

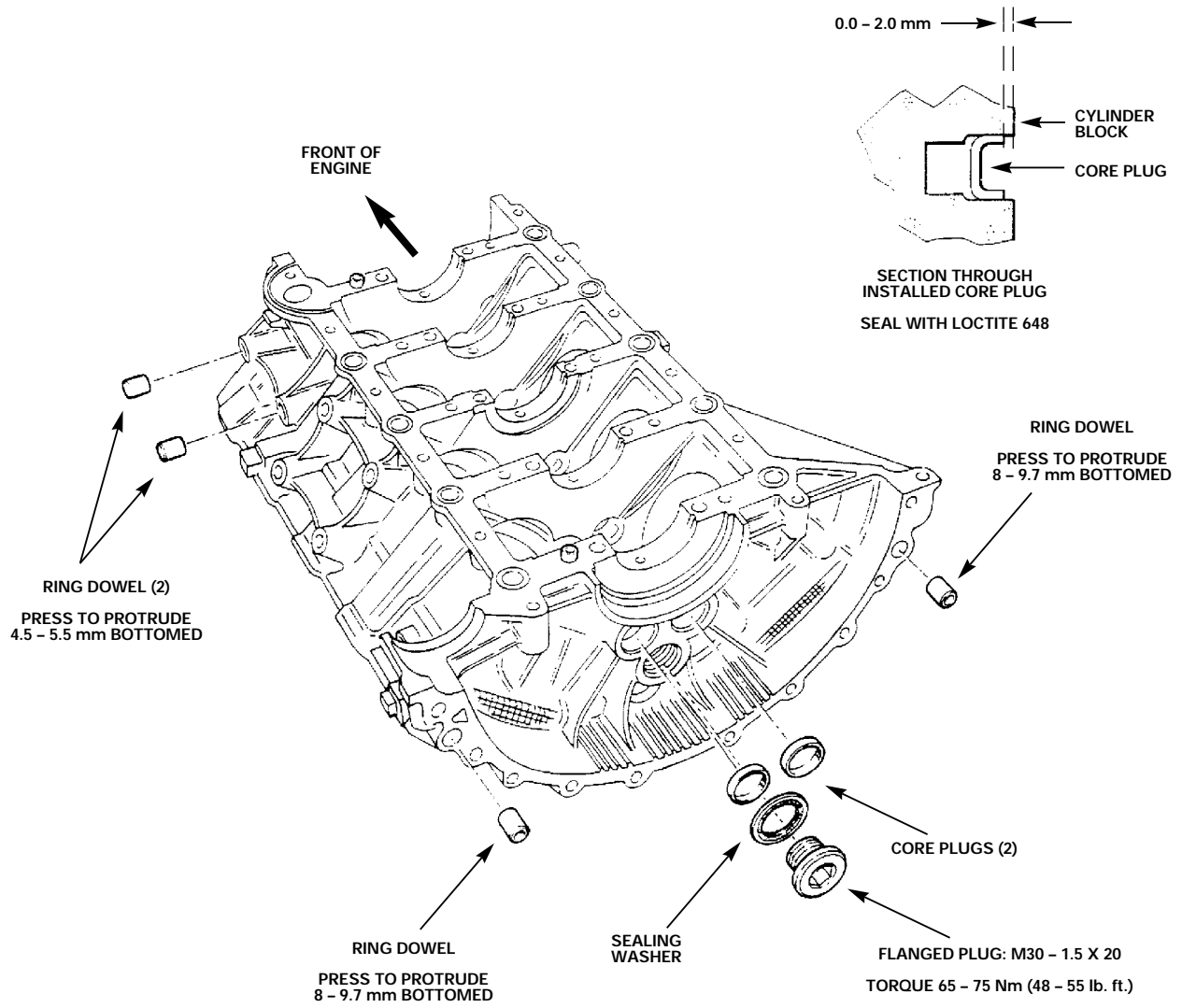
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# AJV8 Engine Assembly

## Cylinder Block Dowels, Plugs and Pipes

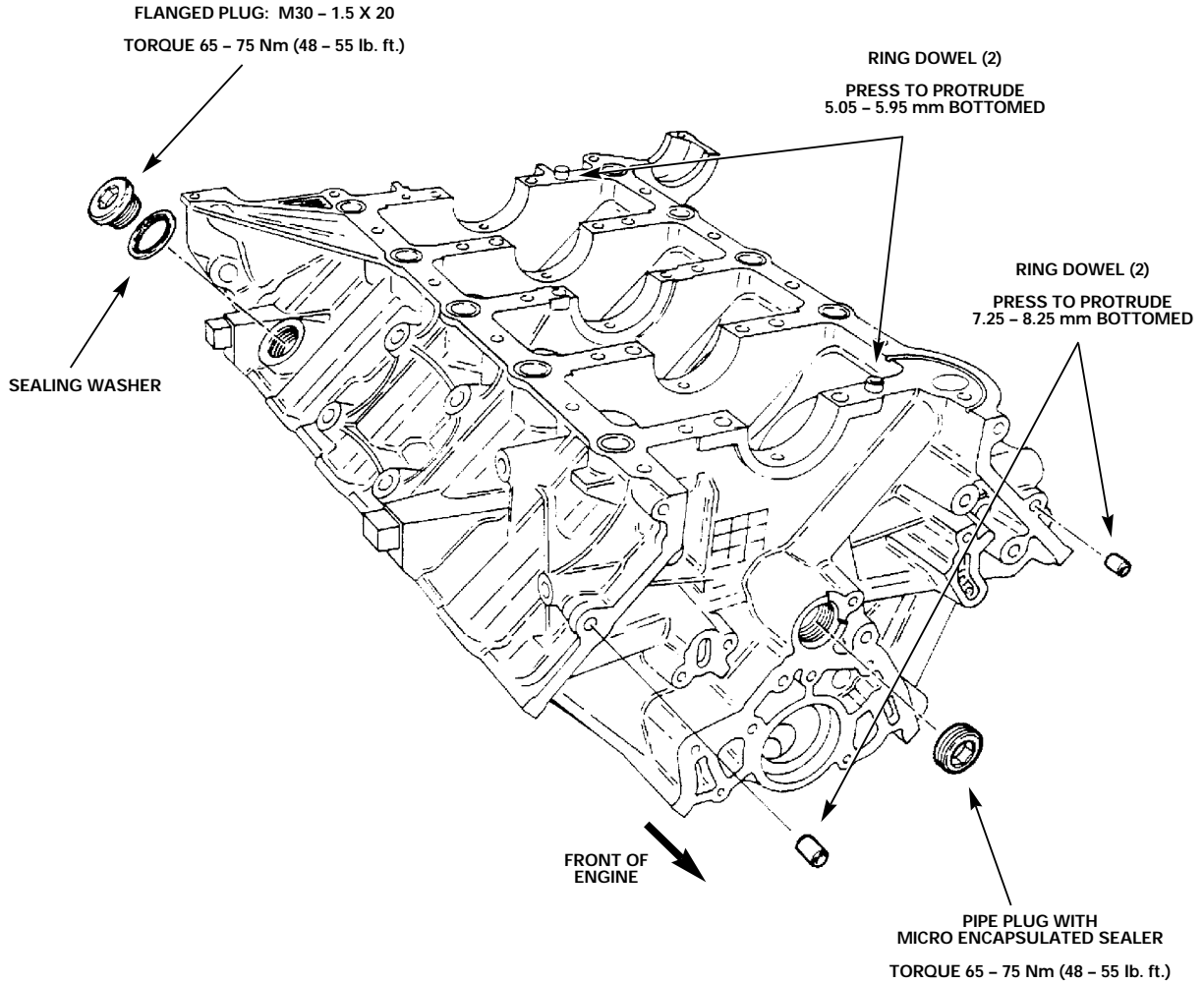
### CYLINDER BLOCK DOWELS, PLUGS AND PIPE INSTALLATION



T180/2.01

### NOTES

## CYLINDER BLOCK DOWELS, PLUGS AND PIPE INSTALLATION



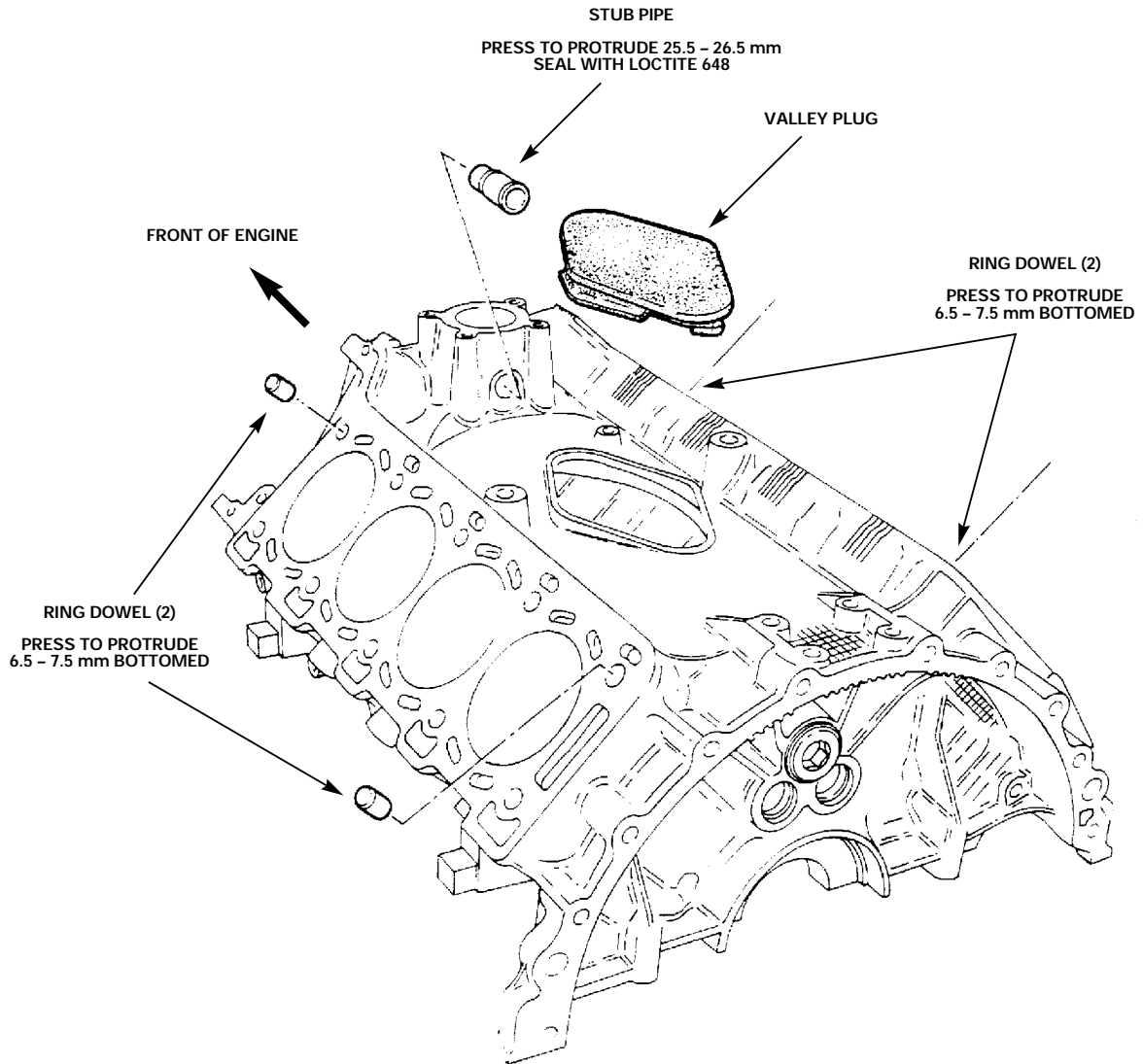
T180/2.02

## NOTES

# AJV8 Engine Assembly

## Cylinder Block Dowels, Plugs and Pipes (continued)

### CYLINDER BLOCK DOWELS, PLUGS AND PIPE INSTALLATION



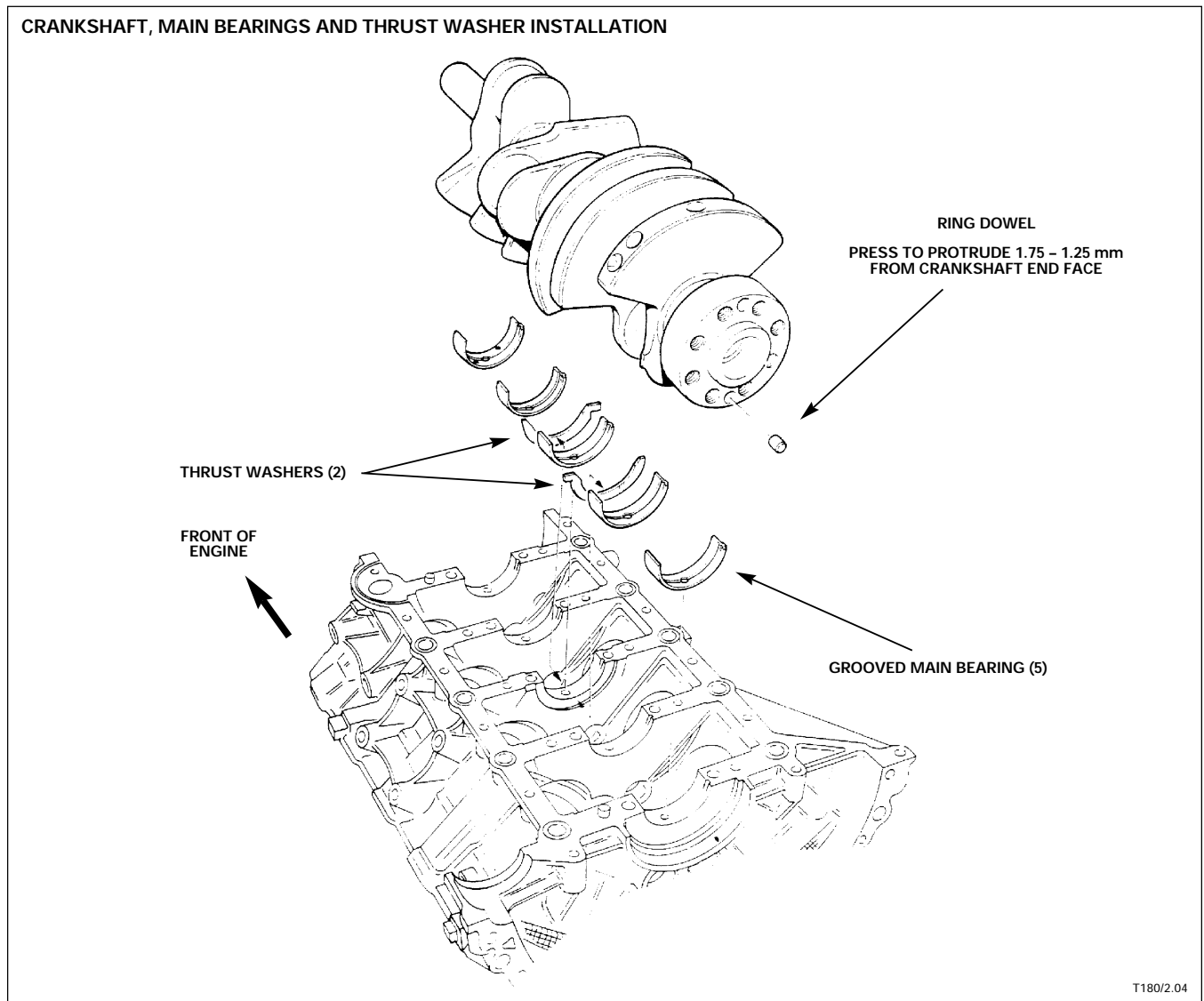
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### NOTES

## Crankshaft Bearing and Cylinder Bore Dimensions

Crankshaft main bearings and connecting rod bearings must be selected to achieve the correct oil clearance. Cylinder block / bed plate main bearings bores and crankshaft main and connecting rod journal diameters are measured during engine manufacturing to 0.001 mm (0.00004 in.) tolerances. Because accurately measuring to these tolerances is extremely difficult under workshop conditions, the dimensions are stamped on the engine as codes during manufacturing.

