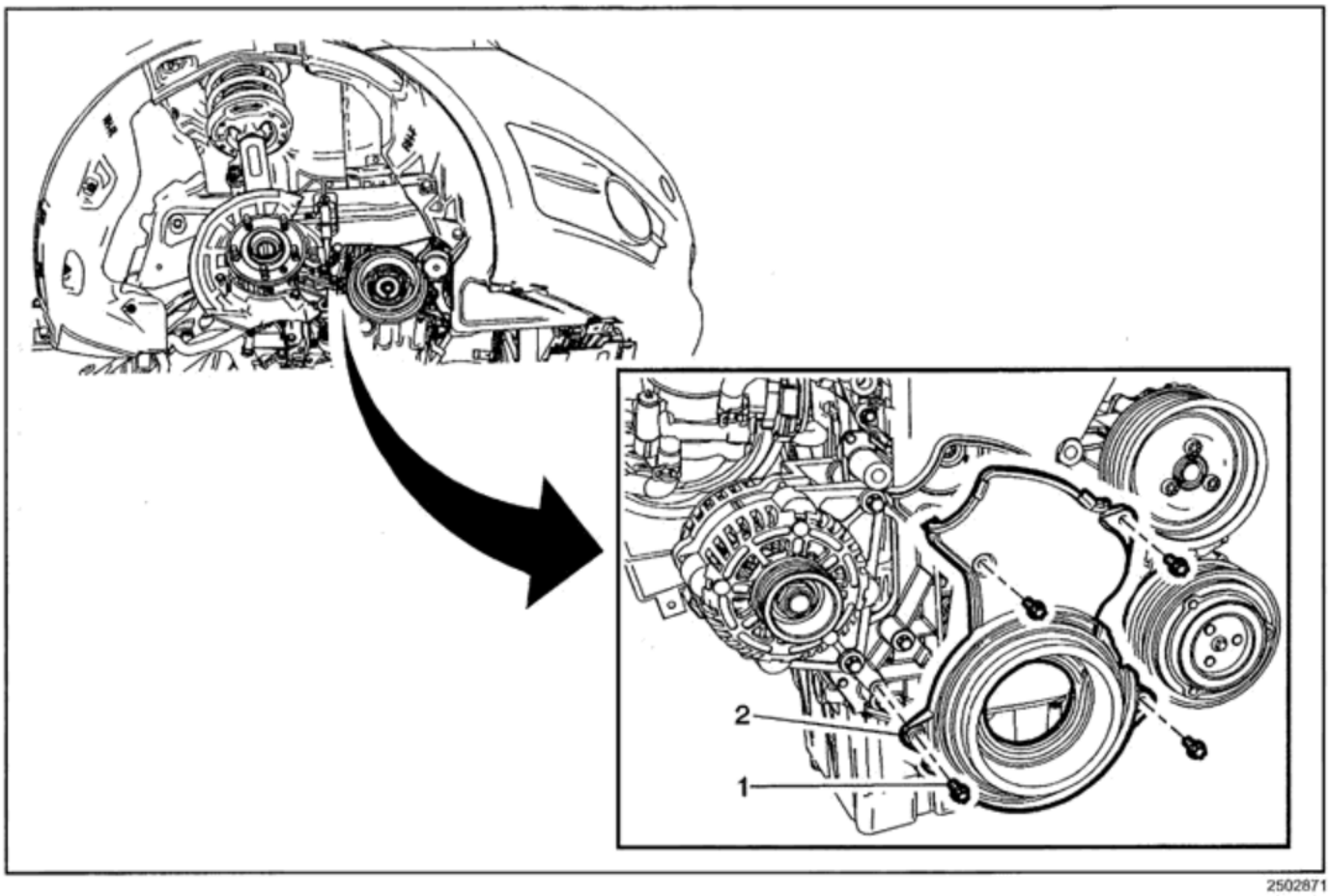


2495359

Timing Belt Upper Front Cover Replacement

Callout	Component Name
1	Timing Belt Upper Front Cover Fastener (Qty: 2) **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 6 N•m (53 lb in)
2	Timing Belt Upper Front Cover

Timing Belt Lower Front Cover Replacement

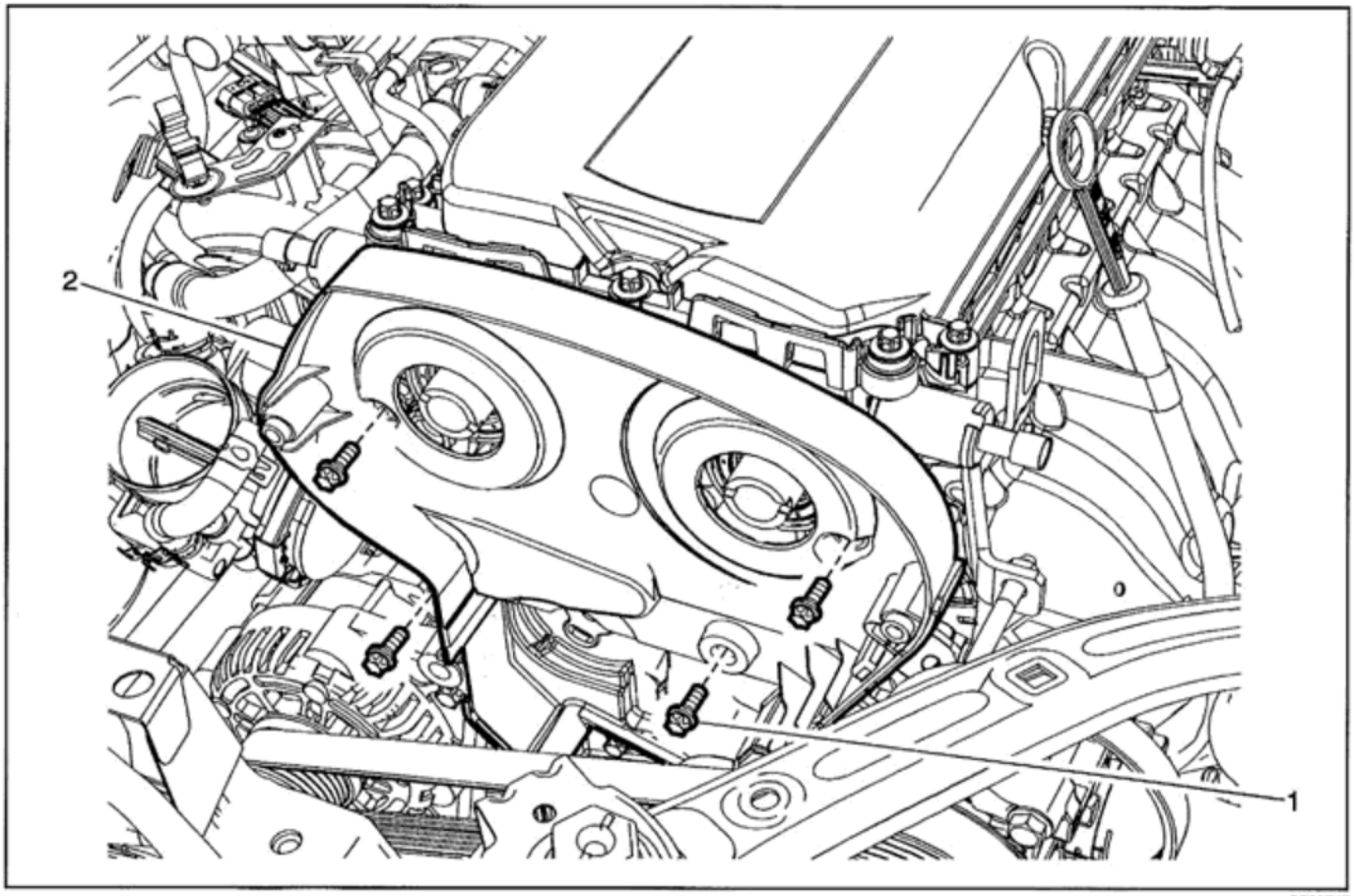


2502871

Timing Belt Lower Front Cover Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the Front Wheelhouse Liner Inner Front Extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left Side) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LWE, LUW) on page 3-149*. 2. Remove the crankshaft balancer Refer to *Crankshaft Balancer Replacement on page 9-1004*. 3. Remove the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-965*.	
1	Timing Belt Lower Front Cover Fastener (Qty; 4) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 6 N•m (53 lb in)
2	Timing Belt Lower Front Cover **Procedure** Transfer parts as necessary.

Timing Belt Rear Cover Replacement



2502717

Timing Belt Rear Cover Replacement

Callout	Component Name
Preliminary Procedures Remove the camshaft sprocket. Refer to *Camshaft Sprocket Replacement on page 9-987*	
1	Timing Belt Rear Cover Fastener (Qty 4) **Caution:** Refer to *Fastener Caution on page 0-8.* **Procedure** 1. New bolt must be used whenever the cover is removed. 2. Apply locking compound to the NEW timing belt rear cover bolts. **Tighten** 6 N•m (53 lb in)
2	Timing Belt Rear Cover **Procedure** Transfer parts as necessary.

Valve Lifter Replacement

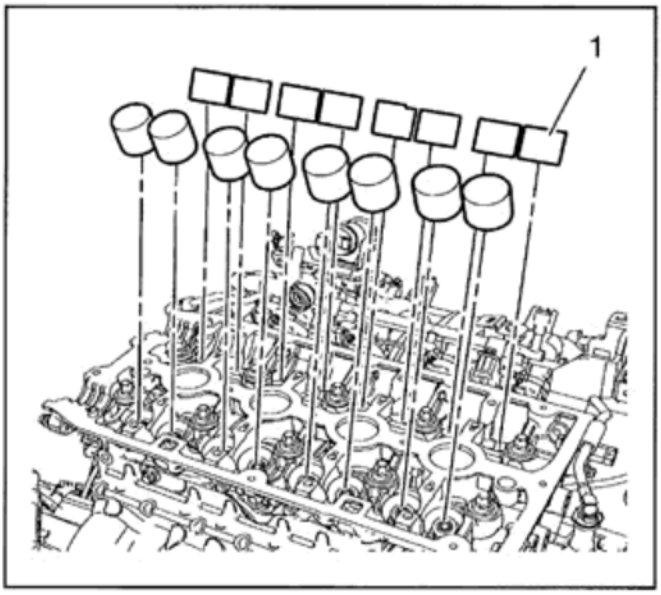
Special Tools

EN-845 Suction Device

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

Removal Procedure

1. Remove the camshaft. Refer to *Camshaft Replacement on page 9-1052*.

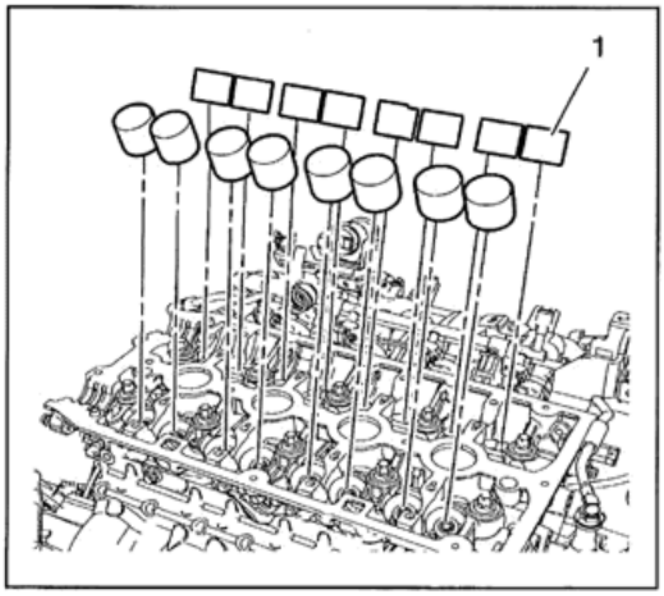


2028318

Note: Mark the assignments.

2. Remove the valve lifter (1) use the *EN-845* suction device.

Installation Procedure



2028318

Note: Observe the correct assignment.

Note: Coat the sliding surfaces with NEW engine oil.

1. Install the valve lifter (1) use the *EN-845* suction device.
2. Install the camshaft. Refer to *Camshaft Replacement on page 9-1052*.

Camshaft Sprocket Replacement

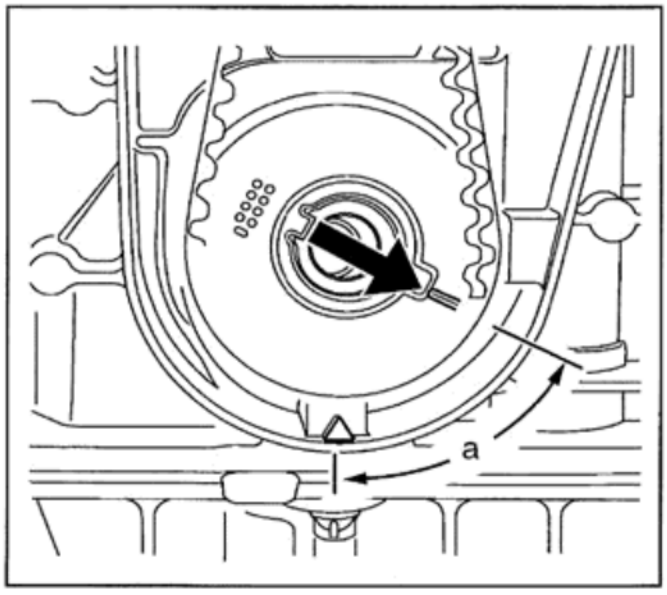
Special Tools

- *EN-6340* Camshaft Adjuster Locking Tool
- *EN-6628–A* Camshaft Locking Tool
- *EN-45059* Angle Meter

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

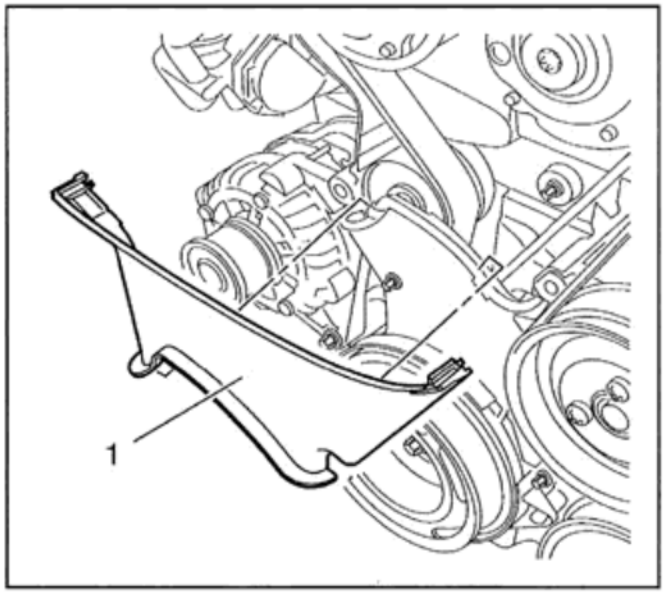
Removal Procedure

1. Open the hood.
2. Remove the air cleaner housing. Refer to *Air Cleaner Assembly Replacement on page 9-582*.
3. Remove the camshaft cover. Refer to *Camshaft Cover Replacement on page 9-1050*.
4. Remove the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966*.
5. Remove the timing belt. Refer to *Timing Belt Replacement on page 9-975*.
6. Remove the timing belt idler pulley. Refer to *Timing Belt Idler Pulley Removal on page 9-1076*.



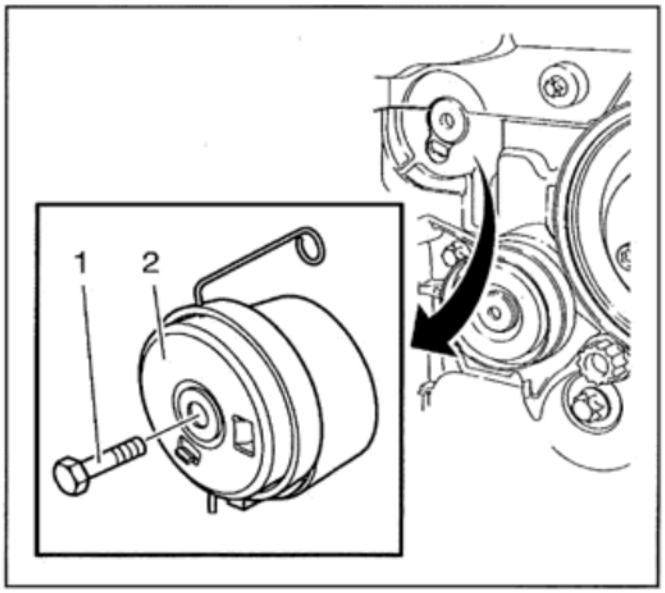
2027016

7. Set the crankshaft in direction of engine rotation to **60°**(a) before TDC. Use the *EN-45059* meter and the crankshaft balancer bolt.
8. Remove the crankshaft sprocket. Refer to *Crankshaft Sprocket Removal on page 9-1077*.
9. Lower the vehicle.
10. Remove the engine mount bracket. Refer to *Engine Mount Bracket Replacement on page 9-968*.



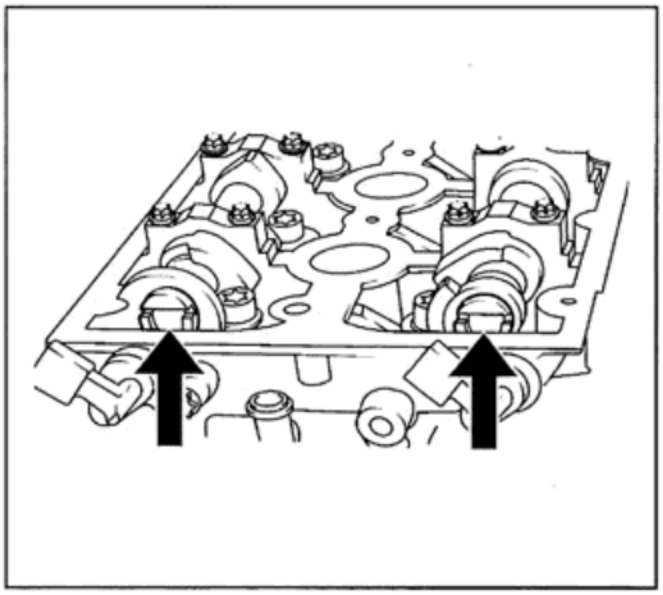
2026839

11. Remove the center front timing belt cover from the rear timing belt cover at 2 locations.
12. Remove the center front timing belt cover (1).



2027017

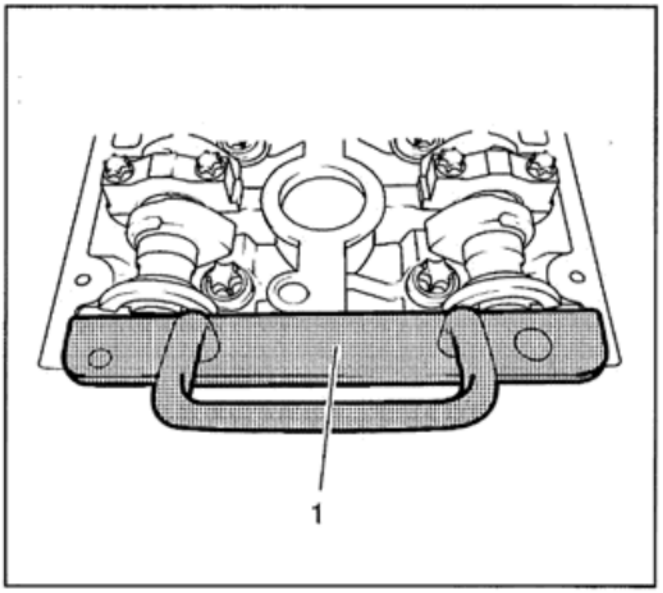
13. Remove the tensioner bolt (1).
14. Remove the timing belt tensioner (2).



2026512

Note: Note the arrows.

15. Turn the camshaft by the hexagon until the groove on the end of the camshafts is horizontal.

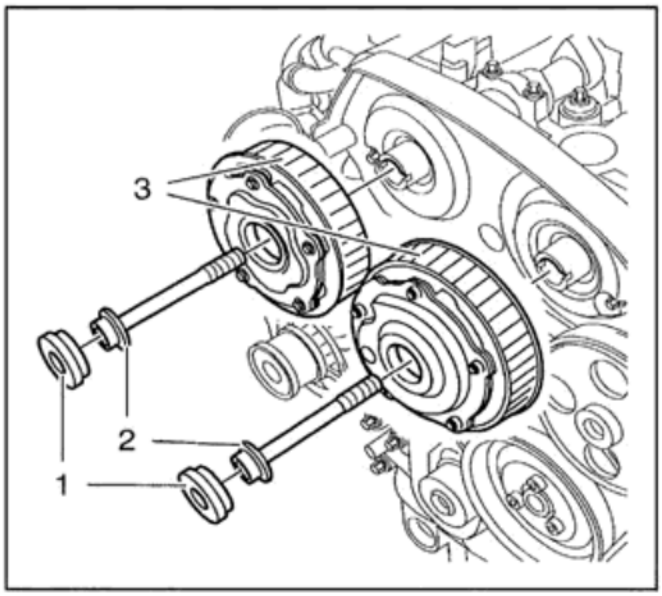


2026534

16. Install the *EN-6628–A* locking tool (1).
17. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.

Note: Some engine oil will run out of the camshaft and the camshaft position actuator adjuster. That is the reason for the removal of the whole timing assembly.

18. Place a collecting basin underneath the vehicle.



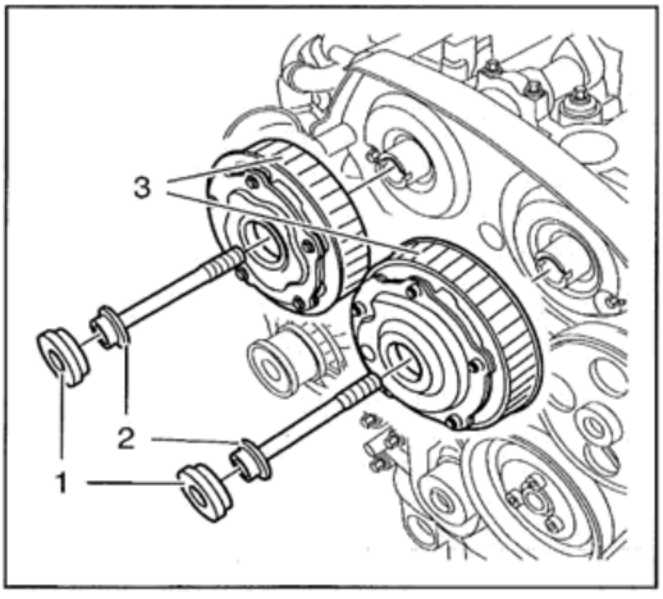
2026844

19. Remove the camshaft position actuator adjuster closure bolt (1) of the intake camshaft position actuator adjuster and/or the exhaust camshaft position actuator adjuster (3).
20. Remove and DISCARD the intake camshaft position actuator adjuster bolt and/or the exhaust camshaft position actuator adjuster bolt (2).

Note: A second person is required. Counterhold against the hexagon of corresponding camshaft with an open-ended wrench.

21. Remove the intake camshaft position actuator adjuster and/or the exhaust camshaft position actuator adjuster (3).

Installation Procedure

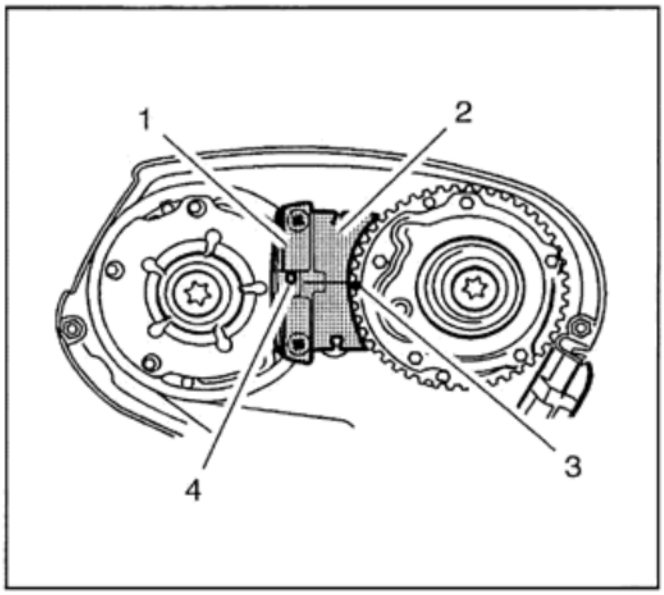


2026844

Note: If the cover is contaminated with oil, you have to clean it close.

Note: A second person is required. Counterhold against the hexagon of corresponding camshaft with an open-ended wrench.

1. Install intake camshaft position actuator adjuster and/or the exhaust camshaft position actuator adjuster (3).
2. Install a NEW intake camshaft position actuator adjuster bolt and/or a NEW exhaust camshaft position actuator adjuster bolt (2).



2373398

3. Install the *EN-6340* locking tool into the camshaft position actuator adjusters.

Note: The spot type marking (4) on the intake camshaft position actuator adjuster does not correspond to the groove of EN-6340-left during this process but must be somewhat above as shown.

3.1. Install the *EN-6340-left* locking tool (1) in the camshaft position actuator adjusters as shown.

Note: The spot type marking (3) on the exhaust camshaft position actuator adjuster must correspond to the groove on EN-6340-right.

3.2. Install the *EN-6340-right* locking tool (2) in the camshaft position actuator adjusters as shown.

Caution: Refer to *Fastener Caution on page 0-8*.

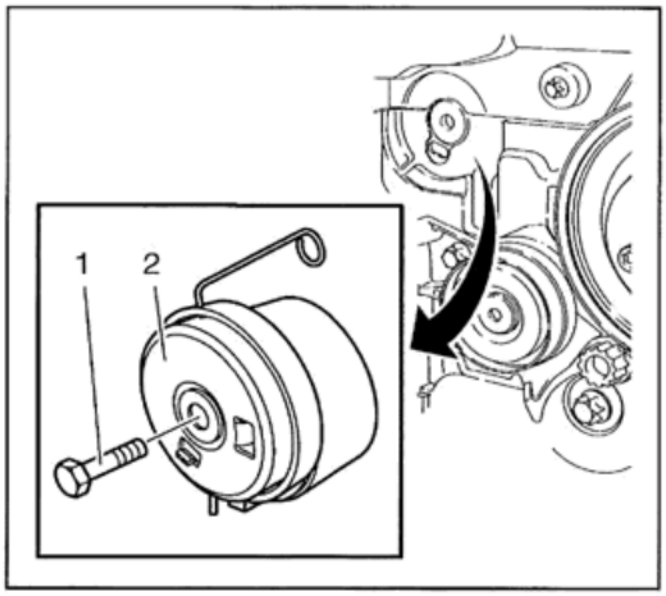
Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

Note: A second person is required. Counterhold at the camshaft hexagon.

4. Tighten the intake camshaft position actuator adjuster or exhaust camshaft position actuator adjuster bolts to **50 N•m (37 lb ft) + 150° + 15°** use the *EN-45059* meter.

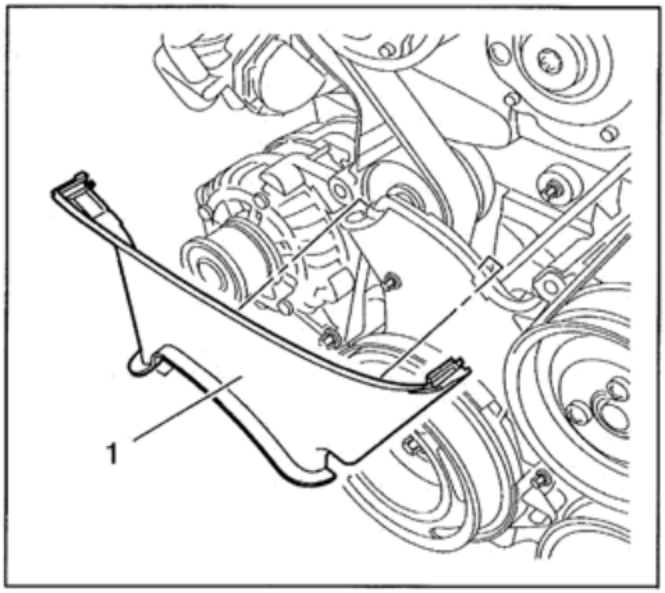
Note: Install a NEW seal ring.

5. Install camshaft closure bolt and tighten to **30 N•m (22 lb ft)**.
6. Remove the *EN-6628–A* locking tool.



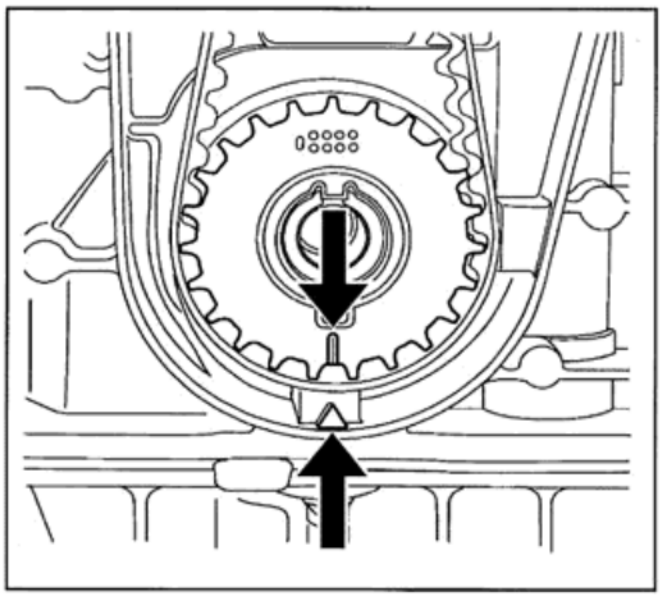
2027017

7. Clean the timing belt tensioner thread.
8. Install the timing belt tensioner (2) and tighten the NEW timing belt tensioner bolt (1) to **20 N•m (15 lb ft)**.



2026839

9. Install the timing belt center front cover (1) to the timing belt rear cover at 2 locations.
10. Install the engine mount bracket. Refer to *Engine Mount Bracket Replacement on page 9-968*.
11. Raise the vehicle.
12. Install the crankshaft sprocket. Refer to *Crankshaft Sprocket Installation on page 9-1122*.



2027014

13. Set the crankshaft in the direction of engine rotation to TDC. Use the crankshaft balancer bolt.
14. Install the timing belt idler pulley. Refer to *Timing Belt Idler Pulley Installation on page 9-1122*.
15. Install the timing belt. Refer to *Timing Belt Replacement on page 9-975*.
16. Install the drive belt tensioner. Refer to *Drive Belt Tensioner Replacement on page 9-966*.
17. Install the camshaft cover. Refer to *Camshaft Cover Replacement on page 9-1050*.
18. Install the air cleaner housing. Refer to *Air Cleaner Assembly Replacement on page 9-582*.
19. Close the hood.

Cylinder Head Replacement

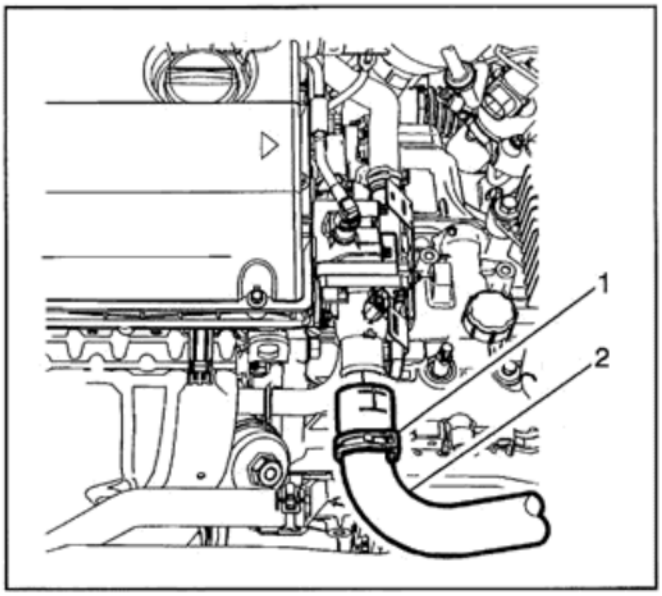
Special Tools

- *BO-38185* Hose Clamp Pliers
- *EN-45059* Angle Meter

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

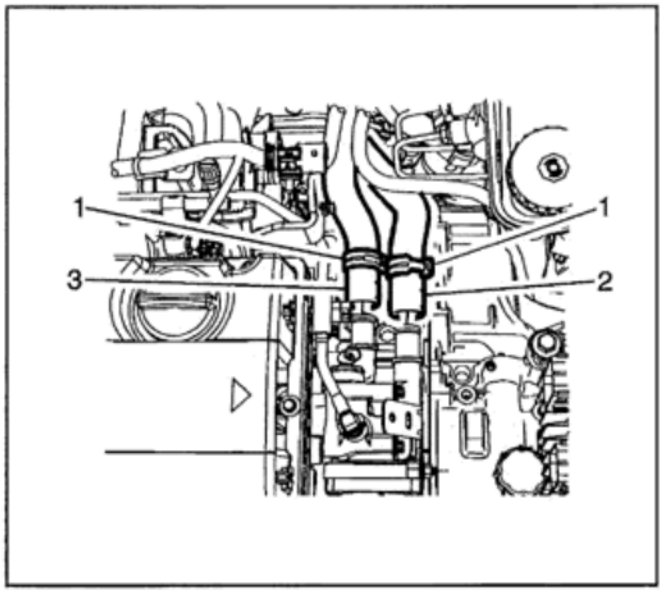
Removal Procedure

1. Disconnect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-713*.
2. Relieve fuel system pressure. Refer to *Fuel Pressure Relief on page 9-547*.
3. Disconnect the fuel feed pipe. Refer to *Fuel Feed Pipe Replacement on page 9-557*.
4. Disconnect EVAP purge solenoid pipes from solenoid. Refer to *Evaporative Emission System Hose/Pipe Replacement on page 9-565*.
5. Drain the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.
6. Remove the coolant surge tank. Refer to *Radiator Surge Tank Replacement on page 9-630*.



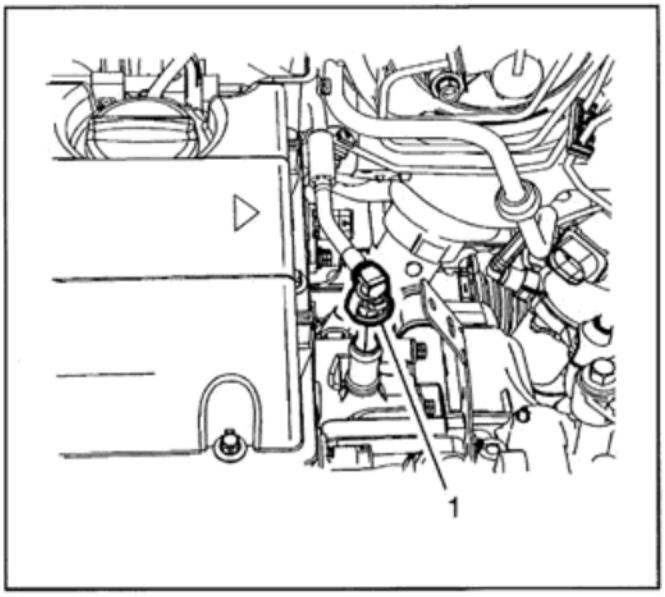
2506800

7. Loosen the radiator inlet hose clamp (1) at the engine using *BO-38185* pliers.
8. Remove the radiator inlet hose (2) from the engine.



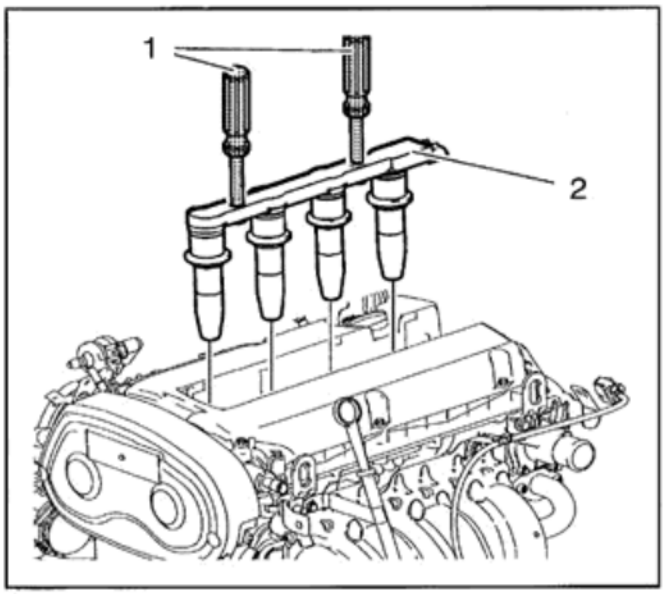
2506820

9. Remove the inlet and outlet heater hose clamp (1) at the engine using *BO-38185* pliers.
10. Remove the inlet hose (2) and outlet (3) from the engine.



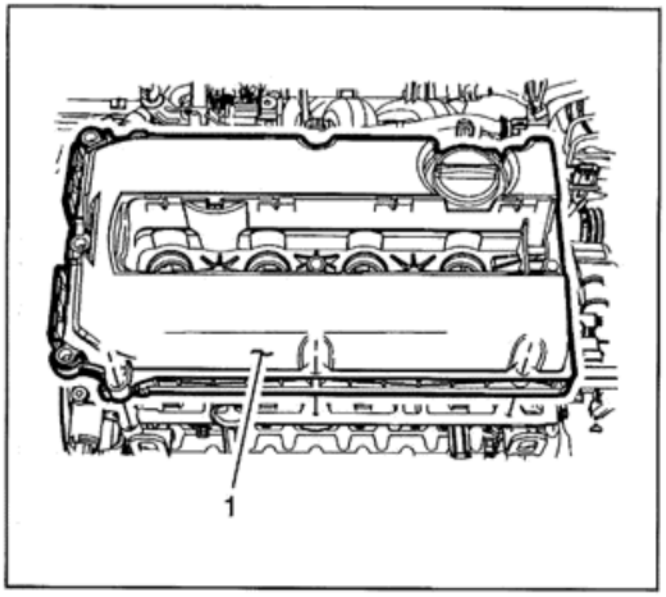
2506822

11. Disconnect the throttle body heater inlet pipe (1).



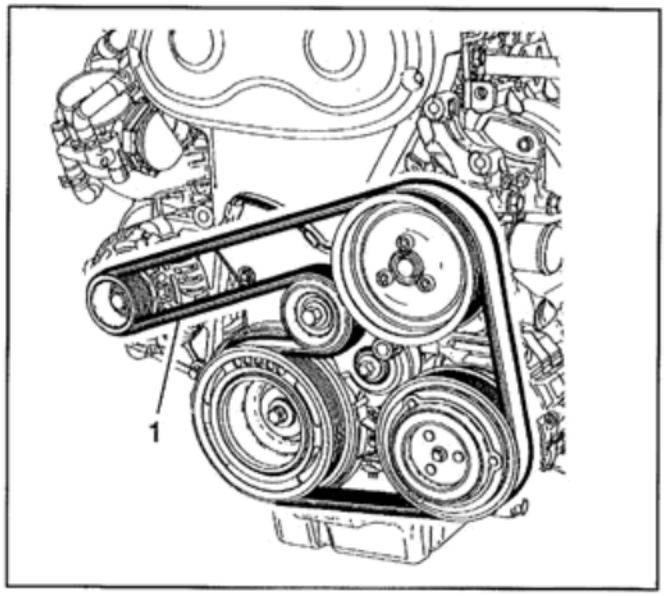
2026537

12. Remove the ignition coil (2) . Refer to *Ignition Coil Replacement on page 9-570*.
13. Disconnect PCV hose. Refer to *Positive Crankcase Ventilation Hose/Pipe/Tube Replacement on page 9-1009*.



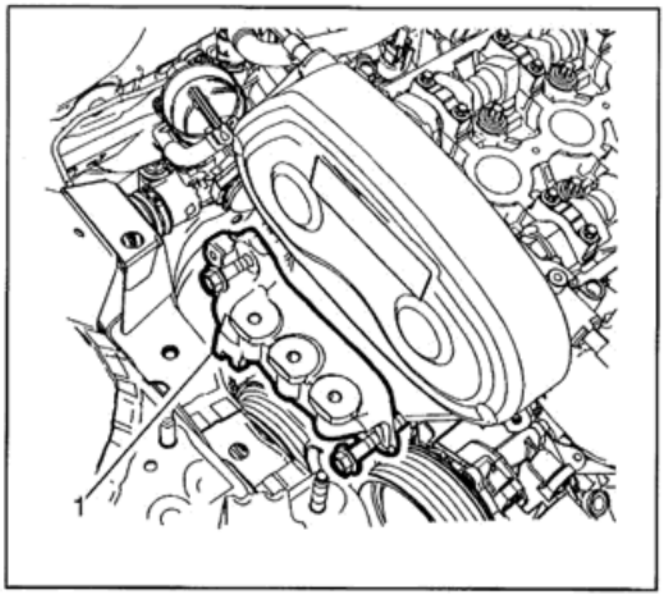
2506823

14. Remove the camshaft cover (1). Refer to *Camshaft Cover Replacement on page 9-1050*.
15. Install engine support fixture. Refer to *Engine Support Fixture on page 9-1060*.
16. Remove the engine mount. Refer to *Engine Mount Replacement on page 9-967*.



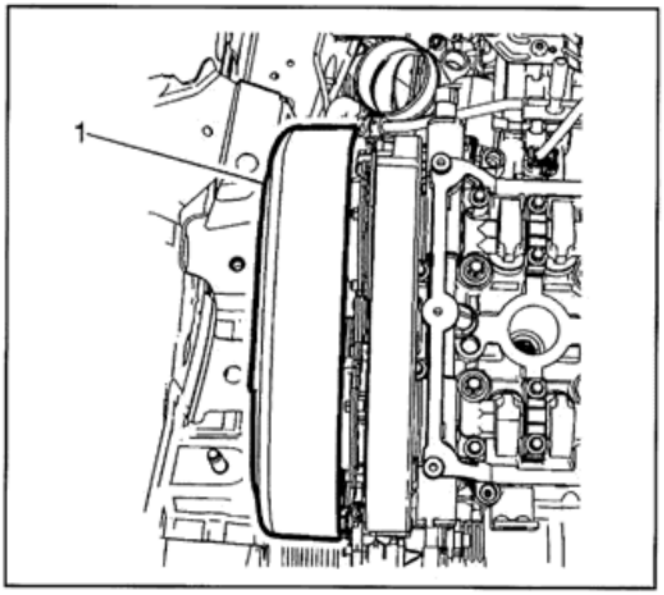
2512912

17. Remove the drive belt (1). Refer to *Drive Belt Replacement on page 9-964*.



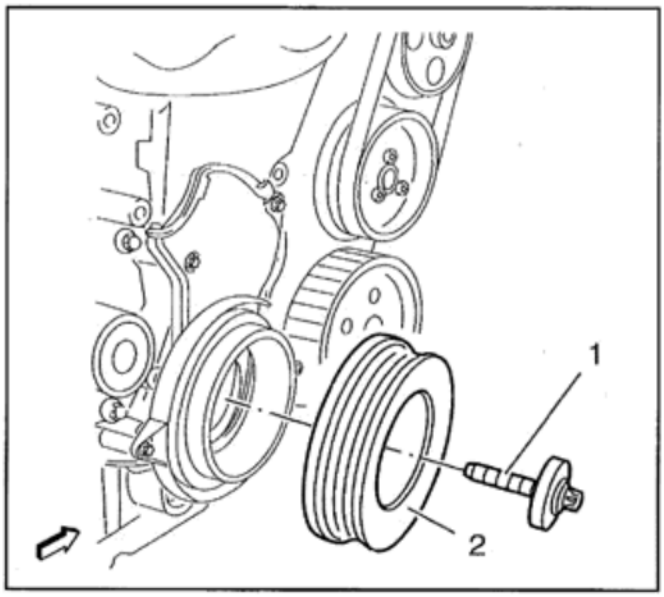
2506824

18. Remove the engine mount bracket (1). Refer to *Engine Mount Bracket Replacement on page 9-968*.



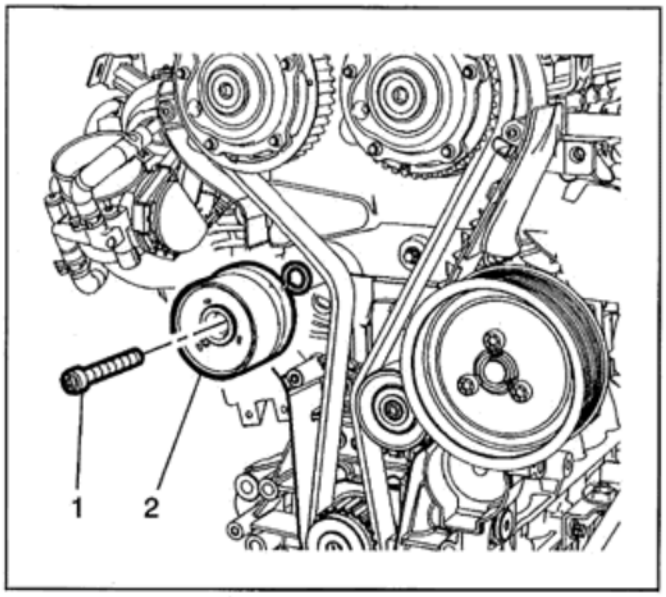
2506828

19. Remove the upper timing cover (1). Refer to *Timing Belt Upper Front Cover Replacement on page 9-984*.
20. Remove the timing belt center front cover. Refer to *Timing Belt Center Front Cover Replacement on page 9-983*.
21. Raise the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.



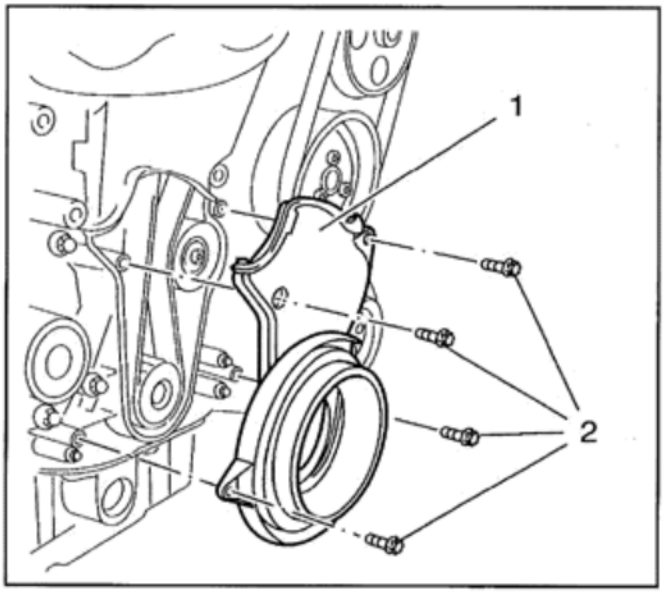
2027569

22. Remove the crankshaft balancer (2). Refer to *Crankshaft Balancer Replacement on page 9-1004*.



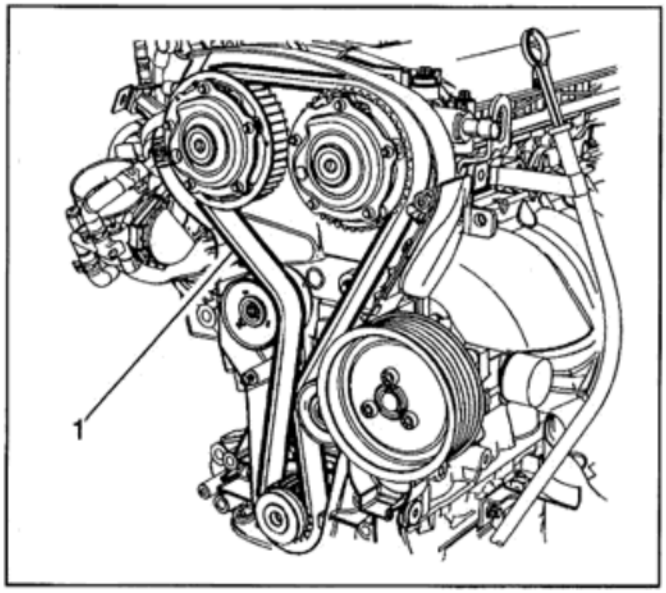
2504687

24. Remove the timing belt tensioner bolt (1) and the timing belt tensioner (2). Refer to *Timing Belt Tensioner Replacement on page 9-980*.



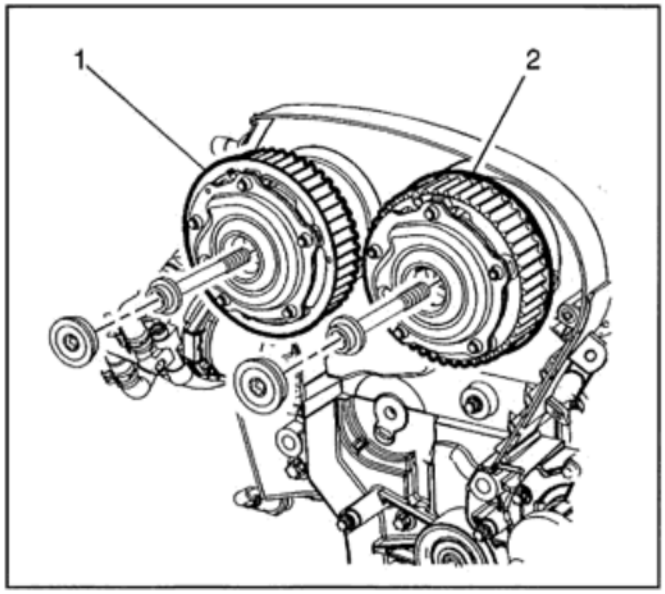
2026840

23. Remove the timing belt lower front cover (1). Refer to *Timing Belt Lower Front Cover Replacement on page 9-985*.



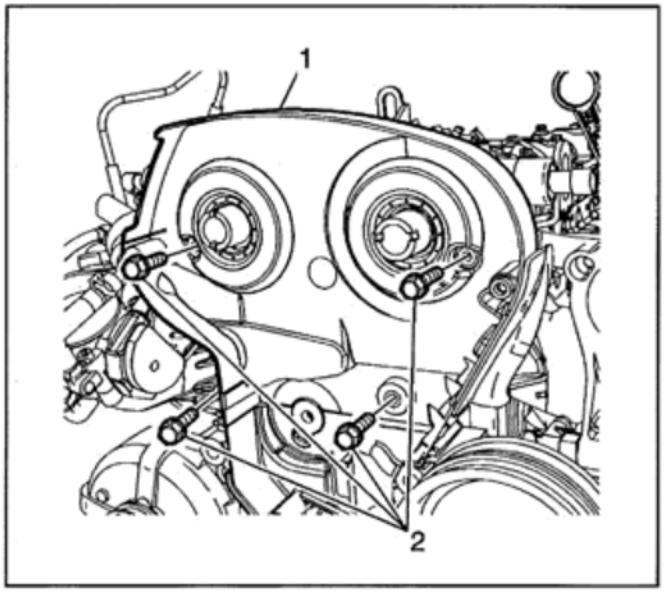
2506526

25. Remove the timing belt (1). Refer to *Timing Belt Replacement on page 9-975*.



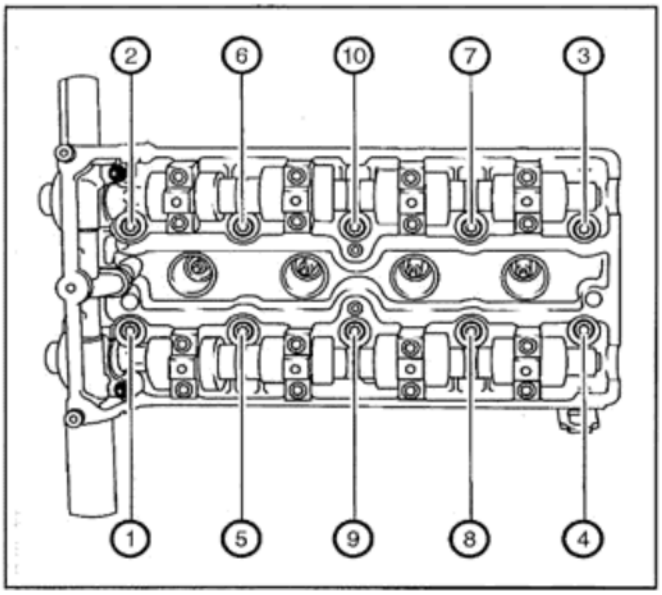
2506830

26. Remove the camshaft sprocket intake (1) and exhaust (2). Refer to *Camshaft Sprocket Replacement on page 9-987*.



2049388

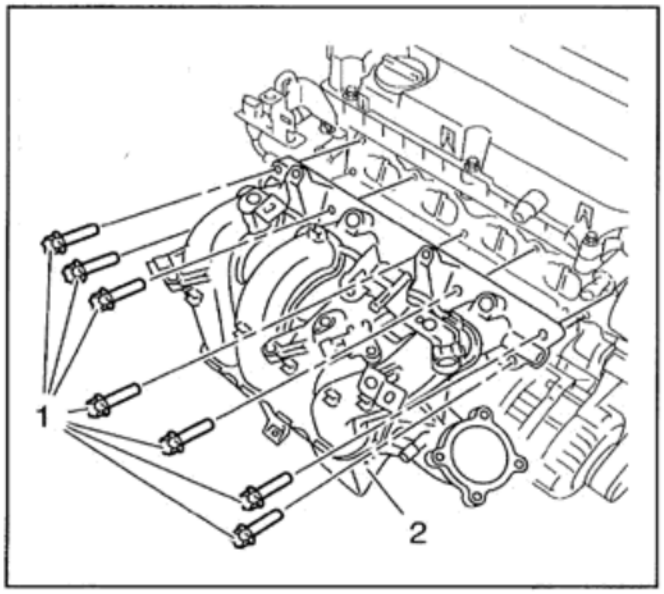
27. Remove the timing belt rear cover (1). Refer to *Timing Belt Rear Cover Replacement on page 9-986*.
28. Remove the exhaust manifold. Refer to *Exhaust Manifold with Catalytic Converter Replacement (LUW) on page 9-737*.
29. Place a floor jack with block of wood under the oil pan.
30. Remove the engine support fixture. Refer to *Engine Support Fixture on page 9-1060*.



2027932

Note: Disconnect electrical and reposition harness and hose as necessary.

31. Remove the ten cylinder head bolts in sequence as shown.
    - Loosen the 10 bolts 90°.
    - Loosen the 10 bolts 180°.
32. Remove the cylinder head and place on a suitable base.
33. Remove the cylinder head gasket.



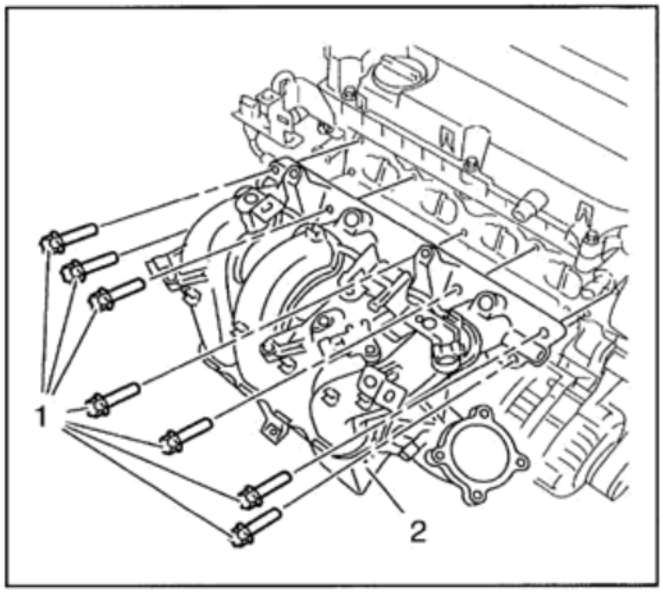
2026837

34. Remove the intake manifold bolts (1) intake manifold (2).
35. Remove engine coolant thermostat housing. Refer to *Engine Coolant Thermostat Housing Replacement (LUW) on page 9-659*.
36. Remove the 2 camshaft position actuator solenoid valve. Refer *Camshaft Position Actuator Solenoid Valve Replacement on page 9-574*.

37. Remove the 2 camshaft position sensor. Refer to *Camshaft Position Sensor Replacement on page 9-576*.
38. Clean and inspect the cylinder head. Refer to *Cylinder Head Cleaning and Inspection on page 9-1096*.
39. For disassembly of the cylinder head, refer to *Cylinder Head Disassemble on page 9-1090*.

Installation Procedure

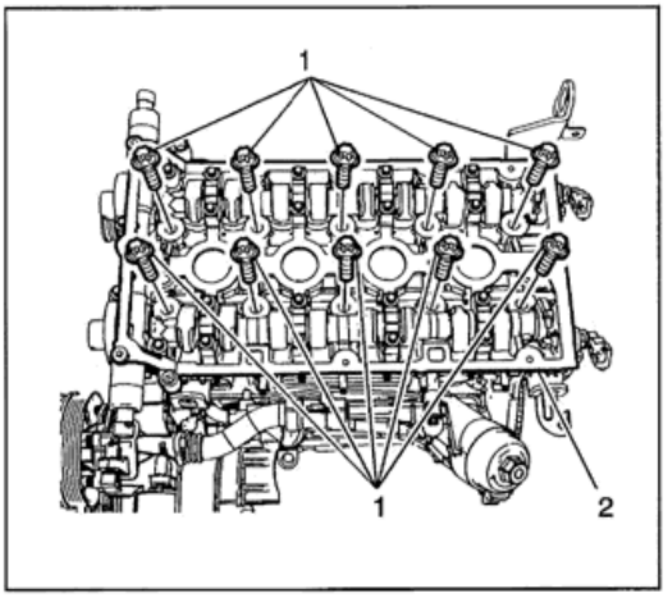
1. For assembly of the cylinder head, refer to *Cylinder Head Assemble on page 9-1105*.
2. Clean sealing surfaces of engine front cover and engine block from grease and old gasket material.
3. Install the 2 camshaft position sensor. Refer to *Camshaft Position Sensor Replacement on page 9-576*.
4. Install the 2 camshaft position actuator solenoid valve. Refer *Camshaft Position Actuator Solenoid Valve Replacement on page 9-574*.
5. Install engine coolant thermostat housing. Refer to *Engine Coolant Thermostat Housing Replacement (LUW) on page 9-659*.



2026837

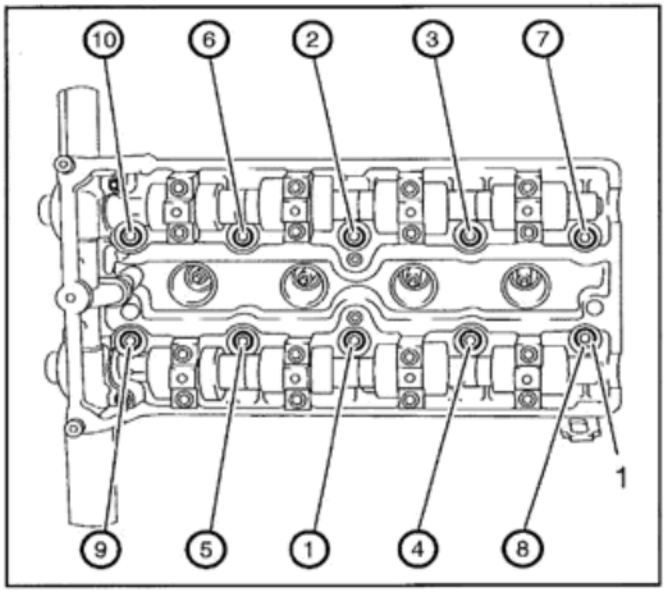
Caution: Refer to *Fastener Caution on page 0-8*.

6. Install the intake manifold (2) and the intake manifold bolts (1) and tighten to **20 N•m (15 lb ft)**.



2049556

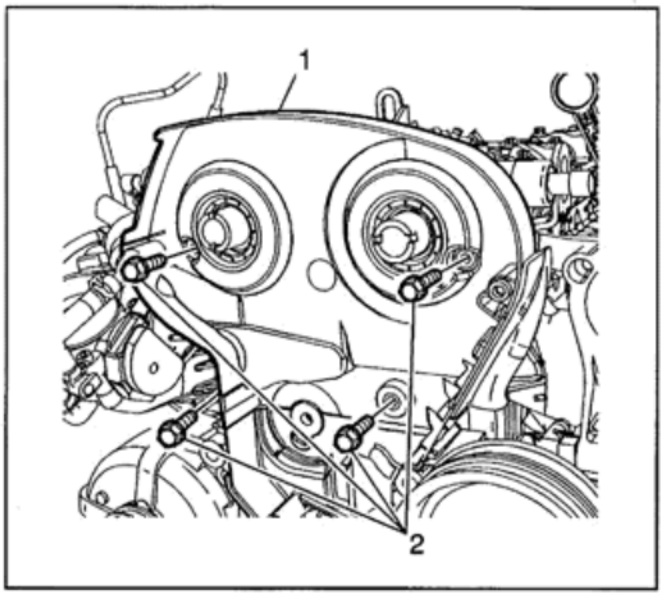
7. Install the cylinder head (2) with the NEW gasket and hand start the NEW bolts.



2027018

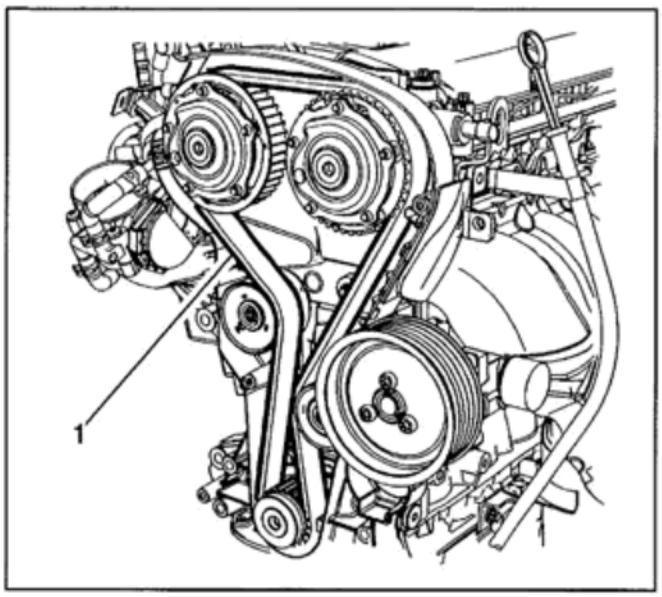
Note: Note the correct tightening sequence.

8. Tighten the bolts (1) in 5 passes. Use the EN-45059 sensor kit :
   - First pass to 25 N•m (18 lb ft).
   - Second pass to 90°.
   - Third pass to 90°.
   - Fourth pass to 90°.
   - Final pass to 45°.
9. Install engine support fixture. Refer to *Engine Support Fixture on page 9-1060*.
10. Remove the floor jack from the vehicle.
11. Install the exhaust manifold. Refer to *Exhaust Manifold with Catalytic Converter Replacement (LUW) on page 9-737*.



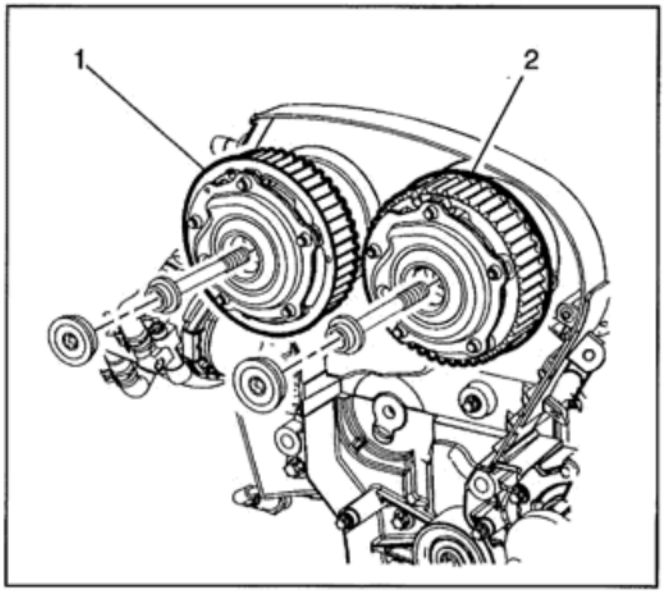
2049388

12. Install the timing belt rear cover (1) and tighten to **6 N•m (53.1 lb in)**.



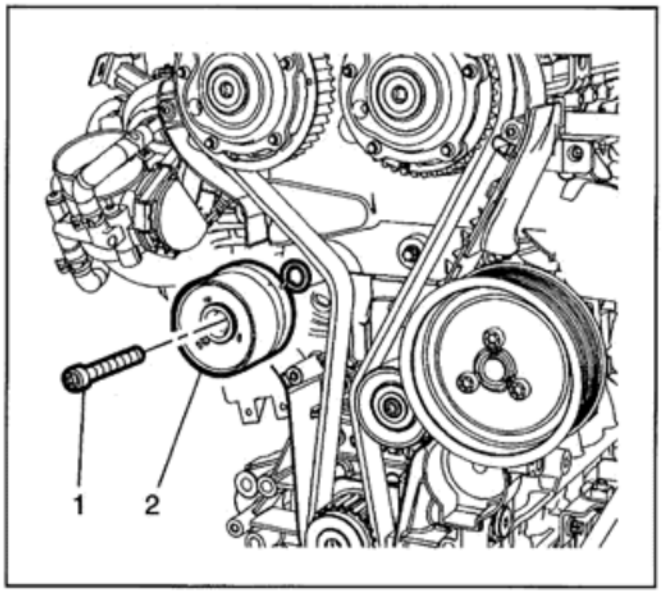
2506528

14. Install the timing belt (1). Refer to *Timing Belt Replacement on page 9-975*.



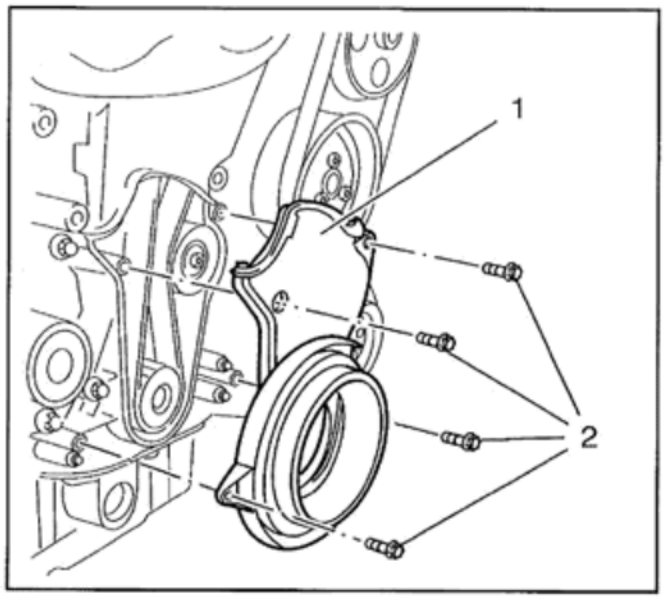
2506830

13. Install the camshaft sprocket intake (1) and exhaust (2). Refer to *Camshaft Sprocket Replacement on page 9-987*.



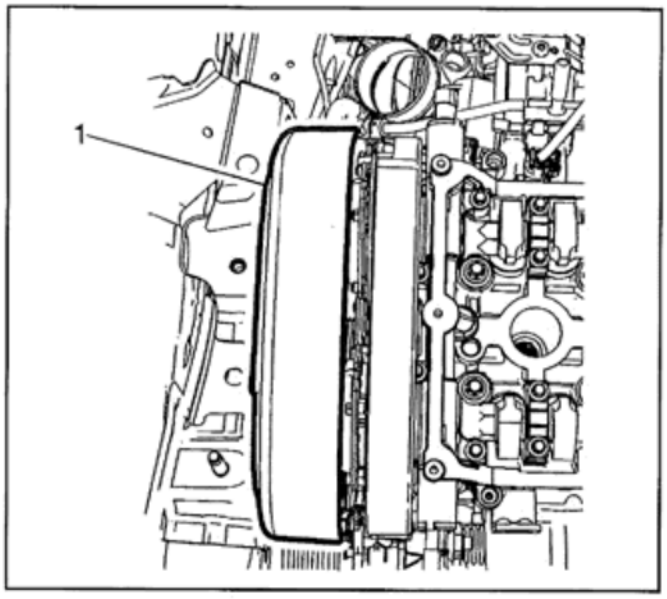
2504687

15. Install the timing belt tensioner bolt (1) and the timing belt tensioner (2). Refer to *Timing Belt Tensioner Replacement on page 9-980*.



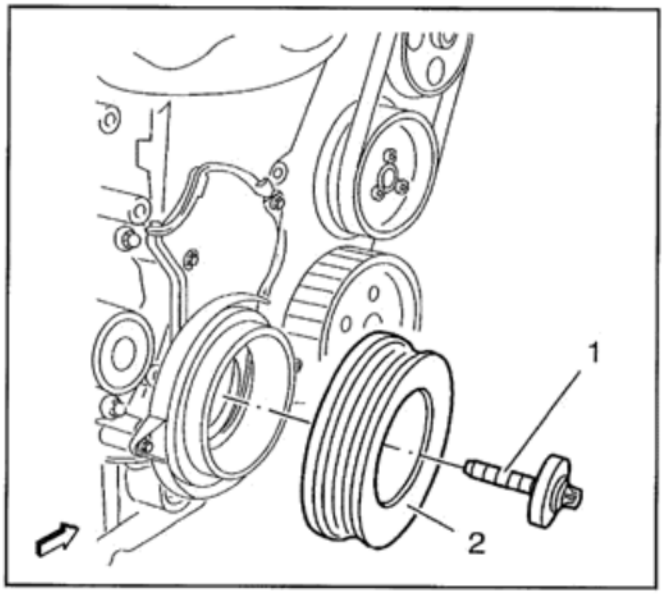
2026840

16. Install the timing belt lower front cover (1). Refer to *Timing Belt Lower Front Cover Replacement on page 9-985*.



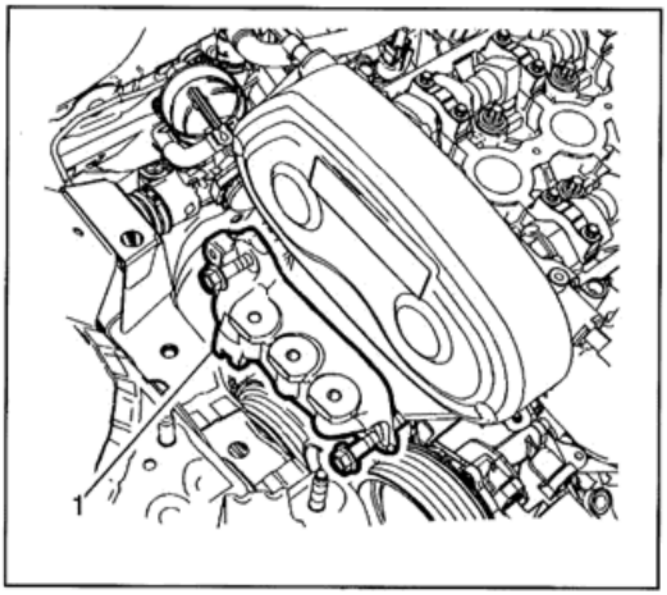
2506828

19. Install the upper timing cover (1). Refer to *Timing Belt Upper Front Cover Replacement on page 9-984*.



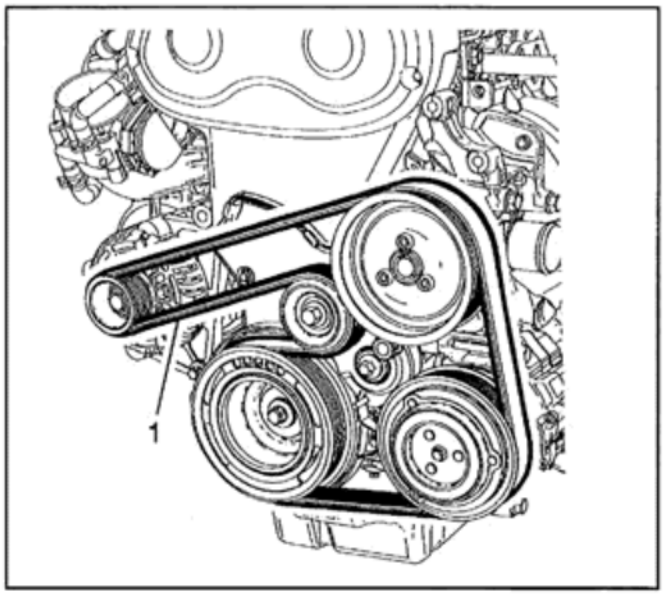
2027569

17. Install the crankshaft balancer (2). Refer to *Crankshaft Balancer Replacement on page 9-1004*.
18. Install the timing belt center front cover. Refer to *Timing Belt Center Front Cover Replacement on page 9-983*.



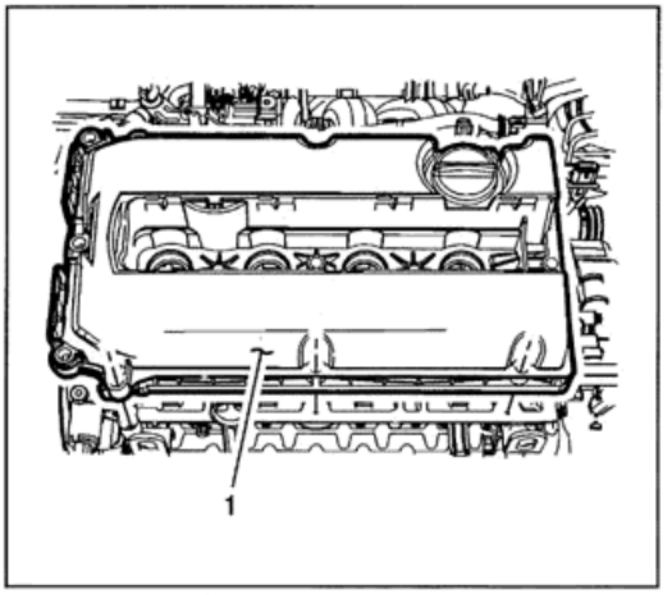
2506824

20. Install the engine mount bracket (1). Refer to *Engine Mount Bracket Replacement on page 9-968*.



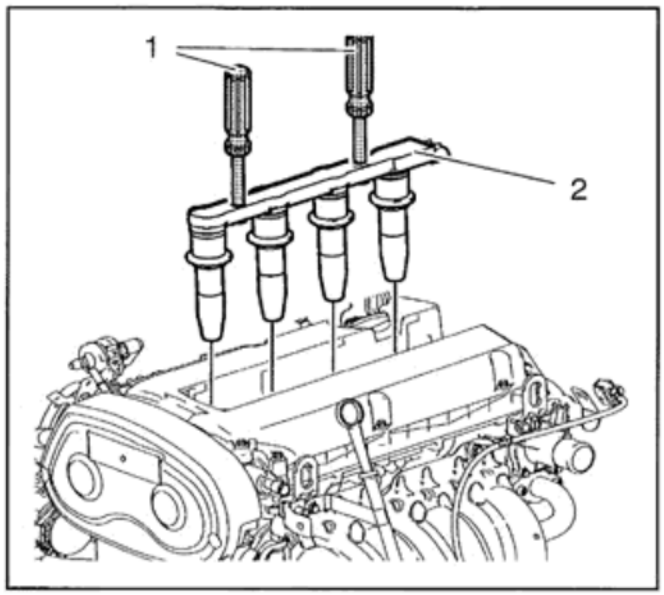
2512912

21. Install the drive belt (1). Refer to *Drive Belt Replacement on page 9-964*.
22. Install the engine mount. Refer to *Engine Mount Replacement on page 9-967*.
23. Remove engine support fixture. Refer to *Engine Support Fixture on page 9-1060*.



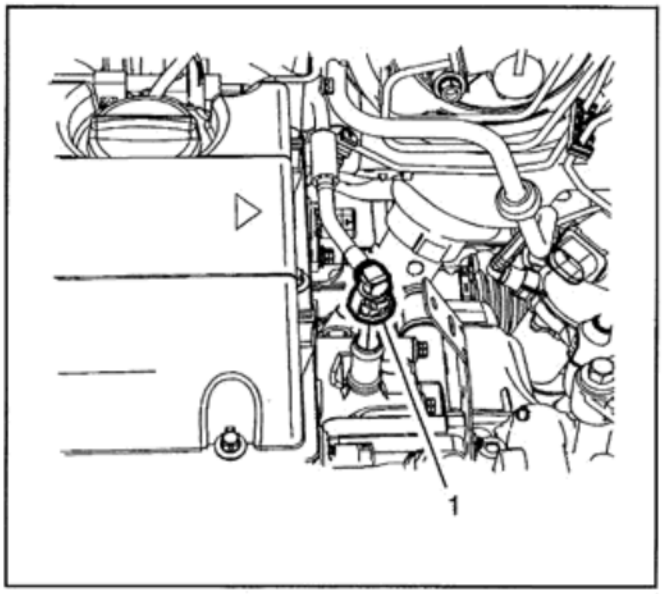
2506823

24. Install the camshaft cover (1). Refer to *Camshaft Cover Replacement on page 9-1050*.
25. Connect PCV hose. Refer to *Positive Crankcase Ventilation Hose/Pipe/Tube Replacement on page 9-1009*.



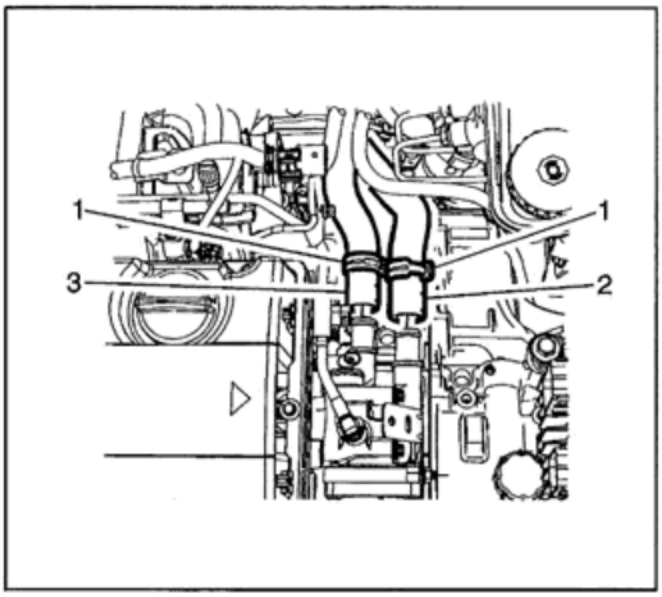
2026537

26. Install the ignition coil (2) . Refer to *Ignition Coil Replacement on page 9-570*.



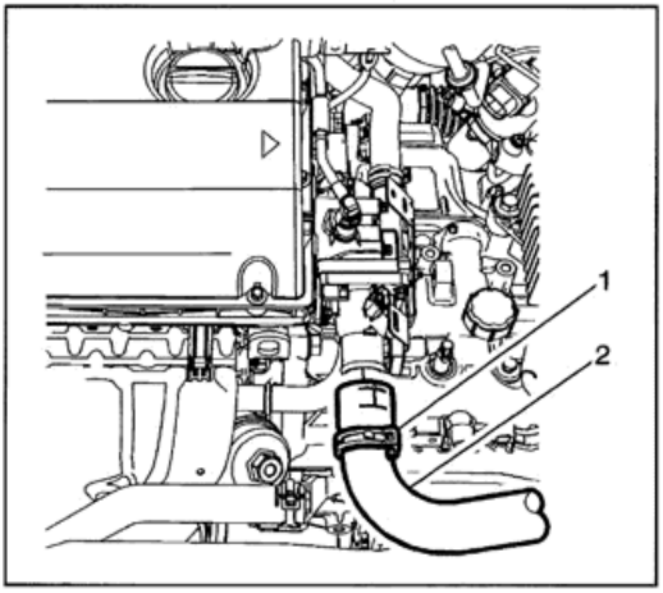
2506822

27. Connect the throttle body heater inlet pipe (1).



2506820

28. Install the inlet hose (2) and outlet (3) to the engine.
29. Install the inlet and outlet heater hose clamp (1) at the engine using *BO-38185* pliers.



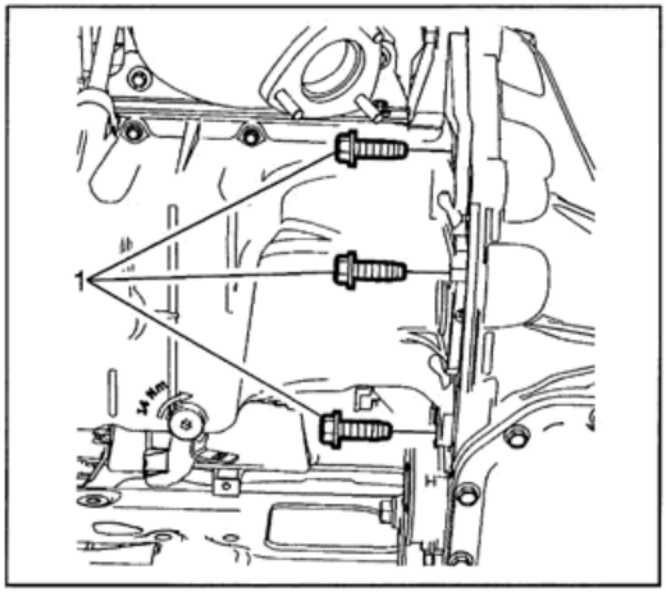
2506800

30. Install the radiator inlet hose (2) to the engine.
31. Install the radiator inlet hose clamp (1) at the engine using *BO-38185* pliers.
32. Install the coolant surge tank. Refer to *Radiator Surge Tank Replacement on page 9-630*.
33. Connect the fuel feed pipe. Refer to *Fuel Feed Pipe Replacement on page 9-557*.
34. Connect EVAP purge solenoid pipes from solenoid. Refer to *Evaporative Emission System Hose/Pipe Replacement on page 9-565*.
35. Fill the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.
36. Connect the negative battery cable. Refer to *Battery Negative Cable Disconnection and Connection on page 9-713*.
37. Check and correct the engine oil.

Oil Pan Replacement

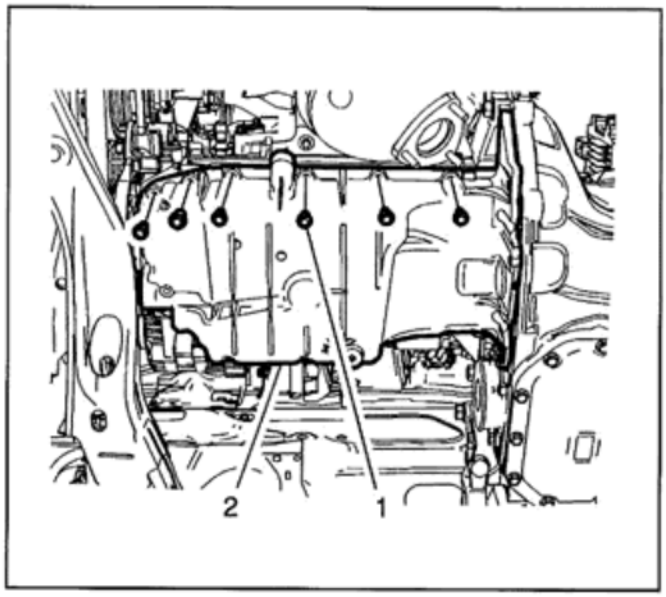
Removal Procedure

1. Drain the engine oil . Refer to *Engine Oil and Oil Filter Replacement on page 9-1046*.
2. Remove the oil level indicator tube. Refer to *Oil Level Indicator Tube Replacement on page 9-1017*
3. Remove the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left SIde) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right SIde, LWE, LUW) on page 3-149*
4. Remove the exhaust flexible pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*



2501593

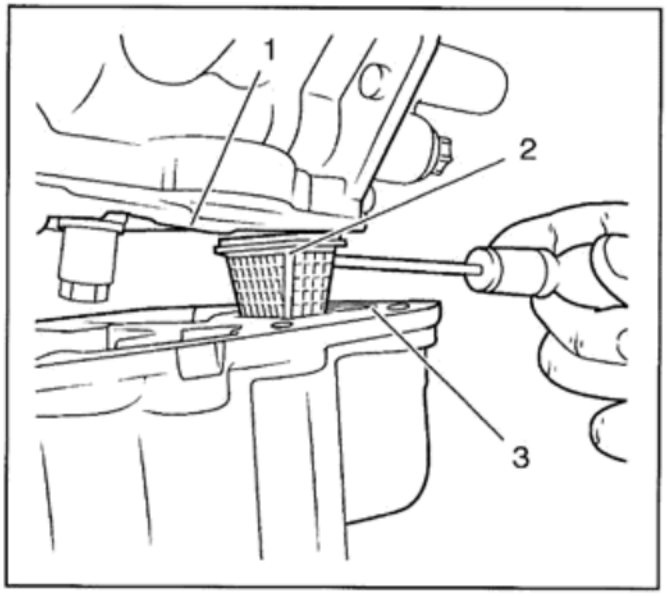
5. Remove the oil pan bolts (1) from the transmission.



2501594

Note: Remove the oil pan evenly all the way around with a suitable tool.

6. Remove the oil pan bolts (1) and remove the oil pan (2).

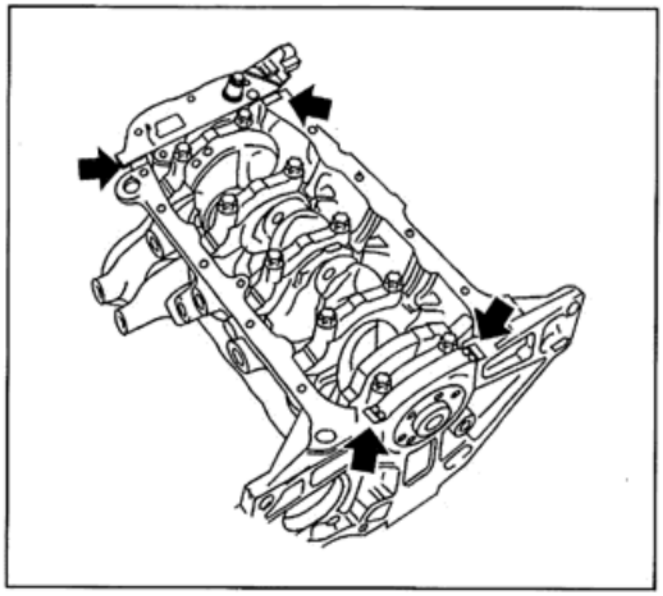


2028080

7. To prevent damage to the oil screen, ensure that the oil screen (2) remains in the oil pan (3). If the oil screen gets caught on the cylinder block (1), push it into the oil pan.
8. Remove the oil pan.

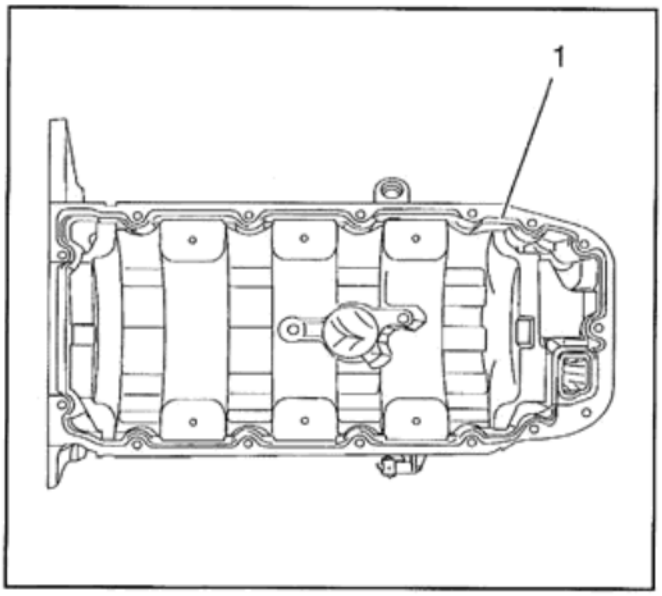
Installation Procedure

1. Clean the sealing surfaces.



1944491

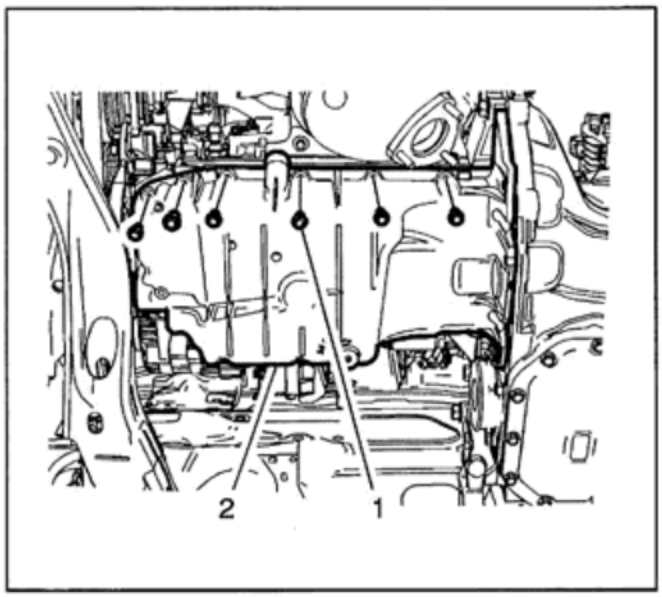
2. Apply an approximately 3.5 mm (0.14 in) thick bead of oil pan sealant to the joints (arrows).



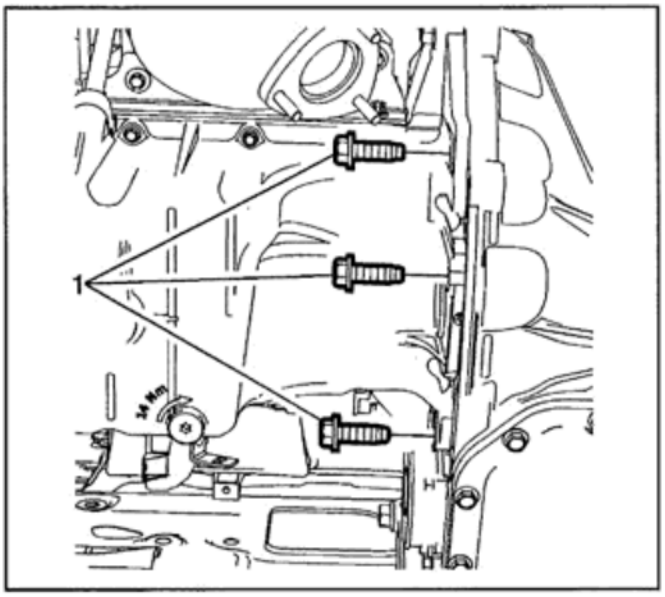
2189266

Note: The assembly time including torque check must take no longer than 10 minutes.

3. Apply an approximately 3.5 mm (0.14 in) thick bead of oil pan sealant (1) as illustrated.



2501594

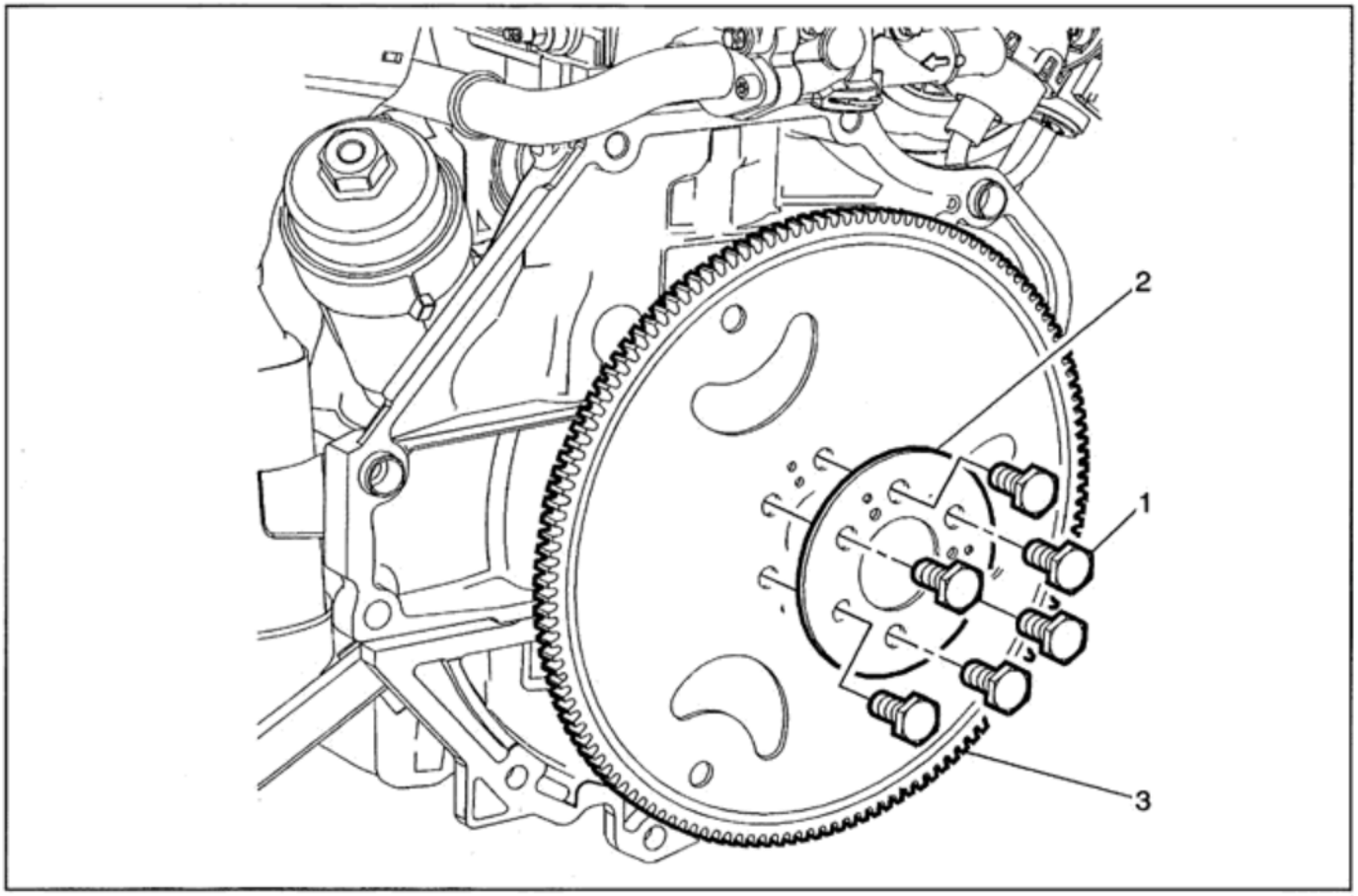


2501593

Caution: Refer to *Fastener Caution on page 0-8*

4. Install the oil pan bolts (1) to the oil pan (2) and tighten to **10** N•m **(89 lb in)**.
5. Install the oil pan bolts (1) and (2) to the transmission and tighten to **40** N•m **(30 lb ft)**.
6. Install the exhaust flexible pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*
7. Install the front wheelhouse liner Inner front extension. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left SIde) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right SIde, LWE, LUW) on page 3-149*.
8. Install the oil level indicator tube. Refer to *Oil Level Indicator Tube Replacement on page 9-1017*
9. Refill the engine oil . Refer to *Engine Oil and Oil Filter Replacement on page 9-1046*.

Automatic Transmission Flex Plate Replacement

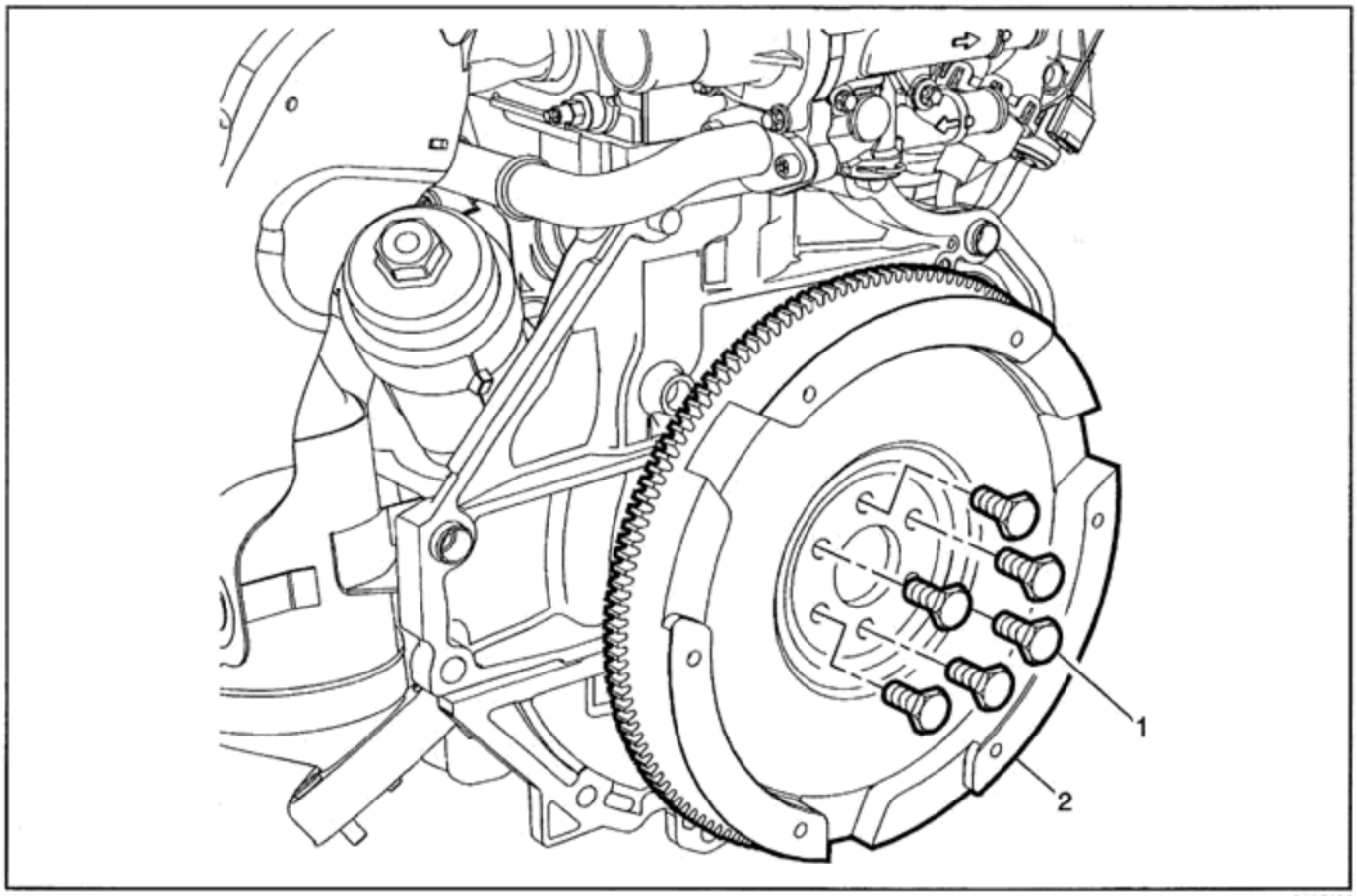


2498791

Automatic Transmission Flex Plate Replacement

Callout	Component Name
Preliminary Procedure Remove the transmission. Refer to *Transmission Replacement (With 1.6L or 1.8L Engine) on page 17-221* or *Transmission Replacement (With 1.2L or 1.4L Engine) on page 17-218*. **Special Tools** *EN 652* Automatic Transmission Flex Plate Holder. For equivalent regional tools. Refer to *Special Tools on page 9-1135*.	
1	Automatic Transmission Flex Plate Fastener (Qty: 6) **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** • 60 N•m (44 lb ft) • Tighten the bolt an additional 5 degrees.
2	Flex Plate
3	Automatic Transmission Flex Plate **Procedure** Inspect the engine flex plate for the following: 1. Stress cracks around the engine flex plate. 2. Cracks at welded areas that retain the ring gear onto the engine flex plate. 3. Damaged or missing ring gear teeth. 4. Do not attempt to repair the welded areas that retain the ring gear to the flex plate.

Engine Flywheel Replacement

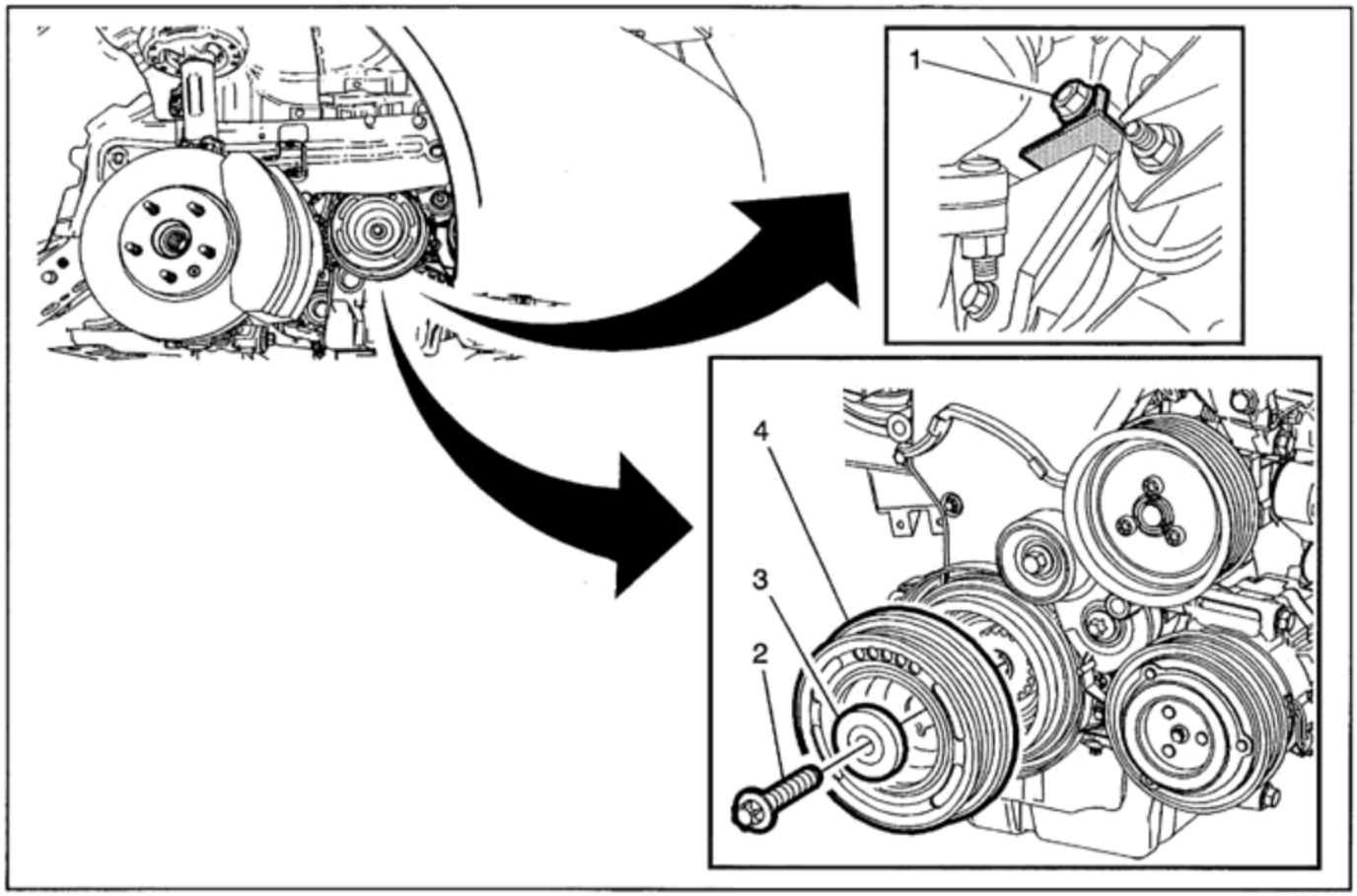


2495480

Engine Flywheel Replacement

Callout	Component Name
Preliminary Procedure Remove the clutch pressure and driven Plate . Refer to *Clutch Pressure and Driven Plate Replacement (1.4L) on page 17-416* or *Clutch Pressure and Driven Plate Replacement (1.8L) on page 17-419*. **Special Tools** • *EN-652* Flywheel Holder • *EN-45059* Torque Angle Sensor Kit For equivalent regional tools. Refer to *Special Tools on page 9-1135*.	
1	Flywheel Fastener (Qty: 6) **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** Discard the flywheel fastener and use a NEW fastener for installation. **Tighten** • First pass to 35 N•m (26 lb ft) • Second pass to additional 30°. • Final pass to an additional 15°.
2	Flywheel **Procedure** Inspect the engine flywheel for the following: 1. Stress cracks around the engine flywheel. 2. Cracks at welded areas that retain the ring gear onto the engine flywheel. 3. Damaged or missing ring gear teeth. 4. Do not attempt to repair the welded areas that retain the ring gear to the engine flywheel plate. Install a new engine flywheel.