Finished pistons and cylinder bores are also measured and graded electronically during manufacture. Any excess wear to the cylinder bore will be evident by visually inspecting the Nikasil finish. If damage to the finish is evident, the cylinder block must be replaced.



### NOTES

## Crankshaft Bearing and Cylinder Bore Dimensions (continued)

### Bearing measuring

#### Main bearing bore measuring

Main bearing bores are measured at two places in the center of the bearing area. Each measurement is at 45° from the cylinder block / bed plate joint.

#### Crankshaft journal measuring

Each crankshaft journal is measured dynamically at the middle of the bearing area.

### Engine Dimension Codes

Following is an explanation of the codes stamped on the engine. The actual diameter measurements represented by the diameter codes are listed in the chart on page 7.

#### Crankshaft code: \*LJDEH\*BBBB\*

##### LJDEH: Main bearing crankshaft journal diameter

|               |          |          |          |          |          |
|---------------|----------|----------|----------|----------|----------|
| Diameter code | <b>L</b> | <b>J</b> | <b>D</b> | <b>E</b> | <b>H</b> |
| Journal #     | 1        | 2        | 3        | 4        | 5        |

Main bearing journal orientation: #1 – front; #5 – rear

##### BBBB: Connecting rod journal diameter

|               |          |          |          |          |
|---------------|----------|----------|----------|----------|
| Diameter code | <b>B</b> | <b>B</b> | <b>B</b> | <b>B</b> |
| Journal #     | 1        | 2        | 3        | 4        |

Connecting rod journal orientation: #1 – front; #4 – rear

#### Block code: \*22112222\*SSRRR\*

##### 22112222: Cylinder bore diameter

|                |          |          |          |          |          |          |          |          |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Diameter grade | <b>2</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>2</b> |
| Cylinder #     | B1       | B2       | B3       | B4       | A4       | A3       | A2       | A1       |

Cylinder bore orientation: 'B' bank – left side; #1 – front

##### SSRRR: Main bearing bore inside diameter

|               |          |          |          |          |          |
|---------------|----------|----------|----------|----------|----------|
| Diameter code | <b>S</b> | <b>S</b> | <b>R</b> | <b>R</b> | <b>R</b> |
| Bearing #     | 1        | 2        | 3        | 4        | 5        |

Main bearing bore orientation: #1 – front; #5 – rear

### Engine Number

#### Engine number example: 9704051158

|           |           |           |             |
|-----------|-----------|-----------|-------------|
| <b>97</b> | <b>04</b> | <b>05</b> | <b>1158</b> |
| (year)    | (month)   | (day)     | (time)      |

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#### NOTES

## Main bearing crankshaft journal diameter codes

| Code | Diameter: mm | (in.)     | Code | Diameter: mm | (in.)     |
|------|--------------|-----------|------|--------------|-----------|
| A    | 62.000       | (2.44094) | M    | 61.989       | (2.44051) |
| B    | 61.999       | (2.44091) | N    | 61.988       | (2.44047) |
| C    | 61.998       | (2.44087) | P    | 61.987       | (2.44043) |
| D    | 61.997       | (2.44083) | R    | 61.986       | (2.44039) |
| E    | 61.996       | (2.44079) | S    | 61.985       | (2.44035) |
| F    | 61.995       | (2.44075) | T    | 61.984       | (2.44031) |
| G    | 61.994       | (2.44071) | V    | 61.983       | (2.44028) |
| H    | 61.993       | (2.44067) | W    | 61.982       | (2.44024) |
| J    | 61.992       | (2.44063) | X    | 61.981       | (2.44020) |
| K    | 61.991       | (2.44059) | Y    | 61.980       | (2.44016) |
| L    | 61.990       | (2.44055) | Z    | 61.979       | (2.44012) |

## Connecting rod journal diameter codes

| Code | Diameter: mm    | (in.)               |
|------|-----------------|---------------------|
| A    | 56.000 – 55.994 | (2.20472 – 2.20449) |
| B    | 55.994 – 55.988 | (2.20449 – 2.20425) |
| C    | 55.988 – 55.982 | (2.20425 – 2.20402) |

## Main bearing bore inside diameter codes

| Code | Diameter: mm | (in.)     | Code | Diameter: mm | (in.)     |
|------|--------------|-----------|------|--------------|-----------|
| A    | 66.032       | (2.59969) | L    | 66.022       | (2.59929) |
| B    | 66.031       | (2.59965) | M    | 66.021       | (2.59925) |
| C    | 66.030       | (2.59961) | N    | 66.020       | (2.59921) |
| D    | 66.029       | (2.59957) | P    | 66.019       | (2.59917) |
| E    | 66.028       | (2.59953) | R    | 66.018       | (2.59913) |
| F    | 66.027       | (2.59949) | S    | 66.017       | (2.59909) |
| G    | 66.026       | (2.59945) | T    | 66.016       | (2.59906) |
| H    | 66.025       | (2.59941) | V    | 66.015       | (2.59902) |
| J    | 66.024       | (2.59937) | W    | 66.014       | (2.59898) |
| K    | 66.023       | (2.59933) |      |              |           |

## Piston / cylinder bore grades

| Code | Diameter: mm    | (in.)               |
|------|-----------------|---------------------|
| 1    | 85.973 – 85.987 | (3.38476 – 3.38531) |
| 2    | 85.983 – 85.997 | (3.38516 – 3.38571) |
| 3    | 85.993 – 86.007 | (3.38555 – 3.38610) |

**NOTE:** Piston and cylinder bore grade must match.

## NOTES

## Crankshaft Bearing and Cylinder Bore Dimensions (continued)

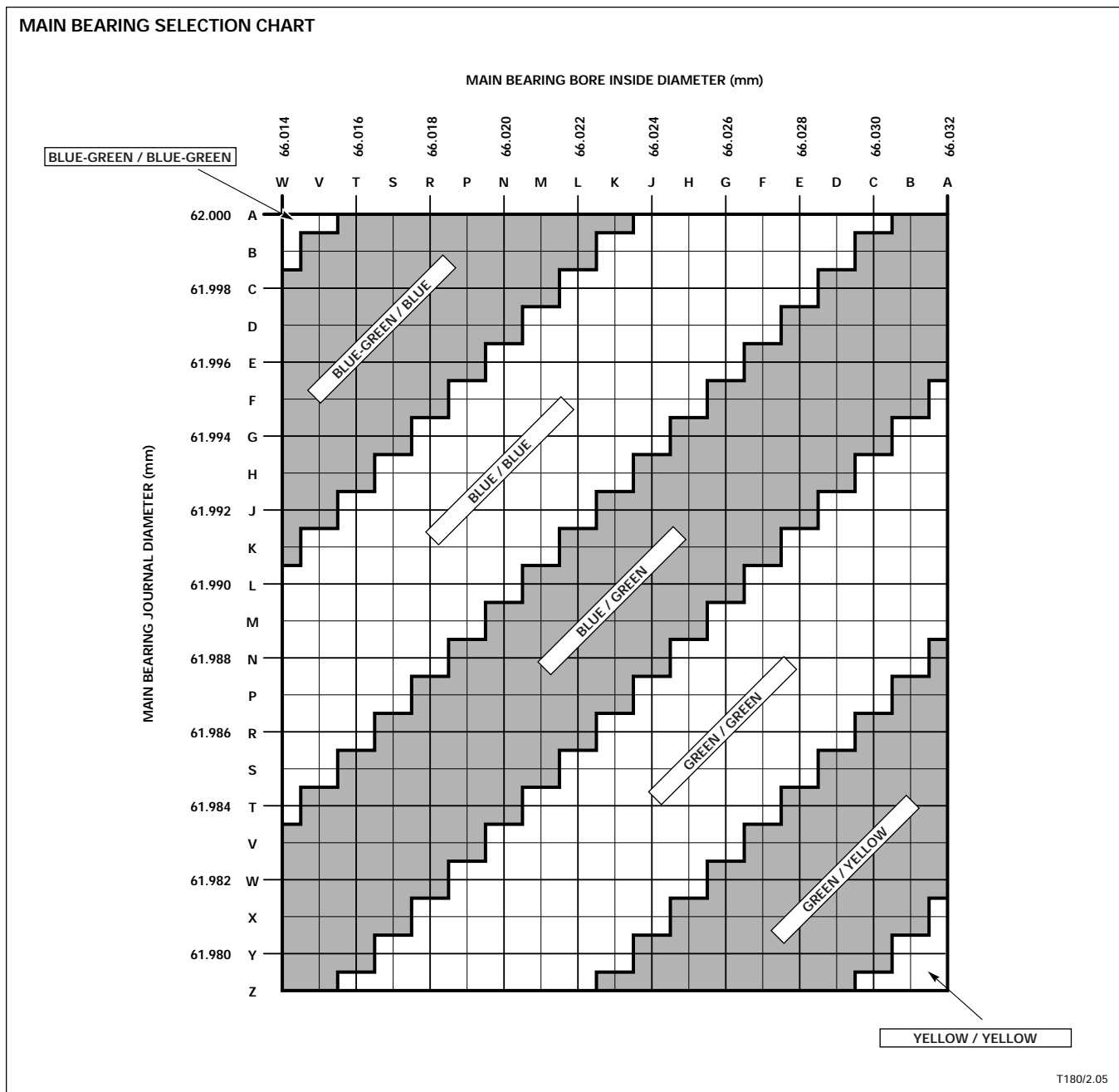
### Main Bearing Selection

To select the correct bearings, find the main bearing codes for the journal or the measured main bearing bore and journal diameter on the chart. The intersection of the two dimensions indicates the color code of the required bearing inserts. If two different color bearing inserts are required, they can be positioned in either the crankcase or bed plate.

**⚠ CAUTION:** A grooved bearing must always be positioned in the crankcase to provide lubrication for the connecting rod bearings.

### Main bearing oil clearance

0.025 – 0.050 mm (0.001 – 0.002 in)

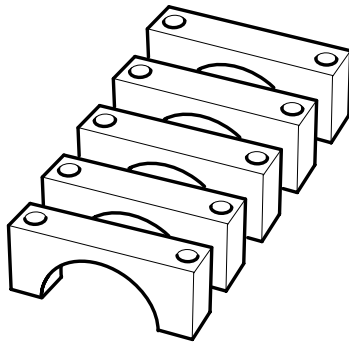




## Crankshaft Installation

Place the crankshaft in position and install 5 dummy main bearing cap tools number JD 220 to hold the bearings and crankshaft in position when fitting the piston / connecting rod assemblies.

MAIN BEARING DUMMY CAP TOOL JD 220

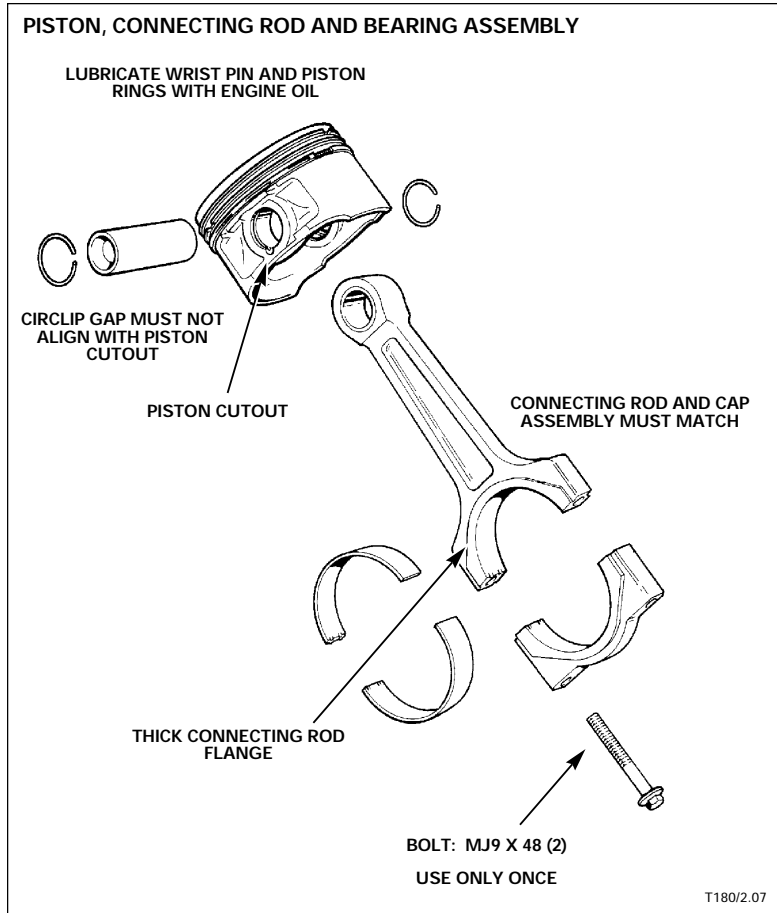


T180/2.06

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## NOTES

## Pistons, Connecting Rods and Bearings



### Pistons

The piston grade code stamped on each piston crown must be the same as the cylinder block grade code for the cylinder.

Any excess wear to the cylinder bore will be evident by visually inspecting the Nikasil finish. If damage to the finish is evident, the cylinder block must be replaced.

'A' bank piston and connecting rod assemblies: arrow on piston and thick flange of connecting rod must face the same direction.

'B' bank piston and connecting rod assemblies: arrow on piston and thin flange of connecting rod must face the same direction.

### Piston rings

Each piston is fitted with three rings:

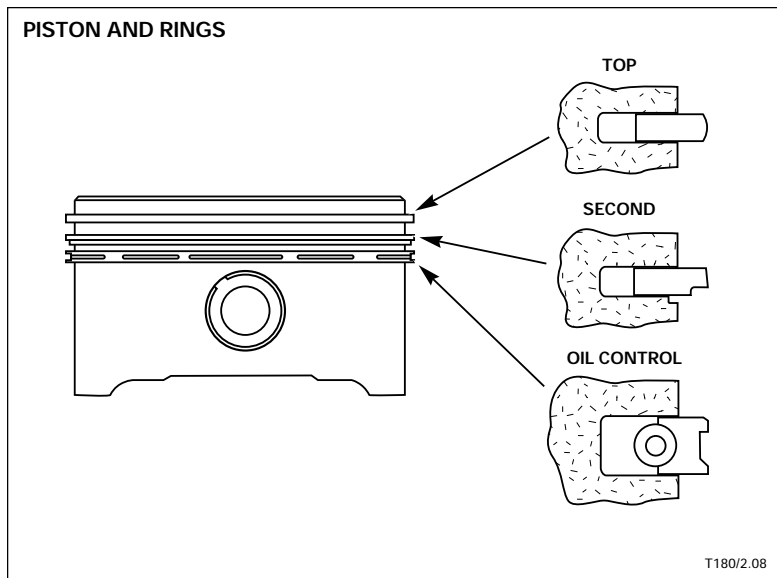
- Top compression ring
- Stepped second compression ring – install with step facing down
- Two-piece oil control ring

Install as shown in the illustration. Align piston ring gaps at least 90° apart.

### Connecting Rods

Connecting rods must be fitted to the cylinder position marked on the rod and the cap.

Each connecting rod has a thick flange and a thin flange. The thin flange side of the connecting rod is also marked with a dimple adjacent to the bearing. Connecting rods are installed on their journals with the dimples (thin flanges) facing each other.



### NOTES

Install the correct bearing shell in the connecting rod and fit bore protector tools JD 221. Lubricate the piston and install the assembly.

## Connecting rod bearing selection chart

| Code | Connecting rod journal diameter: mm (in.)  | Bearing Grade Color |
|------|--|---------------------|
| A    | 55.994 – 56.000 mm (2.20449 – 2.20472 in.) | Blue                |
| B    | 55.988 – 55.994 mm (2.20425 – 2.20449 in.) | Green               |
| C    | 55.982 – 55.988 mm (2.20402 – 2.20425 in.) | Yellow              |

Lubricate the connecting rod cap bearing with two 4 mm drops of EP 90, install and torque the cap bolts in three steps:

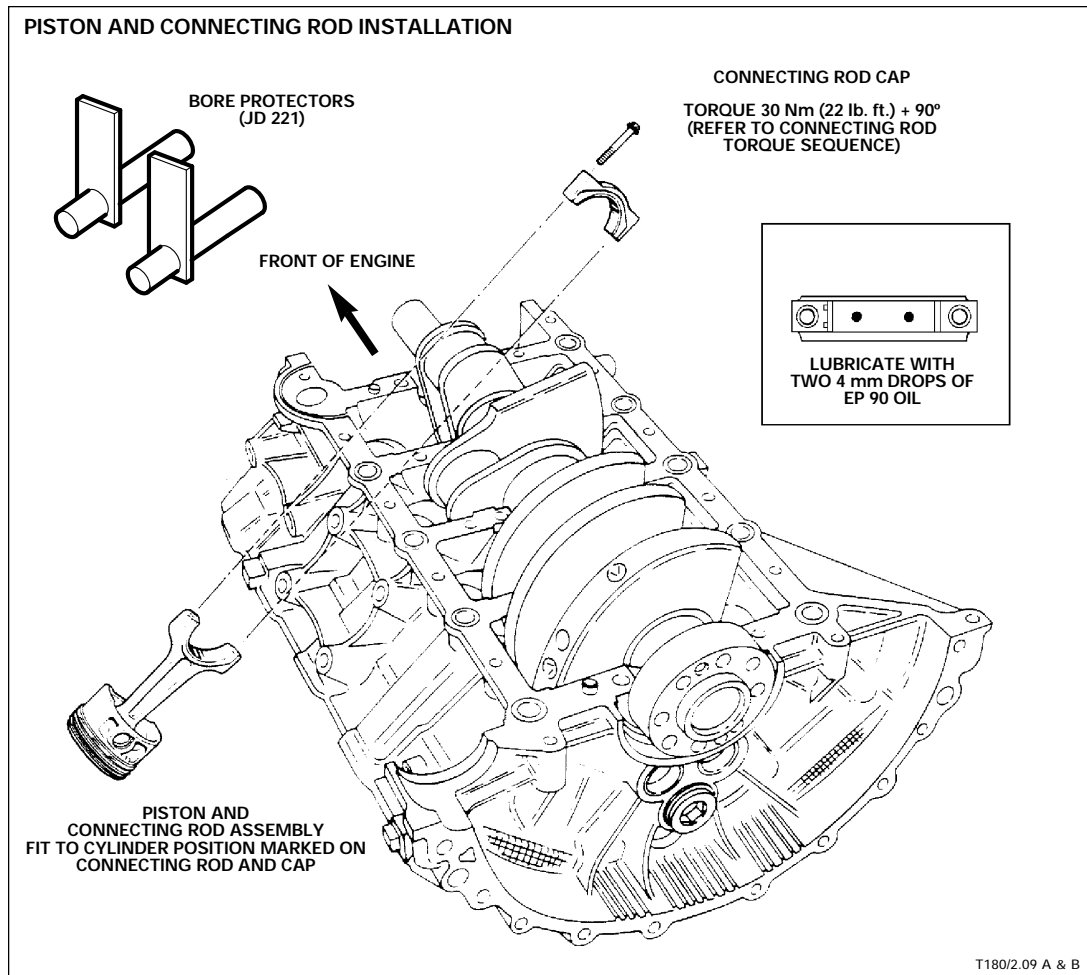
## Connecting rod bolt torque sequence

- Step 1 Torque connecting rod bolts to 8 –12 Nm
- Step 2 Torque connecting rod bolts to 30 Nm
- Step 3 Tighten connecting rod bolts an additional 90°

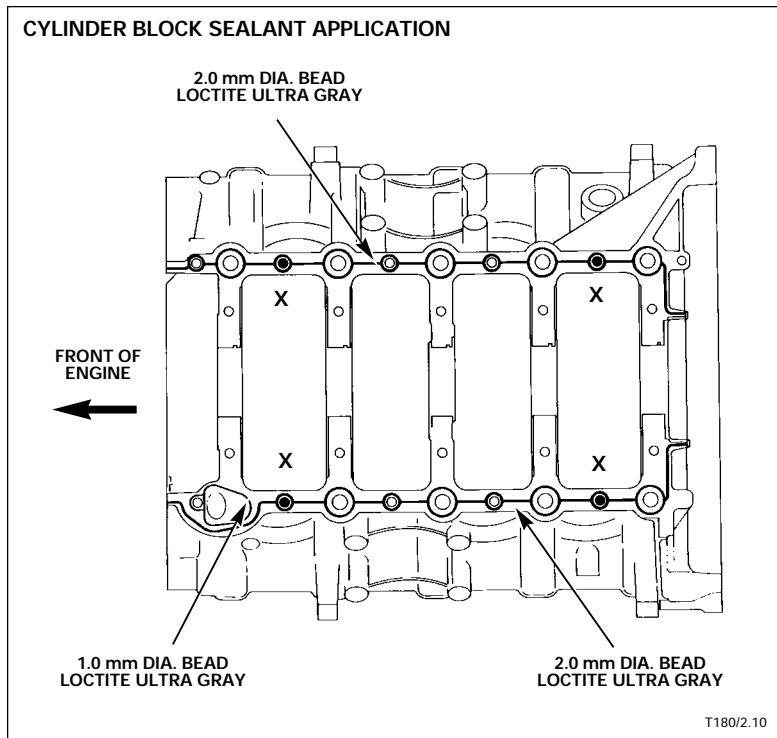
Center punch bolt heads once completely torqued. Do not reuse bolts.

## Connecting rod bearing to journal oil clearance

0.035 – 0.063 mm (0.0014 – 0.0025 in)



## Bed Plate



## Cylinder Block to Bed Plate Installation

Cylinder block and bed plate joints must be clean and free from oil.

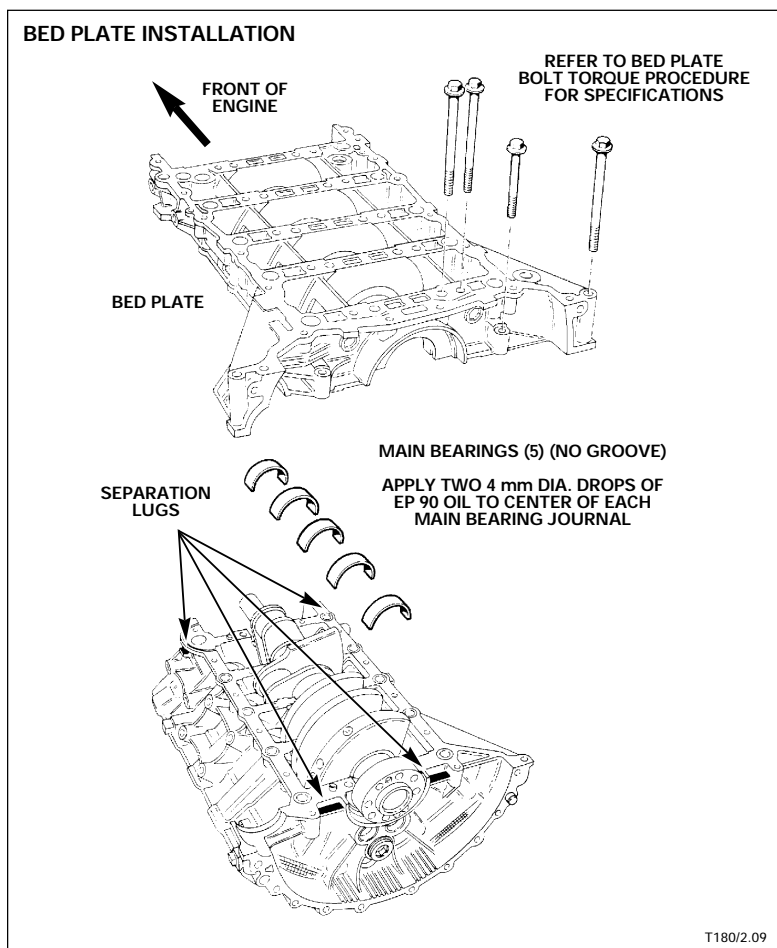
Apply two 4 mm drops of EP 90 Oil to each crankshaft journal in the middle of the bearing length.

Apply a continuous bead of Loctite Ultra Gray 5699 RTV sealant to the cylinder block as shown on the illustration, with the diameter of the bead as indicated. 1 mm gaps are allowed around the oil drain holes. Gaps of 3 mm are allowed elsewhere.

Within 7 minutes of initial sealant application, install the bed plate and the four new M8 x 60 bolts (indicated by an X on the illustration). Torque the four bolts to 7 – 9 Nm (5 – 6.5 lb ft).

Within 20 minutes of initial sealant application, the rest of the bed plate bolts must be installed and torqued following the procedure on page 13.

Remove any excess sealant from the block and the crankshaft main bearing seal bore.



**NOTE:** If the operation is not completed within 20 minutes of initial sealant application, separate the bed plate from the block. Clean the joints with a plastic or wooden scraper and repeat the procedure.

**CAUTION:** Use only the cast separation lugs to separate the bed plate from the block.

## NOTES

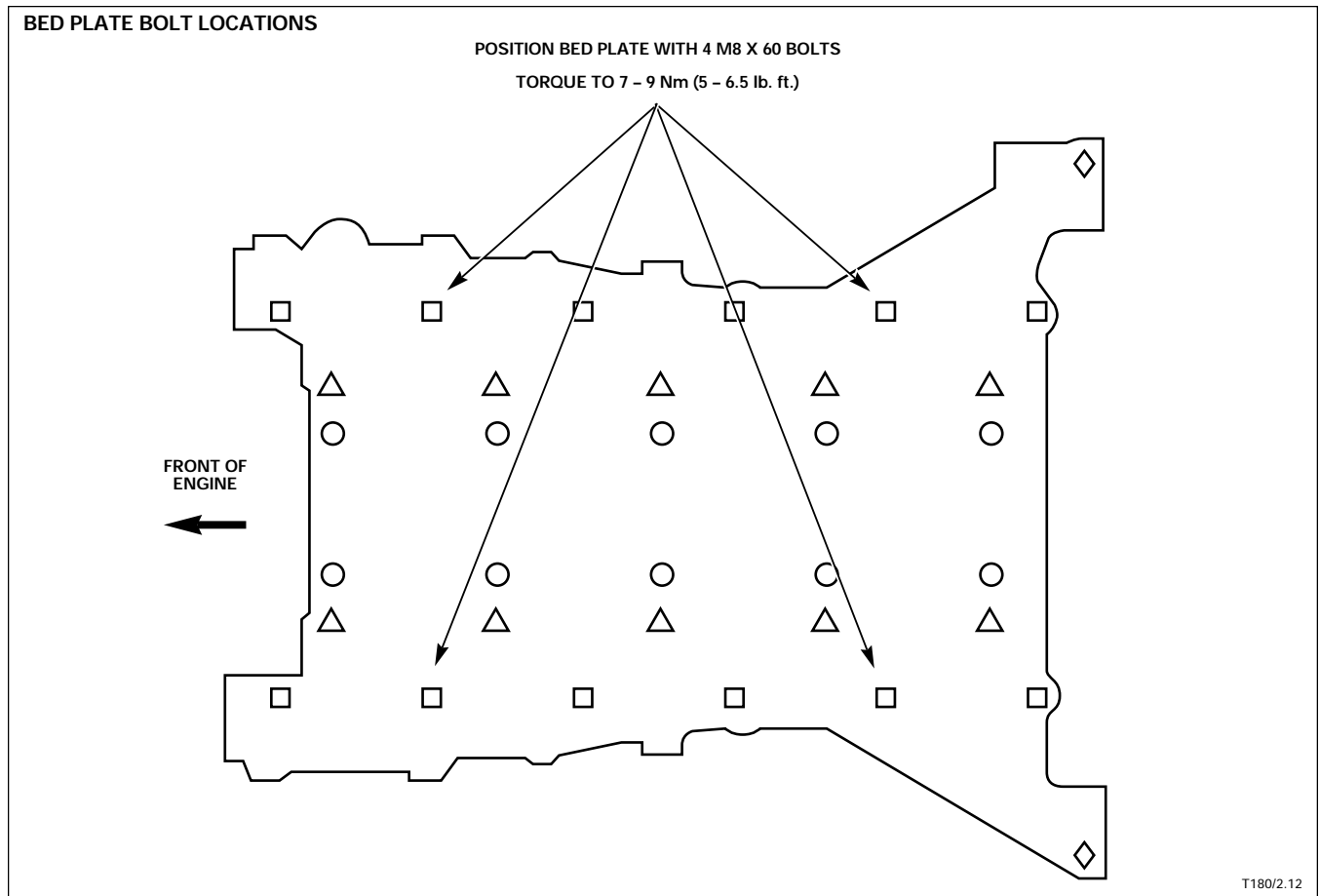
## Bed plate bolt torque procedure

- |                         |                           |
|-------------------------|---------------------------|
| □ 'P' bolt M8 x 60 (12) | ○ 'M' bolt M10 x 114 (10) |
| ◇ 'F' bolt M8 x 110 (2) | △ 'S' bolt M8 x 110 (10)  |