Crankshaft Balancer Replacement



2498204

Crankshaft Balancer Replacement

Callout	Component Name
Preliminary Procedure Remove the drive belt. Refer to *Drive Belt Replacement on page 9-964*.	
1	Engine to Transmission Fastener **Caution:** Refer to *Fastener Caution on page 0-8*. **Procedure** 1. Install the *EN-6625* device on the stud. 2. Ensure the locking device is engaged on the flywheel teeth. 3. Install the engine to transmission nut to hold the locking device. • For Manual Transmission, tighten to **75** N•m **(55 lb ft)** • For Automatic Transmission, tighten to **40** N•m **(30 lb ft)** **Special Tools** *EN-6625* Flywheel Locking Device For equivalent regional tools, refer to *Special Tools on page 9-1135*.
2	Crankshaft Balancer Bolt **Procedure** Discard the crankshaft balancer bolt and use a NEW bolt for installation. **Tighten** 1. 95 N•m (70 lb ft) 2. First pass tighten the bolt to 45 degrees. 3. Final pass tighten the bolt to 15 degrees. **Special Tools** *EN-45059* Torque Angle Sensor Kit. For equivalent regional tools, refer to *Special Tools on page 9-1135*.

Crankshaft Balancer Replacement (cont'd)

Callout	Component Name
3	Crankshaft Balancer Washer
4	Crankshaft Balancer

Crankshaft Front Oil Seal Replacement

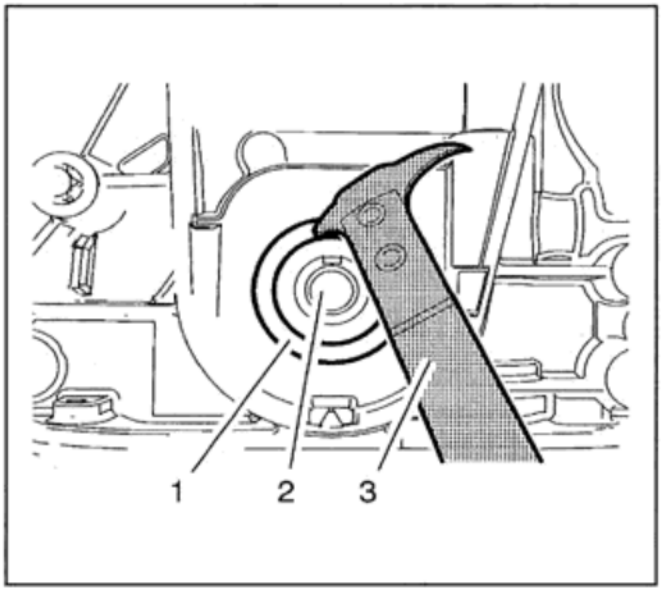
Special Tools

- *EN-6351* Mounting Sleeves
- *EN-45000* Remover

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

Removal Procedure

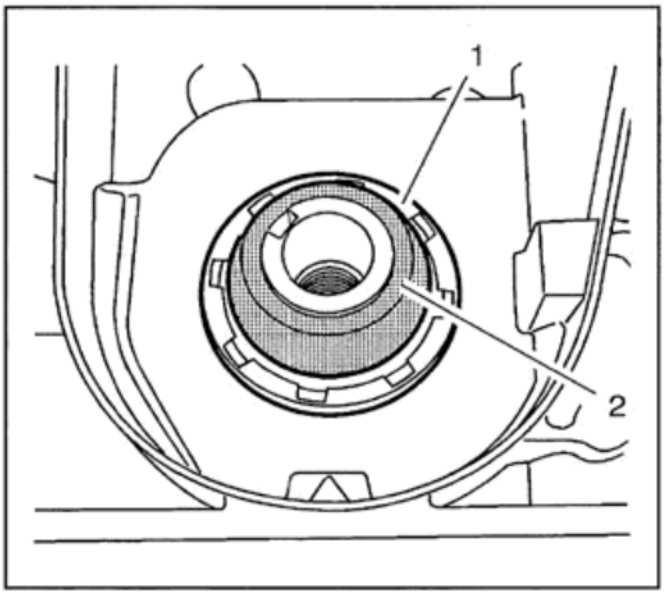
1. Remove the crankshaft sprocket. Refer to *Crankshaft Sprocket Replacement on page 9-1008*.



2501418

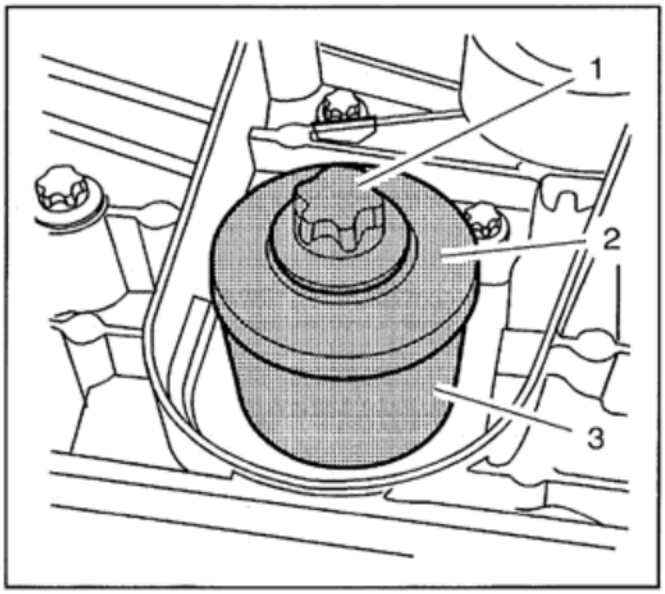
2. Using the EN-45000 remover (3), remove the crankshaft front oil seal (1) from the crankshaft (2).

Installation Procedure



2373394

1. Clean the sealing surfaces.
2. Slide the *EN-6351* sleeves (2) protective sleeve onto the crankshaft journal.
3. Slide the crankshaft front oil seal (1) over the protective sleeve on the crankshaft journal.



2373395

4. Remove the protective sleeve, and using the *EN-6351* sleeves (3), press the seal ring into the pump housing.
5. Use the crankshaft drive gear bolt (1) and washer (2) to press in the crankshaft front oil seal.

6. Install the crankshaft sprocket. Refer to *Crankshaft Sprocket Replacement on page 9-1008*.

Crankshaft Rear Oil Seal Replacement

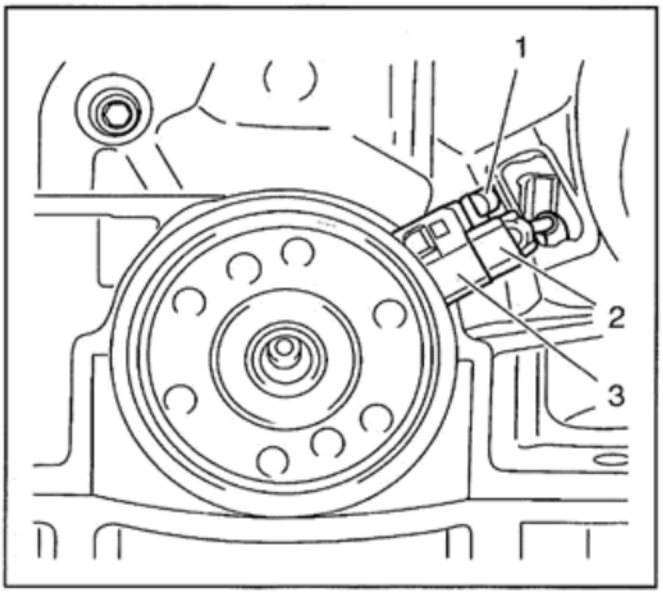
Special Tools

- *EN-235-D* Installer
- *EN-235-6* Installer
- *EN-328-B Pin* Pin Remover
- *EN-658-1* Installer
- *EN-6624* Remover

For equivalent regional tools. Refer to *Special Tools on page 9-1135*.

Removal Procedure

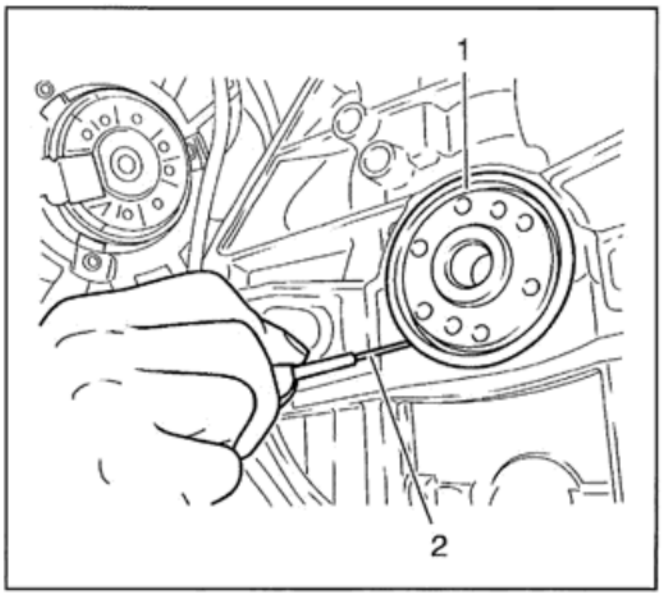
1. If equipped with a manual transmission remove the flywheel. Refer to *Engine Flywheel Replacement on page 9-1003*.
2. If equipped with a automatic transmission, remove the automatic transmission flex plate. Refer to *Automatic Transmission Flex Plate Replacement on page 9-1002*.



2027003

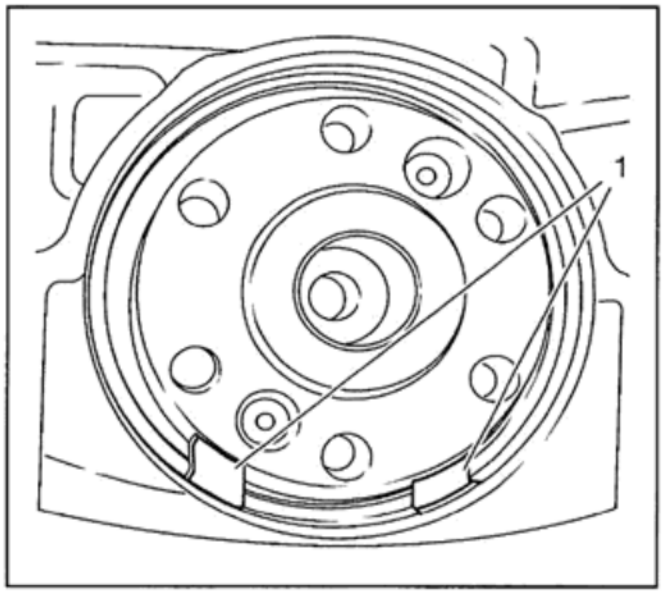
Caution: Do not allow the crankshaft encoder wheel to come into contact with external magnetic fields or sharp metal objects. Do not drop the crankshaft encoder wheel. Do not damage the rubberized encoder track. Failure to follow these precautions may cause damage to the component.

3. Remove the crankshaft position sensor bolt (1).
4. Remove the crankshaft position sensor (2) from the crankshaft rear oil seal housing.
5. Remove the crankshaft rear oil seal housing (3).



2189366

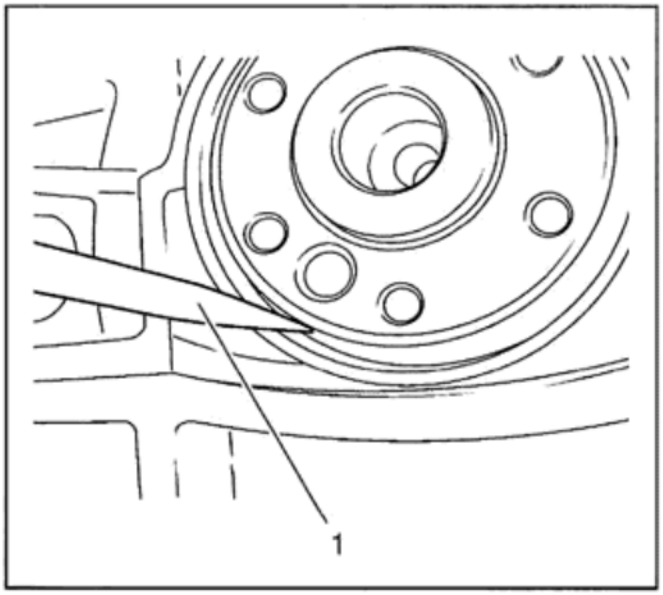
6. Remove the plastic ring (1) with a flat bladed tool (2).



2027001

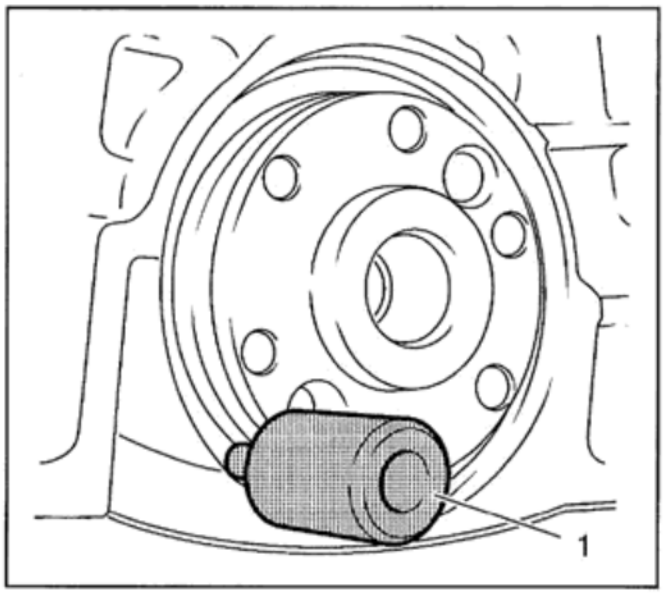
Note: The diameter of the hole must not exceed 2 mm (0.0787 in). If the diameter of the hole exceeds 2 mm (0.0787 in), the bolt of EN-6624 remover will not be able to grip.

7. Only make a hole at the 5 o'clock and 7 o'clock positions (1), these are the only positions where is a cavity behind the seal ring.



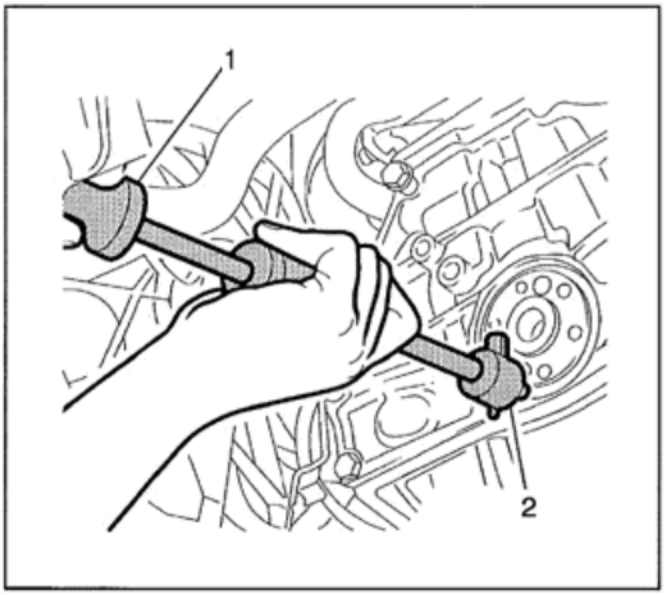
2027002

8. Position the scribe (1) at the outer edge of the crankshaft rear oil seal.
9. Remove the seal ring.



2027005

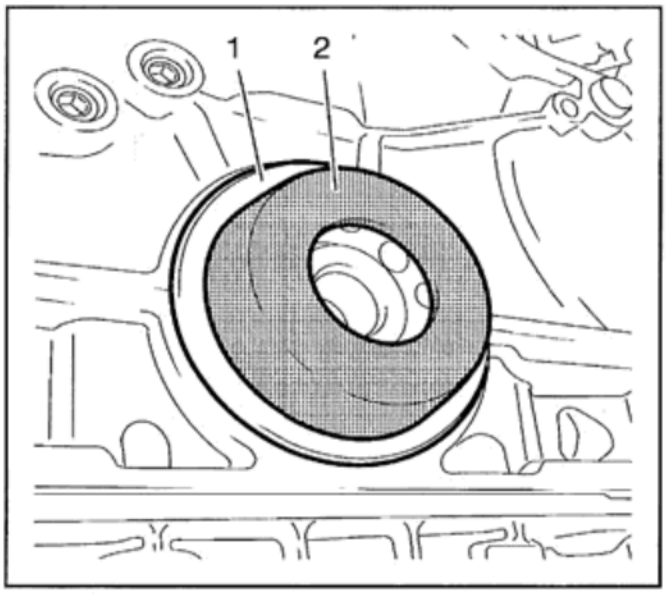
10. Install *EN-6624* remover (1) to the crankshaft rear oil seal and tighten the bolt.



2526186

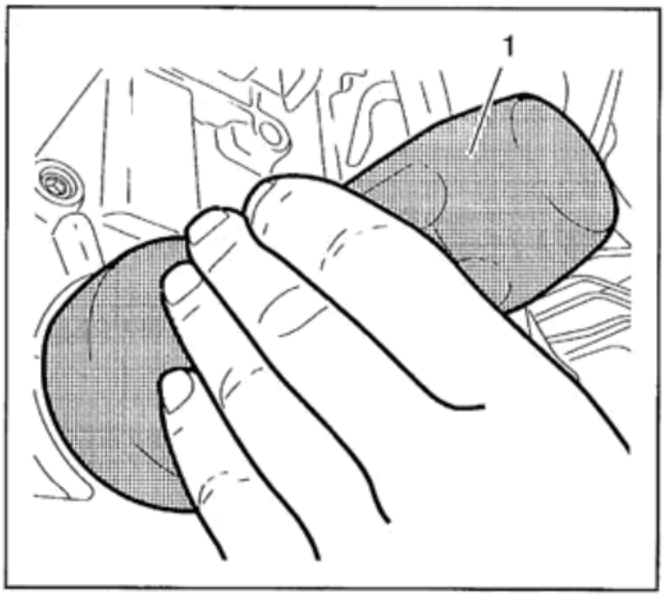
11. Install the *EN-328-B* remover (1) to *EN-6624* remover (2).
12. Using the *EN-328-B* remover (1) and *EN-6624* remover (2) to remove the crankshaft rear oil seal.

Installation Procedure



2190821

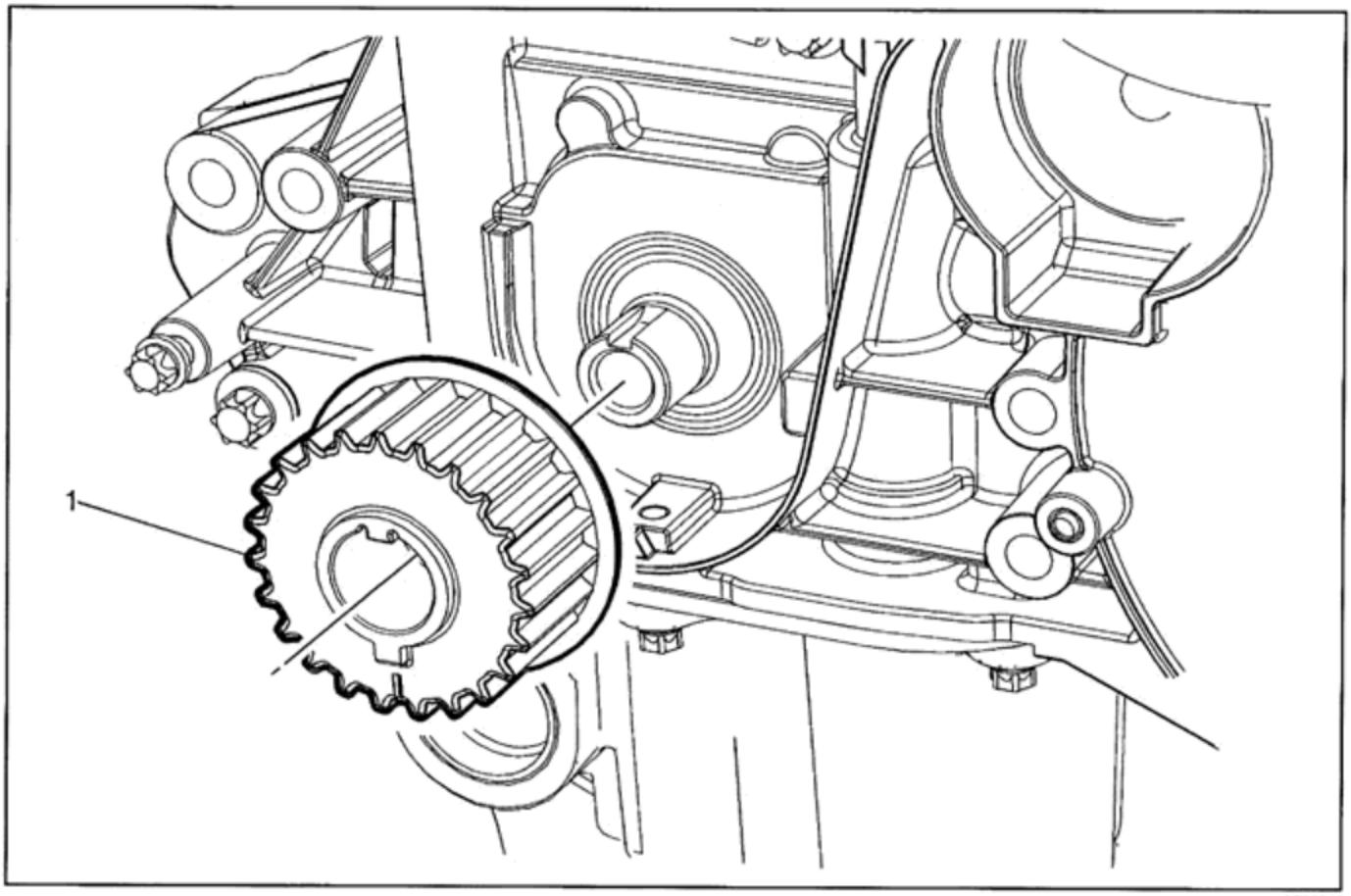
1. Install the crankshaft rear oil seal (1) with *EN-235-6* installer (2) contained in *EN-235-D* kit.



2190822

2. Use *EN-658-1* installer (1) to strike the crankshaft rear oil seal.
3. If equipped with a manual transmission install the flywheel. Refer to *Engine Flywheel Replacement on page 9-1003*.
4. If equipped with a automatic transmission, install the automatic transmission flex plate. Refer to *Automatic Transmission Flex Plate Replacement on page 9-1002*.

Crankshaft Sprocket Replacement

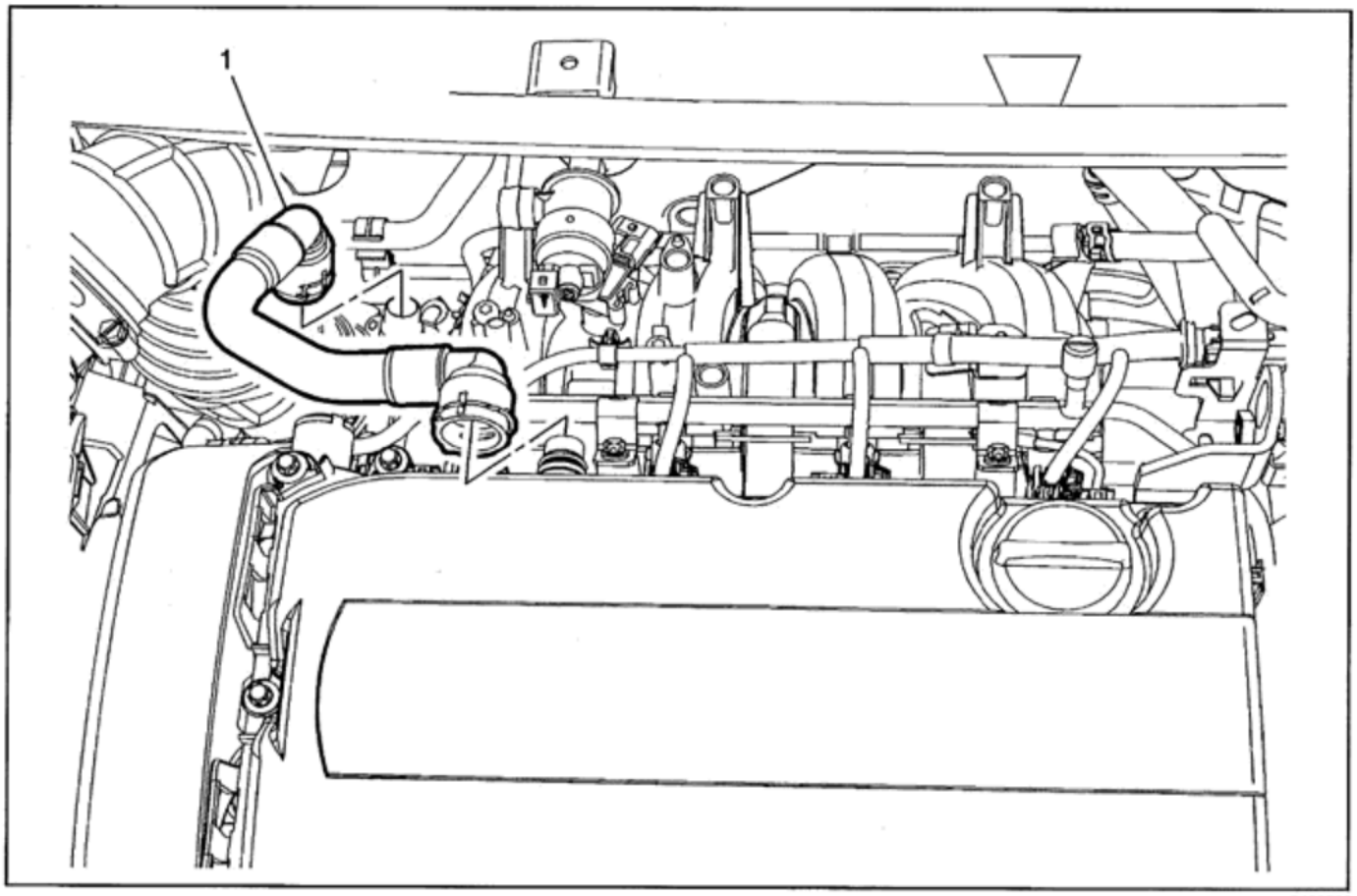


2506945

Crankshaft Sprocket Replacement

Callout	Component Name
Preliminary Procedure Remove the timing belt. Refer to *Timing Belt Replacement on page 9-975.*	
1	Crankshaft Sprocket **Procedure** When installing the crankshaft sprocket, the sprocket and the groove must align.

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement



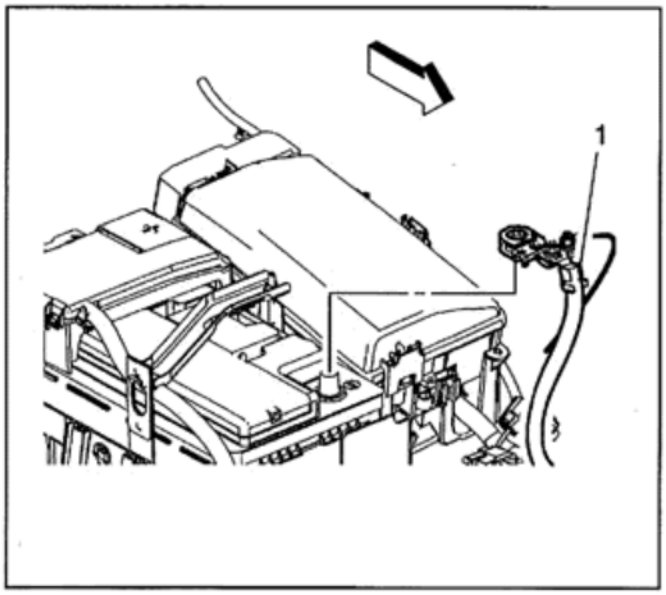
2498708

Positive Crankcase Ventilation Hose/Pipe/Tube Replacement

Callout	Component Name
1	Positive Crankcase Ventilation Hose/Pipe/Tube **Procedure** 1. Release the quick connects. 2. Disconnect electrical connectors as necessary.

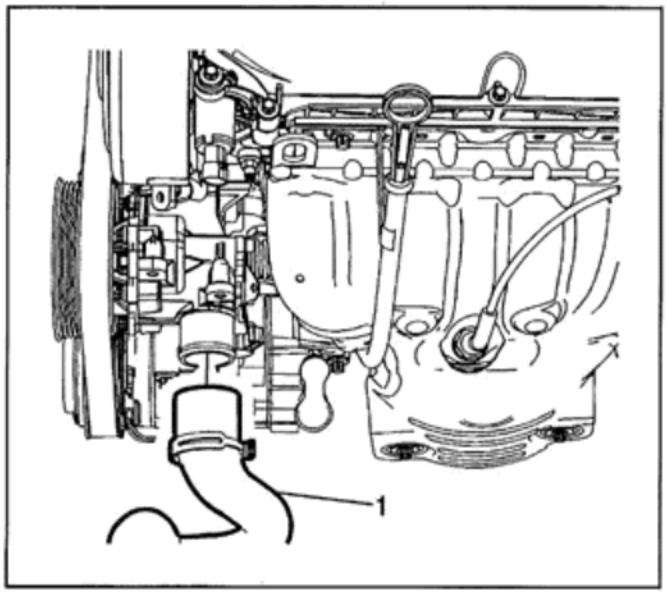
Engine Front Cover with Oil Pump Replacement

Removal Procedure



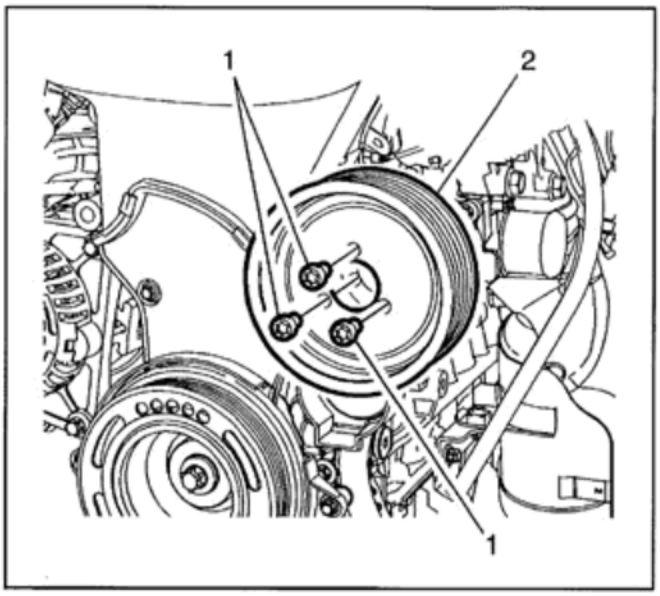
2521420

1. Disconnect the negative battery cable (1). Refer to *Battery Negative Cable Disconnection and Connection on page 9-713*.
2. Drain the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.



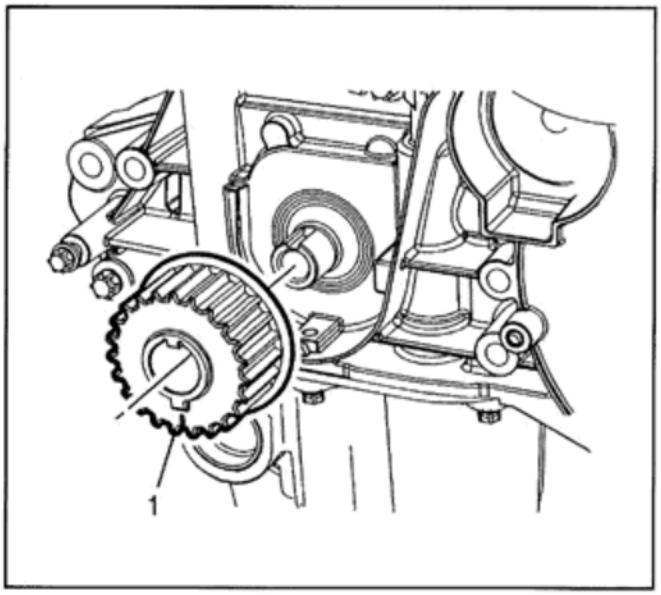
2534391

3. Remove the radiator outlet hose (1) from the water pump. Refer to *Radiator Outlet Hose Replacement (LUV) on page 9-635* or *Radiator Outlet Hose Replacement (LDE LUW) on page 9-636*.
4. Remove the exhaust manifold. Refer to *Exhaust Manifold with Catalytic Converter Replacement (LUW) on page 9-737*.



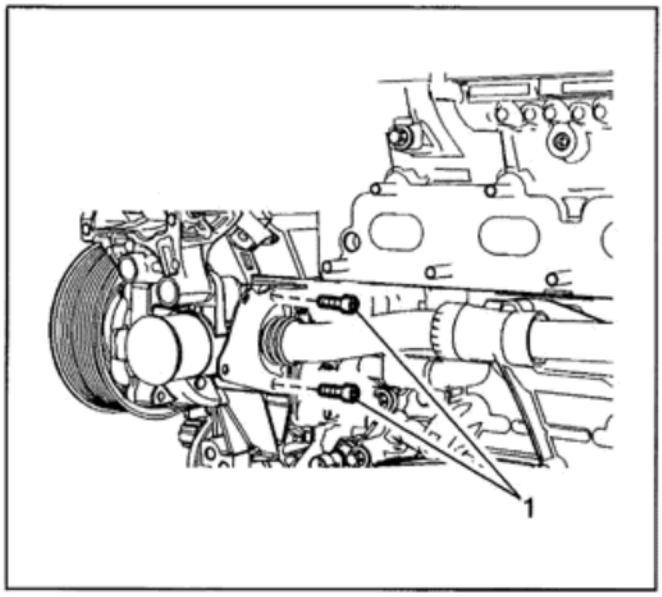
2505668

5. Loosen the bolts before the belt is removed.
6. Remove the water pump bolts (1) and water pump pulley (2). Refer to *Water Pump Pulley Replacement (LUV) on page 9-670* or *Water Pump Pulley Replacement (LUW) on page 9-671*.
7. Remove the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.
8. Remove the air conditioning compressor. Refer to *Air Conditioning Compressor Replacement (LDE, LUW, LWE) on page 10-16* or *Air Conditioning Compressor Replacement (LUV) on page 10-17*.
9. Remove the timing belt tensioner. Refer to *Timing Belt Tensioner Replacement on page 9-980*.



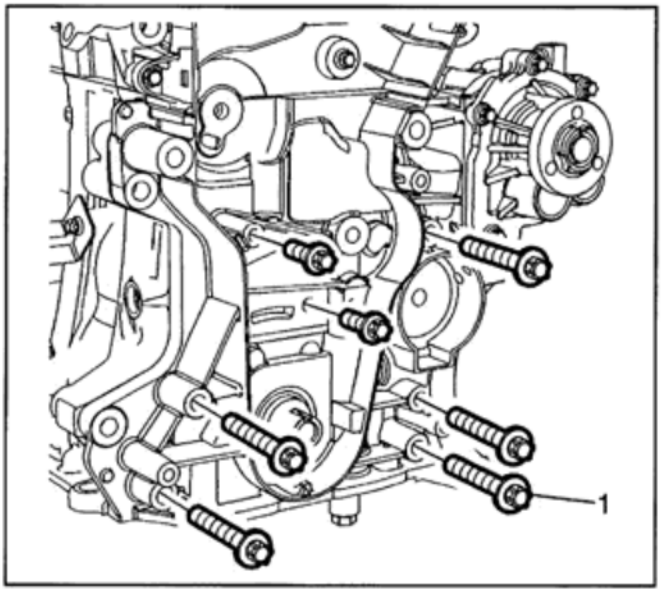
2534389

10. Remove the crankshaft sprocket (1). Refer to *Crankshaft Sprocket Replacement on page 9-1008*.
11. Remove the oil pan. Refer to *Oil Pan Replacement on page 9-999*.



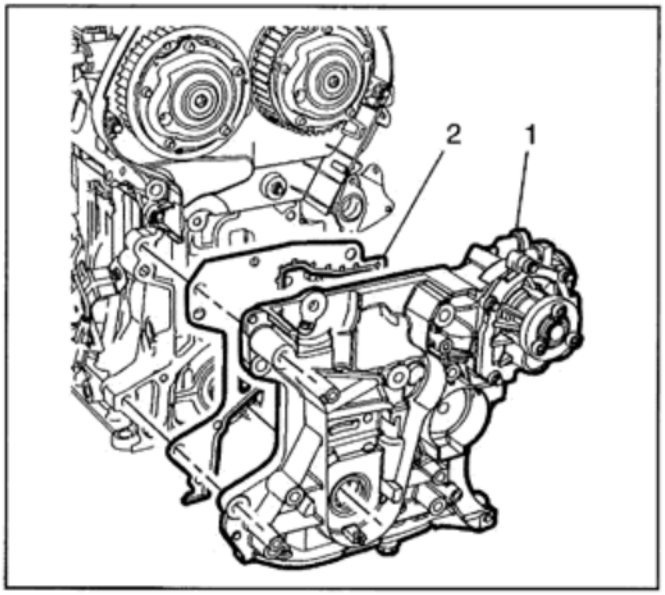
2505669

12. Remove the engine oil cooler outlet pipe bolt (1).



2505670

13. Remove the engine front cover bolts (1).



2505672

14. Remove the engine front cover (1).
15. Remove the engine front cover seal (2).

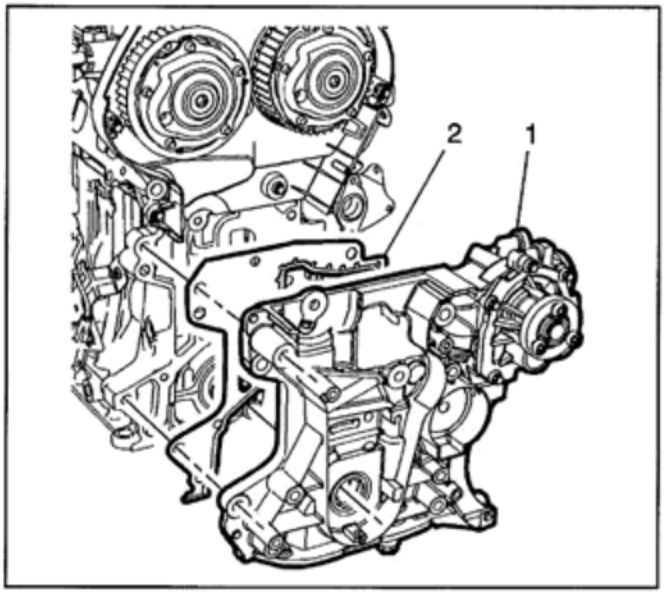
Note: Do NOT use sharp and/or metal gasket scrapers in order to clean the sealing surfaces

16. Carefully clean the engine front cover sealing surfaces.

Note: Insert a piece of cardboard between the oil pan front and the oil pump in order to prevent any contaminants from falling into the oil pan.

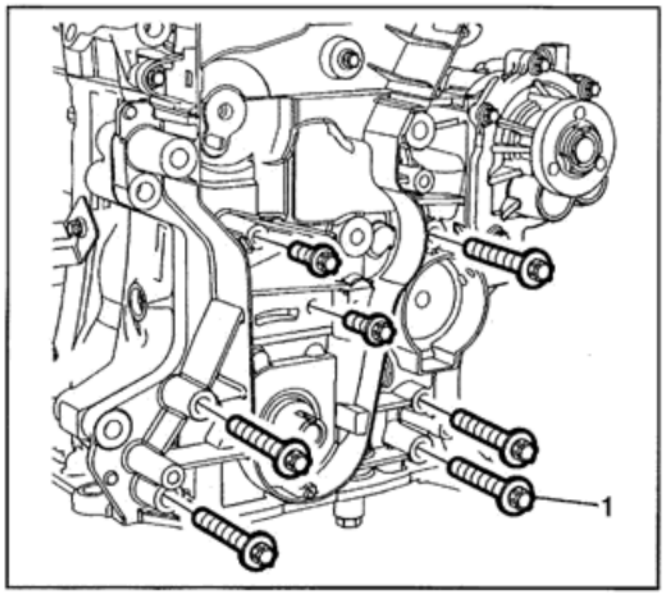
17. Use compressed air in order to remove any engine coolant from the engine cooling passages and from the top of the oil pan scraper (windage tray).

Installation Procedure



2505672

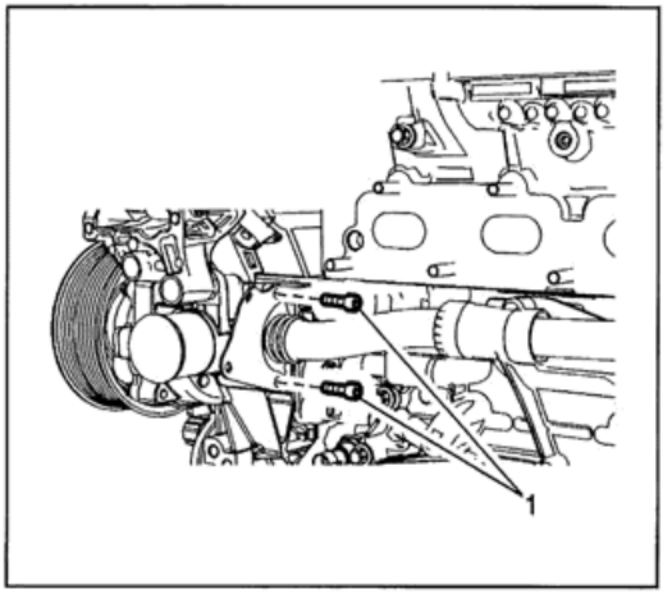
1. Install a NEW engine front cover seal (2).
2. Install the engine front cover (1).



2505670

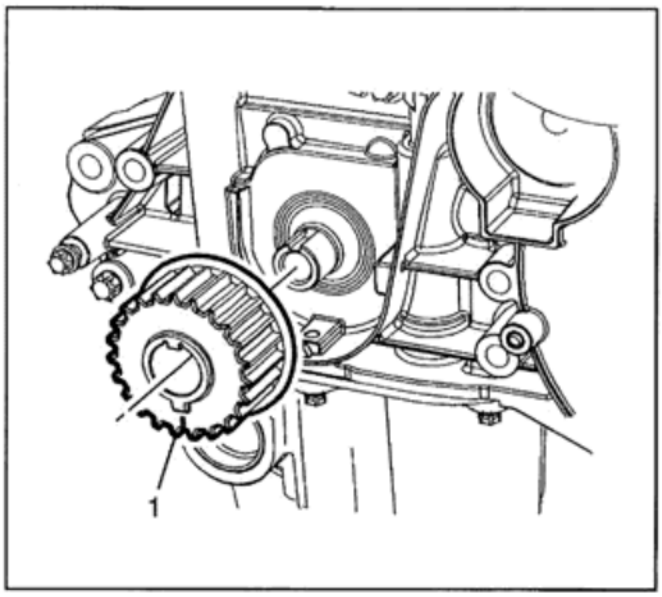
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the engine front cover bolts (1) and tighten to **20 N•m (15 lb ft)**.



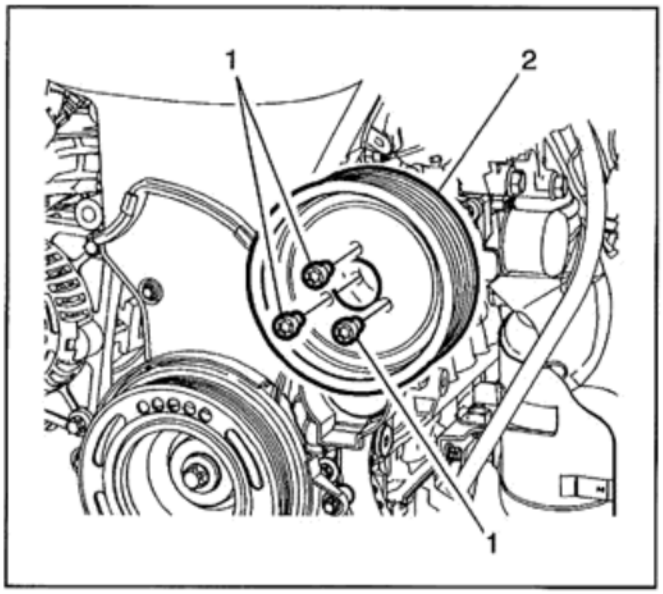
2505669

4. Install the engine oil cooler outlet pipe bolt (1) and tighten to **8 N•m (71 lb in)**.
5. Install the oil pan. Refer to *Oil Pan Replacement on page 9-999*.



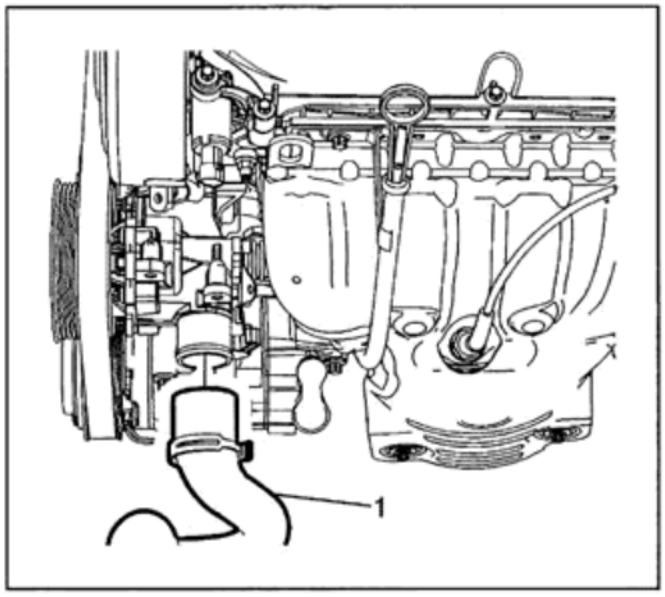
2534389

6. Install the crankshaft sprocket (1). Refer to *Crankshaft Sprocket Replacement on page 9-1008*.



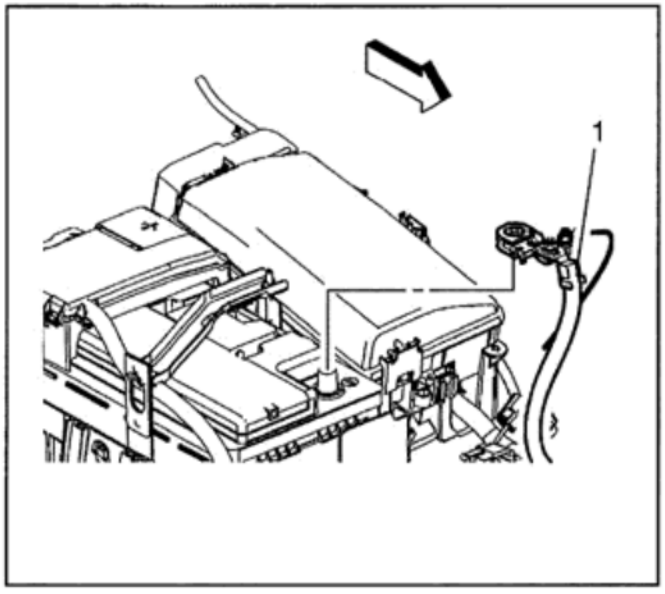
2505668

7. Install the water pump bolts (1) and water pump pulley (2) and tighten to **20 N•m (15 lb ft)**.
8. Install the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.
9. Install the air conditioning compressor. Refer to *Air Conditioning Compressor Replacement (LDE, LUW, LWE) on page 10-16* or *Air Conditioning Compressor Replacement (LUV) on page 10-17*.
10. Install the timing belt tensioner. Refer to *Timing Belt Tensioner Replacement on page 9-980*.



2534391

11. Install the radiator outlet hose (1) to the water pump. Refer to *Radiator Outlet Hose Replacement (LUV) on page 9-635* or *Radiator Outlet Hose Replacement (LDE LUW) on page 9-636*.
12. Fill the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.



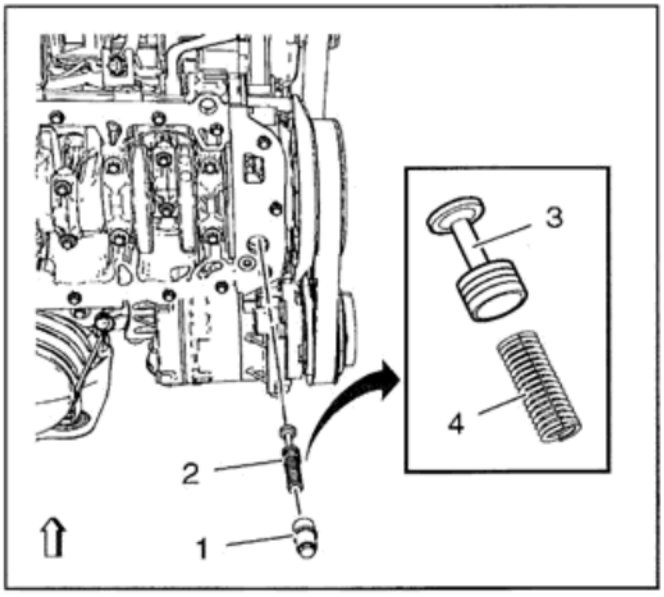
2521420

13. Connect the negative battery cable (1). Refer to *Battery Negative Cable Disconnection and Connection on page 9-713*.

Oil Pressure Relief Valve Replacement

Removal Procedure

1. Remove the oil pan. Refer to *Oil Pan Replacement on page 9-999*.



2028017

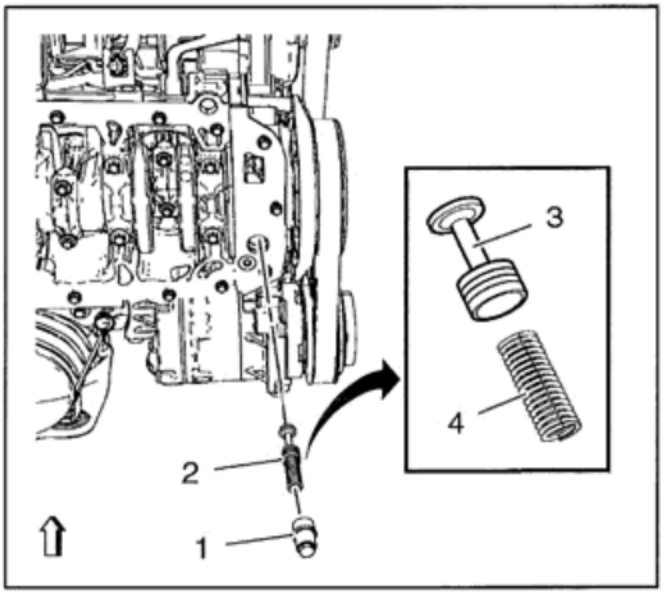
2. Remove the oil pressure relief valve closure bolt (1).
3. Remove the oil pressure relief valve assembly (2).
4. Separate the piston (3) and the spring (4).

Warning: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

Warning: To avoid eye injury, use approved safety lenses, goggles, or face shield when using buffing and cleaning equipment.

5. Clean the parts.
6. Inspect the parts.
7. Clean the thread.

Installation Procedure



2028017

1. Install the piston (3) and the spring (4).
2. Install the oil pressure relief valve assembly (2).

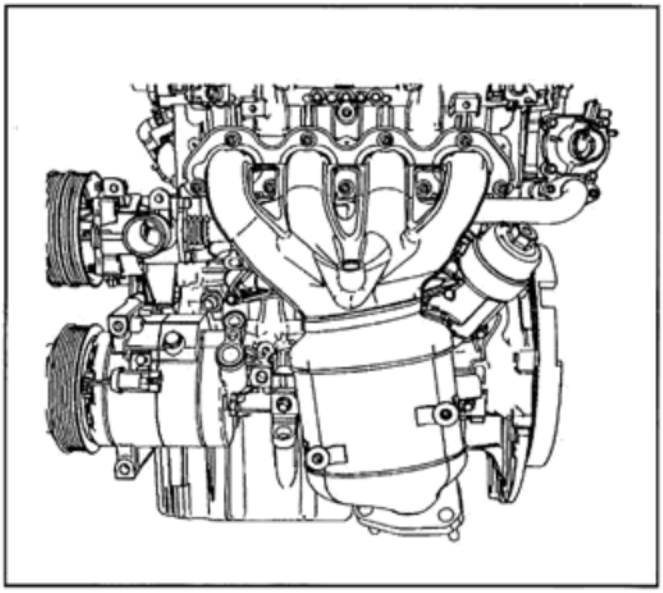
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the oil pressure relief valve closure bolt (1) and tighten to **21** N•m **(16 lb ft)**.
4. Install the oil pan. Refer to *Oil Pan Replacement on page 9-999*.

Engine Oil Cooler Housing Replacement

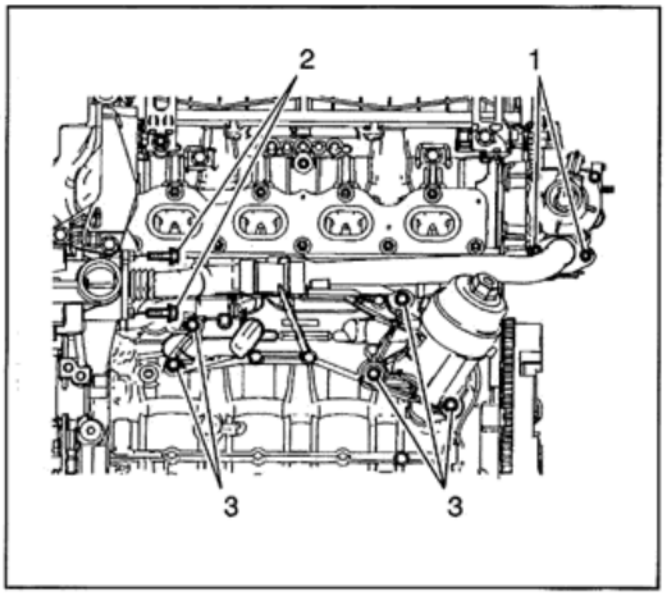
Removal Procedure

1. Drain the engine coolant. Refer to *Cooling System Draining and Filling on page 9-628*.
2. Drain the engine oil. Refer to *Engine Oil and Oil Filter Replacement on page 9-1046*.



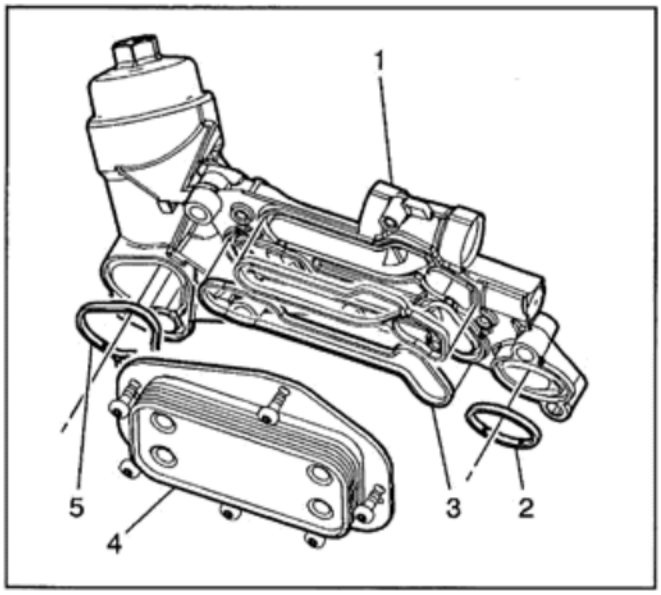
2049036

3. Remove the exhaust manifold. Refer to *Exhaust Manifold with Catalytic Converter Replacement (LUW) on page 9-737*.



2049564

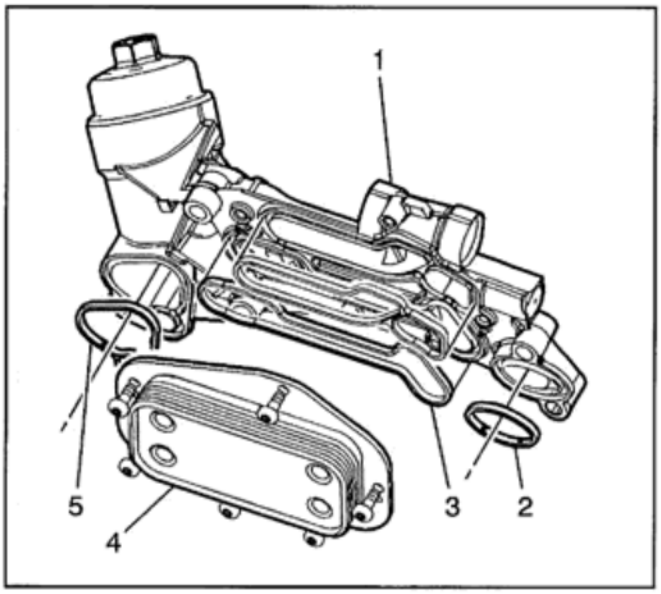
4. Remove the coolant pipe bolts (1) from the engine coolant distributor case .
5. Remove the coolant pipe bolts (2) from the engine front cover.
6. Remove the oil cooler tightening bolts (3).



2049565

7. Remove the heat exchanger (4) with the gasket.

Installation Procedure



2049565

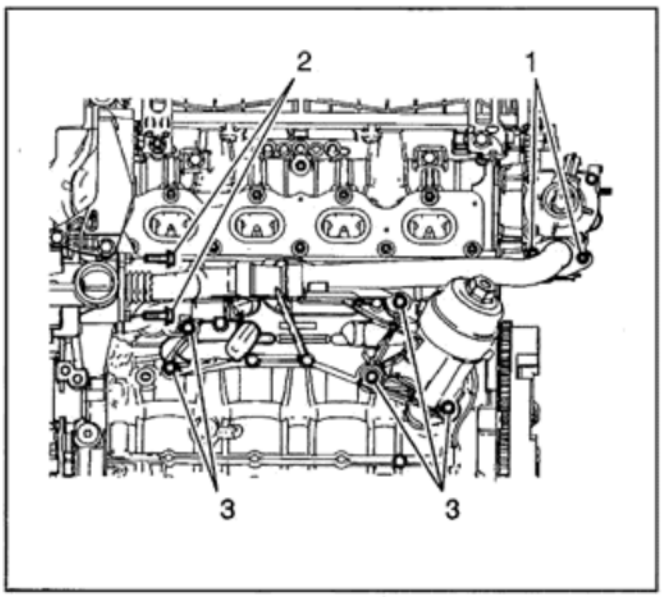
Caution: Refer to *Fastener Caution on page 0-8*.

Note: Check for damage or leakage on the oil cooler gaskets. If damage or leakage, replace the related gasket with a new one.

1. Install the heat exchanger (4) with the gasket to the oil cooler housing.

   Tighten

   Tighten the heat exchanger bolts to 8 N•m (70.8 lb in).



2049564

2. Insert the coolant pipes to the oil cooler housing with the gasket.
3. Install the oil cooler tightening bolts (3).

Tighten

Tighten the oil cooler tightening bolts to 25 N•m (18 lb ft).

4. Install the coolant pipe bolts (2) to the engine front cover.

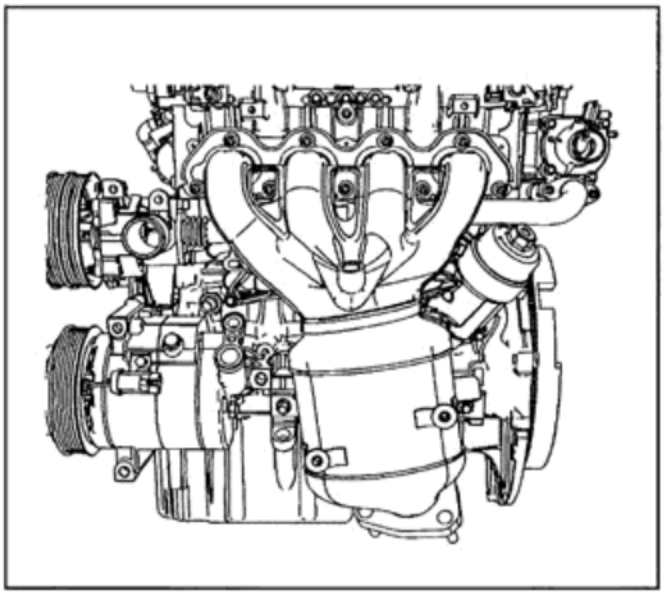
Tighten

Tighten the coolant pipe bolts to 8 N•m (71 lb in).

5. Install the coolant pipe bolts (1) to the engine coolant distributor case.

Tighten

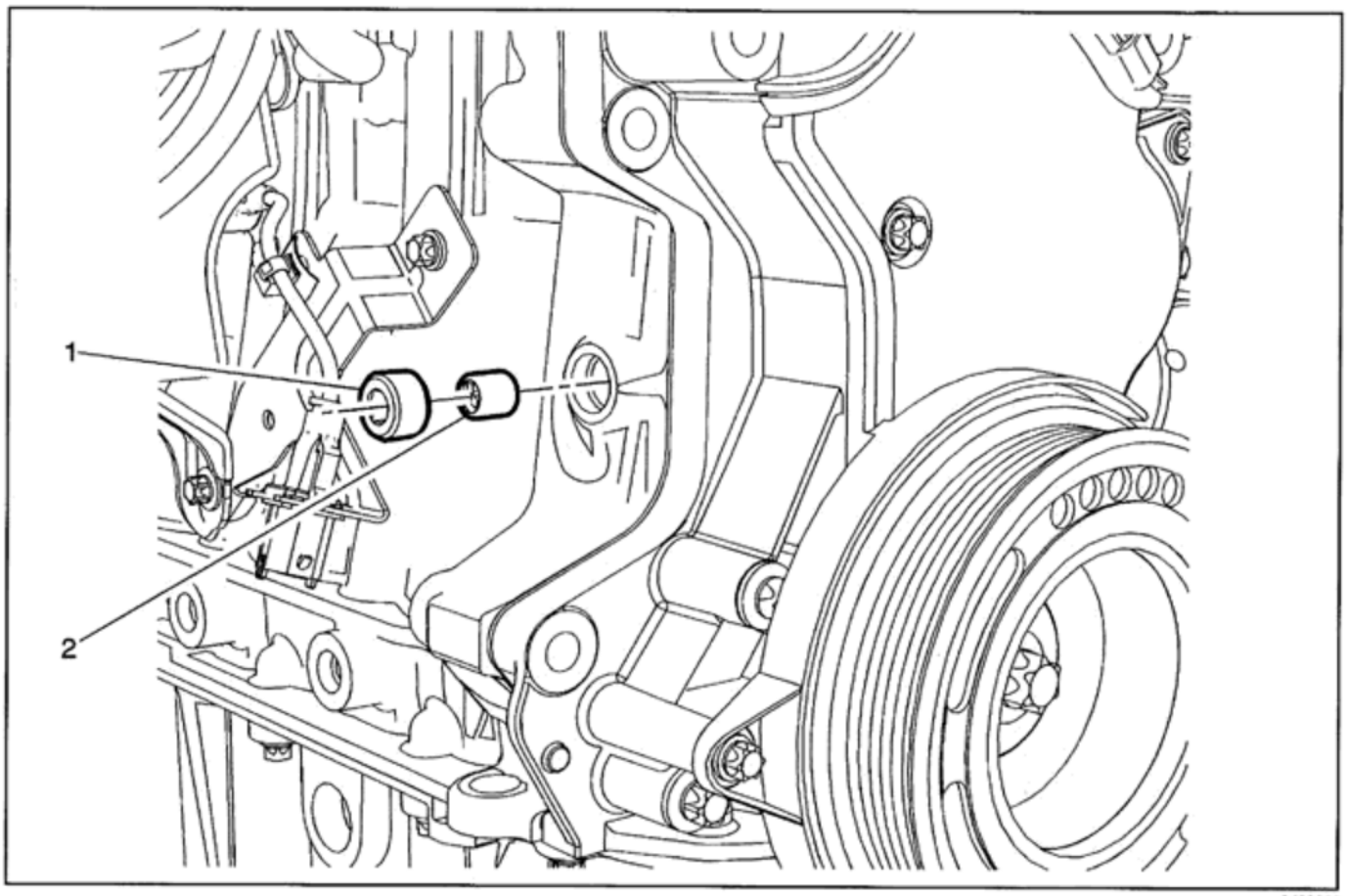
Tighten the coolant pipe bolts to 8 N•m (71 lb in).



2049036

6. Install the exhaust manifold. Refer to *Exhaust Manifold with Catalytic Converter Replacement (LUW) on page 9-737*.
7. Refill the engine oil. Refer to *Engine Oil and Oil Filter Replacement on page 9-1046*.
8. Refill the engine coolant. Refer to *Cooling System Draining and Filling on page 9-628*.

Oil Flow Check Valve Replacement



2498828

Oil Flow Check Valve Replacement

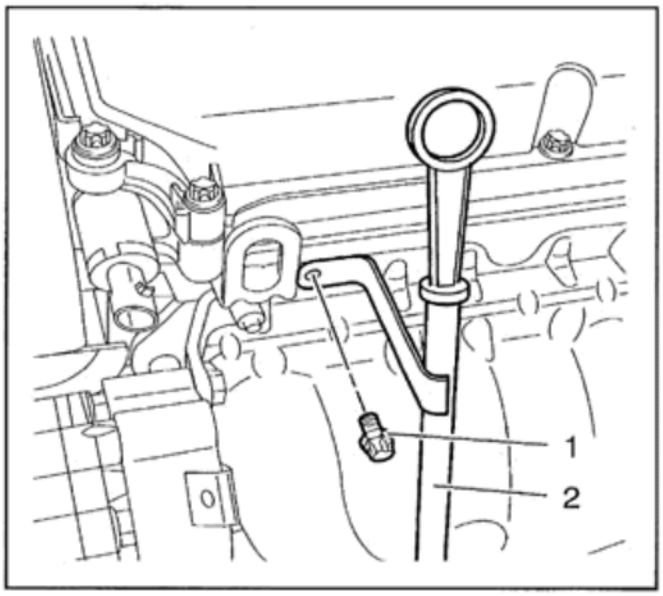
Callout	Component Name
Preliminary Procedure Remove the generator. Refer to *Generator Replacement (LUV) on page 9-726* or *Generator Replacement (LUW) on page 9-727*.	
1	Oil Flow Check Valve Bore Plug **Caution:** Refer to *Fastener Caution on page 0-8*. **Tighten** 21 N•m (16 lb ft)
2	Oil Flow Check Valve

Oil Level Indicator Tube Replacement

Removal Procedure

Note: If the engine oil level is at maximum, some oil may emerge when drawing out the oil dipstick guide tube.

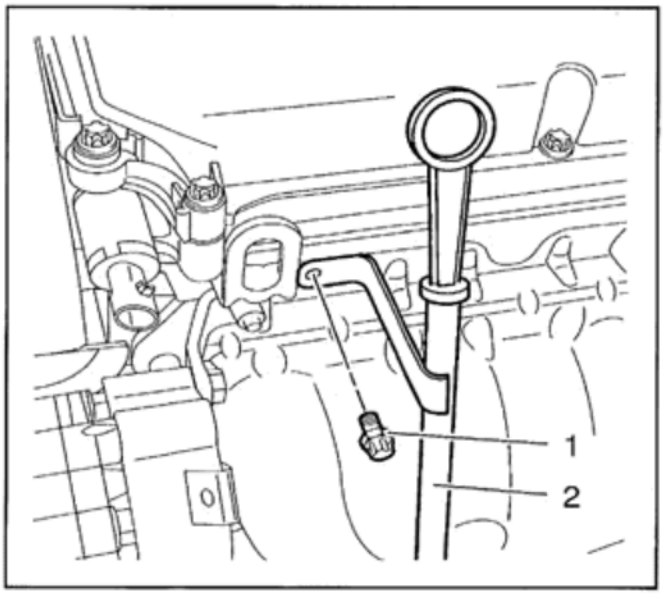
1. Place collecting basin underneath.



2026827

2. Remove the oil level indicator tube bolt (1).
3. Remove the oil level indicator tube (2).

Installation Procedure



2026827

Note: Use a NEW oil level indicator tube seal

1. Install the oil level indicator tube (2).

Caution: Refer to *Fastener Caution on page 0-8*.

2. Install the oil level indicator tube bolt (1) and tighten to **15 N·m (11 lb ft)**.
3. Check the oil level and adjust as necessary.

Engine Replacement (Automatic Transmission)

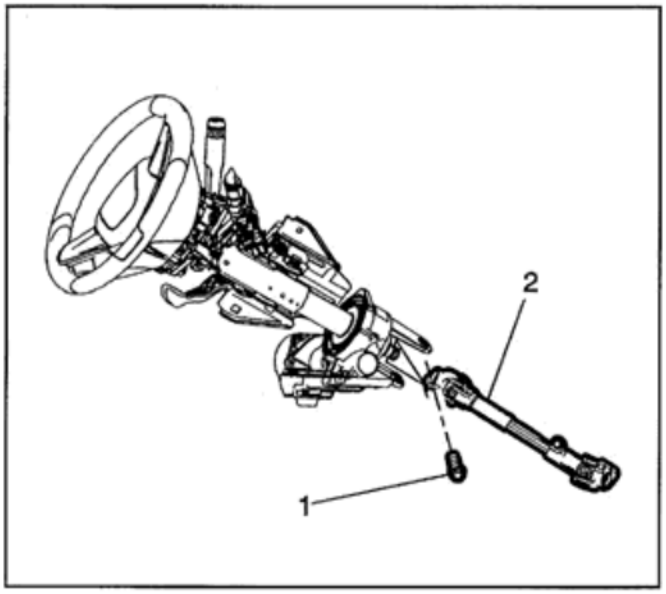
Special Tools

- *J-45859* Wheel Drive Shaft Remover
- *CH-807* Closure Plugs

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

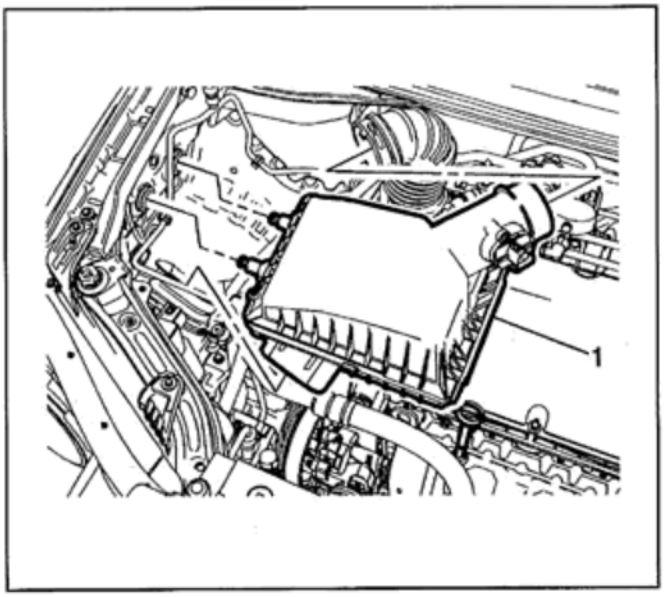
Removal Procedure

1. Remove the battery and battery tray. Refer to *Battery Tray Replacement on page 9-721*.
2. Relieve the fuel system pressure. Refer to *Fuel Pressure Relief on page 9-547*.
3. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging on page 10-13*.
4. Remove the front tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
5. Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-55*.
6. Remove the front wheelhouse liner inner front extensions. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left Side) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LWE, LUW) on page 3-149*.
7. Drain the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.



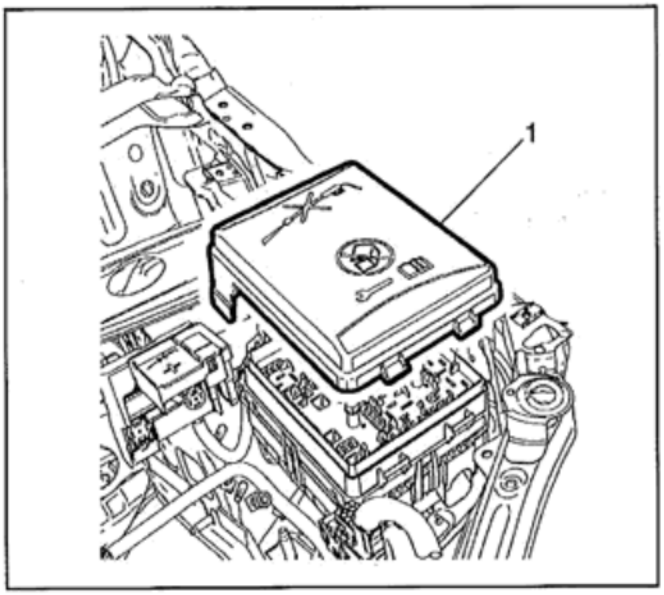
2534608

8. Remove the lower intermediate steering shaft bolt (1) and slide the shaft away from steering column. Refer to *Intermediate Steering Shaft Replacement on page 15-27*.



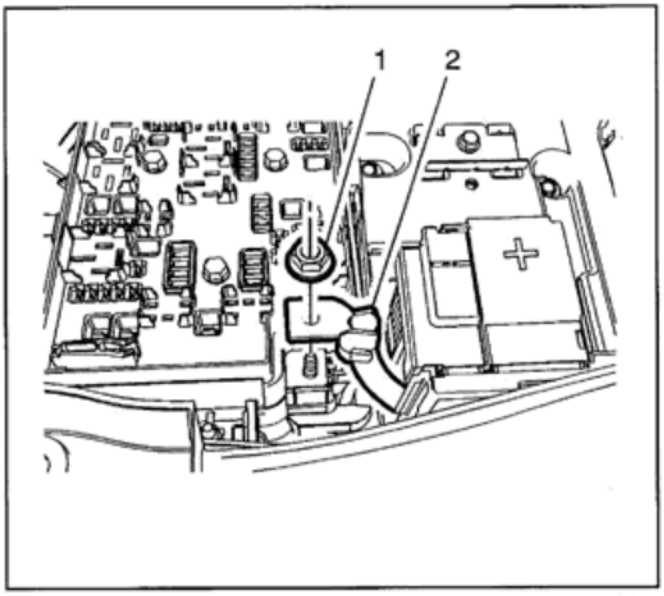
2521421

9. Remove the air cleaner assembly (1). Refer to *Air Cleaner Assembly Replacement on page 9-582*.



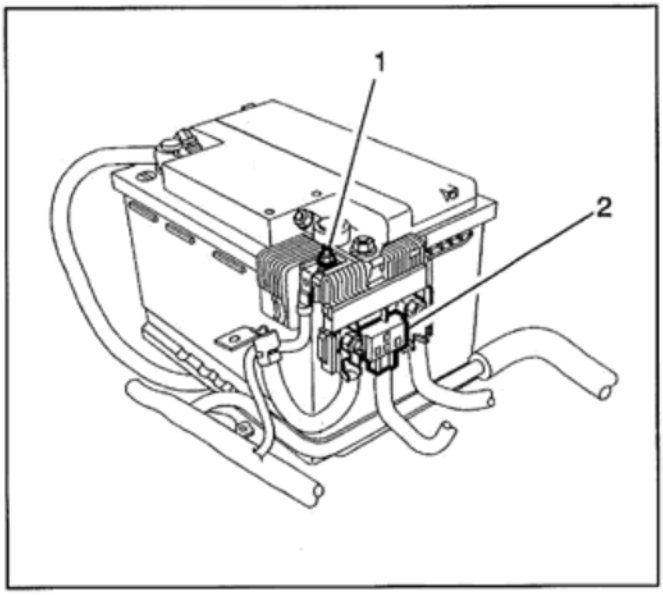
2539745

10. Remove the junction block cover (1).



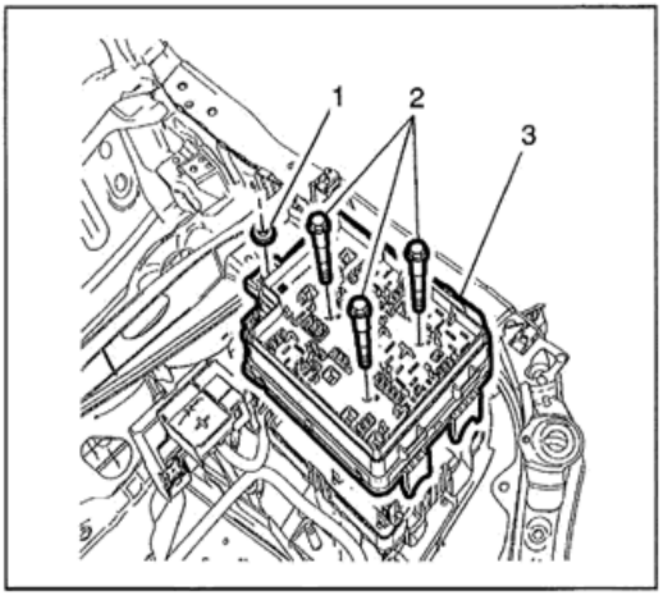
2504689

11. Remove the positive battery cable nut (1) from the junction block.
12. Remove the positive battery cable (2) from the junction block.



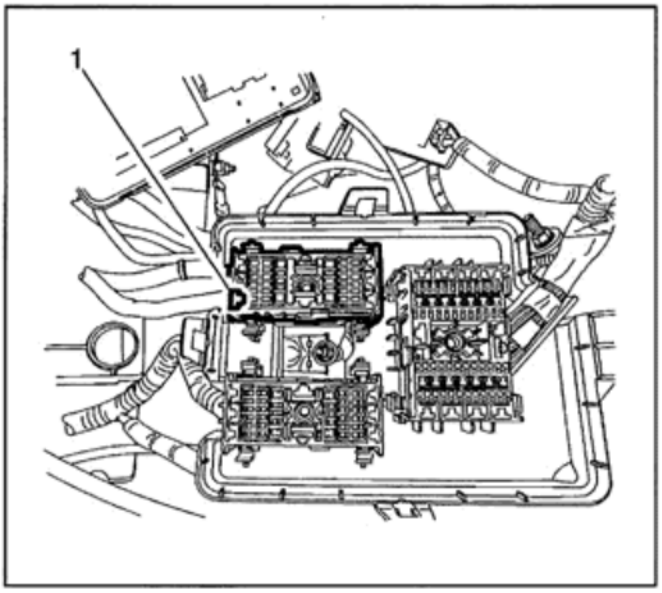
2539751

13. Remove the positive cable nut (1) and battery positive cable, from the battery positive cable junction block.
14. Disconnect the body wiring master harness connector (2), from the battery positive cable junction block.



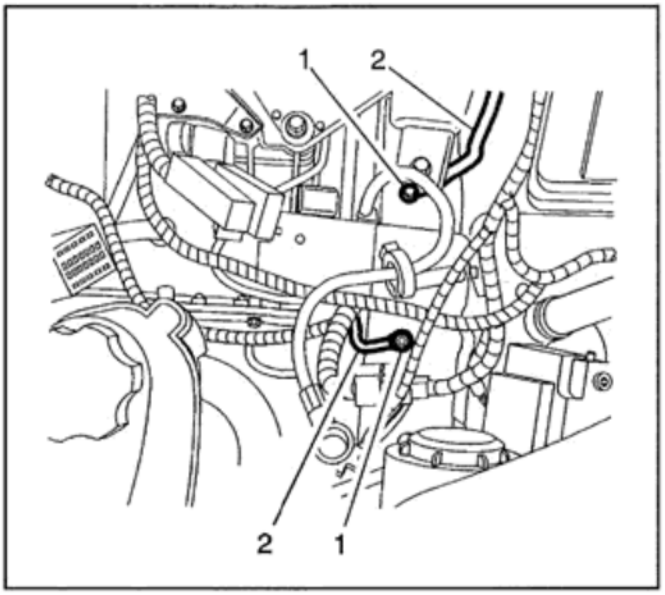
2539757

15. Remove the junction block nut (1).
16. Remove the junction block bolts (2).
17. Disconnect the wiring harness from the junction block base.
18. Remove the junction block (3) from the base.
19. Disconnect the wiring harness plug from the front compartment fuse block.



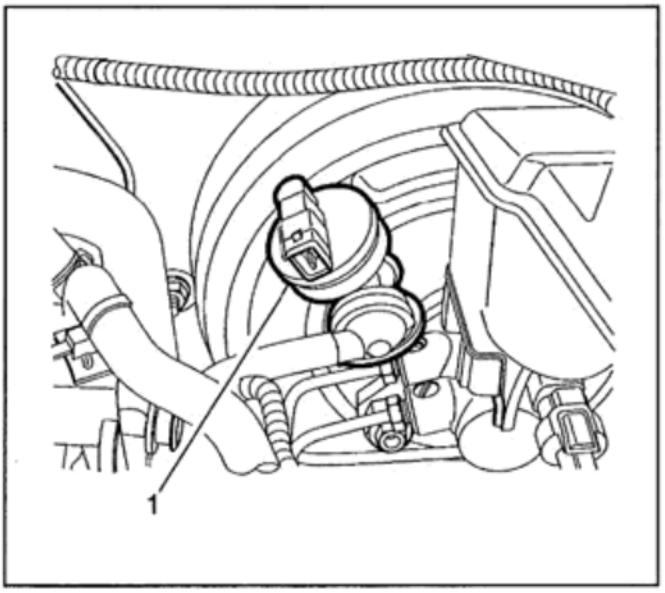
2539762

20. Reposition the wiring harness (1) on top of the engine.



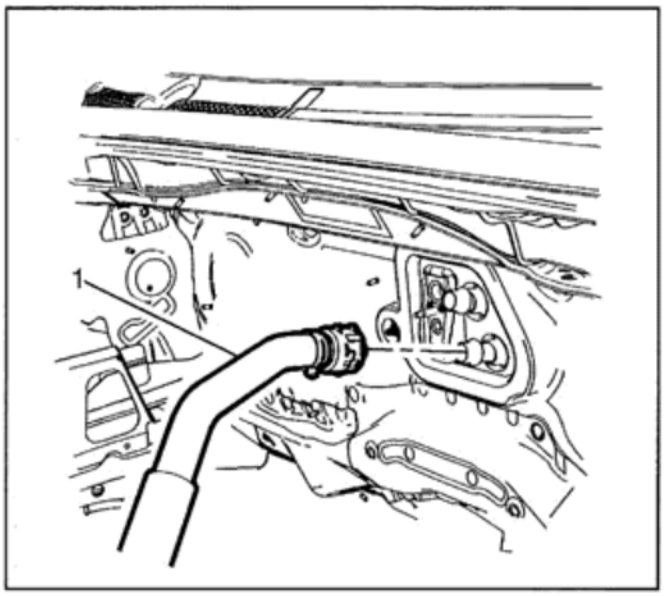
2539765

21. Remove the ground nuts (1) and reposition the wiring harness (2) aside.



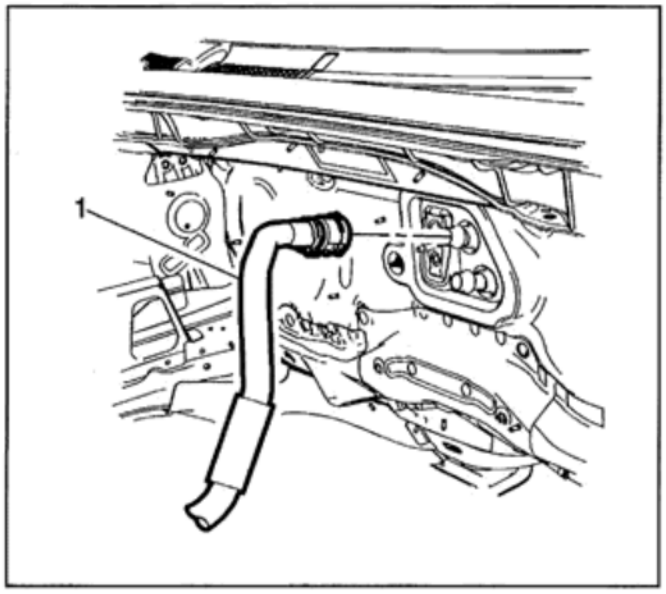
2534615

22. If equipped with electrical vacuum pump, disconnect the electrical connector and remove the brake booster hose (1).



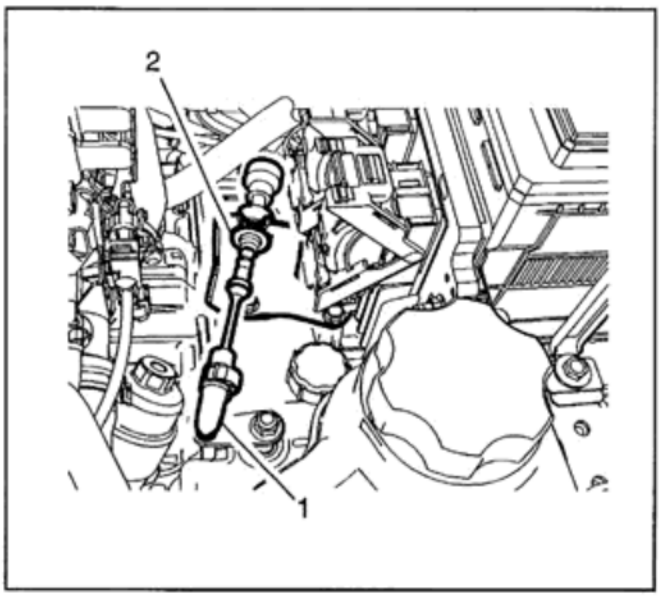
2521422

23. Disconnect the heater inlet hose (1) from the heater core. Refer to *Heater Inlet Hose Replacement (LDE, LUW) on page 10-38* or *Heater Inlet Hose Replacement (LUV) on page 10-38*.



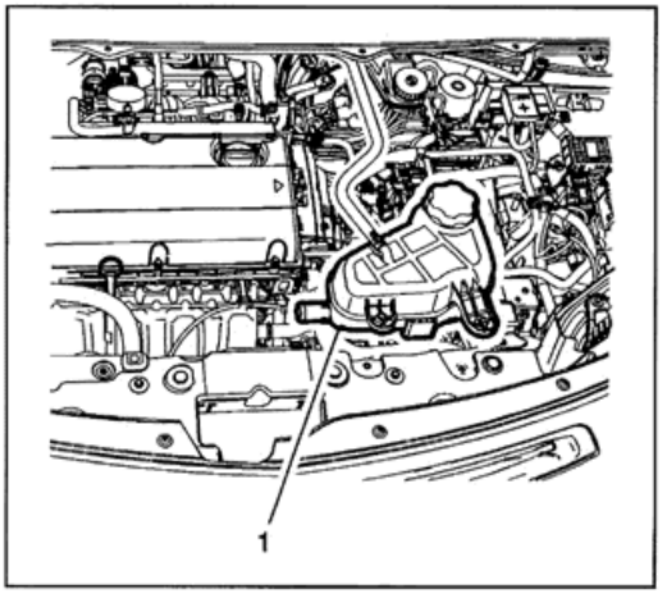
2521427

24. Disconnect the heater outlet hose (1) from the heater core. Refer to *Heater Outlet Hose Replacement (LUV) on page 10-40* or *Heater Outlet Hose Replacement (LDE, LUW) on page 10-40*.



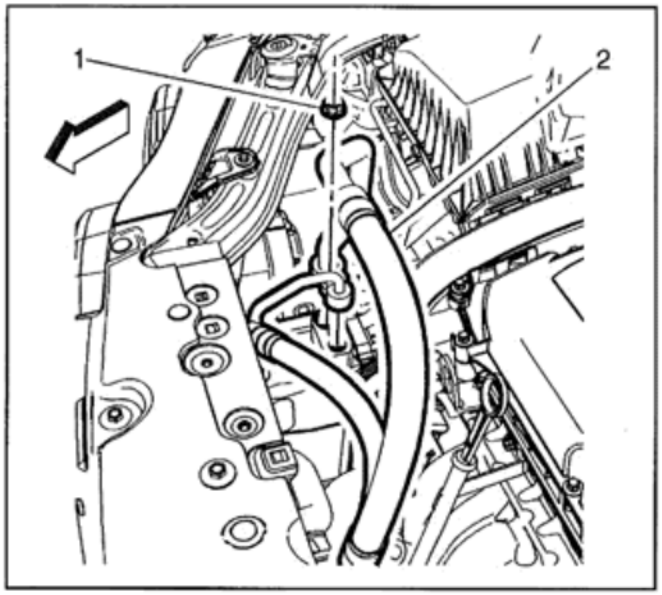
2492632

25. Disconnect the transmission range selector lever cable terminal (1) from the transmission manual shift lever pin.
26. Remove the transmission range selector lever cable (2) from the cable bracket.



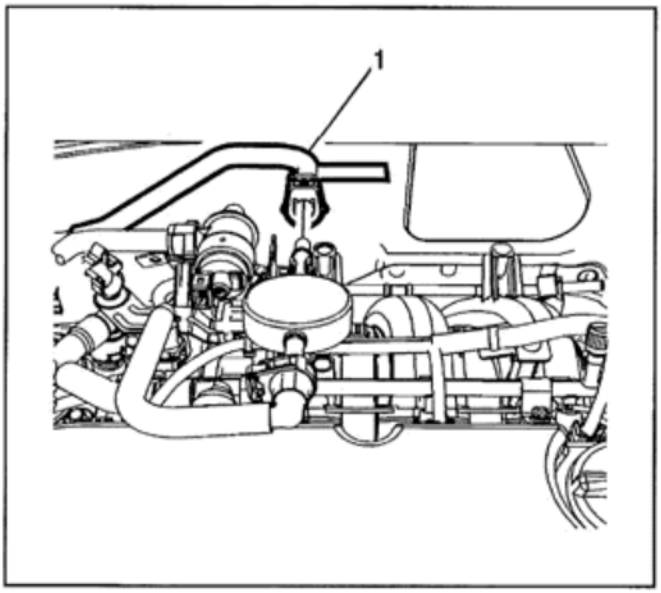
2534616

27. Remove the radiator surge tank (1) and position aside. Refer to *Radiator Surge Tank Replacement on page 9-630*.
28. Disconnect the fan connector.



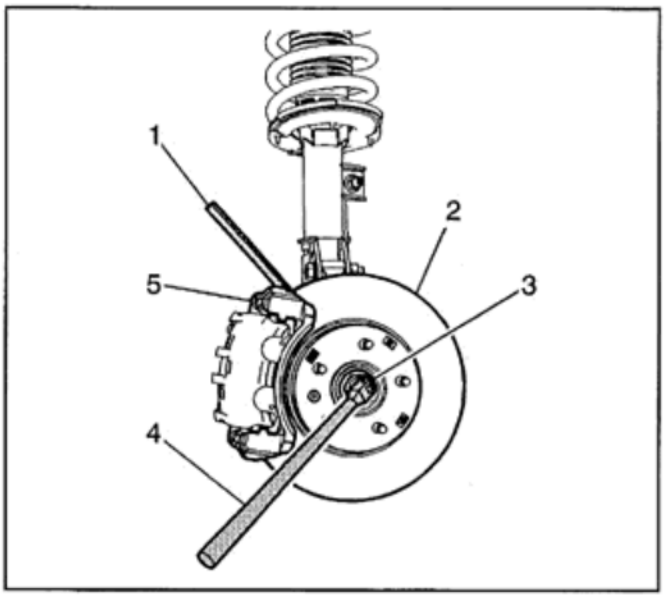
2497607

29. Remove air conditioning compressor and condenser hose nut (1).
30. Remove air conditioning compressor and condenser hose (2) from refrigerant hose.



2509366

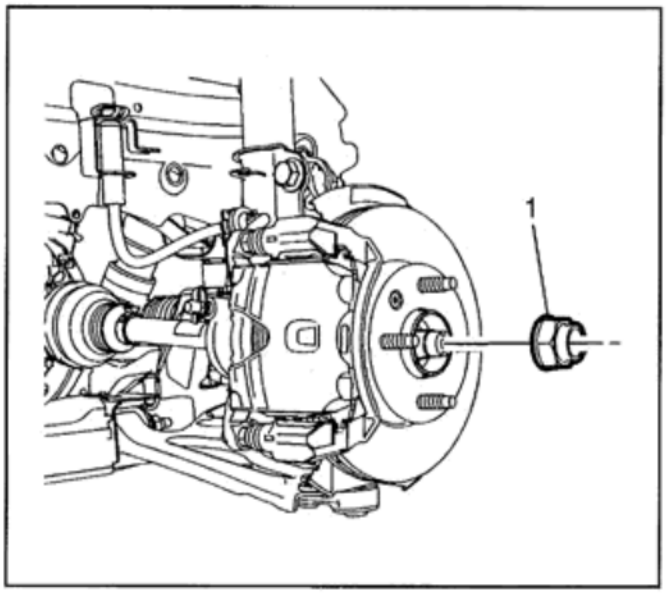
31. Disconnect the fuel feed pipe (1). Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.
32. Install and close the fuel feed pipe with CH-807 plug.
33. Disconnect the engine coolant sensor from radiator.



2001521

Note: Perform steps 33 through 41 to both sides.

34. Insert a brass drift or punch (1) in the cooling fins of the front brake rotor (2).
35. Rotate the brake rotor until it comes in contact with the brake caliper mount bracket (5).

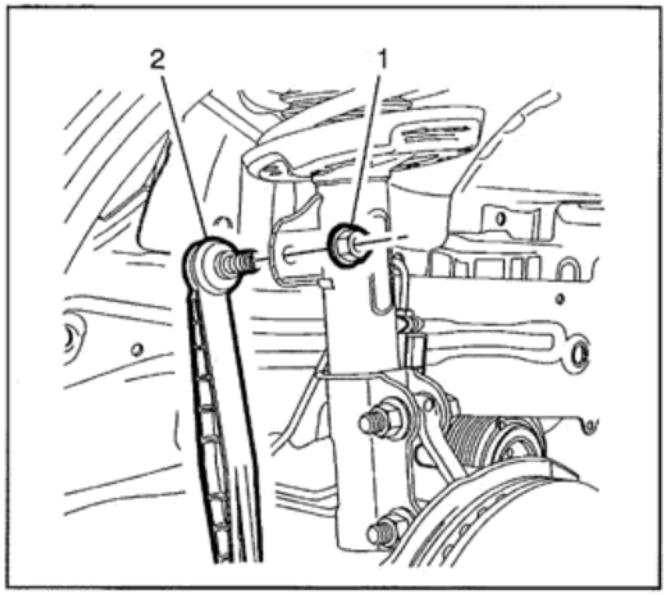


2498078

Note:

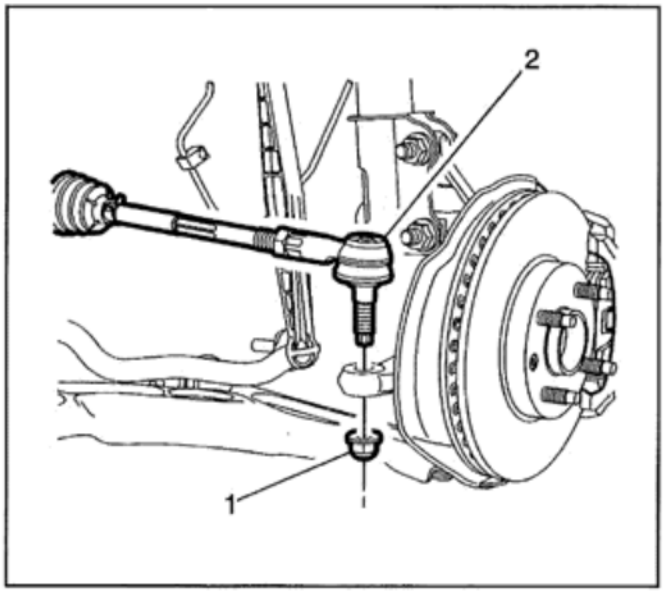
- Use a suitable tool to release the crimping on the wheel drive shaft retaining nut.
- The wheel drive shaft retaining nut (1) must be discarded after removal.

36. Remove and discard the wheel drive shaft nut (1).



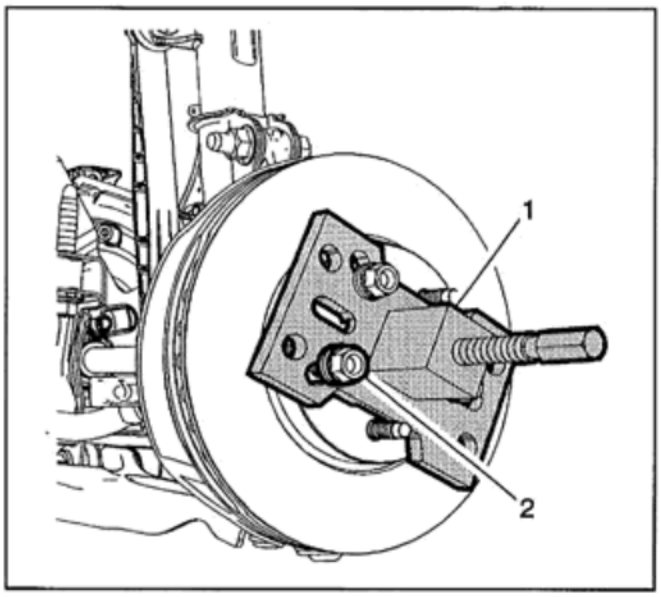
2539770

37. Remove the upper stabilizer shaft link nut (1).
38. Disconnect the stabilizer shaft link (2).



2539785

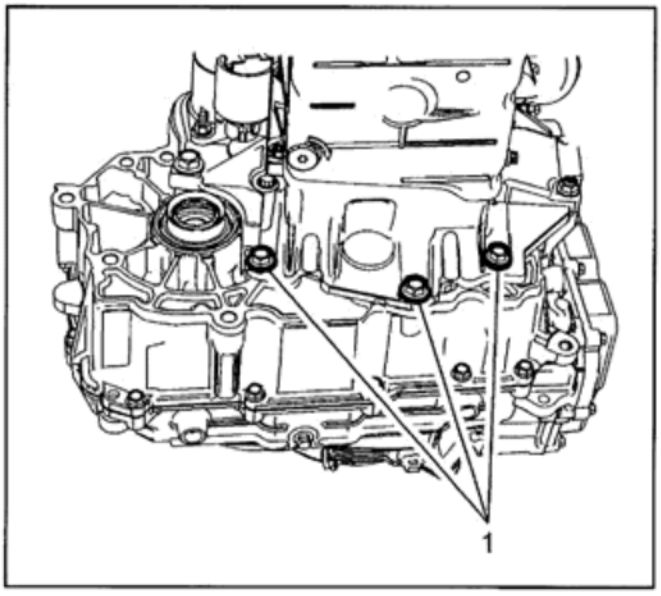
39. Remove and DISCARD the steering linkage outer tie rod nut (1).
40. Separate the steering linkage outer tie rod (2) from the steering knuckle. *Steering Linkage Outer Tie Rod Replacement on page 15-17.*
41. Separate the control arm ball joint from the steering knuckle. Refer to *Lower Control Arm Replacement on page 16-12.*



2739004

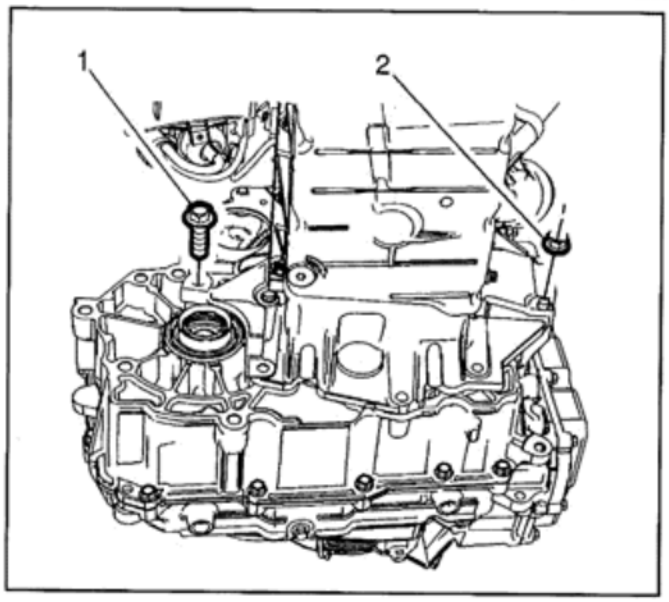
Note: Reverse the wheel lug nuts and washers so the flat part of the wheel nut is facing the washers.

42. Using the *J-45859* wheel drive shaft remover (2), separate the wheel drive shaft from the steering knuckle (1).
43. Remove the upper stabilizer shaft link from the absorber on both sides. Refer to *Stabilizer Shaft Link Replacement on page 16-8.*
44. Remove the front exhaust pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738.*



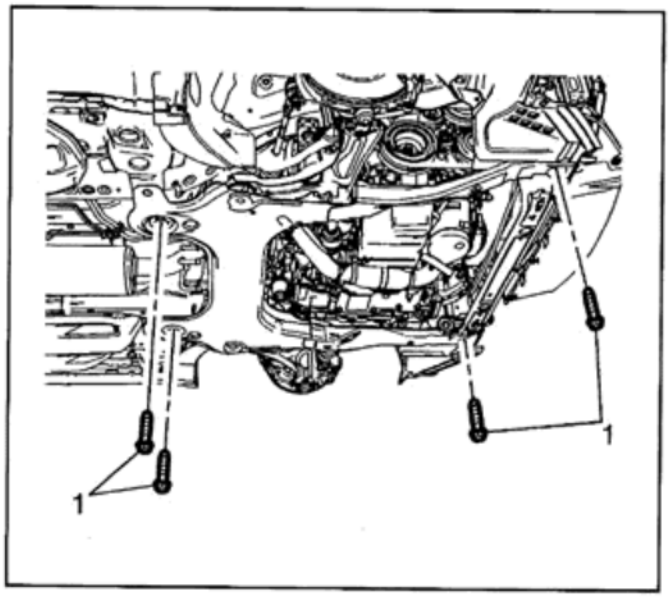
2534617

45. Remove the lower oil pan to transmission lower bolts (1).



2534623

46. Remove the lower oil pan to transmission lower bolts (1) and nut (2).
47. Remove the frame braces.

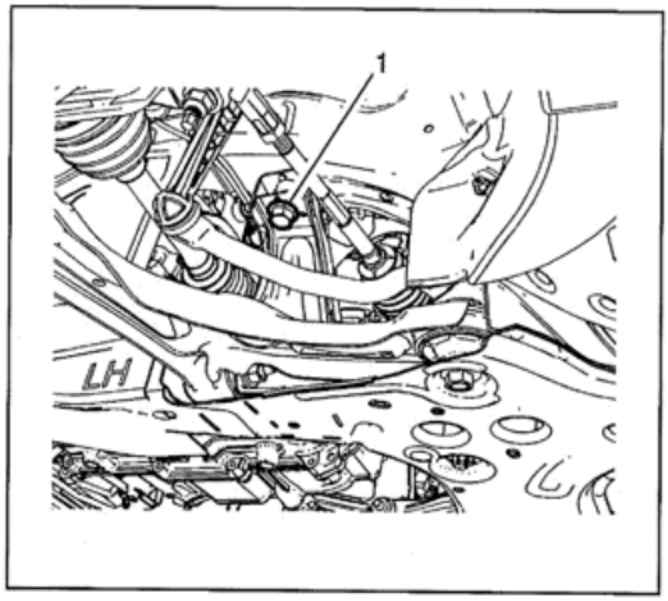


2539786

48. Remove the frame front bolts (1).

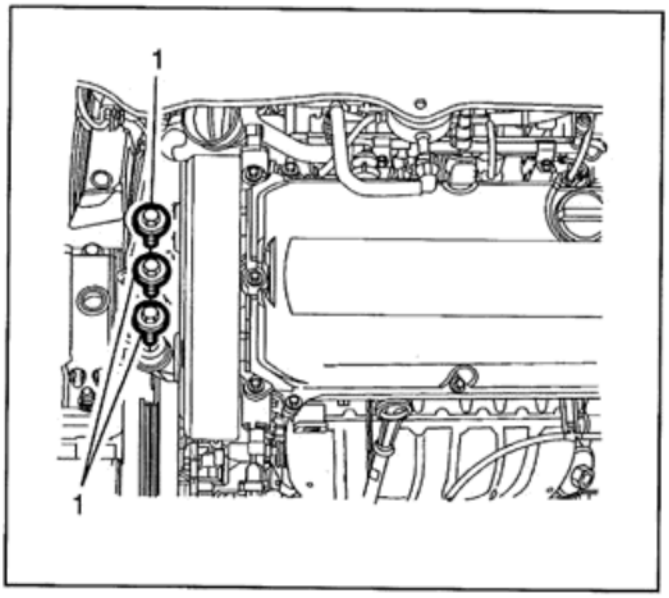
Note: Blocks of wood can be used between the front of the frame and the oil pan to table in order to level the powertrain during the removal.