## Torque specifications

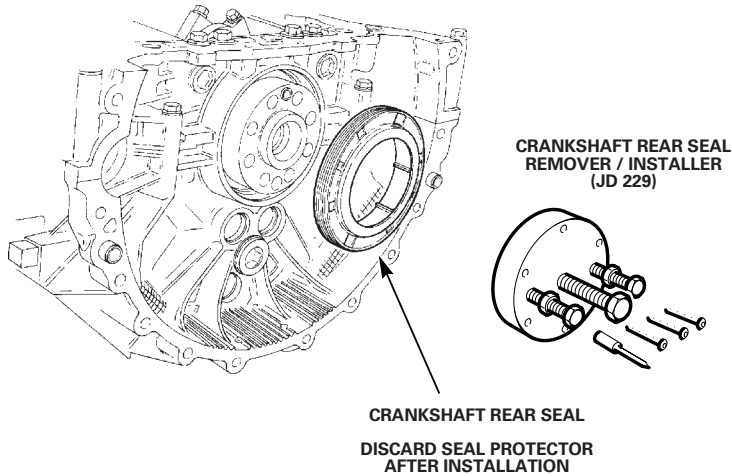
- Step 1 □ 'P' bolts: torque to 14 – 16 Nm (10.5 – 12 lb ft)
- Step 2 ◇ 'F' bolts: torque to 14 – 16 Nm (10.5 – 12 lb ft)
- Step 3 ○ 'M' bolts: torque to 24 – 26 Nm (18 – 19 lb ft)
- Step 4 △ 'S' bolts: torque to 14 – 16 Nm (10.5 – 12 lb ft)
- Step 5 ○ 'M' bolts: torque to 34 – 36 Nm + 135° (25 – 26.5 lb ft + 135°)
- Step 6 △ 'S' bolts: torque to 19 – 21 Nm + 150° (14 – 15.5 lb ft + 150°)
- Step 7 □ 'P' bolts: torque to 19 – 21 Nm + 90° (14 – 15.5 lb ft + 90°)
- Step 8 ◇ ‡ ' bolts: torque to 19 – 21 Nm + 150° (14 – 15.5 lb ft + 150°)

**NOTE:** Bed plate bolts must be center punched after being completely torqued. Center punched bolts must not be reused.



## Oil Pump, Crankshaft Sprocket and Seal

### SHAFT REAR SEAL INSTALLATION



T180/2.13 A & B

### Crankshaft Rear Seal Installation

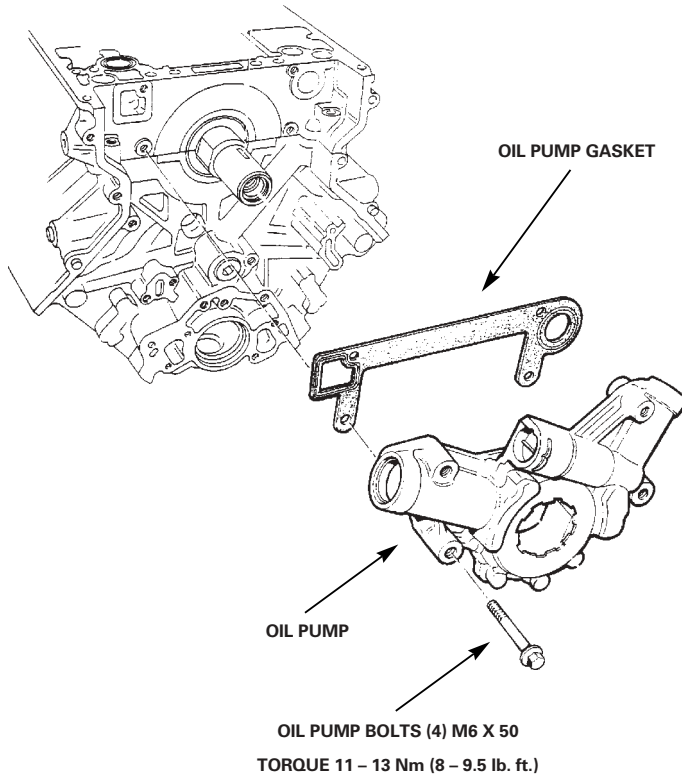
Press the seal into the housing with tool JD 229. Maintain insertion load for 3 – 5 seconds at fitted depth. Outer face of the seal must be parallel to the crankshaft rear face within 0.3 mm (0.012 in.).

### Oil Pump Installation

Install the oil pump gasket dry. The pump must engage with the drive flats on the crankshaft.

### NOTES

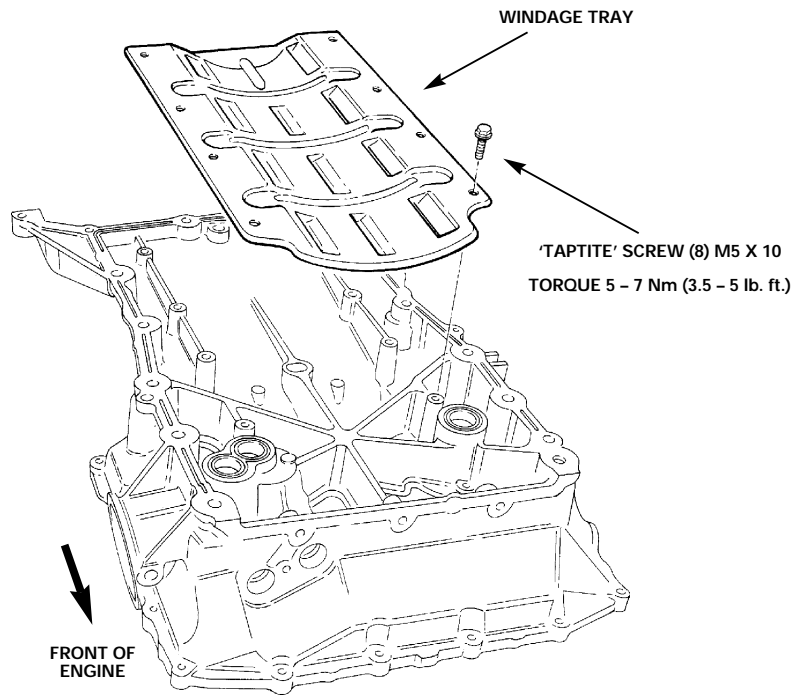
### OIL PUMP INSTALLATION



T180/2.14

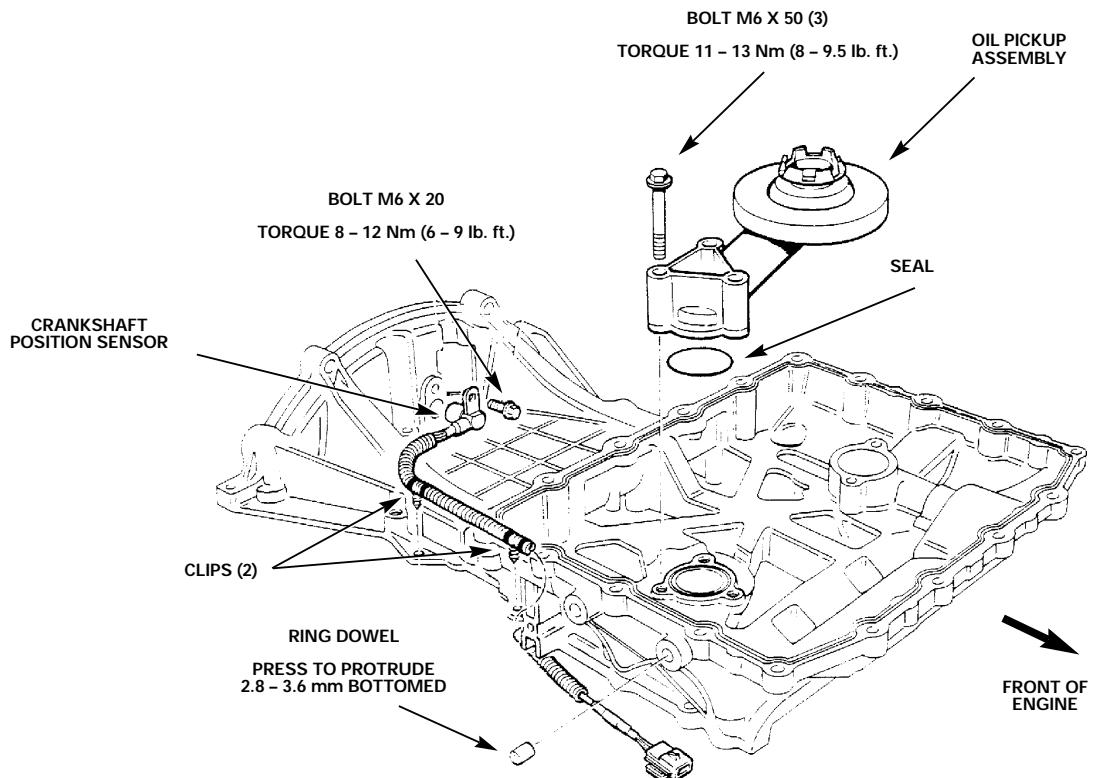
## Structural Sump

STRUCTURAL SUMP (TOP VIEW)



T180/2.15

STRUCTURAL SUMP WITHOUT OIL COOLER (BOTTOM VIEW)

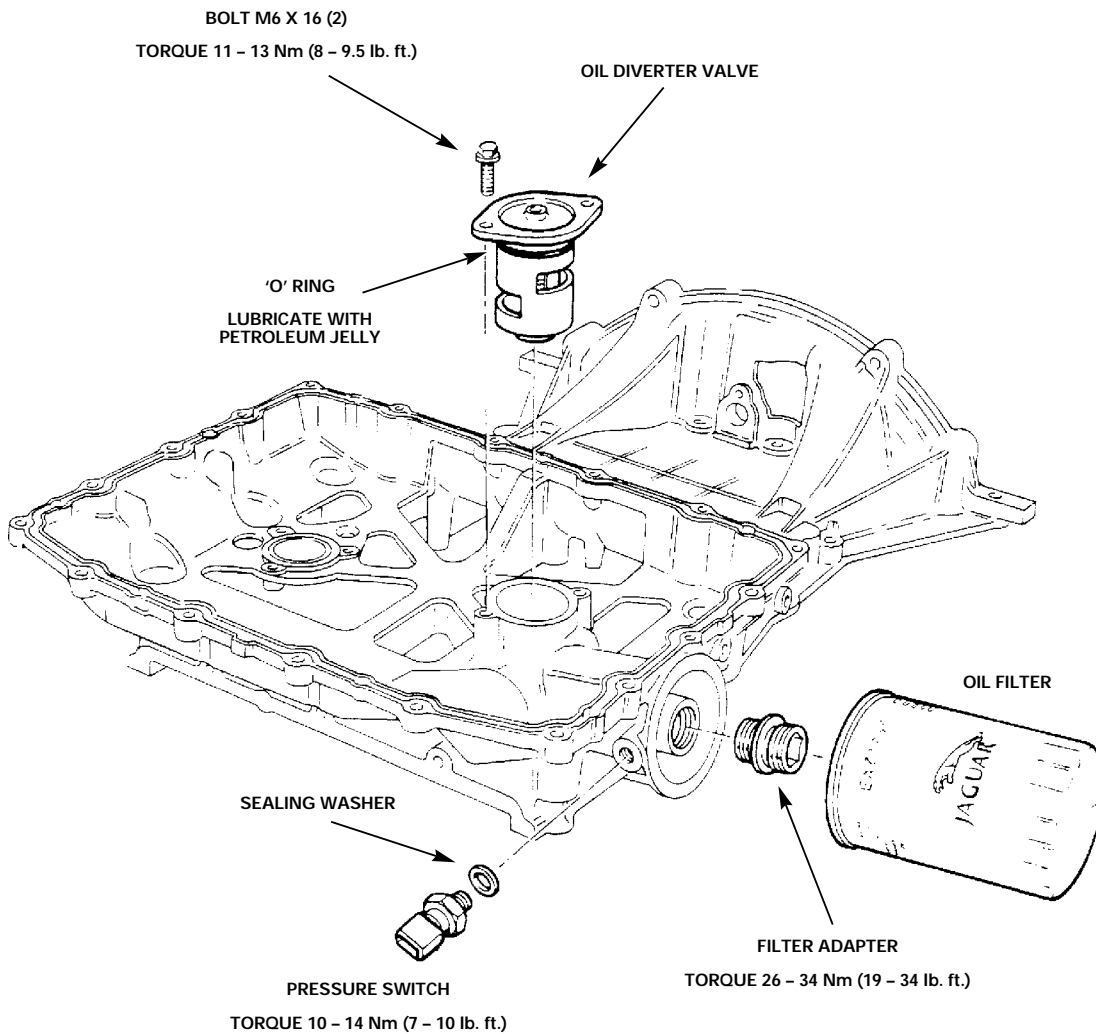


T180/2.16

# AJV8 Engine Assembly

## Structural Sump (continued)

### STRUCTURAL SUMP WITH OIL COOLER (BOTTOM VIEW)



T180/2.17

### NOTES



## Structural sump sealant application

Structural sump and bed plate joints must be clean and free from oil.

Apply a continuous bead of Loctite Ultra Gray 5699 RTV sealant to the bed plate as shown on the illustration, with the diameter of the bead as indicated. No gaps are allowed in the sealant bead.

Within 20 minutes of initial sealant application, the structural sump must be installed and all bolts torqued.

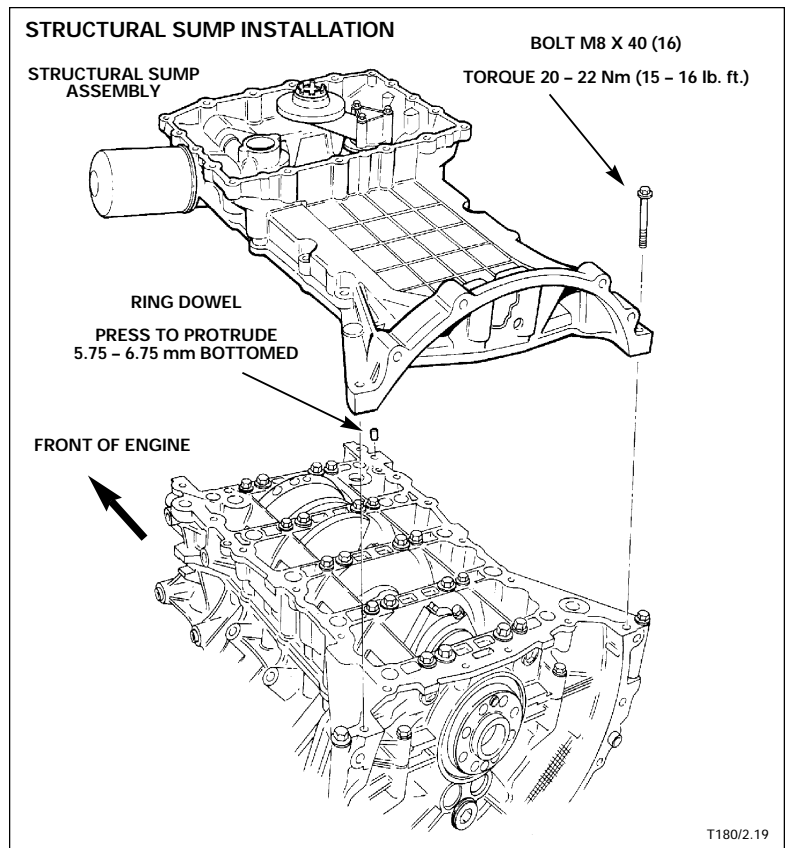
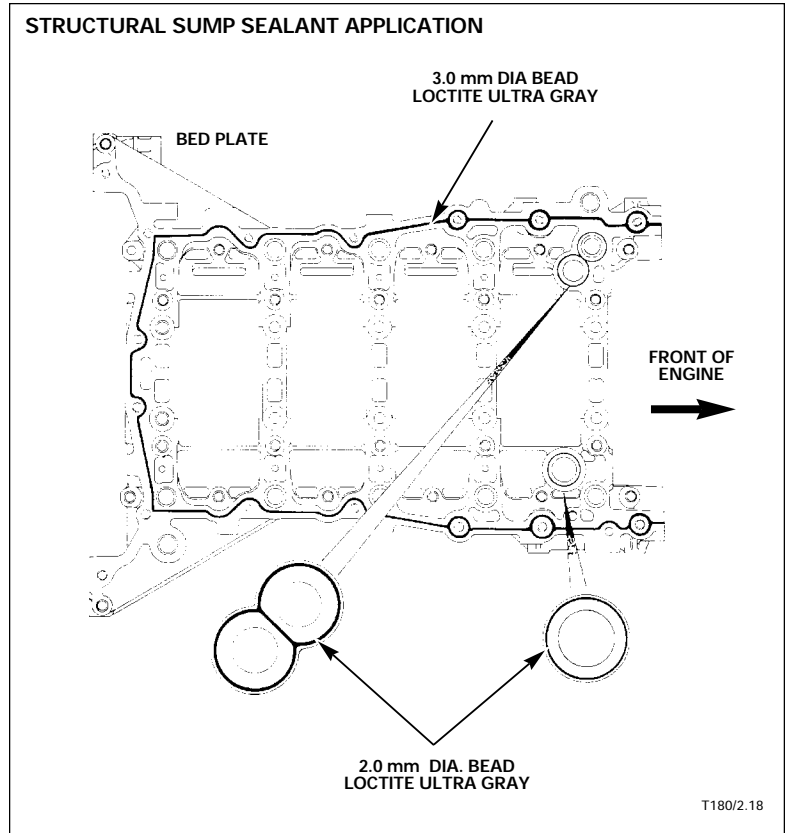
Remove any excess sealant from the joint and the block to timing case joint surface.

**NOTE:** If the operation is not completed within 20 minutes of initial sealant application, separate the structural sump from the bed plate. Clean the joints with a plastic or wooden scraper and repeat the procedure.

## Structural Sump Installation

The transmission bell housing face of the installed structural sump may be from -0.2 mm to +0.1 mm flush with the cylinder block bell housing face.

### NOTES



## Oil Pan

### Oil Pan Installation

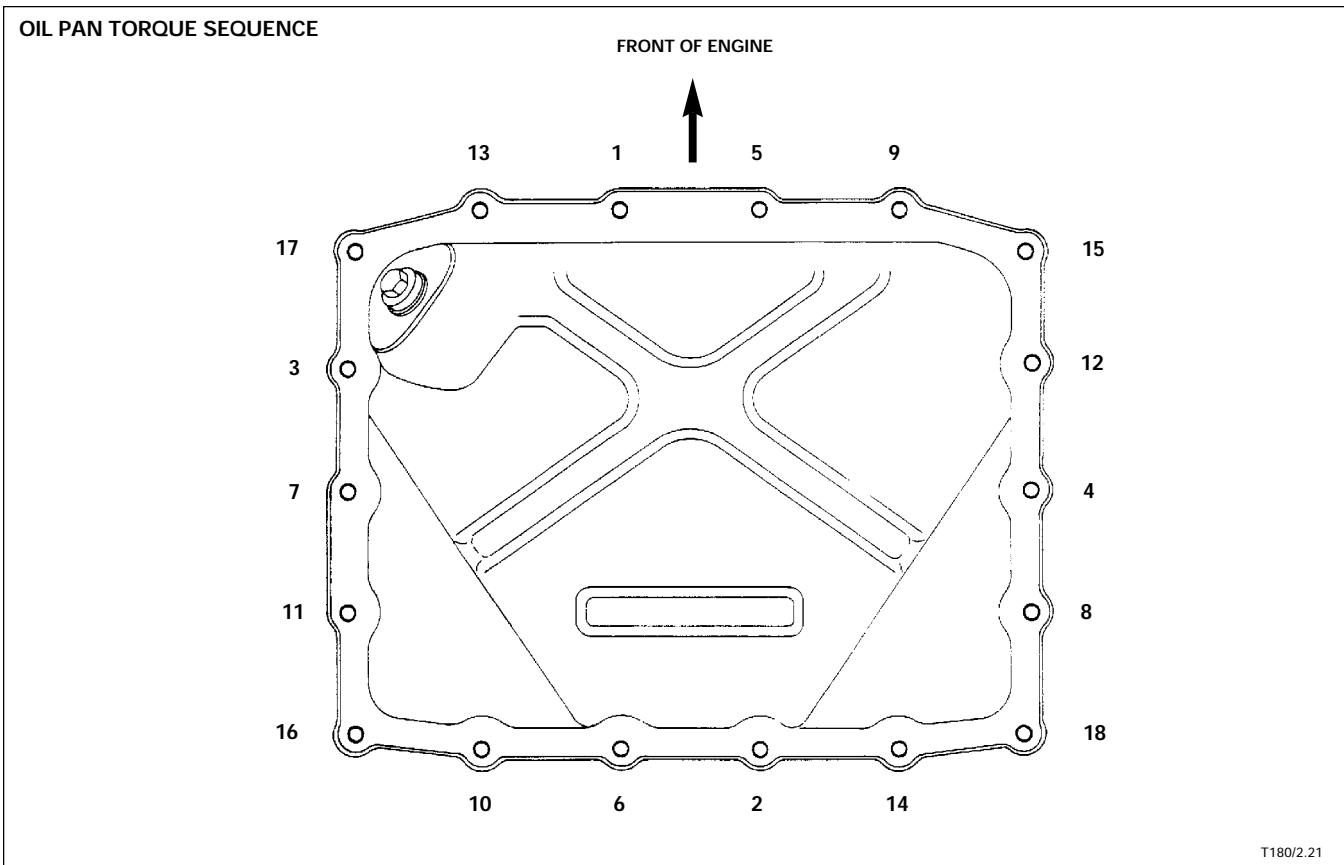
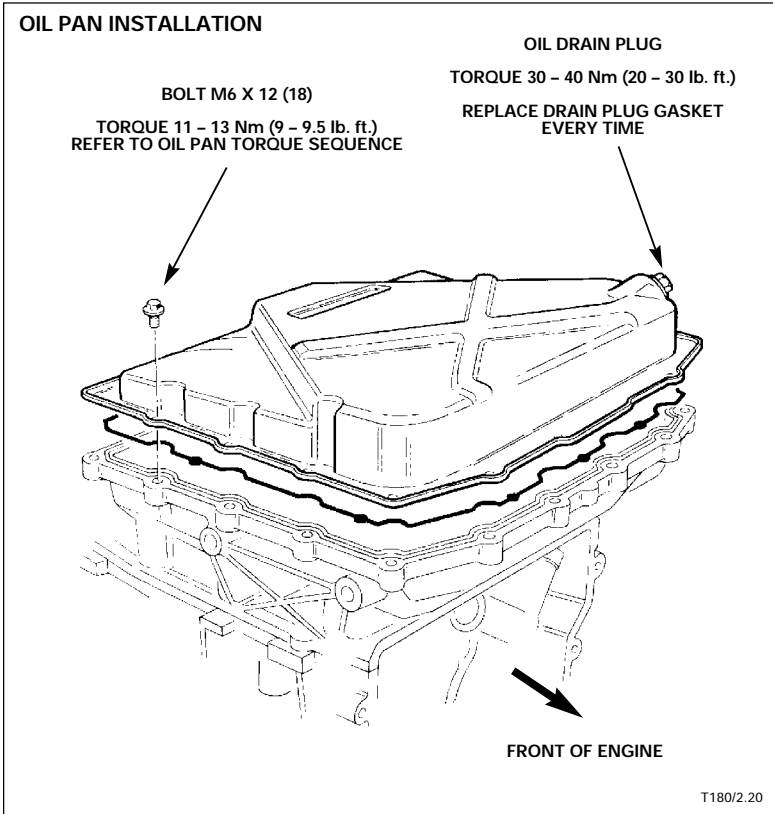
Fully seat the in-groove gasket in the structural sump.

Install all pan bolts finger tight.

Torque the bolts to 11 – 13 Nm following the sequence below.

**NOTE:** The oil drain plug gasket must be replaced whenever the plug is removed.

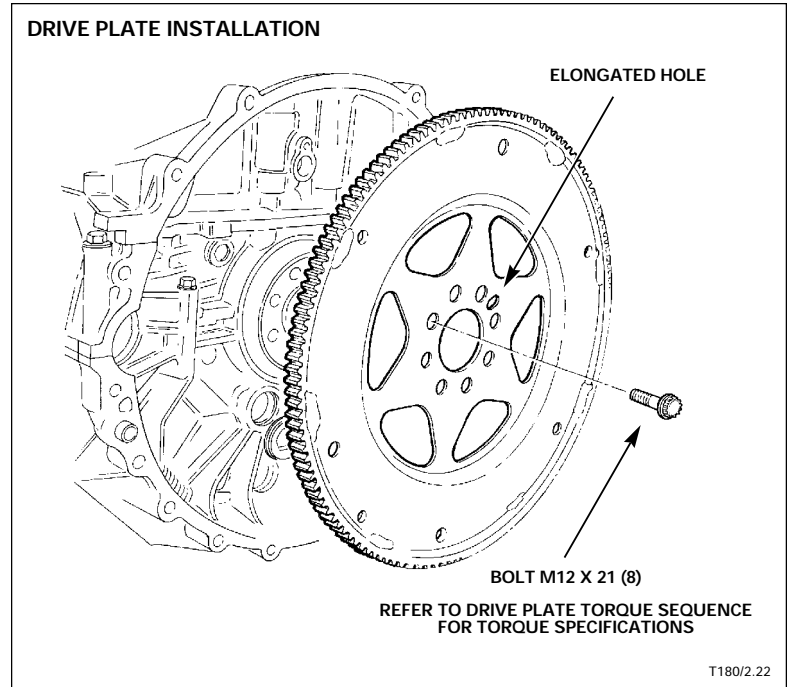
#### NOTES



## Drive Plate

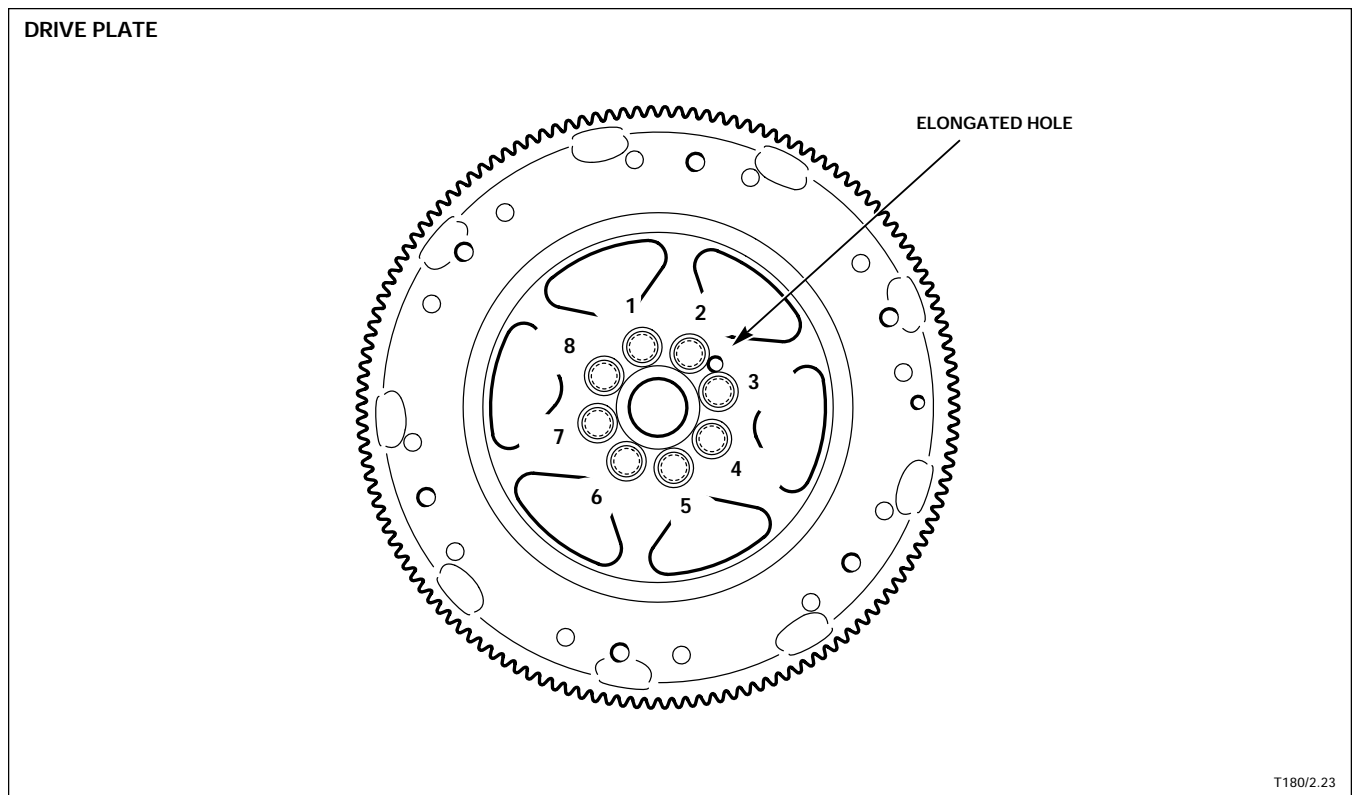
### Drive Plate Installation

Install the drive plate with its elongated hole over the crankshaft dowel. The dowel must not protrude from the outer face of the drive plate. Install all bolts finger tight.