49. Position an engine support table under the powertrain assembly.



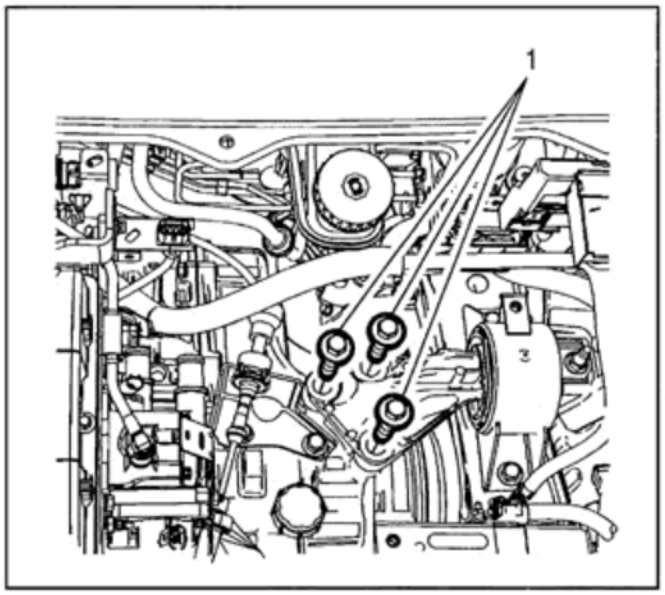
2492995

50. Remove the upper frame suspension retaining bolts (1) on both sides.



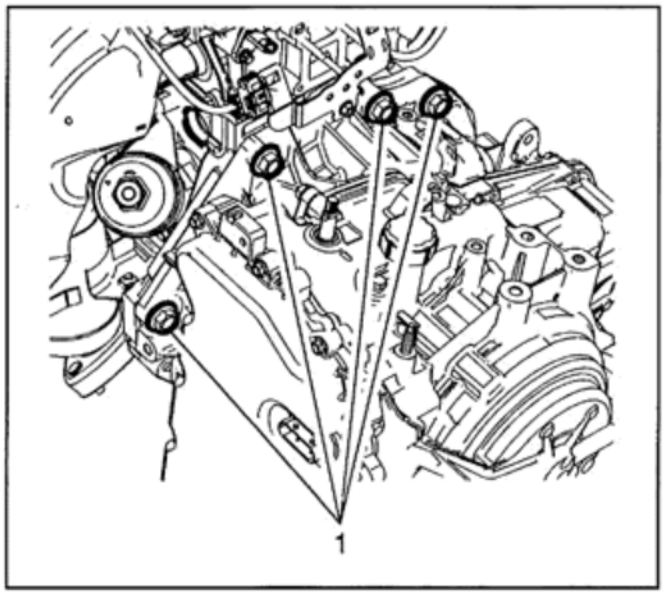
2534620

51. Mark the location of the right engine mount bolts (1) before removing.
52. Remove and Discard the right side engine mount bolts (1). Refer to *Engine Mount Replacement on page 9-967*.



2534621

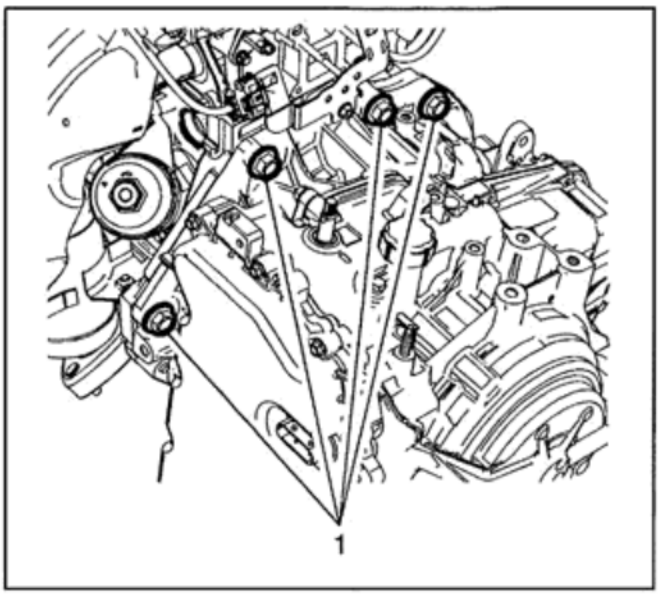
53. Mark the location of the transmission mount bolts (1) before removing.
54. Remove and DISCARD the transmission mount bolts (1) – left side. Refer to *Transmission Mount Replacement - Left Side on page 17-216*.
55. Disconnect any additional electrical connections as necessary.
56. Raise the vehicle until the powertrain is clear for removal.
57. Remove the starter. Refer to *Starter Replacement (LUW) on page 9-722* or *Starter Replacement (LUV) on page 9-724*.
58. Remove the torque converter bolt access plug next to the starter opening.
59. Remove the torque converter bolts.



2534622

60. Remove the upper transmission to engine bolts (1) and separate the engine and transmission.
61. Disconnect any electrical connectors as needed.
62. Install the engine to the engine stand.
63. Transfer parts as needed.

Installation Procedure

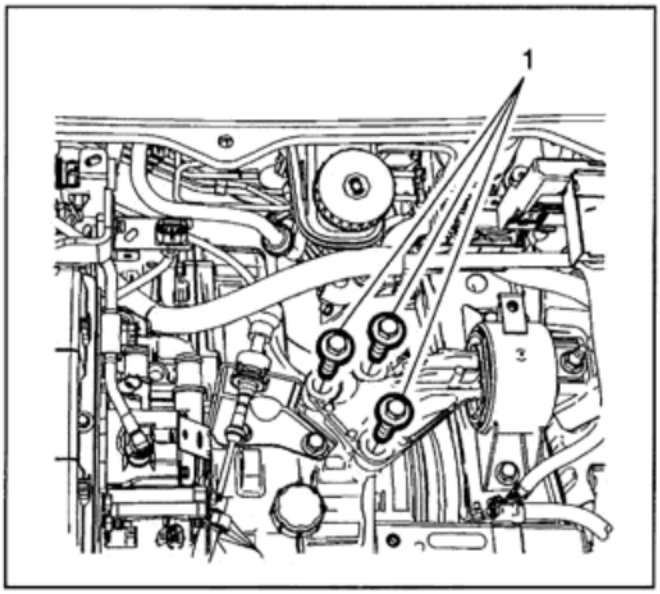


2534622

1. Remove the engine from the engine stand.
2. Install the transmission to the engine.

Caution: Refer to *Fastener Caution on page 0-8*.

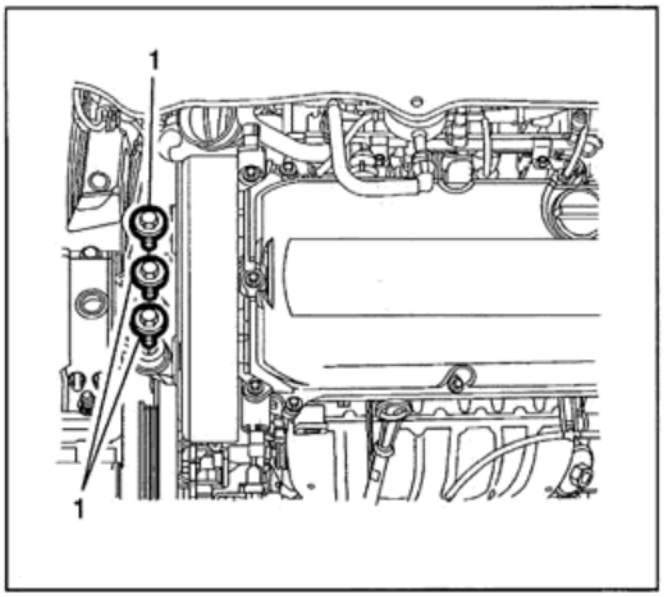
3. Install the upper transmission to engine bolts (1) and tighten to **60** N•m **(44 lb ft)**.
4. Place the powertrain into the front frame.
5. Slowly lower the body onto the powertrain.



2534621

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

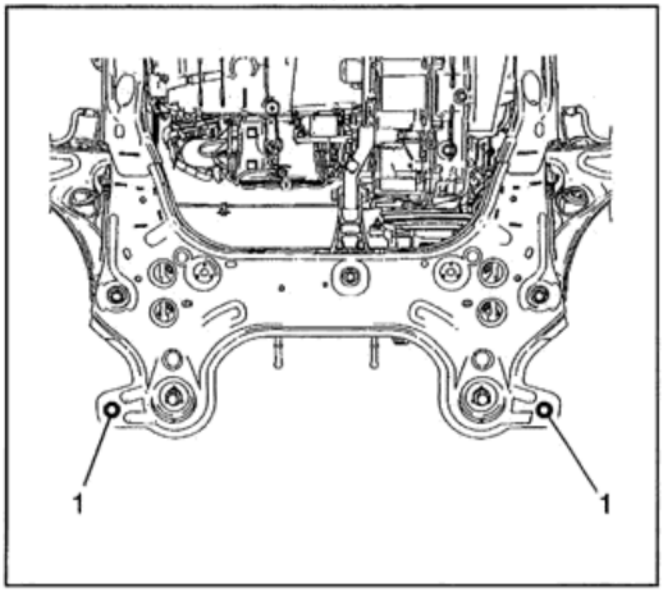
6. Install the NEW left transmission mount to transmission bolts (1) and tighten to **50** N•m **(37 lb ft) plus 70 degrees**.



2534620

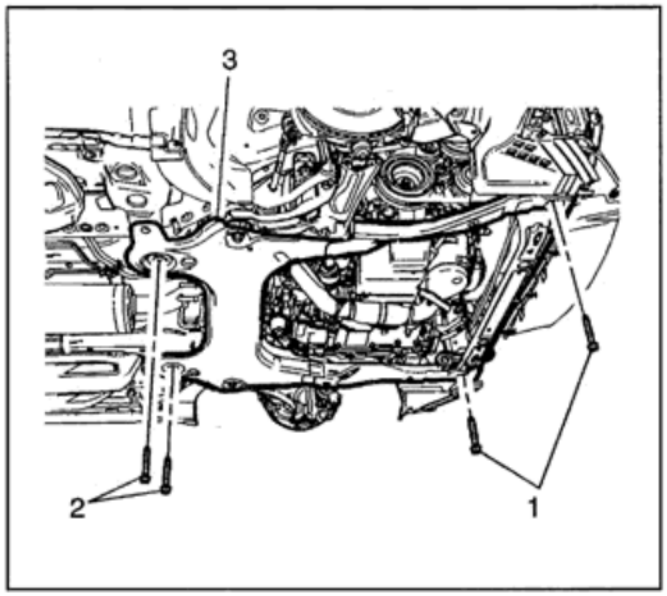
Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10.*

7. Install the NEW right side engine mount bolts (1) and tighten to **50** N•m **(37 lb ft) plus 70 degrees**.
8. Perform Powertrain Mount Balancing.



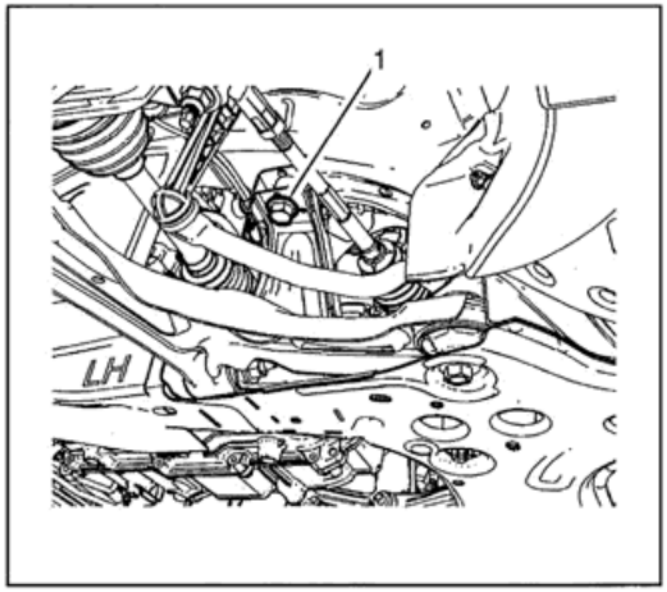
2539810

9. Align the frame and body through alignment hole (1).



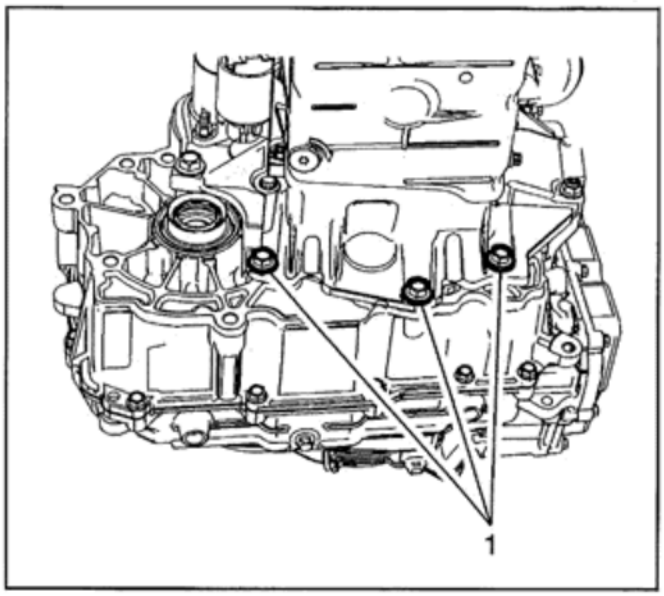
2508892

10. Install the frame (3) rear bolts (2) and tighten to **135** N•m **(100 lb ft)**.
11. Install the frame (3) front bolts (1) and tighten to **58** N•m **(43 lb ft)**.



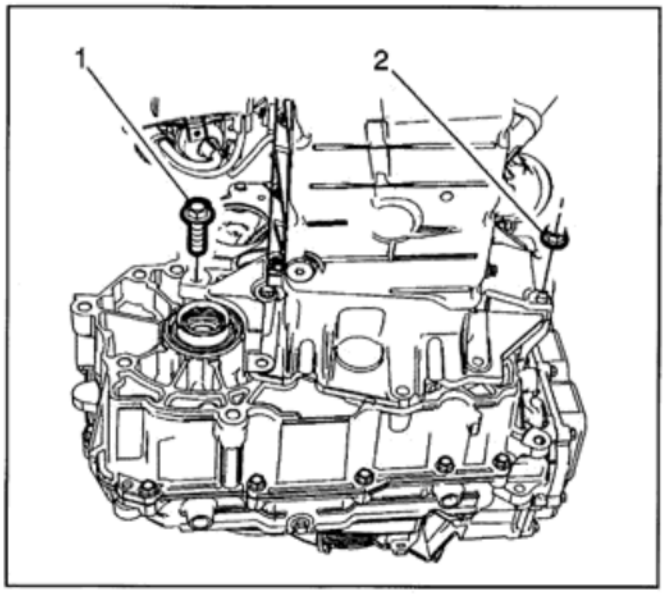
2492995

12. Install the upper frame suspension retaining bolts (1) on both sides and tighten to **135** N•m **(100 lb ft)**.
13. Remove the lift table.



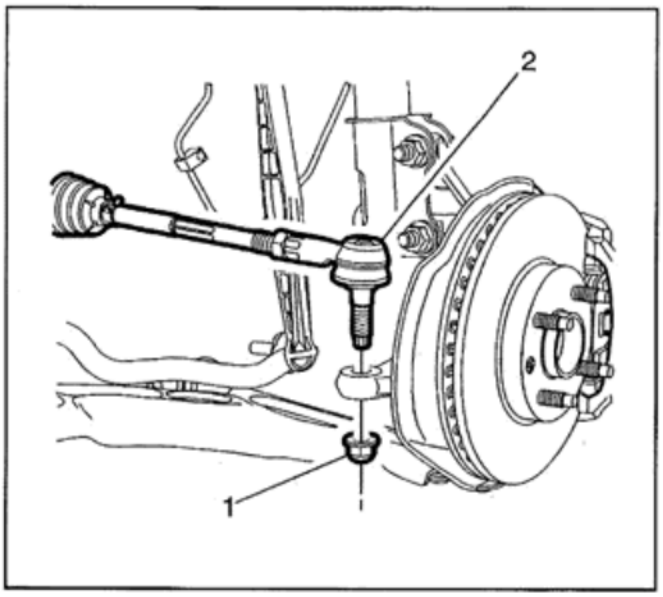
2534617

14. Install the lower oil pan to transmission bolts (1) and tighten to **40** N•m **(30 lb ft)**.



2534623

15. Install the lower oil pan to transmission lower bolts (1) and tighten to **60** N•m **(44 lb ft)**.
16. Install the lower oil pan to transmission lower and nut (2) and tighten to **40** N•m **(30 lb ft)**.
17. Install NEW flex plate to torque converter bolts and tighten to **60** N•m **(44 lb ft)**.
18. Install the starter. Refer to *Starter Replacement (LUW) on page 9-722* or *Starter Replacement (LUV) on page 9-724*.
19. Install the front exhaust pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*.



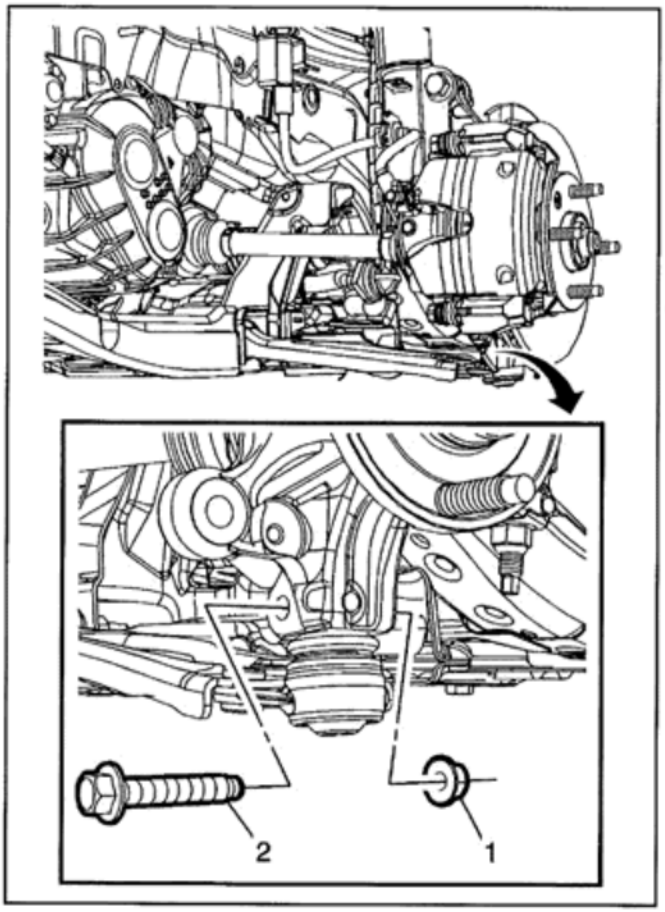
2539785

Note: Perform steps 20 through 29 to both sides.

20. Inset the wheel drive shaft to the steering knuckle.

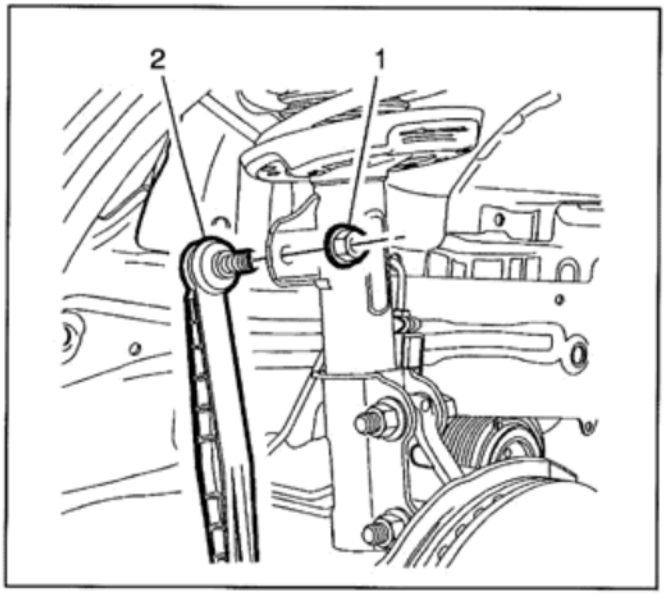
Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

21. Install the NEW steering linkage outer tie rod nut (1) and tighten to **30** N•m **(22 lb ft) Plus 128 degrees**.
22. Install the steering linkage outer tie rod to the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 15-17*.



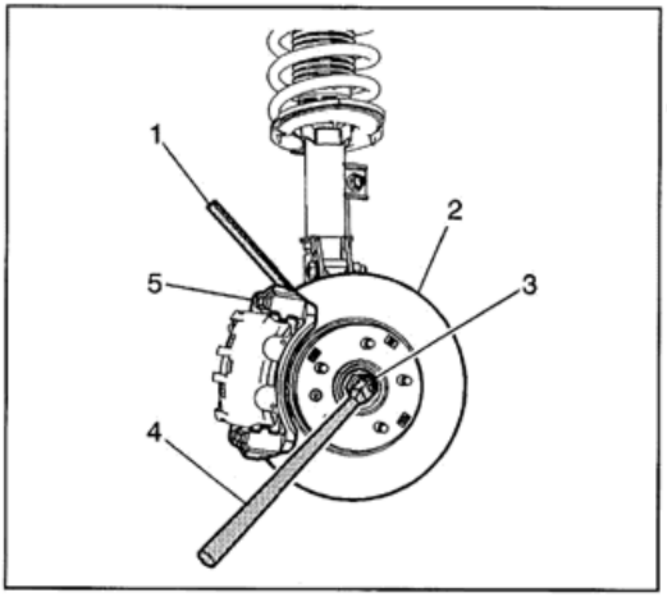
2497213

23. Install the control arm ball joint to the steering knuckle. Refer to *Lower Control Arm Replacement on page 16-12*.



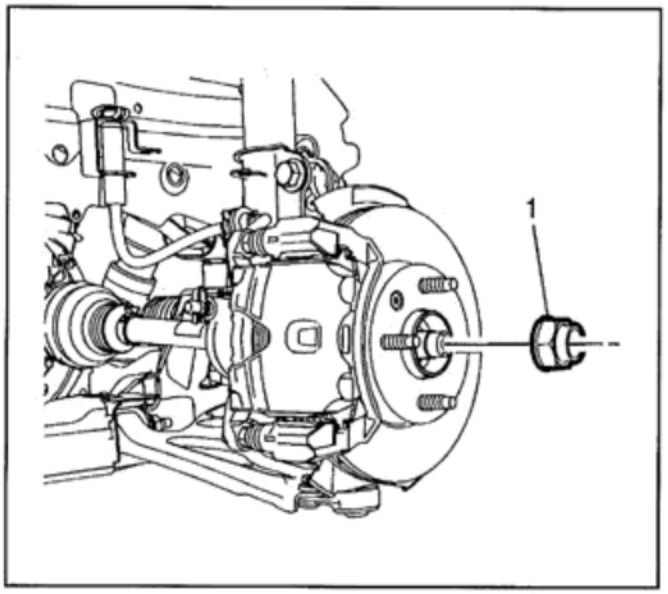
2539770

24. Connect the stabilizer shaft link (2).
25. Install the upper stabilizer shaft link nut (1) and tighten to **65** N•m **(48 lb ft)**.



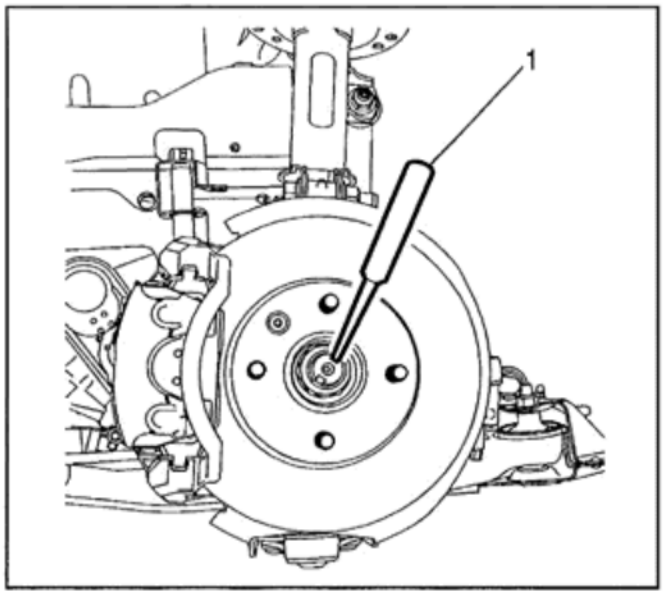
2001521

26. Insert a brass drift or punch (1) in the cooling fins of the front brake rotor (2).
27. Rotate the brake rotor until it comes in contact with the brake caliper mount bracket (5).



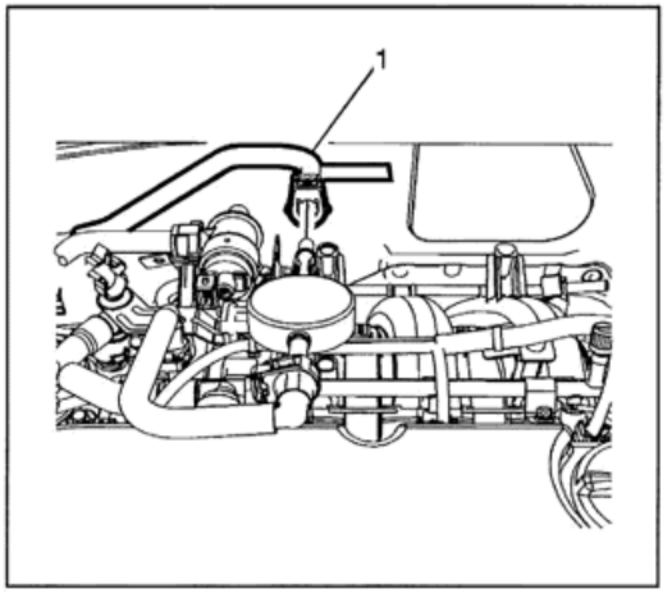
2498078

28. Install the NEW wheel drive shaft nut (1) and tighten to **250** N•m **(184 lb ft)**.



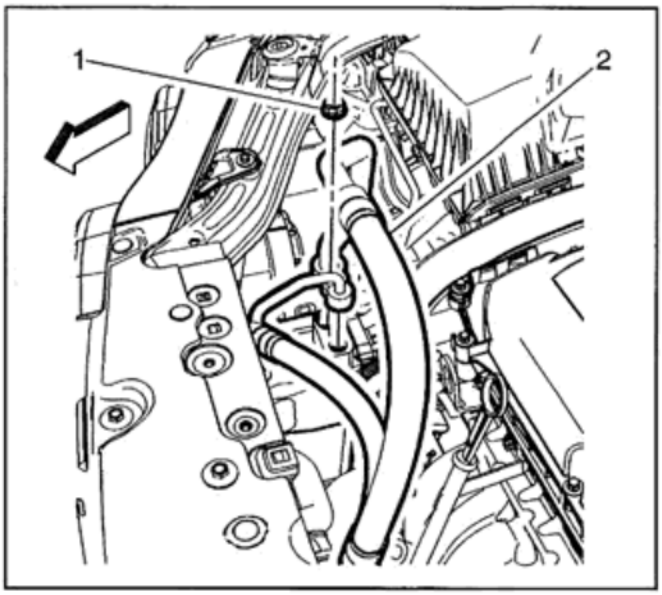
2498125

29. Using a punch (1), stake the wheel drive shaft nut.



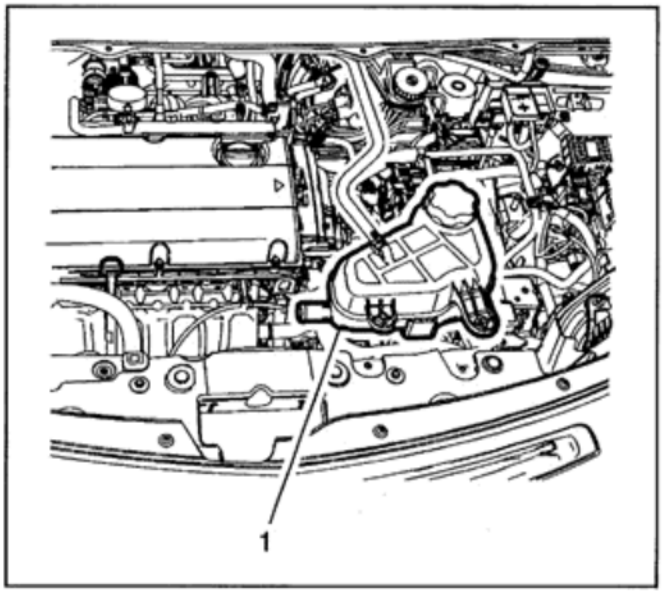
2509366

30. Remove the CH-807 plug.
31. Connect the fuel feed pipe (1). Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.
32. Connect the engine coolant sensor from radiator.



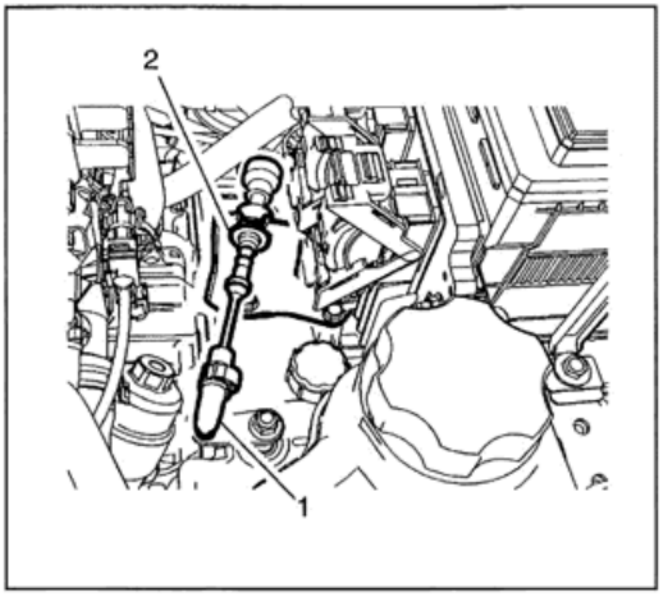
2497607

33. Install air conditioning compressor and condenser hose to the refrigerant hose.
34. Install air conditioning compressor and condenser hose nut (1) tighten nut to **22** N•m **(16 lb ft)**.



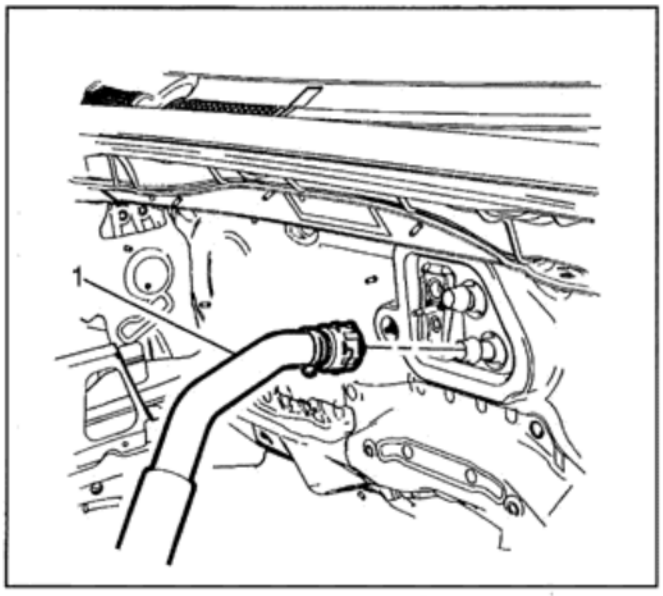
2534616

35. Install the radiator surge tank (1). Refer to *Radiator Surge Tank Replacement on page 9-630*.
36. Connect the fan connector.



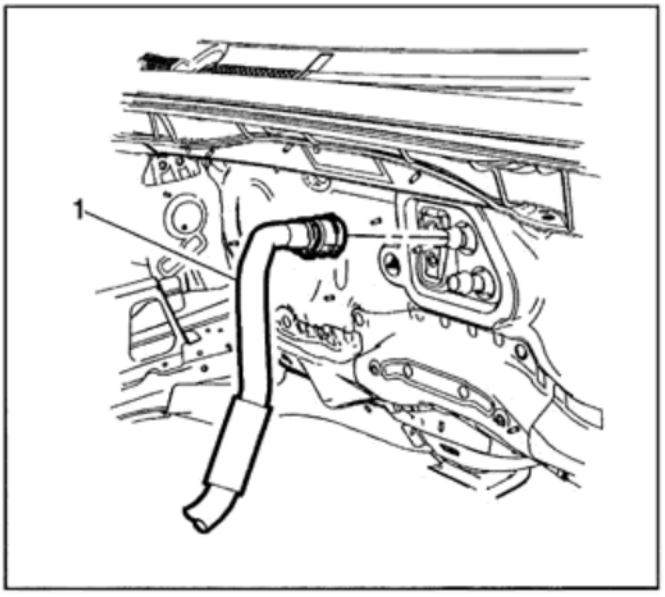
2492632

37. Install the transmission range selector lever cable (2) to the cable bracket.
38. Connect the transmission range selector lever cable terminal (1) to the transmission manual shift lever pin.
39. Adjust the automatic transmission range selector lever cable. Refer to *Range Selector Lever Cable Adjustment on page 17-196*.



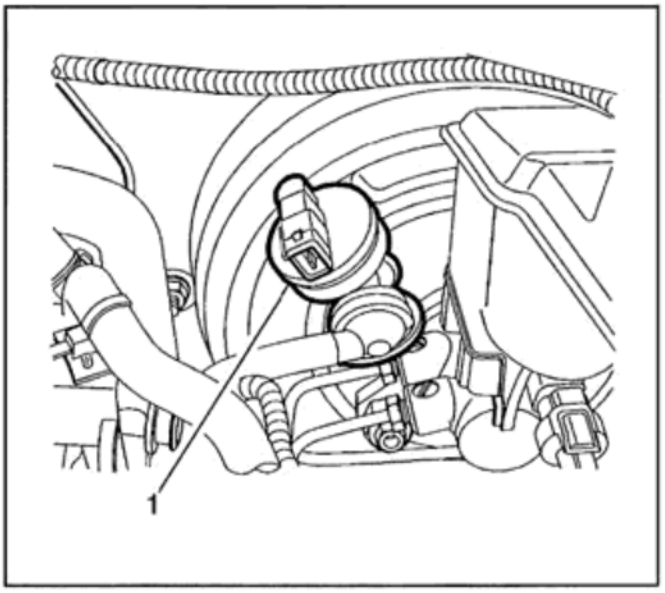
2521422

40. Connect the heater inlet hose to the heater core (1). Refer to *Heater Inlet Hose Replacement (LDE, LUW) on page 10-38* or *Heater Inlet Hose Replacement (LUV) on page 10-38*.



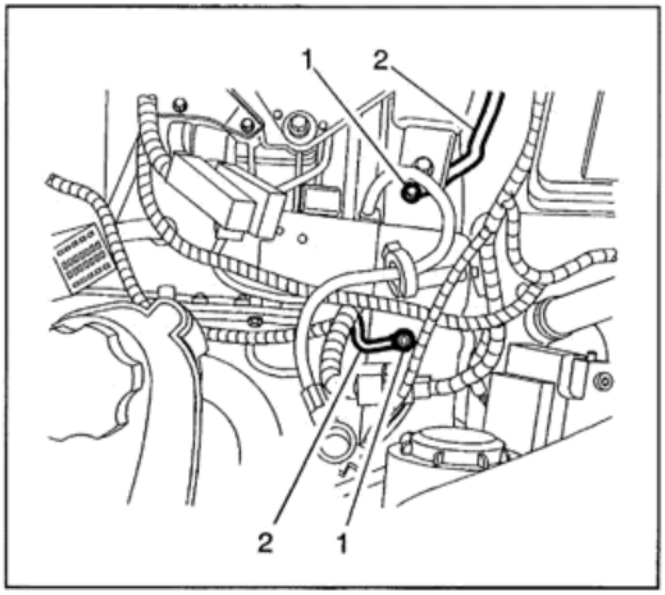
2521427

41. Connect the heater outlet hose to the heater core (1). Refer to *Heater Outlet Hose Replacement (LUV) on page 10-40* or *Heater Outlet Hose Replacement (LDE, LUW) on page 10-40*.



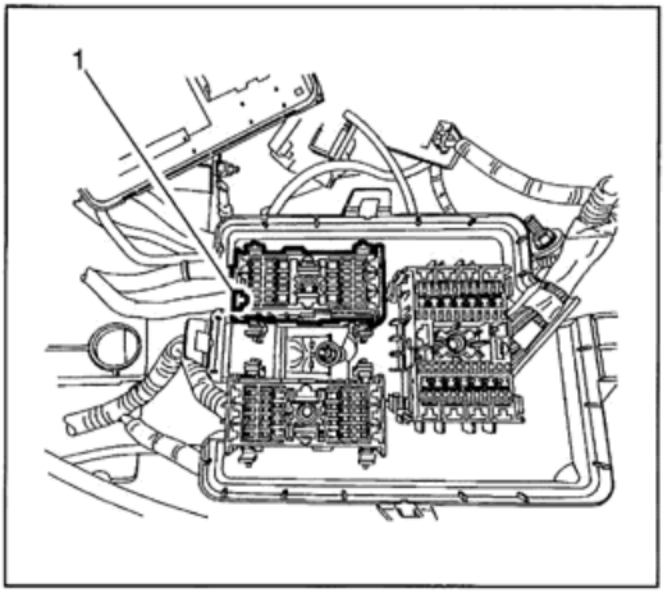
2534615

42. If equipped with electrical vacuum pump, connect the electrical connector and install the brake booster hose (1).



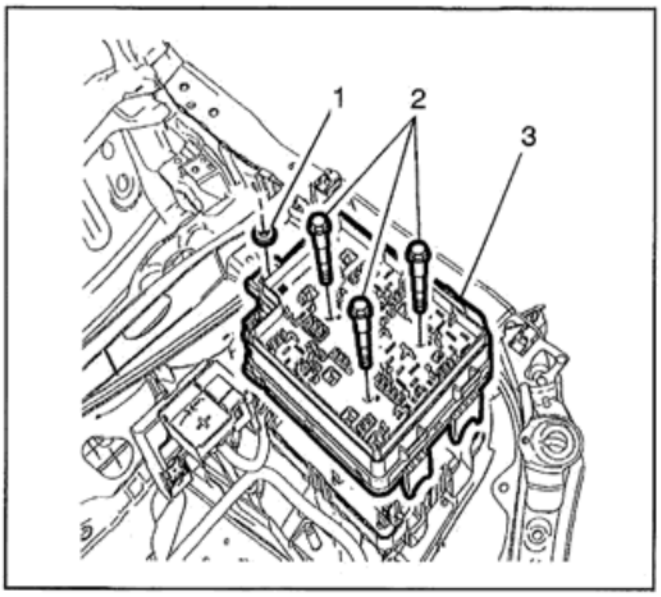
2539765

43. Install the ground nuts (1) and reposition the wiring harness (2).



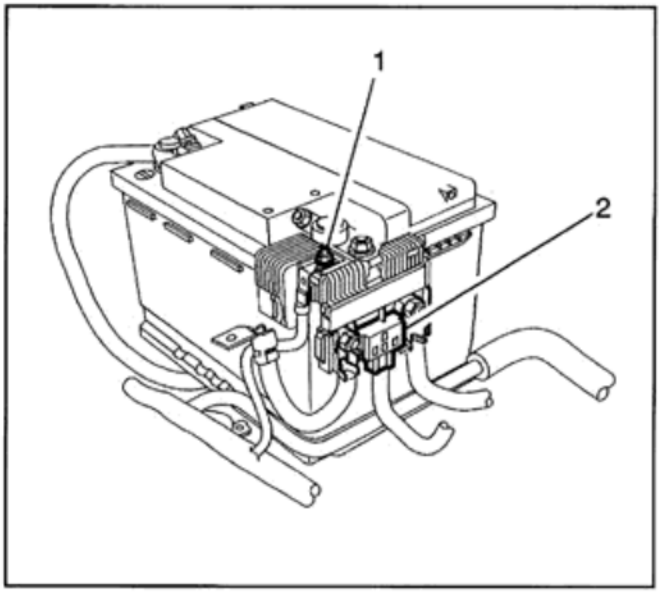
2539762

44. Clip in the wiring harness plugs (1).



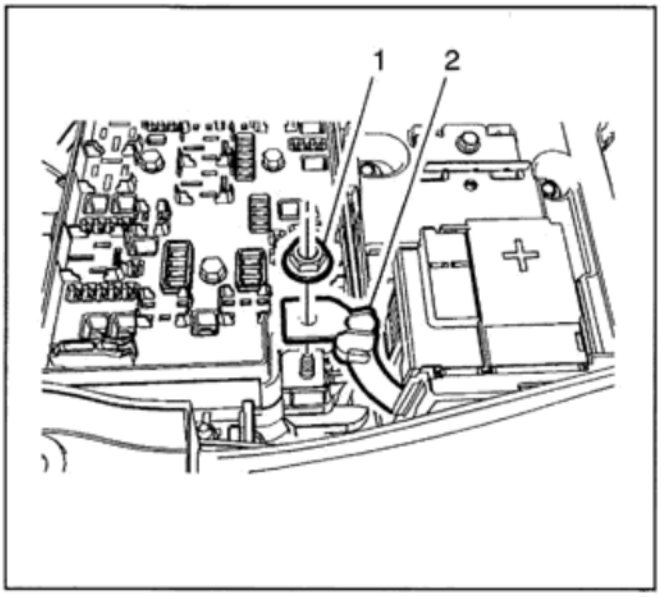
2539757

45. Install the junction block to the base.
46. Install the junction block bolts (2) and tighten to **5** N•m **(44 lb in)**.
47. Install the junction block nut (1) and tighten to **5** N•m **(44 lb in)**.



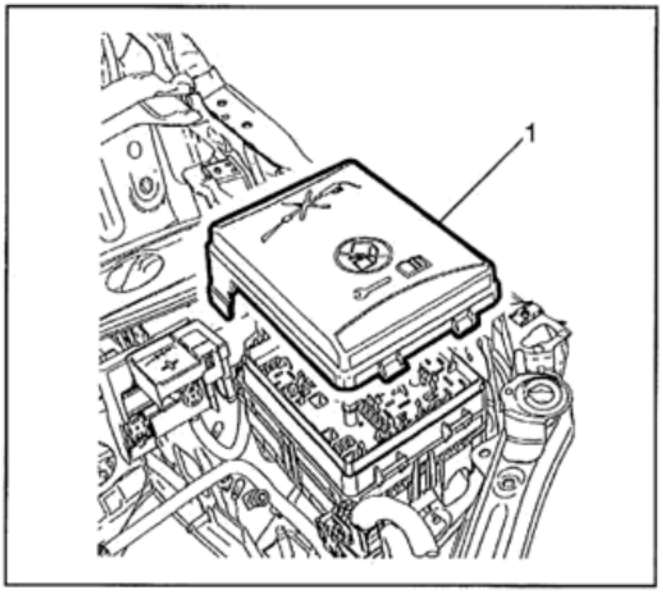
2539751

48. Install the battery positive cable to the battery positive cable junction block and tighten nut (1) to **5** N•m **(44 lb in)**.
49. Connect the body wiring master harness connector (2), to the battery positive cable junction block.



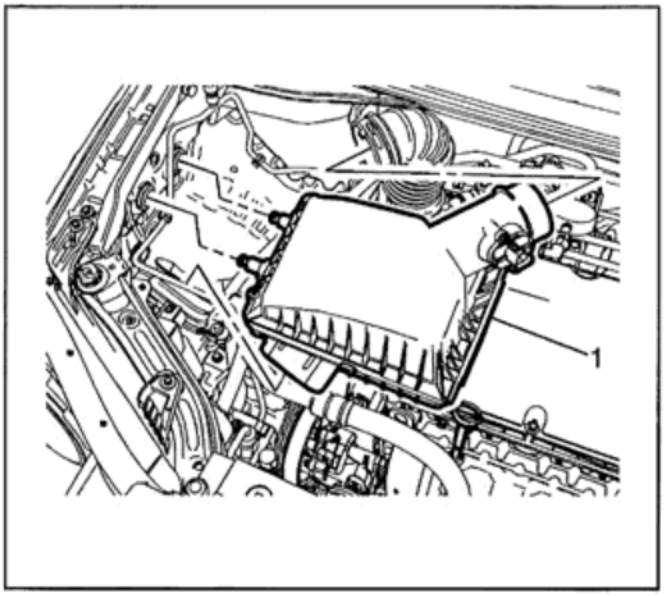
2504689

50. Position the positive battery cable to the junction block.
51. Install the positive battery cable nut (2) and tighten to **7 N•m (62 lb in)**.



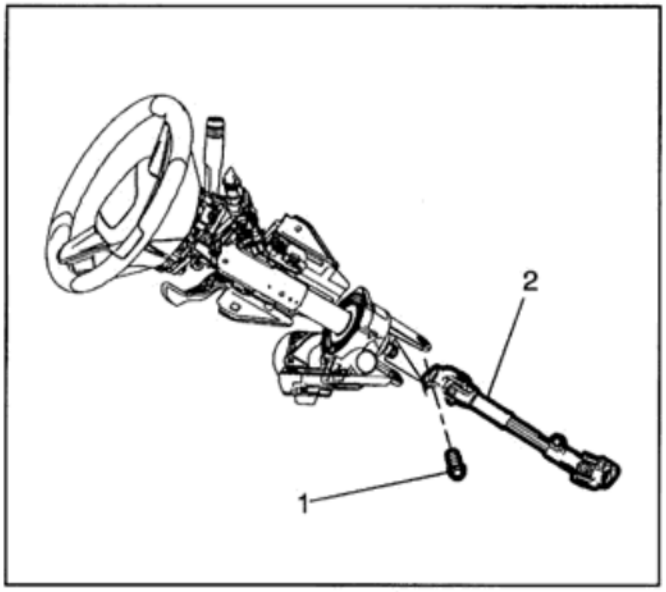
2539745

52. Install the junction block cover (1).



2521421

53. Install the air cleaner assembly (1). Refer to *Air Cleaner Assembly Replacement on page 9-582*.



2534608

54. Install the lower intermediate steering shaft bolt (1). Refer to *Intermediate Steering Shaft Replacement on page 15-27*.
55. Install the battery and battery tray. Refer to *Battery Tray Replacement on page 9-721*.
56. Install the front tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
57. Install the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-55*.

58. Install the front wheelhouse liner inner front extensions. Refer to *Front Wheelhouse Liner Inner Front Extension Replacement (Left Side) on page 3-147* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LUV) on page 3-148* or *Front Wheelhouse Liner Inner Front Extension Replacement (Right Side, LWE, LUW) on page 3-149*.
59. Evacuate and charge the refrigerant system. Refer to *Refrigerant Recovery and Recharging on page 10-13*.
60. Fill the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.

Engine Replacement (Manual Transmission)

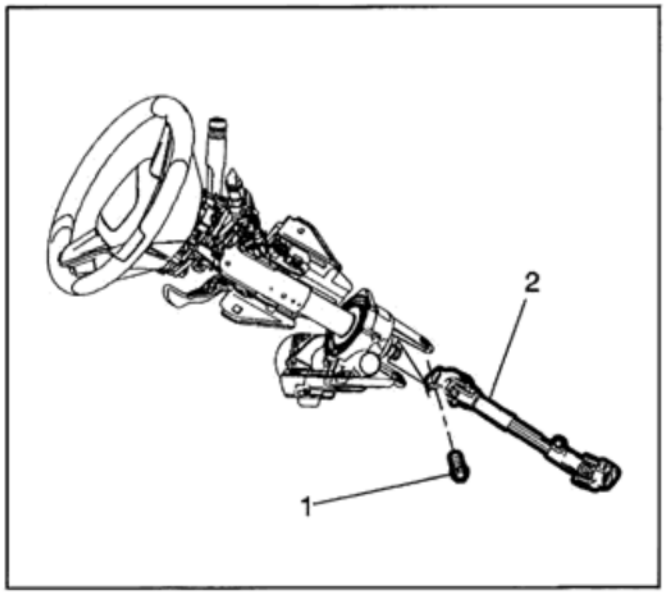
Special Tools

- *J-45859* Wheel Drive Shaft Remover .
- *CH-807* Closure Plugs .

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

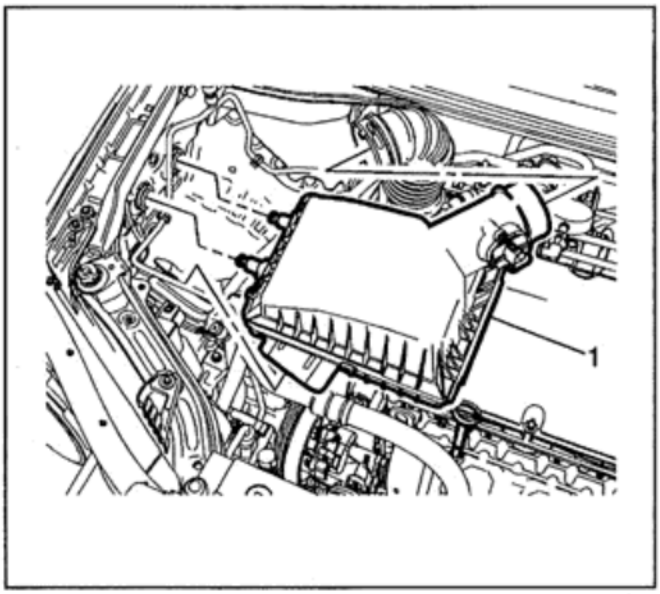
Removal Procedure

1. Remove the battery and battery tray. Refer to *Battery Tray Replacement on page 9-721*.
2. Relieve the fuel system pressure. Refer to *Fuel Pressure Relief on page 9-547*.
3. Recover the refrigerant. Refer to *Refrigerant Recovery and Recharging on page 10-13*.
4. Remove the front tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
5. Remove the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-55*.
6. Drain the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.



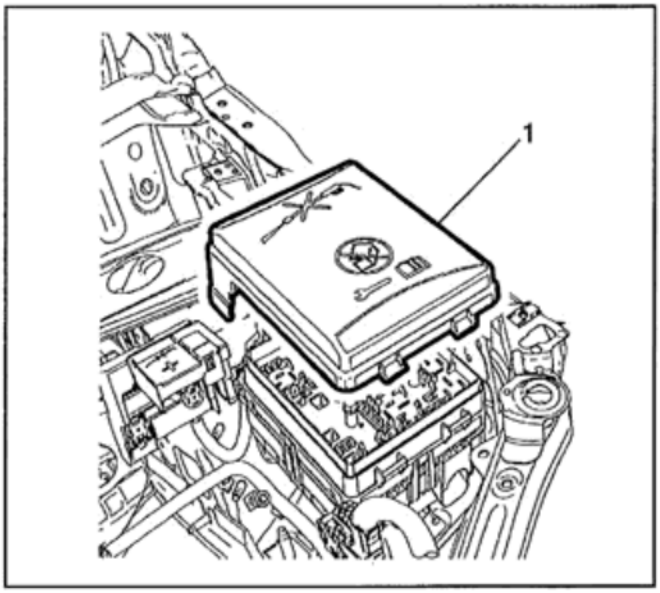
2534608

7. Remove the lower intermediate steering shaft bolt (1) and slide the shaft away from steering column. Refer to *Intermediate Steering Shaft Replacement on page 15-27*.



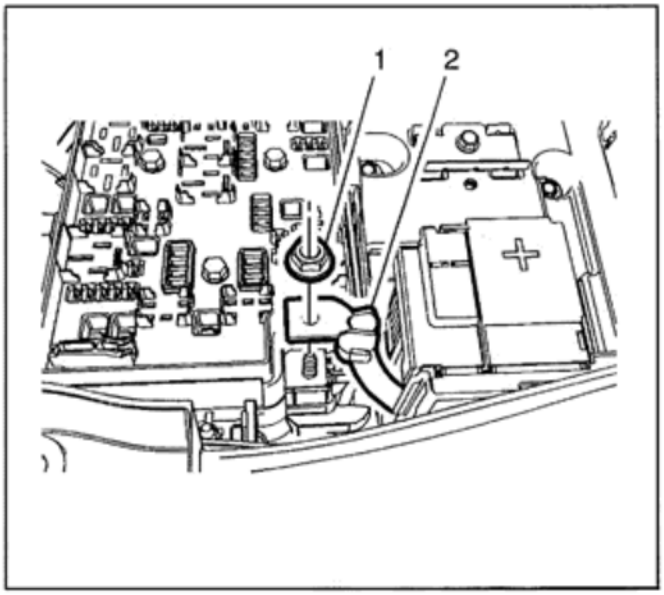
2521421

8. Remove the air cleaner assembly (1). Refer to *Air Cleaner Assembly Replacement on page 9-582*.



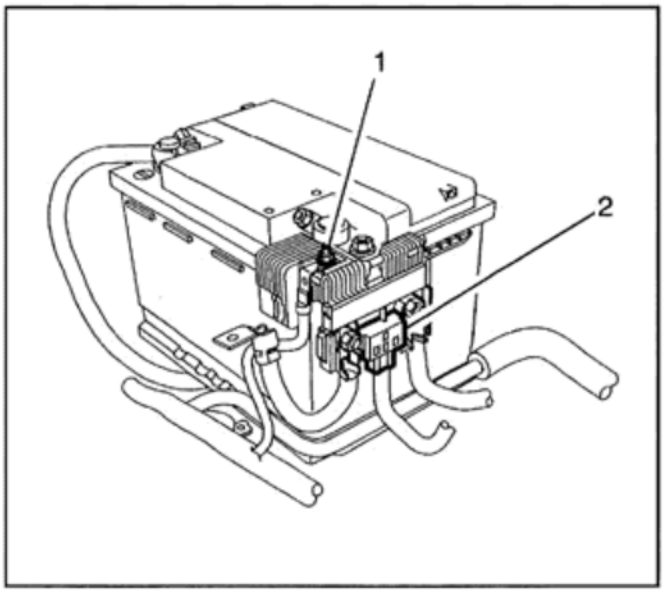
2539745

9. Remove the junction block cover (1).



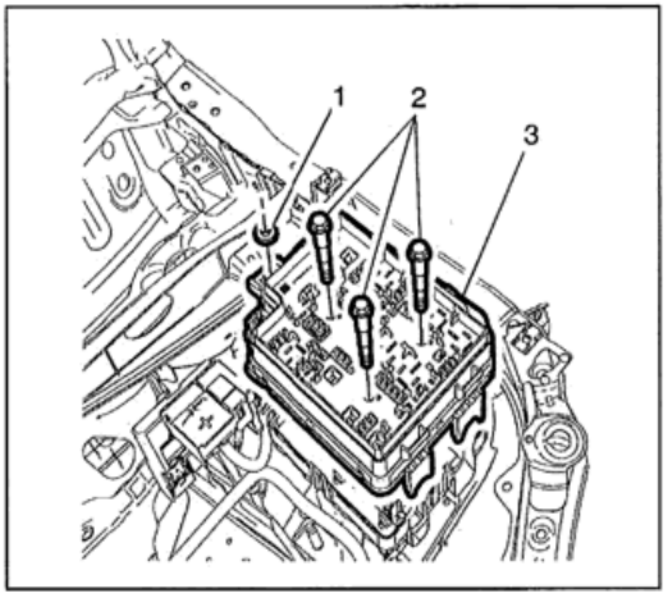
2504689

10. Remove the positive battery cable nut (1) from the junction block.
11. Remove the positive battery cable (2) from the junction block.



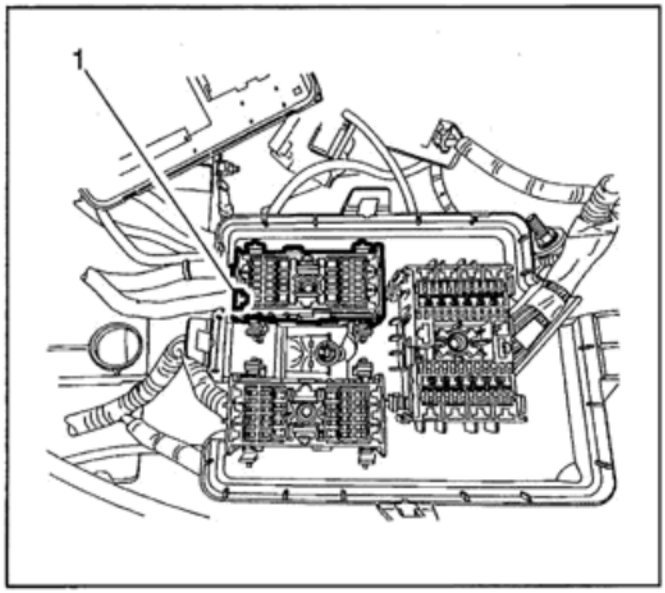
2539751

12. Remove the positive cable nut (1) and battery positive cable, from the battery positive cable junction block.
13. Disconnect the body wiring master harness connector (2), from the battery positive cable junction block.



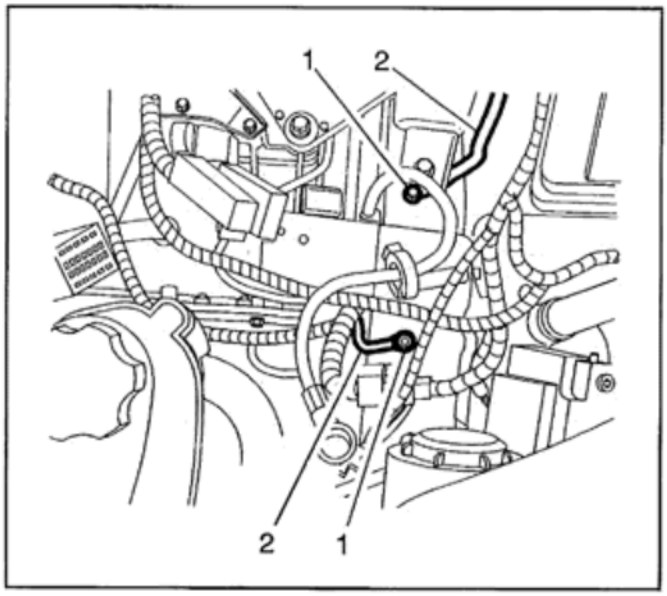
2539757

14. Remove the junction block nut (1).
15. Remove the junction block bolts (2).
16. Disconnect the wiring harness from the junction block base.
17. Remove the junction block (3) from the base.
18. Disconnect the wiring harness plug from the front compartment fuse block.



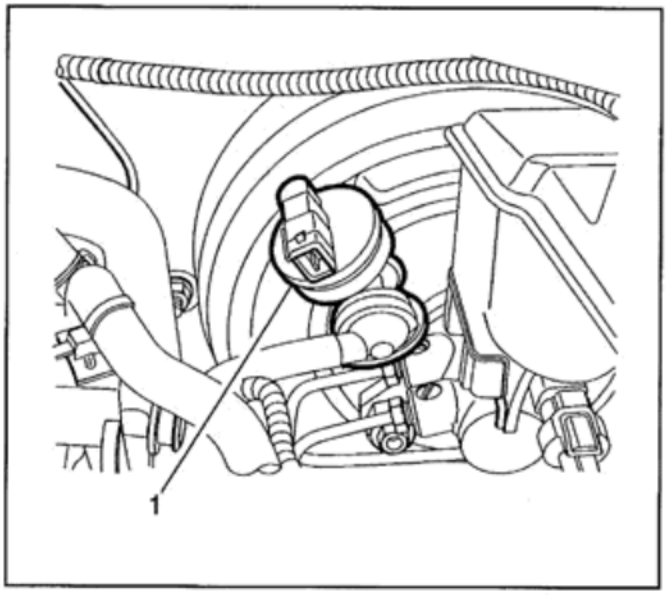
2539762

19. Reposition the wiring harness (1) on top of the engine.



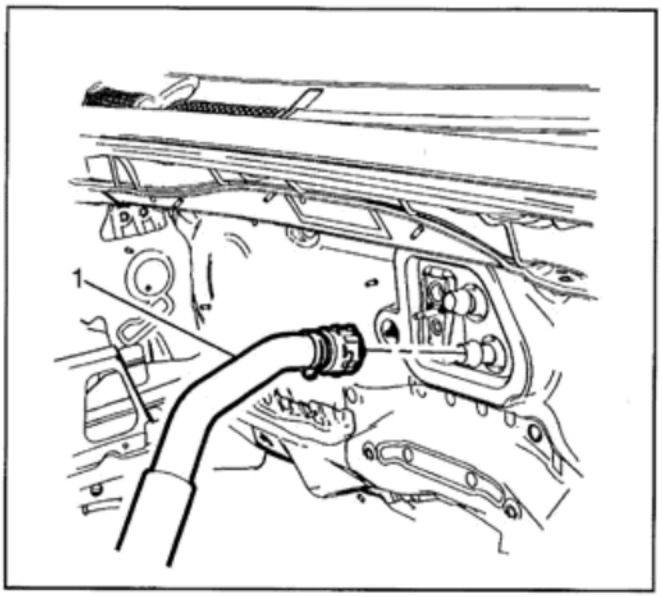
2539765

20. Remove the ground nuts (1) and reposition the wiring harness (2) aside.



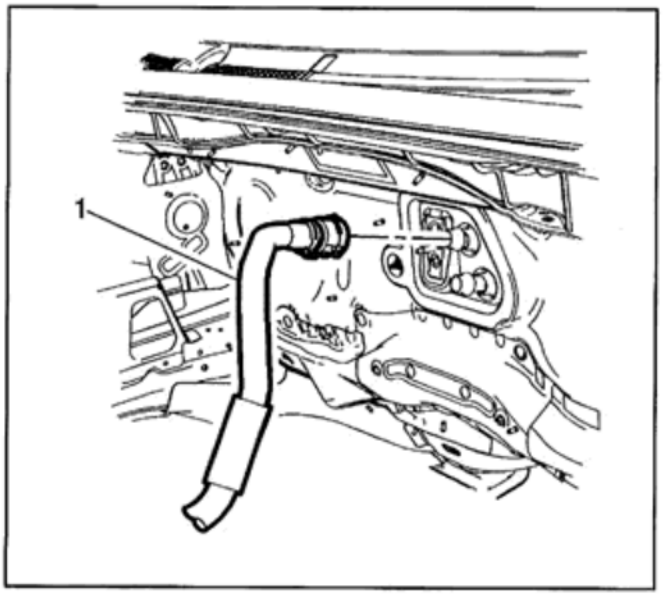
2534615

21. If equipped with electrical vacuum pump, disconnect the electrical connector and remove the brake booster hose (1).



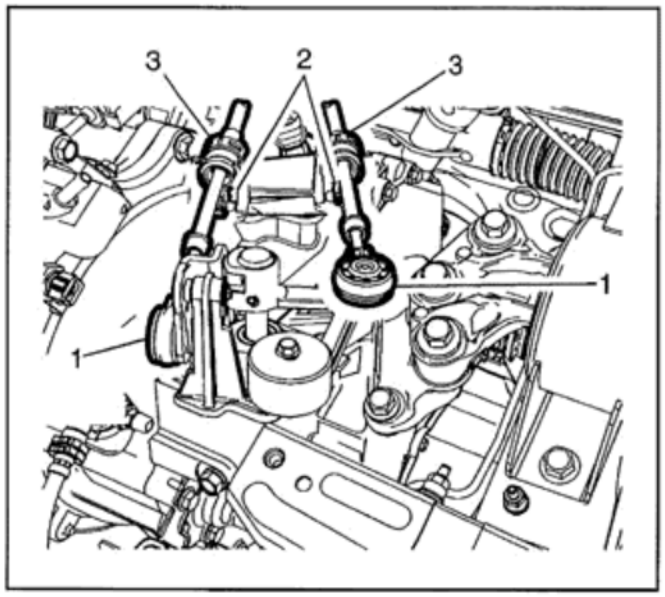
2521422

22. Disconnect the heater inlet hose (1) from the heater core. Refer to *Heater Inlet Hose Replacement (LDE, LUW) on page 10-38* or *Heater Inlet Hose Replacement (LUV) on page 10-38*.



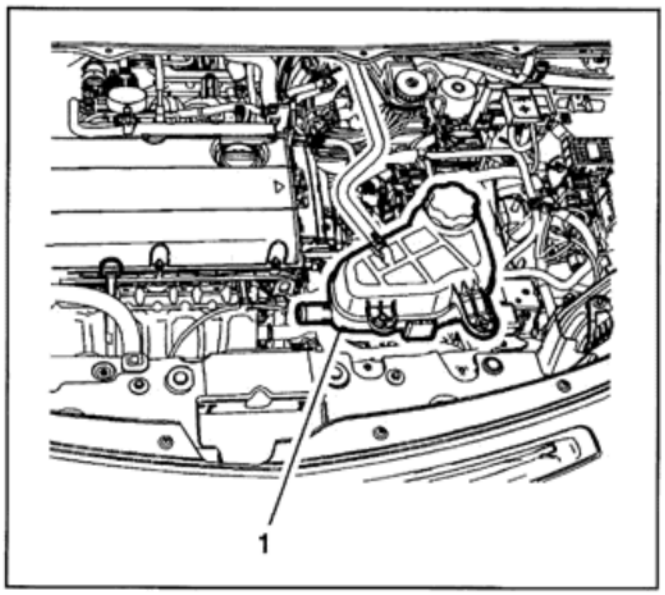
2521427

23. Disconnect the heater outlet hose (1) from the heater core. Refer to *Heater Outlet Hose Replacement (LUV) on page 10-40* or *Heater Outlet Hose Replacement (LDE, LUW) on page 10-40*.



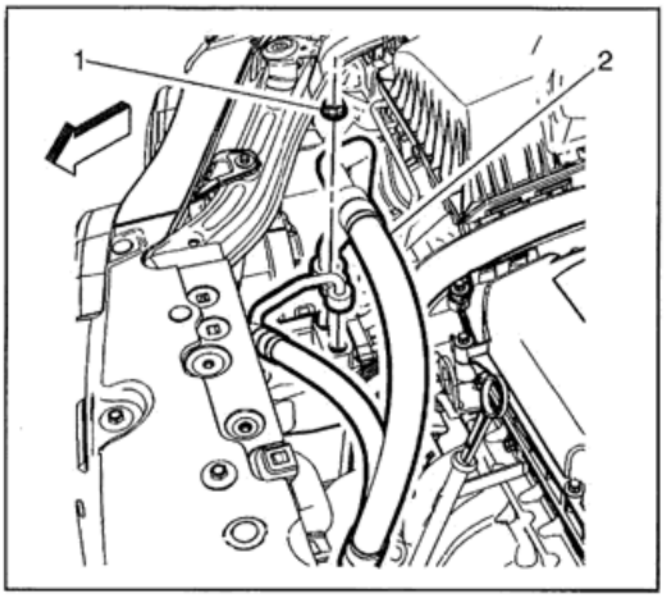
2511540

24. Disconnect the transmission range selector lever cable terminal (1) from the transmission manual pin.
25. Press the locking tab forward in order to release the transmission range selector lever cable (2) from the cable bracket.



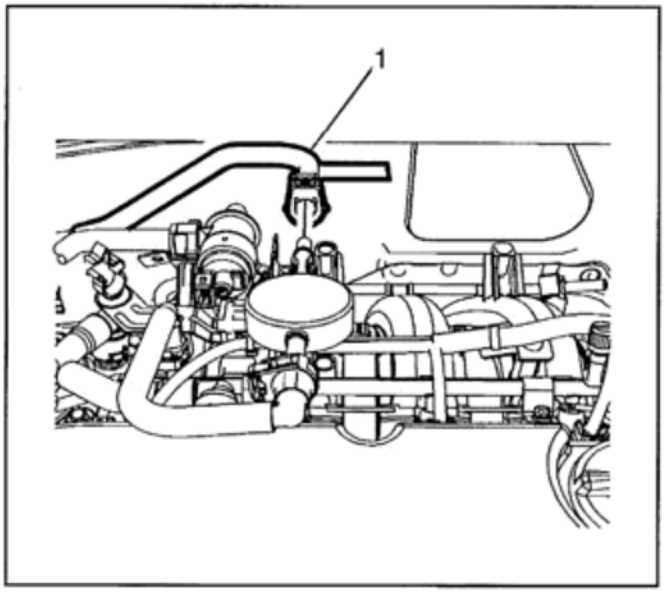
2534616

26. Remove the radiator surge tank (1) and position aside. Refer to *Radiator Surge Tank Replacement on page 9-630*.
27. Disconnect the fan connector.



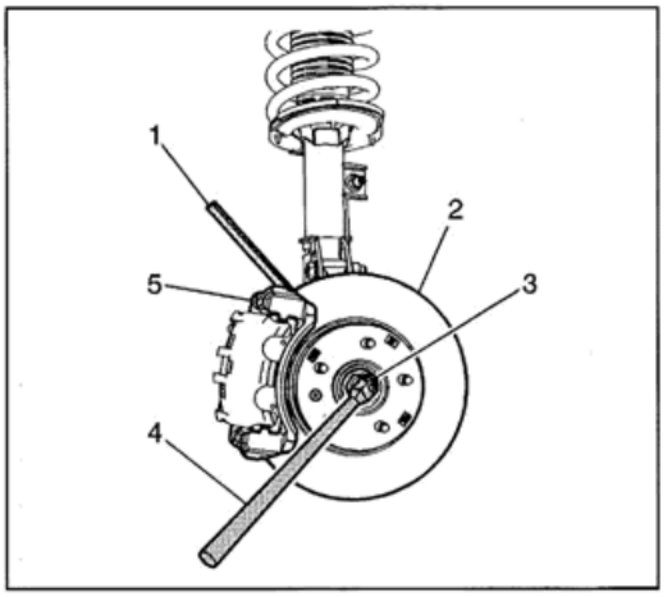
2497607

28. Remove air conditioning compressor and condenser hose nut (1).
29. Remove air conditioning compressor and condenser hose (2) from refrigerant hose.



2509366

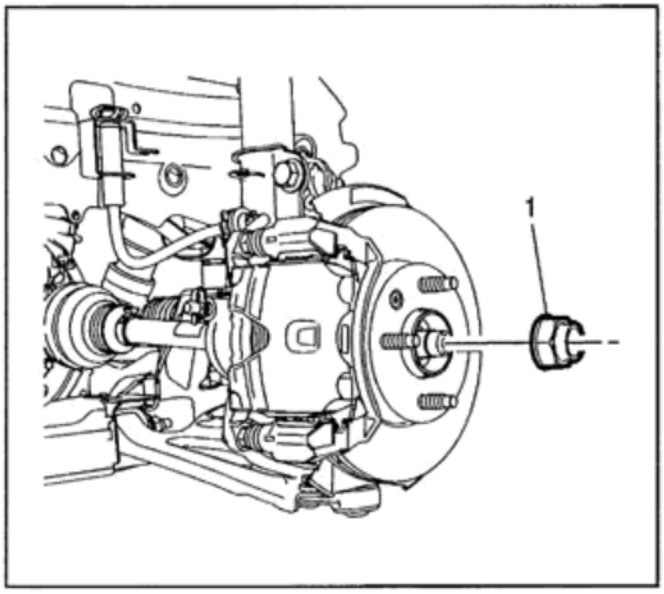
30. Disconnect the fuel feed pipe (1). Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.
31. Install and close the fuel feed pipe with *CH-807* plug.
32. Disconnect the engine coolant sensor from radiator.



2001521

Note: Perform steps 33 through 41 to both sides.

33. Insert a brass drift or punch (1) in the cooling fins of the front brake rotor (2).
34. Rotate the brake rotor until it comes in contact with the brake caliper mount bracket (5).

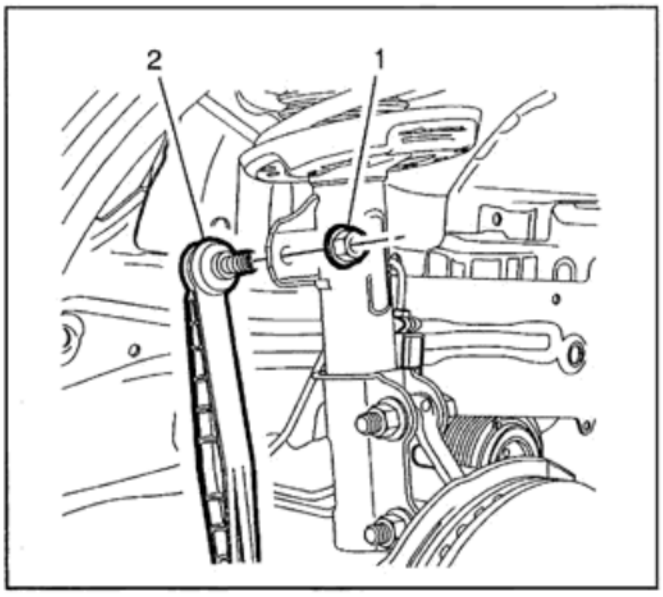


2498078

Note:

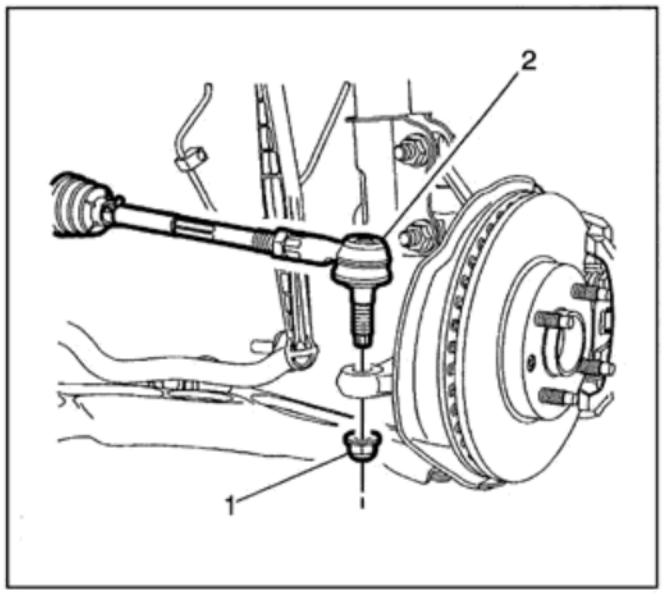
- Use a suitable tool to release the crimping on the wheel drive shaft retaining nut.
- The wheel drive shaft retaining nut (1) must be discarded after removal.

35. Remove and discard the wheel drive shaft nut (1). Replace with NEW only.



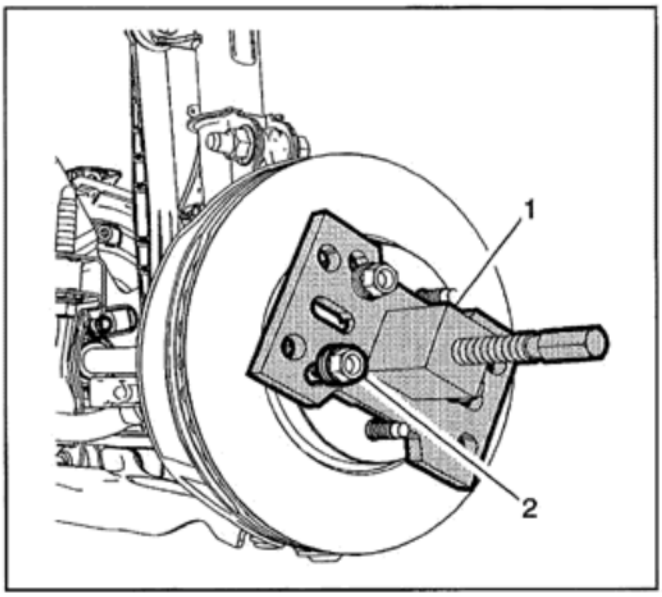
2539770

36. Remove the upper stabilizer shaft link nut (1).
37. Disconnect the stabilizer shaft link (2).



2539785

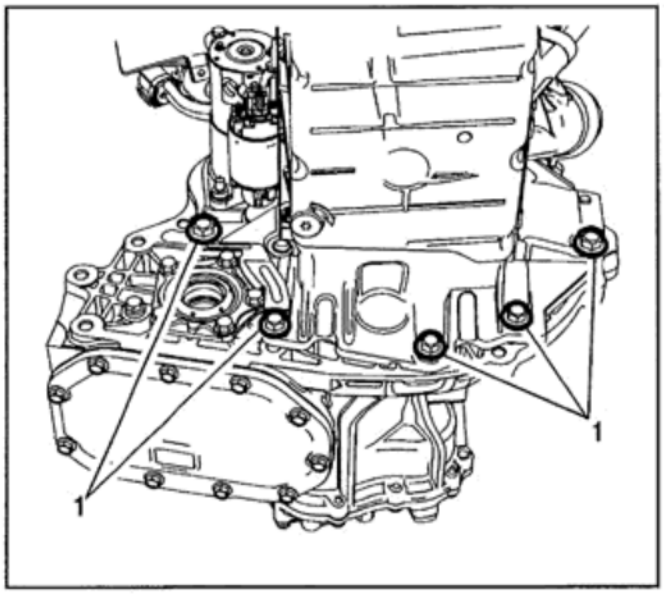
38. Remove the steering linkage outer tie rod nut (1).
39. Separate the steering linkage outer tie rod (2) from the steering knuckle. *Steering Linkage Outer Tie Rod Replacement on page 15-17*.
40. Separate the control arm ball joint from the steering knuckle. Refer to *Lower Control Arm Replacement on page 16-12*.



2739004

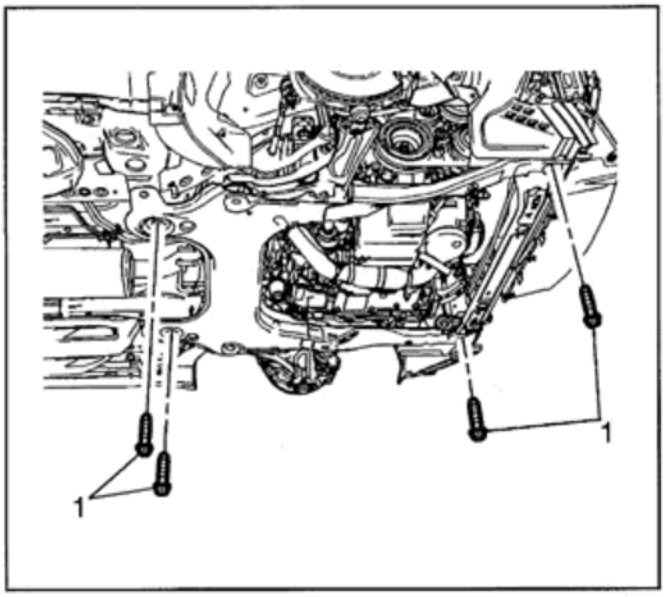
Note: Reverse the wheel lug nuts and washers so the flat part of the wheel nut is facing the washers.

41. Using the *J-45859* remover (2), separate the wheel drive shaft from the steering knuckle (1).
42. Remove the upper stabilizer shaft link from the absorber on both sides. Refer to *Stabilizer Shaft Link Replacement on page 16-8*.
43. Remove the front exhaust pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*.



2535570

44. Remove the lower oil pan to transmission lower bolts (1).

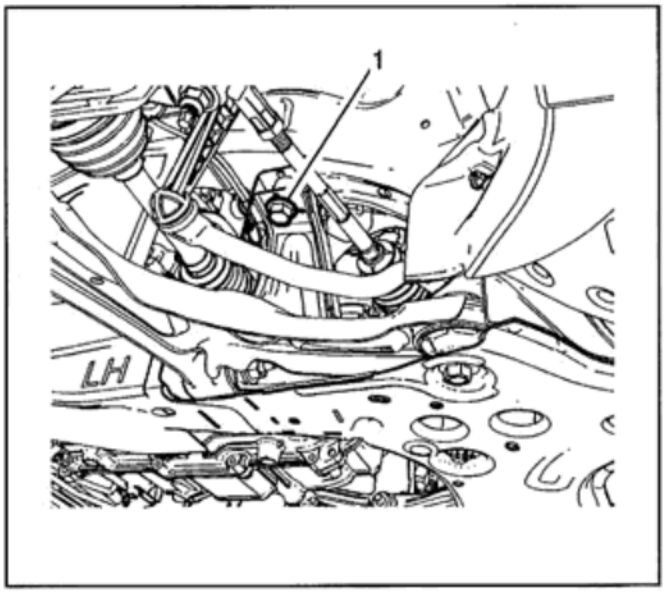


2539786

45. Remove the frame front bolts (1).

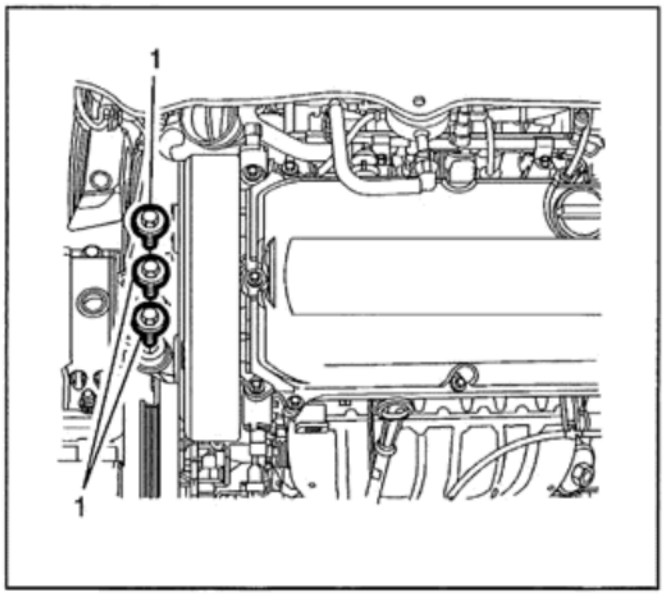
Note: Blocks of wood can be used between the front of the frame and the oil pan to table in order to level the powertrain during the removal.

46. Position a engine support table under the powertrain assembly.



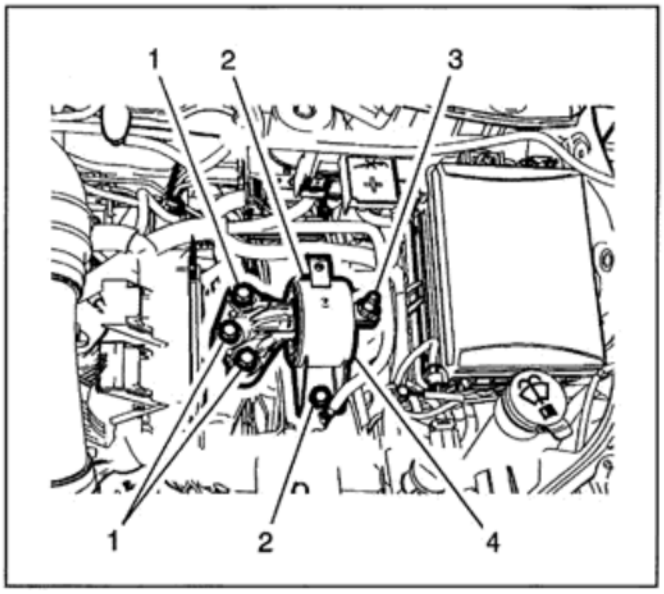
2492995

47. Remove the upper frame suspension retaining bolts (1) on both sides.



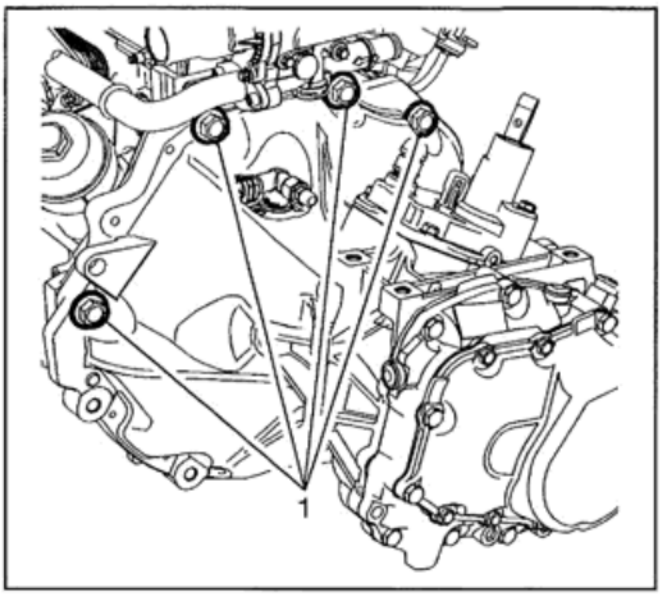
2534620

48. Mark the location of the bolts (1) before removing.
49. Remove the right side engine mount bolts (1). Refer to *Engine Mount Replacement on page 9-967*.



2503695

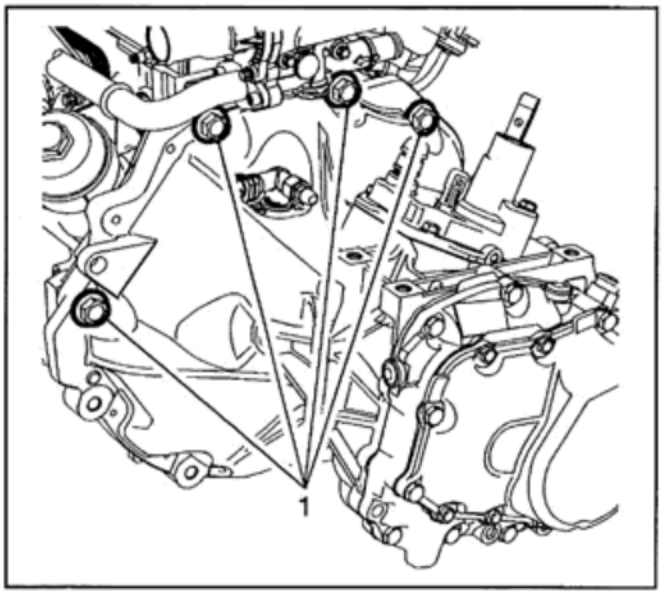
50. Mark the location of the bolts (1) before removing.
51. Remove the transmission mount bolts (1) – left side. Refer to *Engine Mount Replacement on page 9-967*.
52. Disconnect any additional electrical connections as necessary.
53. Raise the vehicle until the powertrain is clear for removal.



2535571

54. Remove the upper transmission to engine bolts (1) and separate the engine and transmission.
55. Disconnect any electrical connectors as needed.
56. Install the engine to the engine stand.
57. Transfer parts as needed.

Installation Procedure

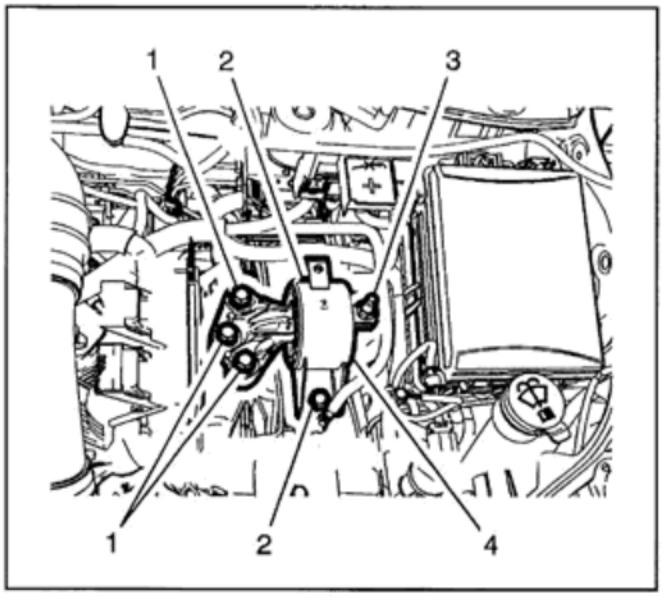


2535571

1. Remove the engine from the engine stand.
2. Install the transmission to the engine.

Caution: Refer to *Fastener Caution on page 0-8*.

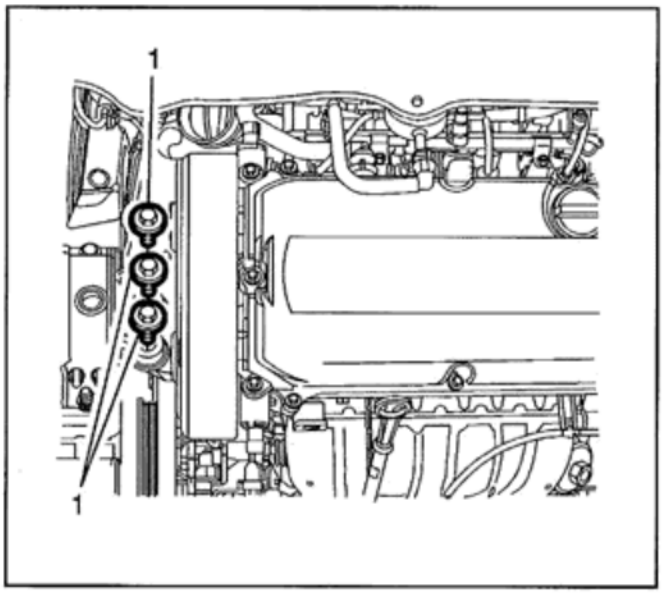
3. Install the upper transmission to engine bolts (1) and tighten to **60 N•m (44 lb ft)**.
4. Place the powertrain into the front frame.
5. Slowly lower the body onto the powertrain.



2503695

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

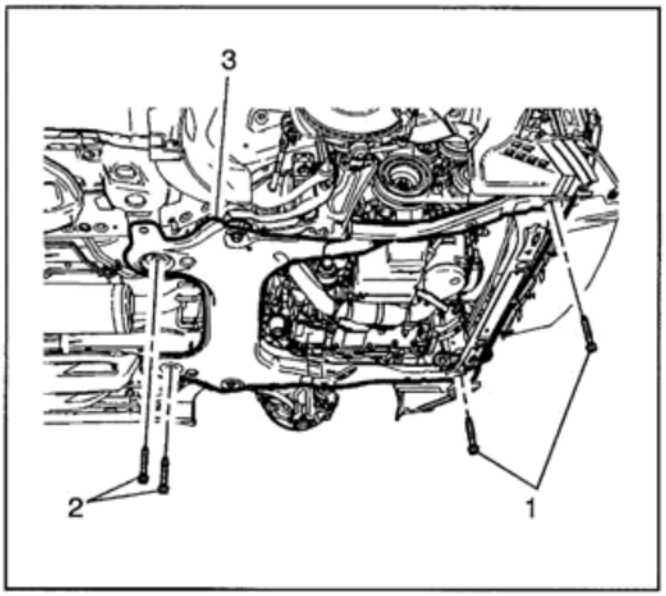
6. Install the NEW left transmission mount to transmission bolts (1) and tighten to **50 N•m (37 lb ft) plus 70 degrees**.



2534620

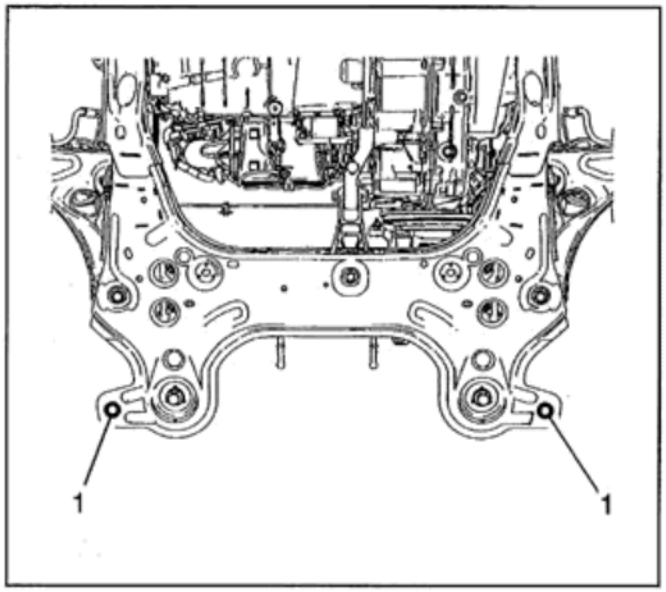
Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

7. Install the right side engine mount bolts (1) and tighten to **50 N•m (37 lb ft) plus 70 degrees**.
8. Perform Powertrain Mount Balancing.



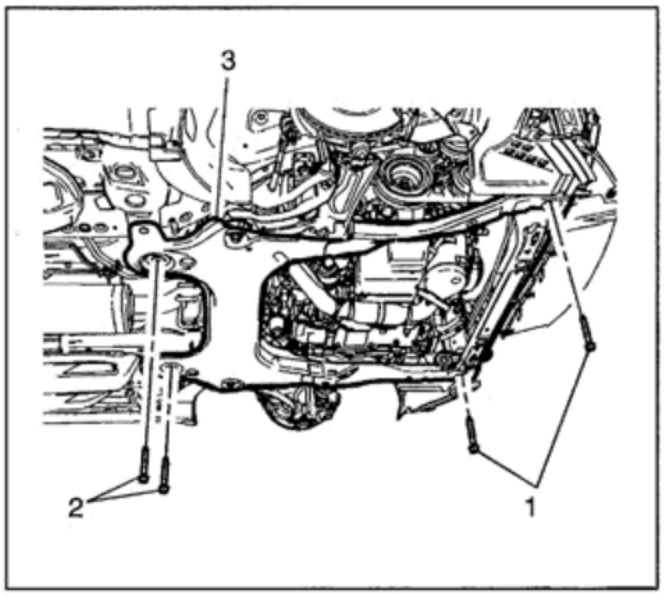
2508892

9. Install the frame (3) rear bolts (2) and front bolts (1), tighten a little bit.



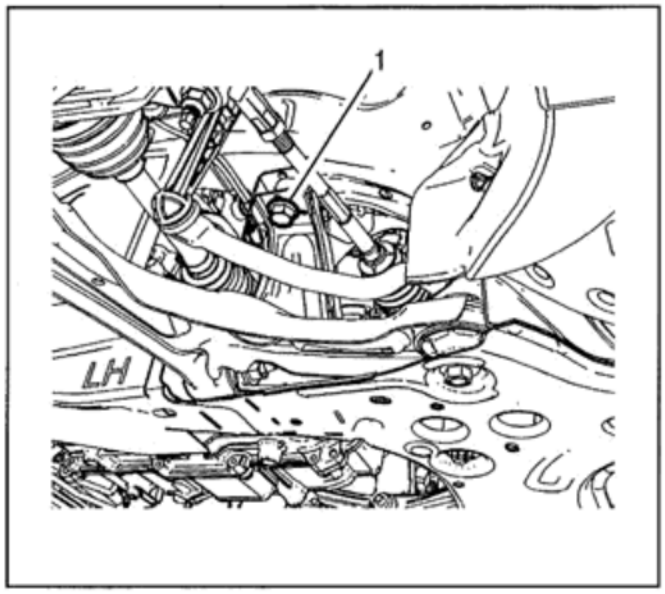
2539810

10. Align the frame and body through alignment hole (1).



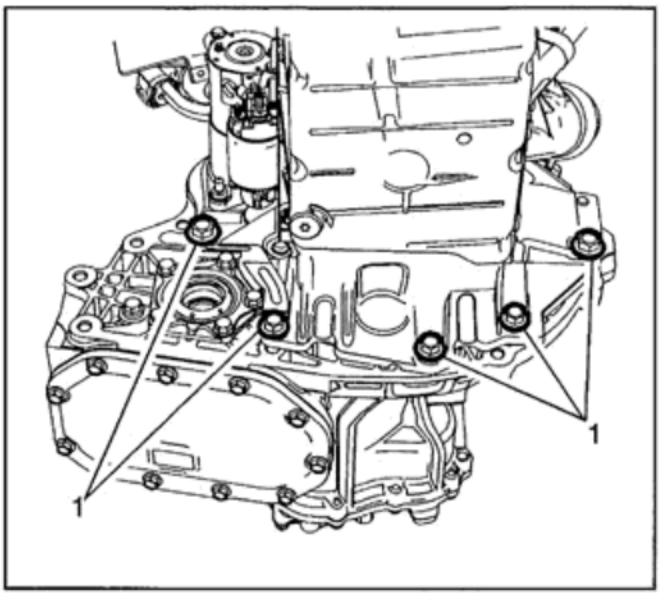
2508892

11. Install the frame (3) rear bolts (2) and tighten to **135** N•m **(100 lb ft)**.
12. Install the frame (3) front bolts (1) and tighten to **58** N•m **(43 lb ft)**.



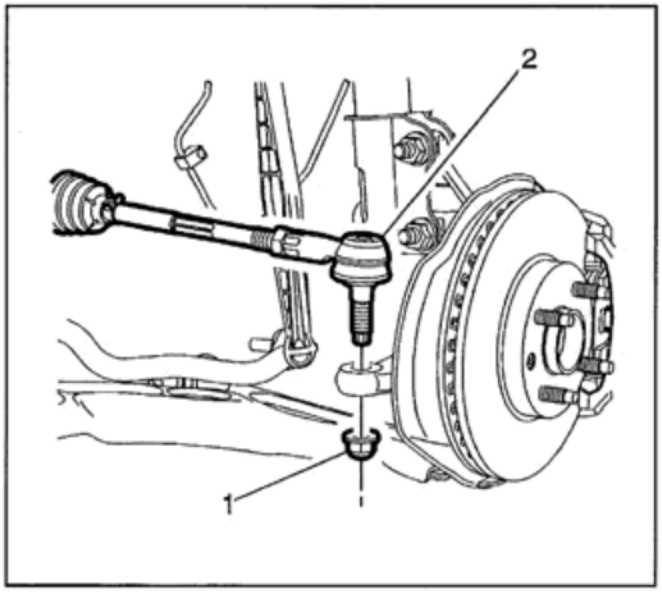
2492995

13. Install the upper frame suspension retaining bolts (1) on both sides and tighten to **135** N•m **(100 lb ft)**.
14. Remove the lift table.



2535570

15. Install the lower oil pan to transmission lower bolts (1) and tighten to **60** N•m **(44 lb ft)**.
16. Install the front exhaust pipe. Refer to *Exhaust Front Pipe Replacement (LUV,LUW) on page 9-738*.

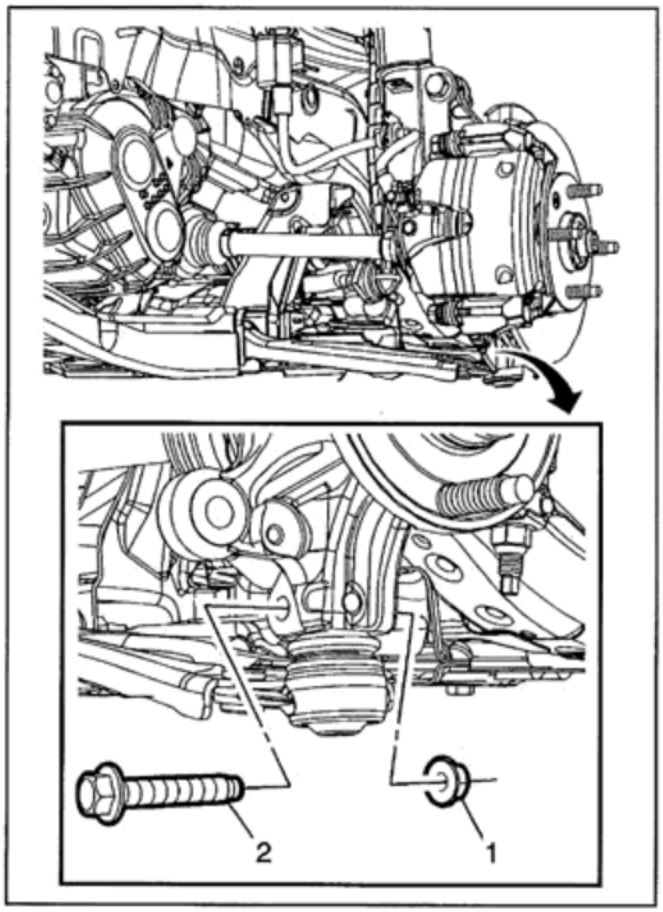


2539785

17. Inset the wheel drive shaft to the steering knuckle.

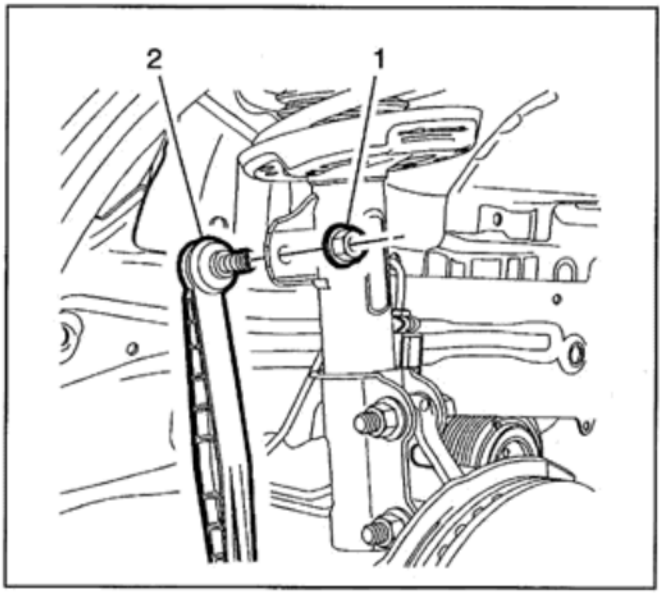
Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

18. Install the NEW steering linkage outer tie rod nut (1) and tighten to **30** N•m **(22 lb ft) Plus 128 degrees**.
19. Install the steering linkage outer tie rod to the steering knuckle. Refer to *Steering Linkage Outer Tie Rod Replacement on page 15-17*.