### Drive plate bolt torque sequence

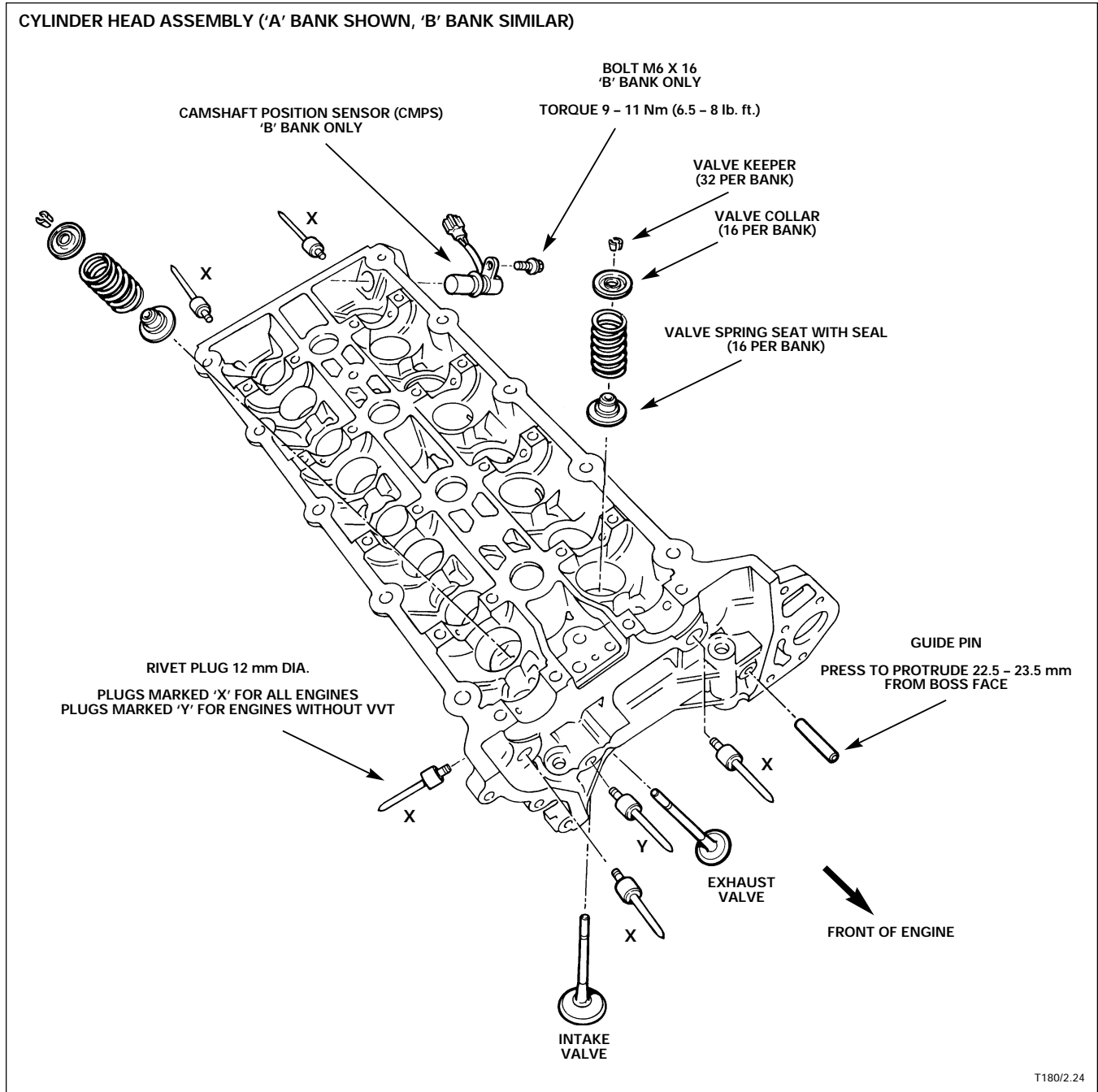
- Step 1 Torque bolts 1,3,5 & 7 to 14 – 16 Nm (10.5 – 12 lb ft).
- Step 2 Torque bolts 1,3,5 & 7 to 97 – 103 Nm (71.5 – 76 lb ft).
- Step 3 Torque bolts 2,4,6 & 8 to 14 – 16 Nm (10.5 – 12 lb ft).
- Step 4 Torques bolts 2,4,6 & 8 to 97 – 103 Nm (71.5 – 76 lb ft).



# AJV8 Engine Assembly

## Cylinder Heads

CYLINDER HEAD ASSEMBLY ('A' BANK SHOWN, 'B' BANK SIMILAR)

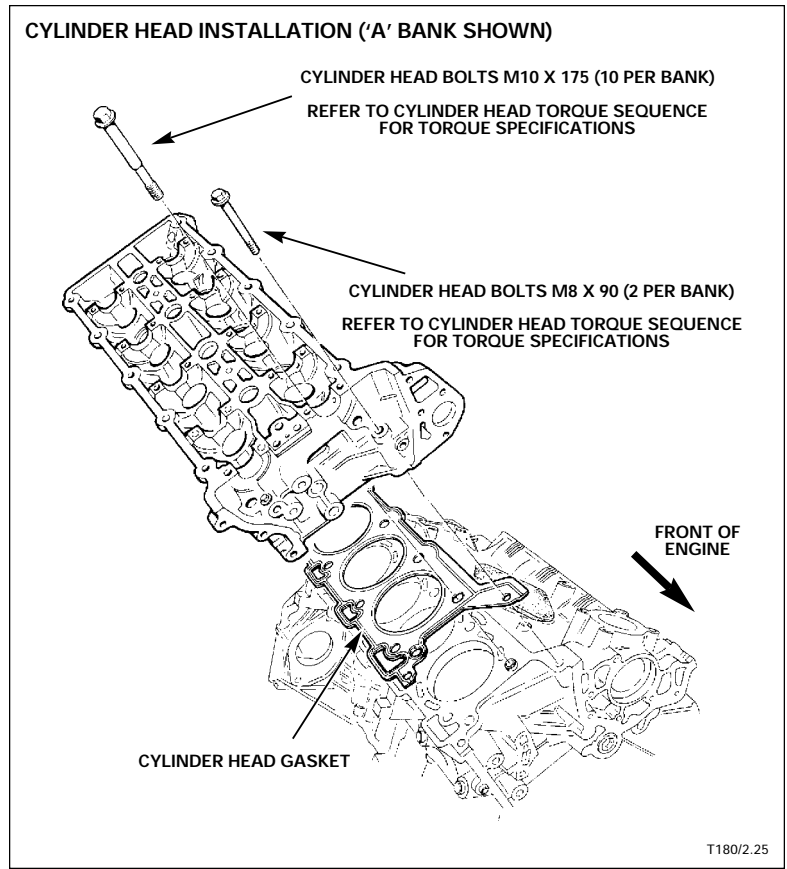


T180/2.24

### NOTES

## Cylinder Head Installation

Cylinder head, gasket mating surfaces, threaded holes, and gaskets must be clean and free from oil.

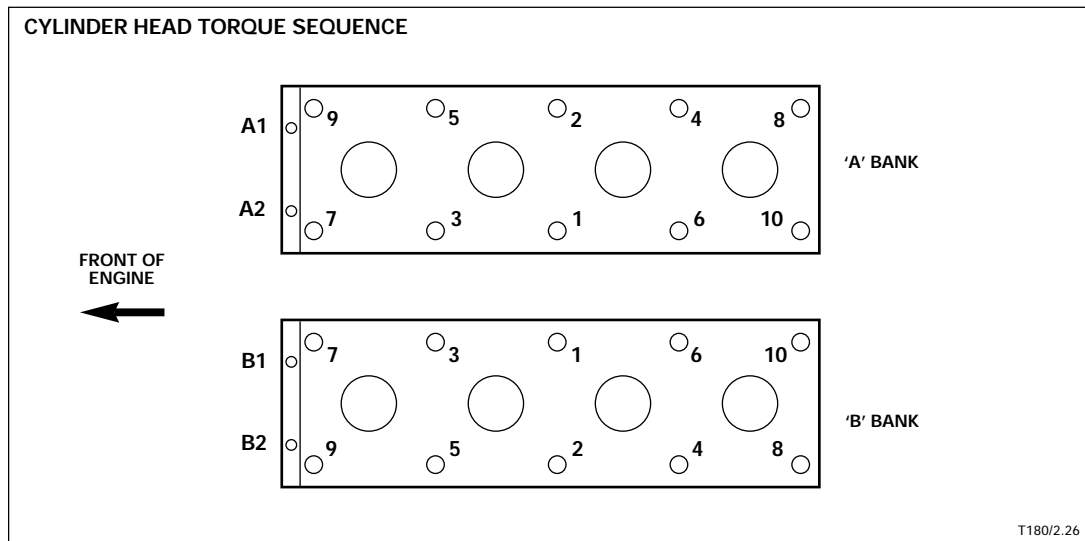


## Cylinder head torque sequence

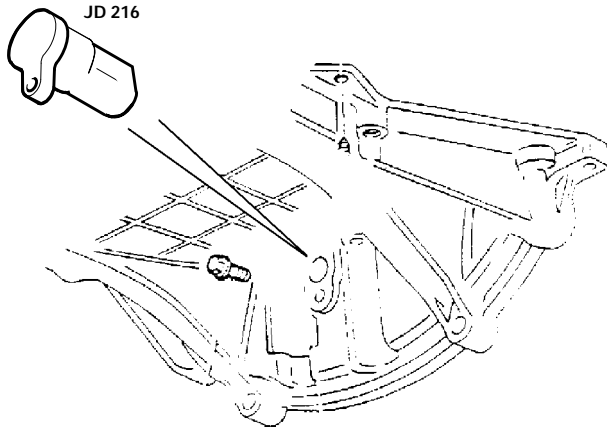
M10 – Bolts numbered 1 – 10 (use once only). Center punch bolt heads when fully torqued.

M8 – Bolts numbered A1 – B2.

- Step 1 Install all bolts hand tight
- Step 2 Torque M10 bolts to 20 Nm (15 lb ft)
- Step 3 Torque M10 bolts to 35 Nm (26 lb ft)
- Step 4 Tighten M10 bolts additional 90°
- Step 5 Tighten M10 bolts additional 90°
- Step 6 Torque M8 bolts to 23 – 27 Nm (17 – 20 lb ft)



## CRANKSHAFT POSITIONING



T180/2.27 A & B

## Camshafts

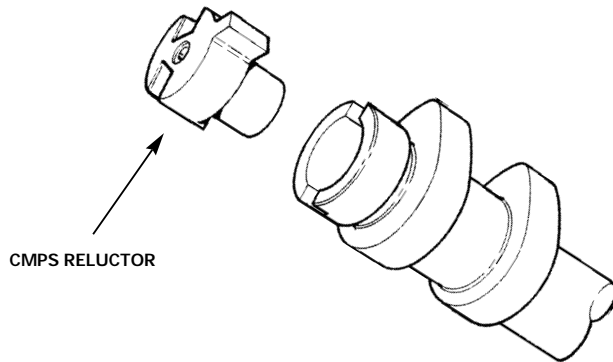
Prior to installing the camshafts, position the crankshaft to 45° ATDC cylinder 1A. Hold the drive plate in position with JD 216 inserted through the cylinder block crankshaft position sensor hole and engaged in the drive plate slot. Do not rotate the crankshaft until valve timing is complete.

**⚠ CAUTION:** Do not use JD 216 to lock the crankshaft when tightening camshaft, crankshaft or vibration damper bolts.

### Camshaft position sensor

The camshaft position sensor retractor is pressed into the 'B' bank intake camshaft. There should be no noticeable gap between the engagement dogs on the retractor and the slots in the camshaft. Refer to Technical Bulletin 303-08.

## 'B' BANK INTAKE CAMSHAFT



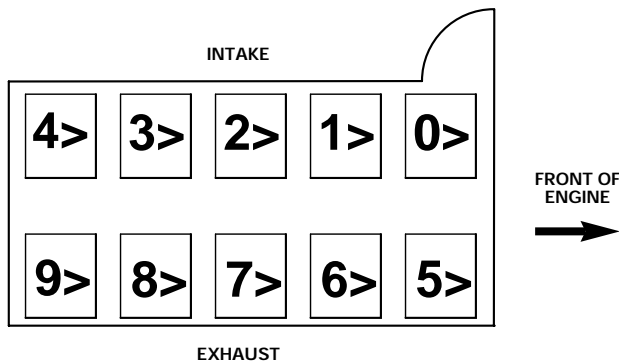
T180/2.28

### Camshaft bearing caps

Camshaft bearing caps must be installed in their original positions as marked on their outer faces. The arrow mark (>) points toward the front of the engine. On 'A' bank bearing caps, the arrow appears after the number (1>); on 'B' bank bearing caps, the arrow appears before the number (>1).

| Camshaft bearing caps | Numbers          |
|-----------------------|------------------|
| Intake                | 0 – 4 from front |
| Exhaust               | 5 – 9 from front |

## CAMSHAFT BEARING CAP MARKINGS ('A' BANK SHOWN)



T180/2.29

## NOTES

Lubricate the valve lifter bores and the valve stem heads with EP 90 oil. Install the valve lifters and adjusting shims in their original positions. Install the shims with the size marking facing down, towards the valve lifter.

Valve adjusting shims must be selected to give the following clearances:

### Exhaust valve clearance

$0.25 \pm 0.02$  mm ( $0.010 \pm 0.0008$  in.)