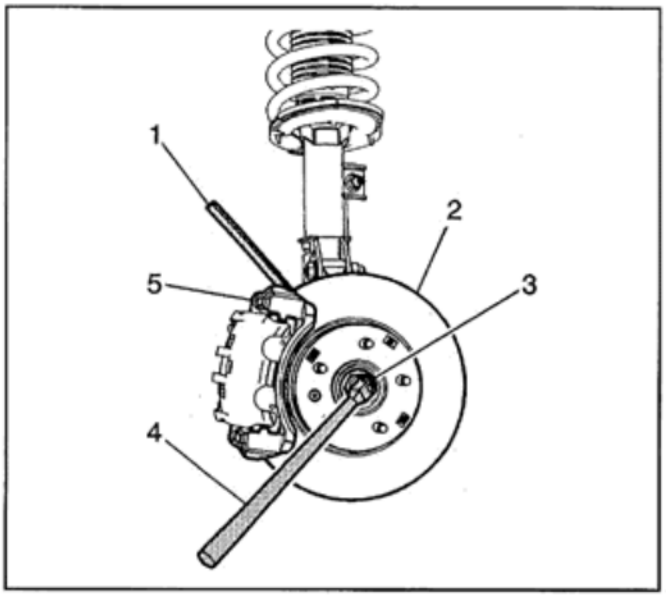
2497213

20. Install the control arm ball joint to the steering knuckle. Refer to *Lower Control Arm Replacement on page 16-12*.



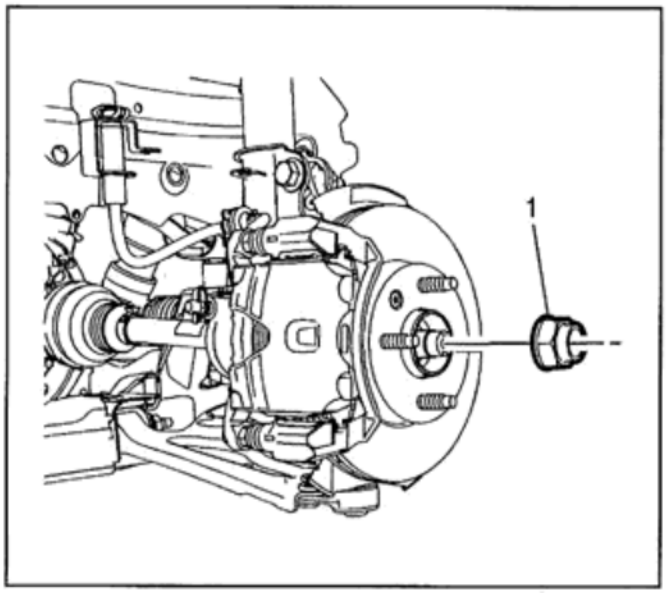
2539770

21. Connect the stabilizer shaft link (2).
22. Install the upper stabilizer shaft link nut (1) and tighten to **65** N•m **(48 lb ft)**.



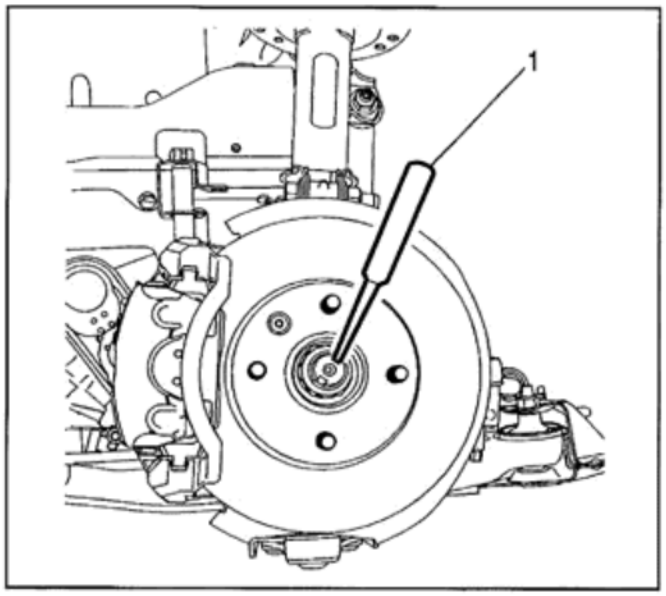
2001521

23. Insert a brass drift or punch (1) in the cooling fins of the front brake rotor (2).
24. Rotate the brake rotor until it comes in contact with the brake caliper mount bracket (5).



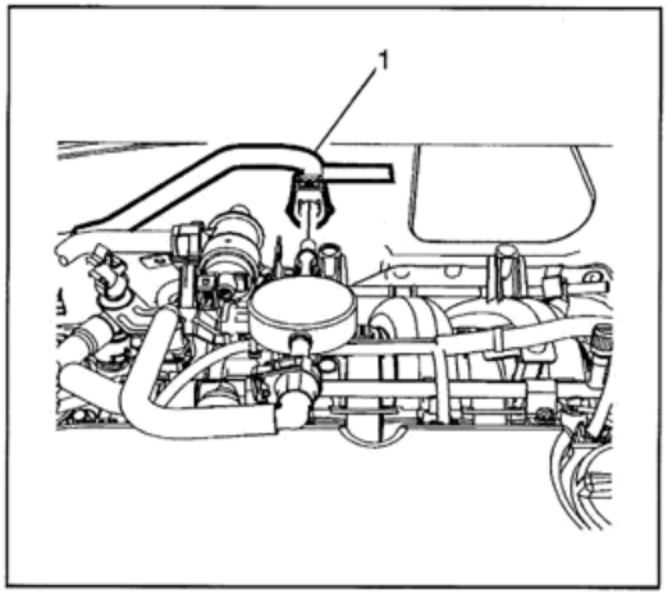
2498078

25. Install the NEW wheel drive shaft nut (1) and tighten to **250** N•m **(184 lb ft)**.



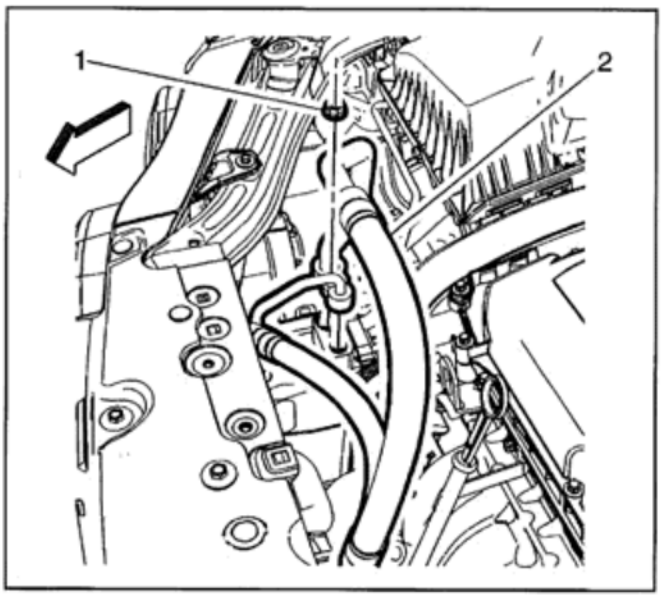
2498125

26. Using a punch (1), stake the wheel drive shaft nut.



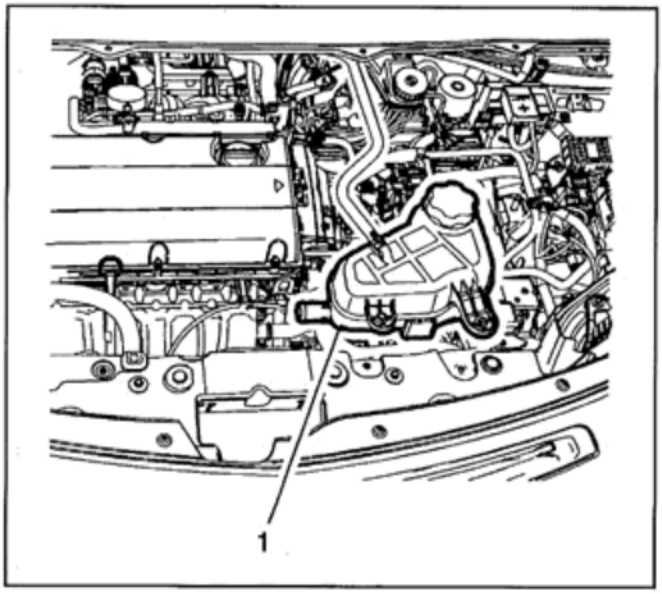
2509366

27. Remove the *CH-807* plug.
28. Connect the fuel feed pipe (1). Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.
29. Connect the engine coolant sensor from radiator.



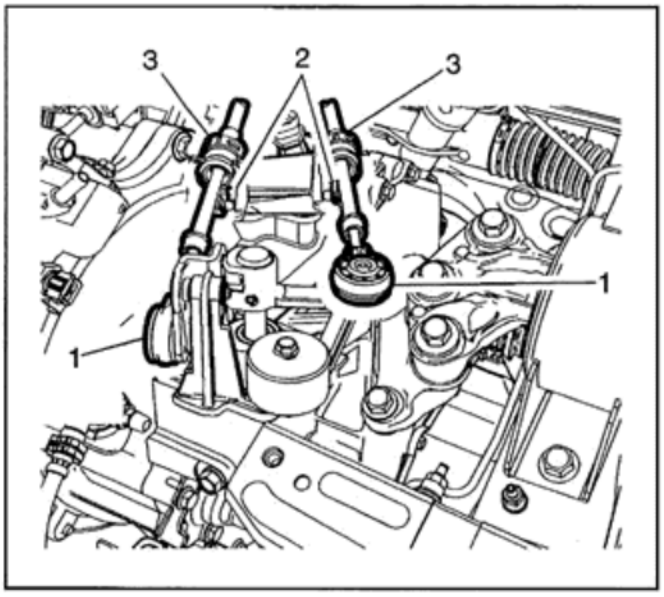
2497507

30. Install air conditioning compressor and condenser hose to the refrigerant hose
31. Install air conditioning compressor and condenser hose nut (1) tighten nut to **22** N•m **(16 lb ft)**.



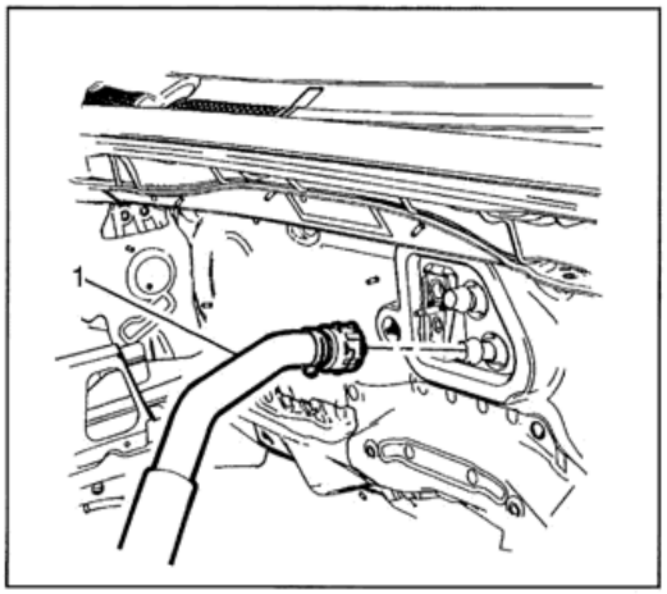
2534616

32. Install the radiator surge tank (1). Refer to *Radiator Surge Tank Replacement on page 9-630*.
33. Connect the fan connector.



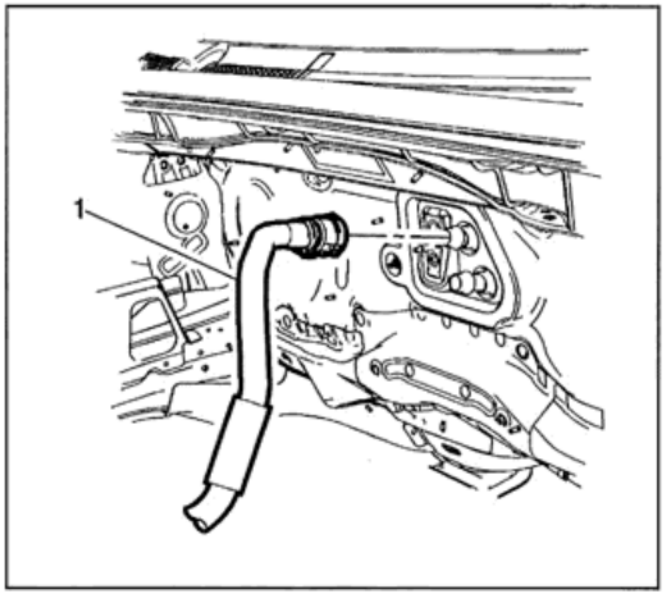
2511540

34. Connect the transmission range selector lever cable terminals (1) to the transmission manual pins.
35. Press the locking tab rearward in order to lock the transmission range selector lever cable (2) to the cable bracket.



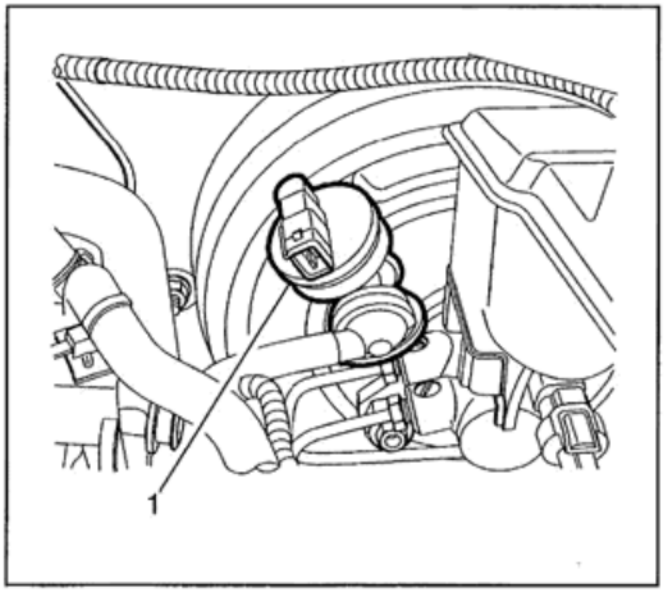
2521422

36. Connect the heater inlet hose to the heater core (1). Refer to *Heater Inlet Hose Replacement (LDE, LUW) on page 10-38* or *Heater Inlet Hose Replacement (LUV) on page 10-38*.



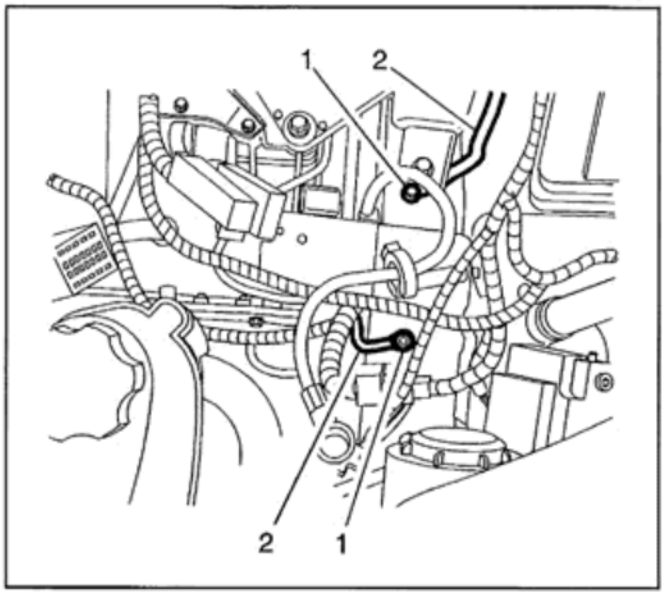
2521427

37. Connect the heater outlet hose to the heater core (1). Refer to *Heater Outlet Hose Replacement (LUV) on page 10-40* or *Heater Outlet Hose Replacement (LDE, LUW) on page 10-40*.



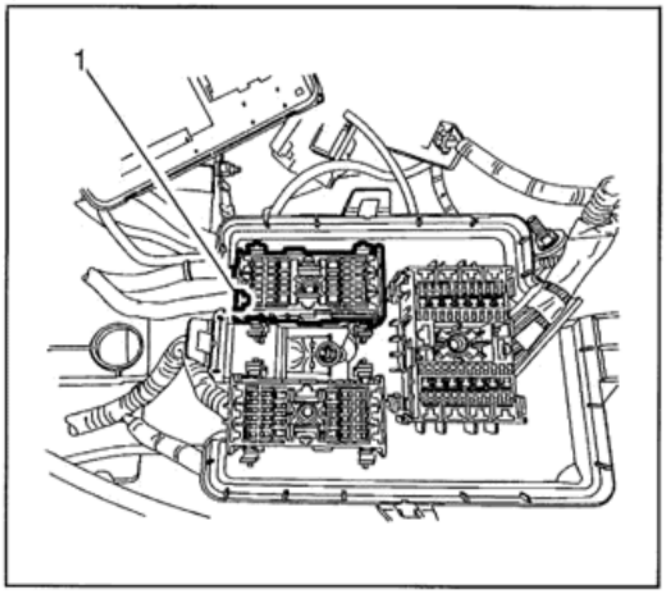
2534615

38. If equipped with electrical vacuum pump, connect the electrical connector and install the brake booster hose (1).



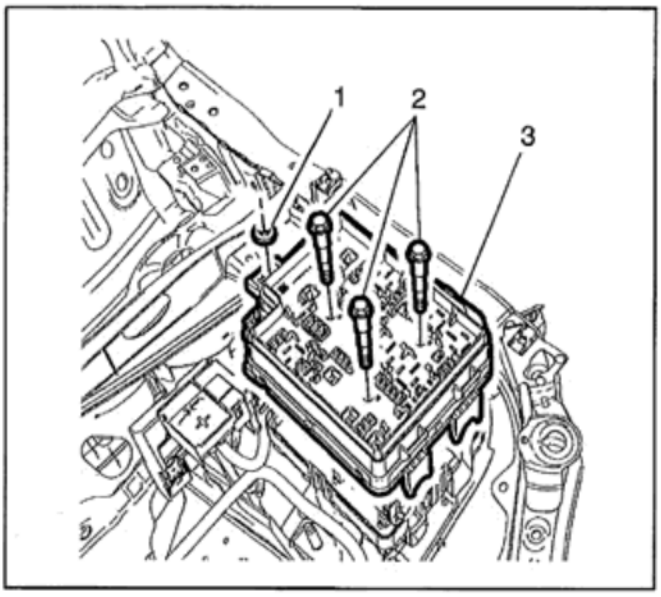
2539765

39. Install the ground nuts (1) and reposition the wiring harness (2).



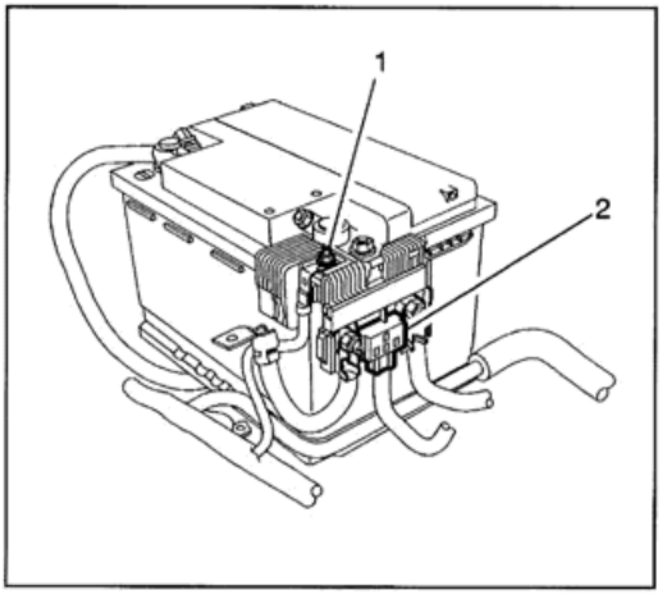
2539762

40. Clip in the wiring harness plugs (1).



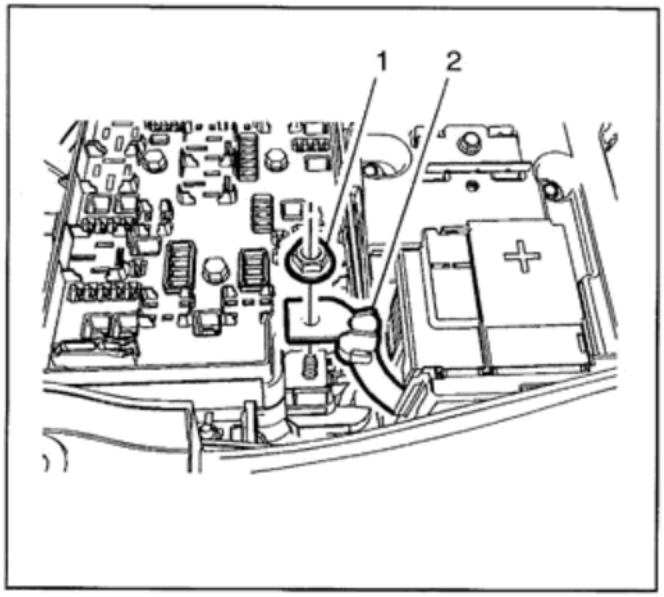
2539757

41. Install the junction block to the base.
42. Install the junction block bolts (2) and tighten to **5** N•m **(44 lb in)**.
43. Install the junction block nut (1) and tighten to **5** N•m **(44 lb in)**.



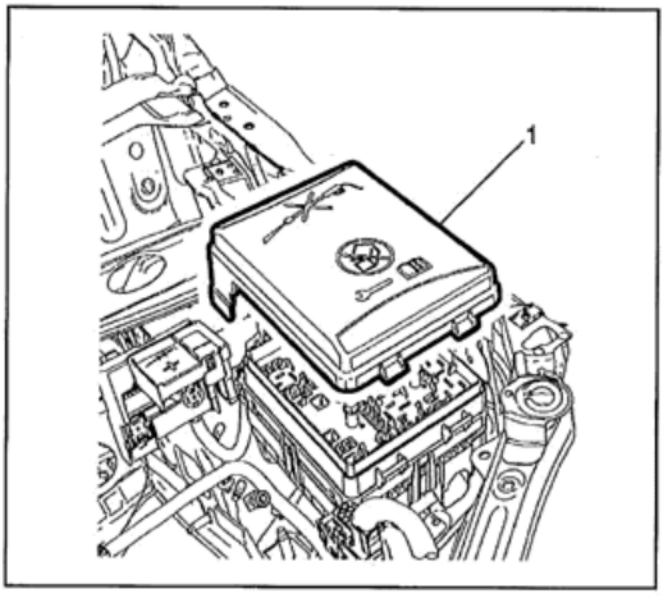
2539751

44. Install the battery positive cable to the battery positive cable junction block and tighten nut (1) to **5** N•m **(44 lb in)**.
45. Connect the body wiring master harness connector (2), to the battery positive cable junction block.



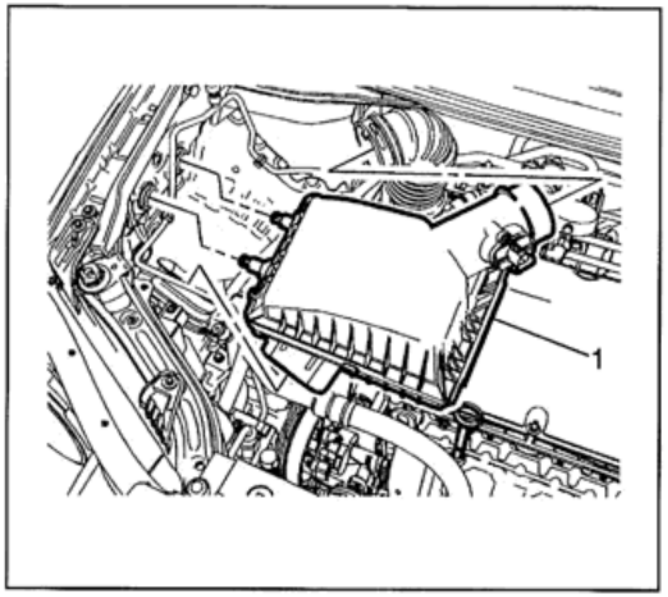
2504689

46. Position the positive battery cable to the junction block.
47. Install the positive battery cable nut (2) and tighten to **10 N•m (89 lb in)**.



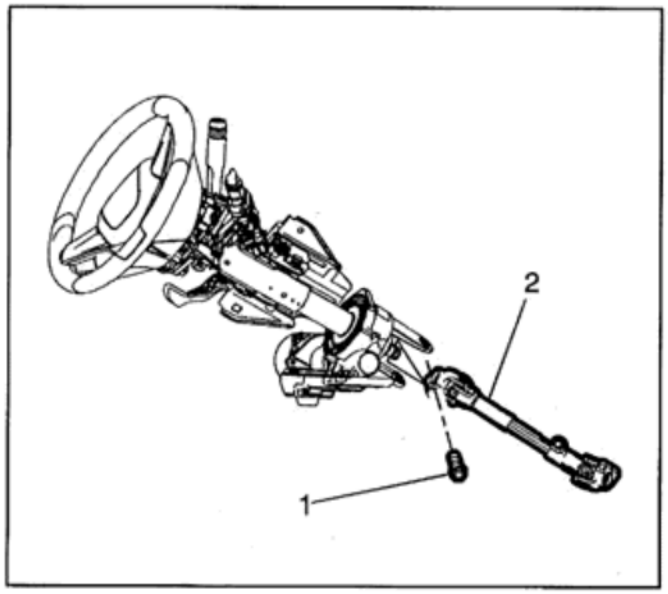
2539745

48. Install the junction block cover (1).



2521421

49. Install the air cleaner assembly (1). Refer to *Air Cleaner Assembly Replacement on page 9-582*.



2534608

50. Install the lower intermediate steering shaft bolt (1). Refer to *Intermediate Steering Shaft Replacement on page 15-27*.
51. Install the battery and battery tray. Refer to *Battery Tray Replacement on page 9-721*.
52. Install the front tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation on page 16-60*.
53. Install the front bumper fascia. Refer to *Front Bumper Fascia Replacement on page 3-55*.
54. Evacuate and charge the refrigerant system. Refer to *Refrigerant Recovery and Recharging on page 10-13*
55. Fill the cooling system. Refer to *Cooling System Draining and Filling on page 9-628*.

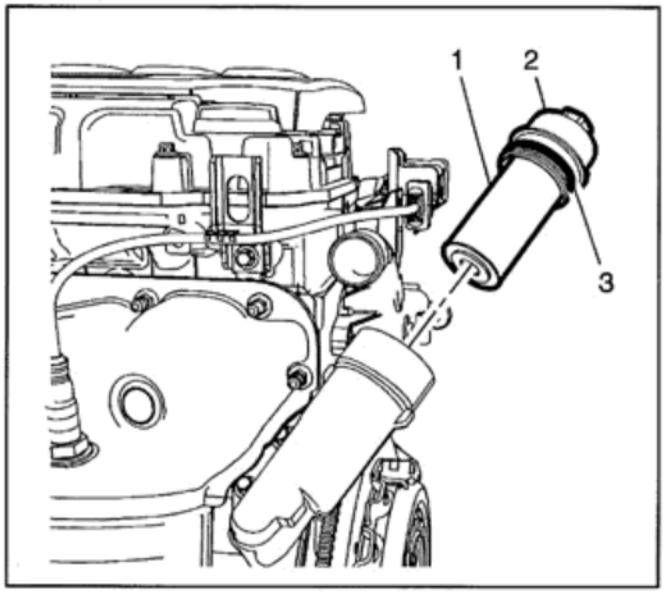
Engine Oil and Oil Filter Replacement

Removal Procedure

1. Open hood.
2. Place a drain pan below the vehicle.

Caution: To prevent damage to oil filter cap ensure proper tool is used. Do not use an open end wrench which may cause damage to filter cap.

3. Using a 24mm socket or closed end wrench loosen oil filter cap. Unscrew filter cap 3 turns and let oil filter and cap assembly drain in housing for 30 seconds.



2852124

Note: Use care when removing engine oil filter cap and filter to minimize fluid spillage. If fluid spillage occurs it must be cleaned with appropriate cleaner.

Note: Inspect oil filter cap for any cracks or damage. If oil filter cap is damaged it must be replaced.

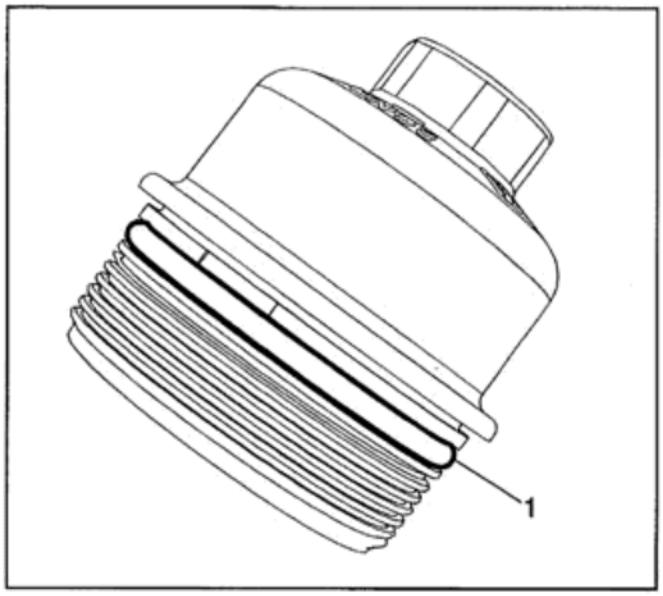
4. Remove the engine oil filter cap (2) with the engine oil filter cap seal ring (3) and the oil filter element (1).
5. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle on page 1-31*.
6. Remove the oil pan drain plug and allow the oil to drain into the drain pan.

Installation Procedure

1. Clean the oil pan drain plug thread in the oil pan.
2. Install a NEW seal ring to the oil pan drain plug.

Caution: Refer to *Component Fastener Tightening Caution on page 0-8*.

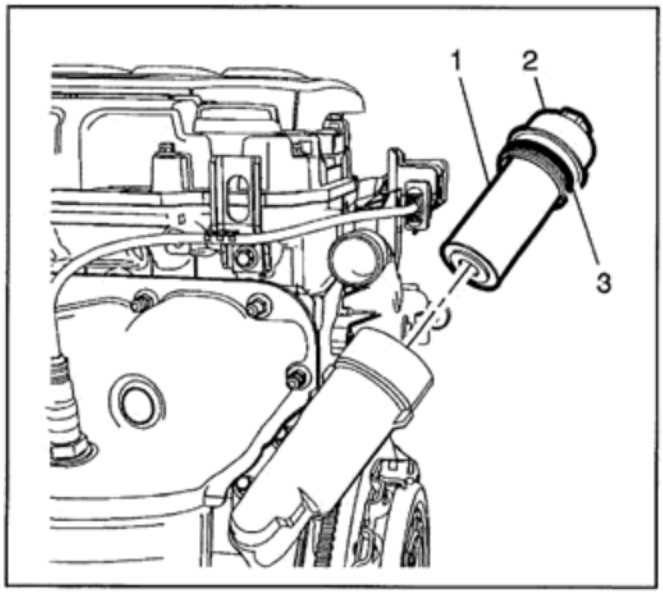
3. Install the oil pan drain plug and tighten to **14** N•m **(10 lb ft)**.
4. Lower the vehicle.



2852132

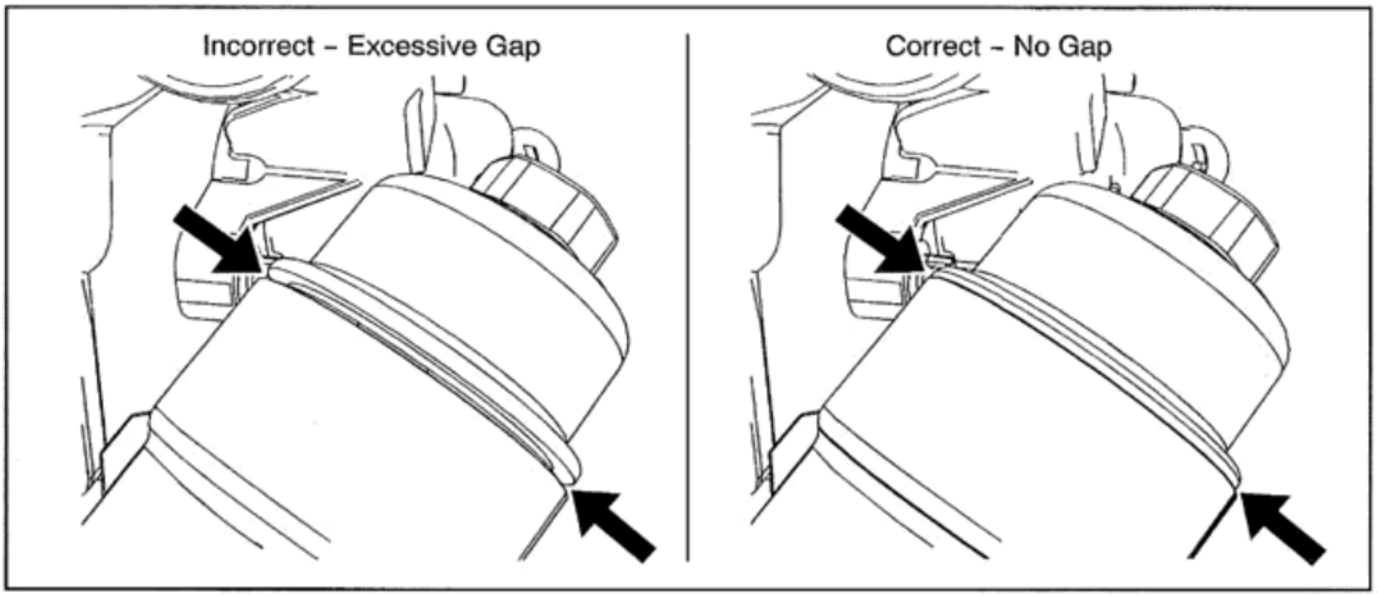
Note: Clean oil filter cap and lubricate the NEW oil filter cap seal ring with clean engine oil. Ensure oil filter cap seal ring is in proper position as shown.

5. Install a NEW oil filter cap seal ring (1).



2852124

6. Install the engine oil filter cap (2) with NEW engine oil filter cap seal ring (3) and NEW oil filter element (1) hand tight.



2852139

Caution: Ensure oil filter cap is completely seated on oil filter housing. If not completely seated an oil leak may occur.

Caution: Over torquing the oil filter cap may cause damage to the oil filter cap resulting in an oil leak.

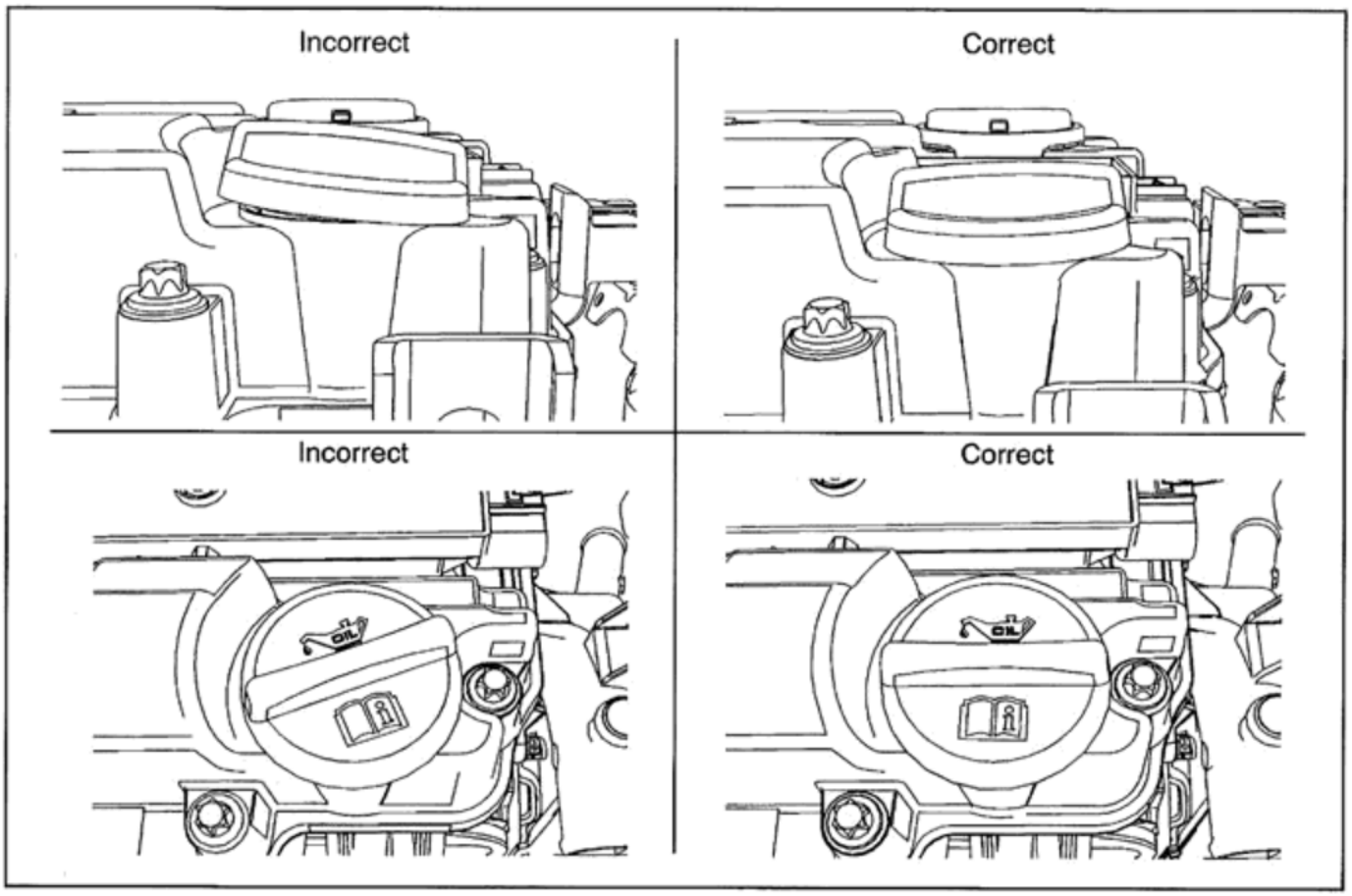
7. Using a 24mm socket or closed end wrench tighten the engine oil filter cap to **25 N•m (18 lb ft)**.

Caution: Using engine oils of any viscosity other than those viscosities recommended could result in engine damage.

Note: Do not overfill the engine with engine oil.

Note: Anytime engine oil is added (top off or oil changes) ensure all engine surfaces are completely free of residual oil. If there is oil on any engine surface clean as necessary.

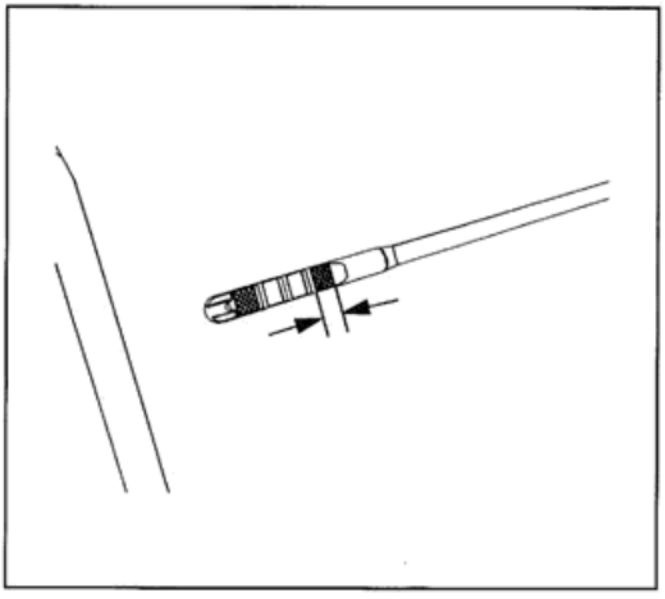
8. Fill engine with NEW oil using Dexos™1 5W-30 specification.



2852494

Note: Oil fill cap must be properly seated and tightened during installation.

9. Install oil fill cap.
10. Start the engine and allow it to run until the oil pressure control indicator goes off. Inspect for any oil leaks around the drain plug, oil filter and oil fill cap.
11. Inspect the engine oil level. The oil level should be in the cross-hatched section of the oil level indicator as shown.
12. Close hood.
13. Reset the engine oil life system monitor.



2852643

Camshaft Seal Replacement

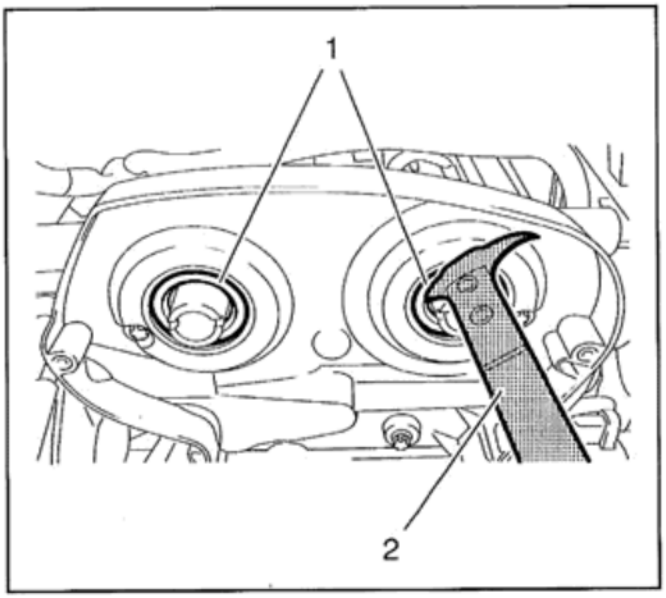
Special Tools

- *EN 422* Installer
- *EN 45000* Remover

For equivalent regional tools, refer to *Special Tools on page 9-1135*

Removal Procedure

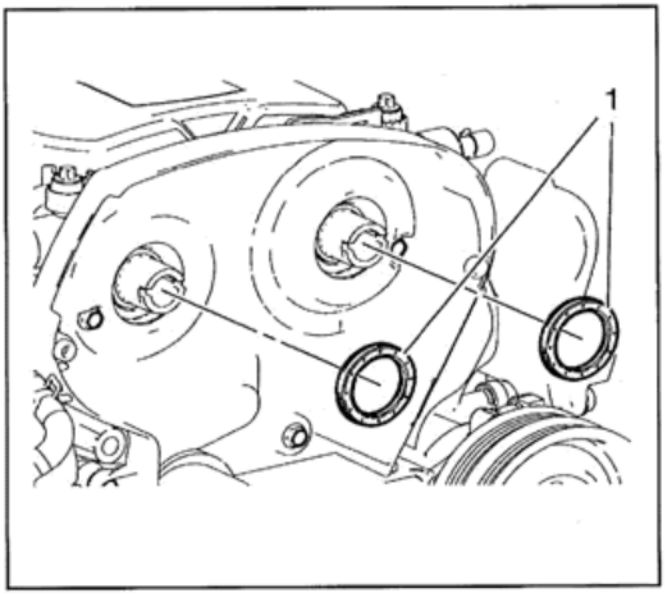
1. Remove the intake and exhaust camshaft sprocket. Refer to *Camshaft Sprocket Replacement on page 9-987*.



2191650

Note: Do not damage the sealing surfaces.

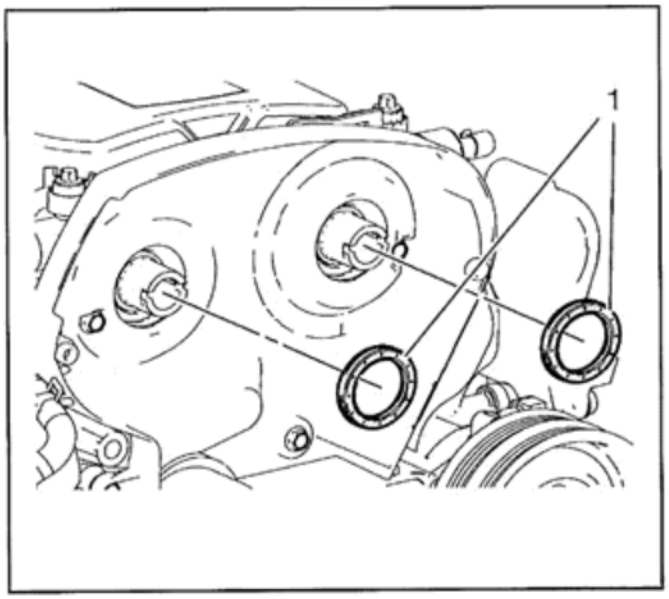
2. Use the *EN-45000* remover to loosen the camshaft front oil seals (1).



2189265

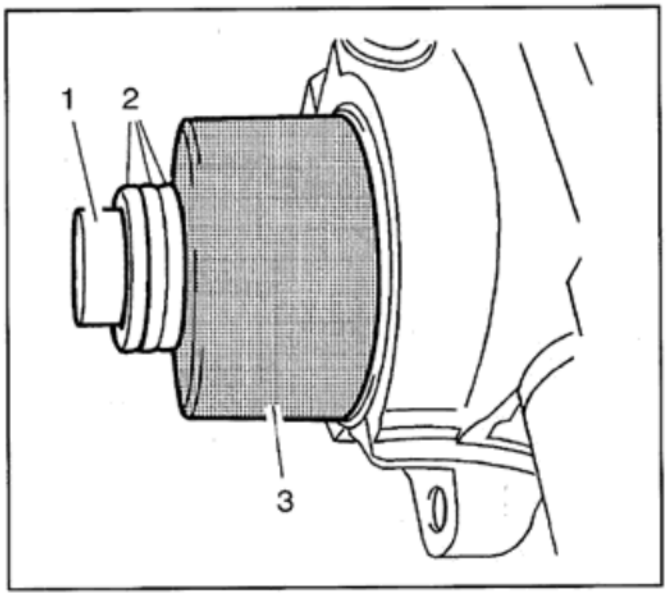
3. Remove the camshaft front oil seals (1).

Installation Procedure



2189265

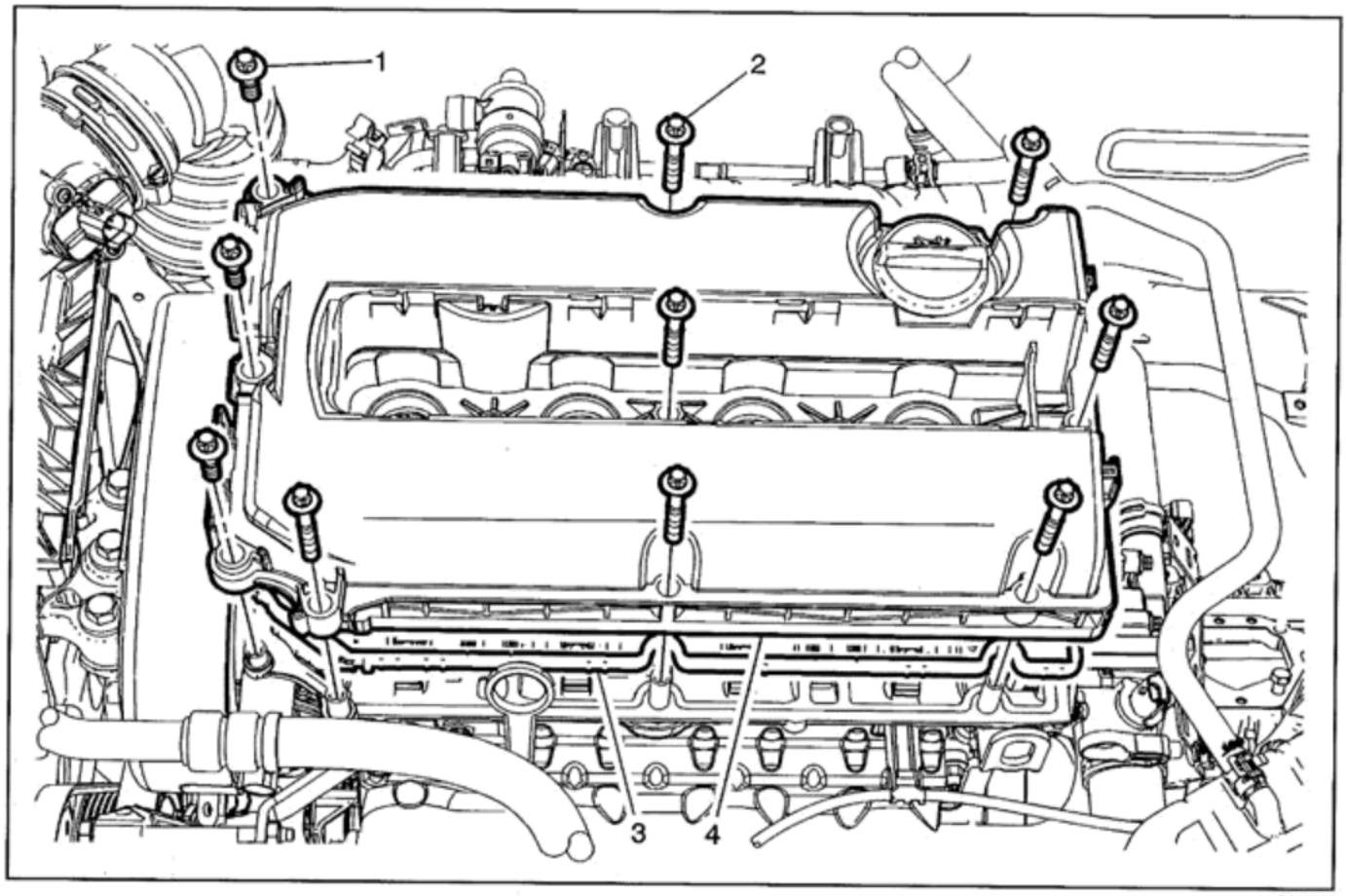
1. Insert 2 NEW camshaft front oil seals (1).



2373396

2. Tighten the seal ring with *EN-422* installer (3) on the camshaft until this is in contact with the cylinder head.
3. To install, use camshaft sprocket bolt (1) in conjunction with shims (2) with a total thickness of approximately 10 mm (0.393 in).
4. Install the camshaft sprocket intake and exhaust. Refer to *Camshaft Sprocket Replacement on page 9-987*.

Camshaft Cover Replacement

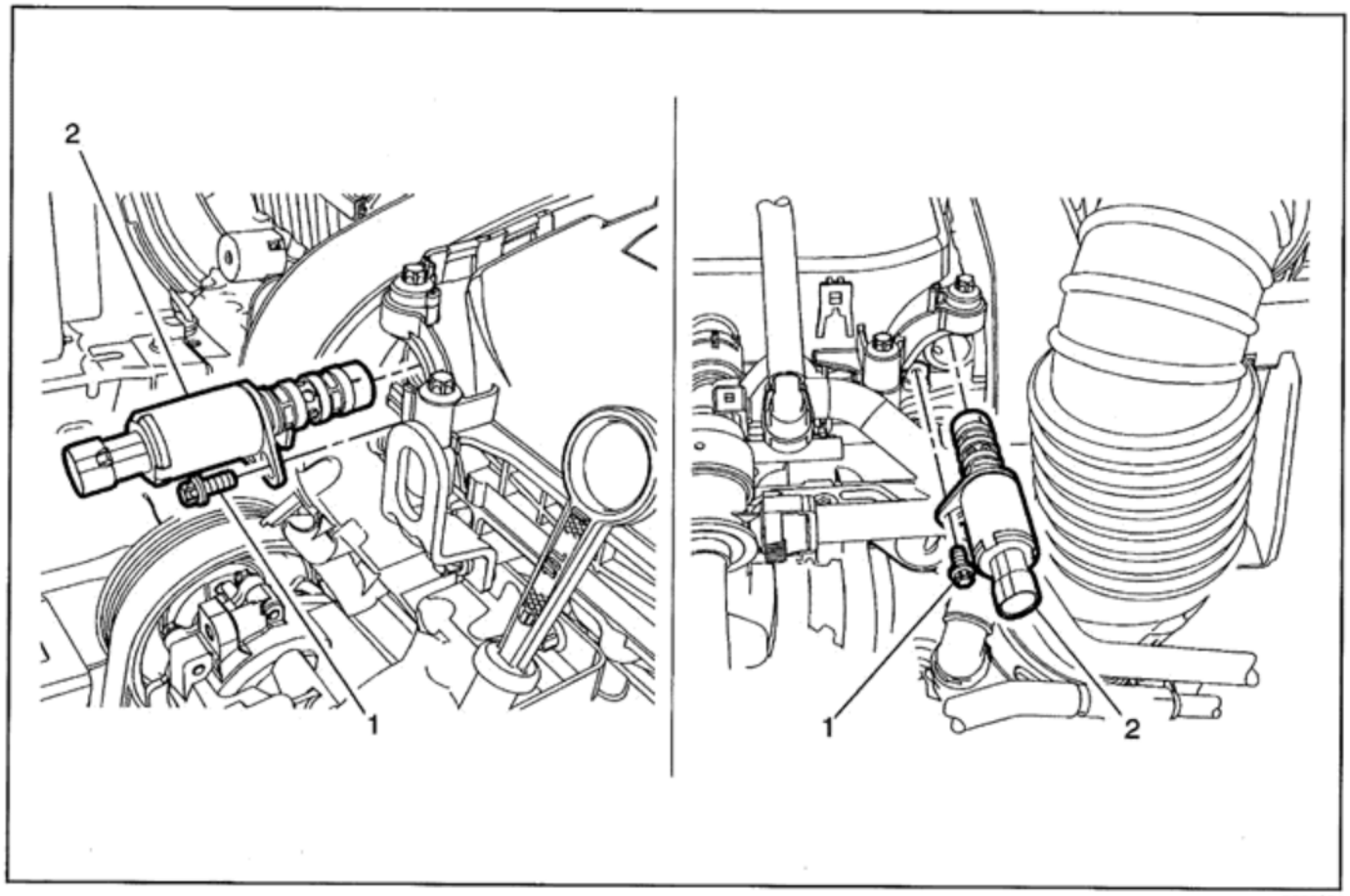


2497959

Camshaft Cover Replacement

Callout	Component Name
Preliminary Procedures 1. Remove the ignition coil. Refer to *Ignition Coil Replacement on page 9-570.* 2. Remove the PCV hose. Refer to *Positive Crankcase Ventilation Hose/Pipe/Tube Replacement on page 9-1009.*	
1	Camshaft Cover Fastener (Qty: 3) **Caution:** Refer to *Fastener Caution on page 0-8.* **Note:** Apply pipe sealant to the center bolt during reinstallation. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943.* **Tighten** 8 N•m (71 lb in)
2	Camshaft Cover Fastener (Qty: 8) **Tighten** 8 N•m (71 lb in)
3	Camshaft Cover Gasket **Procedure** Do not reuse the camshaft gasket. Also use a new gasket when removing or replacing camshaft cover.
4	Camshaft Cover **Procedure** 1. Remove or reposition the clips as necessary. 2. Disconnect electrical connector as necessary. 3. Transfer components as necessary.

Camshaft Position Actuator Solenoid Valve Replacement



2506854

Camshaft Position Actuator Solenoid Valve Replacement

Callout	Component Name
1	Camshaft Position Actuator Solenoid Valve Bolt **Caution:** Refer to *Fastener Caution on page 0-8.* **Tighten** 6 N•m (53 lb in)
2	Camshaft Position Actuator Solenoid Valve **Tip::** Coat the camshaft position actuator solenoid valve seals with NEW engine oil.

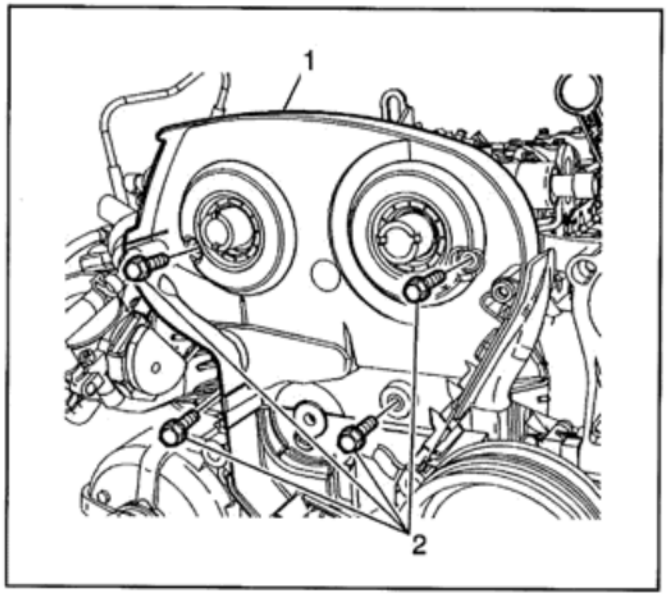
Camshaft Replacement

Special Tools

EN-422 Installer

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

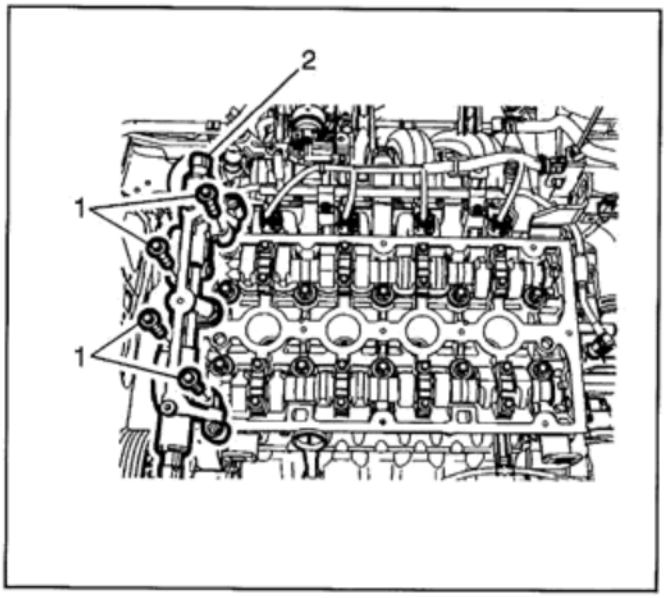
Removal Procedure



2049388

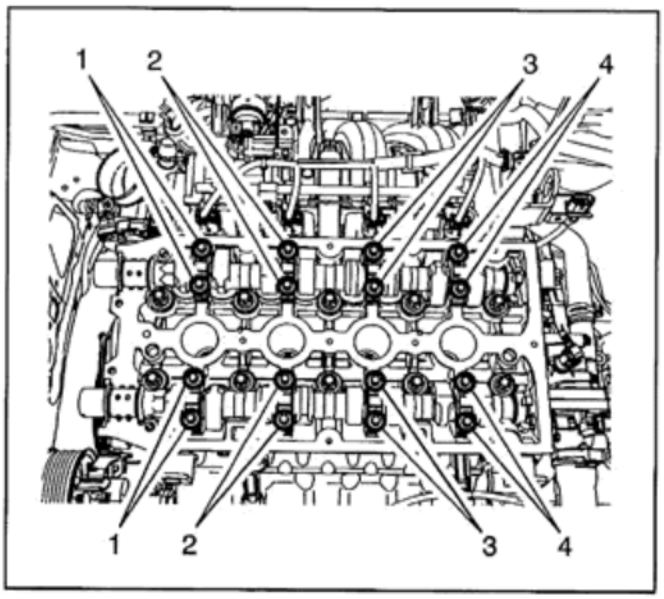
Note: Take extreme care to prevent any scratches, nicks or damage to the camshafts and caps bearing surfaces.

1. Remove the timing belt rear cover (1). Refer to *Timing Belt Rear Cover Replacement on page 9-986*.



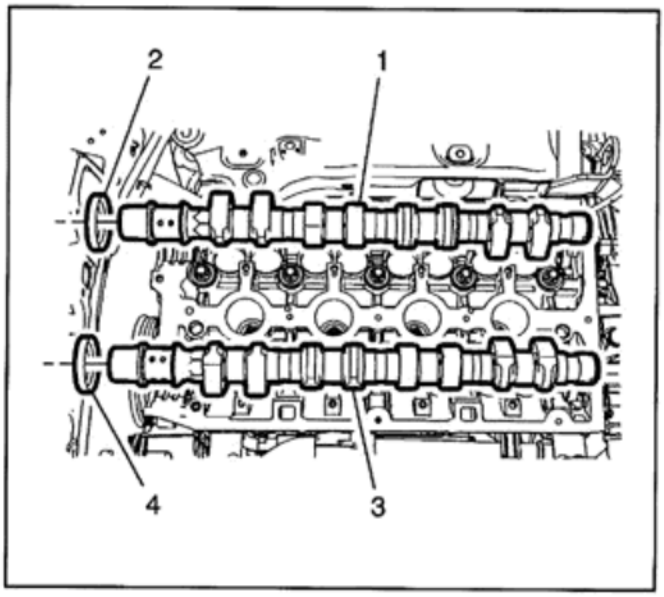
2507071

2. Remove the camshaft position solenoid valve housing bolts (1) and housing (2).



2507077

3. Remove the camshaft cap bolts in sequence (1, 4, 2, 3).
4. Remove the camshaft caps.



2507086

Note: Mark the camshafts upon removal to ensure installation is in the correct position.

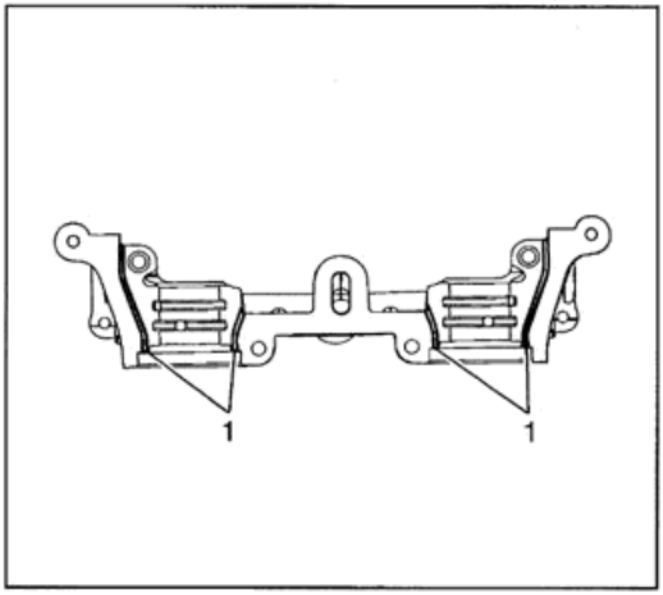
5. Remove the exhaust camshaft (1) and intake camshaft (3) as necessary.

Note: The camshaft seal MUST be replaced whenever the camshaft is removed.

6. Remove exhaust camshaft seal (2) and intake camshaft seal (4) as necessary.

Installation Procedure

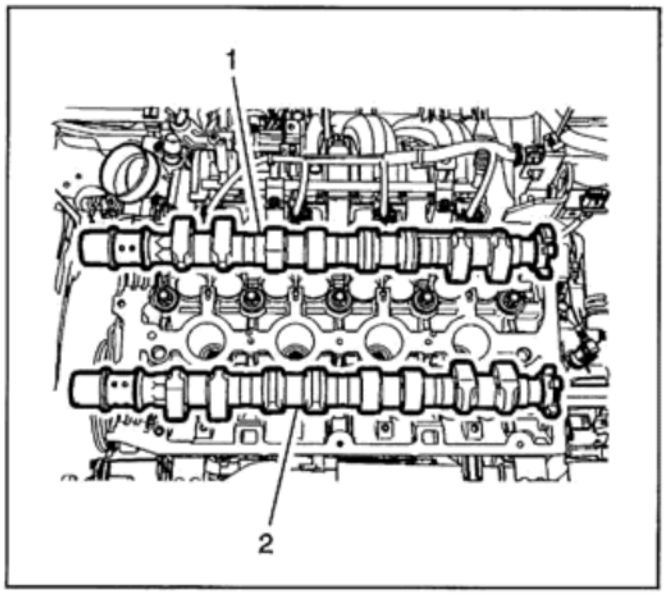
1. Coat and lubricate the camshaft bearing and cam surfaces with clean engine oil.



2049391

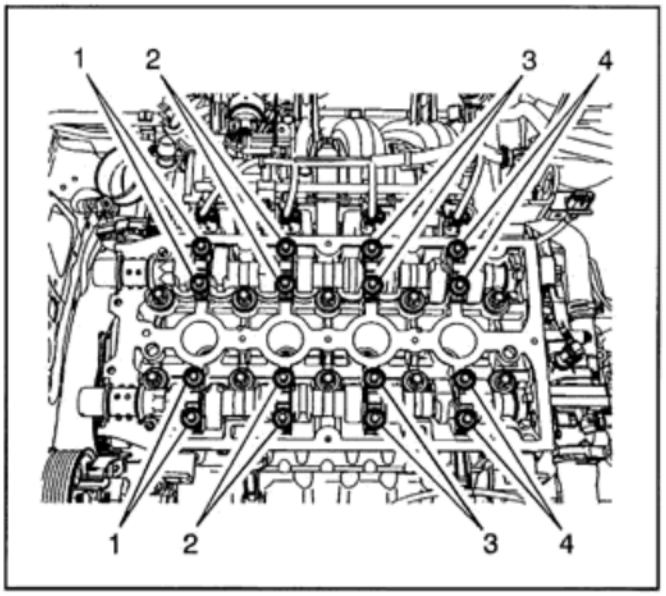
Note: It is essential to ensure that no sealant is applied outside the marked sealing areas.

2. Apply sealant to the surface (1) of the 1st camshaft bearing cap.



2507087

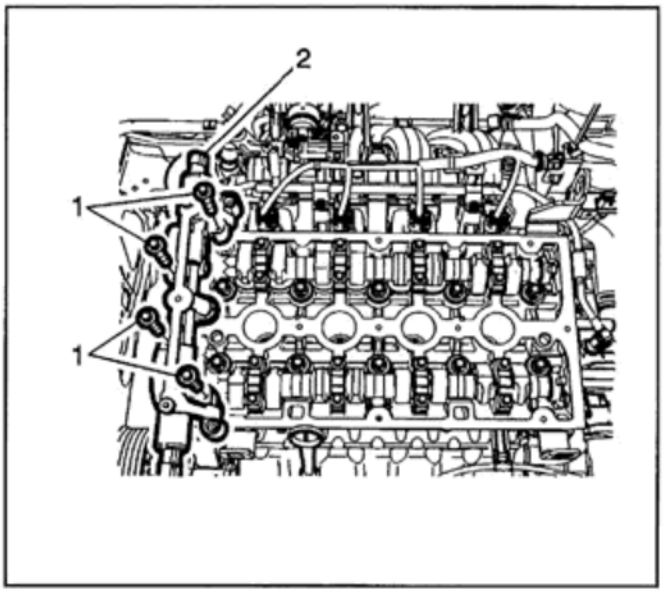
3. Install the exhaust camshaft (1) and intake camshaft (2) on the cylinder head.



2507077

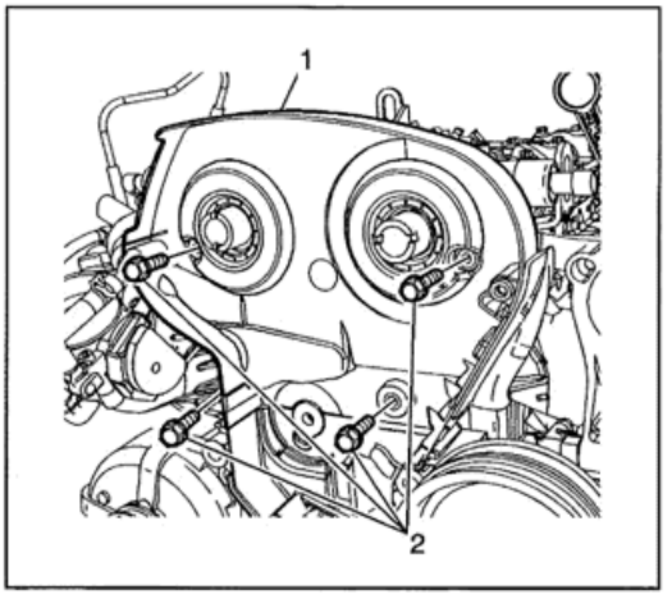
Caution: Refer to *Fastener Caution on page 0-8*.

4. Install the camshaft bearing caps in sequence (2, 3, 1, 4) Tighten the camshaft bearing cap bolts to **8 N•m (71 lb in)**.



2507071

5. Install the camshaft position solenoid valve housing (2) and camshaft position solenoid valve housing bolts (1). Tighten the bolts to **8 N•m (71 lb in)**.
6. Install the new camshaft oil seal rings using *EN-422* installer.



2049388

7. Install the timing belt rear cover (1) and tighten the bolts (2) to **6 N•m (53 lb in)**. Refer to *Timing Belt Rear Cover Replacement on page 9-986*.

Valve Stem Oil Seal and Valve Spring Replacement

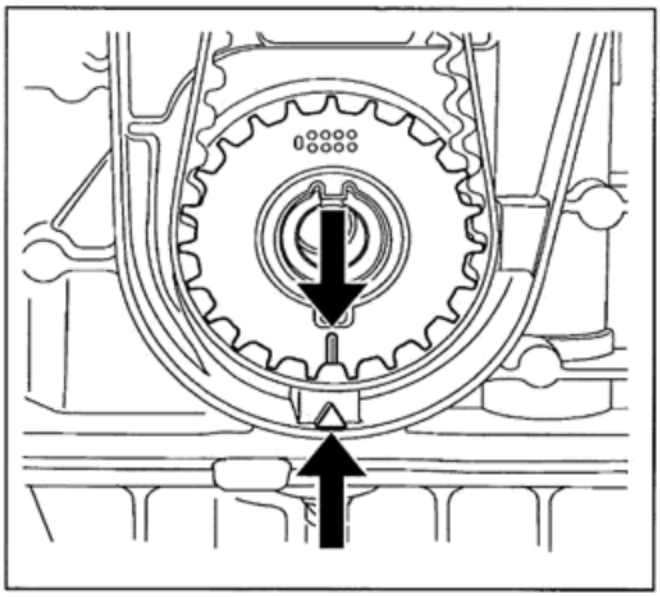
Special Tools

- *207649* Rod Hairpin Clips
- *547324* Flange Screws
- *EN-840* Pliers / Remover
- *EN-958* Installer
- *EN-45059* Angle Meter
- *EN-50717* Kit
- *J-43649–2* Rods

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

Removal Procedure

1. Remove the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.
2. Remove the camshaft position actuator. Refer to *Camshaft Sprocket Replacement on page 9-987*.
3. Remove both camshafts. Refer to *Camshaft Replacement on page 9-1052*.
4. Remove the valve lifter. Refer to *Valve Lifter Replacement on page 9-987*.



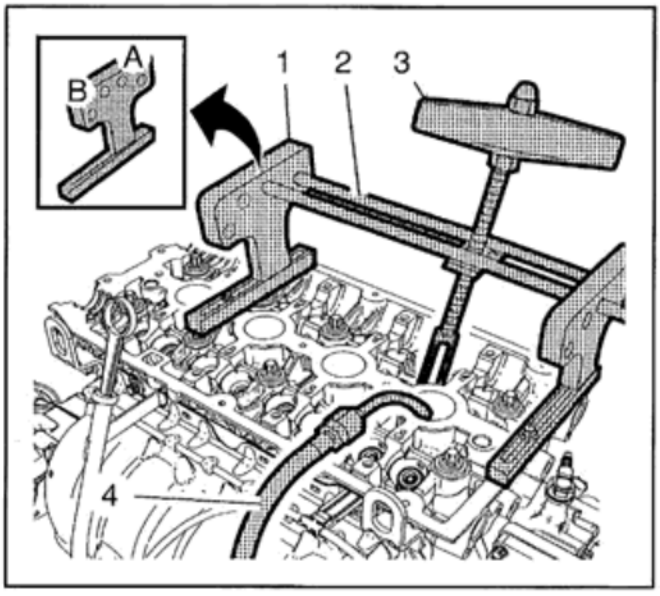
2027014

5. For cylinder 1 and 4 set the crankshaft to TDC marking, cylinder number 1. Use the crankshaft balancer bolt.
6. For cylinder 2 and 3, set the crankshaft BDC (180 degrees from TDC marking). Use the crankshaft balancer bolt.

Note: Wheels must contact the ground.

7. Shift to 1. gear (MT) or park position (AT) and apply the park brake.

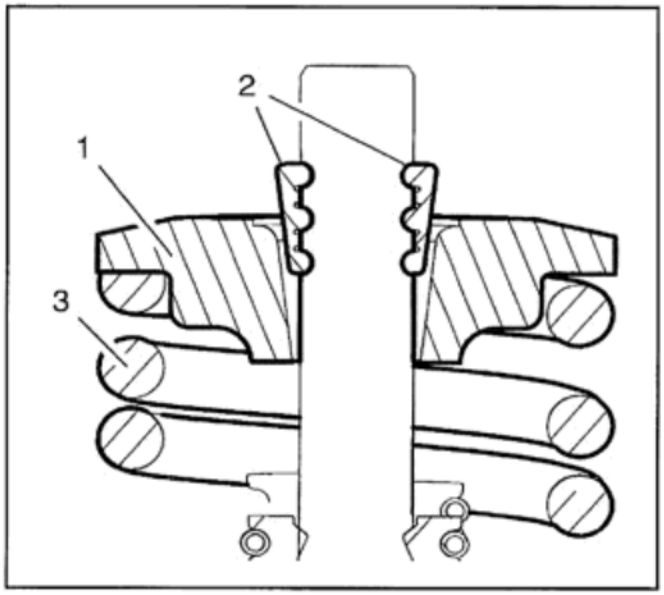
Valve Stem Oil Seal Removal



2725685

1. Install the 2 *EN-50717–1* stands (1) to the cylinder head and fix them with the *547324* screws.
2. Install the 2 *J-43649-2* rods (2) and the *EN-51717–2* compressor (3) to the B-side of the *EN-50717–1* stands. Secure the rods with the *207649* clips then.
3. Install an suitable air pressure adapter (4) to the spark plug hole.

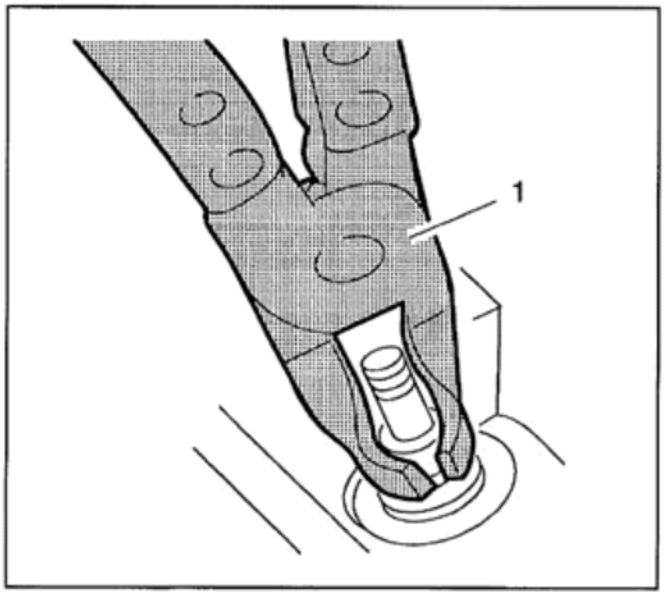
4. Apply air pressure to the corresponding cylinder.
5. Position the *EN-51717–2* compressor (3) so that its adapter proper contacts the valve spring retainer and pretension the compressor.



2678153

Warning: Valve springs can be tightly compressed. Use care when removing the retainers and plugs. Personal injury could result.

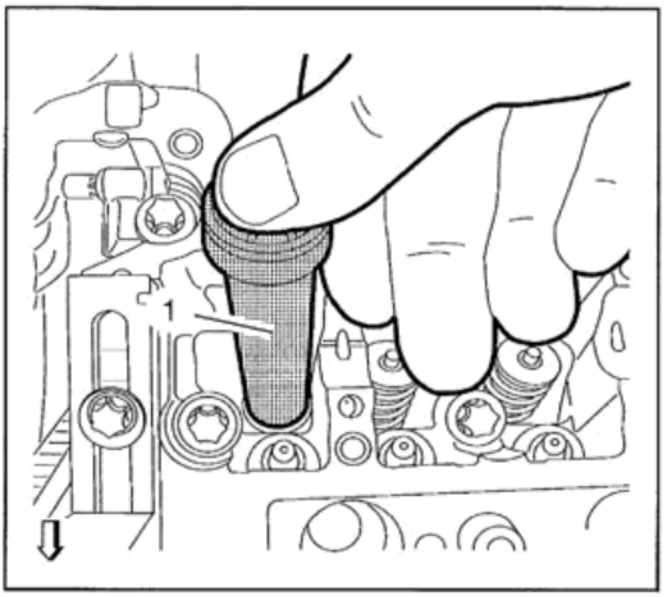
6. Apply pressure to the *EN-50717–2* compressor to push down the vale spring retainer (1) and compress the valve spring (3) until the valve keys (2) are free from tension. Carefully remove the valve keys then.
7. Release the tension from the *EN-50717–2* compressor.
8. Remove the valve spring retainer (1) and the valve spring (3).



2373403

9. Remove and DISCARD the valve stem oil seal, using the *EN-840* pliers (1).

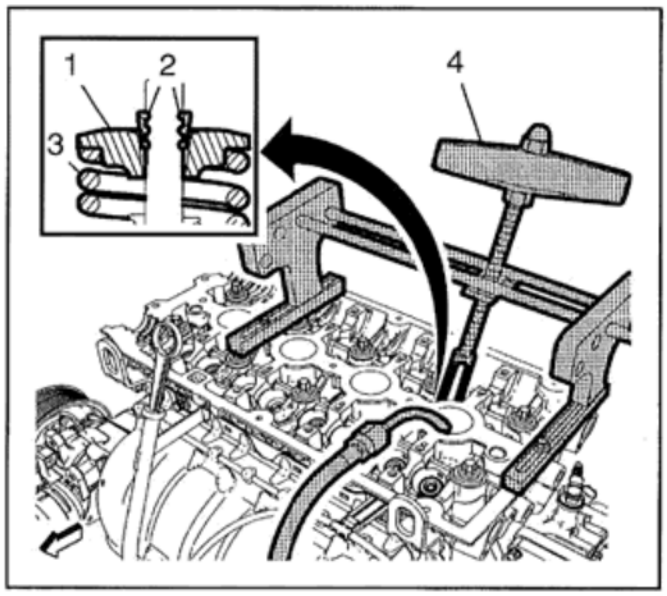
Valve Stem Oil Seal Installation



2373172

Note: Lubricate the NEW valve stem oil seal with clean engine oil.

1. Install the NEW valve stem oil seal, using the *EN-958* installer (1).
2. Loosely install the valve spring and the valve spring retainer.



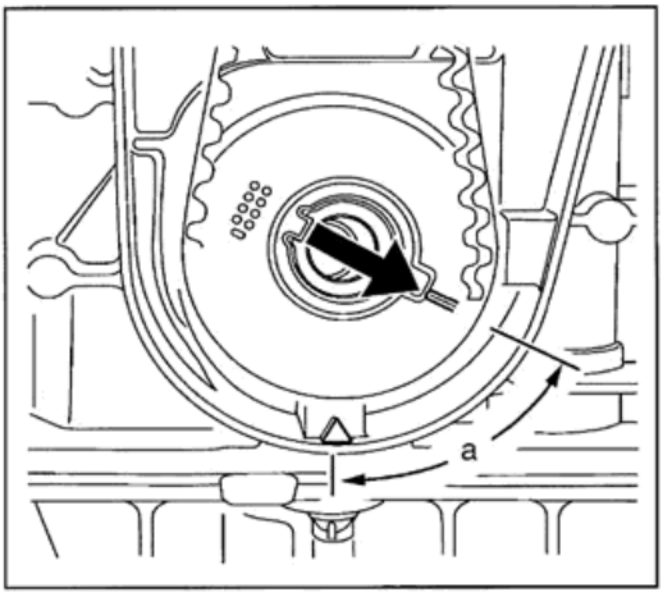
2725894

Caution: The valve stem keys must correctly seat in the valve spring cap. Engine damage may occur by not installing properly.

3. Using the *EN-51717–2* compressor (4), push down the valve spring retainer (1) and compress the valve spring (3) until the valve keys (2) can be inserted. Carefully insert the valve keys then, so that they are proper installed to the valve stem grooves.
4. Carefully release the tension from the *EN-50717–2* compressor.

5. Inspect the valve keys and valve spring retainer for proper seat.
6. Repeat the procedure with the remaining valves and cylinders. Transfer the *EN-50717–1* stands and the *EN-51717–2* compressor as needed.
7. Take care that air pressure is always applied to the combustion chamber of the treated cylinder.

Installation Procedure



2027016

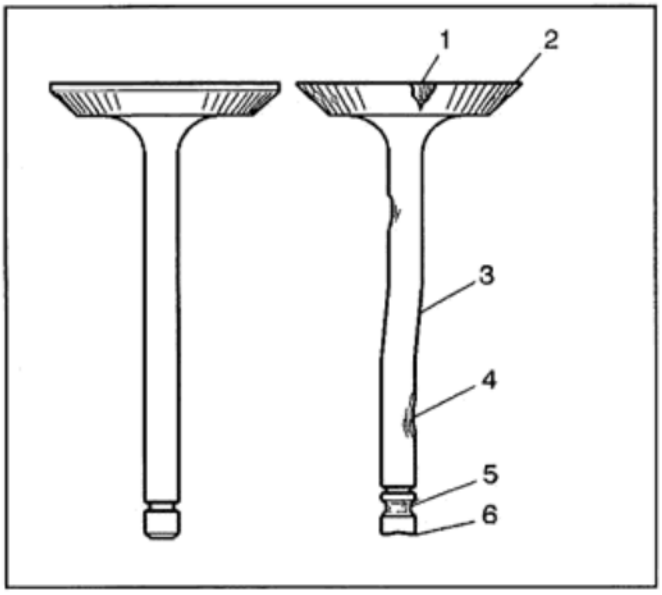
1. Set the crankshaft in direction of engine rotation to **60 degrees** (a) before TDC. Use the *EN-45059* meter and the crankshaft balancer bolt.
2. Install the valve lifter. Refer to *Valve Lifter Replacement on page 9-987*.
3. Install both camshafts. Refer to *Camshaft Replacement on page 9-1052*.
4. Install the camshaft position actuator. Refer to *Camshaft Sprocket Replacement on page 9-987*.
5. Install the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.

Valve Guide Reaming, and Valve and Seat Grinding

Valve Cleaning Procedure

1. Use soft bristle wire brush to clean any carbon build-up from the valve head. DO NOT use a wire brush on any part of the valve stem. The valve stem is chrome plated to provide enhanced wear characteristics. Wire brushing the stem could remove the chrome plating.
2. Thoroughly clean the valve with solvent and wipe dry.

Valve Visual Inspection Procedure



156174

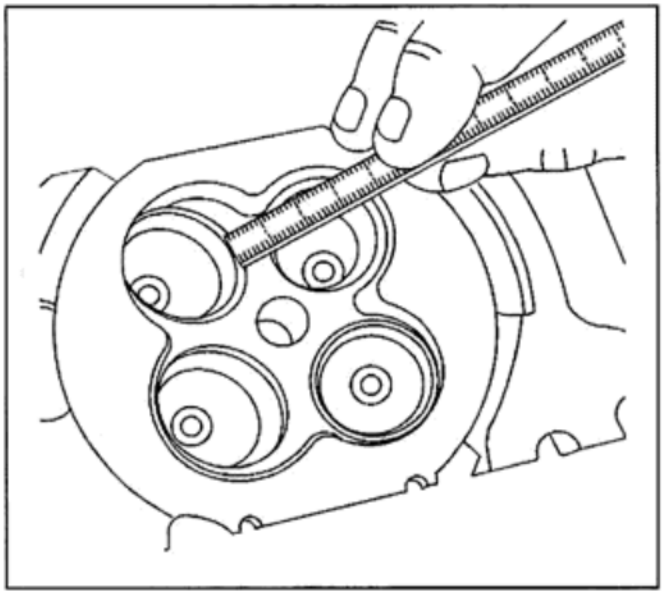
1. Inspect the valve for damage from the head to tip for the following conditions:
   - Pitting in the valve seat area (1)
   - Lack of valve margin (2)
   - Bending in the valve stem (3)
   - Pitting or excessive wear in the stem (4)
   - Worn valve key grooves (5)
   - Worn valve tip (6)
2. Replace the valve if any of these conditions exist.

Valve Measurement and Reconditioning Overview

Note:

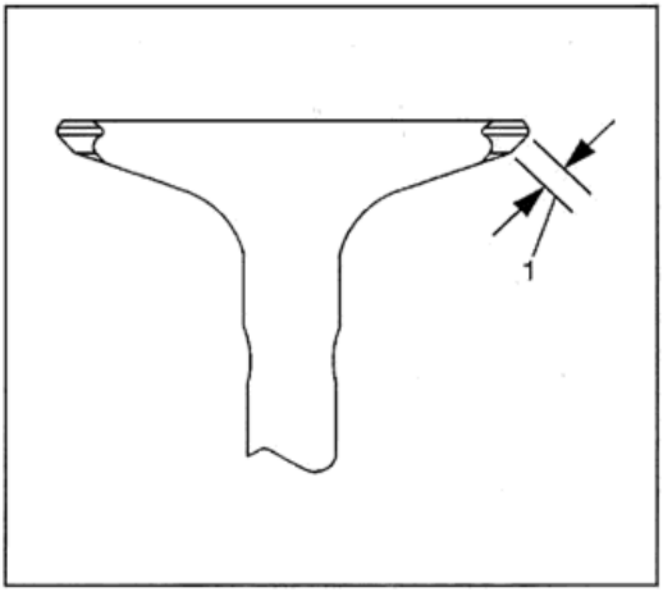
- Proper valve service is critical to engine performance. Therefore, all detailed measurement procedures must be followed to identify components that are out of specification.
- If the measurement procedures reveal that the valve or valve seat must be reconditioned, it is critical to perform the measurement procedures after reconditioning.

Valve Seat Width Measurement Procedure



71387

1. Measure the valve seat width in the cylinder head using a proper scale.



376399

2. Measure the seat width on the valve face (1) using a proper scale.

Note: The seat contact area must be at least 0.5 mm (0.020 in) from the outer diameter (margin) of the valve. If the contact area is too close to the margins, the seat must be reconditioned to move the contact area away from the margin.

3. Compare your measurements with the specifications, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*.
4. If the seat widths are acceptable, check the valve seat roundness using the Valve Seat Roundness Measurement Procedure.
5. If the seat width is not acceptable, you must grind the valve seat using the Valve and Seat Reconditioning Procedure to bring the width back into specification. Proper valve seat width is critical to providing the correct amount of valve heat dissipation.

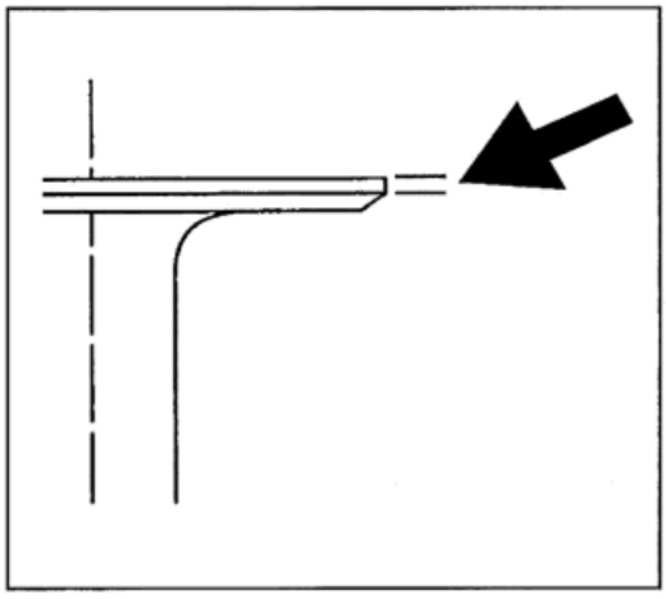
Valve Seat Roundness Measurement Procedure

1. Measure the valve seat roundness using a dial indicator attached to a tapered pilot installed in the guide. The pilot should have a slight bind when installed in the guide.

Caution: The correct size pilot must be used. Do not use adjustable diameter pilots. Adjustable pilots may damage the valve guides.

2. Compare your measurements with the specifications, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*.
3. If the valve seat exceeds the roundness specification, you must grind the valve and valve seat using the Valve and Seat Reconditioning Procedure.
4. If new valves are being used, the valve seat roundness must be within 0.05 mm (0.002 in).

Valve Margin Measurement Procedure

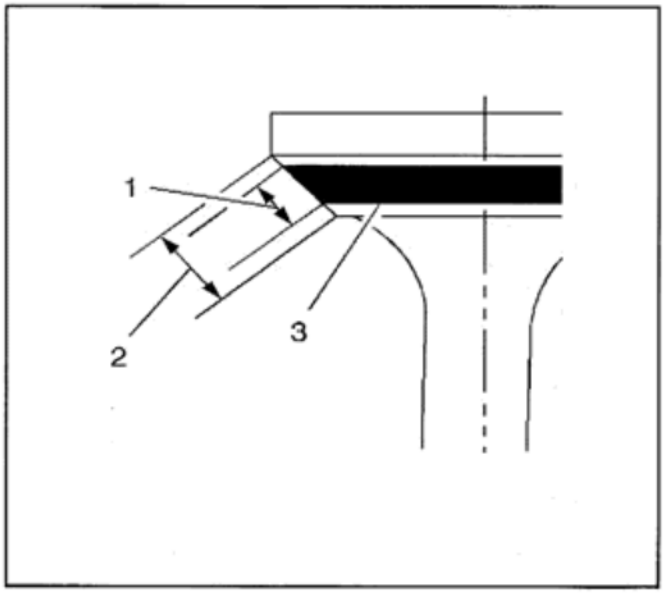


57502

1. Measure the valve margin using an appropriate scale.
2. Reference the specifications in this section for minimum valve margin and compare them to your measurements.
3. If the valve margins are beyond specification, replace the valves.

4. If the valve margins are within specification and do not require refacing, test the valve for seat concentricity using the Valve-to-Seat Concentricity Measurement Procedure.

Valve-to-Seat Concentricity Measurement Procedure



53234

Note:

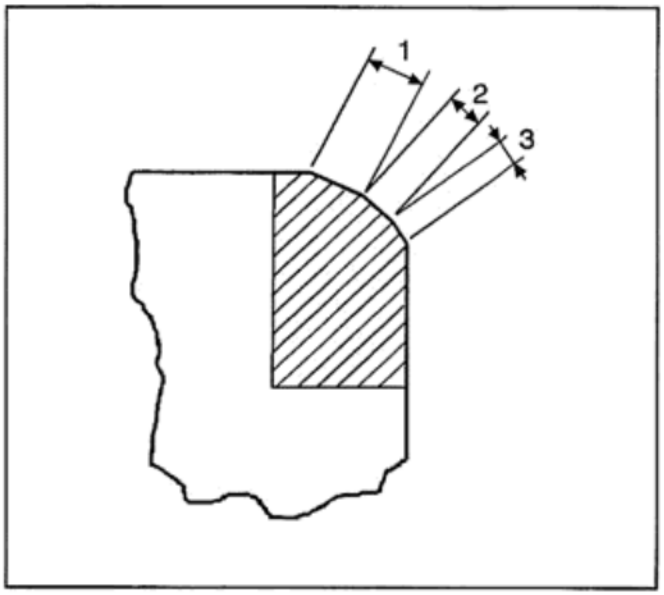
- Checking the valve-to-seat concentricity determines whether the valve and seat are sealing properly.
- You must measure the valve face and the valve seat to ensure proper valve sealing.

1. Coat the valve face lightly with blue dye (3).
2. Install the valve in the cylinder head.
3. Turn the valve against the seat with enough pressure to wear off the dye.
4. Remove the valve from the cylinder head.
5. Inspect the valve face.
   - If the valve face is concentric, providing a proper seal, with the valve stem, a continuous mark will be made around the entire face (1).

Note: The wear mark MUST be at least 0.5 mm (0.020 in) from the outer diameter, the margin, of the valve. If the wear mark is too close to the margin, the seat must be reconditioned to move the contact area away from the margin.

- If the face is not concentric with the stem, the mark will NOT be continuous around the valve face. The valve should be refaced or replaced and the seat must be reconditioned using the Valve and Seat Reconditioning Procedure.

Valve and Seat Reconditioning Procedure



651245

Note:

- If the valve seat width, roundness or concentricity is beyond specifications, you must grind the seats in order to ensure proper heat dissipation and prevent the build up of carbon on the seats.
- It is necessary to reface the valve if seat reconditioning is required unless a new valve is used.

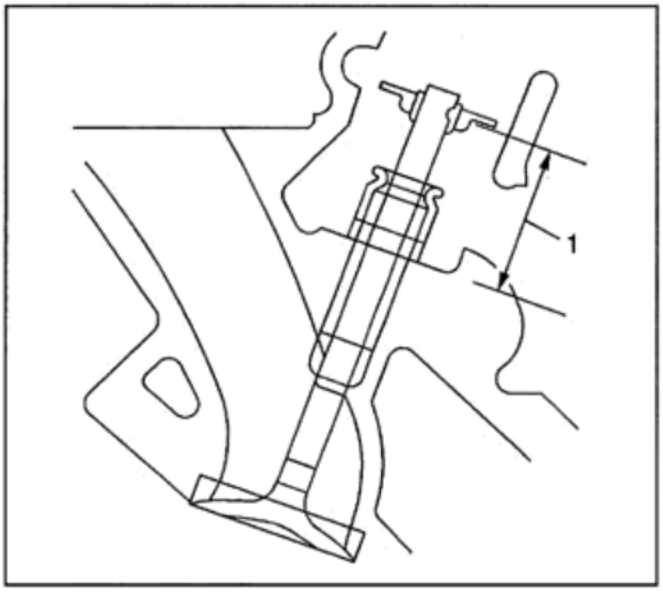
1. Grind the valve seats (2) to the proper angle specification, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*.
2. Using the proper angle specification, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938* , grind, relieve, the valve seats (1) to correctly position the valve seating surface (2) to the valve.
3. Using the proper angle specification listed in engine mechanical specifications, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938* , grind, undercut, the valve seats (3) to narrow the valve seat widths to the specifications, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*.
4. If the original valve is being used, grind the valve to the specifications, refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*. Measure the valve margin again after grinding using the Valve Margin Measurement Procedure. Replace the valve if the margin is out of specification. New valves do not require grinding.

5. When grinding the valves and seats, grind off as little material as possible. Cutting valve seat results in lowering the valve spring pressure.
6. Install the valve in the cylinder head.
   - If you are using refaced valves, lap the valves into the seats with a fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that minimal lapping is required. Excessive lapping will groove the valve face and prevent a good seat when hot.

Note: Be sure to clean any remaining lapping compound from the valve and seat with solvent and compressed air prior to final assembly.

   - If you are using new valves, do not lap the valves under any condition.
7. After obtaining the proper valve seat width in the cylinder head, you must re-measure the valve stem height using the Valve Stem Height Measurement Procedure.
8. If the valve stem height is acceptable, test the seats for concentricity using the Valve-to-Seat Concentricity Measurement Procedure.

Valve Stem Height Measurement Procedure



1254505

Note: To determine the valve stem height measurement, measure from the valve spring seat to the valve spring retainer.

1. Install the valve into the valve guide.
2. Ensure the valve is seated to the cylinder head valve seat.
3. Install the valve stem oil seal.
4. Install the valve spring retainer and valve stem locks.
5. Measure the distance (1) between the cylinder head to the bottom of the valve spring retainer. Refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*.
6. If the maximum height specification is exceeded, a new valve should be installed and the valve stem height re-measured.

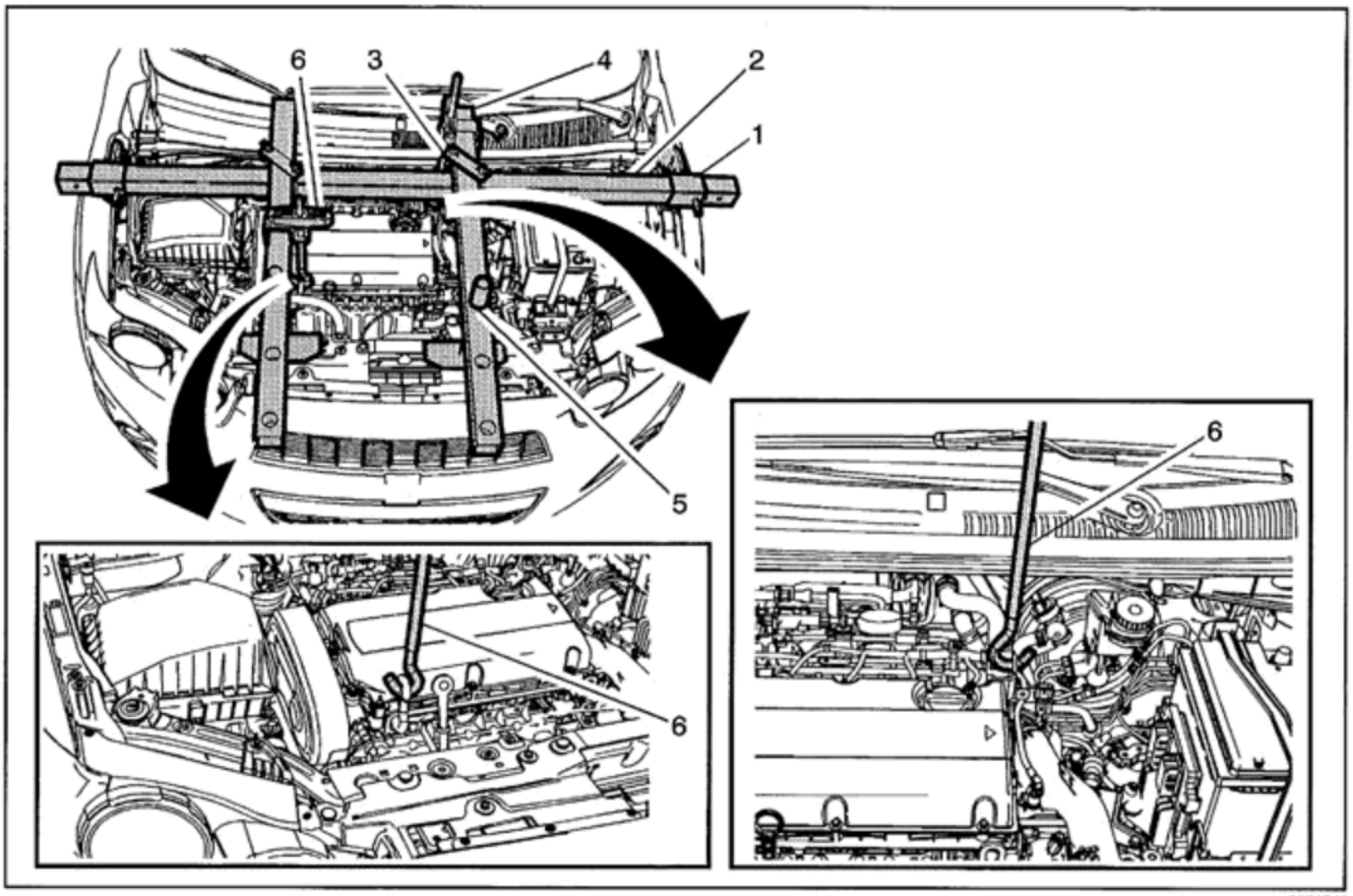
Caution: DO NOT grind the valve stem tip. The tip of the valve is hardened and grinding the tip will eliminate the hardened surface causing premature wear and possible engine damage.

Caution: DO NOT use shims in order to adjust valve stem height. The use of shims will cause the valve spring to bottom out before the camshaft lobe is at peak lift and engine damage could result.

7. If the valve stem height still exceeds the maximum height specification, the cylinder head must be replaced.

Repair Instructions - Off Vehicle

Engine Support Fixture



2673749

Engine Support Fixture

Callout	Component Name
Preliminary Procedure Remove the radiator opening upper cover. Refer to *Front Opening Upper Cover Replacement on page 3-40*. **Special Tools** • *EN-28467-300* Engine Support Fixture Adapter • *J-28467-518* Main Support Beam • *J-28467-1A* Cross Bracket • *J-28467-5A* Strut Tower Support Assembly • *J-28467-2A* Radiator Tube Shelf Assembly • *J-36857* Engine Lift Bracket • *J-28467-8A* Hook Assembly For equivalent regional tools, refer to *Special Tools on page 9-1135*.	
1	Engine Support Fixture Adapter Leg (Qty: 2) **Procedure** Install the bracket to fender frame. Do not install on top of fender lip.
2	Main Support Beam
3	Cross Bracket
4	Strut Tower Support Assembly **Procedure** Adjust the length of the strut tower support assembly.
5	Radiator Tube Shelf Assembly

Engine Support Fixture (cont'd)

Callout	Component Name
6	Hook Assembly **Note:** If the engine is not equipped with engine lift bracket, install J-36857 in place. **Procedure** Use a grade 10.9 bolt to install the engine lift bracket.

Timing Belt Inspection

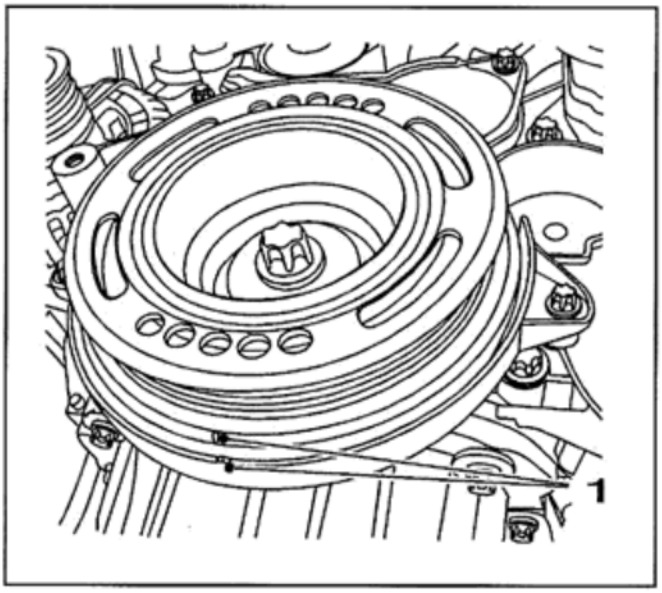
Special Tools

- *EN-6340* Locking Tool
- *EN-6628-A* Locking Tool

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

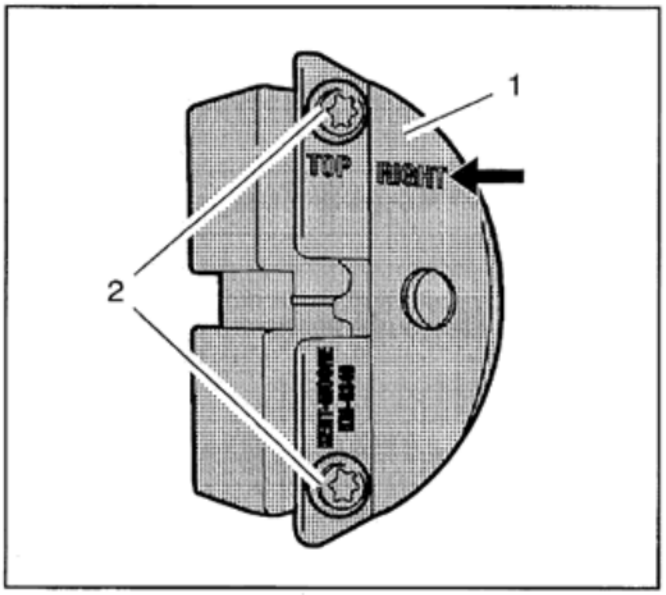
Removal Procedure

1. Remove the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Removal on page 9-1074*.



1936993

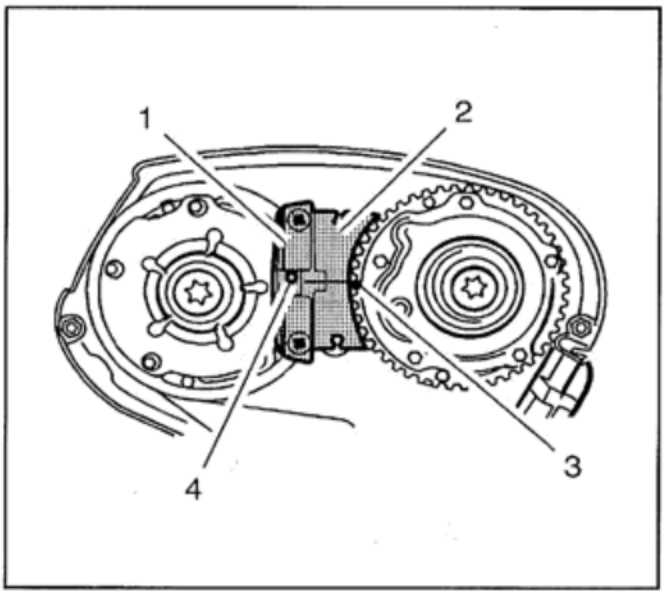
2. Set the crankshaft balancer in the direction of the engine rotation to "1st cylinder TDC" (mark 1).
3. Remove the camshaft cover. Refer to *Camshaft Cover Removal on page 9-1084*.



2373397

Note: The right half of the *EN-6340* locking tool can be recognized by the lettering "right", arrow, on the tool.

4. Prepare the right half of the *EN-6340* locking tool.
   4.1. Remove the 2 bolts (2).
   4.2. Remove the front panel (1) from the *EN-6340* locking tool -right.

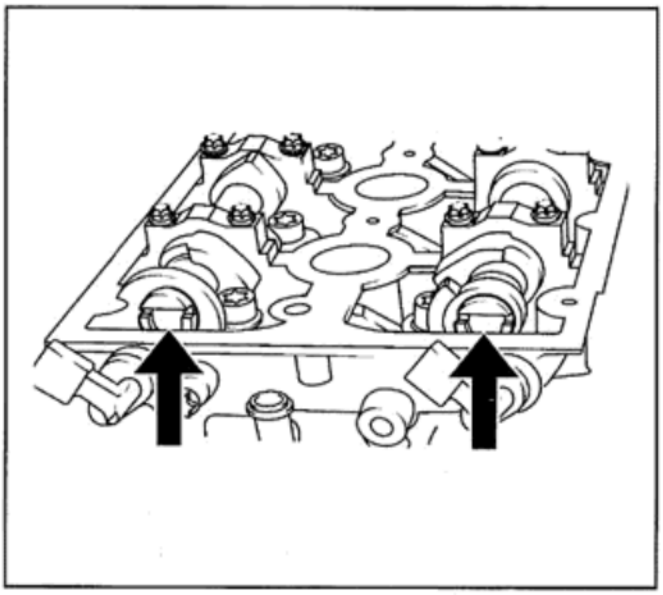


2373398

Note:

- The spot type marking (4) on the intake camshaft position actuator adjuster does not correspond to the groove of the *EN-6340* locking tool - left (1) during this process, but must be somewhat above.
- The spot type marking (3) on the exhaust camshaft position actuator adjuster must correspond to the groove on *EN-6340* locking tool - right (2).

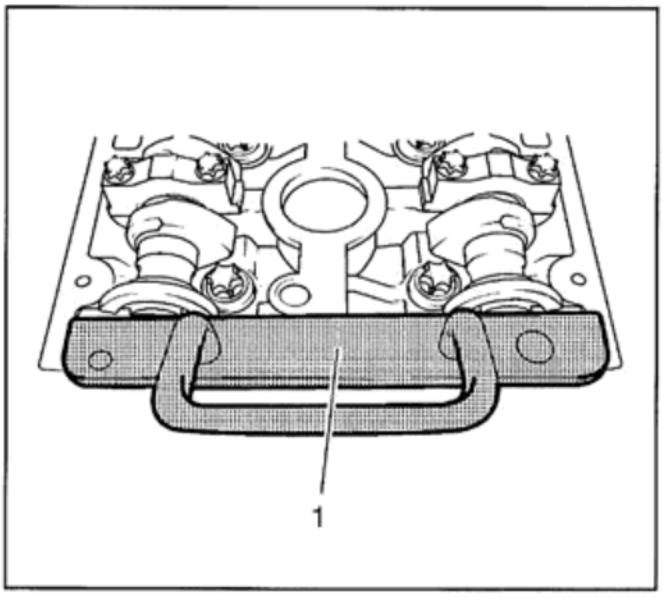
5. Insert the *EN-6340* locking tool - left (1) and the *EN-6340* locking tool - right (2) in the camshaft position actuator adjuster.



2026512

Note: If the *EN-6628-A* locking tool cannot be inserted, the timing must be set.

6. Align the camshafts horizontally by the hexagon (arrows) until the *EN-6628-A* locking tool can be inserted in both camshafts.



2026534

7. Insert the *EN-6628-A* locking tool (1) into the camshafts.

Installation Procedure

1. Remove the *EN-6628-A* locking tool.
2. Remove the *EN-6340* locking tool.
3. Install the camshaft cover. Refer to *Camshaft Cover Installation on page 9-1113.*
4. Install the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Installation on page 9-1126.*

Timing Belt Adjustment

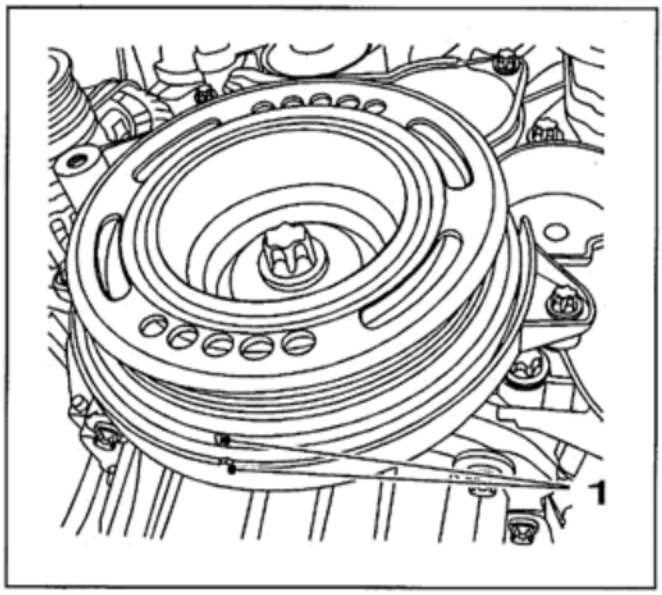
Special Tools

- *EN-652* Flywheel Holder
- *EN-6333* Locking Pin
- *EN-6340* Locking Tool
- *EN-6628-A* Locking Tool
- *EN-45059* Torque Angle Sensor Kit

For equivalent regional tool, refer to *Special Tools on page 9-1135.*

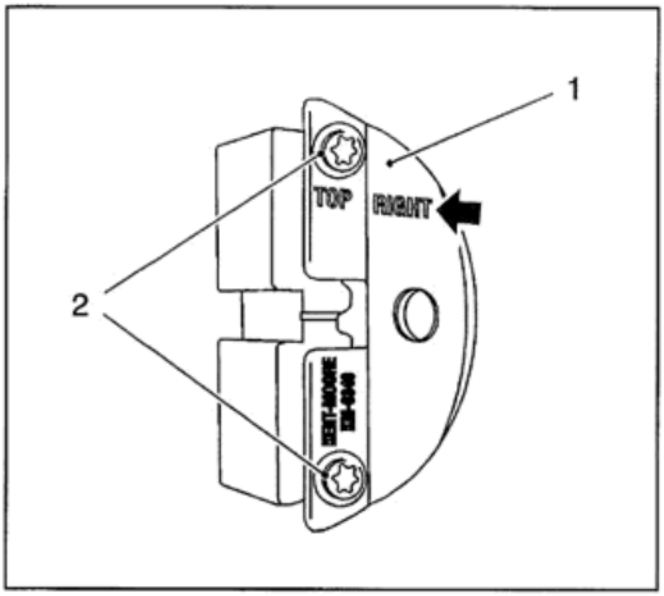
Removal Procedure

1. Remove the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Removal on page 9-1074.*



1936993

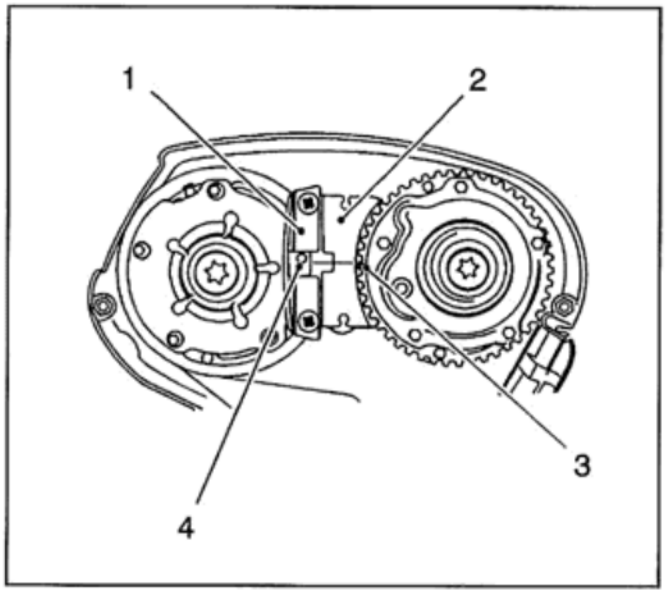
2. Set the crankshaft balancer in the direction of the engine rotation to "1st cylinder TDC" (mark 1).
3. Remove the camshaft cover. Refer to *Camshaft Cover Removal on page 9-1084.*



1944920

Note: The right half of the *EN-6340* locking tool can be recognized by the lettering "right", arrow, on the tool.

4. Prepare the right half of the *EN-6340* locking tool.
   4.1. Remove the 2 bolts (2).
   4.2. Remove the front panel (1) from the *EN-6340* locking tool - right.

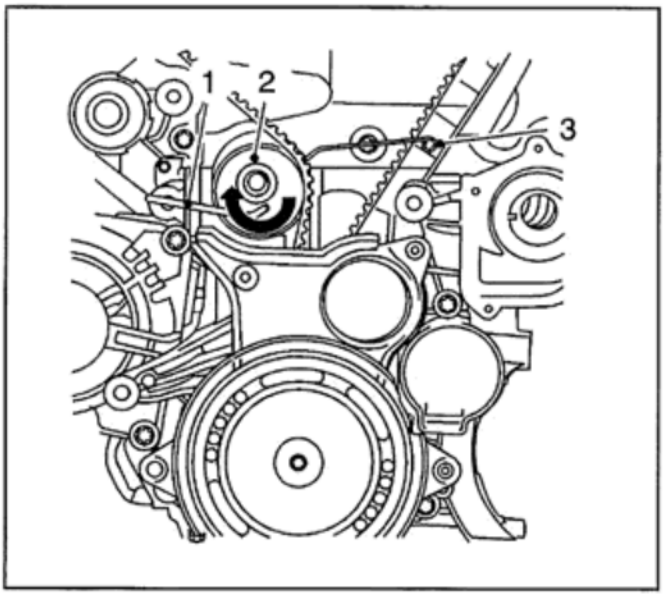


1944922

Note:

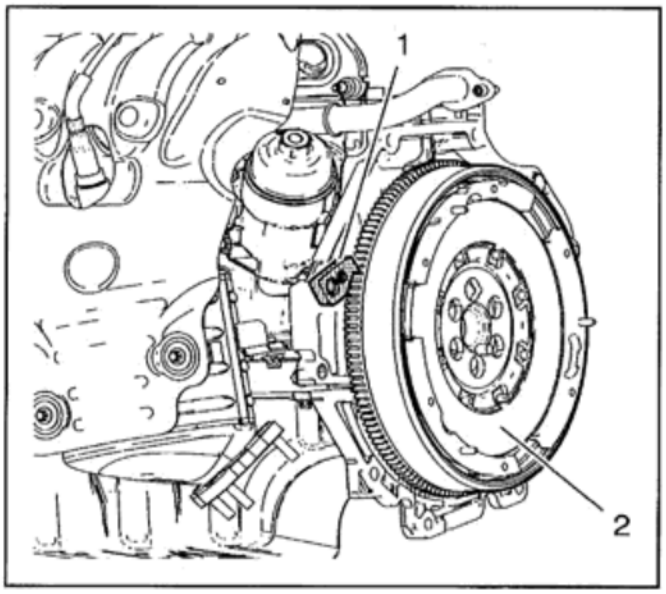
- The spot type marking (4) on the intake camshaft position actuator adjuster does not correspond to the groove of the *EN-6340* locking tool - left (1) during this process, but must be somewhat above.
- The spot type marking (3) on the exhaust camshaft position actuator adjuster must correspond to the groove on *EN-6340* locking tool - right (2).

5. Insert the *EN-6340* locking tool - left (1) and the *EN-6340* locking tool - right (2) in the camshaft position actuator adjuster.



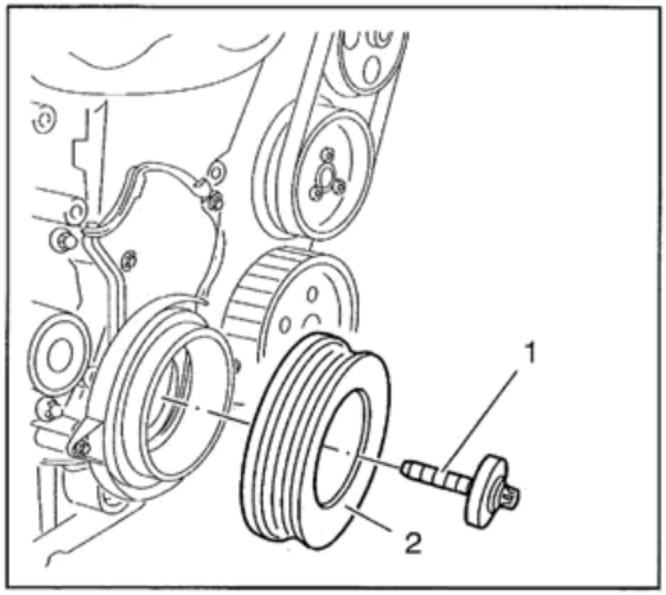
1944384

6. Install the *EN-6333* locking pin (1), apply tension to the timing belt tension roller (2) in the direction of the arrow. Install the *EN-6333* locking pin (3).
7. Mark timing belt in direction of rotation.



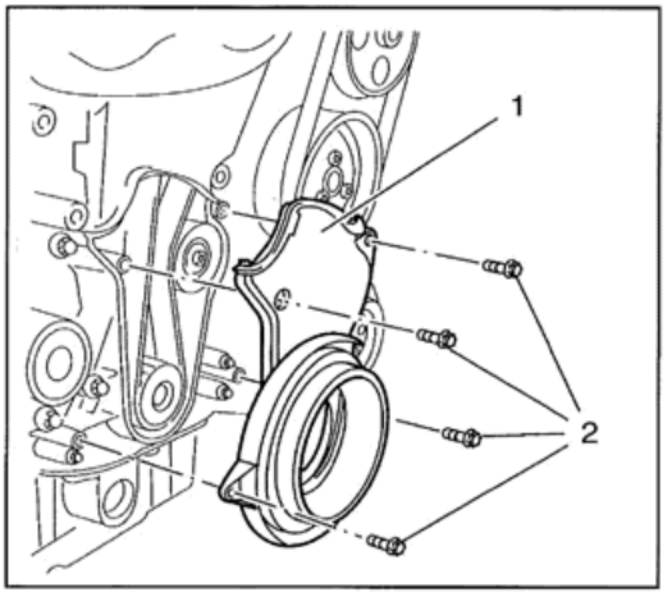
2026535

8. Install the *EN-652* flywheel holder (1), lock the flywheel (2) (or automatic transmission flex respectively) via the starter ring gear.



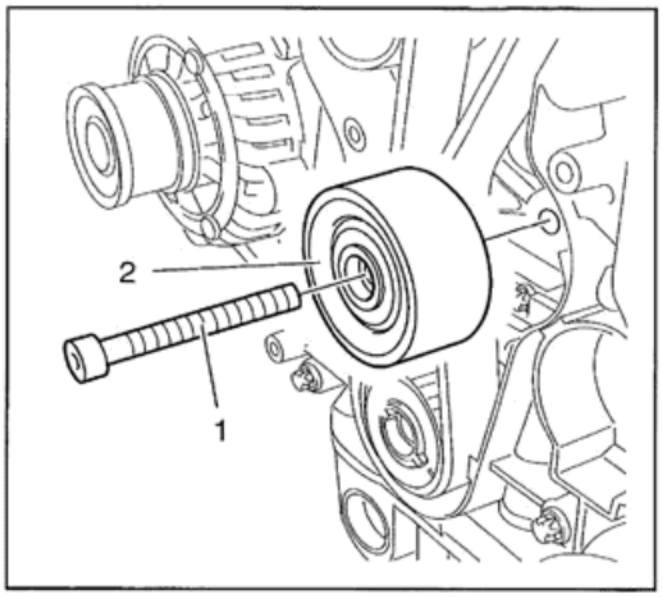
2026822

9. Remove and DISCARD the crankshaft balancer bolt (1).
10. Remove the crankshaft balancer (2).



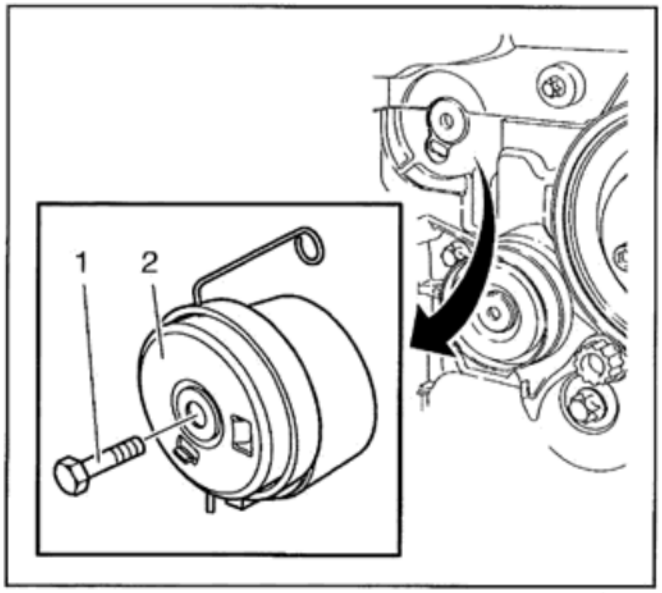
2026840

11. Remove the 4 timing belt lower front cover bolts (2).
12. Remove the timing belt lower front cover (1).



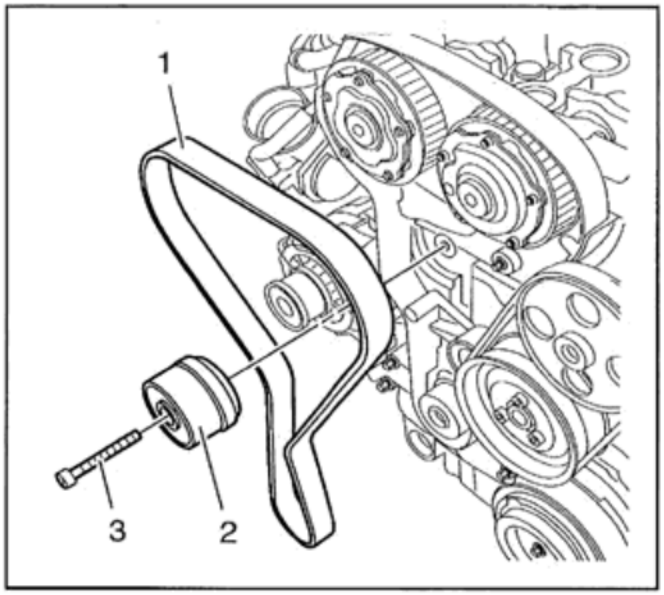
2026843

13. Remove the timing belt idler pulley bolt (1).
14. Remove the timing belt idler pulley (2).



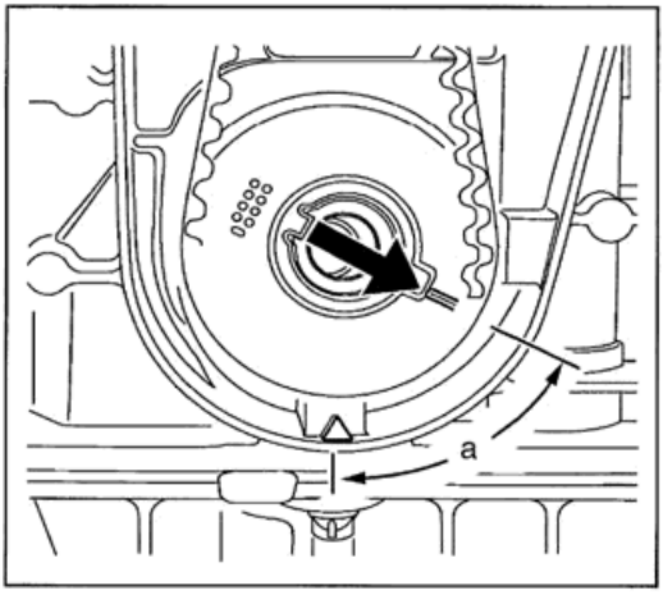
2027017

15. Remove the tensioner bolt (1).
16. Remove the timing belt tensioner (2).



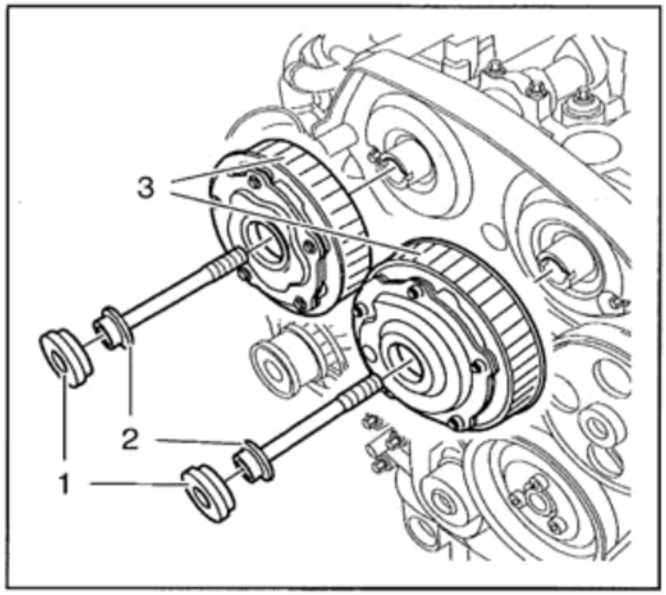
2026841

17. Remove the timing belt (1).
18. Stop the timing belt tensioner (2).
19. Remove the *EN-652* flywheel holder to unlock the crankshaft.



2027016

20. Turn the crankshaft 60° (A) against the direction of engine rotation.

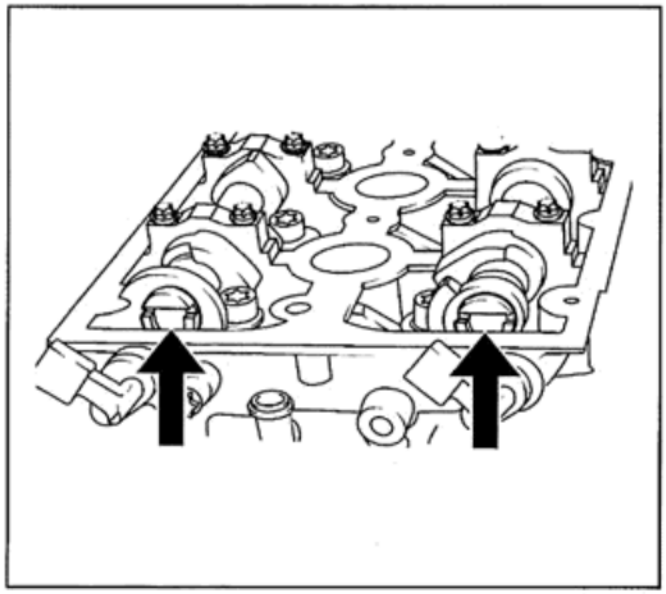


2026844

21. Remove the 2 camshaft position actuator adjuster closure bolts (1).

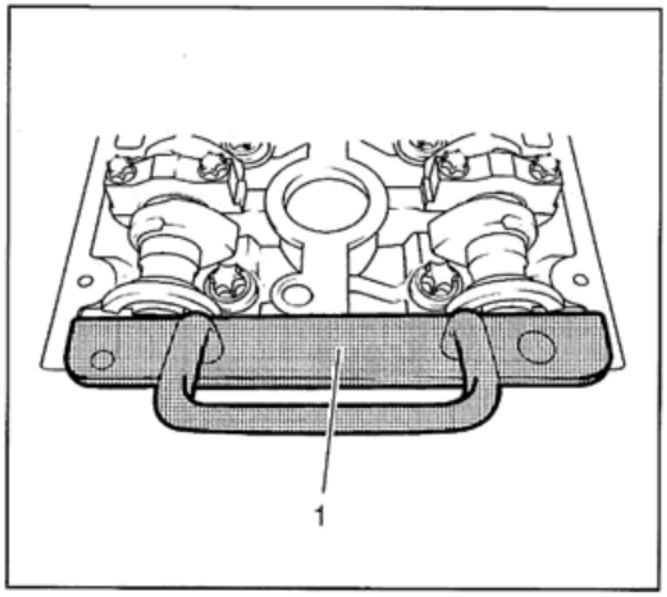
Note: A second technician is required.

22. Loosen the camshaft position actuator adjuster bolts (2).
    Hold at the appropriate camshaft hexagon.
23. Remove and DISCARD the camshaft position actuator adjuster bolts (2) and the camshaft position actuator adjuster (3).



2026512

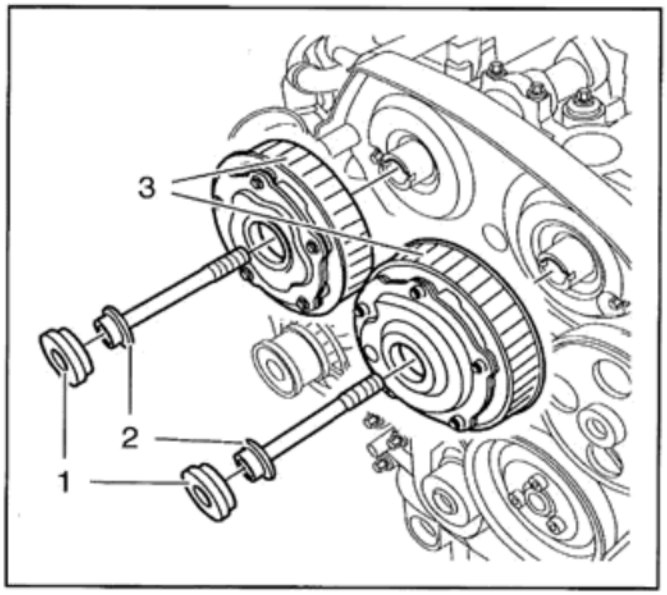
24. Align the camshafts horizontally by the hexagon arrows, until the *EN-6628-A* locking tool can be inserted in both camshafts.



2026534

25. Insert the *EN-6628-A* locking tool (1) into the camshafts.

Installation Procedure



2026844

Note: Do not tighten the camshaft adjuster bolts.

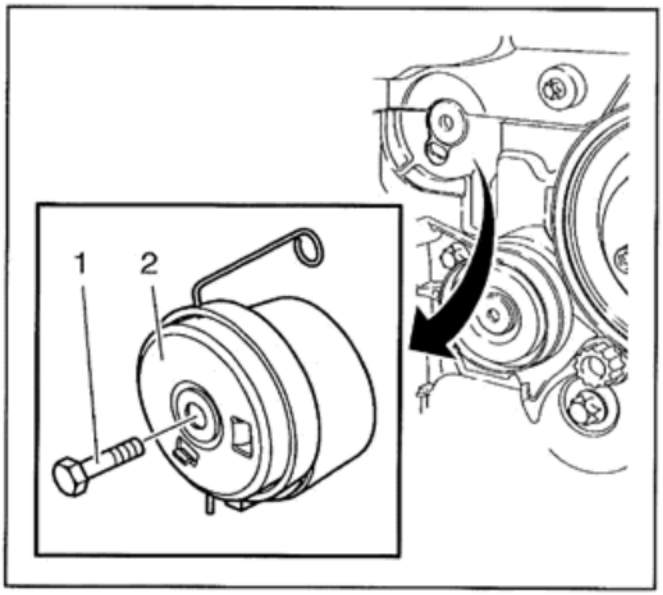
1. Install the camshaft position actuator adjuster (3).
2. Install NEW camshaft position actuator adjuster bolts (2).

Caution: Refer to *Fastener Caution on page 0-8.*

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10.*

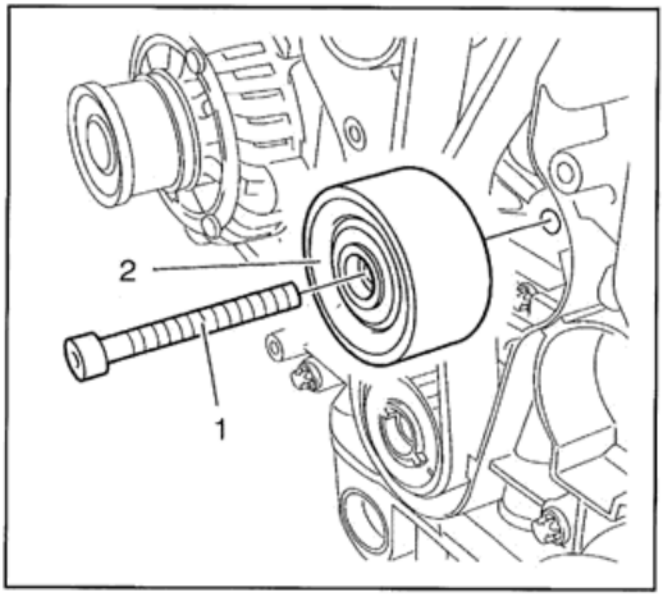
Note: A second technician is required.

3. Tighten the camshaft position actuator adjuster bolts (2) in three passes:
   Hold at the appropriate camshaft hexagon.
   3.1. First pass tighten to **65 N•m (48 lb ft)**.
   3.2. Second pass to **120°**.
   3.3. Third pass to **15°**.
4. Replace the camshaft position actuator adjuster seal rings.
5. Install the 2 camshaft position actuator adjuster closure plugs (1) and tighten to **30 N•m (22 lb ft)**.
6. Remove the *EN-6628-A* locking tool.



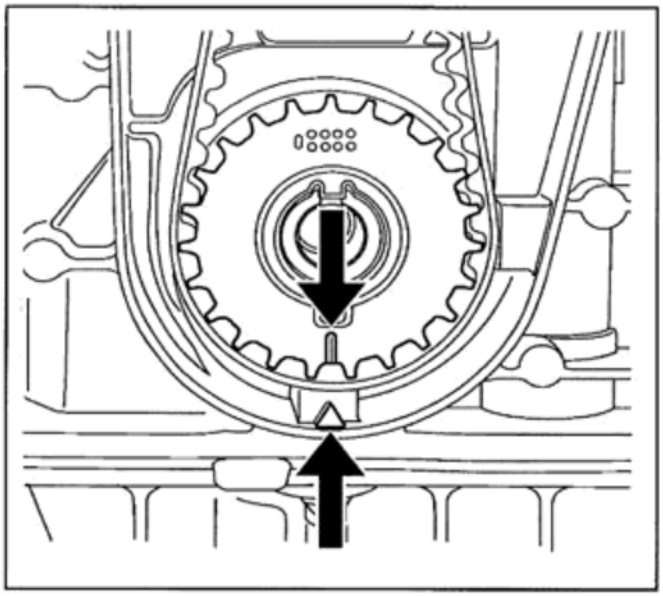
2027017

7. Clean the timing belt tensioner thread.
8. Install the timing belt tensioner (2) and tighten the NEW timing belt tensioner bolt (1) to **20 N•m (15 lb ft)**.
9. Clean the timing belt idler pulley thread.



2026843

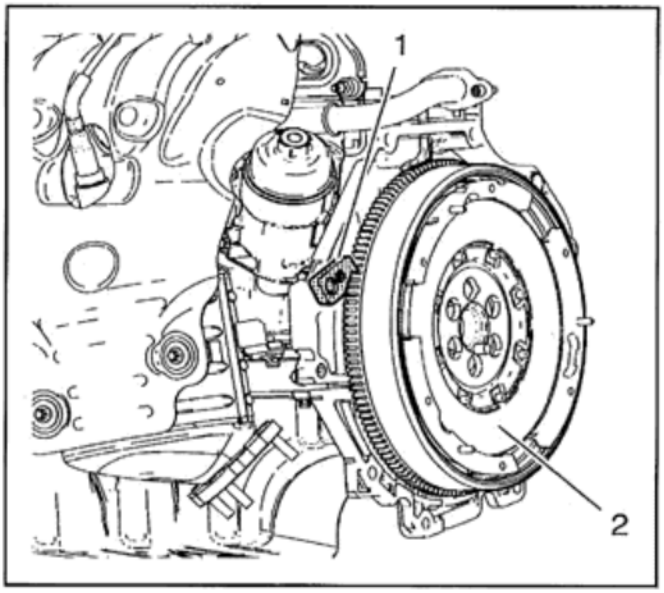
10. Install the timing belt idler pulley (2) and tighten the NEW bolt (1) to **25 N•m (18 lb ft)**.



2027014

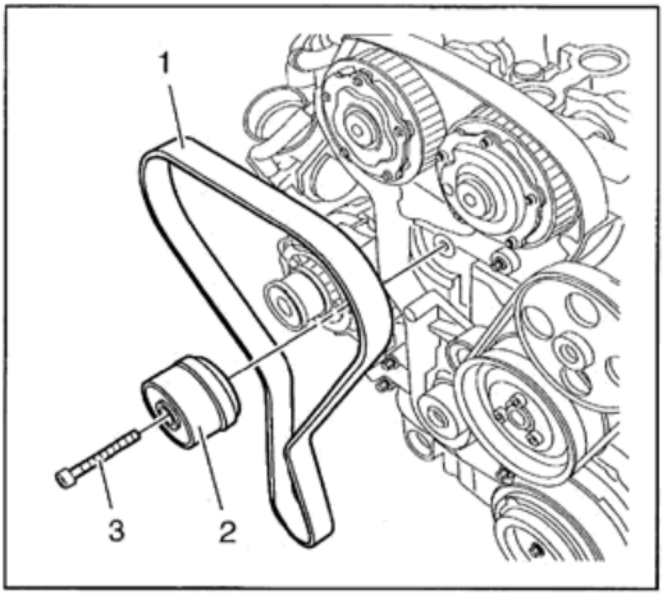
Note: The timing belt drive gear and oil pump housing must align.

11. Turn the crankshaft in the direction of engine rotation, by the crankshaft balancer bolt, to cylinder 1 TDC of combustion stroke.



2026535

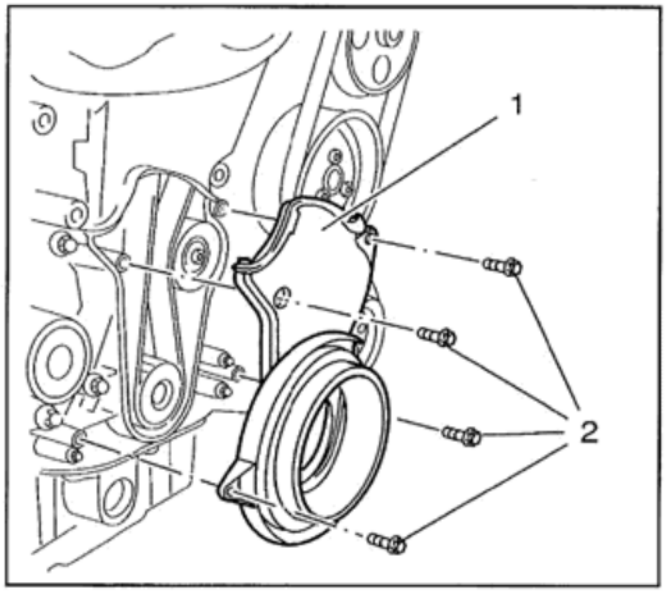
12. Install the *EN-652* flywheel holder (1), lock the flywheel (2) (or automatic transmission flex respectively) via the starter ring gear.



2026841

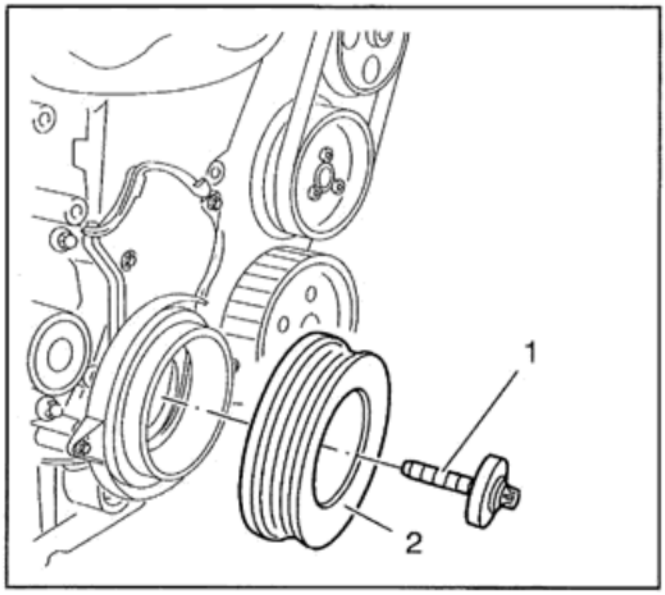
Note: Observe direction of rotation.

13. Insert the timing belt (1).
14. Apply preliminary tension clockwise to the timing belt tension roller.
15. Remove the *EN-6333* locking pin.
16. Release the tension on the timing belt tensioner.



2026840

17. Install the lower front timing belt cover (1) and tighten the 4 bolts (2) to **6 N•m (53 lb in)**.

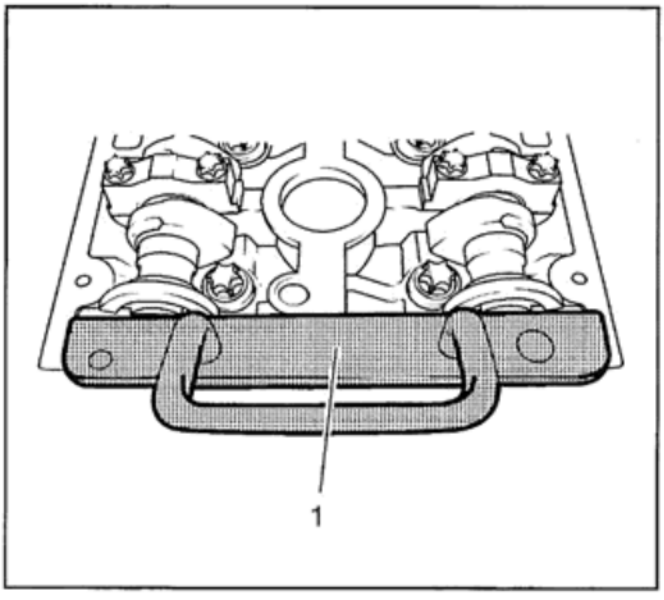


2026822

18. Install the crankshaft balancer (2) and NEW bolt (1) and tighten in 3 passes using the *EN-45059* sensor kit:
    18.1. First pass to **95 N•m (70 lb ft)**.
    18.2. Second pass to **45°**.
    18.3. Third pass to **15°**.
19. Remove the *EN-652* flywheel holder to unlock the crankshaft.
20. Remove the *EN-6340* locking tool.
21. Check position of the camshaft position actuator adjuster.
    21.1. Turn crankshaft **720°** in the direction of engine rotation by the crankshaft balancer bolt.

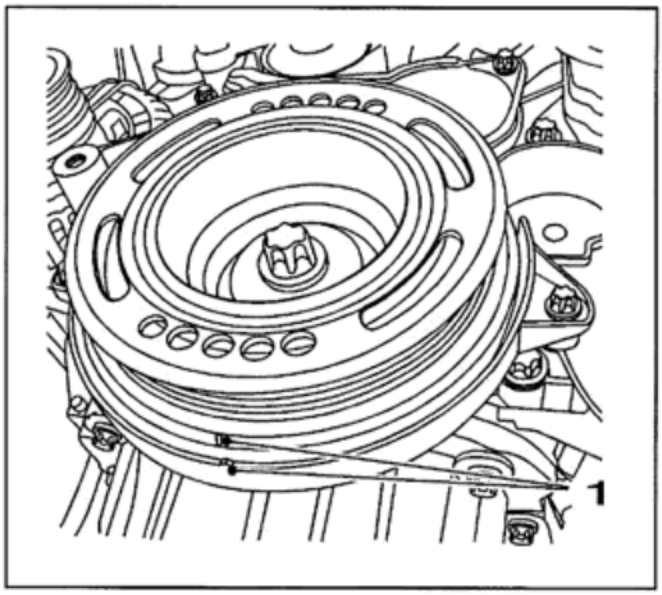
Note: Note marking, camshaft position actuator adjuster.

    21.2. Insert *EN-6340* locking tool into camshaft timing gears.



2026534

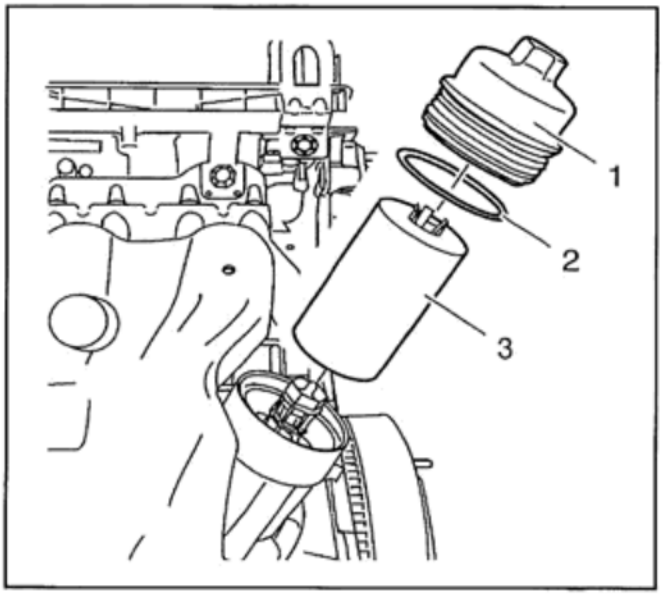
22. Insert the *EN-6628-A* locking tool (1) into the camshafts.
23. Align camshafts by hexagon until *EN-6628-A* locking tool can be inserted in both camshafts.



1936993

24. Check the crankshaft position.
25. Marking on crankshaft balancer must align with marking on timing belt lower cover, see mark (1).
26. Remove the *EN-6628-A* locking tool.
27. Install the camshaft cover. Refer to *Camshaft Cover Installation on page 9-1113.*
28. Install the timing belt upper front cover. Refer to *Timing Belt Upper Front Cover Installation on page 9-1126.*

Draining Fluids and Oil Filter Removal



2026824

1. Place a drip pan underneath.

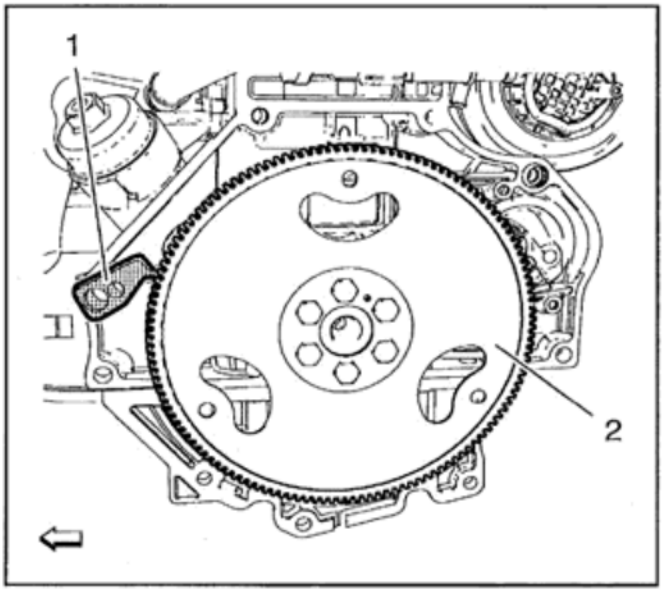
2. Remove the oil filter cap (1).
3. Remove the oil filter cap seal (2).
4. Remove and properly dispose of the oil filter insert (3).
5. Re-install the oil filter cap.
6. Remove the oil drain bolt.
7. Drain the engine oil into the drip pan.

Automatic Transmission Flex Plate Removal

Special Tools

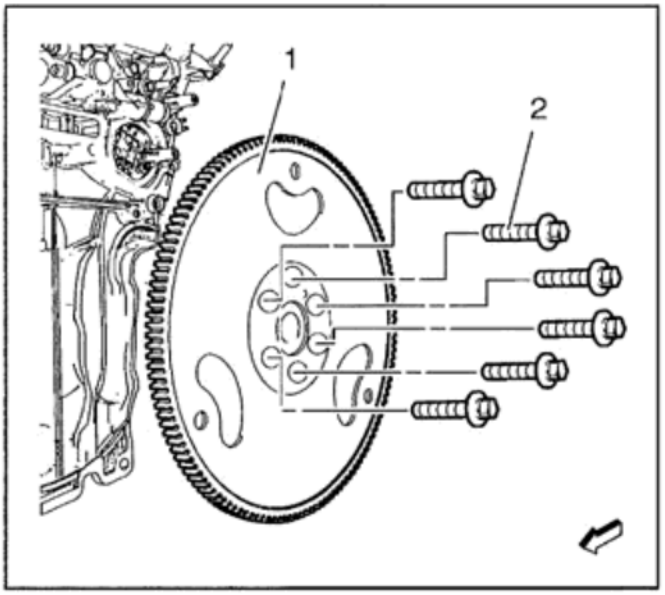
EN-652 Automatic Transmission Flex Plate Holder

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2028106

1. Install the *EN-652* holder (1) to hold the automatic transmission flex plate (2).
2. Loosen the 6 automatic transmission flex plate bolts.
3. Remove the *EN-652* holder (1).



2028105

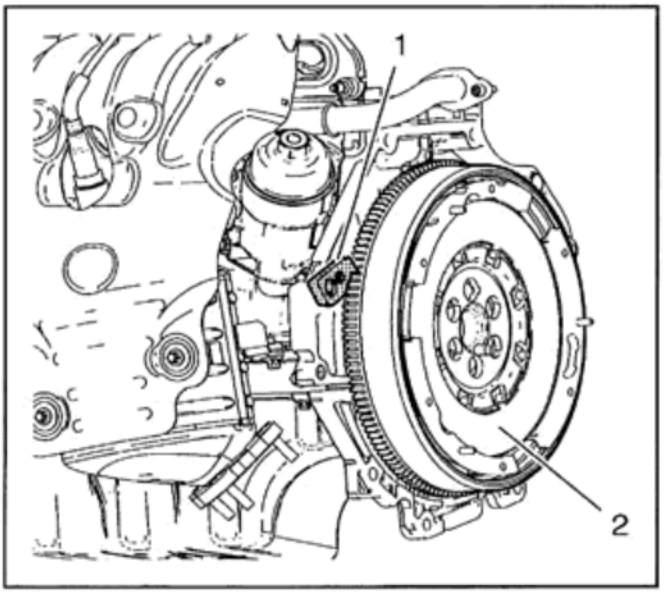
4. Remove the 6 automatic transmission flex plate bolts (2).
5. Remove the automatic transmission flex plate (1).

Engine Flywheel Removal

Special Tools

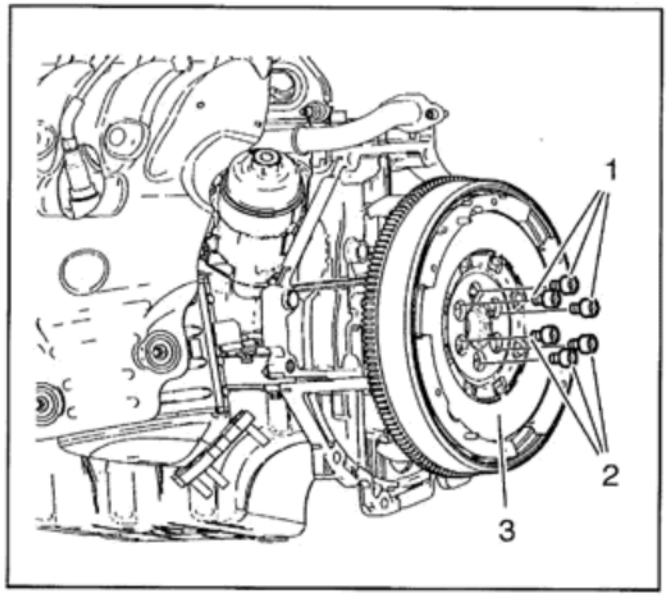
EN-652 Flywheel Holder

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



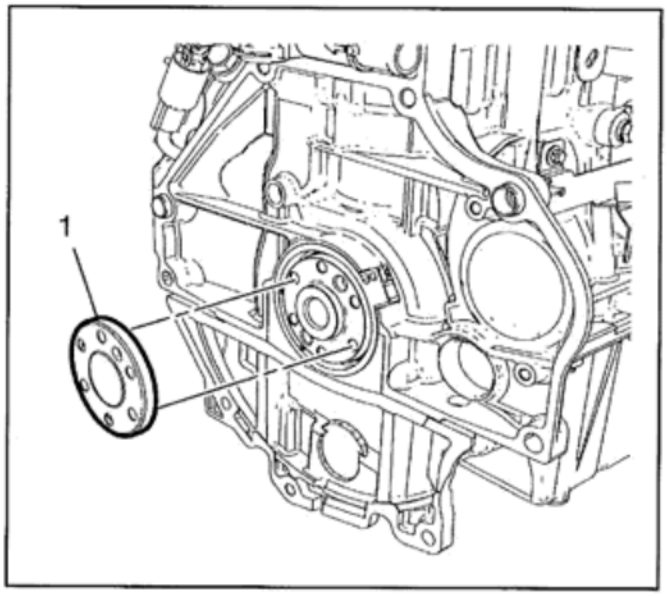
2026535

1. Install the *EN-652* holder (1), lock the flywheel via the starter ring gear.
2. Loosen the 6 flywheel bolts.
3. Remove the *EN-652* holder (1).



2026536

4. Remove and DISCARD the 6 flywheel bolts (1, 2).
5. Remove the flywheel (3).



2743821

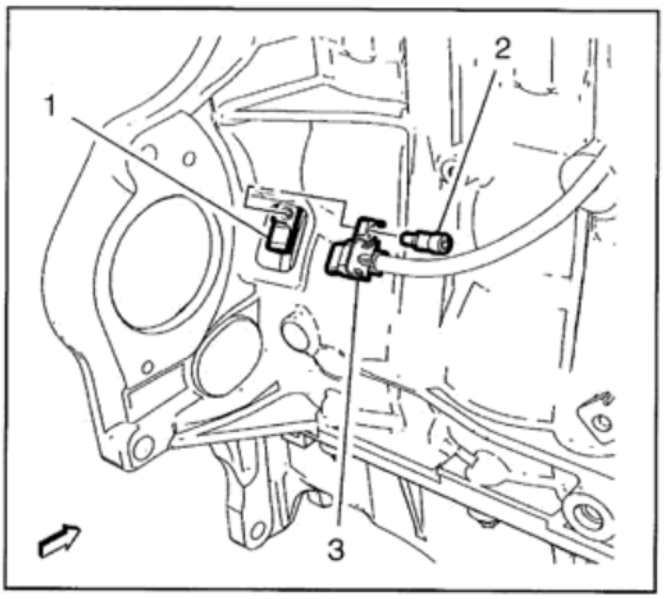
6. Remove the crankshaft position reluctor ring (1).

Crankshaft Rear Oil Seal Removal

Special Tools

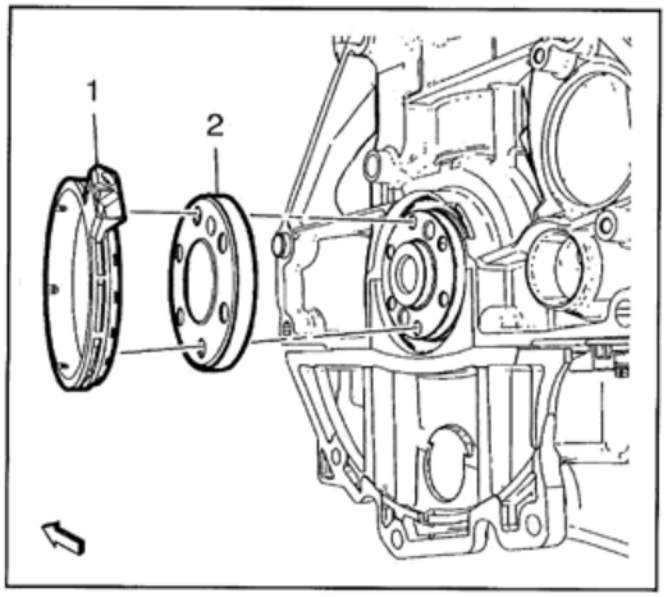
- *EN-328-B* Pin Remover
- *EN-6624* Remover

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2757902

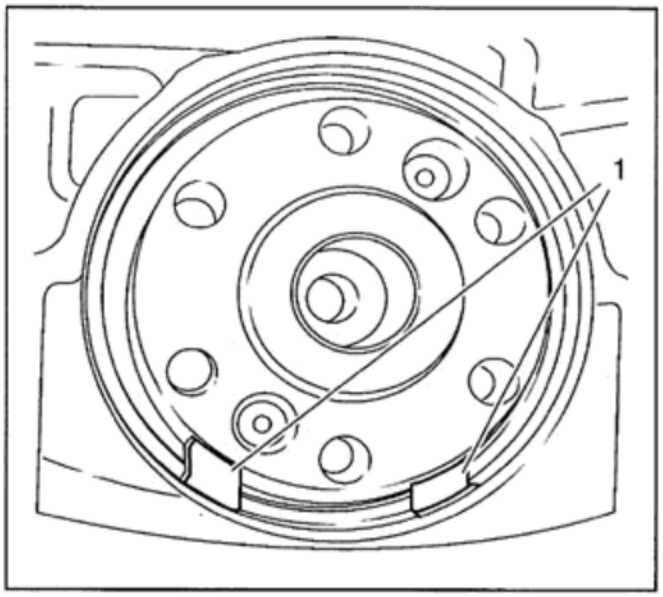
1. Remove the crankshaft position sensor bolt (2).
2. Remove the crankshaft position sensor (3) from the crankshaft rear oil seal housing (1).



2781536

Caution: Do not allow the crankshaft encoder wheel to come into contact with external magnetic fields or sharp metal objects. Do not drop the crankshaft encoder wheel. Do not damage the rubberized encoder track. Failure to follow these precautions may cause damage to the component.

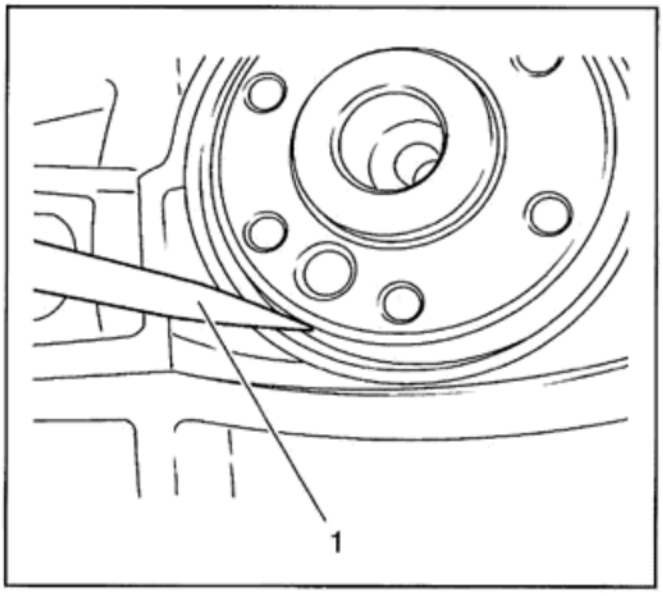
3. Remove the crankshaft rear oil seal housing (1).
4. Remove the crankshaft position sensor reluctor ring (2).



2027001

Note: The diameter of the hole must not exceed 2 mm (0.0787 in). If the diameter of the hole exceeds 2 mm (0.0787 in), the bolt of *EN-6624* remover will not be able to grip.

5. Only make a hole at the 5 o'clock and 7 o'clock positions (1), these are the only positions where is a cavity behind the seal ring.

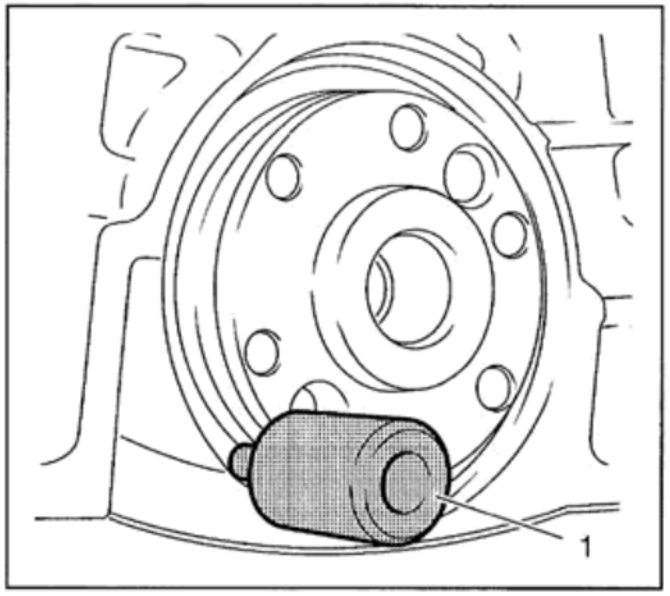


2027002

6. Using a suitable tool, such as a scribe (1), make a hole in the crankshaft rear oil seal.

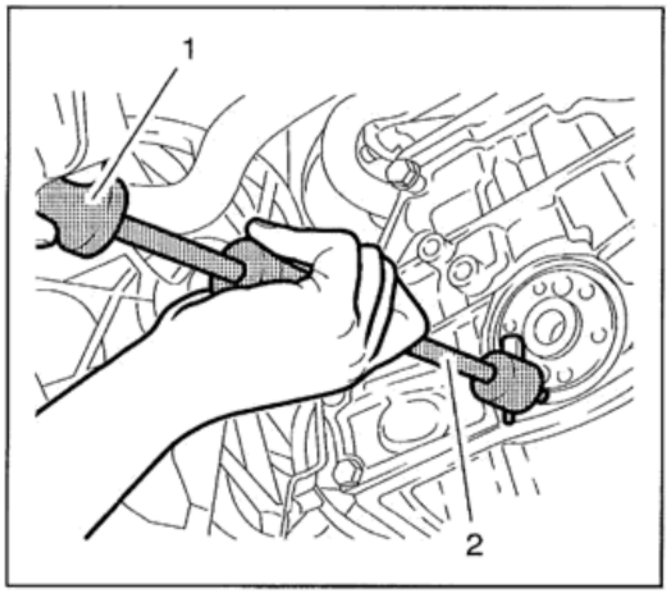
   Position the scribe (1) at the outer edge of the crankshaft rear oil seal.

7. Remove the seal ring.



2027005

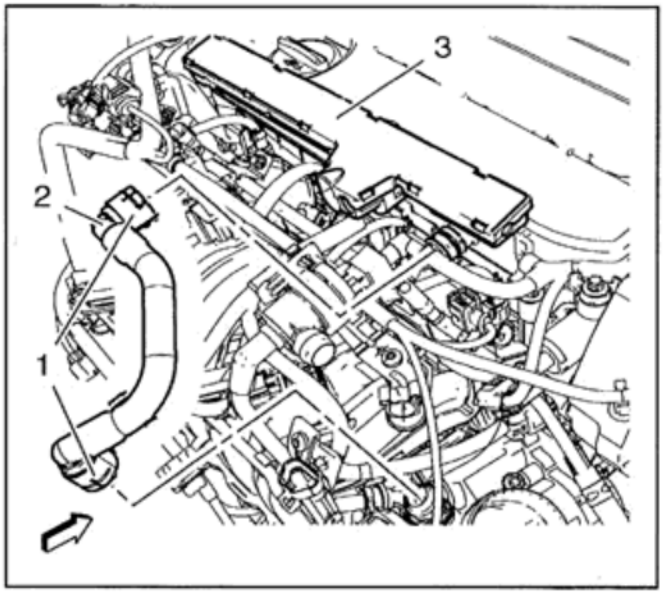
8. Install *EN-6624* remover (1) to the crankshaft rear oil seal and tighten the bolt.



2027006

9. Install the *EN-328-B* remover (1) to *EN-6624* remover (2) and remove the crankshaft rear oil seal.

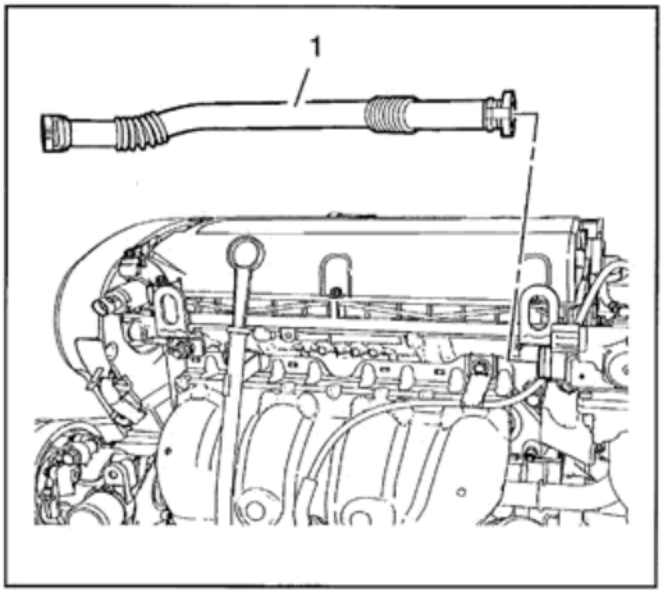
Positive Crankcase Ventilation Pipe Removal



2027614

1. Unclip the ECM wiring harness guide (3) from the cylinder head cover.
2. Disconnect the 2 positive crankcase ventilation tube connectors (1).
3. Remove the positive crankcase ventilation tube (2).

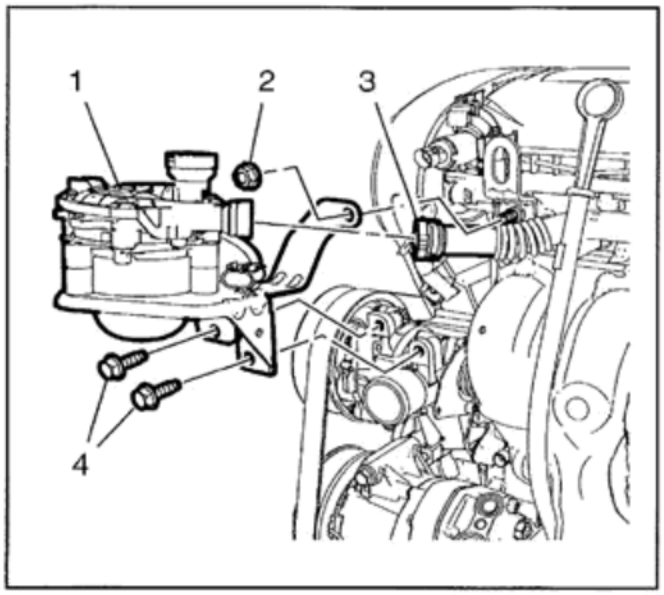
Secondary Air Injection Pump Pipe Removal



2781589

1. Disconnect the secondary air injection pump pipe (3) from the secondary air injection check valve. Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.

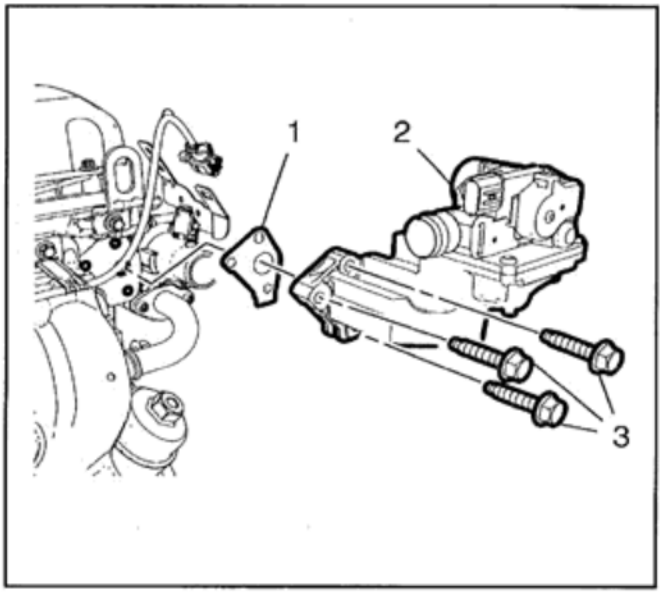
Secondary Air Injection Pump Removal



2781588

1. Disconnect the secondary air injection pump pipe (3). Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.
2. Remove the secondary air injection pump nut (2) and the 2 secondary air injection pump bolts (4).
3. Remove the secondary air injection pump (1).

Secondary Air Injection Check Valve Removal

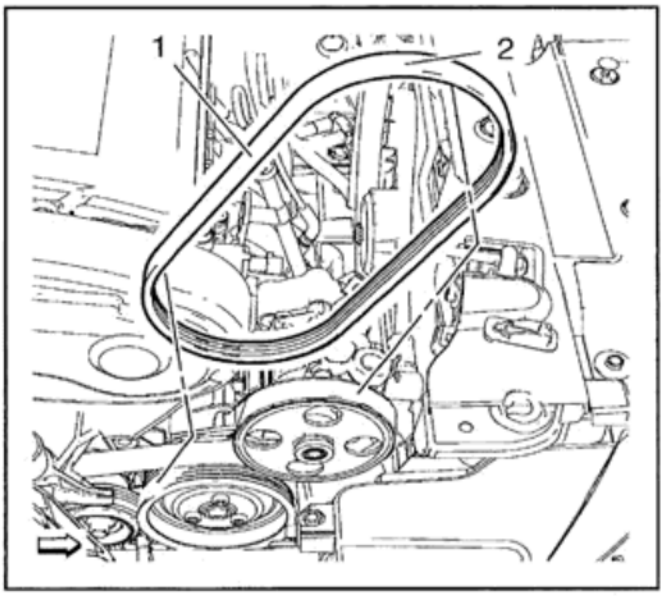


2781590

1. Remove the 3 secondary air injection check valve bolts (3).
2. Remove the secondary air injection check valve (2).

3. Remove and DISCARD the secondary air injection check valve gasket (1).

Power Steering Pump Belt Removal



2028350

Caution: Do not use belt dressing on the drive belt. Belt dressing causes the breakdown of the composition of the drive belt. Failure to follow this recommendation will damage the drive belt.

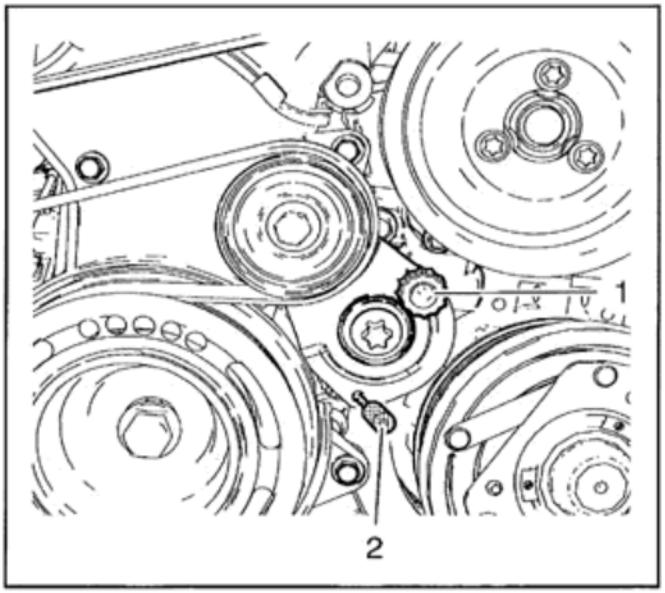
1. Cut the power steering pump belt (2) with a appropriate cutting tool at position (1).
2. Remove the power steering pump belt (2).

Drive Belt Removal

Special Tools

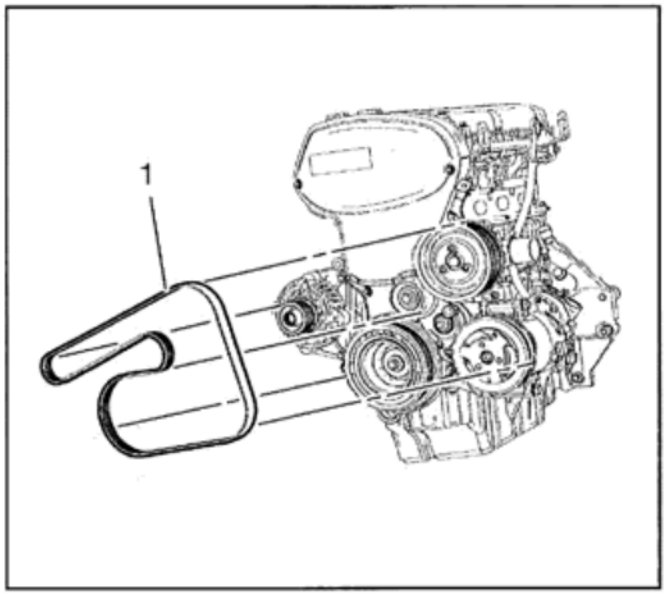
EN-6349 Locking Pin

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2189264

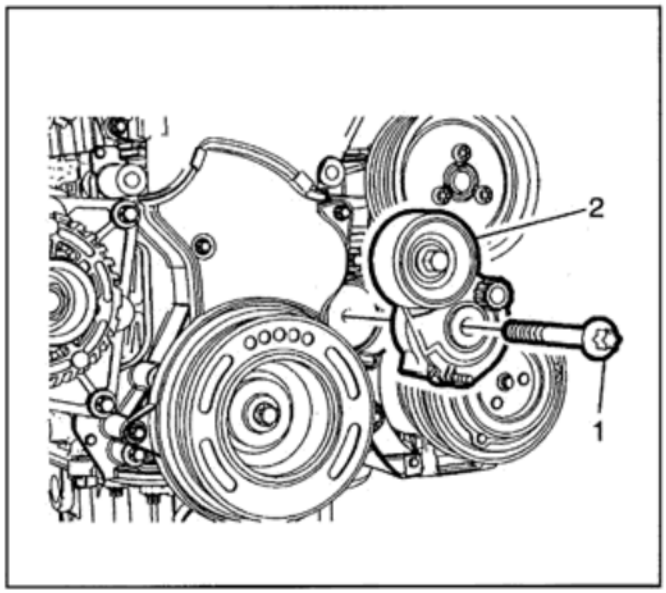
1. Release tension to the drive belt tensioner counterclockwise (1) and lock with *EN-6349* pin (2).



2191162

2. Remove the drive belt (1).

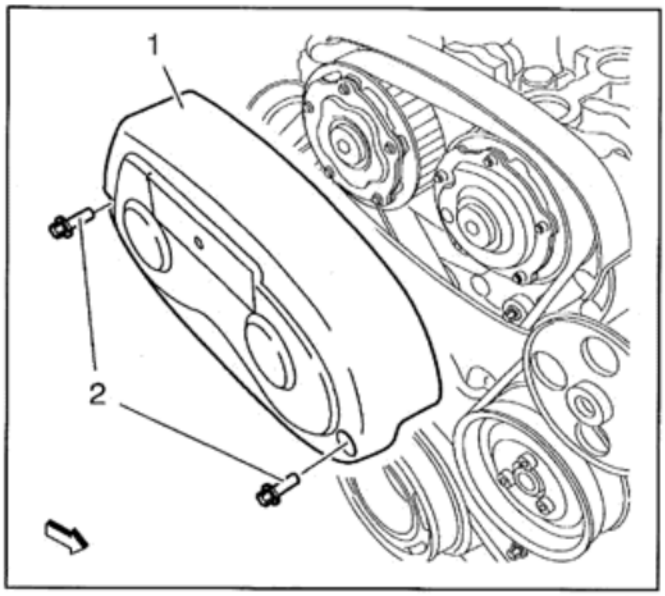
Drive Belt Tensioner Removal



2495148

1. Remove the drive belt tensioner bolt (1).
2. Remove the drive belt tensioner (2).

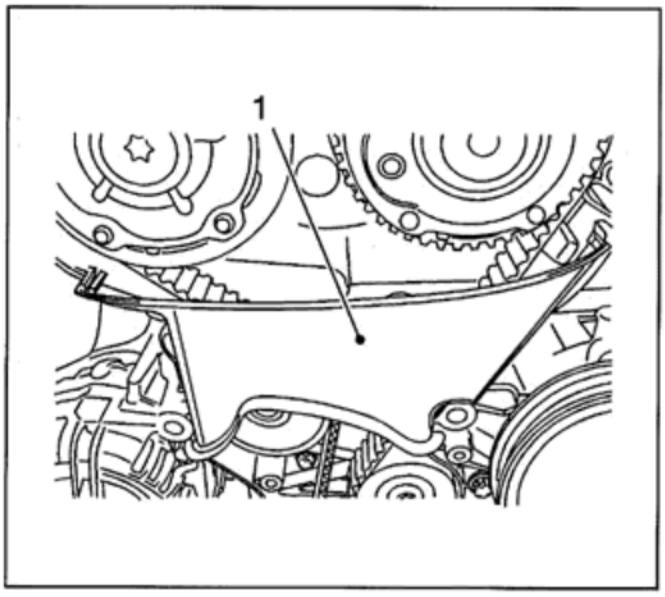
Timing Belt Upper Front Cover Removal



2027572

1. Remove the 2 timing belt upper front cover bolts (2).
2. Remove the timing belt upper front cover (1).

Timing Belt Center Front Cover Removal



1945761

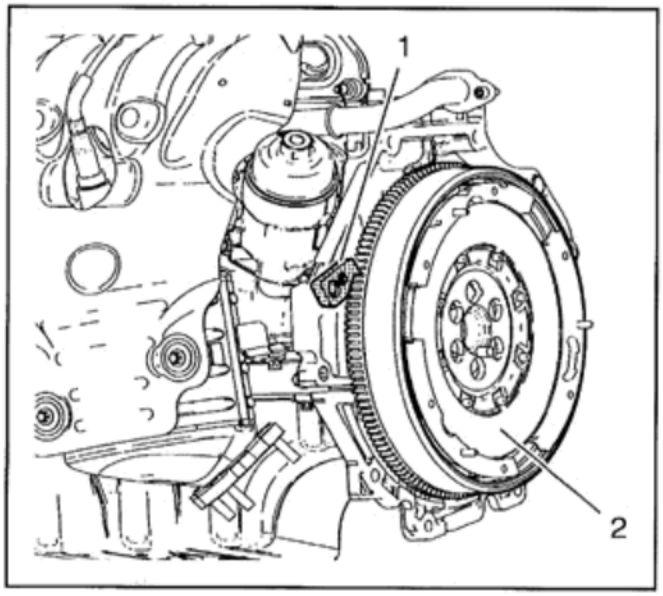
1. Remove the center front timing belt cover from the rear timing belt cover at 2 locations.
2. Remove the center front timing belt cover (1).

Crankshaft Balancer Removal

Special Tools

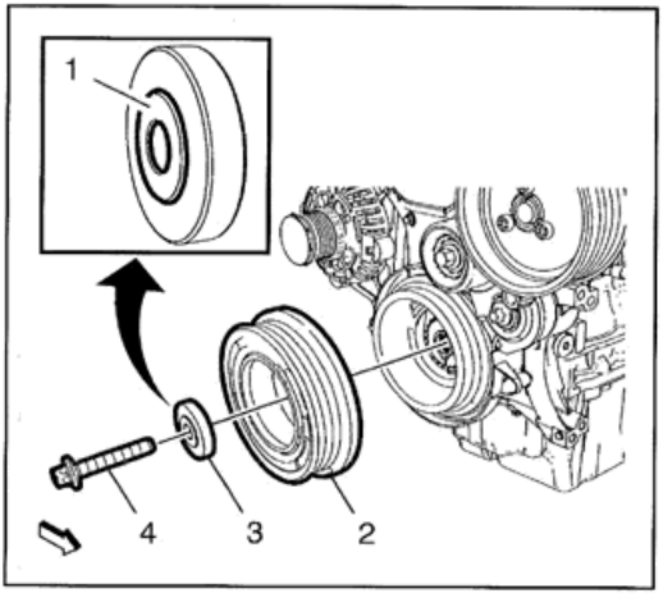
EN-652 Flywheel Holder

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2026535

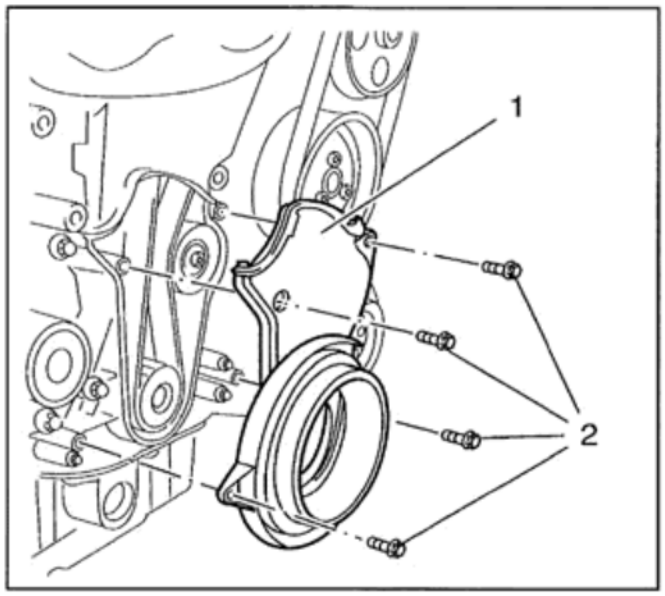
1. Install the *EN-652* holder (1). Lock the flywheel (2) or the automatic transmission flex plate via the starter ring gear.



2814173

2. Remove and DISCARD the crankshaft balancer bolt (4).
3. Remove the crankshaft balancer washer (3).
4. Remove the crankshaft balancer (2).

Timing Belt Lower Front Cover Removal



2026840

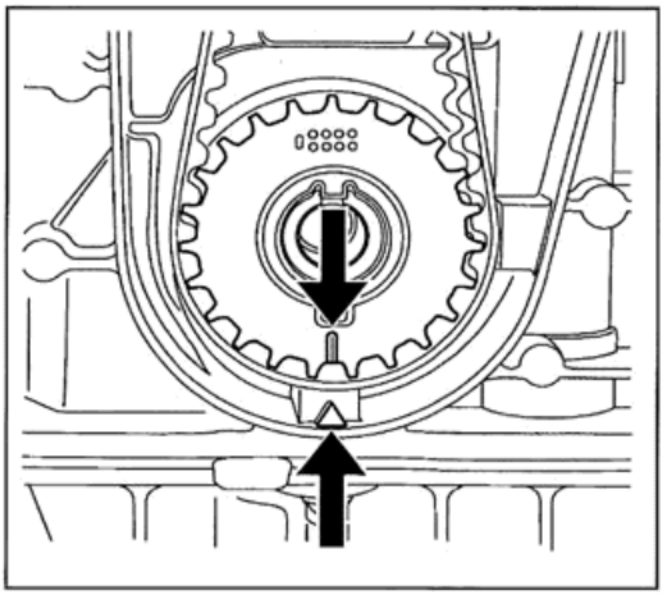
1. Remove the 4 timing belt lower front cover bolts (2).
2. Remove the timing belt lower front cover (1).

Timing Belt Removal

Special Tools

- *EN-6333* Locking Pin
- *EN-6340* Locking Tool

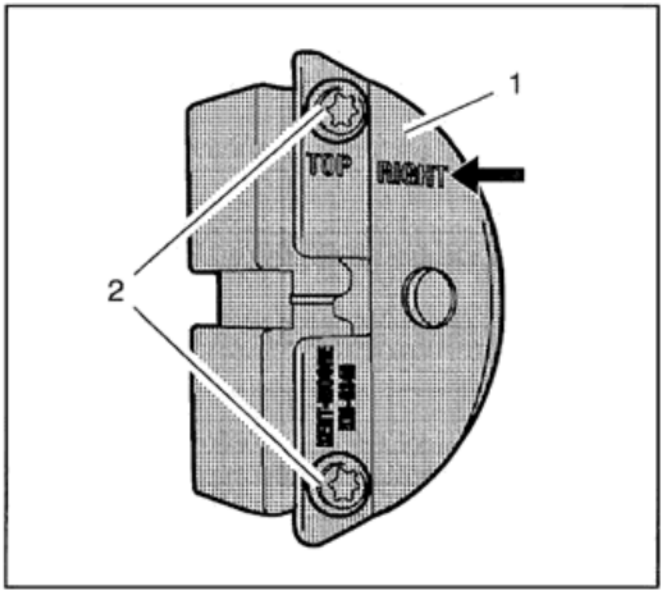
For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2027014

Note: The timing belt drive gear and oil pump housing must align.

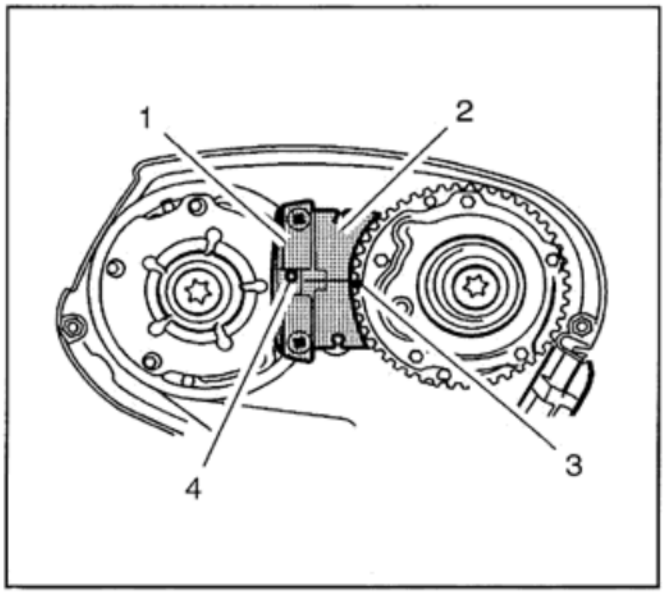
1. Turn the crankshaft in the direction of engine rotation, by the crankshaft balancer bolt, to cylinder 1 TDC of combustion stroke.



2373397

Note: The right half of the *EN-6340* locking tool can be recognized by the lettering right, arrow, on the tool.

2. Prepare the right half of the *EN-6340* locking tool.
   2.1. Remove the 2 bolts (2).
   2.2. Detach the front panel (1) from the *EN-6340* locking tool - right.

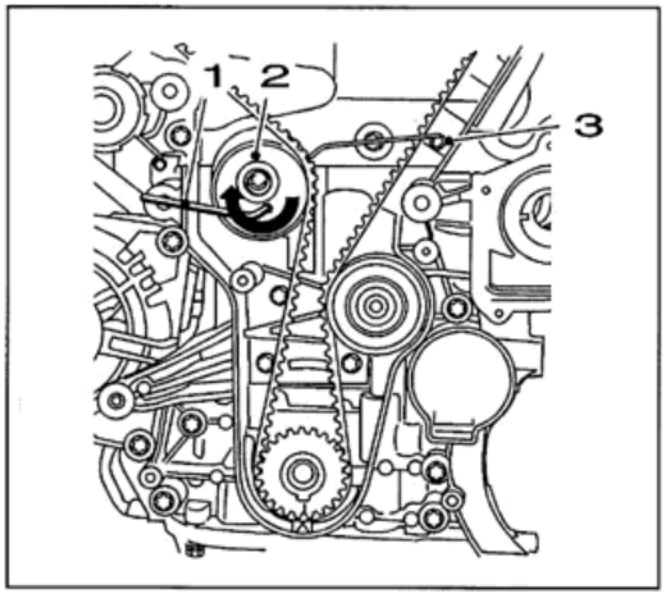


2373398

Note:

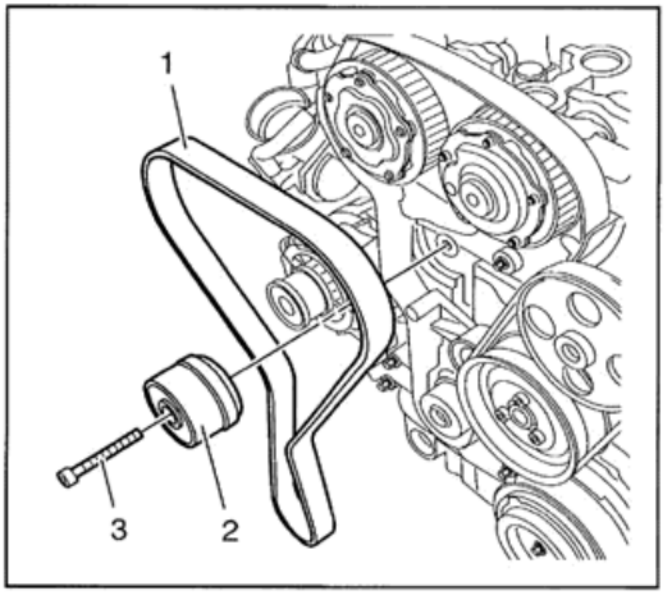
- The spot type marking (4) on the intake camshaft adjuster does not correspond to the groove of the *EN-6340* locking tool - left (1) during this process, but must be somewhat above.
- The spot type marking (3) on the exhaust camshaft adjuster must correspond to the groove on *EN-6340* locking tool - right (2).

3. Insert the *EN-6340* locking tool - left (1) and the *EN-6340* locking tool - right (2) in the camshaft adjuster.



1937014

4. Install the *EN-6333* locking pin (3), apply tension to the timing belt tension roller (2) in the direction of the arrow, using an Allen key (1).
5. Stop the timing belt tensioner.

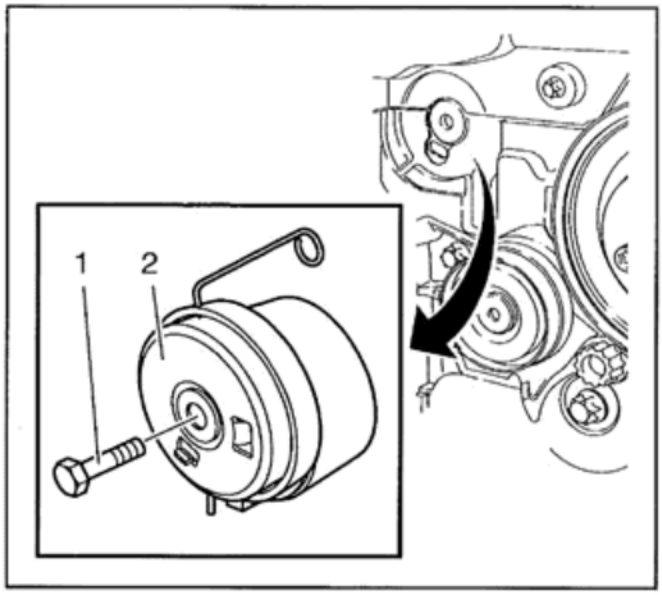


2026841

Note: Observe direction of rotation.

6. Remove the timing belt (1).

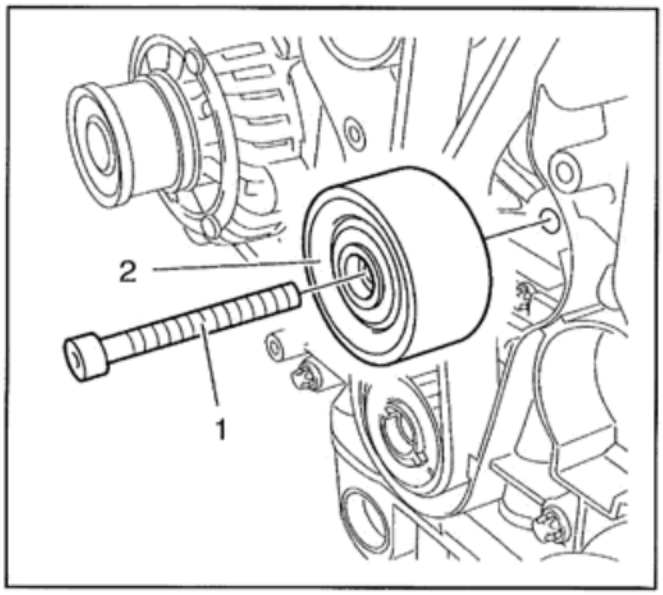
Timing Belt Tensioner Removal



2027017

1. Remove the tensioner bolt (1).
2. Remove the timing belt tensioner (2).

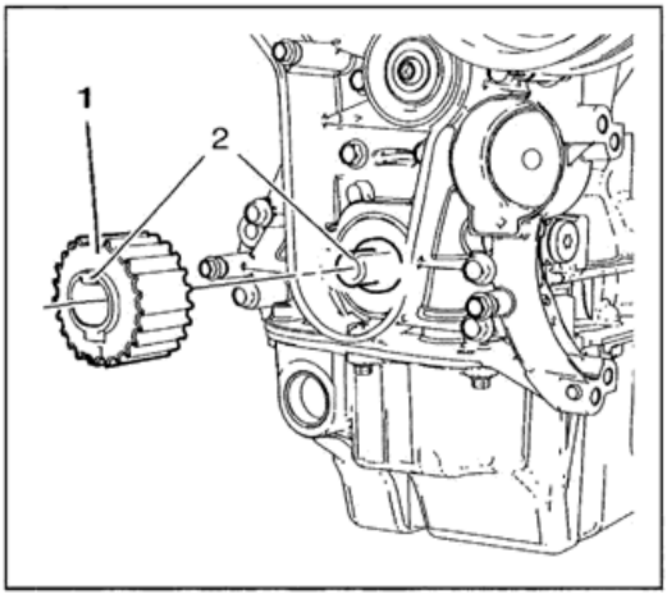
Timing Belt Idler Pulley Removal



2026843

1. Remove the timing belt idler pulley bolt (1).
2. Remove the timing belt idler pulley (2).

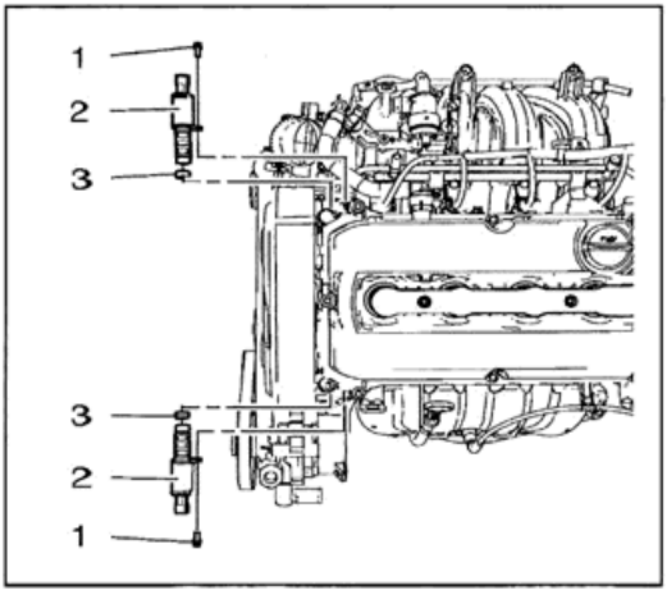
Crankshaft Sprocket Removal



2028278

Remove the crankshaft sprocket (1).

Camshaft Position Actuator Solenoid Valve Removal



2028075

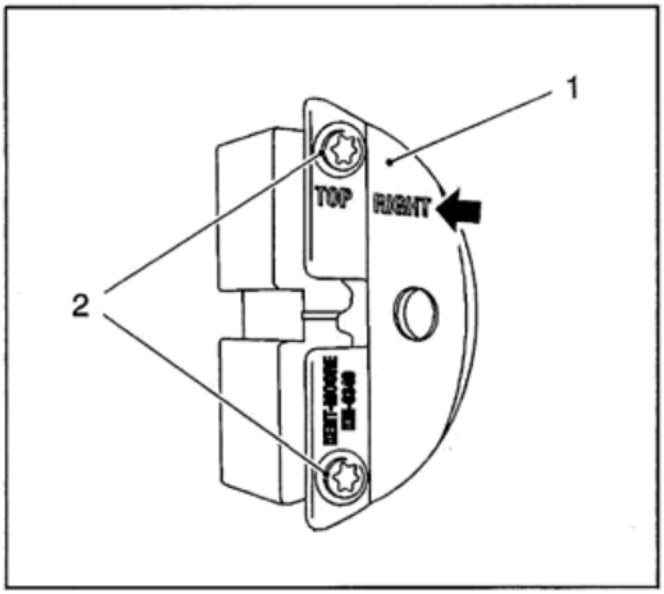
1. Remove the camshaft position actuator solenoid valve bolts (1).
2. Remove the camshaft position actuator solenoid valves (2).
3. Remove the camshaft position actuator solenoid valve seals (3).

Camshaft Position Actuator Adjuster Removal

Special Tools

- *EN-6340* Camshaft Adjuster Locking Tool
- *EN-6628-A* Camshaft Locking Tool

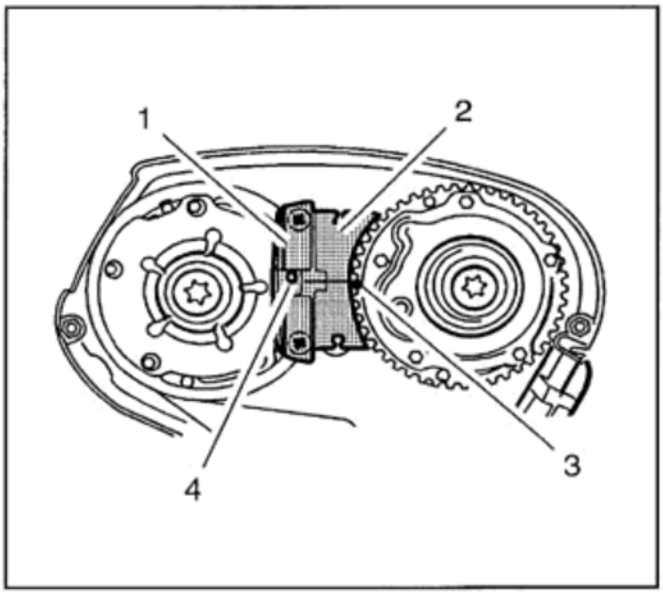
For equivalent regional tools, refer to *Special Tools on page 9-1135*.



1944920

Note: The right half of the *EN-6340* locking tool can be recognized by the lettering "right", arrow, on the tool.

1. Prepare the right half of the *EN-6340* locking tool.
   1.1. Remove the 2 bolts (2).
   1.2. Remove the front panel (1) from the *EN-6340* locking tool - right.



2373398

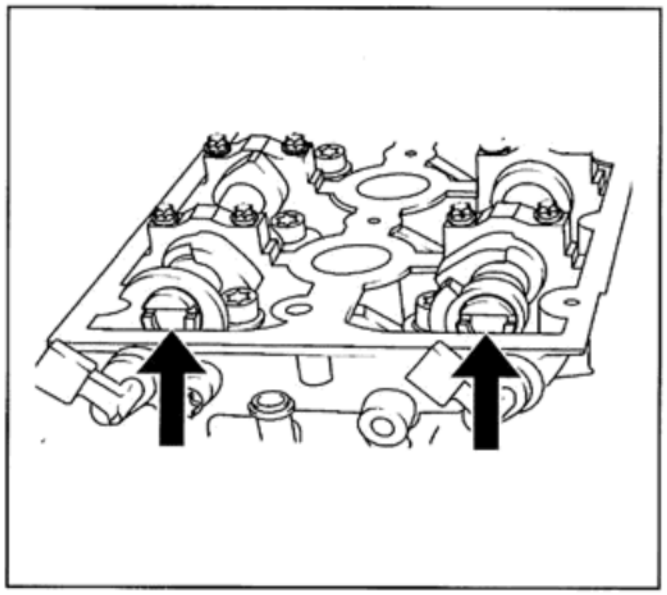
2. Install the *EN-6340* locking tool into the camshaft adjusters.

Note: The spot type marking (4) on the intake camshaft adjuster does not correspond to the groove of *EN-6340* locking tool - left during this process but must be somewhat above as shown.

- Install the *EN-6340* locking tool - left (1) into the camshaft adjusters as shown.

Note: The spot type marking (3) on the exhaust camshaft adjuster must correspond to the groove on *EN-6340* locking tool - right.

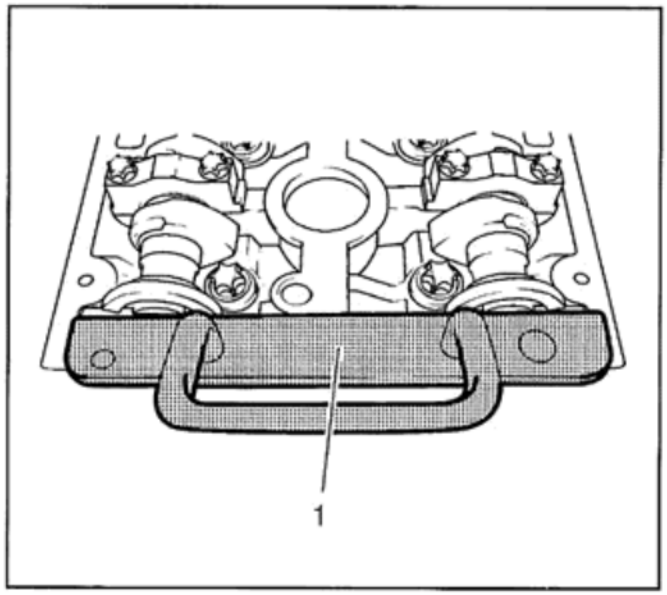
- Install *EN-6340* locking tool - right (2) into the camshaft adjusters as shown.



2026512

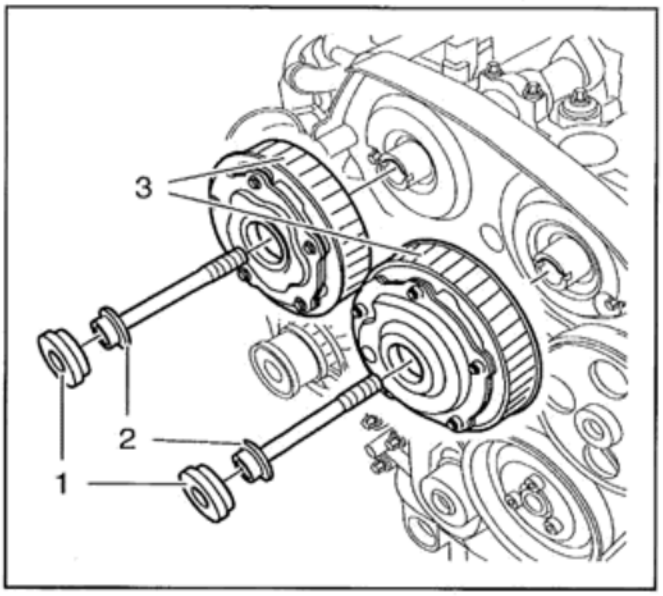
Note: Note the arrows.

3. Turn the camshaft by the hexagon until the groove on the end of the camshafts is horizontal.



2026534

4. Install the *EN-6628-A* locking tool (1).



2026844

5. Remove the camshaft position actuator adjuster closure bolt (1) of the intake camshaft position actuator adjuster and/or the exhaust camshaft position actuator adjuster (3).

Note: A second technician is required.

Note: Use an appropriate open-end wrench in order to counterhold the camshaft hexagon. A thin cross-section wrench is required for a better fit. The usage of *EN-6628-A* locking tool is for the camshaft adjustment to prevent misalignment of the camshafts. The wrench is required to counterhold the camshafts during bolt torque procedure.

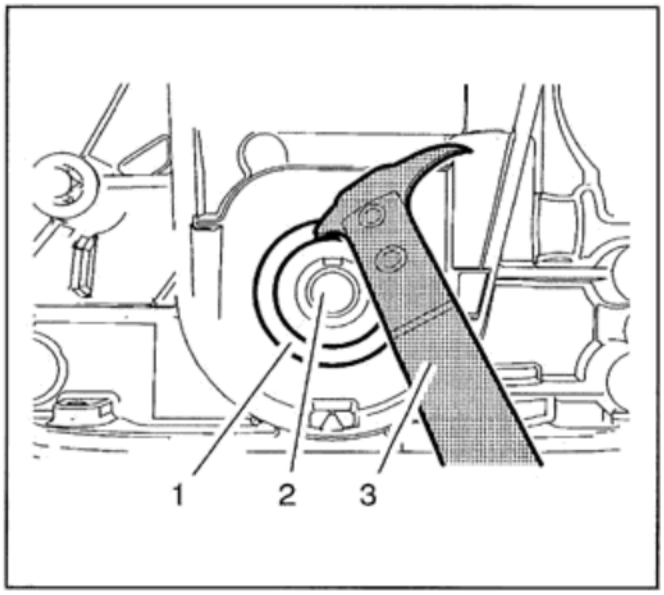
6. Remove and DISCARD the intake camshaft position actuator adjuster bolt and/or the exhaust camshaft position actuator adjuster bolt (2).
7. Remove the intake camshaft position actuator adjuster and/or the exhaust camshaft position actuator adjuster (3).

Crankshaft Front Oil Seal Removal

Special Tools

EN-45000 Remover

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

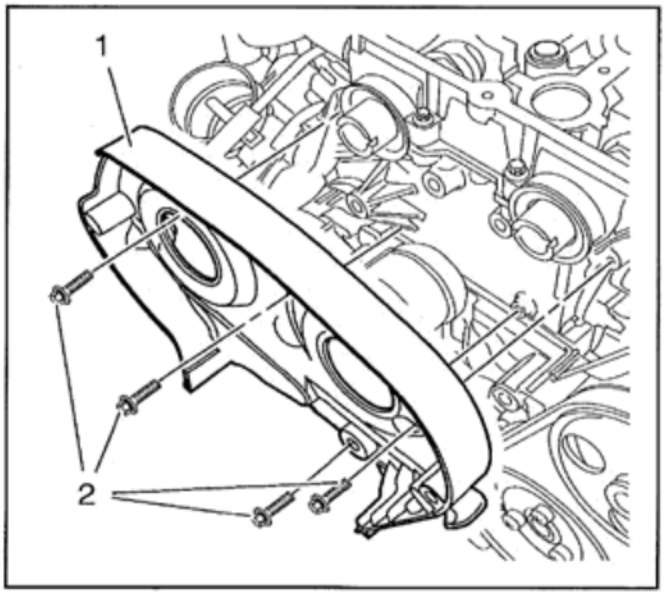


2501418

Caution: Clean the crankshaft sealing surface with a clean, lint-free towel. Inspect lead-in edge of crankshaft for burrs/sharp edges that could damage the rear main oil seal. Remove burrs/sharp edges with crocus cloth before proceeding.

Using the *EN-45000* remover (3), remove the crankshaft front oil seal (1) from the crankshaft (2).