### Inlet valve clearance

$0.20 \pm 0.02$  mm ( $0.008 \pm 0.0008$  in.)

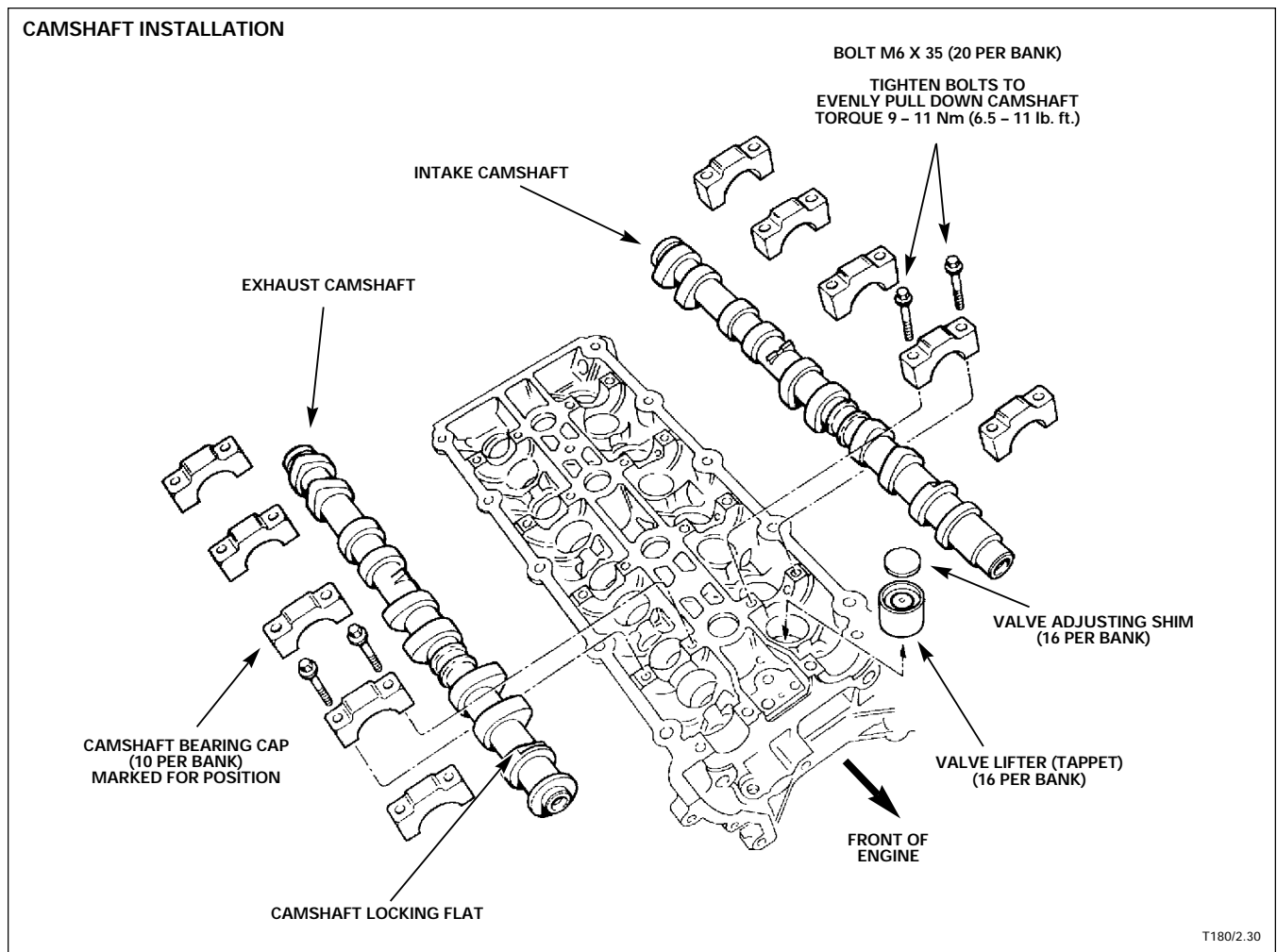
Lubricate the top of the adjusting shims and the camshaft lower bearings with engine oil.

Apply a drop of EP 90 oil to each camshaft lobe and install the camshafts with their locking flats parallel with the top face of the camshaft cover gasket surface.

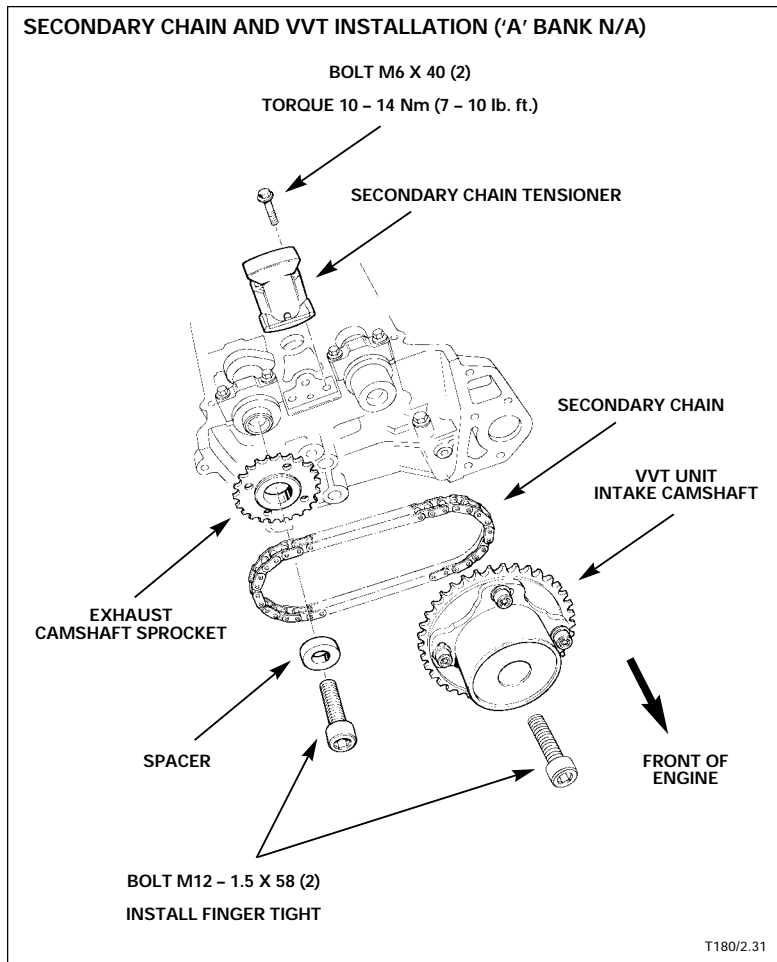
Apply a 4 mm drop of EP 90 oil to each camshaft bearing cap and position the caps according to their location markings. Refer to Camshaft Bearing Cap Markings, page 22.

Tighten the camshaft bearing caps in stages evenly. Torque to 9 – 11 Nm (6.5 – 8 lb ft).

Install a JD 215 camshaft locking bar across the cylinder head. Rotate each camshaft slightly until its locking flat is aligned with the locking bar.



## Timing Chain and VVT Unit



### Chain Tensioner and Guide Installation

#### Secondary tensioners

Insert a stiff piece of wire into the hole in the chain tensioner to release the check valve and collapse the tensioner. Install the tensioners as follows:

- 'A' bank secondary tensioner - hydraulic piston faces down.
- 'B' bank secondary tensioner - hydraulic piston faces up.

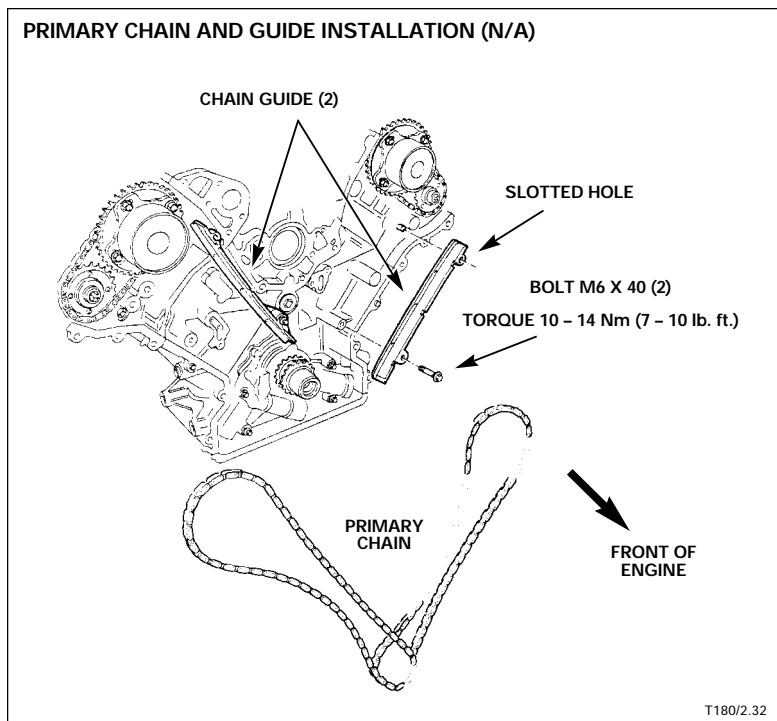
#### Primary chain tensioners and guides

Install the chain guides with the slotted hole up and the raised side toward the cylinder block. Install the primary chain tensioner blades. Insert a stiff piece of wire into the hole in the primary chain tensioners to release the check valve and collapse the tensioner. Install the tensioners and blanking plates as illustrated.

**⚠ CAUTION:** Blanking plates can be incorrectly installed. Incorrect installation reduces engine oil pressure to the tensioners.

**NOTE:** Supercharged AJV8 engines have fly-wheels in place of the VVT units.

#### NOTES



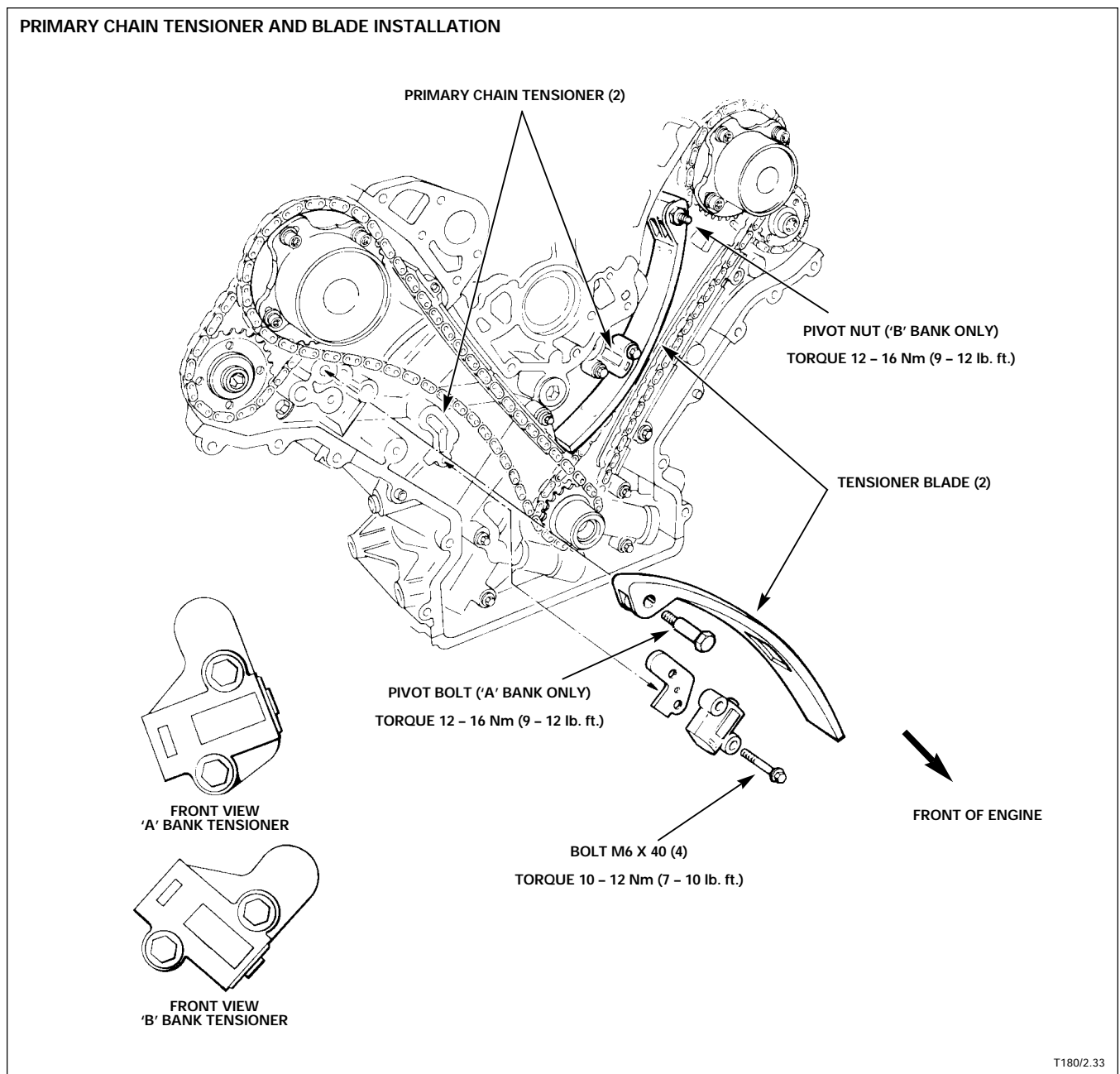


## Chain Installation

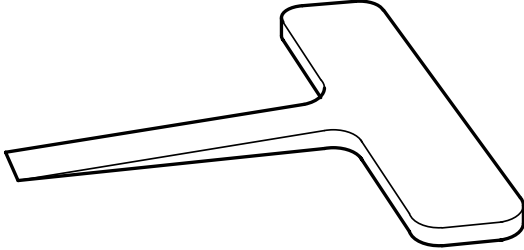
Assemble the 'B' bank primary and secondary chain and sprocket assembly on the bench. Slide the assembly over the crankshaft and camshafts. The crankshaft key must engage in the sprocket and the chains should be positioned as illustrated. Install the camshaft sprocket bolts hand tight to allow the sprockets to rotate on the camshaft.

Repeat the procedure for the 'A' bank chains. The crankshaft sprockets must be positioned with their teeth out of phase. The tooth point of one sprocket should align with the valley of the other sprocket. If the alignment is incorrect, remove the 'A' bank sprocket, turn it over and reinstall.

Install the 'A' bank chain and sprocket assembly. The camshaft sprocket bolts must be left loose to allow the sprocket to rotate on the camshaft.