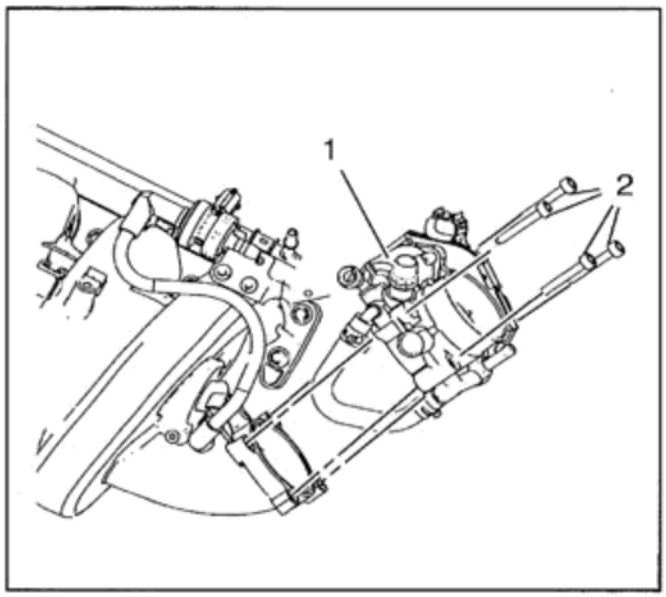
Timing Belt Rear Cover Removal



2026845

1. Remove and DISCARD the 4 timing belt rear cover bolts (2).
2. Remove the timing belt rear cover (1).

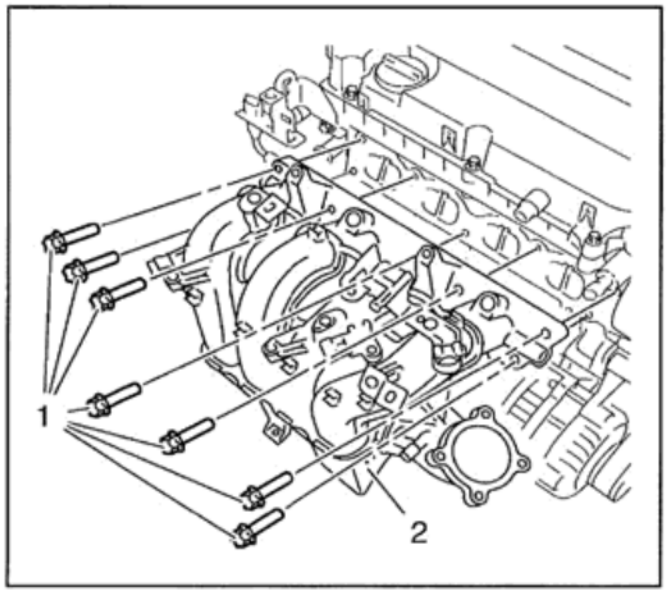
Throttle Body Assembly Removal



2027010

1. Remove the 4 throttle body bolts (2).
2. Remove the throttle body (1).
3. Remove the throttle body seal.

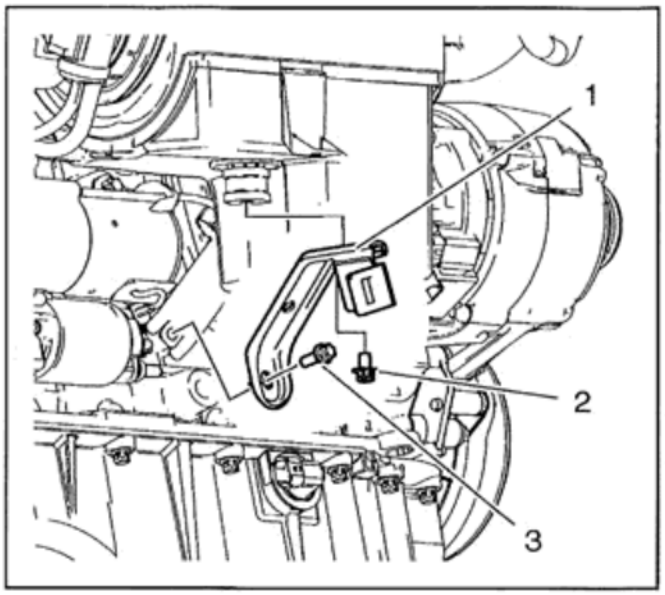
Intake Manifold Removal (1.6L LDE)



2026837

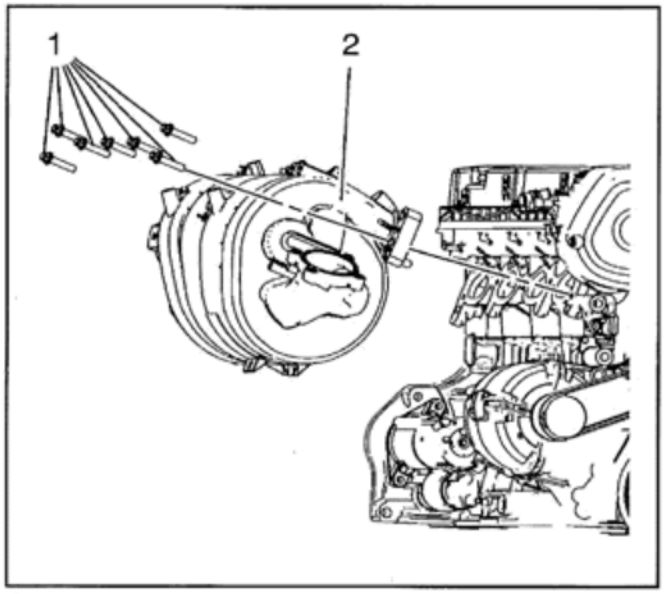
1. Remove the 7 intake manifold bolts (1).
2. Remove the intake manifold (2).
3. Remove the intake manifold gasket.

Intake Manifold Removal (1.8L LUW and LWE)



2026538

1. Remove the 2 intake manifold brace bolts (2, 3).
2. Remove the intake manifold brace (1).

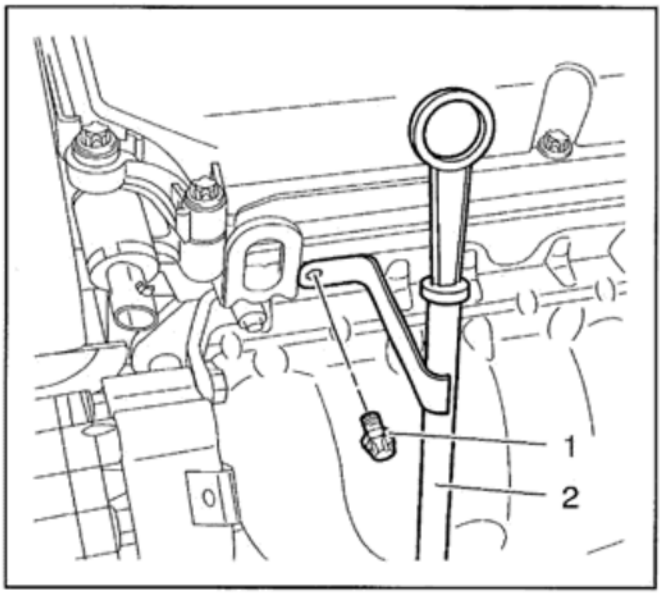


2026541

3. Remove the 7 intake manifold bolts (1).
4. Remove the intake manifold (2) and the 4 intake manifold gaskets.

Oil Level Indicator and Tube Removal

1. Remove the oil dipstick.



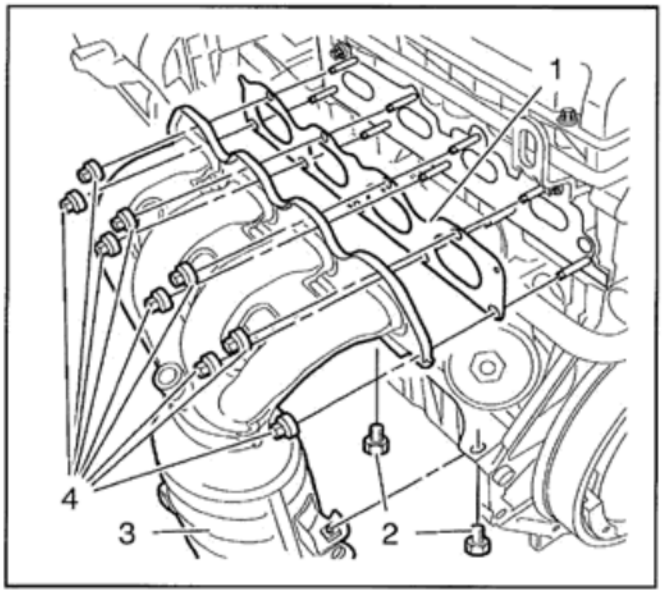
2026827

2. Remove the oil level indicator tube bolt (1).

Note: If the engine oil level is at the maximum level, oil may emerge while removing the oil dipstick guide tube.

3. Remove the oil level indicator tube (2) and oil level indicator seal.

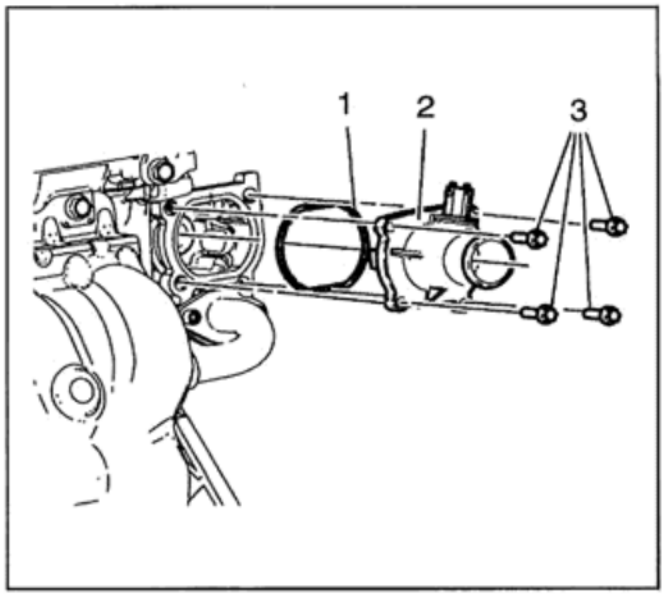
Exhaust Manifold Removal



2026825

1. Remove the 9 exhaust manifold nuts (4).
2. Remove the 2 exhaust manifold bolts (2)
3. Remove the exhaust manifold (3) and gasket (1).
4. Clean all of the gasket surfaces.

Engine Coolant Thermostat Removal

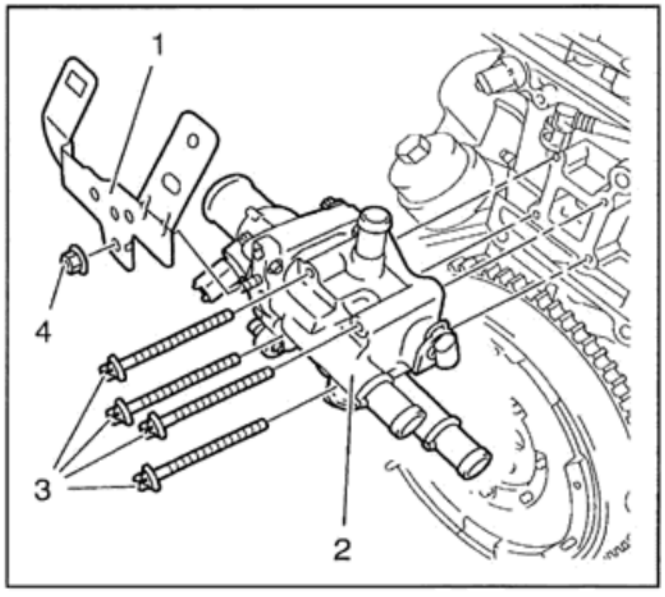


2028006

Caution: Refer to *Engine Coolant Thermostat Housing Caution on page 0-8*.

1. Remove the 4 engine coolant thermostat bolts (3).
2. Remove the engine coolant thermostat assembly (2).
3. Remove the engine coolant seal (1).

Engine Coolant Thermostat Housing Removal

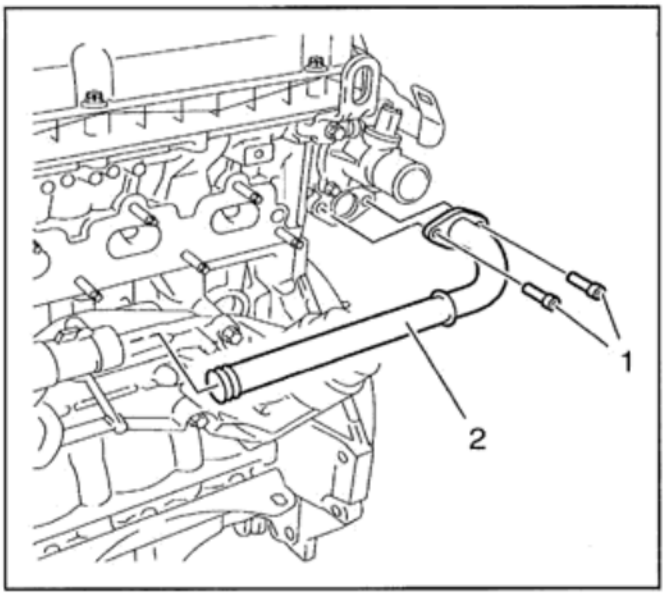


2026832

Caution: Refer to *Engine Coolant Thermostat Housing Caution on page 0-8*.

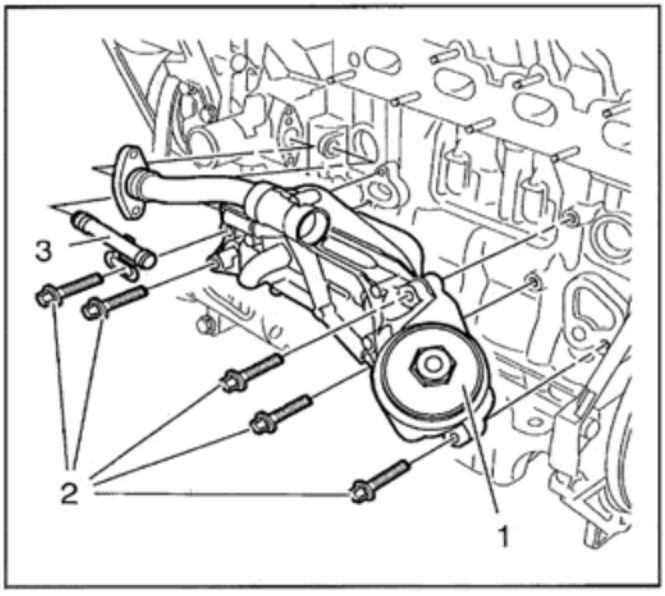
1. Remove the engine coolant thermostat housing retainer nut (4).
2. Remove the engine coolant thermostat housing retainer (1).
3. Remove the 4 engine coolant thermostat housing bolts (3).
4. Remove the engine coolant thermostat housing (2).

Engine Oil Cooler Housing Removal



2026830

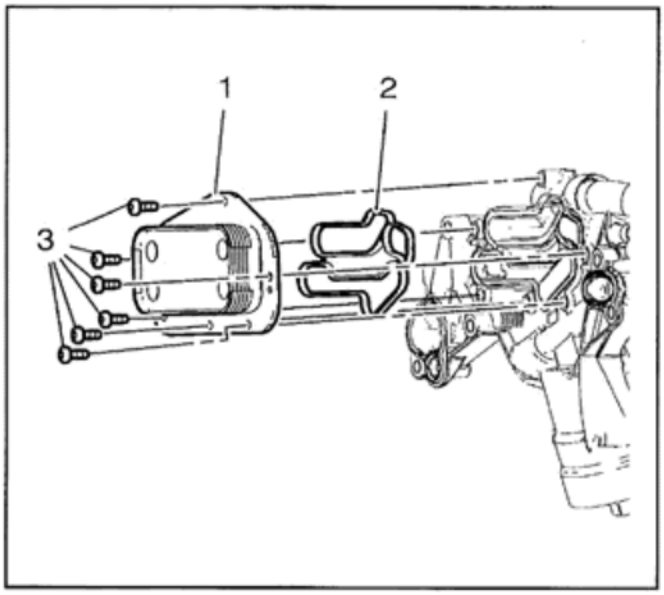
1. Remove the 2 engine oil cooler pipe bolts (1).
2. Remove the oil cooler pipe (2).



2026867

3. Remove the 5 engine oil cooler housing bolts (2).
4. Remove the engine oil cooler housing (1).
5. Remove the engine oil cooler inlet pipe (3).

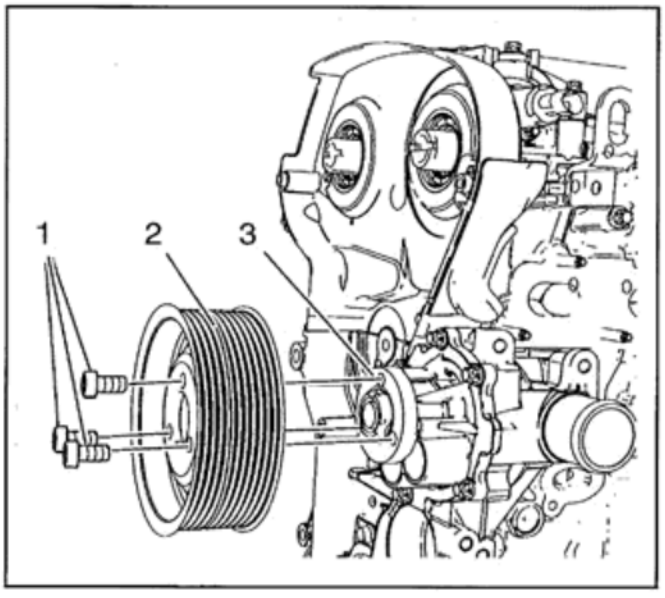
Engine Oil Cooler Removal



2188658

Remove the 6 engine oil cooler bolts (3), the engine oil cooler (1) and the engine oil cooler gasket (2) from the engine oil cooler housing.

Water Pump Pulley Removal

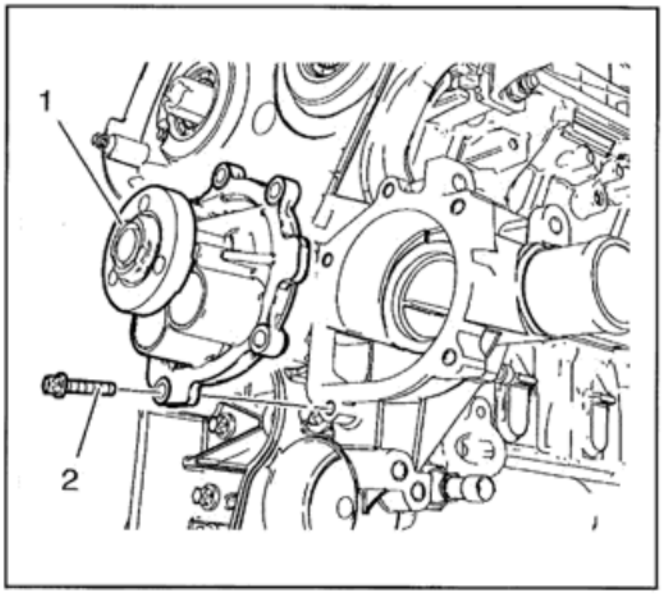


2026887

Note: Counterhold the crankshaft balancer. For this procedure the drive belt has to be installed.

1. Loosen the 3 water pump pulley bolts (1).
2. Remove the 3 water pump pulley bolts (1).
3. Remove the water pump pulley (2) from the water pump (3).

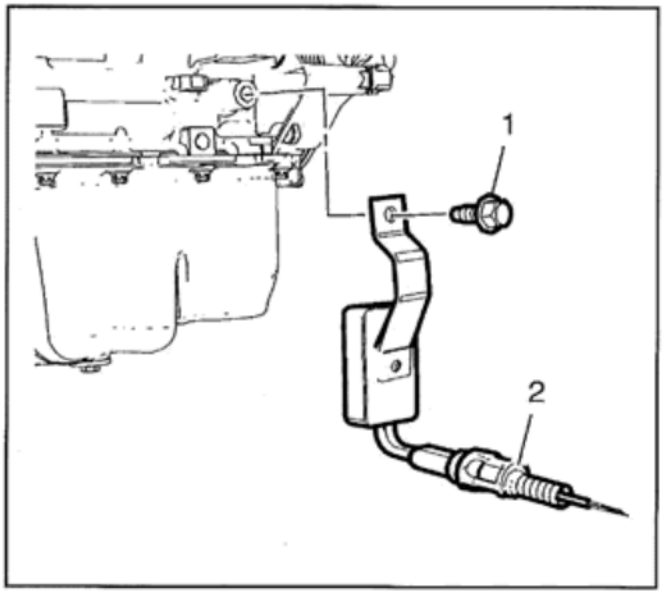
Water Pump Removal



2026886

1. Remove the 5 water pump bolts (2).
2. Remove the water pump (1).
3. Remove the water pump seal.

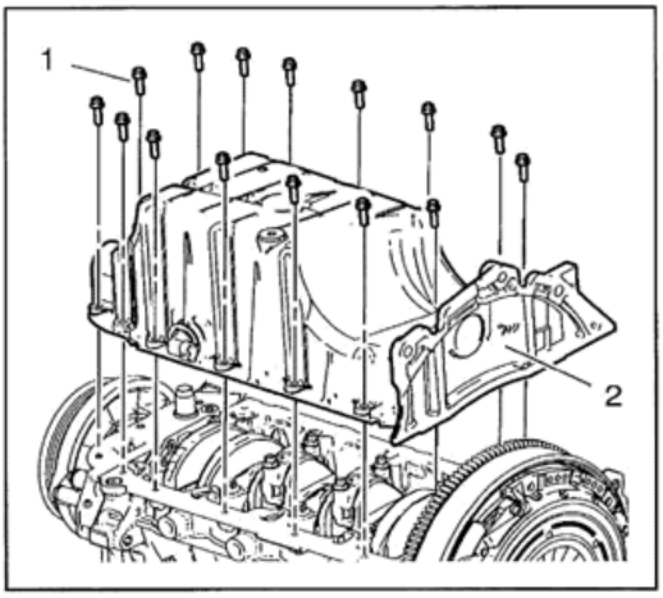
Engine Oil Heater Removal



2372985

1. Remove the engine oil heater bolt (1).
2. Remove the engine oil heater (2).

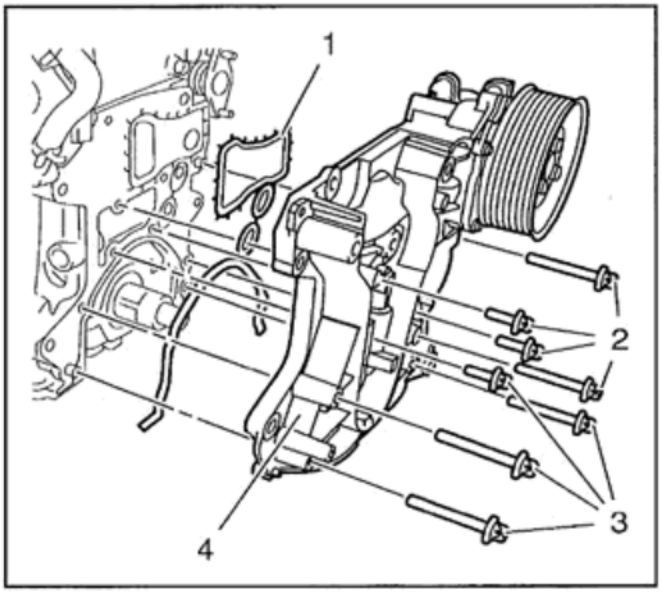
Oil Pan Removal



2027008

1. Remove the 15 oil pan bolts (1) from the engine block.
2. Use a suitable tool to remove the oil pan (2) evenly all the way around.

Engine Front Cover and Oil Pump Removal



2026848

Note: Note the different screw lengths.

1. Remove the 8 bolts (2, 3).
2. Remove the engine front cover with the included oil pump (4).
3. Remove the gasket (1).

Note: Do not damage the sealing surfaces.

4. Clean the sealing surface.

Ignition Coil Removal

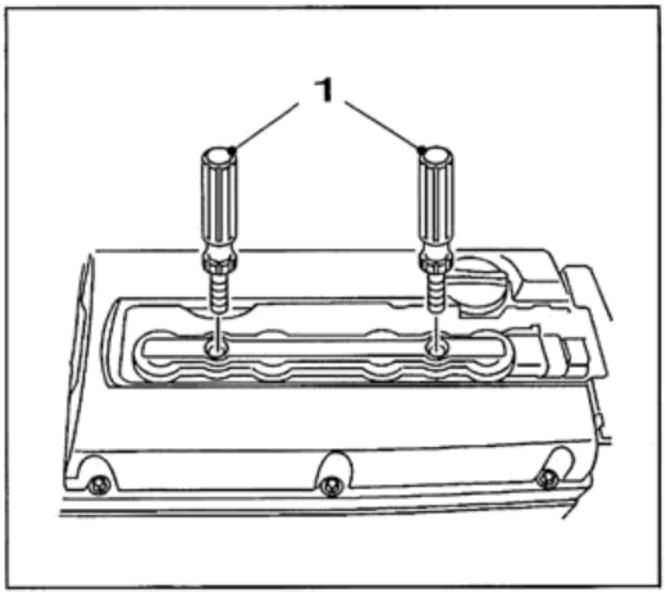
Special Tools

EN-6009 Remover/Installer Ignition Module

For equivalent regional tools, refer to *Special Tools on page 9-1135.*

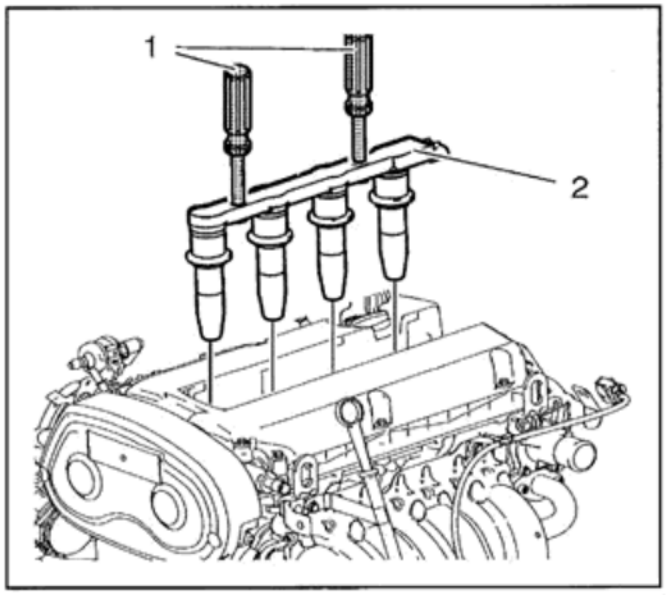
Note: Note the arrow on the cover.

1. Remove the cover of the DIS ignition coil in the direction of the arrow.
2. Remove the 2 ignition coil bolts.



1936914

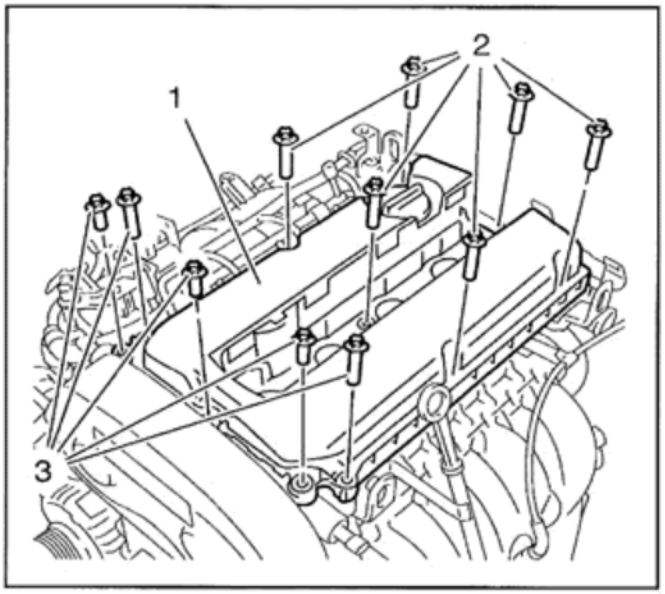
3. Install the *EN-6009* remover/installer (1).



2026537

4. Remove the ignition coil module (2) with the *EN-6009* remover/installer (1).

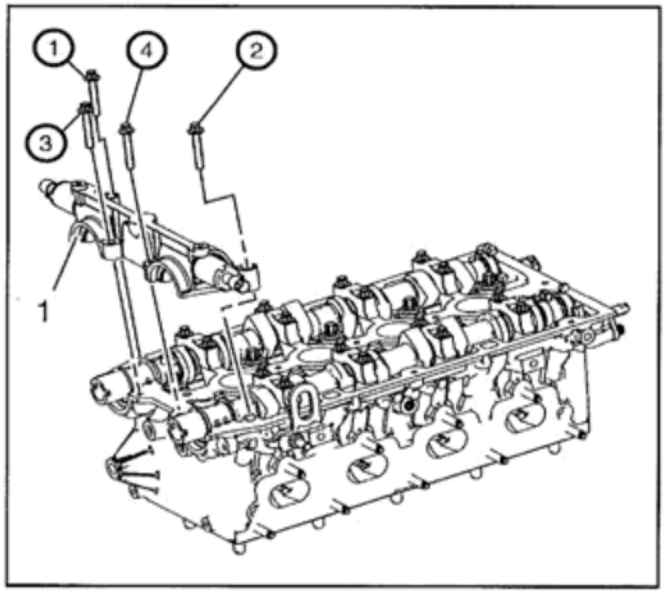
Camshaft Cover Removal



2026821

1. Remove the 11 bolts (2, 3).
2. Remove the camshaft cover (1).

Camshaft Removal



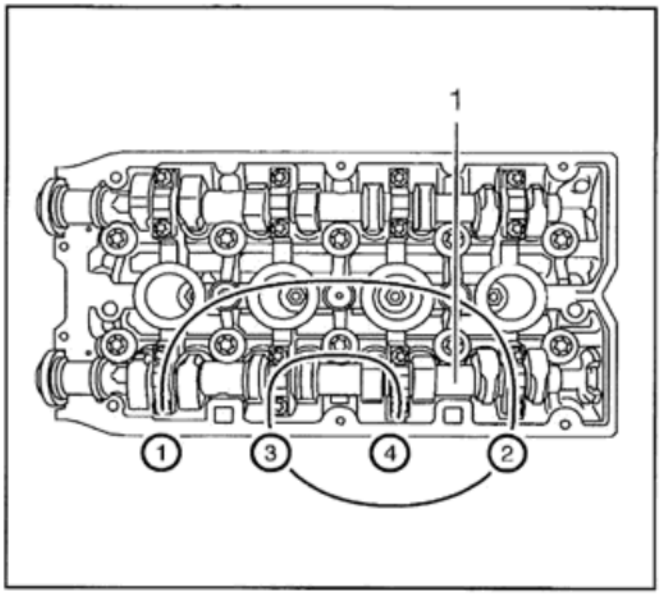
2026542

Note: Note removal sequence 1–4.

1. Remove the 4 camshaft bearing cap bolts.

Note: Release the bearing support by striking it gently with a plastic hammer.

2. Remove the first camshaft bearing cap (1).

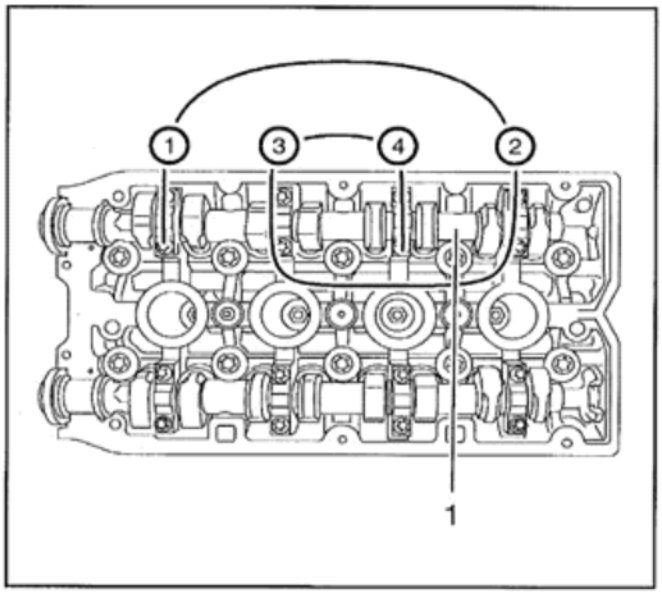


2027653

3. Loosen the 8 exhaust camshaft bearing cap bolts working from outside to inside in a spiral in steps of 1/2 up to 1 turn.
4. Remove the 8 exhaust camshaft bearing cap bolts.

Note: Mark camshaft bearing caps before removal.

5. Remove the 4 exhaust camshaft bearing caps numbers 6–9 from the cylinder head.
6. Remove the exhaust camshaft (1).



2027651

7. Loosen the 8 intake camshaft bearing cap bolts working from outside to inside in a spiral in steps of 1/2 up to 1 turn.
8. Remove the 8 intake camshaft bearing cap bolts.

Note: Mark camshaft bearing caps before removal.

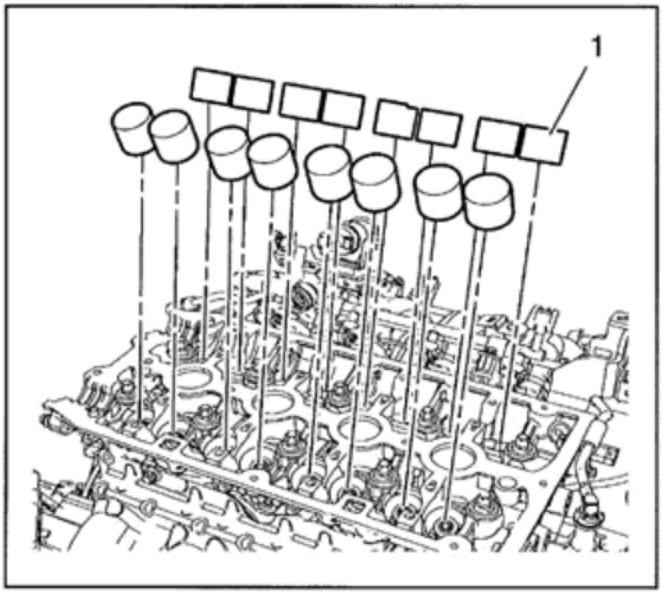
9. Remove the 4 intake camshaft bearing caps numbers 2–5 from the cylinder head.
10. Remove the intake camshaft (1).
11. Remove the camshaft seal rings.

Valve Lifter Removal

Special Tools

EN-845 Suction Device

For equivalent regional tools, refer to *Special Tools on page 9-1135.*

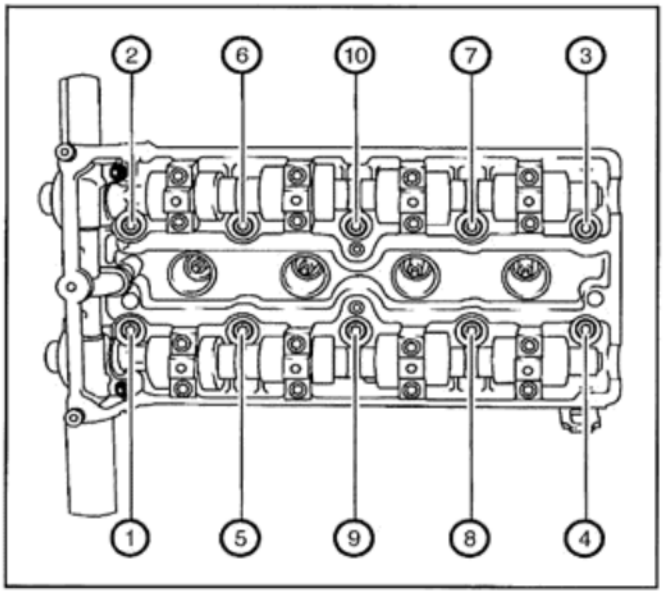


2028318

Note: Mark the locations.

Remove the 16 valve lifter (1) use the *EN-845* suction device.

Cylinder Head Removal

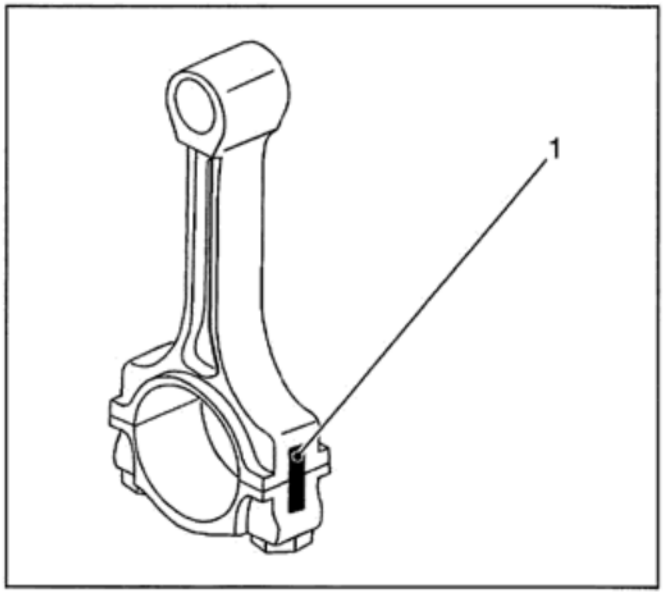


2027932

1. Remove the 10 cylinder head bolts in sequence as shown.
   1.1. Loosen the 10 bolts **90°**.
   1.2. Loosen the 10 bolts **180°**.
2. Remove the cylinder head and place on a suitable base.
3. Remove the cylinder head gasket.

Piston, Connecting Rod, and Bearing Removal

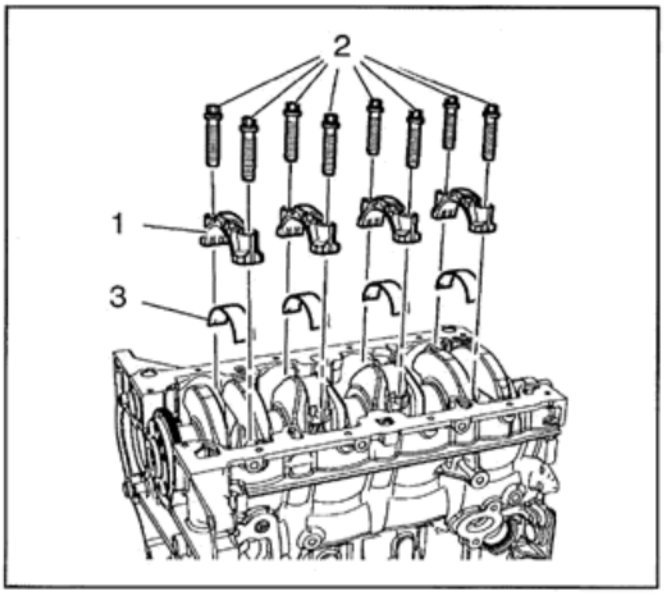
1. Install the crankshaft balancer bolt.
2. Set the pistons 1 and 4 to TDC in direction of engine rotation.



1948709

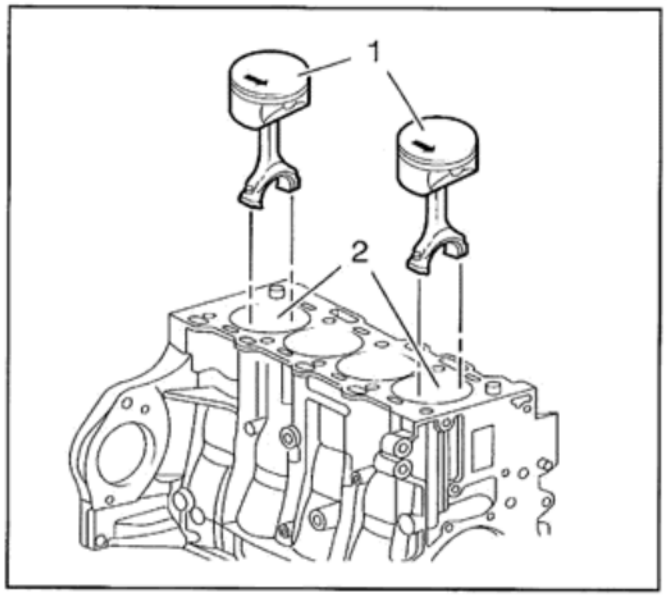
Note: Note cylinder sequence.

3. Mark the connecting rod with the connecting rod bearing cover (1).



2028299

4. Remove the 4 connecting rod bearing caps bolts (2) of cylinder 1 and 4.
5. Remove the connecting rod bearing caps (1) and the connecting rod bearing (3).

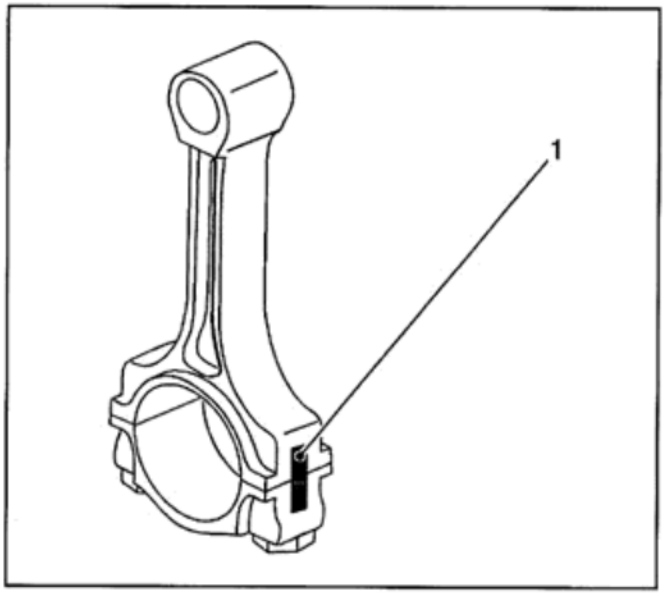


2028300

6. Push the pistons 1 and 4 (1) out of the cylinder bore (2).

Note: The shear surfaces of the con-rod and the con-rod bearing cover form a unique fit and must not be swapped or damaged. Do not lay down on the shear surfaces.

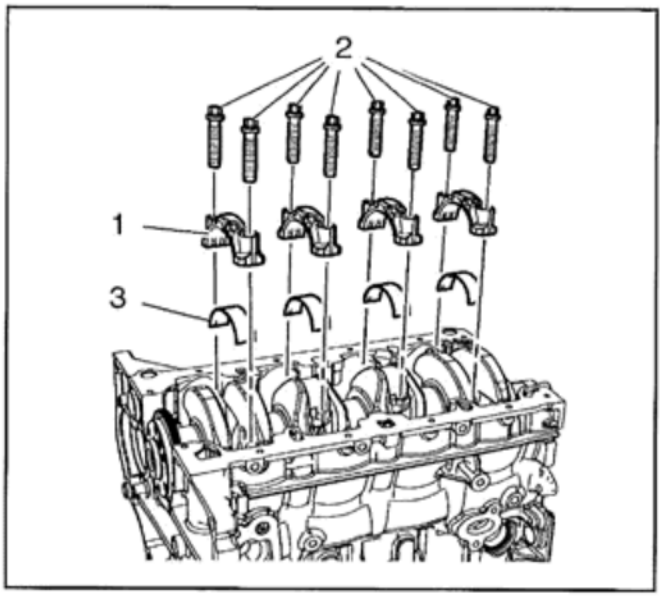
7. Remove the pistons 1 and 4 (1).
8. Turn crankshaft on crankshaft balancer through 180° in direction of rotation of engine.



1948709

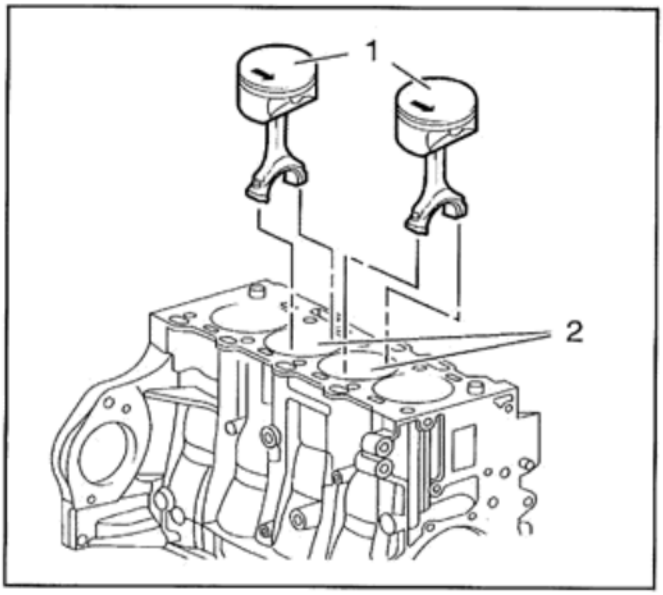
Note: Note cylinder sequence.

9. Mark the connecting rod with the connecting rod bearing cover (1).



2028299

10. Remove the 4 connecting rod bearing caps bolts (2) of cylinder 2 and 3.
11. Remove the connecting rod bearing caps (1) and the connecting rod bearing (3).

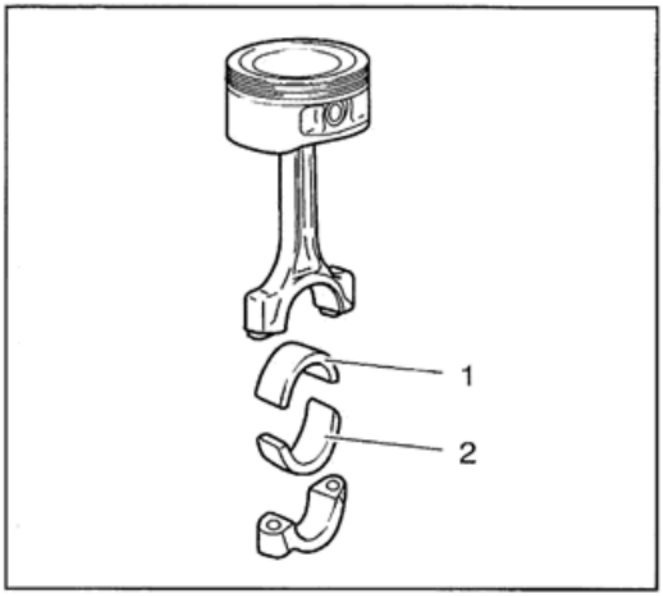


2028301

12. Push the pistons 2 and 3 (1) out of the cylinder bore (2).

Note: The shear surfaces of the con-rod and the con-rod bearing cover form a unique fit and must not be swapped or damaged. Do not lay down on the shear surfaces.

13. Remove the pistons 2 and 3 (1).

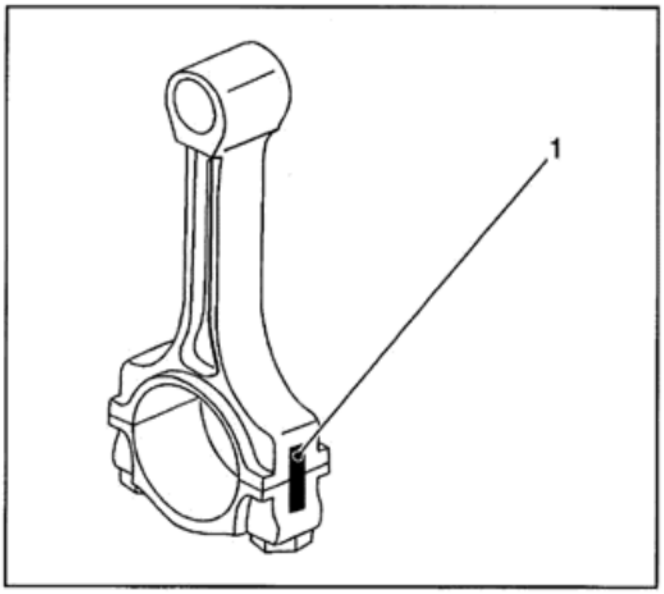


2028302

Note: Observe correct fitting position, observe alignment.

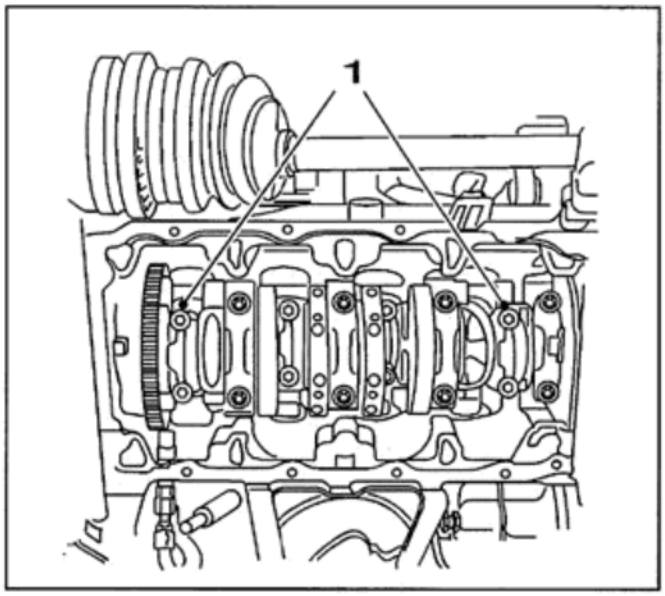
14. Remove the connecting rod bearing (1, 2).
15. Check the components. Refer to *Piston, Connecting Rod, and Bearing Cleaning and Inspection on page 9-1097*.

Crankshaft and Bearing Removal



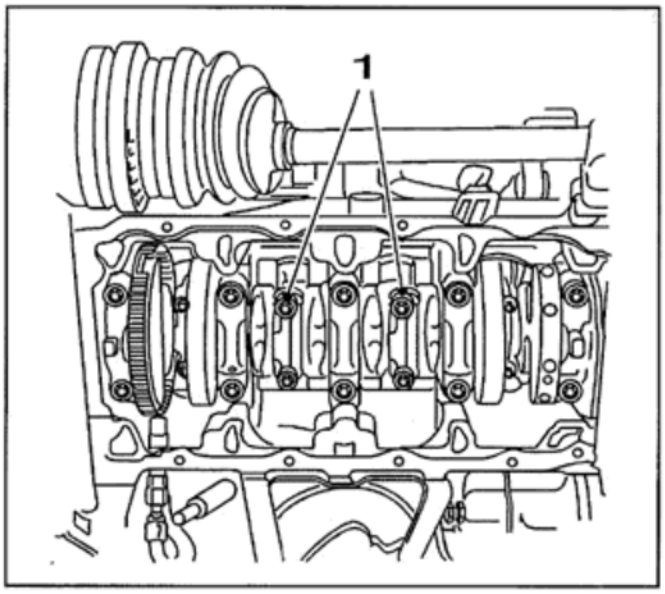
1948709

1. Identify all the connecting rod bearing caps (1).



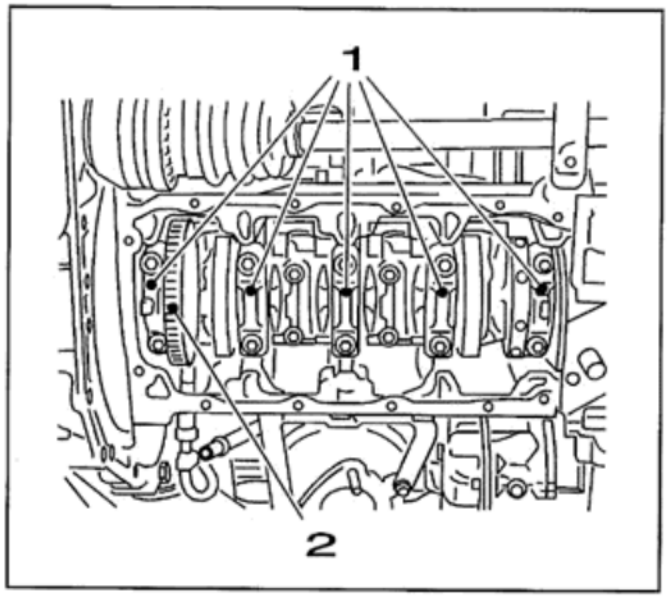
1937053

2. Remove the 4 bolts.
3. Remove the connecting rod bearing caps 1 and 4 (1).
4. Turn the crankshaft through 180°.



1937048

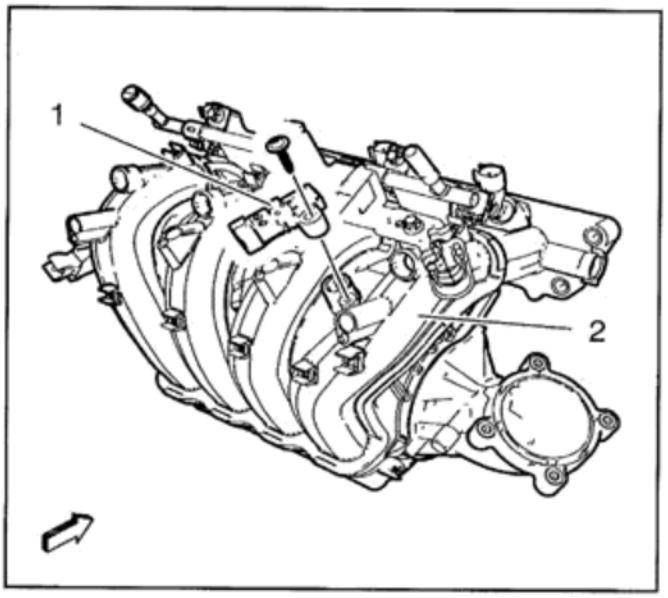
5. Remove the 4 bolts.
6. Remove the connecting rod bearing caps 2 and 3 (1).
7. Identify the crankshaft bearing caps.



1937120

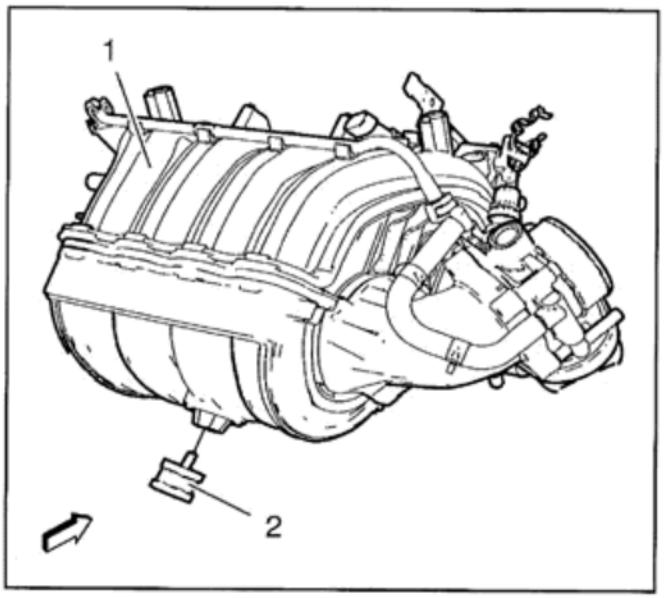
8. Remove the crankshaft bearing caps (1).
9. Remove the 10 bolts.
10. Remove the crankshaft (2).
11. Remove the crankshaft bearing clips.

Intake Manifold Disassemble (1.6L LDE)



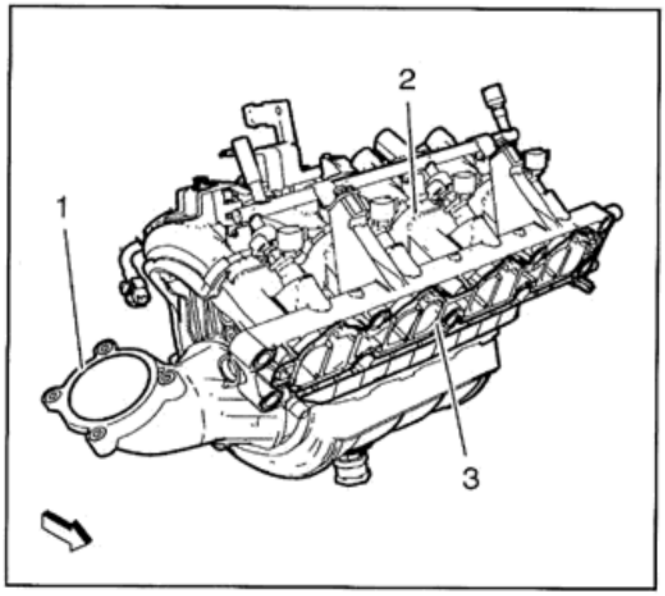
2028179

1. Remove the intake manifold absolute pressure sensor bolt.
2. Remove the manifold absolute pressure sensor (1) from the intake manifold (2).



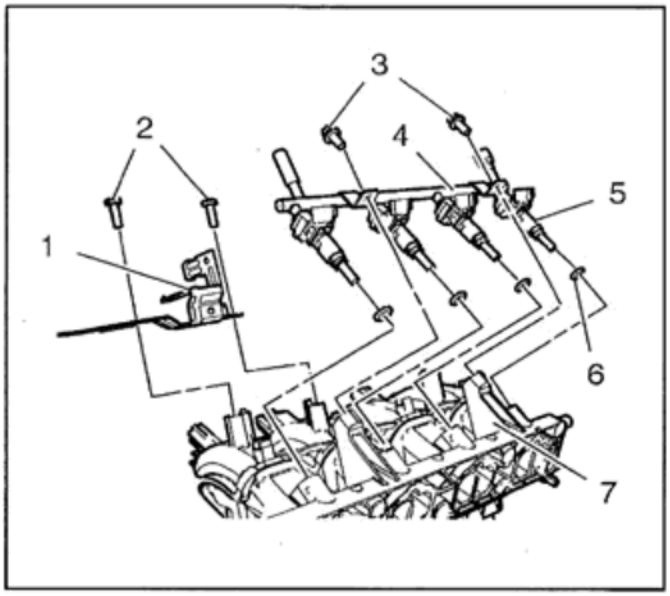
2028187

3. Remove the intake manifold mount (2) from the intake manifold (1).



2028190

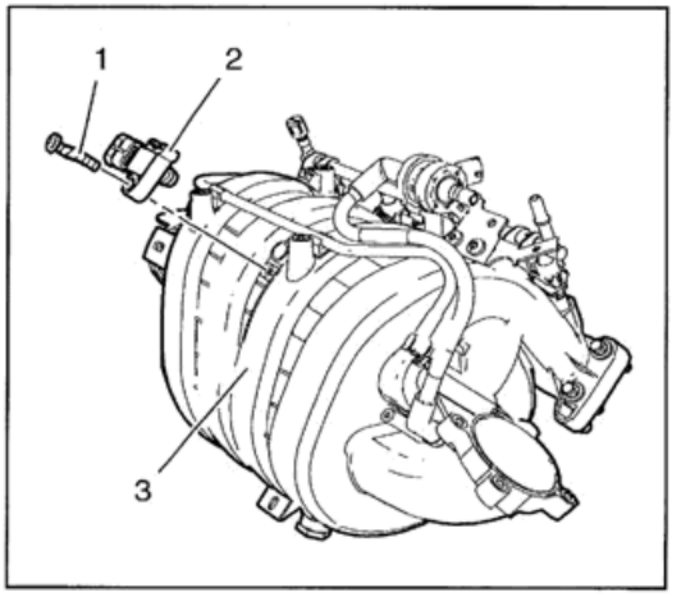
4. Remove the throttle body seal (1).
5. Remove the intake manifold seal (3) from the intake manifold (2).



2028209

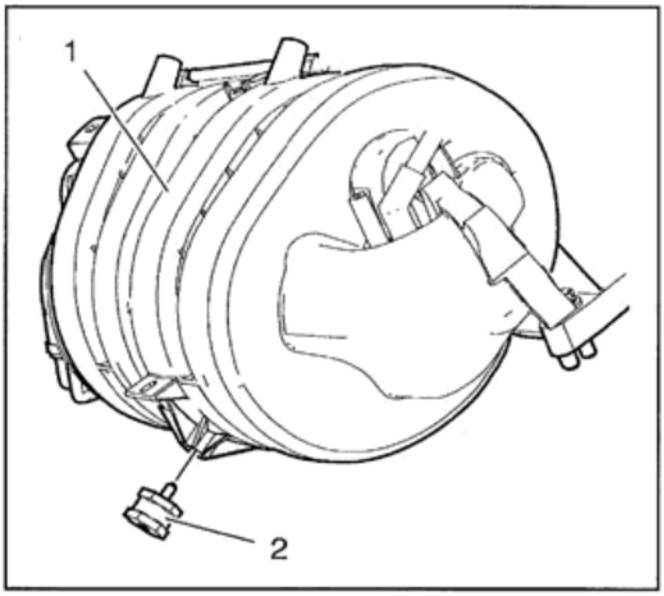
6. Remove the 2 evaporative emission canister purge solenoid valve bracket bolts (2).
7. Remove the evaporative emission canister purge solenoid valve bracket (1) from the intake manifold (7).
8. Remove the 2 multiport fuel injection fuel rail bolts (3).
9. Remove the multiport fuel injection fuel rail (4) and the fuel injectors (5) from the intake manifold (7).
10. Remove the 4 multiport fuel injector seals (6).

Intake Manifold Disassemble (1.8L LUW and LWE)



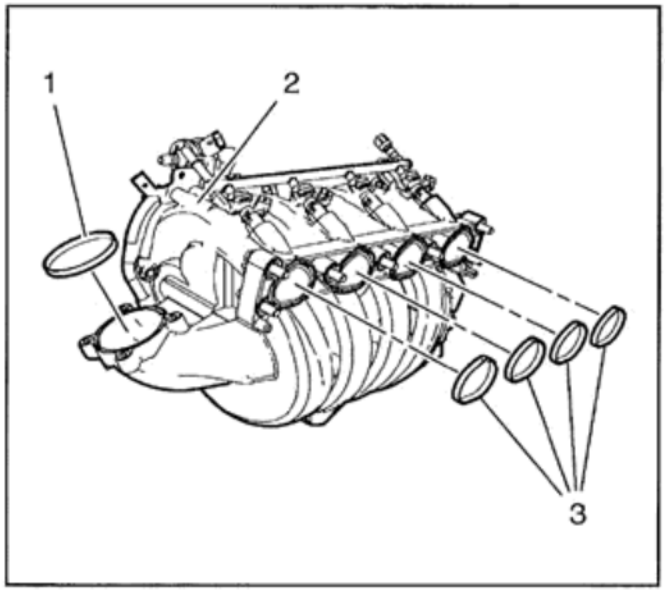
2189143

1. Remove the intake manifold absolute pressure sensor bolt (1).
2. Remove the manifold absolute pressure sensor (2) from the intake manifold (3).



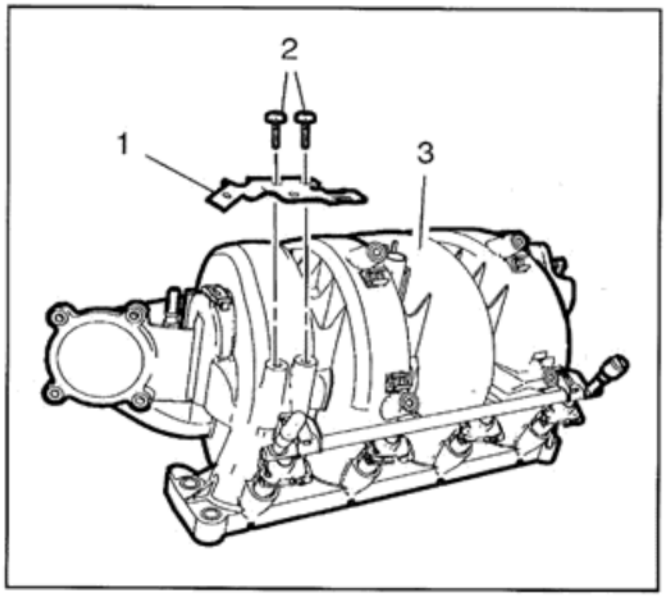
2189144

3. Remove the intake manifold mount (2) from the intake manifold (1).



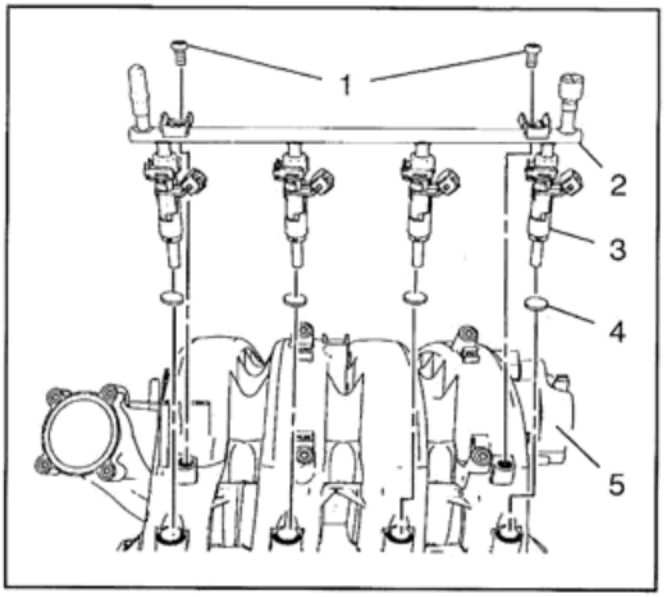
2189145

4. Remove the throttle body seal (1).
5. Remove the intake manifold seal (3) from the intake manifold (2).



2373076

6. Remove the 2 evaporative emission canister purge solenoid valve bracket bolts (2).
7. Remove the evaporative emission canister purge solenoid valve bracket (1) from the intake manifold (3).



2373077

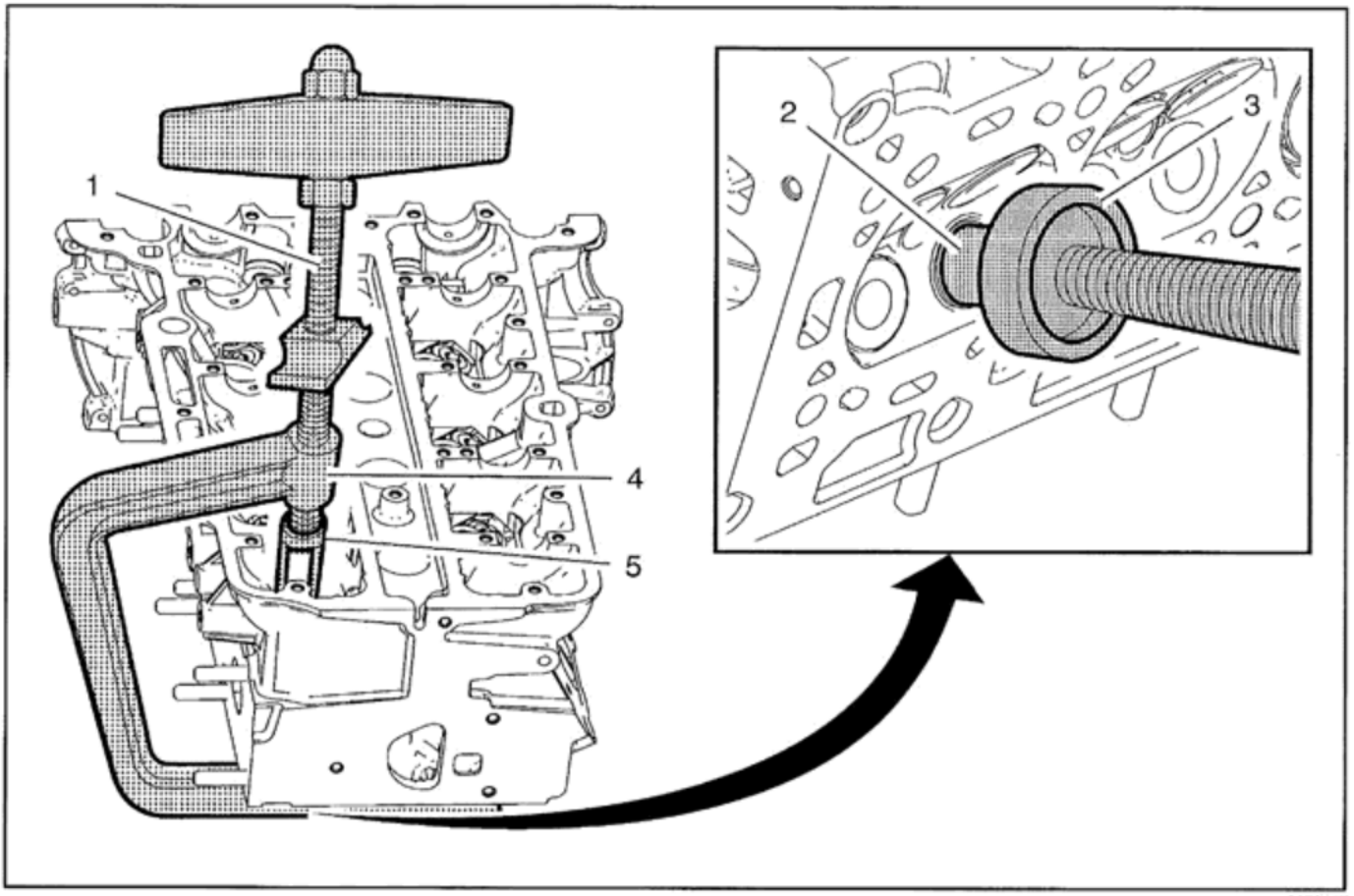
8. Remove the 2 multiport fuel injection fuel rail bolts (1).
9. Remove the multiport fuel injection fuel rail (2) and the fuel injectors (3) from the intake manifold (5).
10. Remove the 4 multiport fuel injector seals (4).

Cylinder Head Disassemble

Special Tools

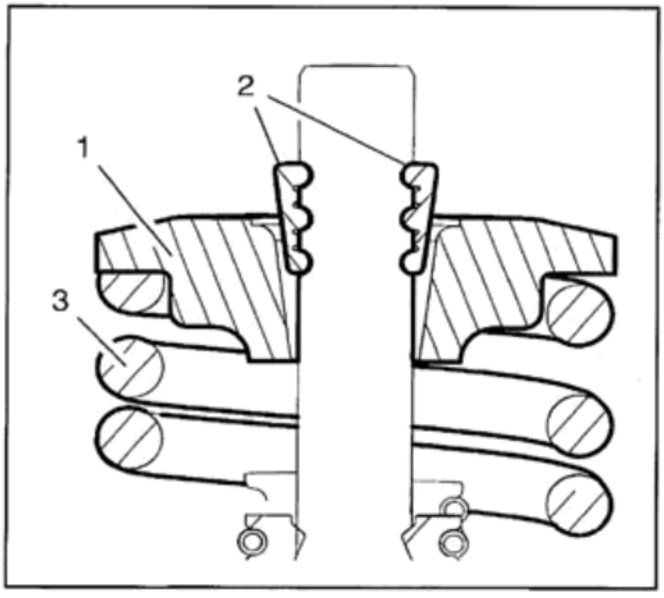
- *EN-840* Pliers/Remover
- *EN-8062* Valve Spring Compressor
- *EN-8062-5* Adapter
- *EN-50717-2* Compressor Assembly of *EN-50717* Kit

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2678147

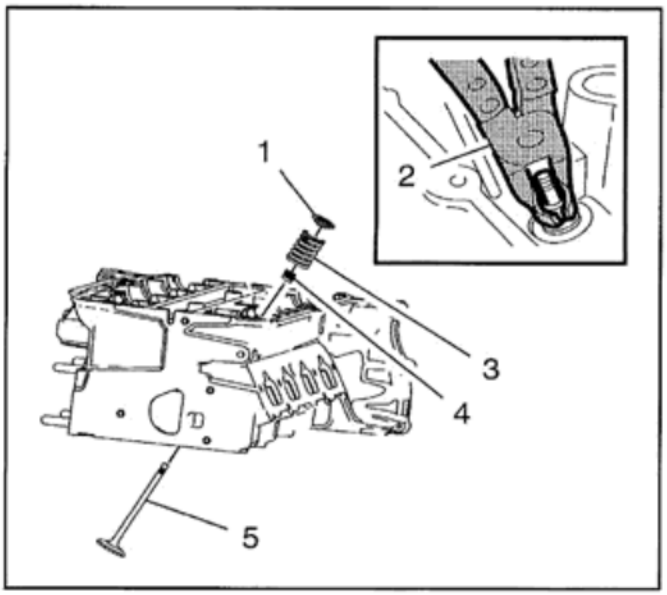
1. Install the *EN-50717–2* assembly (1) to the *EN-8062* compressor (4).
2. Install the *EN-8062–5* adapter (3) to the *EN-8062* compressor.
3. Install the compressor assembly to the cylinder head, so that the adapter (5) of the *EN-50717–2* assembly (1) contacts the valve spring retainer properly and the *EN-8062–5* adapter (3) contacts the valve disc (2). Prefix the *EN-8062* compressor (4).



2678153

Warning: Valve springs can be tightly compressed. Use care when removing the retainers and plugs. Personal injury could result.

4. Apply pressure to the *EN-50717–2* assembly to push down the vale spring retainer (1) and compress the valve spring (3) until the valve keys (2) are free from tension. Carefully remove the valve keys.



2678154

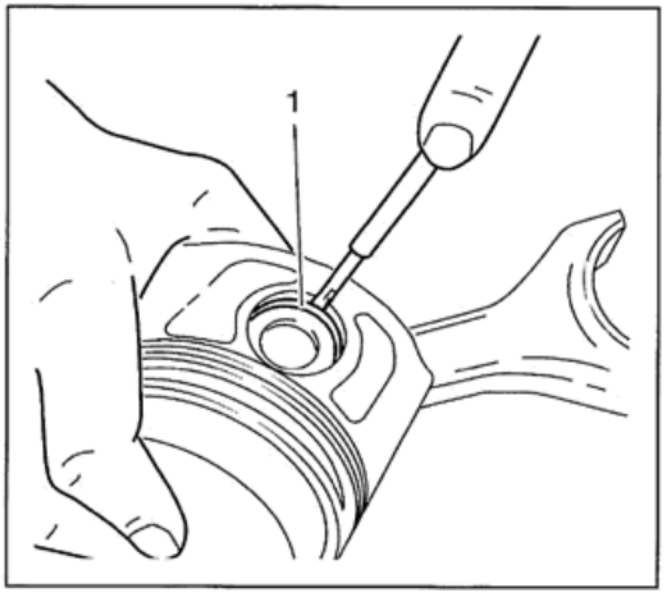
5. Slowly and carefully loosen the *EN-50717–2* assembly until the valve spring is entirely expanded.
6. Remove the compressor assembly from the cylinder head.
7. Remove the valve spring retainer (1) and the valve spring (3).
8. Remove and DISCARD the valve stem oil seal (4), using the *EN-840* pliers (2).
9. Remove the valve (5).

Note: Ensure that the valve train components are kept together and identified in order for proper installation in their original position.

10. Repeat the procedure with the remaining valves.
11. In case of re-using the cylinder head, refer to *Cylinder Head Cleaning and Inspection on page 9-1096*.

Piston and Connecting Rod Disassemble

1. Remove the piston with connection rod. Refer to *Piston, Connecting Rod, and Bearing Removal on page 9-1085*.



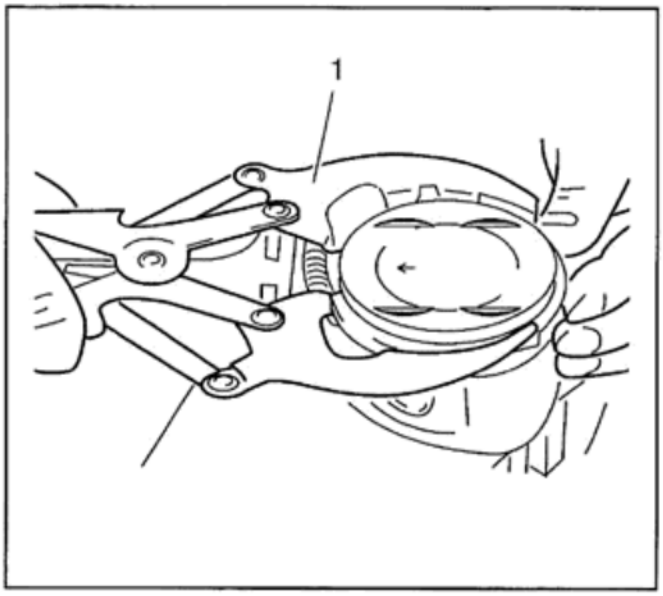
2026856

Note: Note installation position of the piston in respect of the connection rod.

2. Detach the piston from the connection rod.

Note: Do not damage the bore.

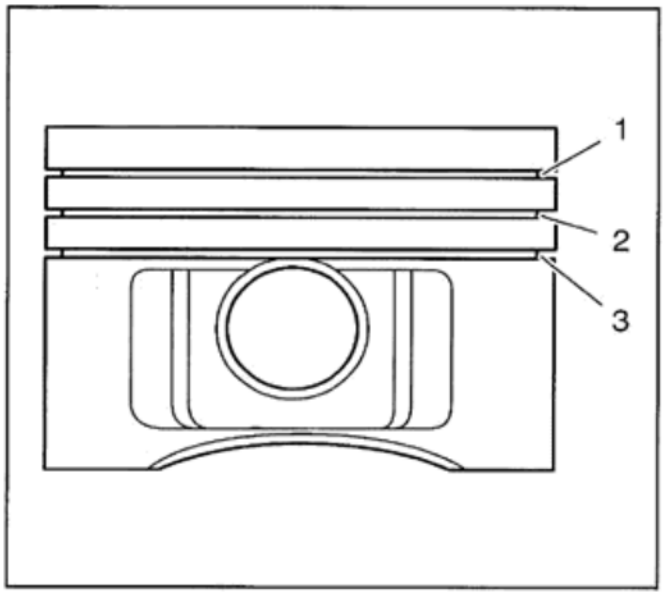
3. Remove the retainer (1) from the piston eye.
4. Press the piston pin out of the piston.



2026859

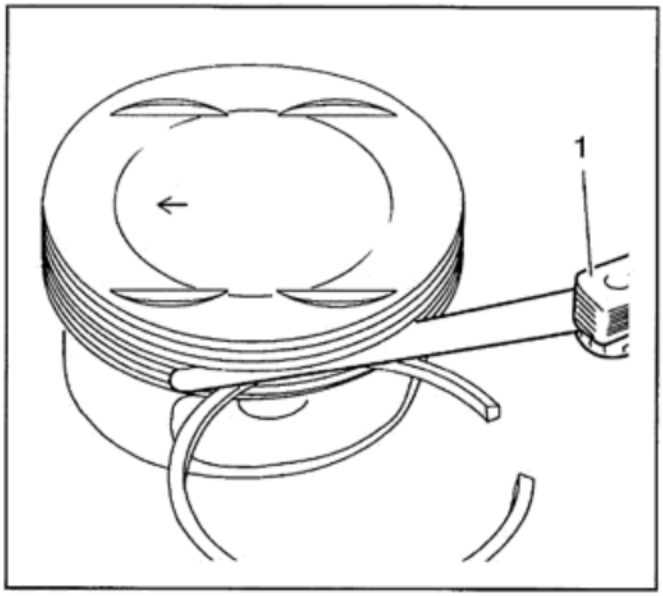
5. Remove the piston rings, using piston ring pliers (1).

   Remove oil carbon from the groove with a split piston ring, filed to a wedge-shape.



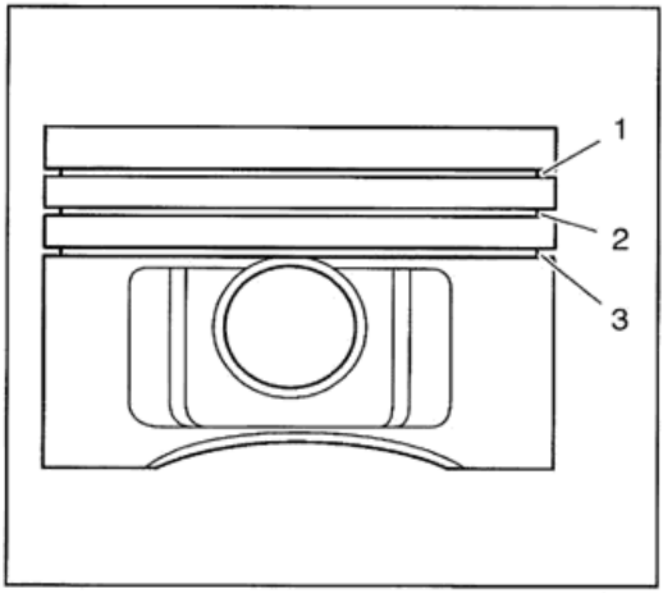
2026860

6. Measure the piston ring gap.
   - Tension the piston ring in the cylinder and measure the gap with a feeler gauge.
   - Permissible ring gap:
     – Rectangular compression ring (1): 0.20-0.40 mm (0.007-0.015 in)
     – Tapered compression ring (2): 0.40-0.60 mm (0.015-0.023 in)
     – Oil scraper ring (3): 0.25-0.75 mm (0.009-0.029 in)



2026857

7. Check piston ring vertical play with a feeler gauge (1) in the piston ring groove.

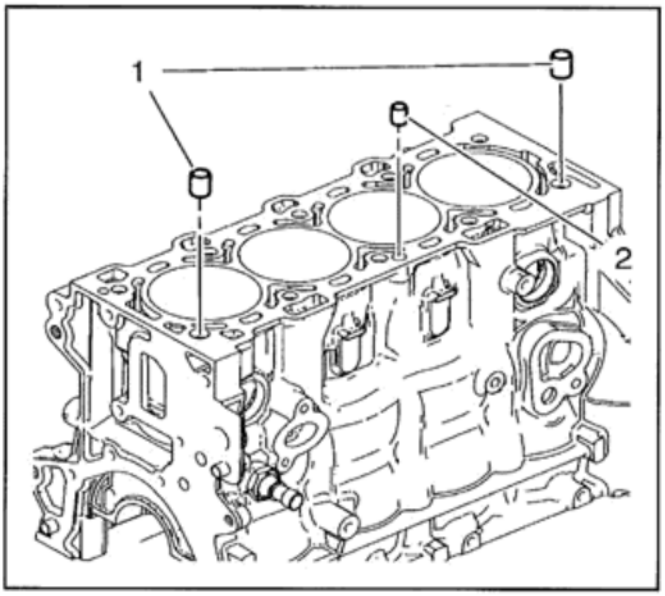


2026860

Permissible vertical play:

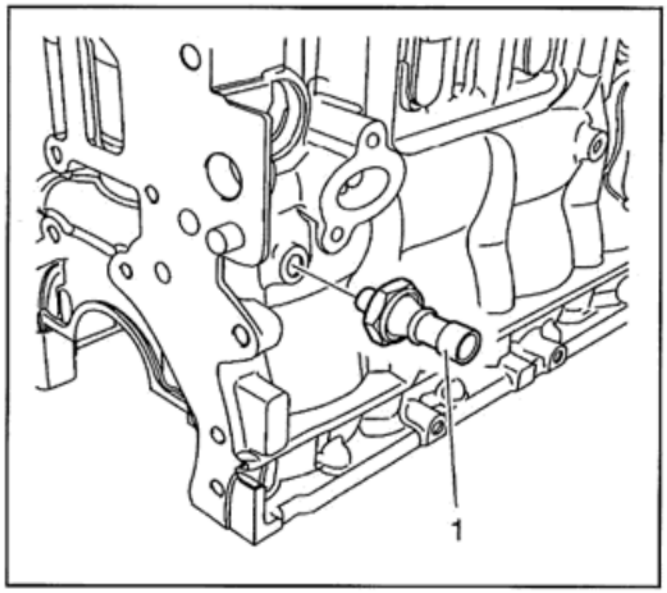
- Rectangular compression ring (1): 0.04-0.08 mm (0.001-0.003 in)
- Tapered compression ring (2): 0.03-0.07 mm (0.001-0.002 in)
- Oil scraper ring (3): 0.03-0.13 mm (0.001-0.005 in)

Engine Block Disassemble



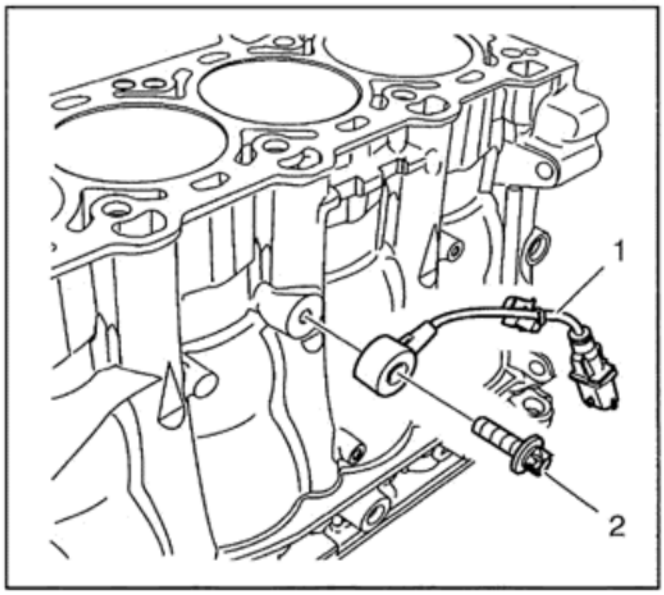
2026868

1. Remove the cylinder head locating (1, 2).



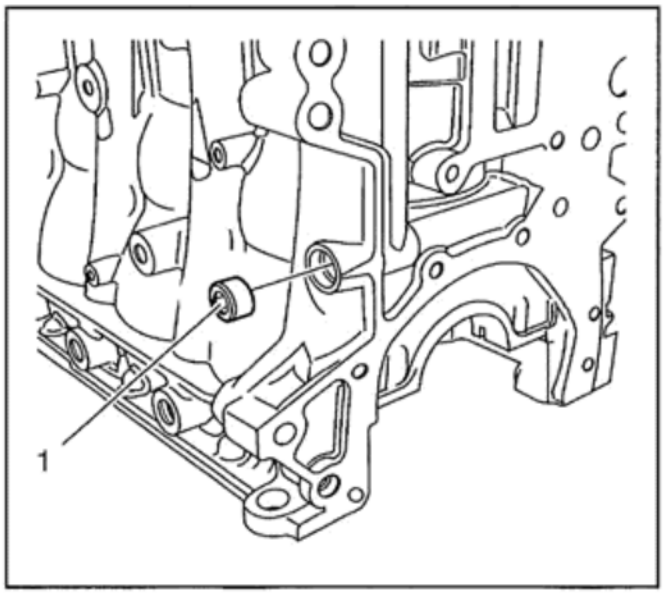
2026870

2. Remove the oil pressure switch (1).



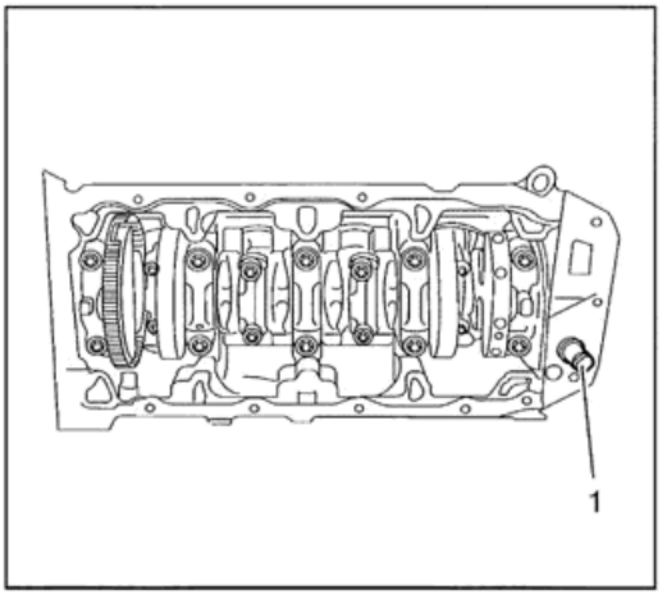
2026869

3. Remove the knock sensor bolt (2) and the knock sensor (1).
4. Clean the thread.



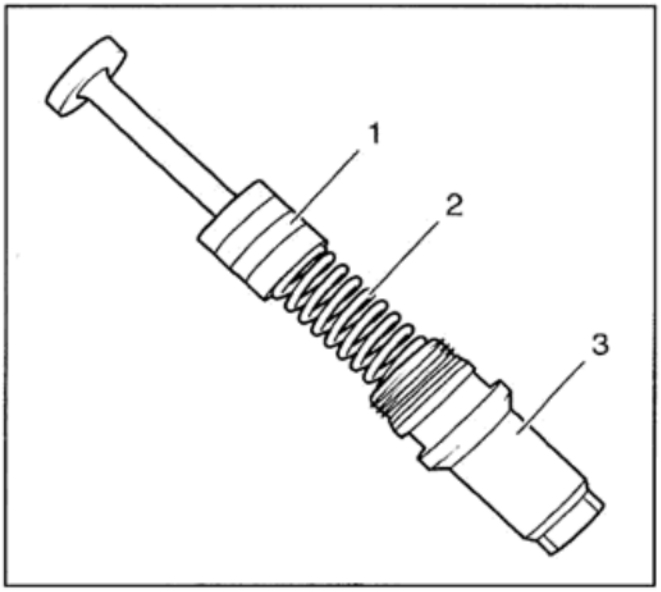
2026901

5. Remove the oil flow check valve (1).



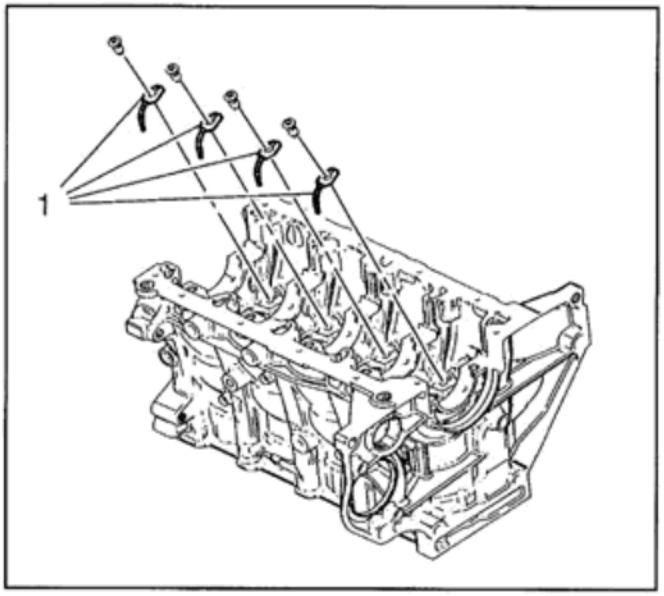
2026539

6. Remove the oil pressure relief valve closure bolt (1) and the oil pressure relief valve.



2026540

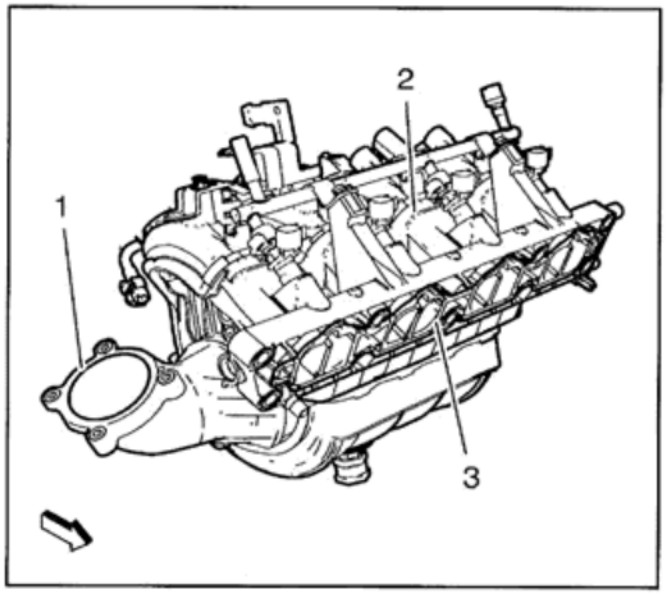
7. Remove the piston (1) and spring (2) from the oil pressure relief valve closure bolt (3).
8. Clean and inspect the components. Refer to *Engine Block Cleaning and Inspection on page 9-1101*.
9. Clean the thread.



2026902

10. Remove the 4 piston oil nozzles (1).

Intake Manifold Cleaning and Inspection



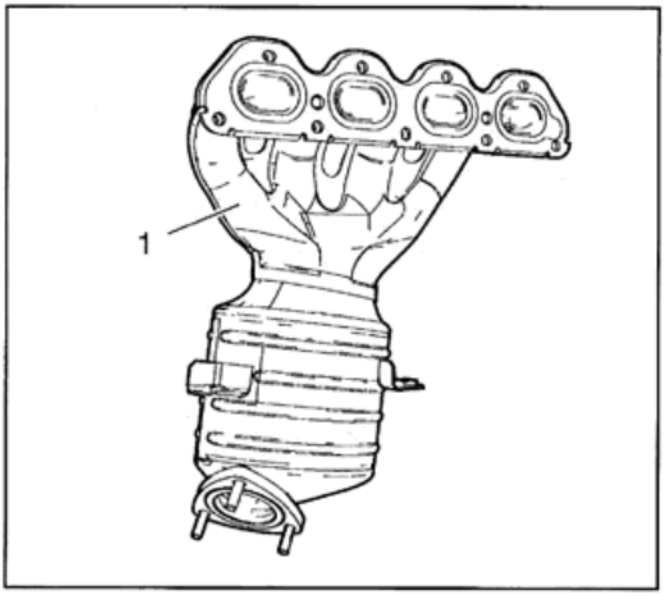
2028190

1. Clean the intake manifold mating surfaces.
2. Inspect the intake manifold (2) for damage.
3. Inspect the intake manifold for cracks near metallic inserts.
4. Inspect the crankcase ventilation passages in the intake manifold face for blockage.

Warning: Wear safety glasses in order to avoid eye damage.

5. Clean the crankcase ventilation passages with compressed air if necessary. Use a maximum of 172 kPa (25 psi) of air pressure.
6. Clean the throttle body sealing surface (1).
7. Clean the intake manifold to cylinder head sealing surface (3).
8. Replace the intake manifold as necessary.

Exhaust Manifold Cleaning and Inspection



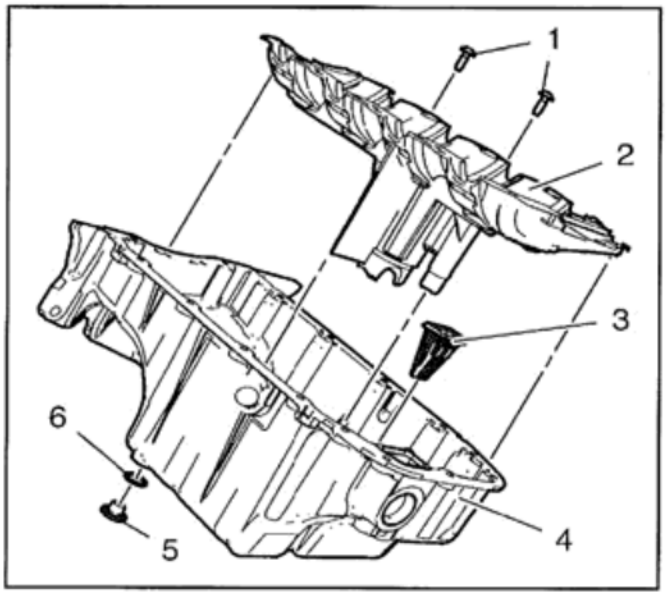
2028210

1. Clean the exhaust manifold (1) in solvent.

Warning: Wear safety glasses in order to avoid eye damage.

2. Dry the exhaust manifold (1) with compressed air.
3. An exhaust manifold leak or damage may cause an exhaust leak and may effect OBD II system performance. A damaged exhaust must be replaced.

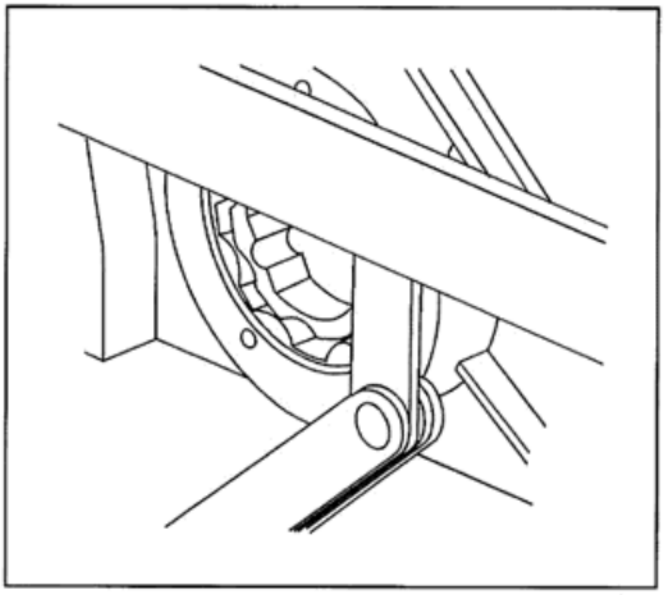
Oil Pan Cleaning and Inspection



2028262

1. Remove the 2 oil pan baffle bolts (1) and the oil pan baffle (2).
2. Remove the oil pump screen (3).
3. Clean the oil pan (4). Remove all the sludge and the oil deposits.
4. Remove the oil pan drain plug (5) and the oil pan drain plug seal (6).
5. Inspect the thread of the oil pan drain plug.
6. Inspect the oil pan for cracking near the pan rail and the transmission mounting points.
7. Inspect the oil pan for cracking resulting from impact or flying road debris.
8. Inspect the oil pan baffle and oil pump screen.
9. Repair or replace the oil pan as necessary.

Oil Pump Cleaning and Inspection



1948717

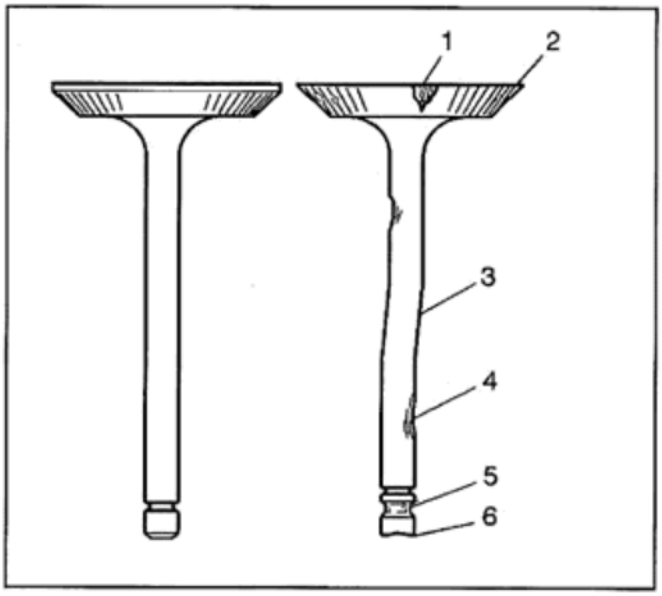
1. Remove the external rotor with the internal rotor.
2. Visually inspect the components.
3. Install the external and the internal rotors.
4. Inspect the axial clearance of the rotors in respect to the control unit housing upper edge.

Specifications

Permissible measurement is 0.02–0.058 mm (0.00079–0.00228 in).

Cylinder Head Cleaning and Inspection

Valve Cleaning and Inspection



156174

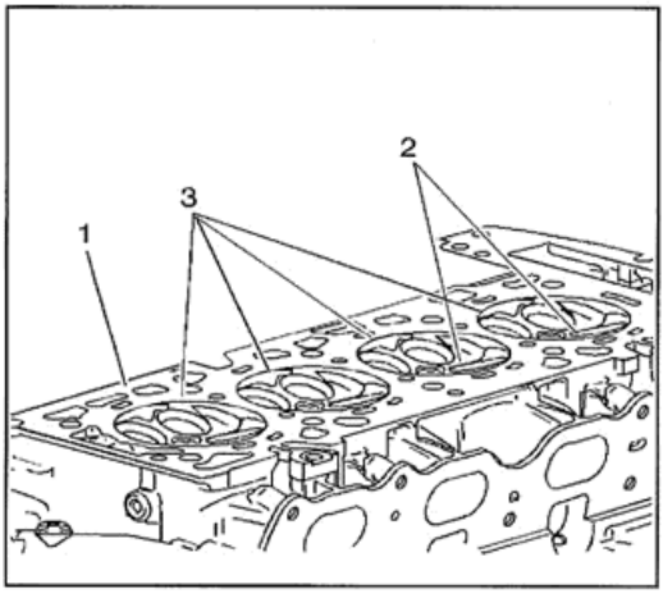
Warning: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

Note: Do not scratch the valve stem with the wire brush.

1. Clean the valves of carbon, oil and varnish. Carbon can be removed with a wire brush. Varnish can be removed by soaking in Parts Immersion Solvent.
2. Clean the valve guides.
3. Inspect the valve stem for wear (4).
4. Inspect the valve key groove for chipping or wear (5). Replace the valve if chipped or worn.
5. Inspect the valve face for burning or cracking (1). If pieces are broken off, inspect the corresponding piston and cylinder head area for damage.
6. Inspect the valve stem for burrs and scratches. Burrs and minor scratches may be removed with an oil stone.
7. Inspect the valve stem for straightness and the valve head for bending or distortion (3) using V blocks. Bent or distorted valves must be replaced.
8. Clean the deposits from the valve face. Inspect the valve face for grooving.
9. Replace the valve if the face is grooved. Valve faces cannot be machined. If worn, or damaged, the valves must be replaced.
10. The valves may be lightly lapped to the valve seats.

Cylinder Head and Gasket Surface Cleaning and Inspection

1. Remove the spark plugs. Refer to *Spark Plug Replacement on page 9-573*.
2. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, use the following faults to determine the cause:
   2.1. Improper installation.
   2.2. Loose or warped cylinder head.
   2.3. Missing, off location or not fully seated dowel pins.
   2.4. Corrosion in the seal area around the coolant passages.
   2.5. Chips or debris in the cylinder head bolt holes.
   2.6. Bolt holes in the cylinder block not drilled or tapped deep enough.



415011

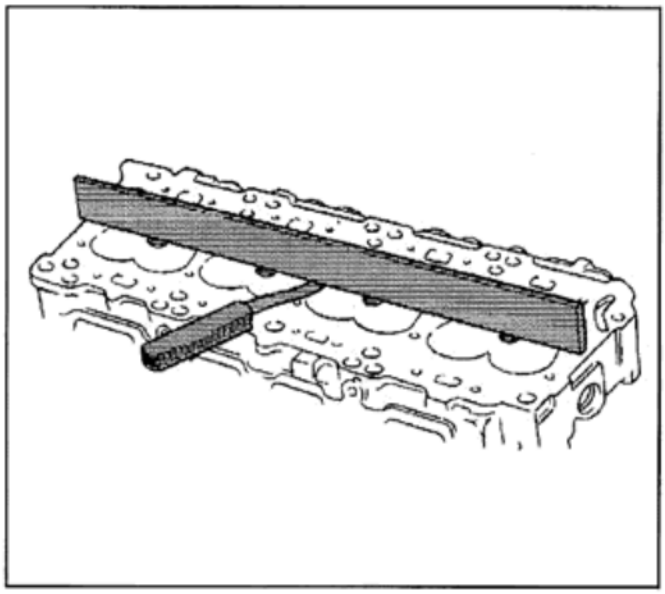
3. Inspect the cylinder head gasket surface.
   - Cylinder head may be reused if corrosion is found only outside a 4 mm (0.375 in) band around each combustion chamber (1).
   - Replace the cylinder head if the area between the valve seats is cracked (2).
   - Replace the cylinder head if corrosion has been found inside a 4 mm (0.375 in) band around each combustion chamber (3).
4. Clean the cylinder head bolts.

Note: Do not use a wire brush on any gasket sealing surface.

5. Clean the cylinder head. Remove all varnish, soot and carbon to the bare metal.
6. Clean the valve guides.
7. Clean the threaded holes. Use a nylon bristle brush.
8. Clean the remains of the sealer from the plug holes.
9. Inspect the cylinder head bolts for damaged threads or stretching and damaged heads caused by improper use of tools.
10. Replace all suspect bolts.
11. Inspect the cylinder head for cracks. Check between the valve seats and in the exhaust ports.

Note: Do not attempt to weld the cylinder head, replace it.

12. Inspect the cylinder head deck for corrosion, sand inclusions and blow holes.



63062

13. Inspect the cylinder head deck surface for flatness. Refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*. If the cylinder head is out of specification, replace the cylinder head. Do not machine the cylinder head.
14. Inspect all the threaded holes for damage. Threads may be reconditioned with thread inserts.
15. Inspect the sealing surfaces.
16. Inspect the cylinder head plugs.

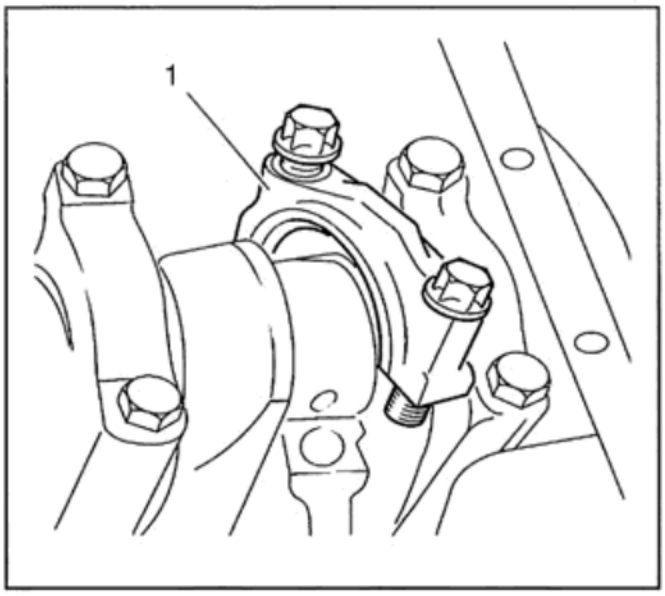
Piston, Connecting Rod, and Bearing Cleaning and Inspection

Special Tools

EN-45059 Torque Angle Sensor Kit

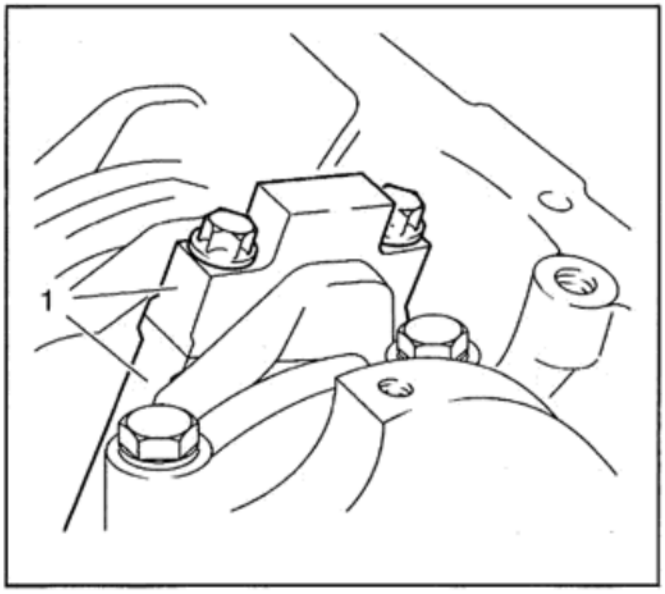
For equivalent regional tools, refer to *Special Tools on page 9-1135*.

1. Remove the oil pan. Refer to *Oil Pan Removal on page 9-1083*.



2026855

2. Remove the connecting rod bearing cap (1).



2026853

2.1. Mark the installation position (1) of the connecting rod bearing cap.
2.2. Remove the 2 bolts.
2.3. Degrease the connecting rod bearing cap and wet the connecting rod bearing clip with engine oil.

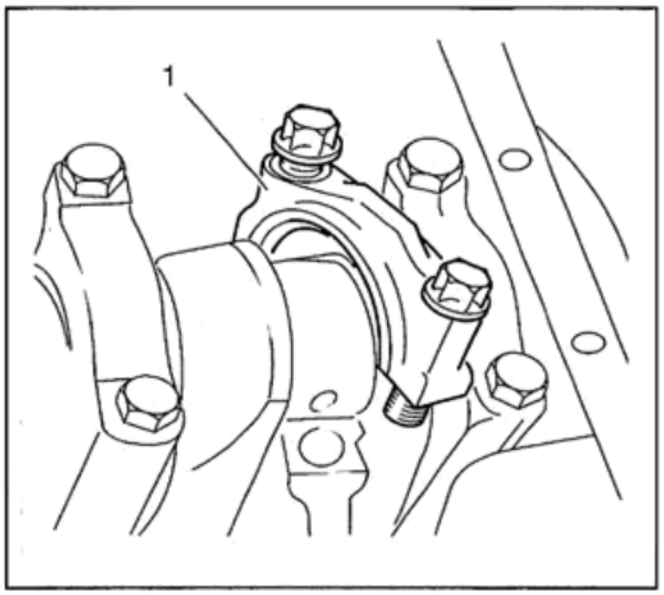
Note: Do not rotate the crankshaft.

3. Lay on plastigage. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943*.

   Lay plastigage (flexible plastic thread) over the entire width of the connecting rod bearing journal.
4. Install the connecting rod bearing cap.

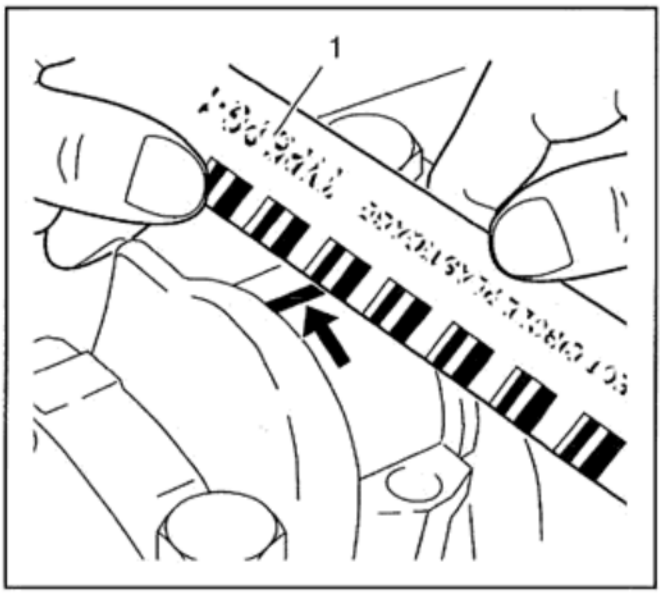
Caution: Refer to *Fastener Caution on page 0-8*

5. Tighten the 2 bolts in three passes using the *EN-45059* sensor kit:
   5.1. First pass tighten to **35 N·m (26 lb ft)**.
   5.2. Second pass tighten to an additional **45°**
   5.3. Third pass tighten to an additional **15°**



2026855

6. Remove the 2 bolts.
7. Remove the connecting rod bearing cap (1).



2191437

Note: When reading the value, do not confuse millimeters and inches on the measuring scale (1).

8. Measure the connecting rod bearing play.
   - Compare the width of the flattened plastic thread with the measuring scale.
   - Permissible connecting rod bearing play: 0.019-0.071 mm (0.0007-0.0028 in).

Note: Check markings on parts.

9. Install the connecting rod bearing cap.
   - Wet the connecting rod bearing journal and con-rod bearing clips with engine oil.
   - Renew the bolts.
10. Tighten the 2 bolts in three passes using the *EN-45059* sensor kit:
    10.1. First pass tighten to **35 N•m (26 lb ft)**
    10.2. Second pass tighten to an additional **45°**
    10.3. Third pass tighten to an additional **15°**
11. Install the oil pan. Refer to *Oil Pan Installation on page 9-1114*.

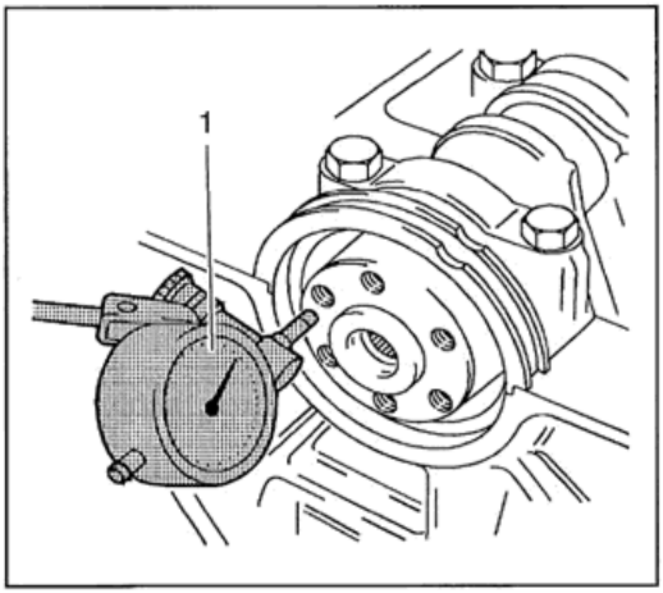
Crankshaft and Bearing Cleaning and Inspection

Special Tools

- *EN-45059* Torque Angle Sensor Kit
- *GE-571-B* Dial Gauge

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

Crankshaft End Play, Check

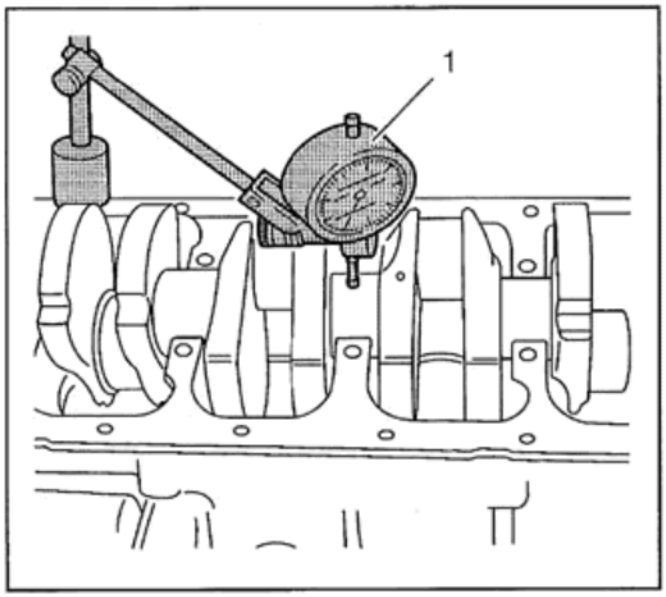


2190913

Note: Crankshaft attached with crankshaft bearing caps.

1. Install the *GE-571-B* gauge (1).
   1.1. Install in the holder on the front of the engine block.
   1.2. Place the dial gauge plunger against the crankshaft and adjust.
2. Measure the longitudinal play of the crankshaft.
   2.1. Move the crankshaft in the longitudinal direction.
   2.2. Permissible crankshaft end play: 0.100–0.202 mm (0.0039–0.0080 in)
3. Remove the *GE-571-B* gauge.

Crankshaft Out-of-Round, Check

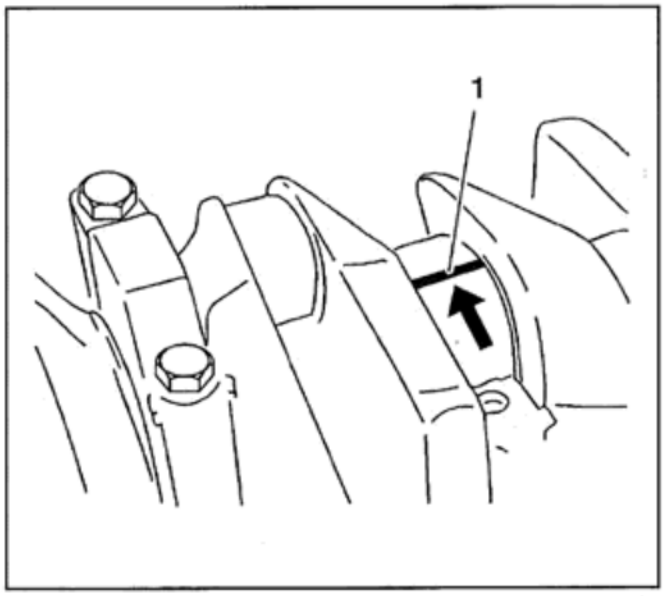


2190919

Note: Crankshaft removed.

1. Insert the crankshaft in the engine block.
2. Install the *GE-571-B* gauge.
   2.1. Attach to the bracket on the engine block.
   2.2. Place the dial gauge plunger against the crankshaft bearing journal and adjust.
3. Check the rotational play of the crankshaft.
   3.1. Turn the crankshaft evenly.
   3.2. Maximum permissible rotational play: 0.03 mm (0.001 in).
4. Remove the *GE-571-B* gauge (1).

Check Crankshaft Bearing Clearance (With Plastigage)



2190912

Note:

- Crankshaft removed.
- Do not rotate the crankshaft.

1. Lay on plastigage.

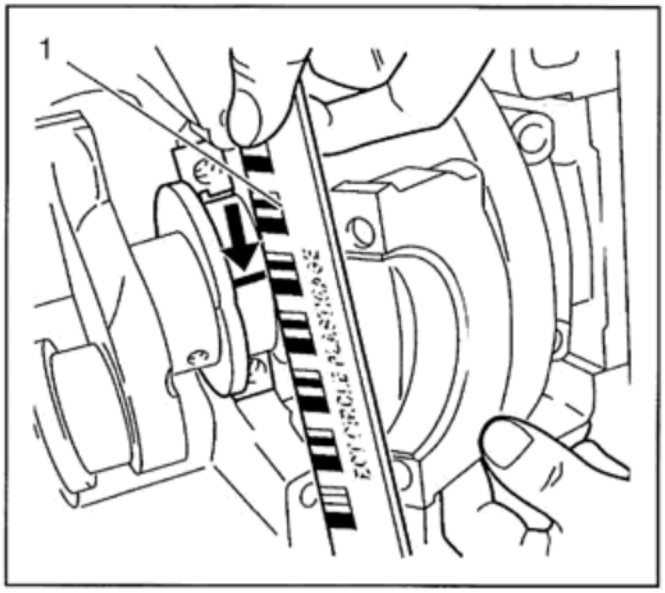
   Lay out plastigage (flexible plastic thread) around the entire width of the con-rod bearing journal (1).

Caution: Refer to *Fastener Caution on page 0-8.*

Note:

- Note the correct tightening sequence.
- The bolts can be reused for checking the crankshaft bearing play.

2. Install the crankshaft bearing cap. Tighten the 2 crankshaft bearing cap bolts in 3 passes. Use the *EN-45059* sensor kit:
   2.1. First pass to **50 N•m (37 lb ft)**
   2.2. Second pass to **45°**
   2.3. Third pass to **15°**
3. Remove the 2 crankshaft bearing cap bolts.



2190914

Note: When reading the value, do not confuse millimeters and inches on the measuring scale (1).

4. Measure the crankshaft bearing play.
   4.1. Compare the width of the flattened plastic thread (arrow) to the measuring scale.
   4.2. Permissible crankshaft bearing play: 0.005–0.059 mm (0.0002–0.0023 in).

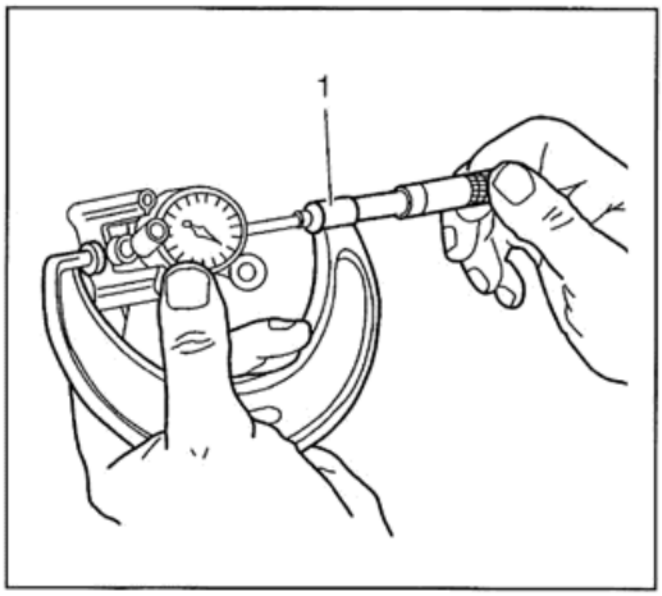
Check Crankshaft Bearing Clearance (With Micrometer Gauge Internal Measuring Device)

Note:

- Note the correct tightening sequence.
- The bolts can be reused for checking the crankshaft bearing play.

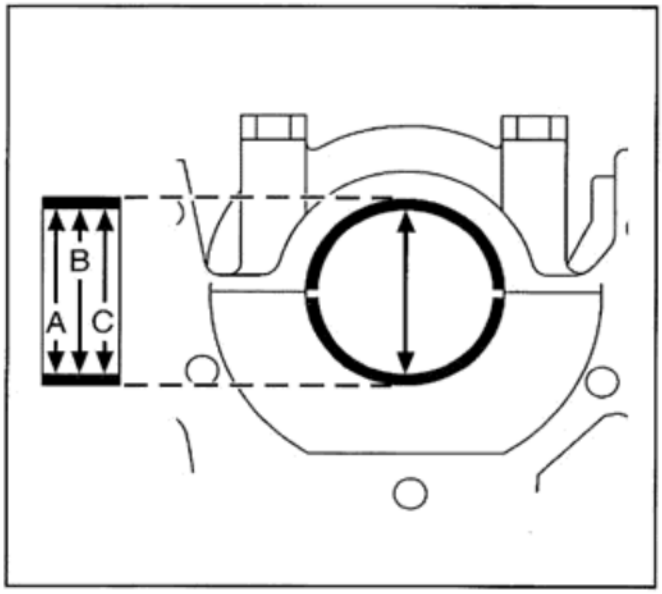
1. Install the crankshaft bearing cap with the crankshaft bearing clips to the cylinder block.

   Tighten the 2 crankshaft bearing cap bolts in 3 passes. Use the *EN-45059* sensor kit:
   1.1. First pass to **50 N•m (37 lb ft)**
   1.2. Second pass to **45°**
   1.3. Third pass to **15°**



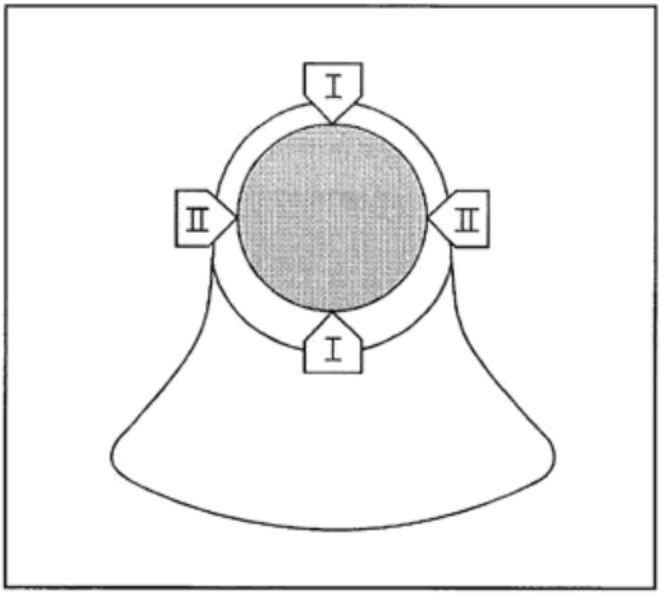
2026849

2. Install the inner plunger and calibrate with the micrometer gauge (1).



2026850

3. Measure the crankshaft bearing diameter at 3 points.
   - Measure at points A, B and C with the internal measuring device.
   - Calculate the average crankshaft bearing diameter.
   - Formula: A + B + C /3.



1935590

4. Measure the crankshaft bearing journal diameter at 2 points.

   Measure at points I and II with the micrometer gauge.
5. Calculate the average crankshaft bearing journal diameter.

   Formula: I + II/2.
6. Determine the crankshaft bearing play.

   Calculation formula: average crankshaft bearing diameter minus average crankshaft bearing journal diameter.
7. Nominal-Actual comparison.

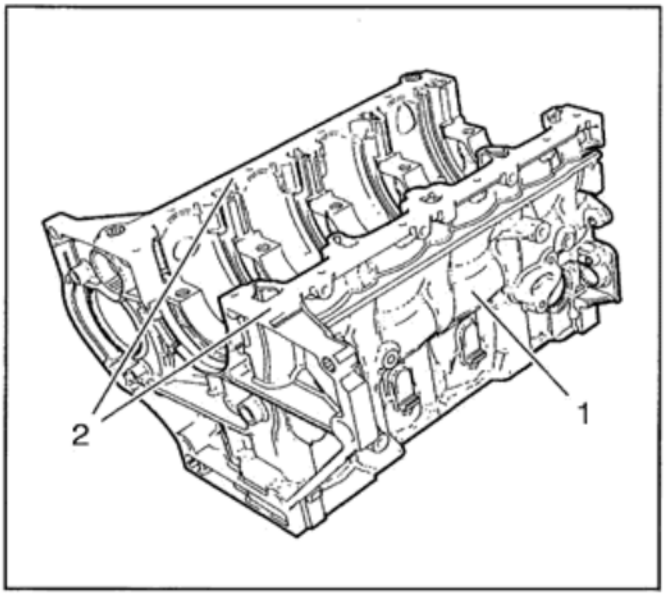
   Permissible crankshaft bearing play: 0.005–0.059 mm (0.0002–0.0023 in).

Engine Block Cleaning and Inspection

Special Tools

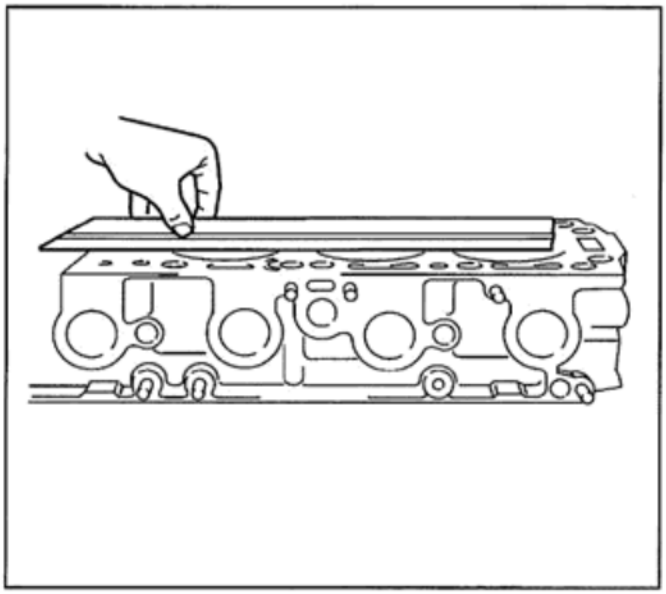
EN-8087 Cylinder Gauge

For equivalent regional tools, refer to *Special Tools on page 9-1135.*



2026861

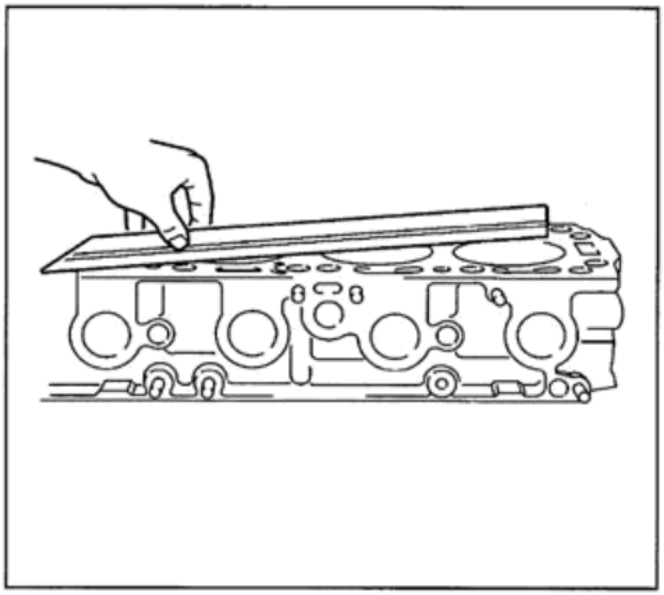
1. Clean the sealing material from the gasket mating surfaces (2).
2. Clean the engine block (1) and lower crankcase in a cleaning tank with solvent appropriate for aluminum. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943* for the recommended solvent.
3. Flush the engine block with clean water or steam.
4. Clean the oil passages.
5. Clean the blind holes.
6. Spray the cylinder bores and the machined surfaces with engine oil.
7. Inspect the threaded holes. Clean the threaded holes with a rifle brush. If necessary, drill out the holes and install thread inserts. Refer to *Thread Inserts on page 1-22.*



2026862

Note: Do not attempt to machine the lower crankcase to engine block surfaces.

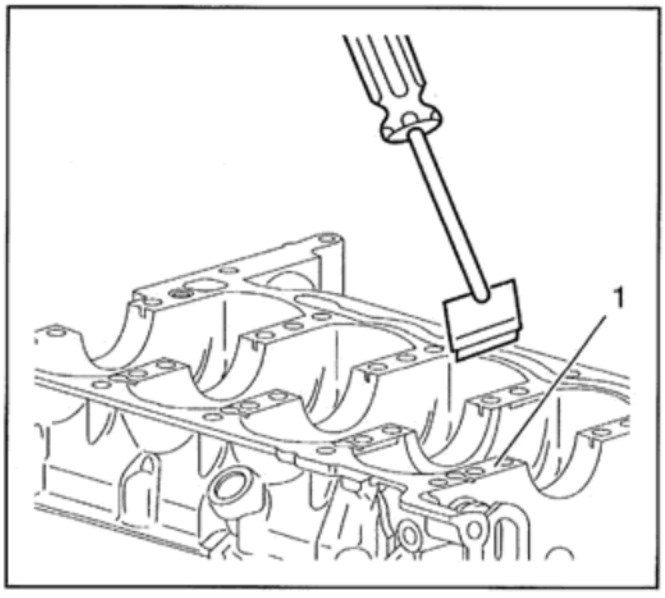
8. Inspect the engine block for sag in length and width on the sealing surfaces.



2026863

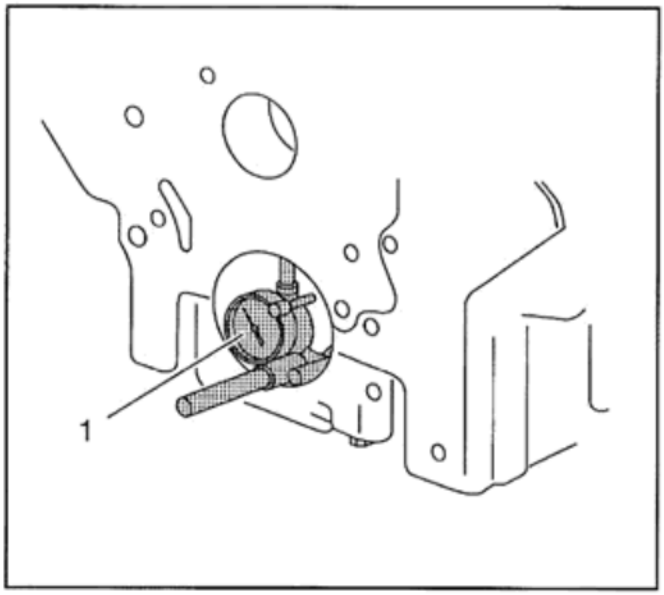
9. Inspect the engine block for distortion along the diagonals.

   If the deck surface is out of specification, replace the block. Do not machine the block.



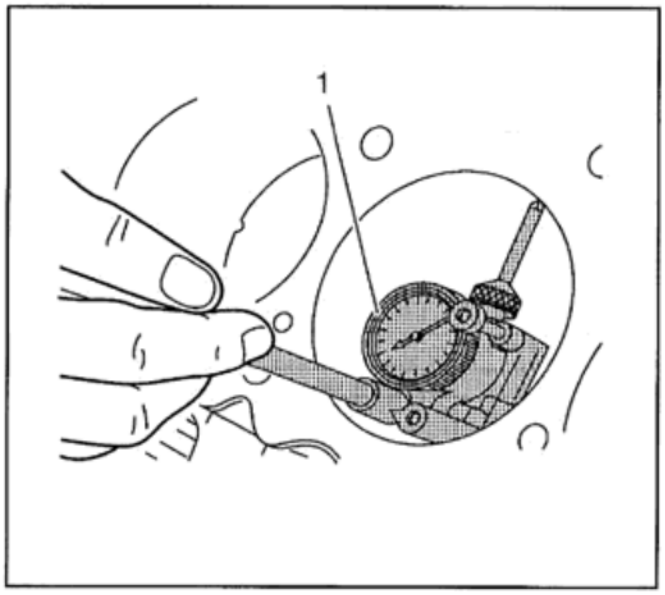
2026763

10. Clean the sealing material from the gasket mating surfaces (1) on the lower crankcase oil pan side.



2026766

11. Inspect the crankshaft main bearing bores. Use the *EN-8087* gauge (1) to measure the bearing bore concentricity and alignment.
12. Replace the engine block and bed plate if the crankshaft bearing bores are out of specification.



2026767

13. Inspect the cylinder bores using the *EN-8087* gauge (1). Inspect for the following items:
    - Wear
    - Taper
    - Runout
    - Ridging
14. Check the cylinder bores specifications. Refer to *Engine Mechanical Specifications (1.8L LUW and LWE) on page 9-940* or *Engine Mechanical Specifications (1.6L LDE) on page 9-938*.
15. If the cylinder bores are out of specification, replace the engine block.

Service Prior to Assembly

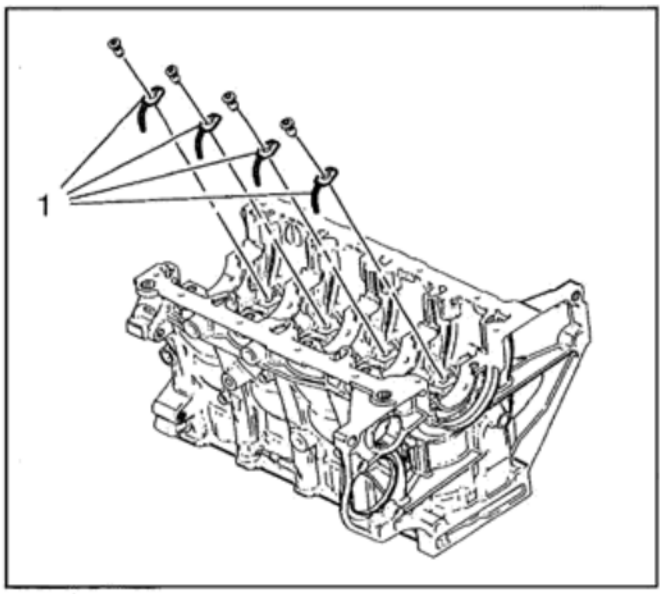
The importance of cleanliness during assembly cannot be overstated. Dirt or debris will cause engine damage. An automobile engine is a combination of many machined, honed, polished and lapped surfaces with minor tolerances. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly in order to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas are part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Use the proper tools to measure the components when checking for excessive wear. Components not within the manufacturer's specification must be repaired or replaced.

Lubricate all moving parts with engine oil or a specified assembly lubricant. This will provide lubrication for initial start up.

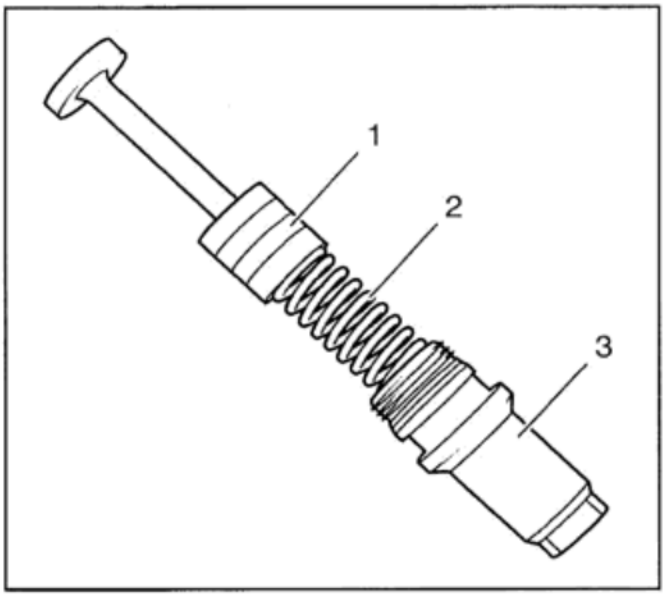
When the components are reinstalled into an engine, return the components to their original location, position, and direction.

Engine Block Assemble



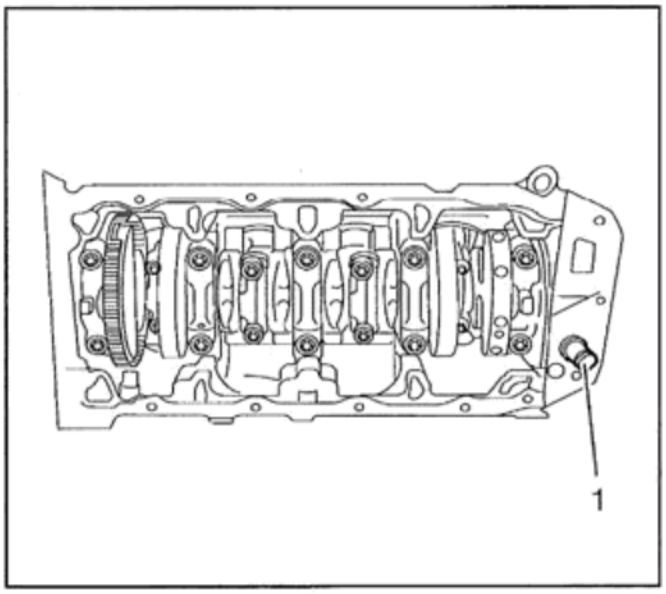
2026902

1. Install the 4 piston oil nozzles (1).



2026540

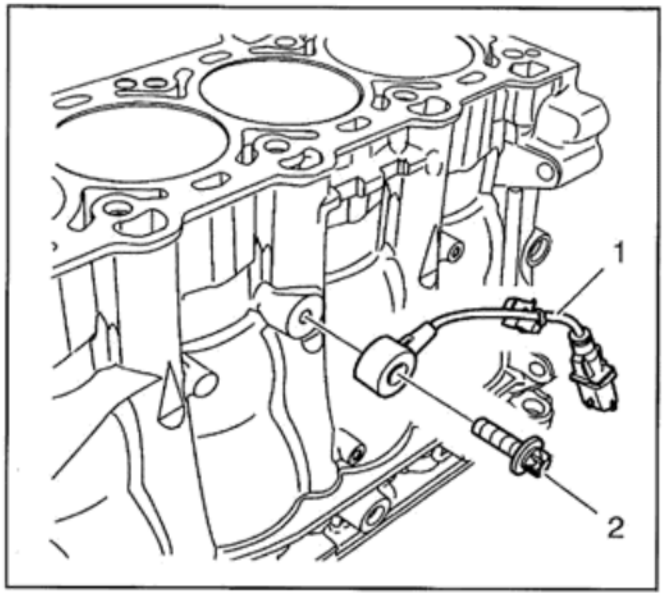
2. Install the piston (1) and spring (2) to the oil pressure relief valve closure bolt (3).



2026539

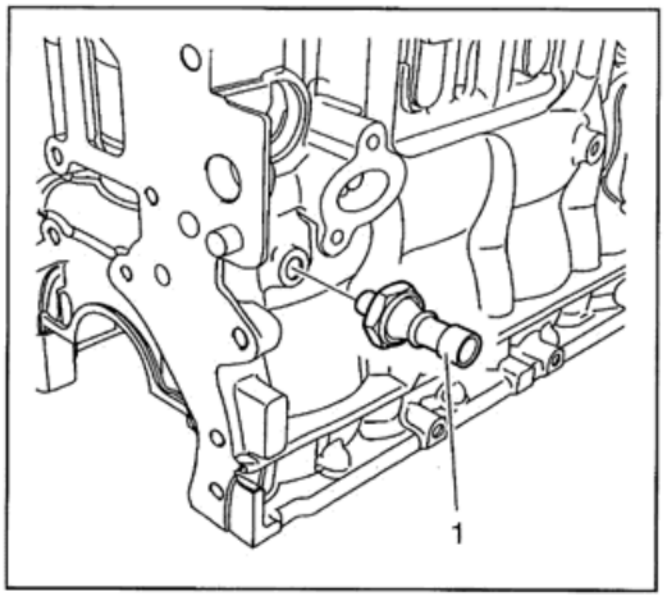
Caution: Refer to *Fastener Caution on page 0-8.*

3. Install the oil pressure relief valve and the oil pressure relief valve closure bolt (1) and tighten to **21 N•m (16 lb ft)**.



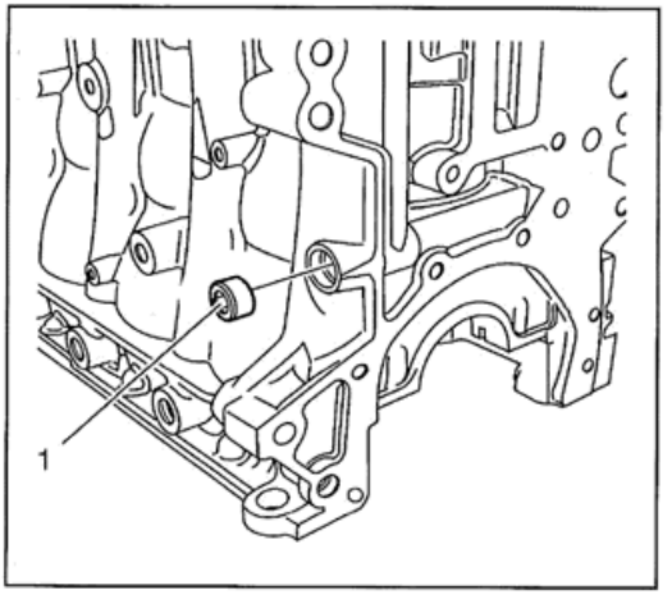
2026869

4. Install the knock sensor (1) and the knock sensor bolt (2) and tighten to **20** N•m **(15 lb ft)**.



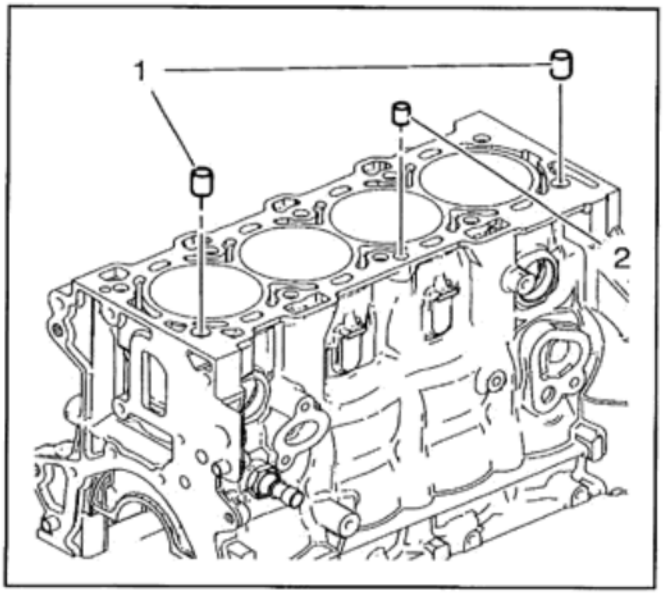
2026870

6. Install the oil pressure switch (1) and tighten to **20** N•m **(15 lb ft)**.



2026901

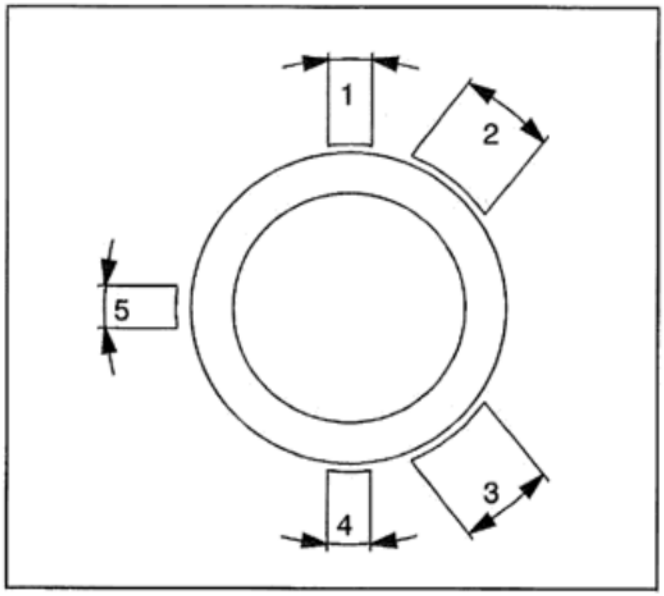
5. Install the oil flow check valve (1).



2026868

7. Install the cylinder head locating (1, 2).

Piston and Connecting Rod Assemble



1948716

1. Install the piston rings.
   - Insert into the pistons with piston ring wrench and "TOP" pointing upwards.
   - Set the piston ring gap.
     - First piston ring (right-hand ring) in position (1)
     - Second piston ring (minute ring) in position (2)
     - Interim ring of oil scraper ring in position (3), steel band rings of oil scraper ring in position (4 and/or 5)

Note: Note installation position of the piston in respect of the connection rod.

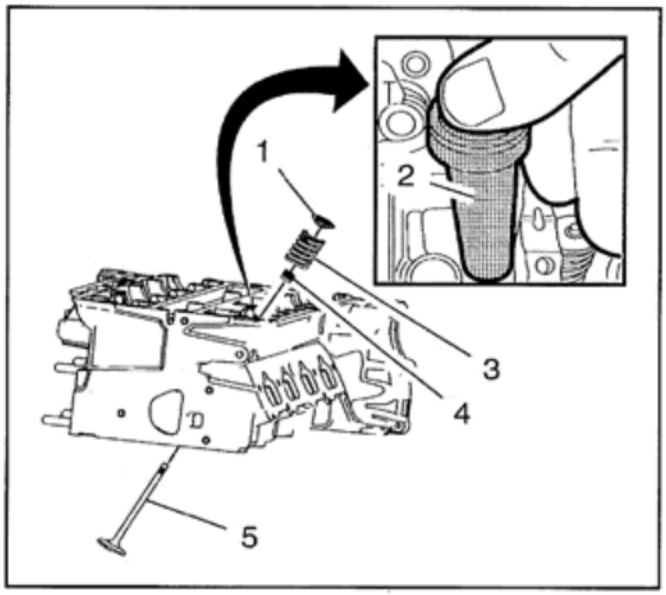
2. Attach the piston to the connection rod.
   2.1. Press the piston pin into the piston and the connection rod by hand.
   2.2. Insert the retainer in the annular groove on the piston.
   2.3. Ensure the retainer is firmly seated in the groove.
3. Install the piston with connection rod. Refer to *Piston, Connecting Rod, and Bearing Installation on page 9-1110*.

Cylinder Head Assemble

Special Tools

- *EN-958* Valve Stem Seal Installer
- *EN-8062* Valve Spring Compressor
- *EN-8062-5* Adapter
- *EN-50717-2* Compressor Assembly of *EN-50717* Kit

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

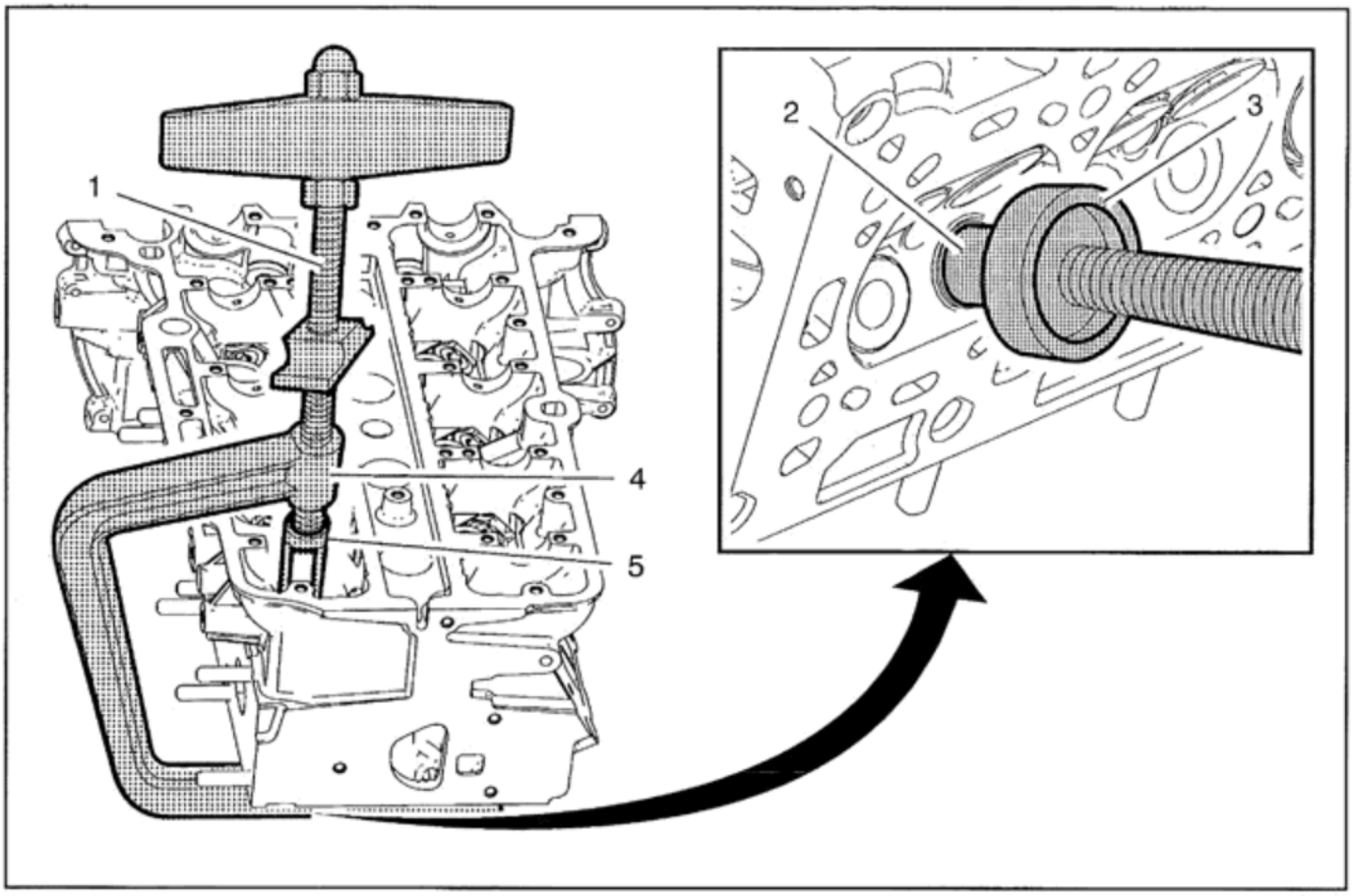


2678156

1. Lubricate the valve stem and the valve guide with clean engine oil.

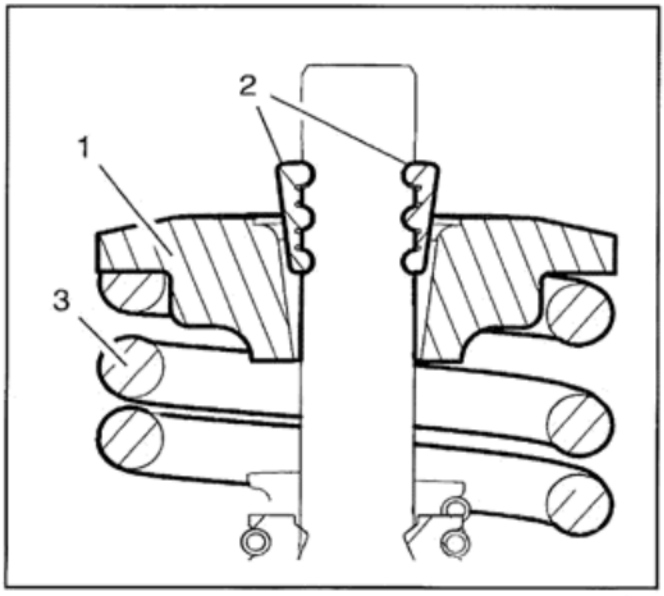
Note: Ensure all valve train components will be installed in their original position.

2. Install the valve (5).
3. Install the NEW valve stem oil seal (4), using the *EN-958* installer (2).
4. Loosely install the valve spring (3) and the valve spring retainer (1).



2678147

5. Install the *EN-50717–2* assembly (1) to the *EN-8062* compressor (4).
6. Install the *EN-8062–5* adapter (3) to the *EN-8062* compressor.
7. Install the compressor assembly to the cylinder head, so that the adapter (5) of the *EN-50717–2* assembly (1) contacts the valve spring retainer properly and the *EN-8062–5* adapter (3) contacts the valve disc (2). Prefix the *EN-8062* compressor (4).

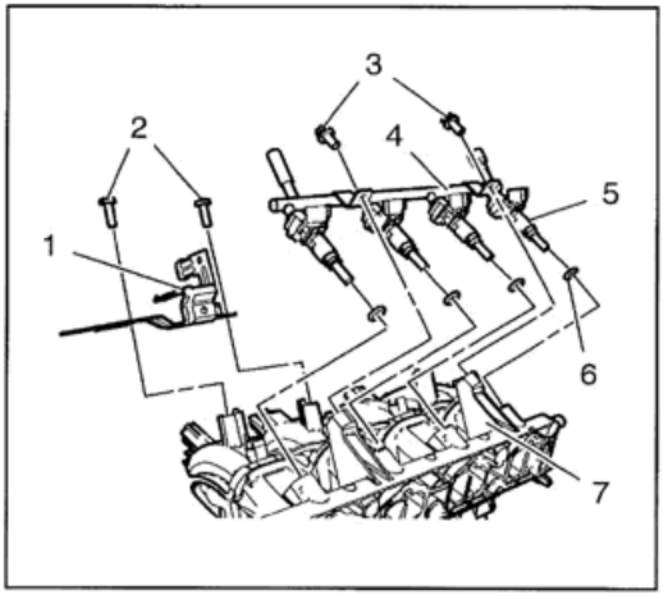


2678153

Caution: The valve stem keys must correctly seat in the valve spring cap. Engine damage may occur by not installing properly.

8. Apply pressure to the *EN-50717–2* assembly to push down the vale spring retainer (1) and compress the valve spring (3) until the valve keys (2) can be inserted. Carefully insert the valve keys then, so that they are proper installed to the valve stem grooves.
9. Carefully release the tension from the *EN-50717–2* assembly.
10. Inspect the valve keys and valve spring retainers for proper seat.
11. Remove the compressor assembly from the cylinder head.
12. Repeat the procedure with the remaining valves.

Intake Manifold Assemble (1.6L LDE)

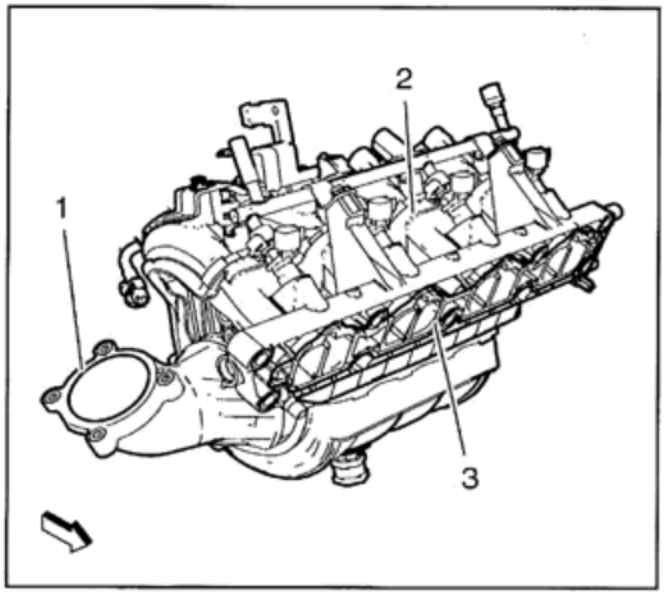


2028209

1. Install the 4 multiport fuel injector seals (6).
2. Install the multiport fuel injection fuel rail (4) and the fuel injectors (5) to the intake manifold (7).

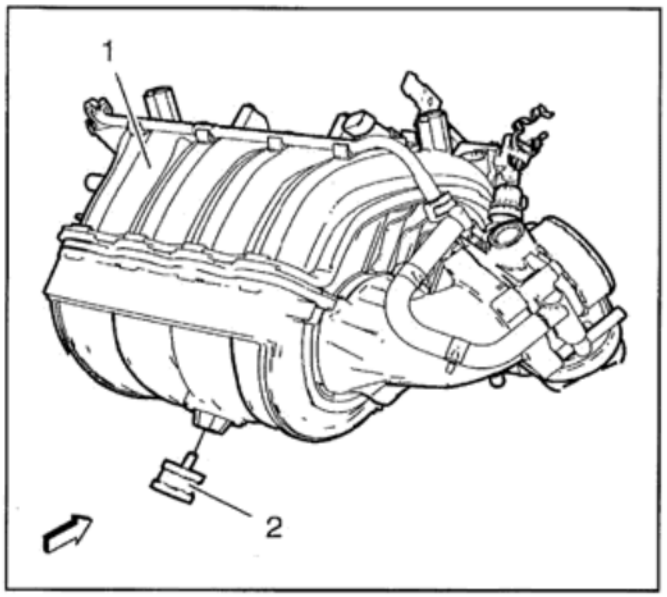
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the 2 multiport fuel injection fuel rail bolts and tighten to **9 N•m (80 lb in)**.
4. Install the evaporative emission canister purge solenoid valve bracket (1) to the intake manifold (7).
5. Install the 2 evaporative emission canister purge solenoid valve bracket bolts (2) and tighten to **8 N•m (71 lb in)**.



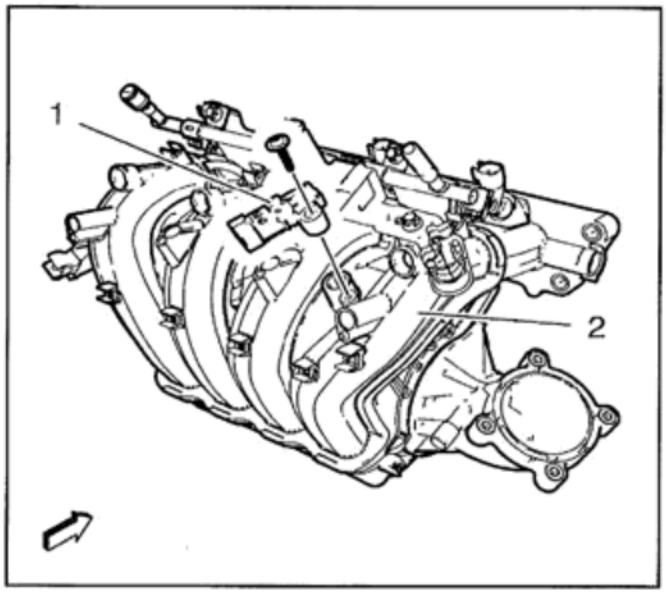
2028190

6. Install the NEW intake manifold seal (3) to the intake manifold (2).
7. Install the NEW throttle body seal (1).



2028187

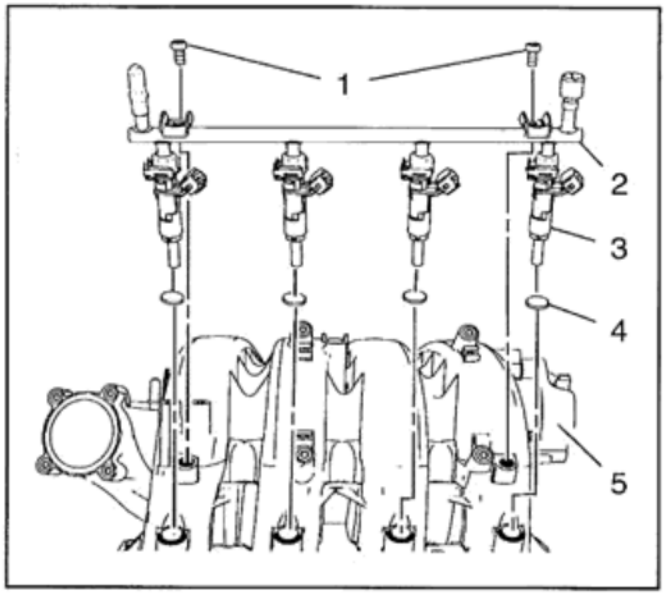
8. Install the intake manifold mount (2) to the intake manifold (1) and tighten to **9 N•m (80 lb in)**.



2028179

9. Install the manifold absolute pressure sensor (1) to the intake manifold (2).
10. Install the intake manifold absolute pressure sensor bolt and handtighten.

Intake Manifold Assemble (1.8L LUW and LWE)

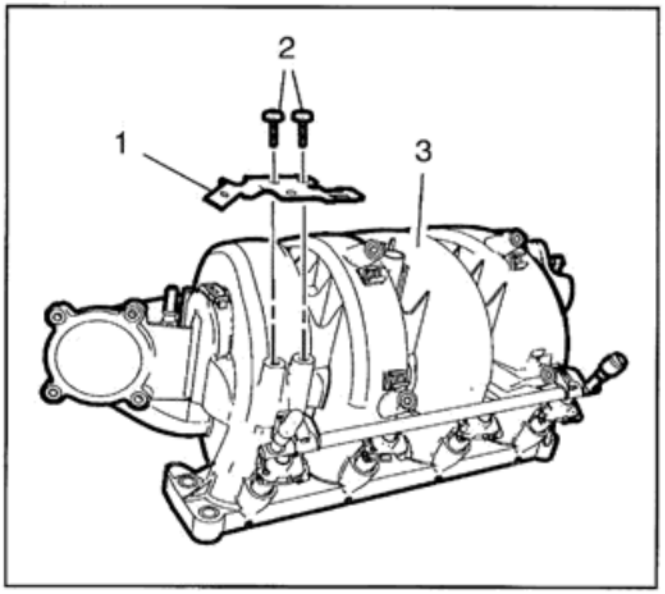


2373077

1. Install the 4 NEW multiport fuel injector seals (4).
2. Install the multiport fuel injection fuel rail (2) and the fuel injectors (3) to the intake manifold (5).

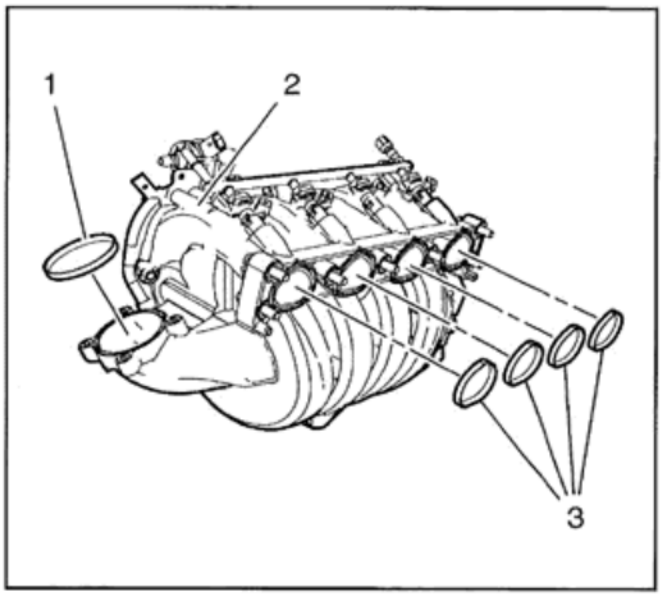
Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the 2 multiport fuel injection fuel rail bolts (1) and tighten to **8 N•m (71 lb in)**.



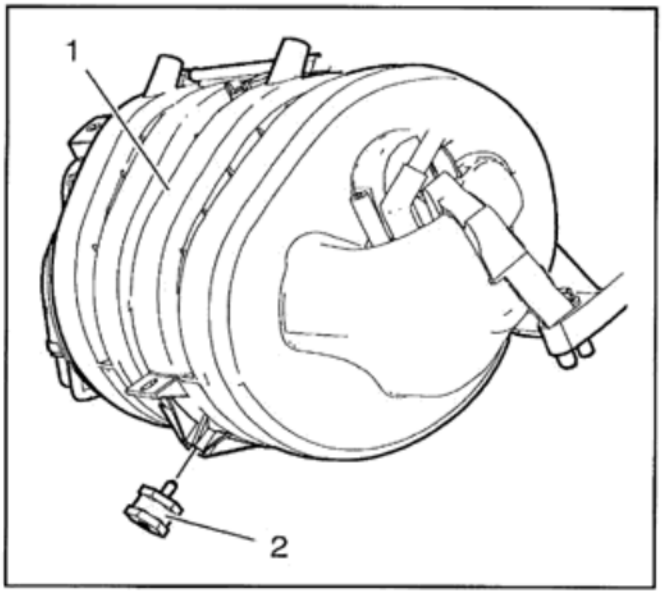
2373076

4. Install the evaporative emission canister purge solenoid valve bracket (1) to the intake manifold (3).
5. Install the 2 evaporative emission canister purge solenoid valve bracket bolts (2) and tighten to **7 N•m (62 lb in)**.



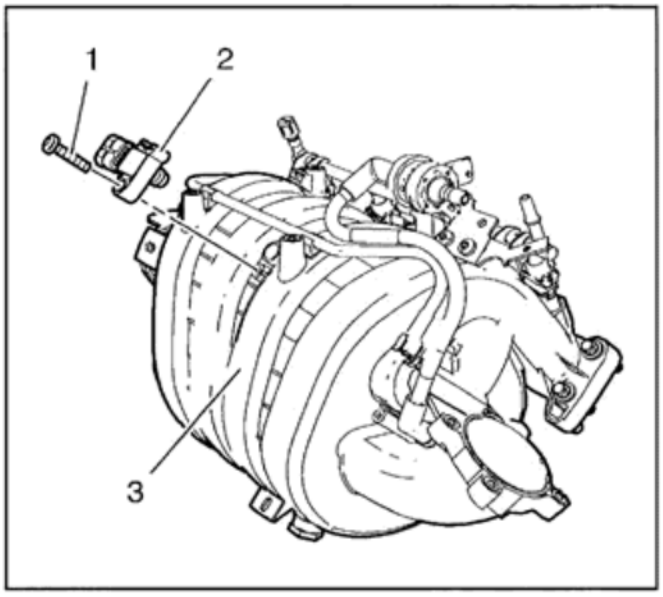
2189145

6. Install the NEW intake manifold seal (3) to the intake manifold (2).
7. Install the NEW throttle body seal (1).



2189144

8. Install the intake manifold mount (2) to the intake manifold (1) and tighten to **8 N•m (71 lb in)**.



2189143

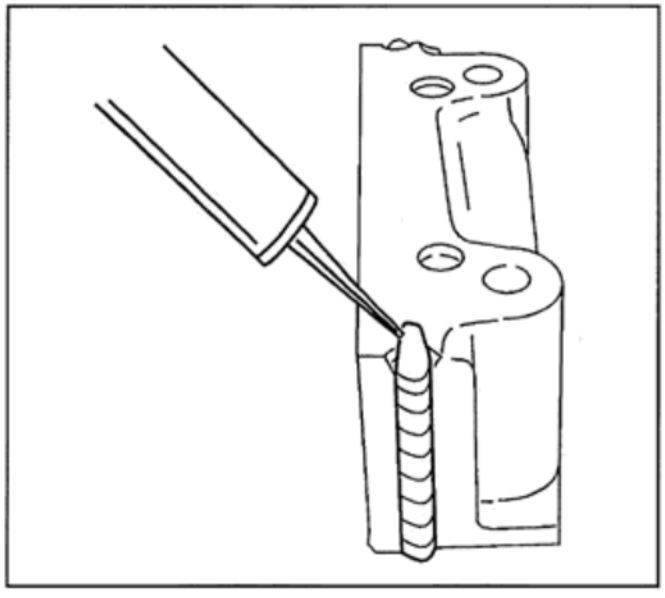
9. Install the manifold absolute pressure sensor (2) to the intake manifold (3).
10. Install the intake manifold absolute pressure sensor bolt (1) and tighten to **6 N•m (53 lb in)**.

Crankshaft and Bearing Installation

Special Tools

EN-45059 Torque Angle Sensor Kit

For equivalent regional tools, refer to *Special Tools on page 9-1135*



1935559

Note: Inspect the installation position.

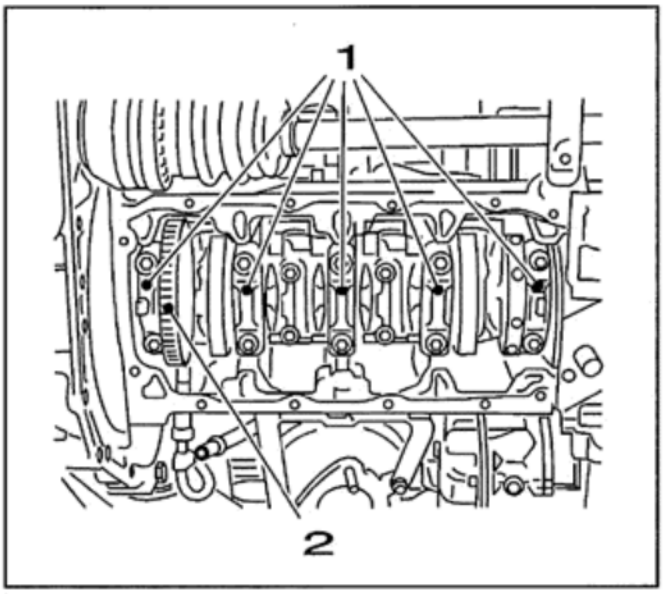
1. Install the crankshaft bearing clips, oil bearing clips.
2. Install the crankshaft.

Note: Inspect the installation position.

3. Install the crankshaft bearing caps 1-4.
   - Oil bearing clips.
   - Install the 8 NEW crankshaft bearing cap bolts.

Note: Inspect the installation position.

4. Install the crankshaft bearing cap.
   4.1. Apply black adhesive sealing compound to the grooves of the rear crankshaft bearing cap.
   4.2. Install the 2 NEW crankshaft bearing cap bolts.

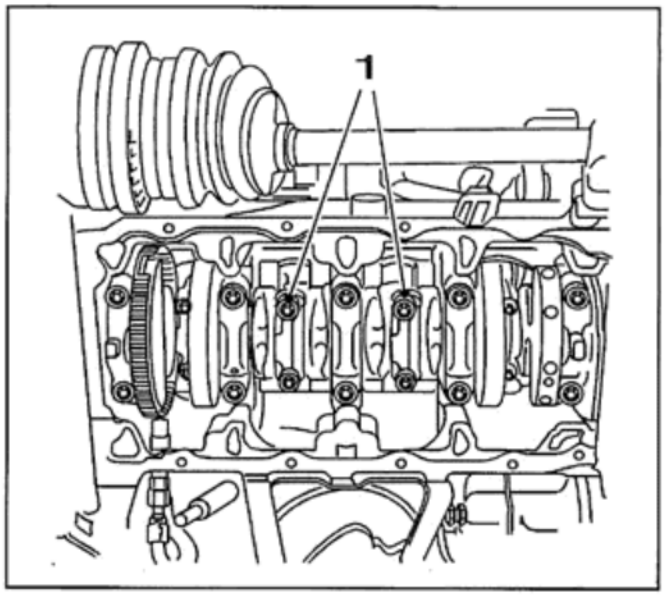


1937120

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

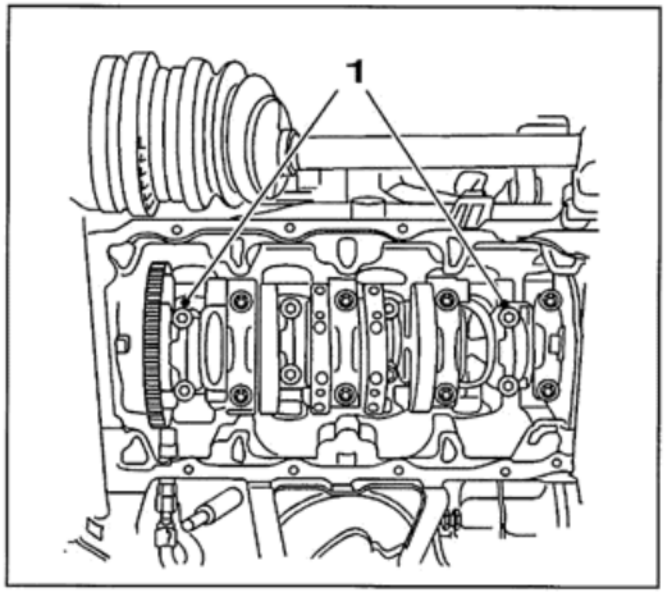
5. Tighten the bolts for the crankshaft bearing caps (1) in 3 passes using the *EN-45059* sensor kit:
   - First pass to **50 N•m (37 lb ft)**
   - Second pass to **45°**
   - Third pass to **15°**



1937048

Note: Inspect the installation position.

6. Install the connecting rod bearing caps 2 and 3 (1) and oil the bearing clips.
7. Install 4 NEW connecting rod bearing cap bolts and tighten in 3 passes use the *EN-45059* sensor kit:
   - First pass to **35 N•m (26 lb ft)**
   - Second pass to **45°**
   - Third pass to **15°**



1937053

8. Turn the crankshaft through **180°**.

Note: Inspect the installation position.

9. Install the connecting rod bearing caps 1 and 4 (1) and oil the bearing clips.
10. Install 4 NEW connecting rod bearing cap bolts and tighten in 3 passes use the *EN-45059* sensor kit:
    - First pass to **35 N•m (26 lb ft)**
    - Second pass to **45°**
    - Third pass to **15°**

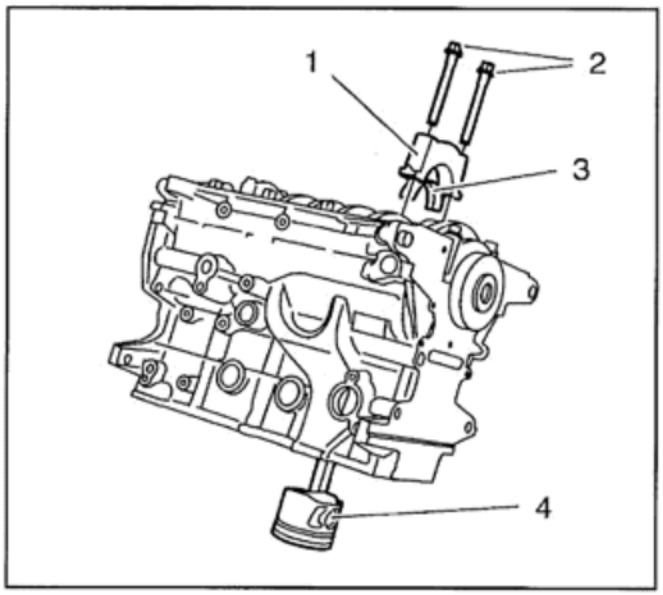
Piston, Connecting Rod, and Bearing Installation

Special Tools

EN-45059 Angle Meter

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

1. Lubricate the piston rings, piston, inner cylinder bore surface and a piston ring compressor with clean engine oil.
2. Install the piston ring compressor in order to compress the piston rings.



2026656

3. Install the piston and connecting rod assembly (4).
4. Install the connecting rod bearing (3).
5. Install the connecting rod cap (1).

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

6. Install NEW connecting rod bolts (2) and tighten a first pass to **35 N•m (26 lb ft)**.
7. Tighten the NEW connecting rod bolts a second pass to an additional **45 degrees**, using the *EN-45059* meter.
8. Tighten the NEW connecting rod bolts a final pass to an additional **15 degrees**, using the *EN-45059* meter.
9. Assemble the caps and connecting rods in the marked position.
10. Rotate the crankshaft to a position where the connecting rod bolts are easy accessible.

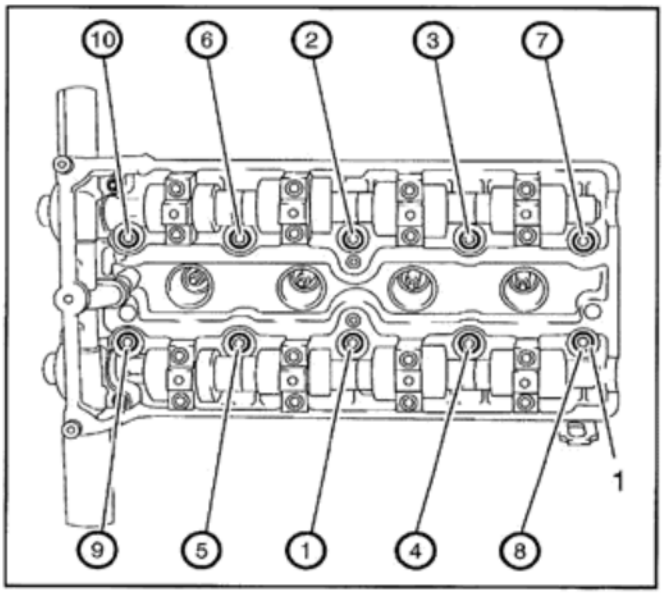
Cylinder Head Installation

Special Tools

EN-45059 Torque Angle Sensor Kit

For equivalent regional tools, refer to *Special Tools on page 9-1135*.

1. Clean the sealing surfaces.
2. Inspect for plane surface.
   - Cylinder block, cylinder head
   - Straight-edge, feeler gauge
3. Install the cylinder head gasket.
4. Install the cylinder head.



2027018

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

Note: Note the correct tightening sequence.

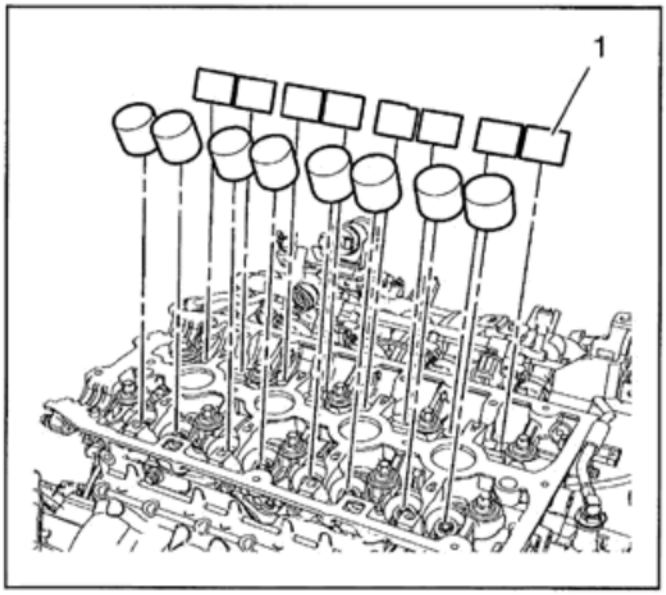
5. Install NEW cylinder head bolts.
6. Tighten the bolts (1) in 5 passes. Use the *EN-45059* sensor kit:
   - First pass to **25 N·m (18 lb ft)**
   - Second pass to **90°**
   - Third pass to **90°**
   - Fourth pass to **90°**
   - Fifth pass to **45°**

Valve Lifter Installation

Special Tool

EN-845 Suction Device

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2028318

Note: Observe the correct locations.

Note: Coat the sliding surfaces with NEW engine oil.

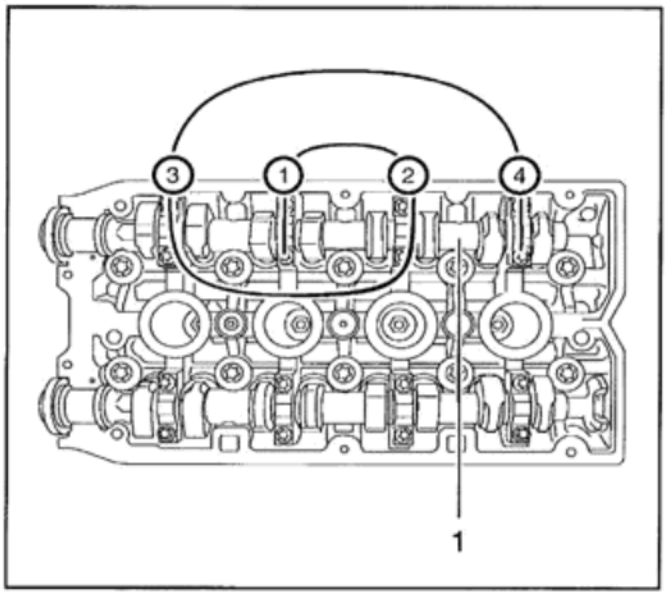
Install the 16 valve lifter (1), using the *EN-845* suction device.

Camshaft Installation

Special Tools

EN-422 Installer

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2027632

Note: Coat with MoS 2 lubricating paste. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943*.

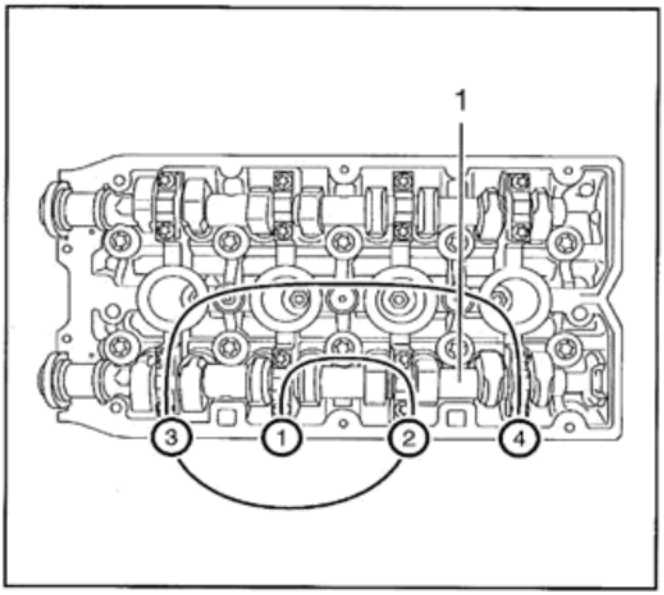
1. Install the intake camshaft (1).

Note: Note the identification marking on the camshaft bearing cover.

2. Install the 4 intake camshaft bearing cover number 2-5.

Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the 8 intake camshaft bearing cover bolts and tighten in a spiral from the inside to the outside to **8 N•m (71 lb in)**.



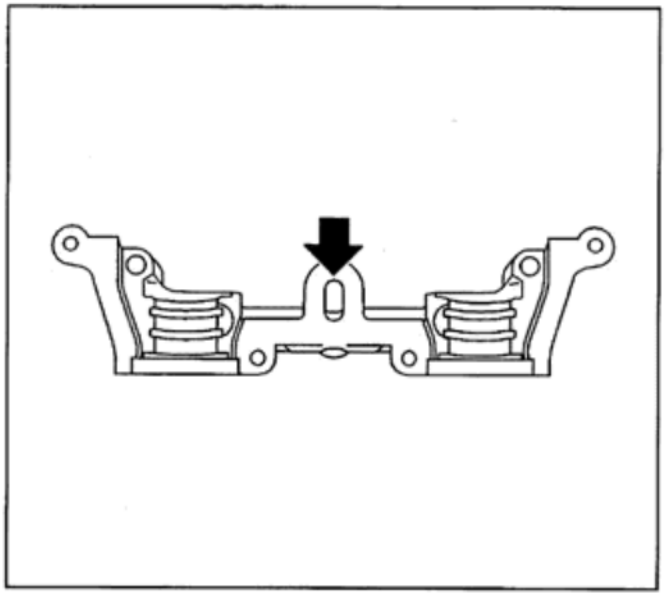
2027633

Note: Coat with MoS 2 lubricating paste. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943*.

4. Install the exhaust camshaft (1).

Note: Note the identification marking on the camshaft bearing cover.

5. Install the 4 exhaust camshaft bearing cover number 6-9.
6. Install the 8 exhaust camshaft bearing cover bolts and tighten in a spiral from the inside to the outside to **8 N•m (71 lb in)**.

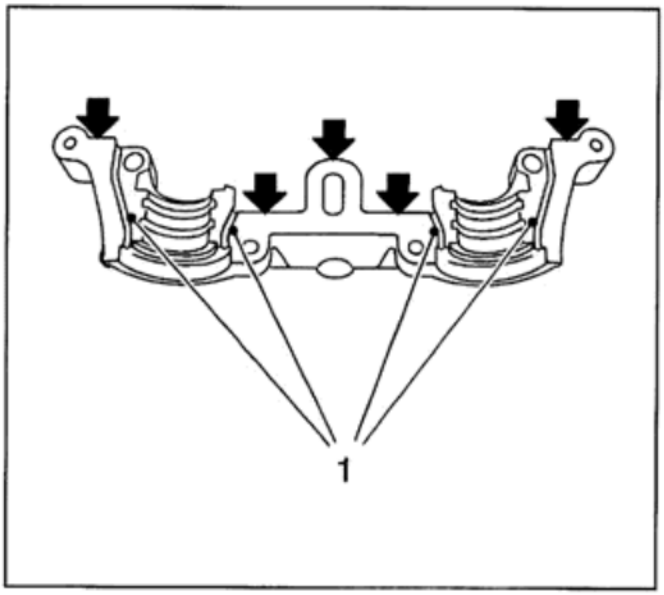


1947413

Note: Sealing surfaces must be free from oil and grease.

7. Clean sealing surfaces of the first camshaft bearing support and the cylinder head with a suitable tool.

   Clean oil duct from any sealant residue.

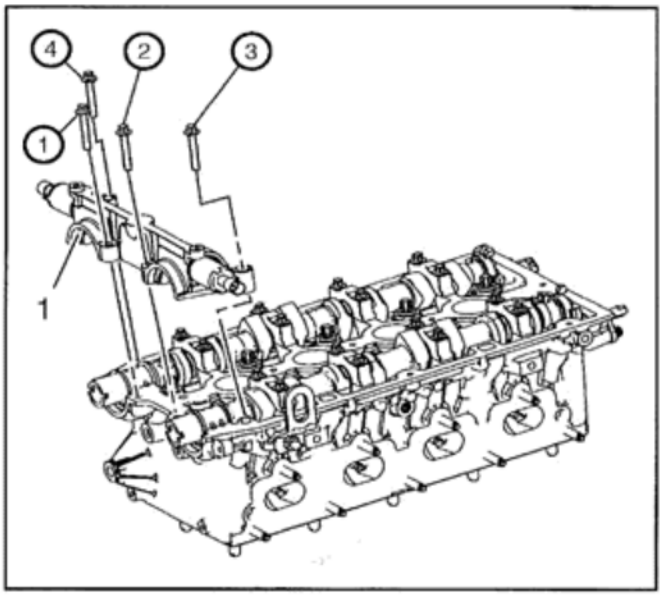


1947417

Note:

- Sealing surfaces (arrows) must be free from oil and grease.
- It is essential to ensure that no sealant is applied outside the marked sealing areas (1).
- The grooves adjacent to the sealing surfaces must remain free from sealant.

8. Apply surface sealant to sealing surfaces of the first camshaft bearing cap thinly and evenly.
9. Position the first camshaft bearing cap on the cylinder block and tighten the bolts approximately to **2 N•m (18 lb in)**.



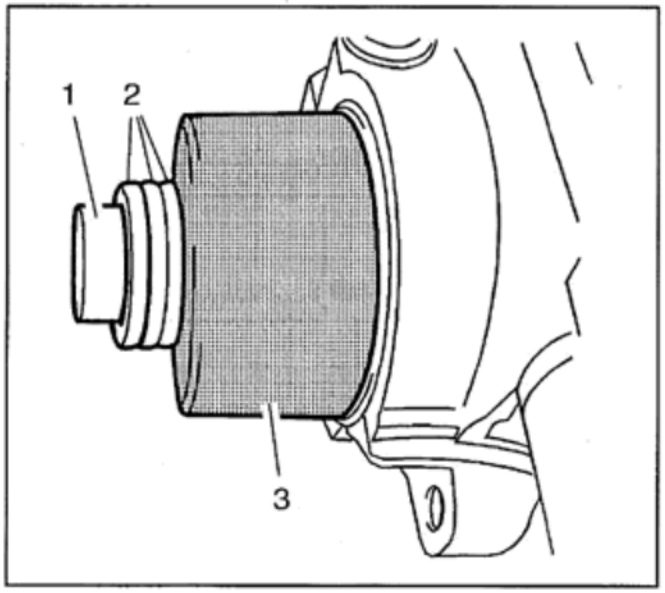
2027009

Note: No sealant may reach the camshafts.

10. Install the first camshaft bearing cap.

Note: Note installation sequence 1-4.

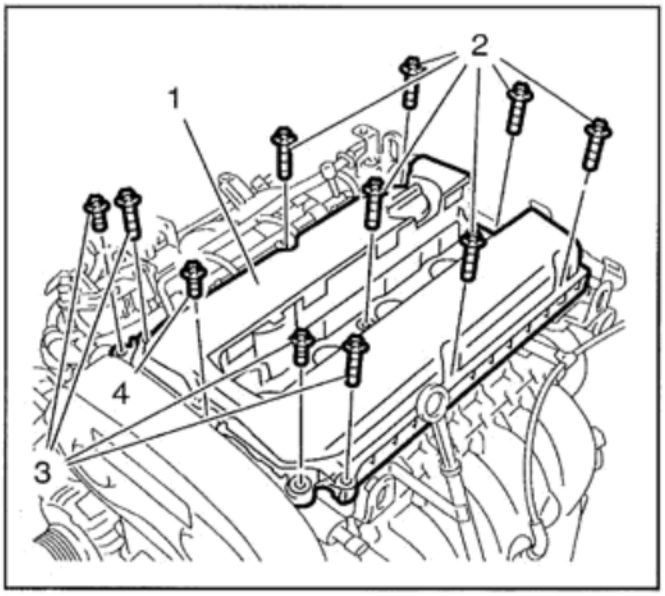
11. Install the first camshaft bearing cap (1) bolts and tighten to **8 N•m (71 lb in)**.



2373396

12. Install 2 NEW sealing rings to the camshafts.
13. Tighten the seal ring with *EN-422* installer (3) on the camshaft until this is in contact with the cylinder head.
14. To install, use camshaft sprocket bolt (1) in conjunction with shims (2) with a total thickness of approximately 10 mm.
15. Remove the *EN-422* installer (3).

Camshaft Cover Installation



3213247

1. Clean the bolt and the camshaft cover bolt (4) thread.
2. Apply sealant to the camshaft cover bolt (4). Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943*.
3. Insert a NEW gasket in the camshaft cover.
4. Install the camshaft cover (1).

Caution: Refer to *Fastener Caution on page 0-8*.

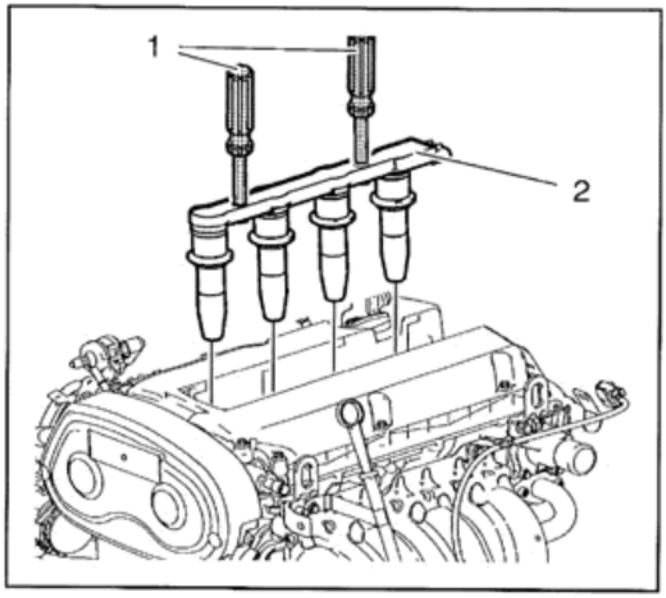
5. Install the 11 bolts (2, 3, 4) and tighten to **8 N•m (71 lb in)**.

Ignition Coil Installation

Special Tools

EN-6009 Remover/Installer Ignition Module

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2026537

1. Install the ignition coil module (2) with the *EN-6009* remover/installer (1).
2. Remove the *EN-6009* remover/installer (1).

Caution: Refer to *Fastener Caution on page 0-8*

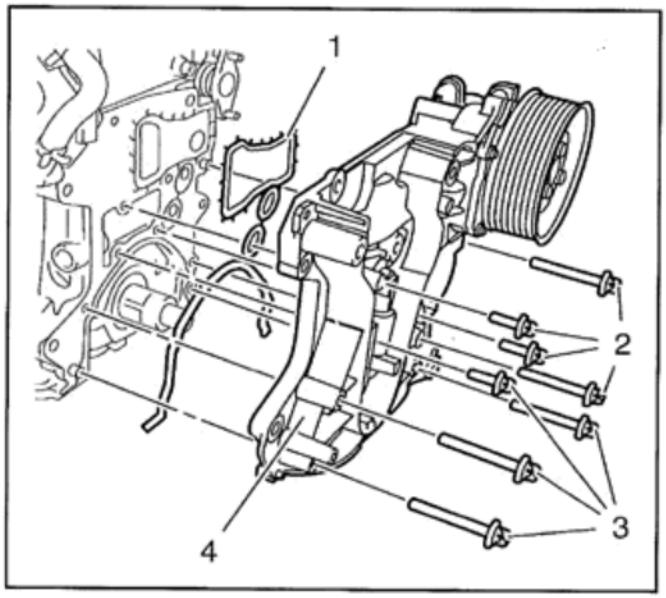
Note: Note the arrow on the cover.

3. Install the 2 ignition coil bolts and tighten to **8 N•m (71 lb in)**.

Note: Note the arrow on the cover.

4. Install the cover of the DIS ignition coil against the direction of the arrow.

Engine Front Cover and Oil Pump Installation



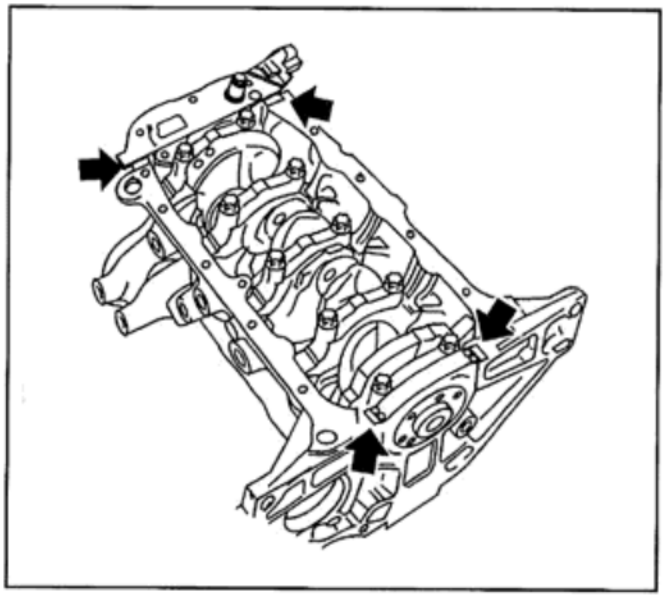
2026848

1. Install the NEW engine cover gasket (1).
2. Install the engine cover with the included oil pump (4).

Caution: Refer to *Fastener Caution on page 0-8.*

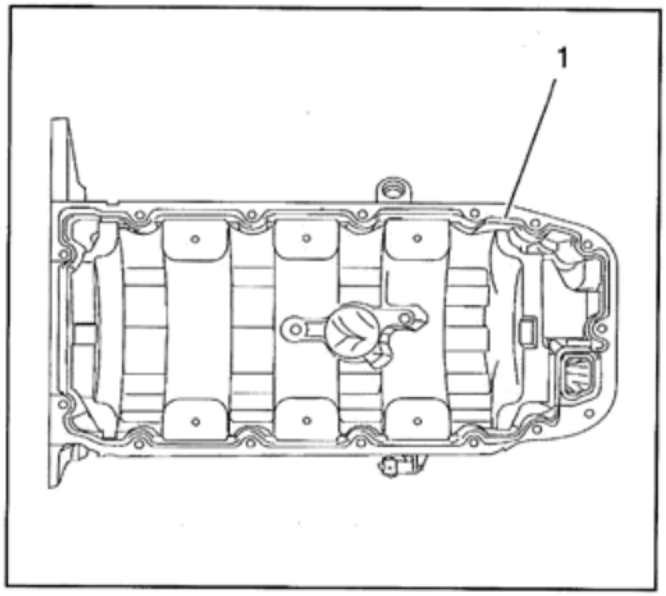
3. Install the 8 engine cover bolts (2, 3) and tighten to **20 N•m (15 lb ft)**.

Oil Pan Installation



1944491

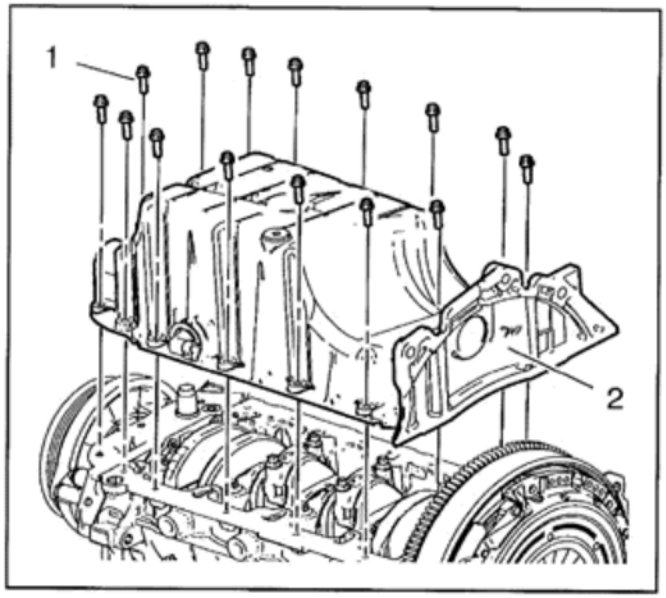
1. Clean the sealing surfaces.
2. Apply approximately a 3.5 mm (0.138 in) thick bead of oil pan sealant to the joints (arrows). Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943* for the recommended sealant.



2189266

Note: The assembly time, including torque check, must take no longer than 10 minutes.

3. Apply approximately a 3.5 mm (0.138 in) thick bead of oil pan sealant (1) to the oil pan. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943* for the recommended sealant.



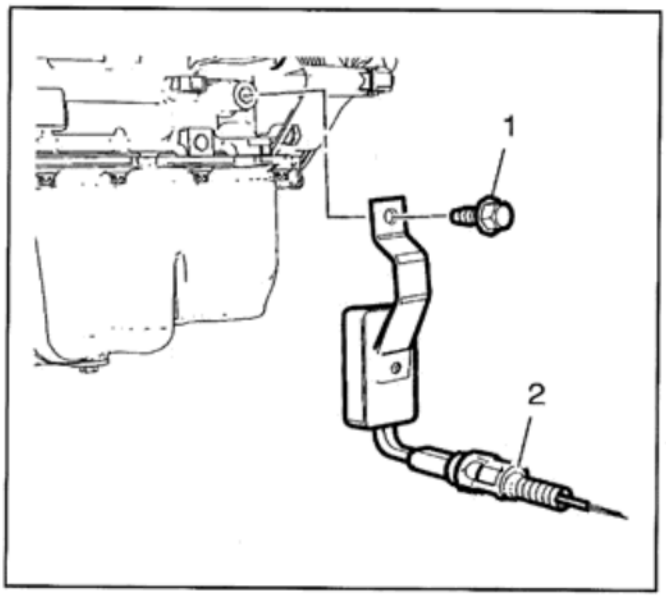
2027008

4. Install the oil pan (2).

Caution: Refer to *Fastener Caution on page 0-8*

5. Install the 15 oil pan bolts (1) on the cylinder block and tighten to **10** N•m **(89 lb in)**.

Engine Oil Heater Installation



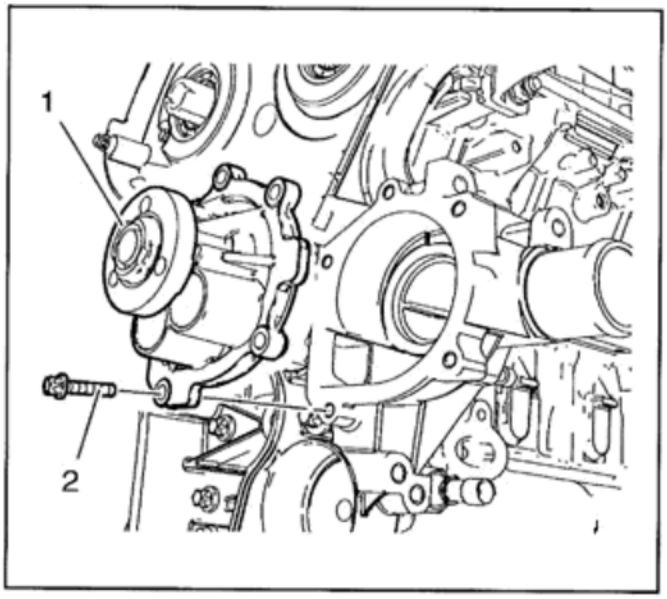
2372985

1. Install the engine oil heater (2).

Caution: Refer to *Fastener Caution on page 0-8.*

2. Install the engine oil heater bolt (1) and tighten to **40** N•m **(30 lb ft)**.

Water Pump Installation



2026886

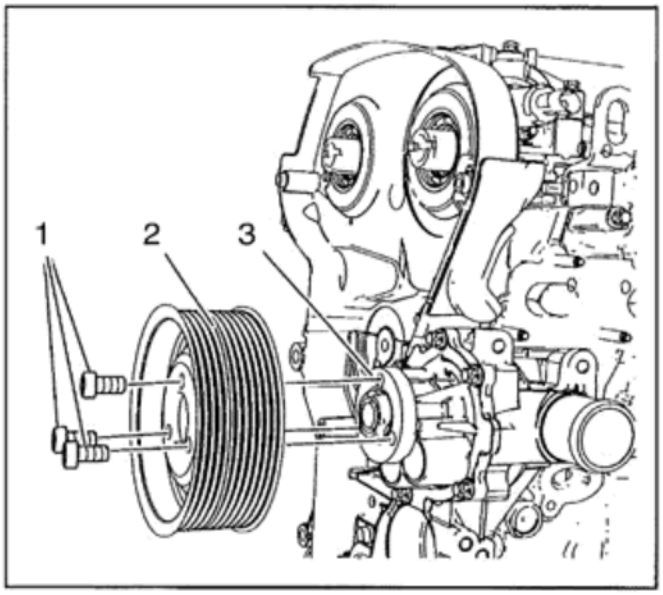
1. Clean the sealing surfaces and the 3 coolant pump threads.
2. Install NEW gasket.

Caution: Refer to *Fastener Caution on page 0-8.*

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10.*

3. Install the coolant pump (1).
4. Install 5 NEW bolts (2) and tighten to **8** N•m **(71 lb in)**.

Water Pump Pulley Installation



2026887

Note: Counterhold the crankshaft balancer. The belt has to be installed for this procedure.

1. Install the water pump pulley (2) to the water pump (3).

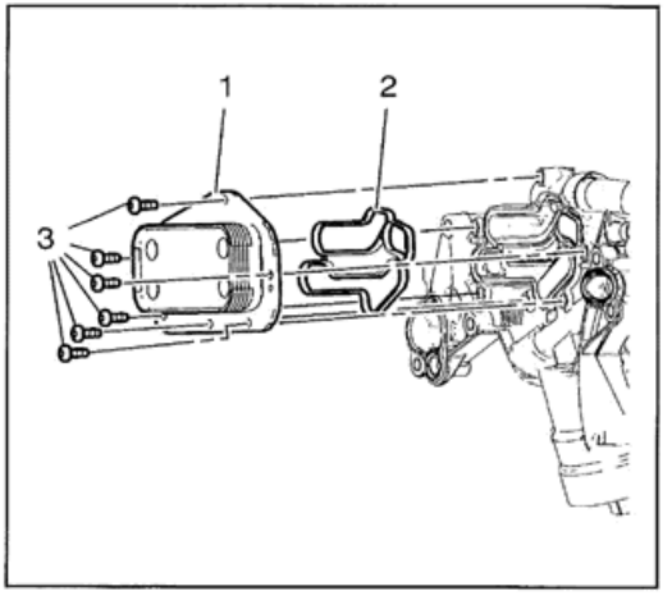
Caution: Refer to *Fastener Caution on page 0-8.*

2. Install the 3 water pump pulley bolts (1) with locking compound and tighten to **20** N•m **(15 lb ft)**.

   Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943.*

Engine Oil Cooler Installation

1. Clean the engine oil cooler to the oil filter housing sealing surfaces.



2188658

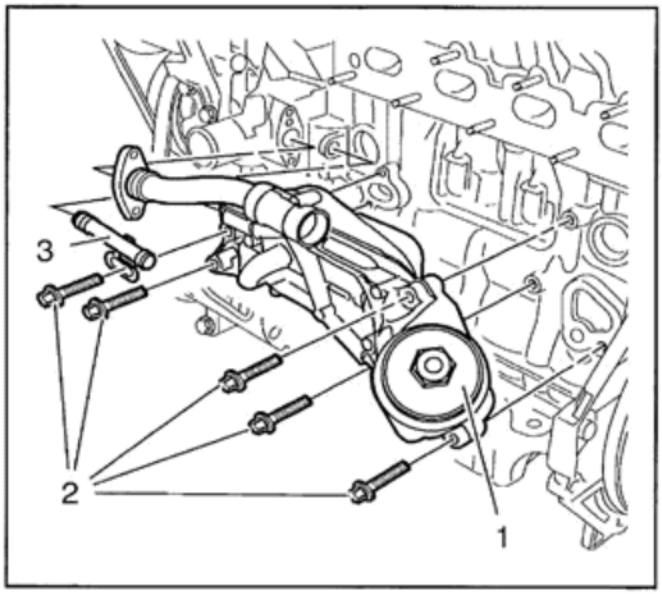
2. Install the NEW engine oil cooler gasket (2) and the engine oil cooler (1) to the engine oil cooler housing.

Caution: Refer to *Fastener Caution on page 0-8.*

3. Install the 6 engine oil cooler bolts (3) and tighten to **8** N•m **(71 lb in)**.

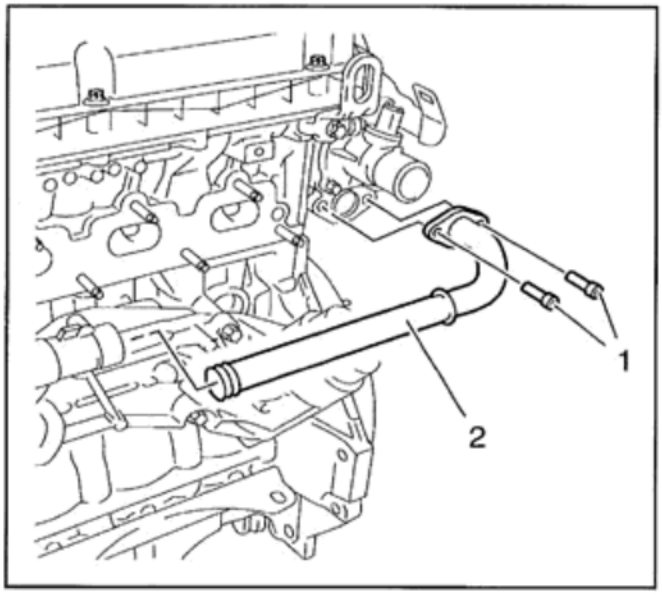
Engine Oil Cooler Housing Installation

1. Clean the engine oil cooler housing to thermostat housing sealing surfaces.
2. Install 2 NEW gaskets.



2026867

3. Install the engine oil cooler inlet pipe (3).
4. Install the engine oil cooler housing (1) and the 5 engine oil cooler bolts (2) and tighten to **25** N•m **(18 lb ft)**.



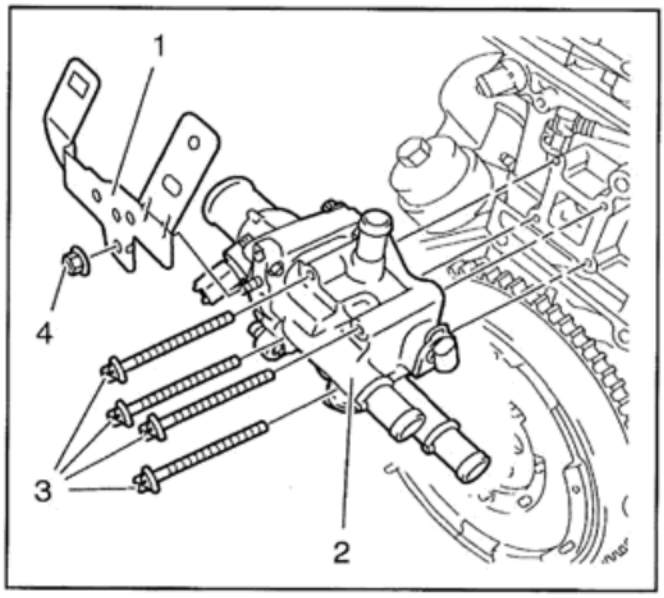
2026830

5. Install the thermostat housing coolant pipe (2) to the engine oil cooler housing.
6. Install the 2 thermostat housing coolant pipe bolts (1) and tighten to **8** N•m **(71 lb in)**.

Engine Coolant Thermostat Housing Installation

Caution: Refer to *Engine Coolant Thermostat Housing Caution on page 0-8.*

1. Clean sealing surface.
2. Install a NEW engine coolant thermostat housing seal.



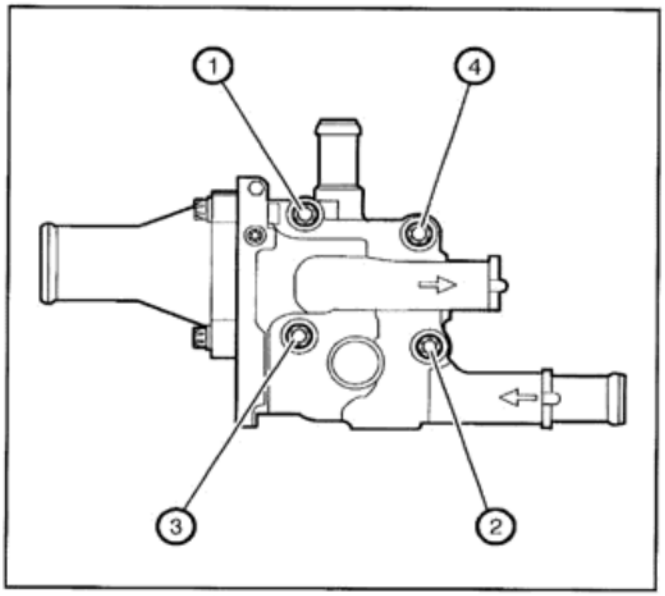
2026832

3. Install the engine coolant thermostat housing (2).

Caution: Refer to *Fastener Caution on page 0-8.*

Note: Screw in the 4 bolts until the engine coolant thermostat housing is in contact with the cylinder head.

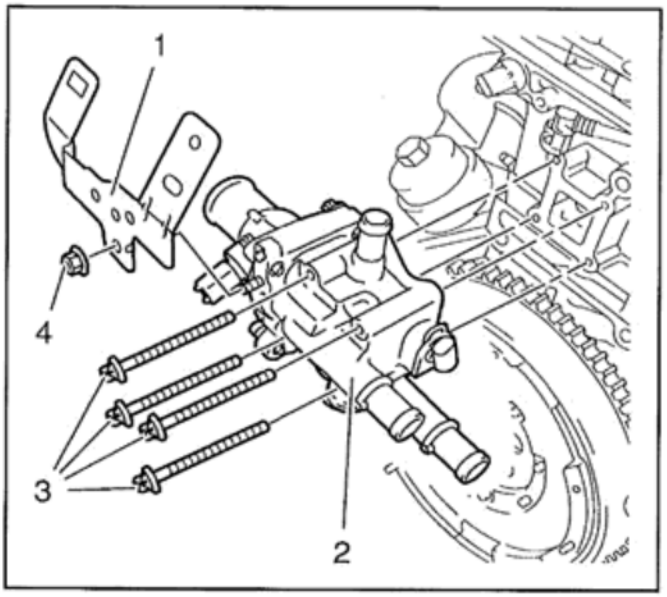
4. Install the 4 engine coolant thermostat housing bolts (3) and tighten to **2 N•m (18 lb in)**.



2028129

Caution: Following the proper fastener tightening sequence and torque is essential. Failure to do so may fracture the thermostat housing.

5. Tighten the 4 engine coolant thermostat housing bolts to **8 N•m (71 lb in)** in sequence (1–2–3–4).



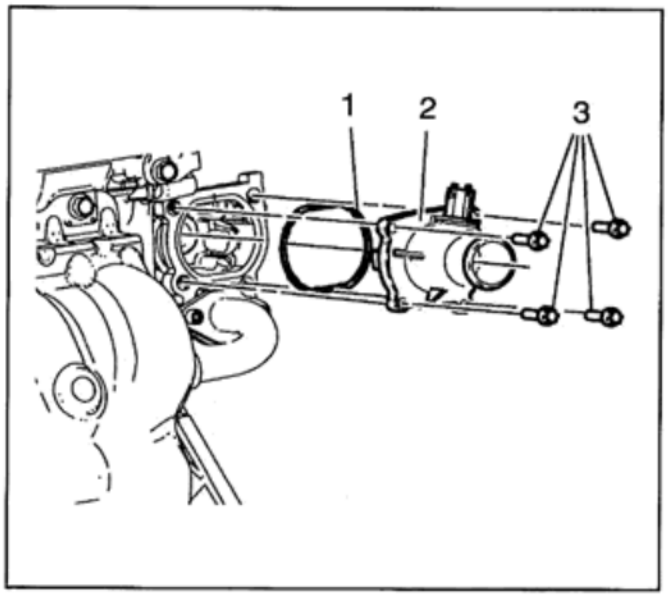
2026832

6. Install the engine coolant thermostat housing retainer (1).
7. Install the engine coolant thermostat housing retainer nut (4) and tighten to **6 N•m (53 lb in)**.

Engine Coolant Thermostat Installation

Caution: Refer to *Engine Coolant Thermostat Housing Caution on page 0-8.*

1. Clean the engine coolant sealing surfaces.



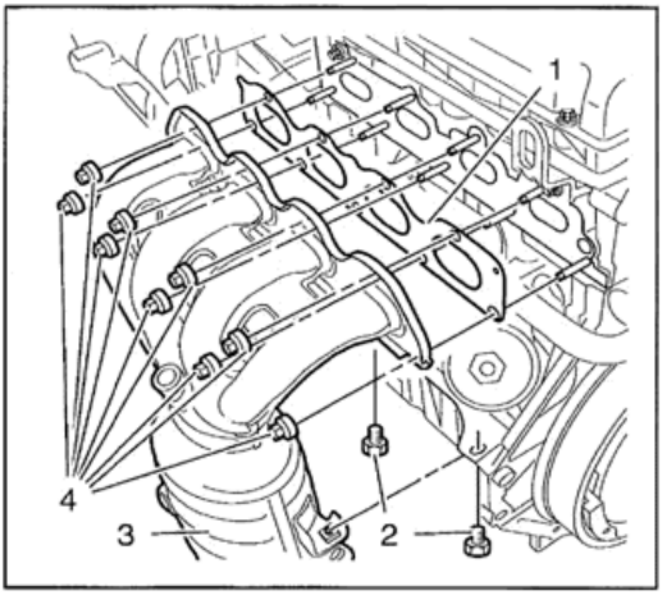
2028006

2. Install the engine coolant seal (1).
3. Install the engine coolant thermostat assembly (2).

Caution: Refer to *Fastener Caution on page 0-8.*

4. Install the 4 engine coolant thermostat bolts (3) and tighten to **8 N•m (71 lb in)**.

Exhaust Manifold Installation



2026825

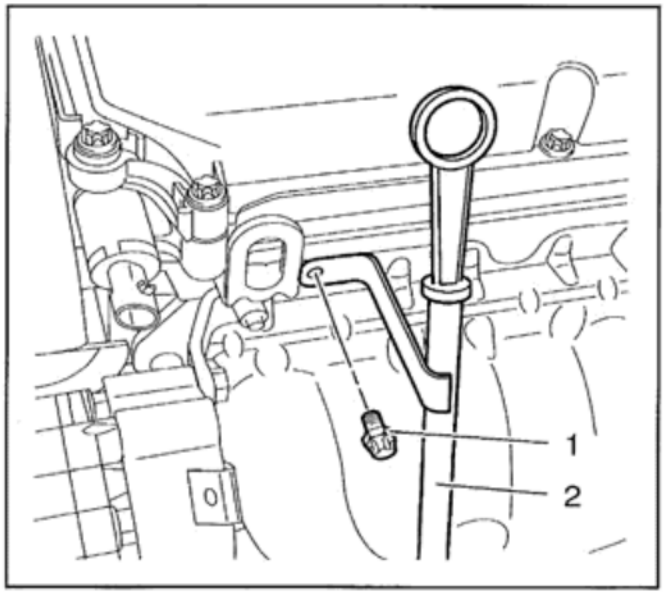
1. Clean the exhaust manifold sealing surface.
2. Install a NEW exhaust manifold gasket (1) to the cylinder head.

Caution: Refer to *Fastener Caution on page 0-8.*

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10.*

3. Install the exhaust manifold (3) and tighten the NEW nuts (4) to **20 N•m (15 lb ft)**.
4. Install the 2 exhaust manifold bracket bolts (2) to **20 N•m (15 lb ft)**.

Oil Level Indicator and Tube Installation



2026827

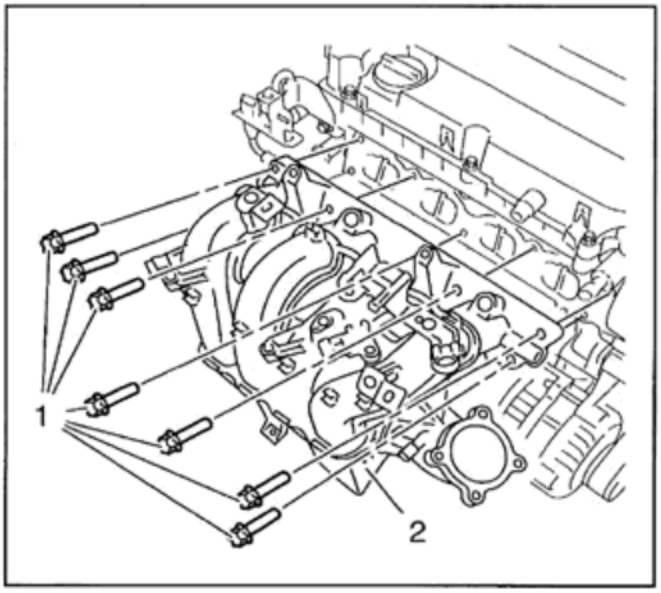
1. Install a NEW oil level indicator tube gasket.
2. Install the oil level indicator tube (2).

Caution: Refer to *Fastener Caution on page 0-8.*

3. Install the oil level indicator tube bolt (1) and tighten to **15 N•m (11 lb ft)**.
4. Install the oil dipstick.

Intake Manifold Installation (1.6L LDE)

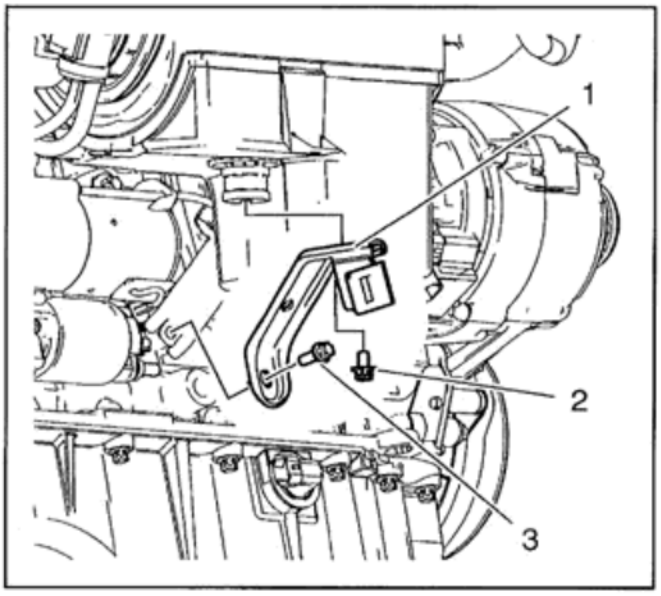
1. Clean the sealing surfaces.
2. Insert the NEW gasket.



2026837

Caution: Refer to *Fastener Caution on page 0-8.*

3. Install the intake manifold (2) and the 7 intake manifold bolts (1) and tighten to **20 N•m (15 lb ft)**.

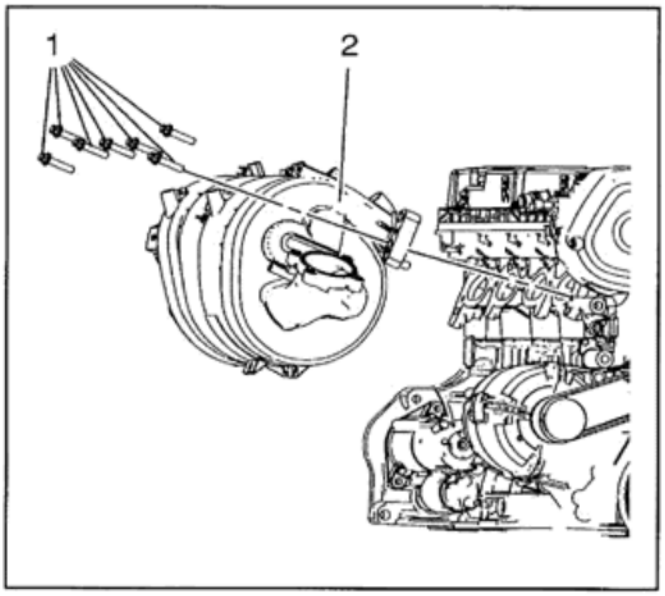


2026538

4. Install the intake manifold support (1) and the 2 bolts (2, 3) and tighten to **8 N•m (71 lb in)**.

Intake Manifold Installation (1.8L LUW and LWE)

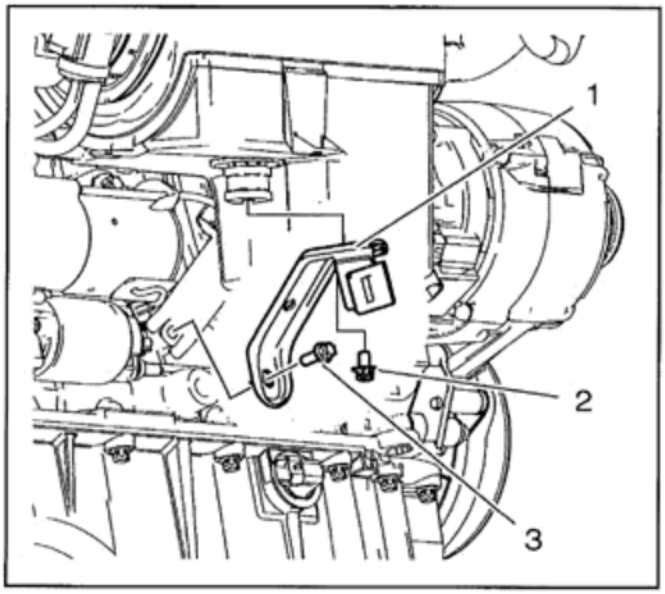
1. Clean the sealing surfaces.
2. Install 4 NEW gaskets.



2026541

Caution: Refer to *Fastener Caution on page 0-8.*

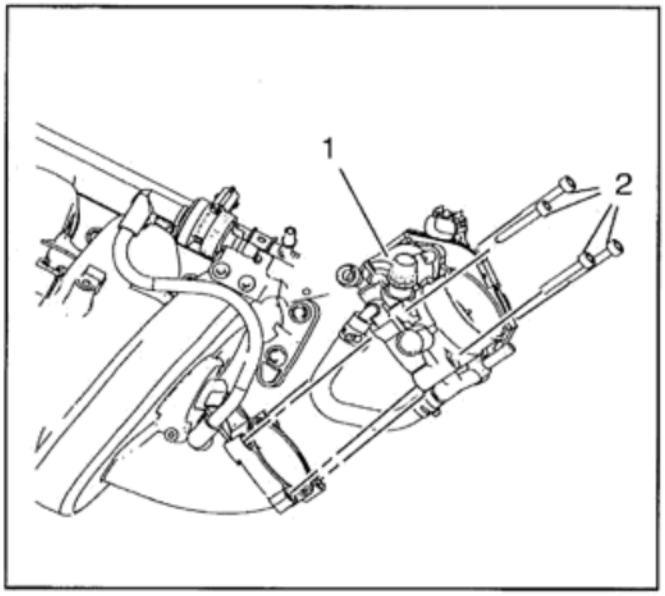
3. Install the intake manifold (2) and the 7 intake manifold bolts (1) and tighten to **20 N•m (15 lb ft)**.



2026538

4. Install the intake manifold brace (1).
5. Install the 2 intake manifold brace bolts (2, 3) and tighten to **8 N•m (71 lb in)**.

Throttle Body Assembly Installation



2027010

1. Install a NEW throttle body seal.
2. Install the throttle body (1).

Caution: Refer to *Fastener Caution on page 0-8.*

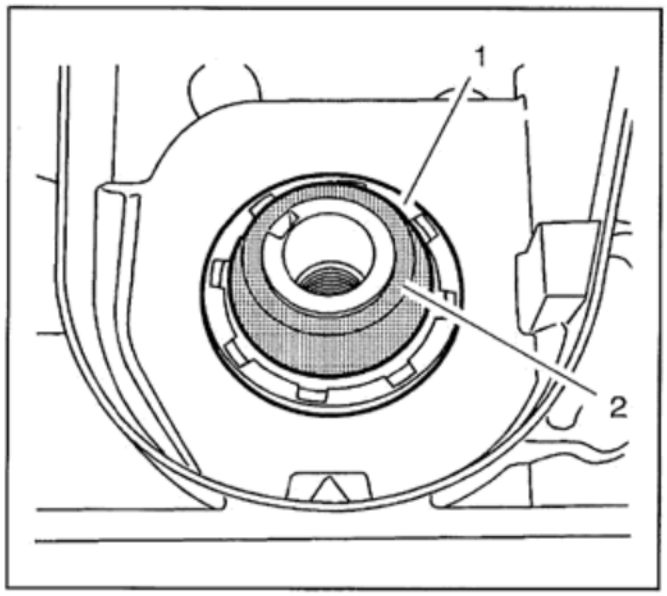
3. Install the 4 throttle body bolts (2) and tighten to **8 N•m (71 lb in)**.

Crankshaft Front Oil Seal Installation

Special Tools

EN-6351 Mounting Sleeves

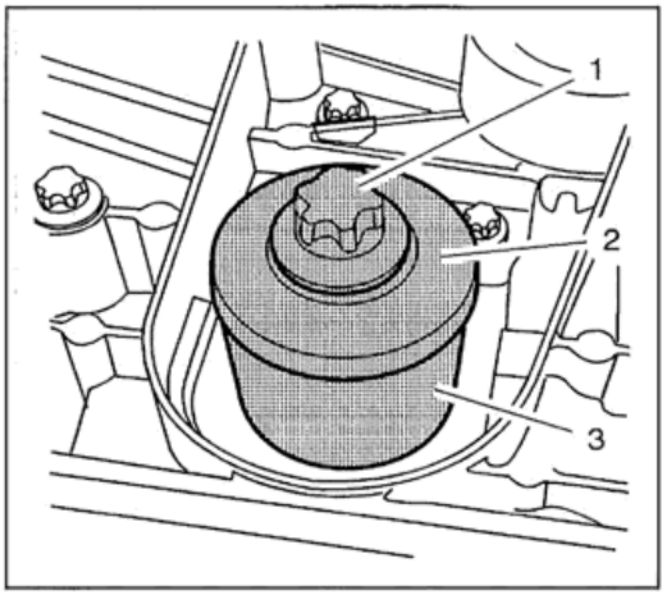
For equivalent regional tools, refer to *Special Tools on page 9-1135.*



2373394

1. Clean the sealing surfaces.
2. Slide the *EN-6351* sleeves (2) protective sleeve onto the crankshaft journal.

3. Slide the crankshaft front oil seal (1) over the protective sleeve on the crankshaft journal.

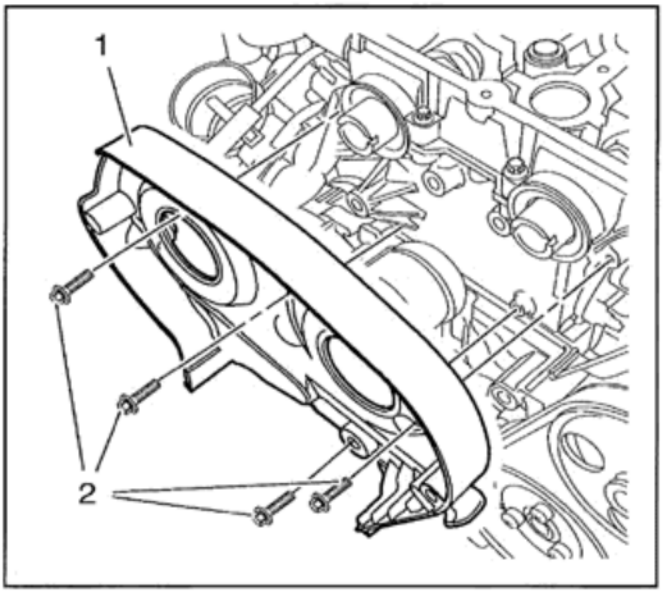


2373395

4. Remove the protective sleeve, and using the *EN-6351* sleeves (3), press the seal ring into the pump housing.
5. Use the crankshaft drive gear bolt (1) and washer (2) to press in the crankshaft front oil seal.

Timing Belt Rear Cover Installation

1. Re-cut the 4 rear timing belt cover threads.



2026845

2. Install the timing belt rear cover (1).

Caution: Refer to *Fastener Caution on page 0-8*.

Note: Service may offer bolts that are not microencapsulated. If this is the case apply thread lock agent to the bolt. If fastener is microencapsulated, install a NEW 4 timing belt rear cover bolts. DO NOT reuse the old bolt.

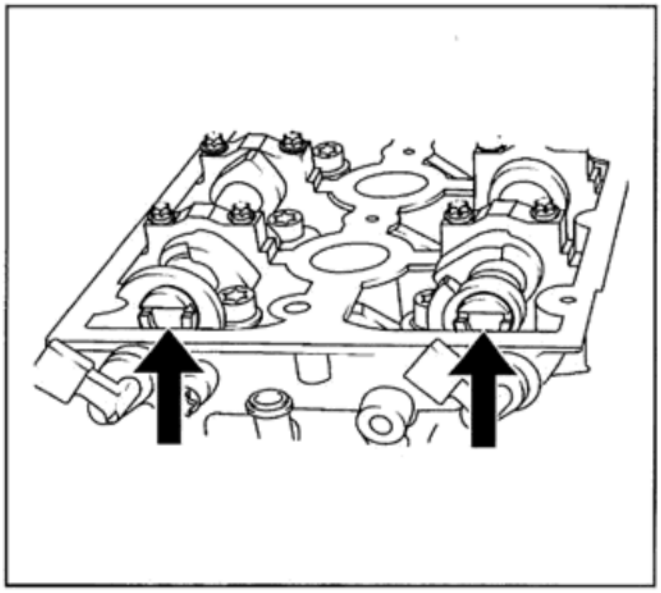
3. Install the 4 NEW timing belt rear cover bolts (2) and tighten to **6 N•m (53 lb in)**.

Camshaft Position Actuator Adjuster Installation

Special Tools

- *EN-6340* Camshaft Adjuster Locking Tool
- *EN-6628-A* Camshaft Locking Tool
- *EN-45059* Angle Meter

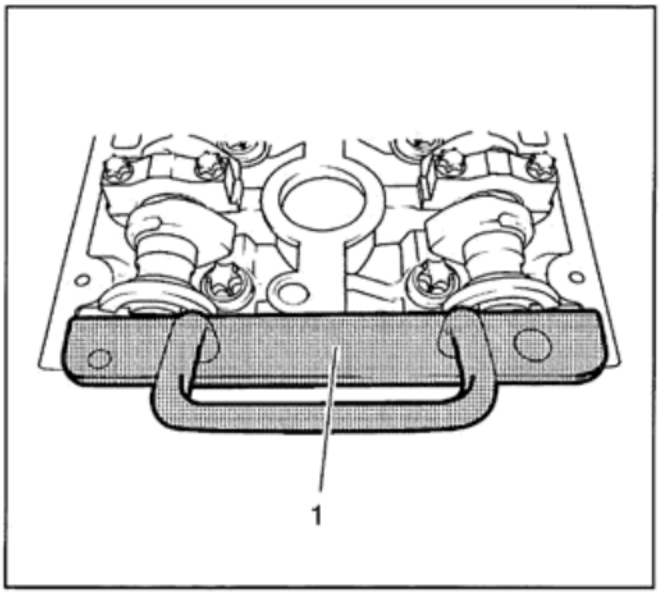
For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2026512

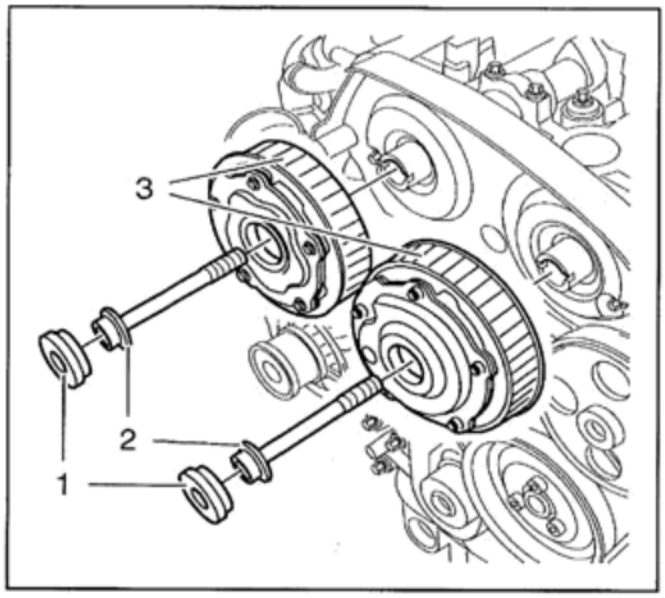
Note: Note the arrows.

1. Turn the camshaft by the hexagon until the groove on the end of the camshafts is horizontal.



2026534

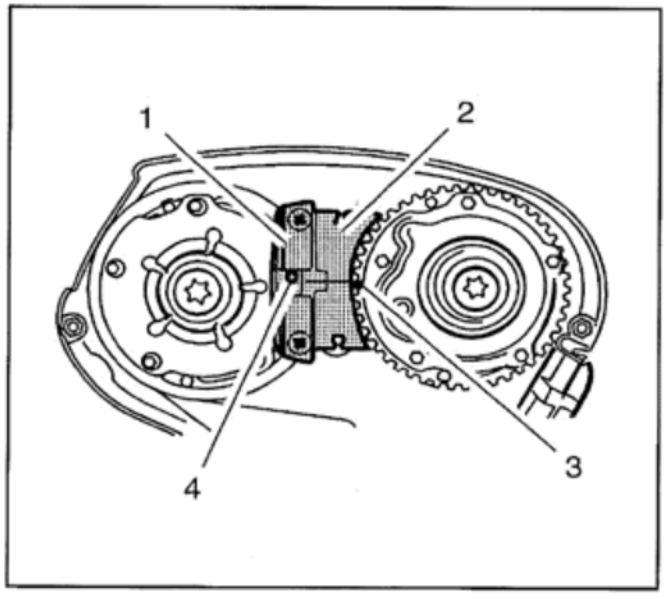
2. Install the *EN-6628-A* locking tool (1).



2026844

Note: If the cover is contaminated with oil, you have to clean it close.

3. Install intake camshaft position actuator adjuster and/or the exhaust camshaft position actuator adjuster (3).
4. Install a NEW intake camshaft position actuator adjuster bolt and/or a NEW exhaust camshaft position actuator adjuster bolt (2). DO NOT tighten the bolts yet.



2373398

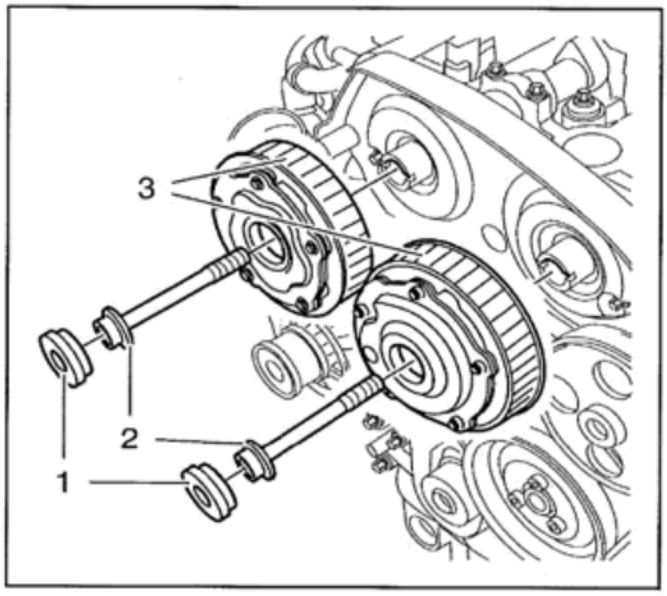
5. Install the *EN-6340* locking tool into the camshaft position actuator adjusters.

Note: The spot type marking (4) on the intake camshaft position actuator adjuster does not correspond to the groove of *EN-6340-left* locking tool - left during this process but must be somewhat above as shown.

5.1. Install the *EN-6340-left* locking tool (1) in the camshaft position actuator adjusters as shown.

Note: The spot type marking (3) on the exhaust camshaft position actuator adjuster must correspond to the groove on *EN-6340-left* locking tool - right.

5.2. Install the *EN-6340-right* locking tool (2) in the camshaft position actuator adjusters as shown.



2026844

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

Note: A second technician is required.

Note: Use an appropriate open-end wrench in order to counterhold the camshaft hexagon. A thin cross-section wrench is required for a better fit. The usage of EN-6628-A locking tool is for the camshaft adjustment to prevent misalignment of the camshafts. The wrench is required to counterhold the camshafts during bolt torque procedure.

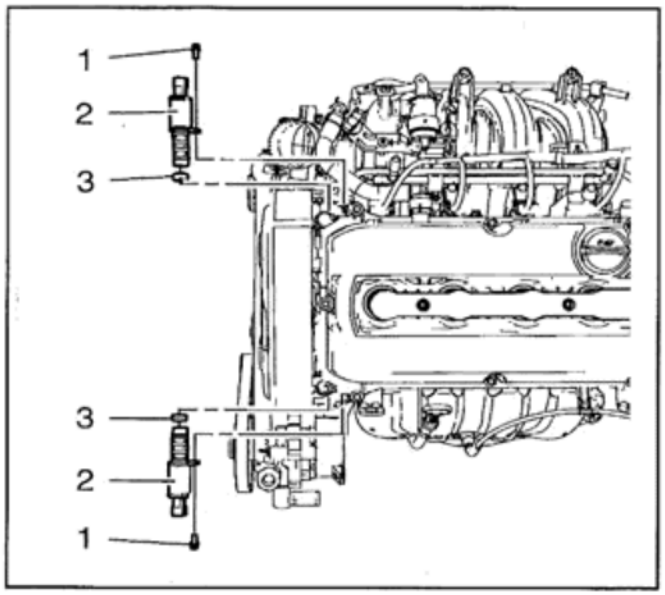
6. Install the camshaft position actuator adjuster bolts (2) and tighten the bolts in 3 passes using the *EN-45059* meter.
   6.1. First pass to **50** N•m **(37 lb ft)**
   6.2. Second pass to an additional **150 degrees**
   6.3. Final pass to an additional **15 degrees**

Note: Check the closure bolt seal ring.

7. Install the 2 camshaft position actuator adjuster closure plugs (1) and tighten to **30** N•m **(22 lb ft)**.
8. Remove the *EN-6628-A* locking tool.

9. After the installation of the timing belt, rotate the engine 720 degrees and check the position of the crankshaft and camshafts, again. Refer to *Timing Belt Adjustment on page 9-1062*.

Camshaft Position Actuator Solenoid Valve Installation



2028075

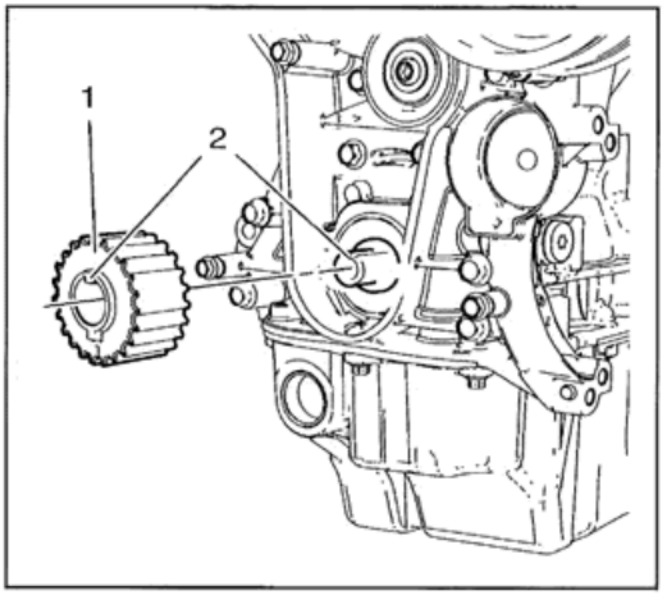
Note: Lubricate the NEW camshaft position actuator solenoid valve seals with NEW engine oil. Refer to *Adhesives, Fluids, Lubricants, and Sealers on page 9-943*.

1. Install NEW camshaft position actuator solenoid valve seals (3).
2. Install the camshaft position actuator solenoid valves (2).

Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the camshaft position actuator solenoid valve bolts (1) and tighten to **6 N•m (53 lb in)**.

Crankshaft Sprocket Installation



2028278

Note: When installing the crankshaft sprocket, the cam and the groove must align (2).

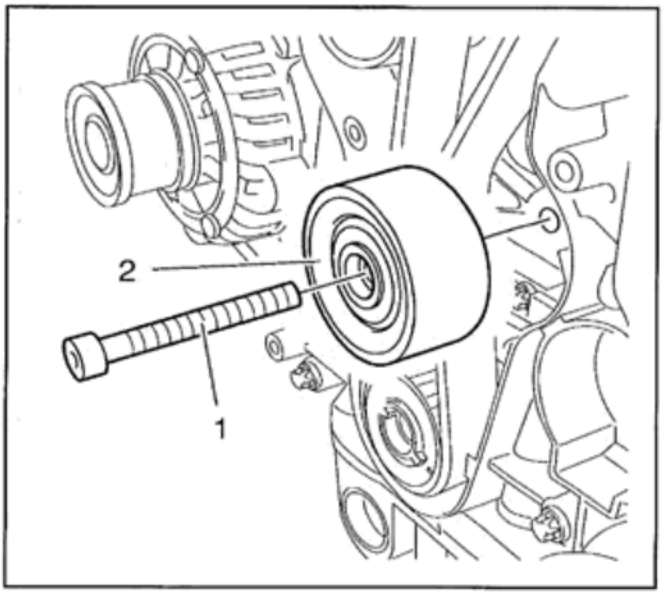
Install the crankshaft sprocket (1).

Timing Belt Idler Pulley Installation

Special Tools

EN-45059 Angle Meter

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2026843

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

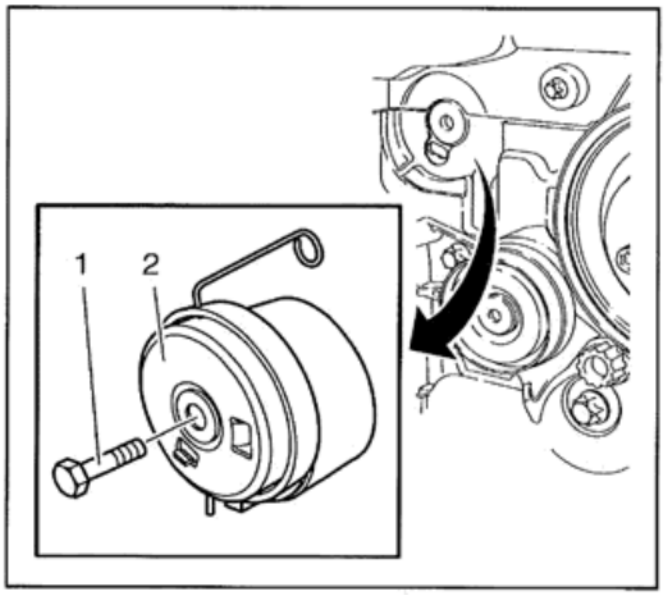
1. Re-cut the timing belt idler pulley thread.
2. Install the timing belt idler pulley (2) and tighten the NEW timing belt idler pulley bolt (1) a first pass to **20 N•m (15 lb ft)**.

3. Tighten the NEW timing belt idler pulley bolt a second pass to an additional **120 degrees**, using the *EN-45059* meter.
4. Tighten the NEW timing belt idler pulley bolt a final pass to an additional **15 degrees**, using the *EN-45059* meter.

Timing Belt Tensioner Installation

Special Tools

EN-45059 Angle Meter



2027017

1. Clean the timing belt tensioner thread.
2. Install the timing belt tensioner (2).

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

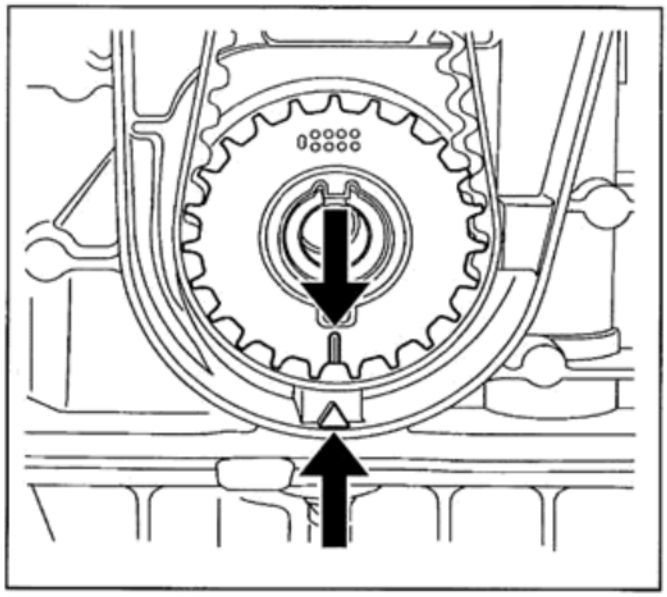
3. Install a NEW timing belt tensioner bolt (1) and tighten the bolt in 3 passes using the *EN-45059* meter.
   3.1. First pass to **20** N•m **(15 lb ft)**.
   3.2. Second pass to an additional **120 degrees**.
   3.3. Final pass to an additional **15 degrees**.

Timing Belt Installation

Special Tools

- *EN-6333* Locking Pin
- *EN-6340* Locking Tool

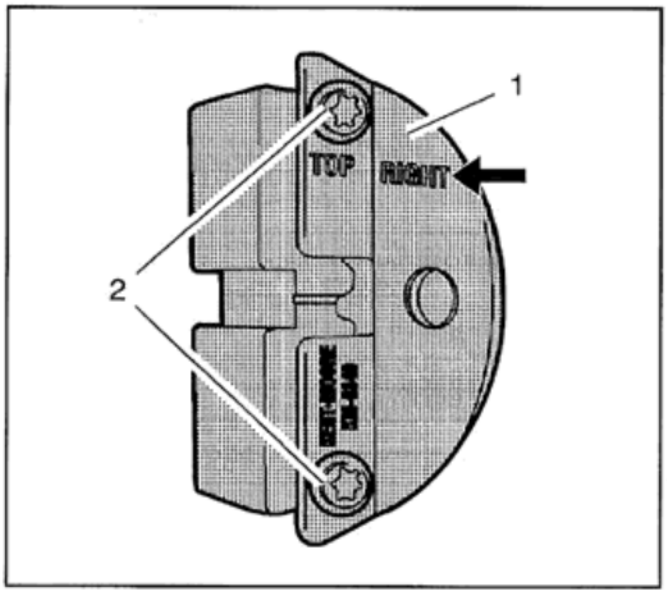
For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2027014

Note: The timing belt drive gear and oil pump housing must align.

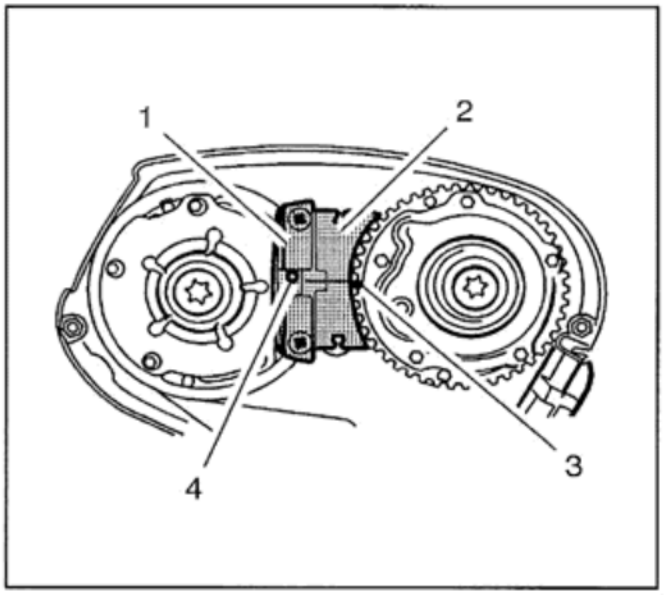
1. Turn the crankshaft in the direction of engine rotation, by the crankshaft balancer bolt, to cylinder 1 TDC of combustion stroke.



2373397

Note: The right half of the *EN-6340* locking tool can be recognized by the lettering right, arrow, on the tool.

2. Prepare the right half of the *EN-6340* locking tool.
   2.1. Remove the 2 bolts (2).
   2.2. Detach the front panel (1) from the *EN-6340* locking tool - right.

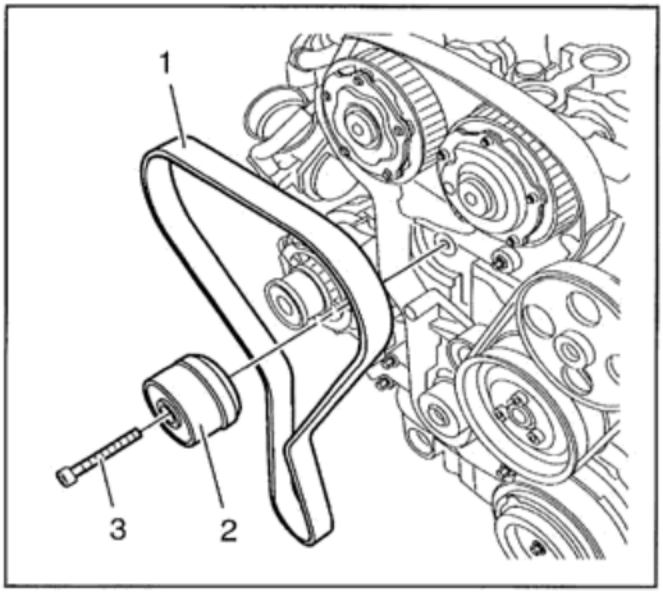


2373398

Note:

- The spot type marking (4) on the intake camshaft adjuster does not correspond to the groove of the *EN-6340* locking tool - left (1) during this process, but must be somewhat above.
- The spot type marking (3) on the exhaust camshaft adjuster must correspond to the groove on *EN-6340* locking tool - right (2).

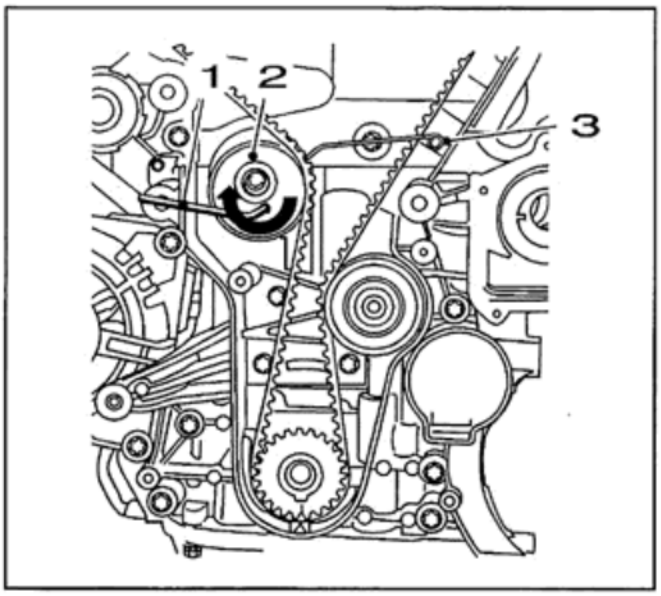
3. Insert the *EN-6340* locking tool - left (1) and the *EN-6340* locking tool - right (2) in the camshaft adjuster.



2026841

Note: Observe direction of rotation.

4. Insert the timing belt (1).



1937014

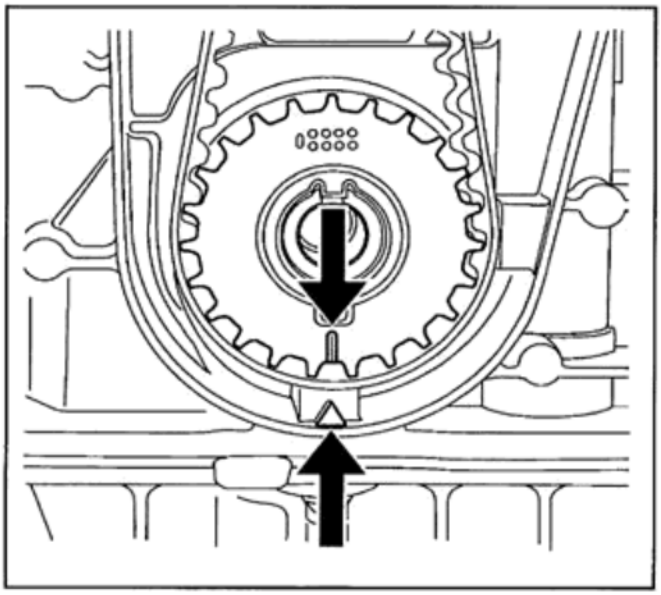
5. Apply tension to the timing belt tensioner (2) in the direction of the arrow, using an Allen key (1).
6. Remove the *EN-6333* locking pin (3).

Note: The timing belt tensioner moves automatically to the correct position.

7. Release tension on timing belt tensioner.
8. Remove the *EN-6340* locking tool.
9. Check position of the camshaft sprocket.
   9.1. Turn crankshaft 720° in the direction of engine rotation by the crankshaft balancer bolt.

Note: Note the marking on the camshaft sprocket.

   9.2. Insert *EN-6340* locking tool into camshaft sprockets.

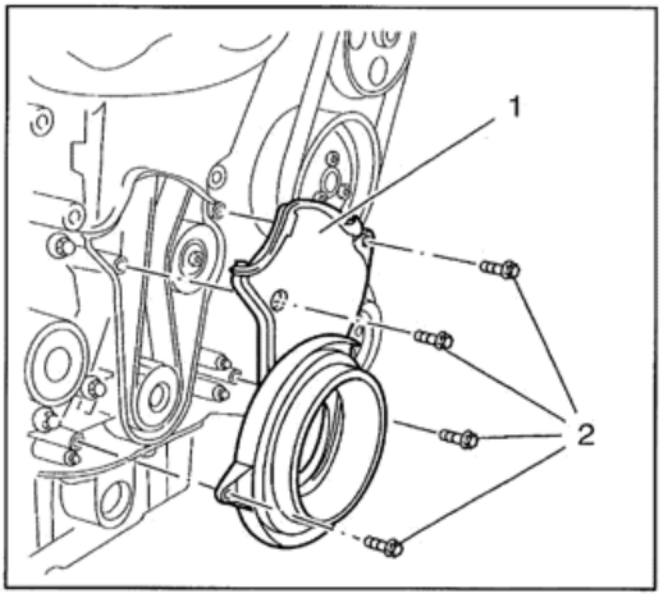


2027014

Note: The timing belt drive gear and oil pump housing must align.

10. Check the crankshaft position.

Timing Belt Lower Front Cover Installation



2026840

Caution: Refer to *Fastener Caution on page 0-8.*

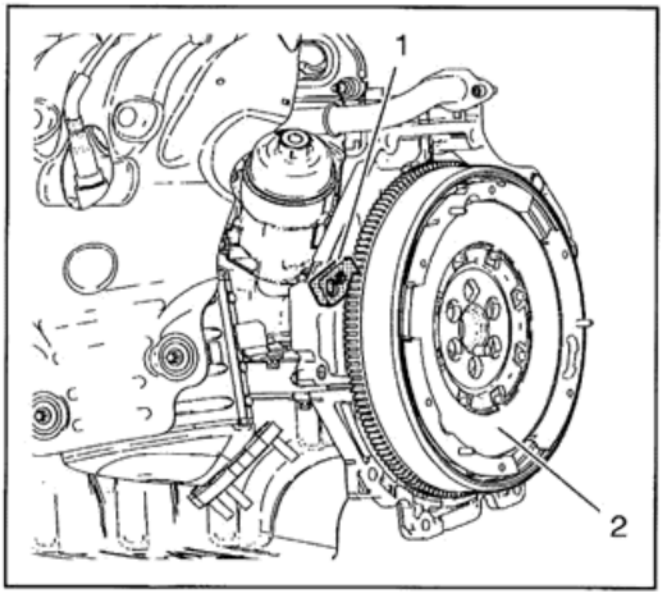
Install the timing belt cover (1) and tighten the 4 timing belt lower front cover bolts (2) to **6** N•m **(53 lb in)**.

Crankshaft Balancer Installation

Special Tools

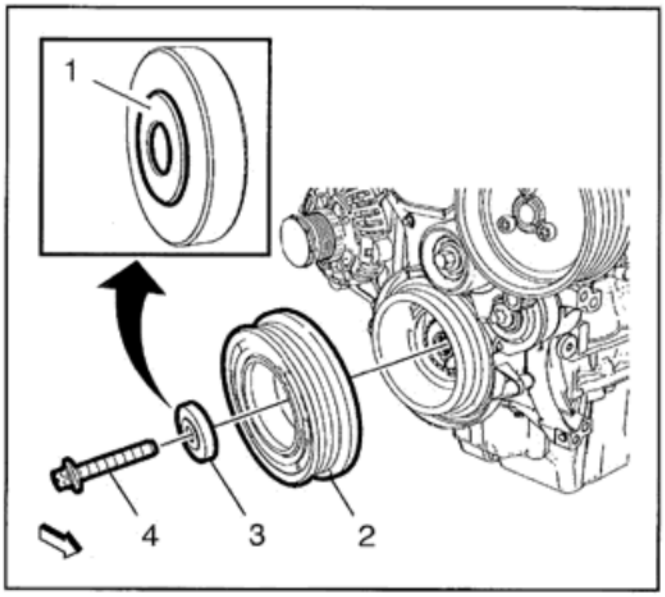
- *EN-652* Flywheel Holder
- *EN-45059* Angle Meter

For equivalent regional tools, refer to *Special Tools on page 9-1135.*



2026535

1. Install the *EN-652* holder (1), lock the flywheel (2) or the automatic transmission flex plate via the starter ring gear.



2814173

Note: Use care that the height (1) of the washer is facing towards the bolt.

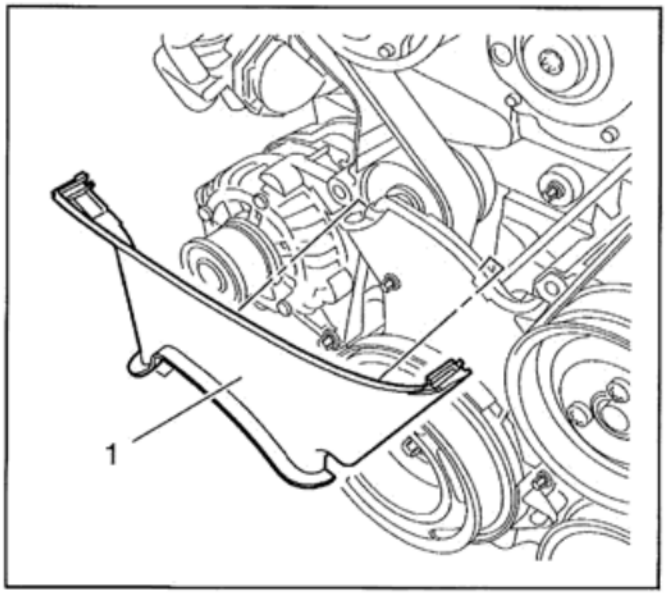
2. Install the crankshaft balancer (2) and the washer (3).

Caution: Refer to *Fastener Caution on page 0-8.*

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10.*

3. Install a NEW crankshaft balancer bolt (4) and tighten the bolt in 3 passes using the *EN-45059* meter
   - 3.1. First pass to **95** N•m **(70 lb ft)**.
   - 3.2. Second pass to an additional **45°**,
   - 3.3. Final pass to an additional **15°**.

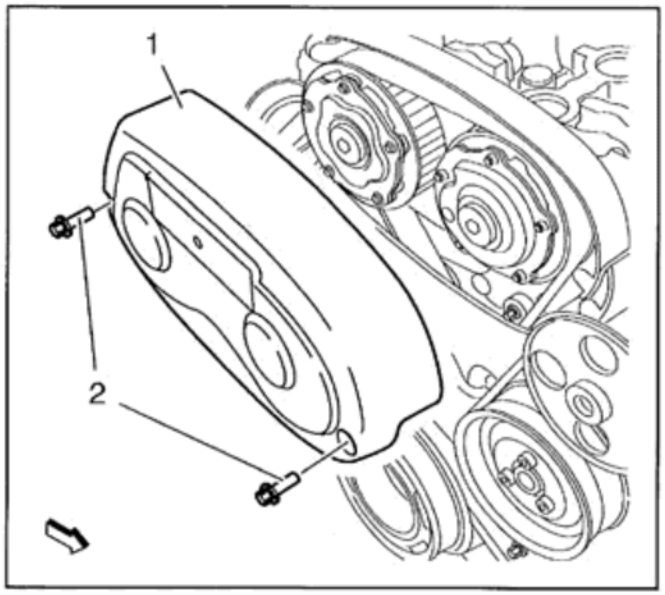
Timing Belt Center Front Cover Installation



2026839

Install the timing belt center front cover (1) to the timing belt rear cover at 2 locations.

Timing Belt Upper Front Cover Installation



2027572

1. Install the timing belt upper front cover (1).

Caution: Refer to *Fastener Caution on page 0-8*.

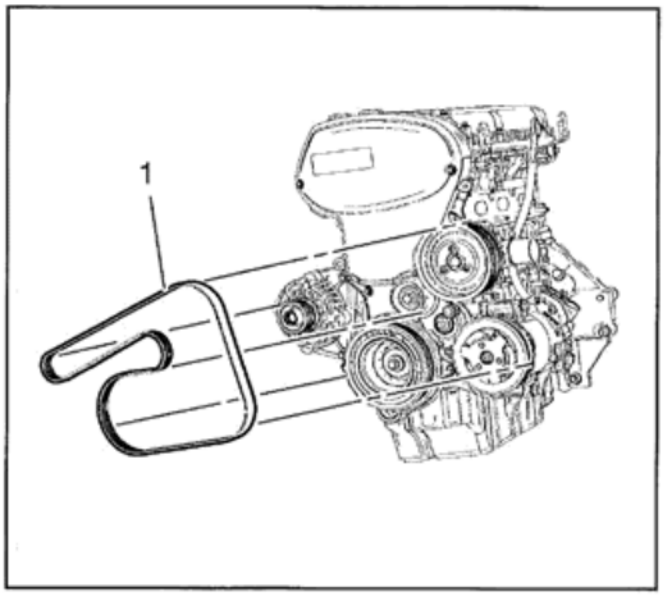
2. Install the 2 timing belt upper front cover bolts (2) and tighten to **6 N·m(53 lb in)**.

Drive Belt Installation

Special Tools

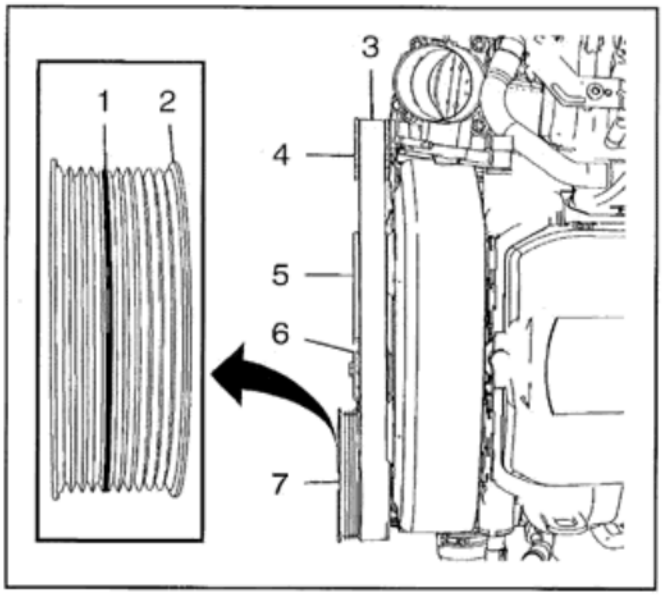
EN–6349 Locking Pin

For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2191162

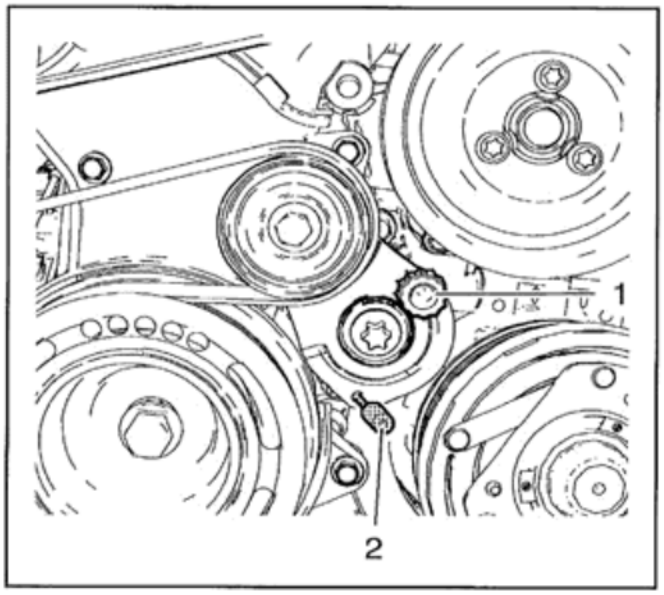
1. Install the drive belt (1).



2547260

Note: Make sure that the drive belt is aligned on the generator pulley (4), crankshaft balancer (5), drive belt tensioner (6) and water pump pulley (7). The drive belt must lie on the water pump pulley between the flange (1) and (2).

2. Check the position of the drive belt (3).



2189264

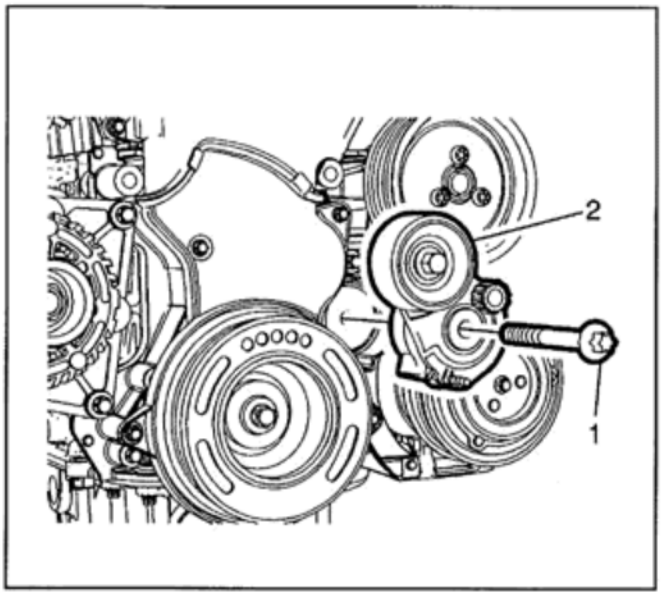
3. Release tension to the tensioner counterclockwise (1).

Note: Allow tensioner to slide back slowly.

4. Remove *EN–6349* pin (2).
5. Apply tension to the tensioner at projection (1) clockwise.

Drive Belt Tensioner Installation

1. Clean the drive belt tensioner thread.



2495148

2. Install drive belt tensioner (2).

Caution: Refer to *Fastener Caution on page 0-8*.

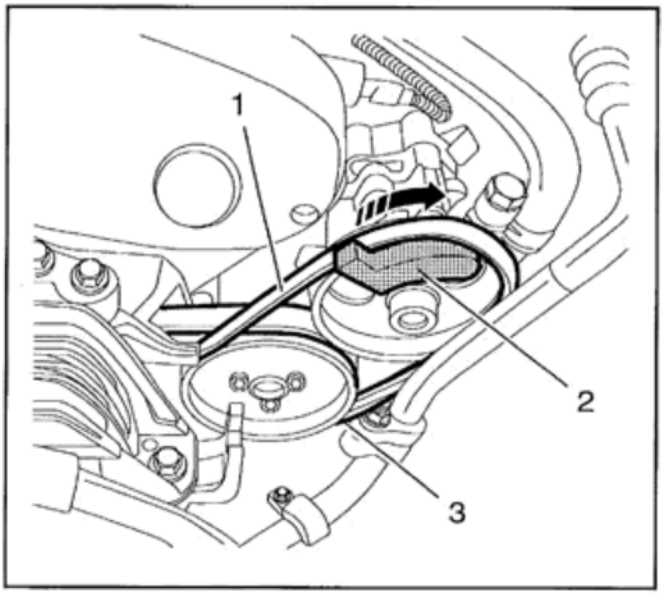
3. Install drive belt tensioner bolt (1) and tighten to **55** N•m **(41 lb ft)**.

Power Steering Pump Belt Installation

Special Tools

EN-50098 Belt Installer

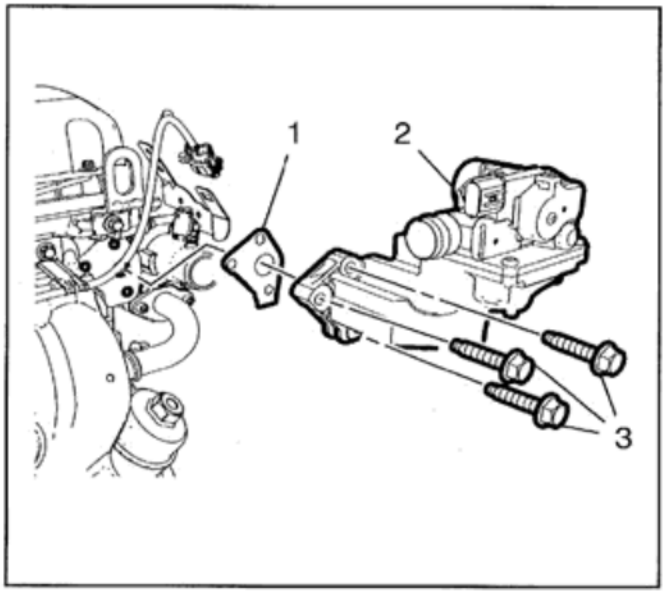
For equivalent regional tools, refer to *Special Tools on page 9-1135*.



2191708

1. Install *EN-50098* installer (2) and a NEW power steering pump belt (1) to water pump pulley and power steering pump pulley.
2. Turn the engine slowly clockwise at the crankshaft balancer bolt.
3. During turn the engine take care of the proper installation of the power steering pump belt to the water pump pulley (3).
4. Remove the *EN-50098* installer (2).
5. Check the power steering pump belt is installed clearly.

Secondary Air Injection Check Valve Installation



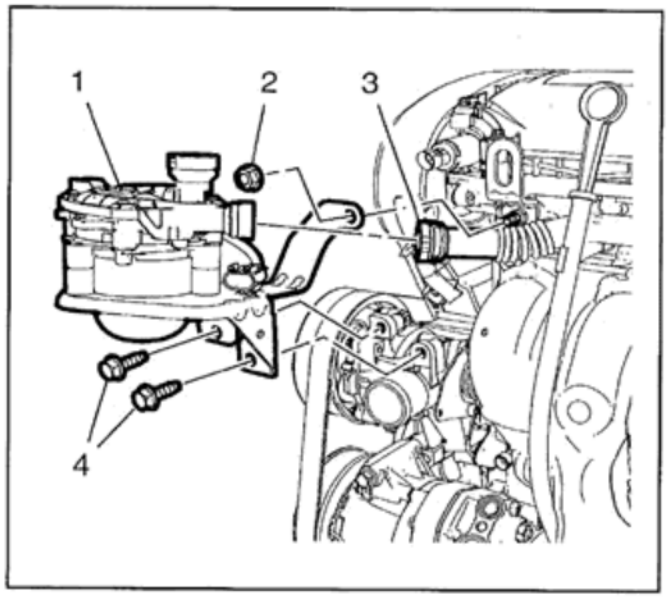
2781590

1. Install a NEW secondary air injection check valve gasket (1).
2. Install the secondary air injection check valve (2).

Caution: Refer to *Fastener Caution on page 0-8*.

3. Install the 3 secondary air injection check valve bolts (3) and tighten to **22** N•m **(16 lb ft)**.

Secondary Air Injection Pump Installation



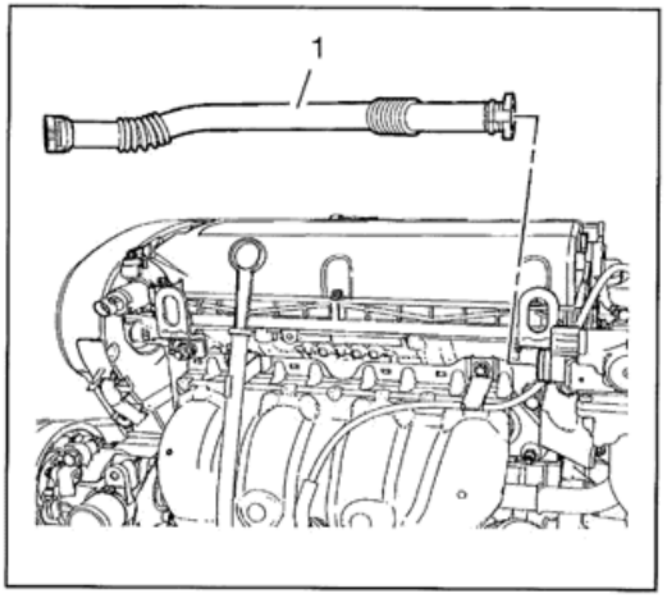
2781588

1. Install the secondary air injection pump (1).
2. Loosely install the secondary air injection pump nut (2) and the 2 secondary air injection pump bolts (4).

Caution: Refer to *Fastener Caution on page 0-8*.

3. Tighten the secondary air injection pump nut (2) and the 2 secondary air injection pump bolts (4) to **22 N•m (16 lb ft)**.
4. Connect the secondary air injection pump pipe (3). Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.

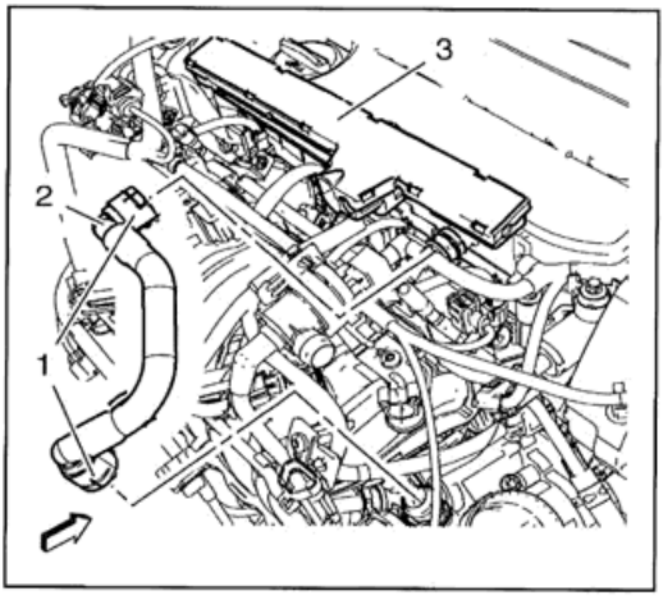
Secondary Air Injection Pump Pipe Installation



2781589

1. Connect the secondary air injection pump pipe (3) to the secondary air injection check valve. Refer to *Plastic Collar Quick Connect Fitting Service on page 9-547*.

Positive Crankcase Ventilation Pipe Installation



2027614

1. Install the positive crankcase ventilation tube (2).
2. Connect the 2 positive crankcase ventilation tube connectors (1).
3. Clip in the ECM wiring harness guide (3) to the cylinder head cover.

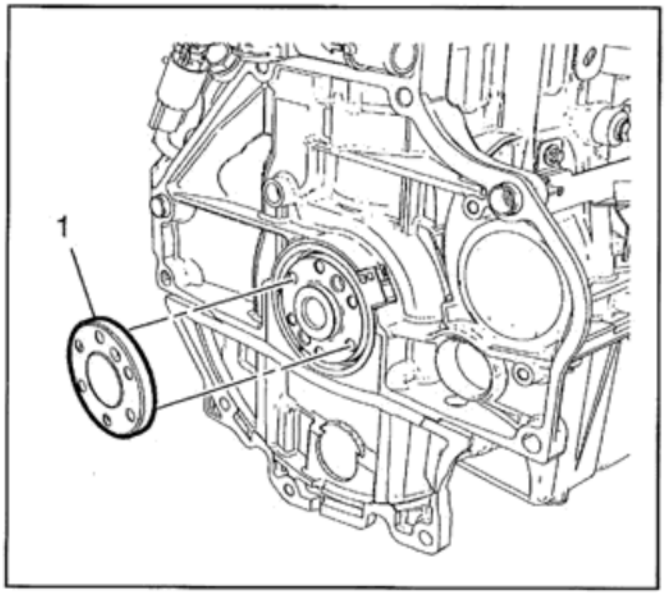
Engine Flywheel Installation

Special Tools

- *EN-652* Flywheel Holder
- *EN-45059* Torque Angle Sensor Kit

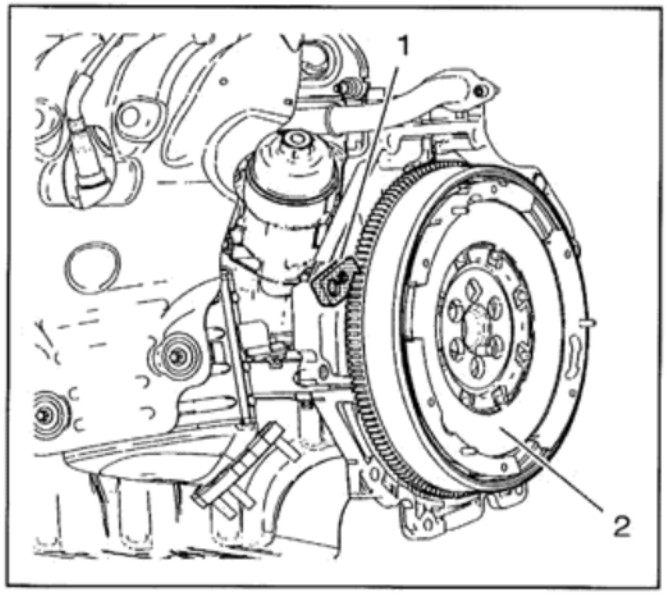
For equivalent regional tools, refer to *Special Tools on page 9-1135*.

1. Clean the thread in the crankshaft.



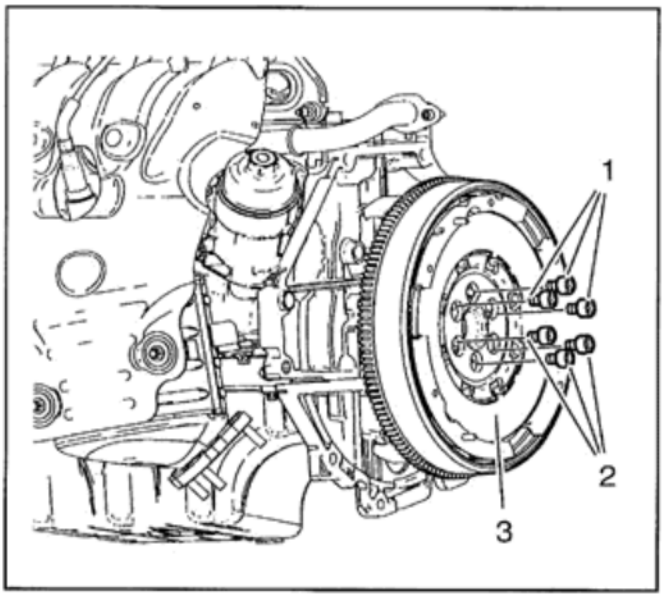
2743821

2. Install the crankshaft position reluctor ring (1).



2026535

3. Install the flywheel (2).
4. Install the *EN-652* holder (1).



2026536

Caution: Refer to *Fastener Caution on page 0-8*.

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10*.

5. Install the 6 NEW flywheel bolts (1, 2) and tighten the bolts in 3 passes using the *EN-45059* sensor kit:
   5.1. First pass to **35 N•m (26 lb ft)**.
   5.2. Second pass to additional **30°**.
   5.3. Third pass to an additional **15°**.
6. Remove the *EN-652* holder.

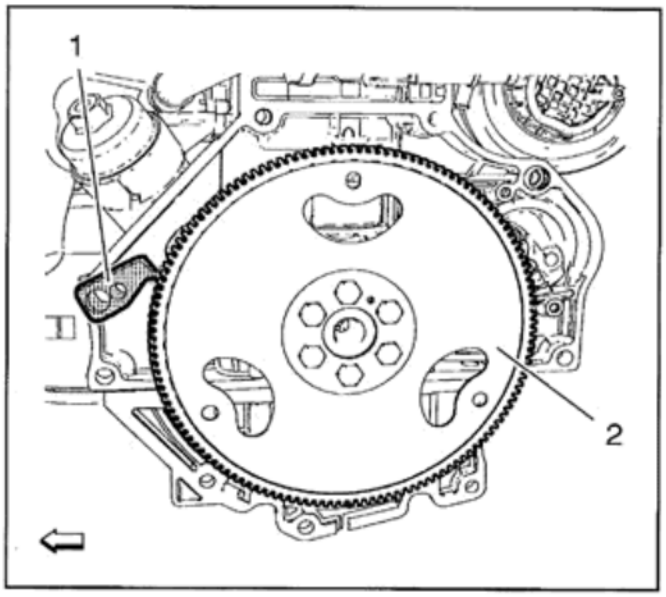
Automatic Transmission Flex Plate Installation

Special Tools

EN-652 Automatic Transmission Flex Plate Holder

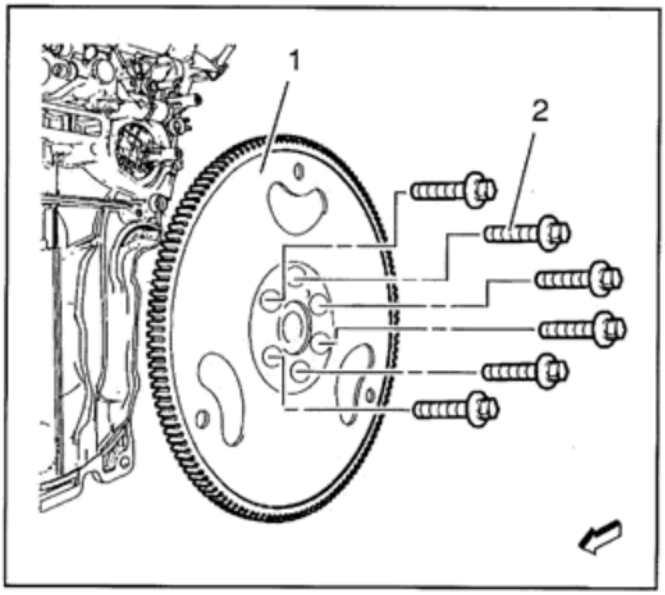
For equivalent regional tools, refer to *Special Tools on page 9-1135*.

1. Clean the automatic transmission flex plate bolt threads.



2028106

2. Install the automatic transmission flex plate (2) and the *EN-652* holder to hold the automatic transmission flex plate (2).



2028105

Caution: Refer to *Fastener Caution on page 0-8.*

Caution: Refer to *Torque-to-Yield Fastener Caution on page 0-10.*

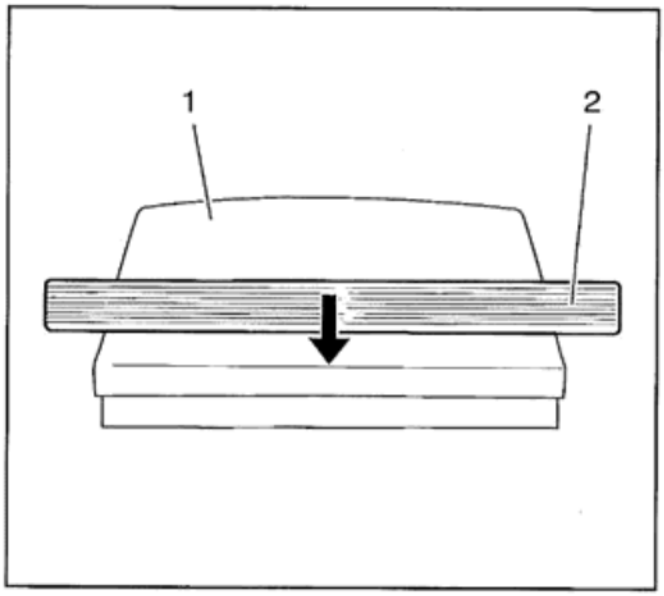
3. Install the 6 NEW automatic transmission flex plate bolts (2) and tighten the bolts to **60 N•m (44 lb ft) ± 5°**.
4. Remove the *EN-652* holder.

Crankshaft Rear Oil Seal Installation

Special Tools

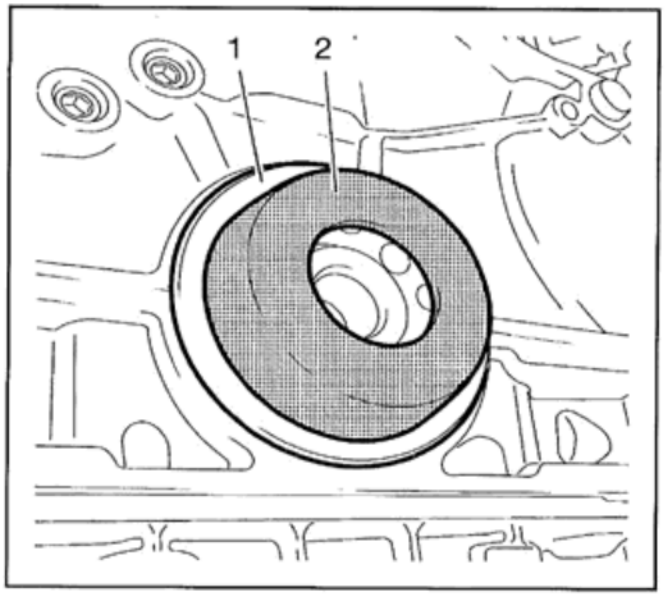
- *EN-658-1* Installer
- *EN-235-6* Installer

For equivalent regional tools, refer to *Special Tools on page 9-1135.*



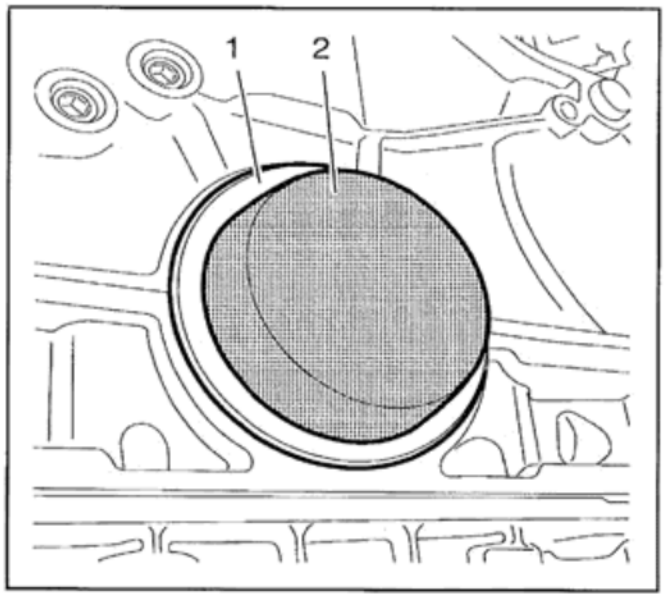
2757896

1. Slide the crankshaft rear oil seal (2) across the *EN-235-6* installer (1).



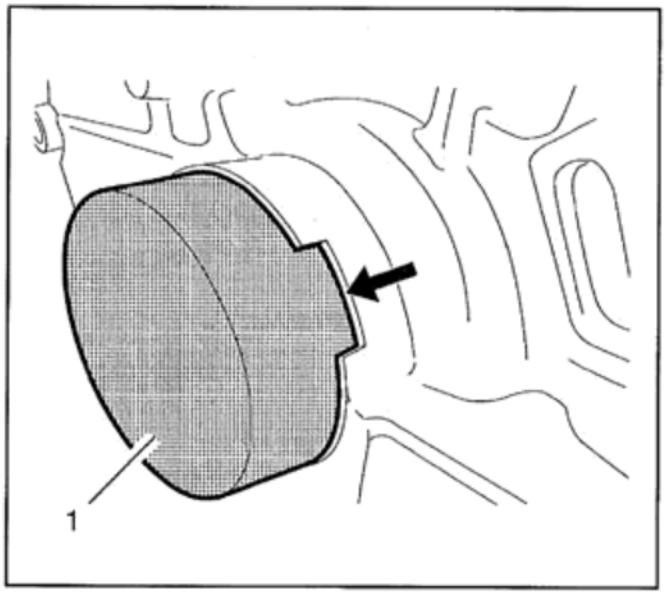
2190821

2. Install the crankshaft rear oil seal (1) with *EN-235-6* installer (2) to the crankshaft.



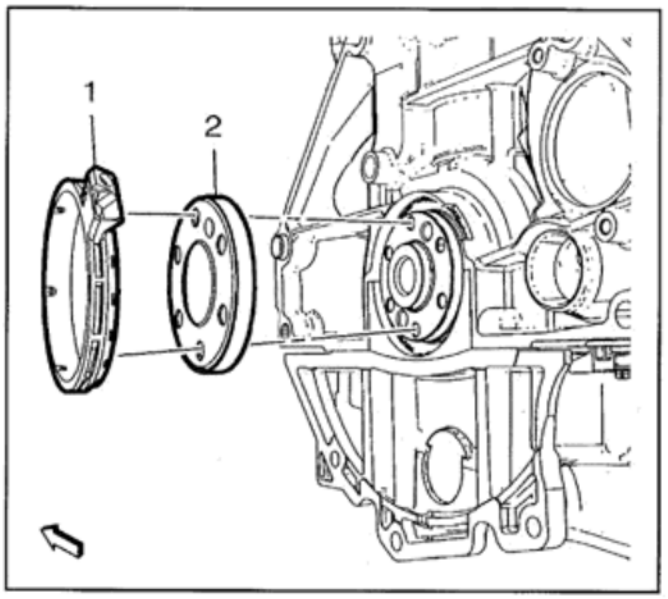
2750534

3. Use *EN-658-1* installer (2) to strike the crankshaft rear oil seal (1)



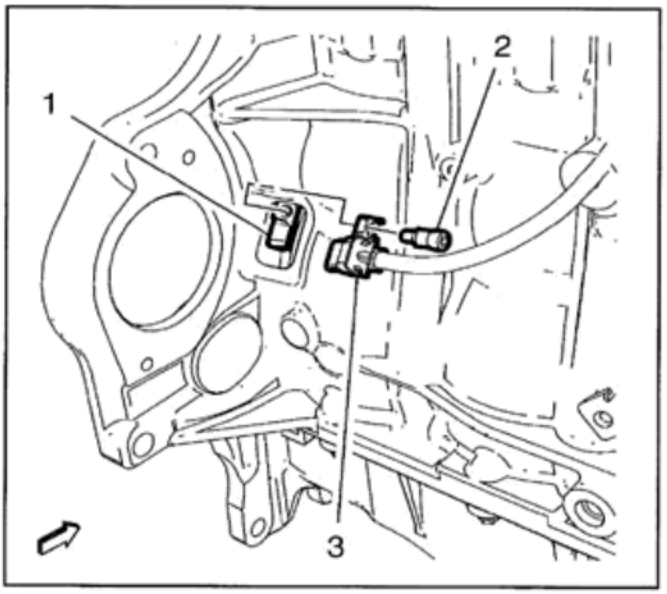
2757895

4. Check the crankshaft rear oil seal for proper seat, the *EN-658-1* installer must be flush with the cylinder block at the position (1).



2781536

5. Install the reluctor ring (2).
6. Install the crankshaft rear oil seal housing (1).



2757902

7. Install the crankshaft position sensor (3) to the crankshaft rear oil seal housing (1).

Caution: Refer to *Fastener Caution on page 0-8*.

8. Install the crankshaft position sensor bolt (2) and tighten to **4.5 N·m (40 lb in)**.

Description and Operation

Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished, and lapped surfaces with tolerances that are measured in ten thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces during initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas are part of the repair procedure. This is considered standard shop practice even if not specifically stated.

When valve train components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Engine Component Description

Cylinder Block

The cylinder hollow frame structured 4 cylinder in-line. The block has 5 crankshaft bearings with the thrust bearing located on the third bearing from the front of the engine.

Crankshaft

The crankshaft is a steel crankshaft. It is supported in 5 main journals with main bearings which have oil clearance for lubricating. The 3rd bearing of the 5 main bearing is the thrust bearing whose the crankshaft has properly axial end play. A harmonic damper is used to control torsional vibration.

Oil Pump

The oil pump is a crankshaft driven oil pump integrated in pump module. The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or other engine components. When the crankshaft rotates, the oil pump driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows. At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages.

Oil Pan

The oil pan is a structural aluminum oil pan with transmission attachment. It includes the oil suction pipe, this pipe is connected with the oil pump. The oil pan is attached at the engine block.

Piston and Connecting Rod

The Pistons are aluminum pistons with top land and floating pin. The connecting rods are fractured steel connecting rods with bushing.

Cylinder Head

This cylinder head is double over head camshaft (DOHC) type and has 2 camshafts that open 4 valves per cylinder with tappets. The camshaft sprocket wheels are installed in front of the camshafts. The cylinder head is made of cast aluminum alloy for better strength in hardness with light weight. The combustion chamber of the cylinder head is designed for increasing of squish and swirl efficiency and then this is maximized to gasoline combustion efficiency.

Valves

There are 2 intake and 2 exhaust valves with tappets per cylinder.

Camshaft

Two camshafts are used, one for all intake valves, the other for all exhaust valves. The camshafts are cast iron. The camshafts are driven by the crankshaft over the timing belt.

Camshaft Drive

A timing belt is used for camshaft drive. There is a tensioner to control the tension of the belt. Instead of camshaft gears or camshaft sprockets the engine is equipped with camshaft adjuster. The camshaft adjuster readjust itself at the engine speed. So the valve timing is adjusted for a low consumption, optimal power and torque.

Intake Manifold

The intake manifold is the air flow passage to the cylinder combustion chamber through the throttle body and has an effect on engine torque, power, noise, drivability, emission, fuel economy and performance. It is made of plastic for better strength in hardness with little weight.

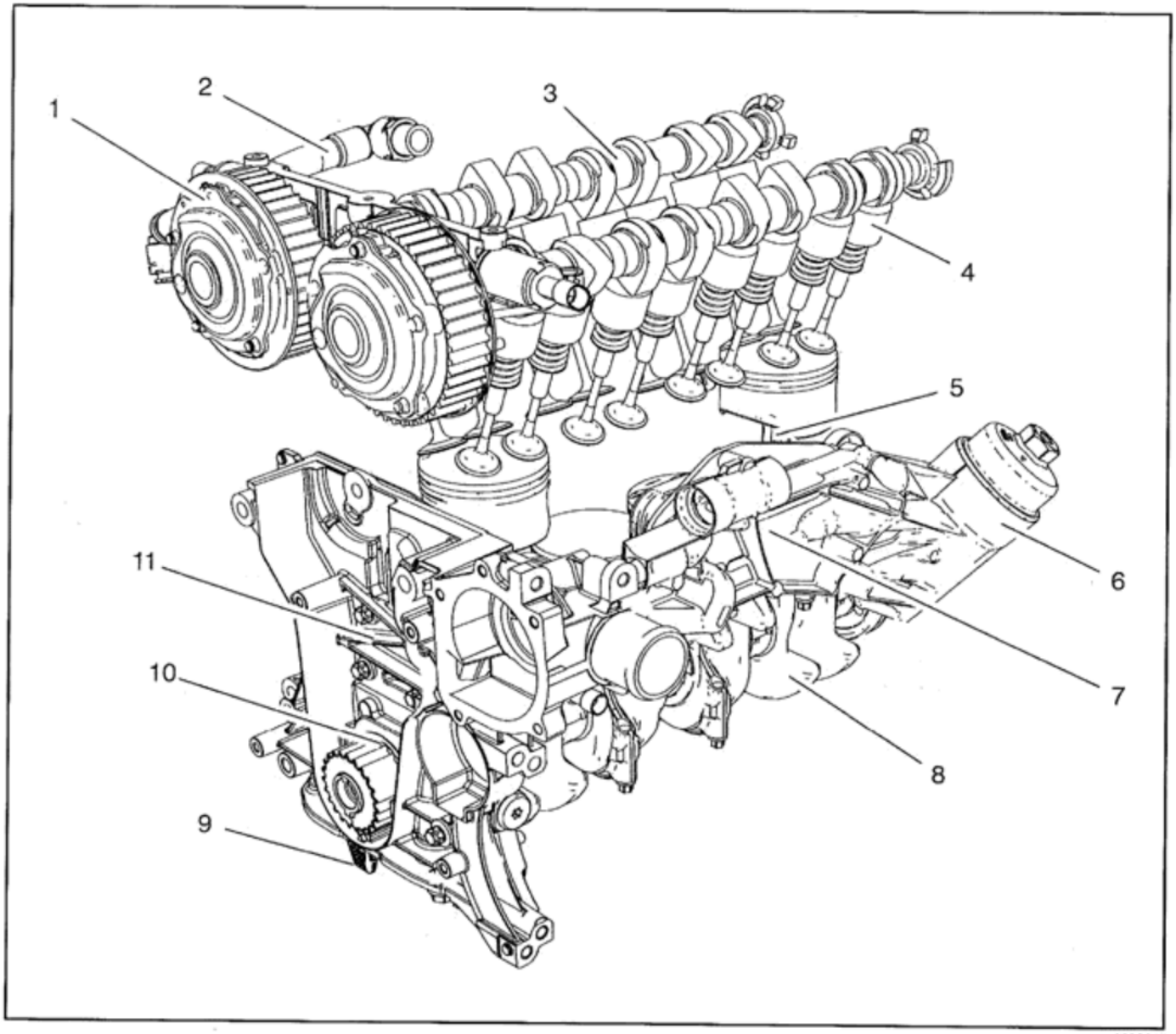
Exhaust Manifold

The exhaust manifold is located to the cylinder head and channels the exhaust gas out of the combustion chamber. It is designed to endure on high pressure and high temperature. The exhaust manifold includes the catalytic converter.

Positive Crankcase Ventilation System

The crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting vapors to the atmosphere. Fresh air from the intake system is supplied to the crankcase, mixed with blow-by gases and then passed through a calibrated orifice into the throttle body. The primary control is through the positive crankcase ventilation (PCV) orifice which meters the flow at a rate depending on inlet vacuum. The PCV orifice is an integral part of the camshaft cover. If abnormal operating conditions occur, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent into the intake system to be consumed by normal combustion.

Lubrication Description



2699314

Oil is applied under pressure to the crankshaft (8), connecting rods (5), camshaft adjuster (1), camshaft bearing surfaces (3) and valve tappets (4). All other moving parts are lubricated by gravity flow or splash. Oil enters the rotor type oil pump (10) through a fixed inlet screen (9). The oil pump is driven by the crankshaft. The oil pump body is within the engine front cover (11). The pressurized oil from the pump passes through the oil cooling system and the oil filter (6). The oil filter is integrated with the oil cooling system housing (7) that is connected to the front of the engine block. The oil filter is a disposable cartridge type. A by-pass valve in the filter cap allows continuous oil flow in case the oil filter should become restricted. The connecting rod bearings are oiled by constant oil flow passages through the crankshaft connecting the main journals to the rod journals. A groove around each upper main bearing furnishes oil to the drilled crankshaft passages. The pressurized oil passes through the cylinder head restrictor orifice into the cylinder head and then into each camshaft feed gallery.

An engine oil pressure switch or sensor is installed at the end. Oil returns to the oil pan through passages cast into the cylinder head. The crankcase ventilation system does not contain to the lubrication system, but to the oil circuit. It is used to consume crankcase vapors in the combustion process instead of venting them to atmosphere. Fresh air from the intake system is supplied to the crankcase, mixed with blow by gases and then passed through a calibrated orifice of the crankcase ventilation tube (2) into the intake manifold.

Replacing Engine Gaskets

Gasket Reuse and Applying Sealants

- Do not reuse any gasket unless specified.
- Gaskets that can be reused will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless called out in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Remove all gasket and sealing material from the part using a scraping tool.
- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces.
  - These methods of cleaning can cause damage to the component sealing surfaces.
  - Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil.
  - This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Do not allow the sealant to enter into any blind threaded holes, as it may prevent the bolt from clamping properly or cause component damage when tightened.
- Tighten bolts to specifications. Do not overtighten.

Separating Parts

Note:

- Disassembly of the piston, press fit design piston pin, and connecting rod may create scoring or damage to the piston pin and piston pin bore. If the piston, pin, and connecting rod have been disassembled, replace the components as an assembly.
- Many internal engine components will develop specific wear patterns on their friction surfaces.
- When disassembling the engine, internal components MUST be separated, marked, or organized in a way to ensure installation to their original location and position.

Separate, mark, or organize the following components:

- Piston and the piston pin
- Piston to the specific cylinder bore
- Piston rings to the piston
- Connecting rod to the crankshaft journal
- Connecting rod to the bearing cap—A paint stick or etching/engraving type tool are recommended. Stamping the connecting rod or cap near the bearing bore may affect component geometry.
- Crankshaft main and connecting rod bearings
- Camshaft and valve tappets
- Valve to the valve guide
- Valve spring and shim to the cylinder head location
- Engine block main bearing cap location and direction
- Oil pump drive and driven gears

Tools and Equipment

Special tools are listed and illustrated throughout this section with a complete listing at the end of the section. These tools, or their equivalents, are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools will also minimize possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. Torque wrenches and a torque angle meter are necessary for the proper tightening of various fasteners.

To properly service the engine assembly, the following items should be readily available:

- Approved eye protection and safety gloves
- A clean, well lit, work area
- A suitable parts cleaning tank
- A compressed air supply
- Trays or storage containers to keep parts and fasteners organized
- An adequate set of hand tools
- Approved engine repair stand
- An approved engine lifting device that will adequately support the weight of the components

Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant

Pipe Joint Compound

Note: Three types of sealer are commonly used in engines. These are RTV sealer, anaerobic gasket eliminator sealer, and pipe joint compound. The correct sealer and amount must be used in the proper location to prevent oil leaks. DO NOT interchange the 3 types of sealers. Use only the specific sealer or the equivalent as recommended in the service procedure.

- Pipe joint compound is a pliable sealer that does not completely harden. This type sealer is used where 2 non-rigid parts, such as the oil pan and the engine block, are assembled together.
- Do not use pipe joint compound in areas where extreme temperatures are expected. These areas include: exhaust manifold, head gasket, or other surfaces where gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.

  To remove the sealant or the gasket material.
- Apply the pipe joint compound to a clean surface. Use a bead size or quantity as specified in the procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer to enter any blind threaded holes, as it may prevent the bolt from clamping properly or cause component damage when the bolt is tightened.
- Apply a continuous bead of pipe joint compound to one sealing surface. Sealing surfaces to be resealed must be clean and dry.
- Tighten the bolts to specifications. Do not overtighten.

Special Tools and Equipment

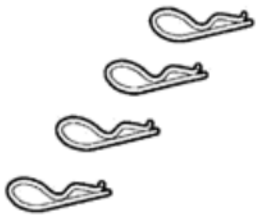
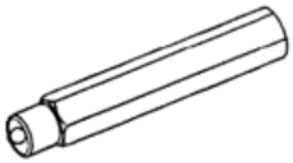
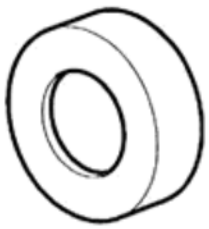
Illustration	Tool Number/Description
 2678170	207649 Rod Hairpins
 2678172	547324 Flange Screws
 2149047	EN-232 KM-232 J-21867-L40 Oil Pressure Check Adapter
 2757892	EN-235-6 KM-235-6 Installer

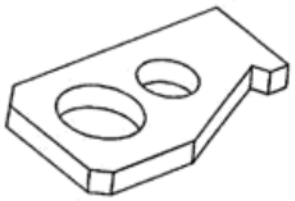
Illustration	Tool Number/Description
 1941118	EN-328–B GE-328-B KM-328-B GE-6125-1B Remover
 1936516	EN-422 KM-422 83 94 959 Installer
 1844744	EN-498–B GE-21867-A J-21867-A KM-498-B CH-48027 Pressure Gauge and Adapter Set
 1938128	EN-652 KM-652 Flywheel Holder
 2750538	EN-658-1 KM-658-1 J-35264 Installer

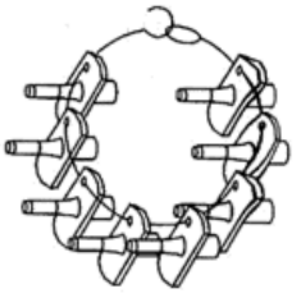
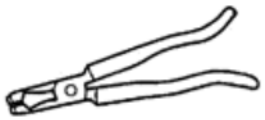
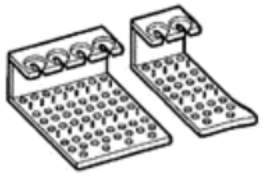
Illustration	Tool Number/Description
 1940941	EN-796 KM-796-A Dismantler
 1941086	CH-807 KM-807 Closure Plugs
 2026925	EN-840 KM-840 J-36017 83 94 157 Remover
 1936949	EN-845 KM-845 Suction Device
 2026927	EN-849 KM-849 Assembly Tray

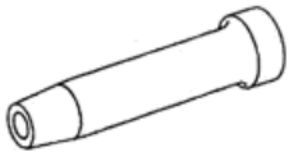
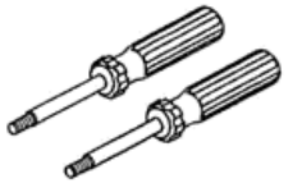
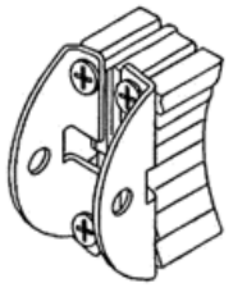
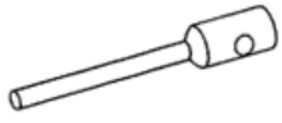
Illustration	Tool Number/Description
 1937997	EN-958 KM-958 Valve Stem Seal Installer
 1936461	EN-6009 KM-6009 83 96 335 J-43301 Remover/Installer
 1936975	EN-6333 KM-6333 Locking Pin
 1936979	EN-6340 KM-6340 Locking Tool
 1936982	EN-6349 KM-6349 Locking Pin

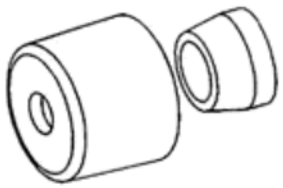
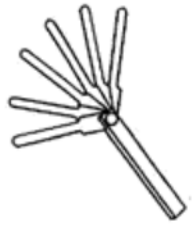
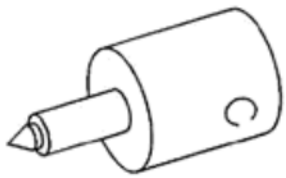
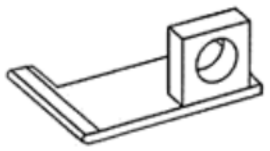
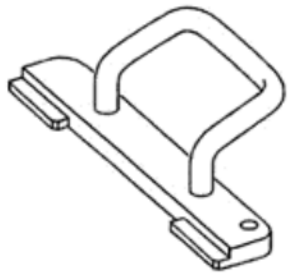
Illustration	Tool Number/Description
 1937136	EN-6351 KM-6351 Assembly Sleeves
 1937135	EN-6361 KM-6361 Feeler Gauge Set
 1944492	EN-6624 KM-6624 Remover
 1945838	EN-6625 KM-6625 Flywheel Locking Device
 1945840	EN-6628-A KM-6628-A Locking Tool

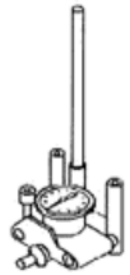
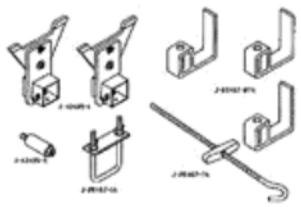
Illustration	Tool Number/Description
 5110	EN-8087 J-8087 Cylinder Bore Gauge
 190562	EN-28467-B J-28467-B Universal Engine Support Fixture
 1936492	EN-34730-91 KM-34730-91 Pressure Tester
 68653	EN-36857 J-36857 Engine Lift Bracket
 883170	EN-43405 J-43405 Support Foot Set

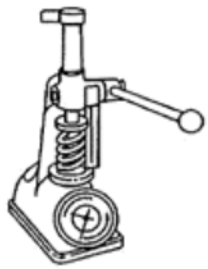
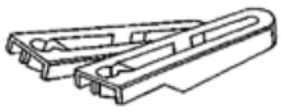
Illustration	Tool Number/Description
 1936281	EN-45000 KM-45000 J-45000 Seal Remover
 1197696	EN-45059 J-45059 Angle Meter
 1940948	GE-571-B MKM-571-B GE-8001 J-8001 Dial Gauge
 167039	GE-22738-B J-22738-B Valve Spring Tester
 13542	J-37088-A KM-37088A Fuel Line Disconnect Tool Set

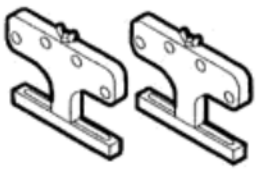
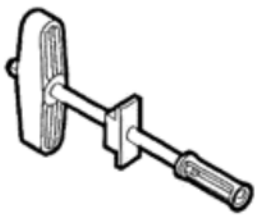
Illustration	Tool Number/Description
 2678169	EN-50717-1 Stands
 2684938	EN-50717-2 Compressor

Illustration	Tool Number/Description
 2684941	EN-8062 J-8062 Valve Spring Compressor