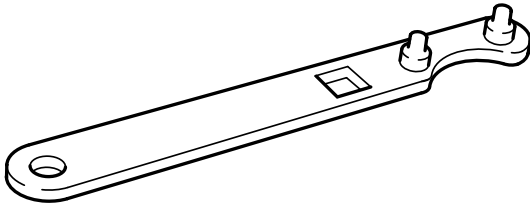


**JD 218 TIMING CHAIN TENSIONER WEDGE**



T180/2.34

**JD 217 TIMING CHAIN TENSIONER TOOL**



T180/2.35

## Camshaft Timing

Check that the crankshaft is positioned to 45° ATDC with a JD 216 drive plate locking pin installed.

Using a JD 215 camshaft locking bar, check that the camshafts are held with their flats up and parallel with the top face of the cylinder head.

Check that the VVT units are fully retarded.

Tighten the 'B' bank primary chain by inserting 1 or 2 JD 218 timing chain tensioning wedges between the 'B' bank primary chain tensioner and the tensioner blade.

Fit the JD 217 timing chain tensioner tool to the 'B' bank exhaust sprocket and apply 10 – 15 Nm (7 – 11 lb ft) counter clockwise torque to the exhaust camshaft sprocket while torquing the exhaust camshaft sprocket bolt to 110 – 130 Nm (81 – 96 lb ft). Continue to hold the tension and torque the intake camshaft sprocket bolt to 110 – 130 Nm (81 – 96 lb ft).

Repeat the procedure for the 'A' bank chains.

Remove the JD 216 locking pin from the drive plate, the JD 215 camshaft locking bars and the JD 218 timing chain tensioning wedges.

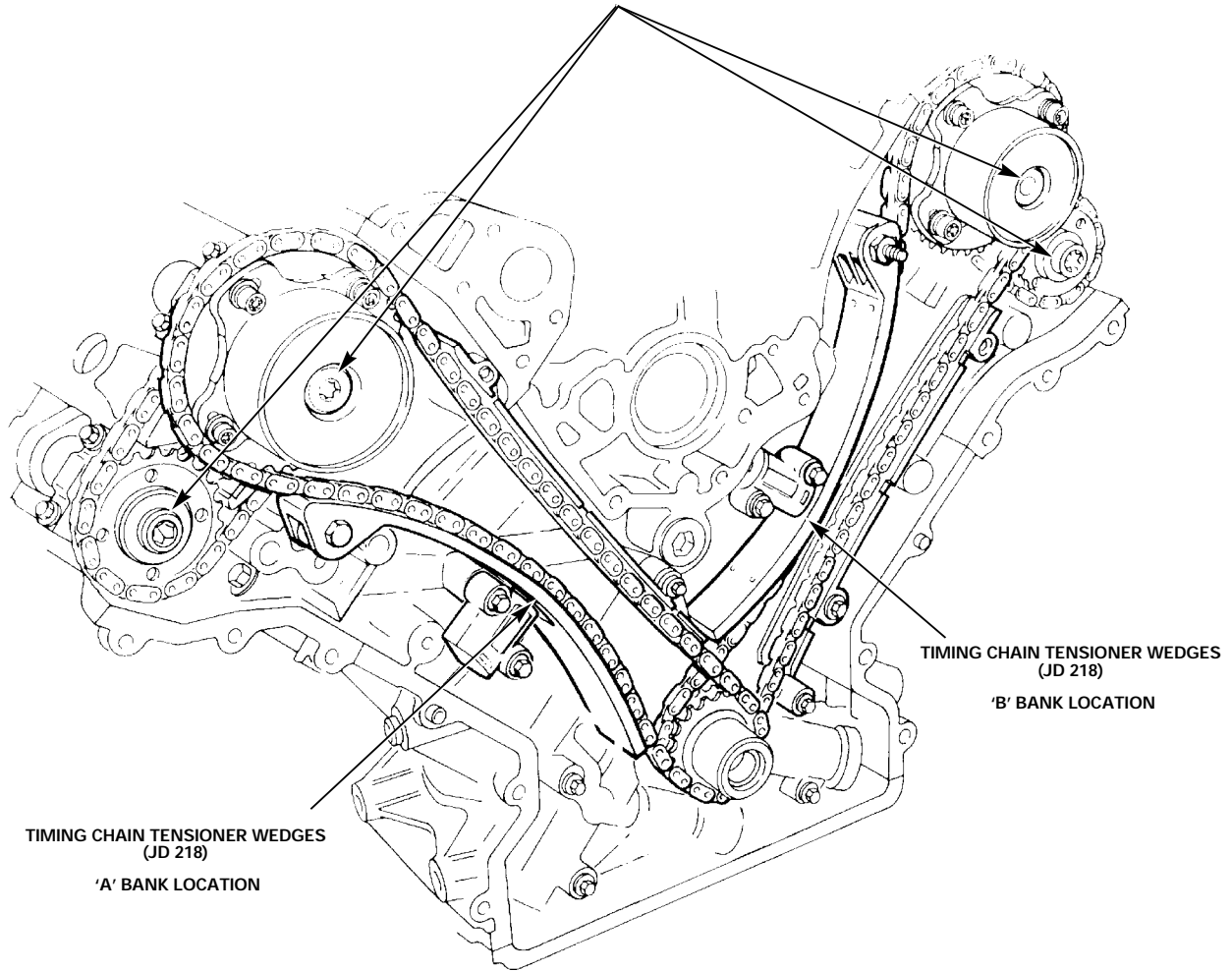
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### NOTES

## CAMSHAFT SPROCKET TIGHTENING PROCEDURE

EXHAUST CAMSHAFT SPROCKETS:  
APPLY AND HOLD 10 - 15 Nm (7 - 11 lb. ft.) TORQUE TO THE LEFT WITH JD 217

TORQUE 110 - 130 Nm (81 - 96 lb. ft.)



T180/2.36

## NOTES

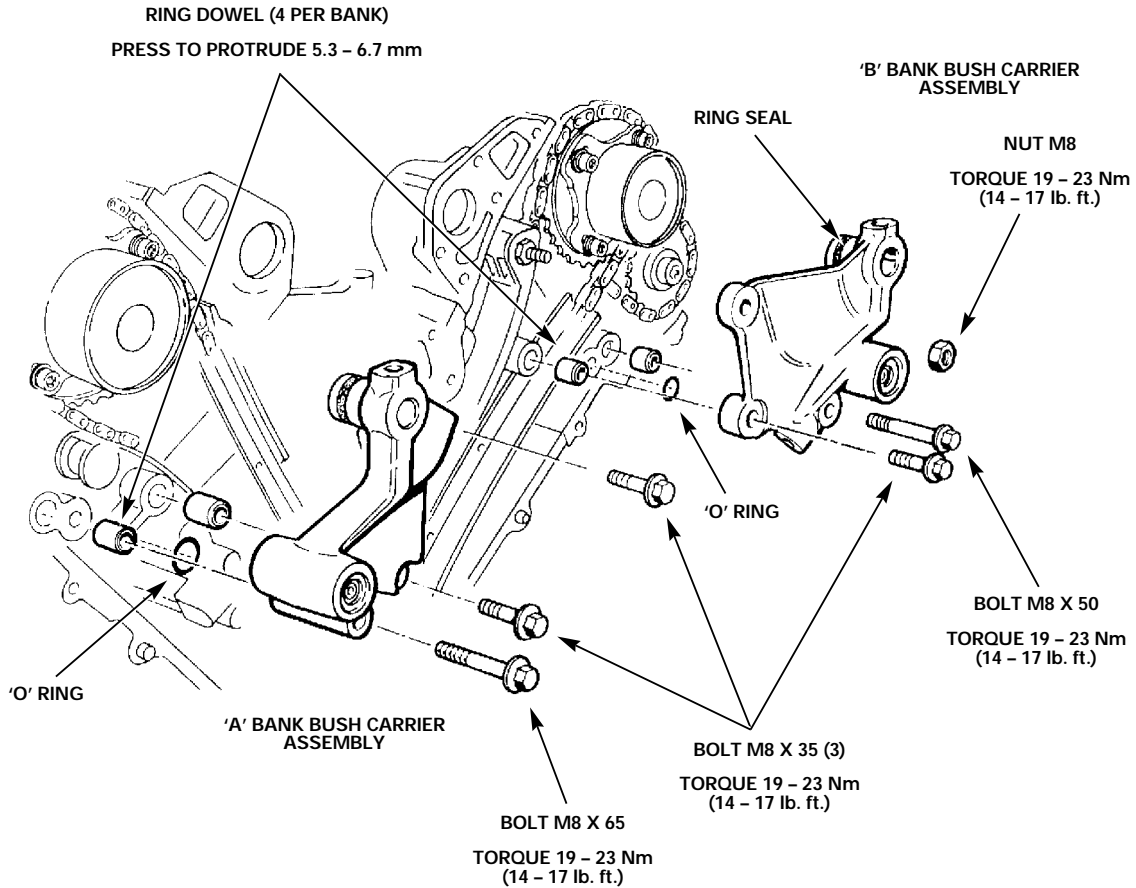
# AJV8 Engine Assembly

## Bush Carriers

Use petroleum jelly to hold the 'O' rings in the bush carrier recesses during installation.

Insert the bush into the VVT unit, compressing the ring seal with fingers as required. Locate the bush carrier onto the dowels and fully seat by hand before fitting bolts.

### BUSH CARRIER INSTALLATION (N/A ONLY)



T180/2.37

### NOTES

## Timing Cover

Insert and fully seat the timing cover in-groove gaskets in the cover.

Apply a 12 mm long, 3 mm diameter bead of Loctite Ultra Gray 5699 RTV sealant to the cylinder block assembly joints marked X. The cover must be installed and torqued within 20 minutes of initial sealant application.

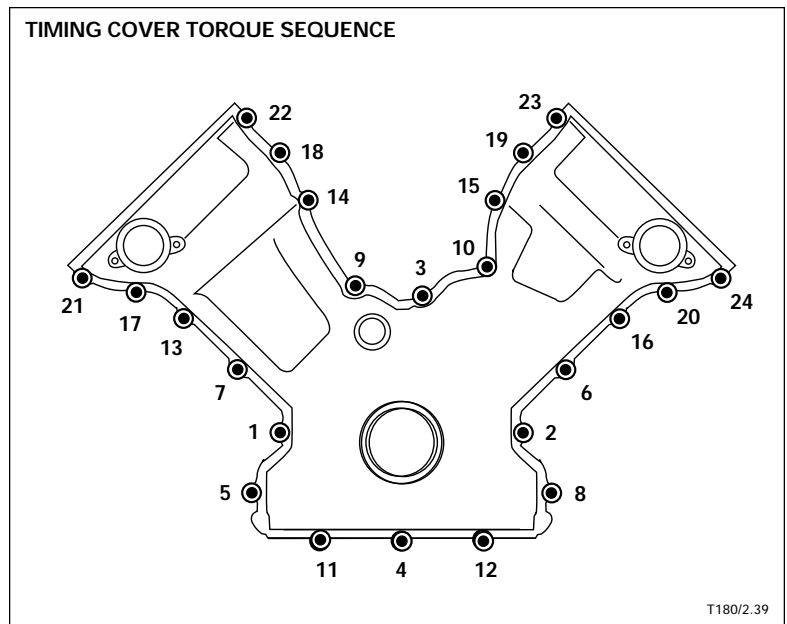
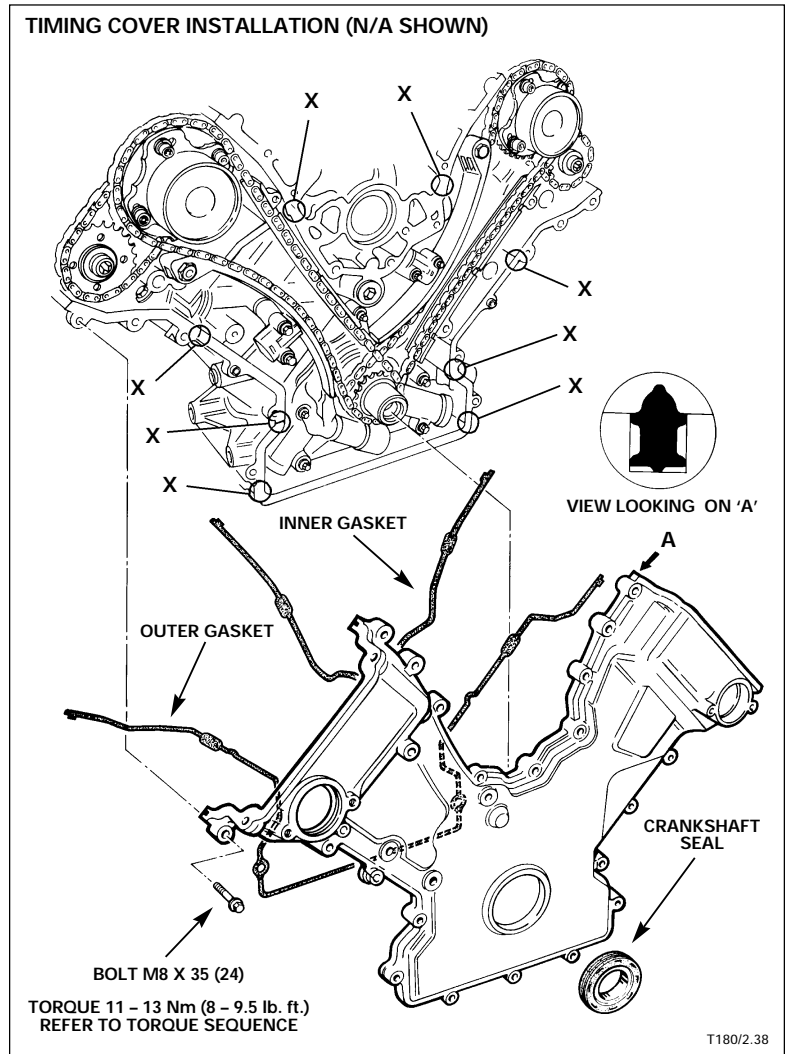
Locate the timing cover on its dowels and install so that the sealant and in-groove gaskets are not smeared.

Install the bolts and torque to 11 – 13 Nm (8 – 9.5 lb ft) following the torque sequence.

### Front crankshaft seal installation

Install the front seal with JD 235. Maintain the insertion load for 3 – 5 seconds. The seal must be parallel to the front face of the crankshaft within 0.3 mm.

### NOTES



## Crankshaft Vibration Damper and VVT Solenoids

**NOTE:** The crankshaft vibration damper bolt has a locking patch and must not be reused. If the bolt is removed, clean the threads in the crankshaft with a M16 x 2 – 6H plug tap and replace the bolt.

### Up to engine No. 961216XXXX: vibration damper without locking cone

Refer to Service Bulletin 303-05.

### From engine No. 961217XXXX: vibration damper with locking cone

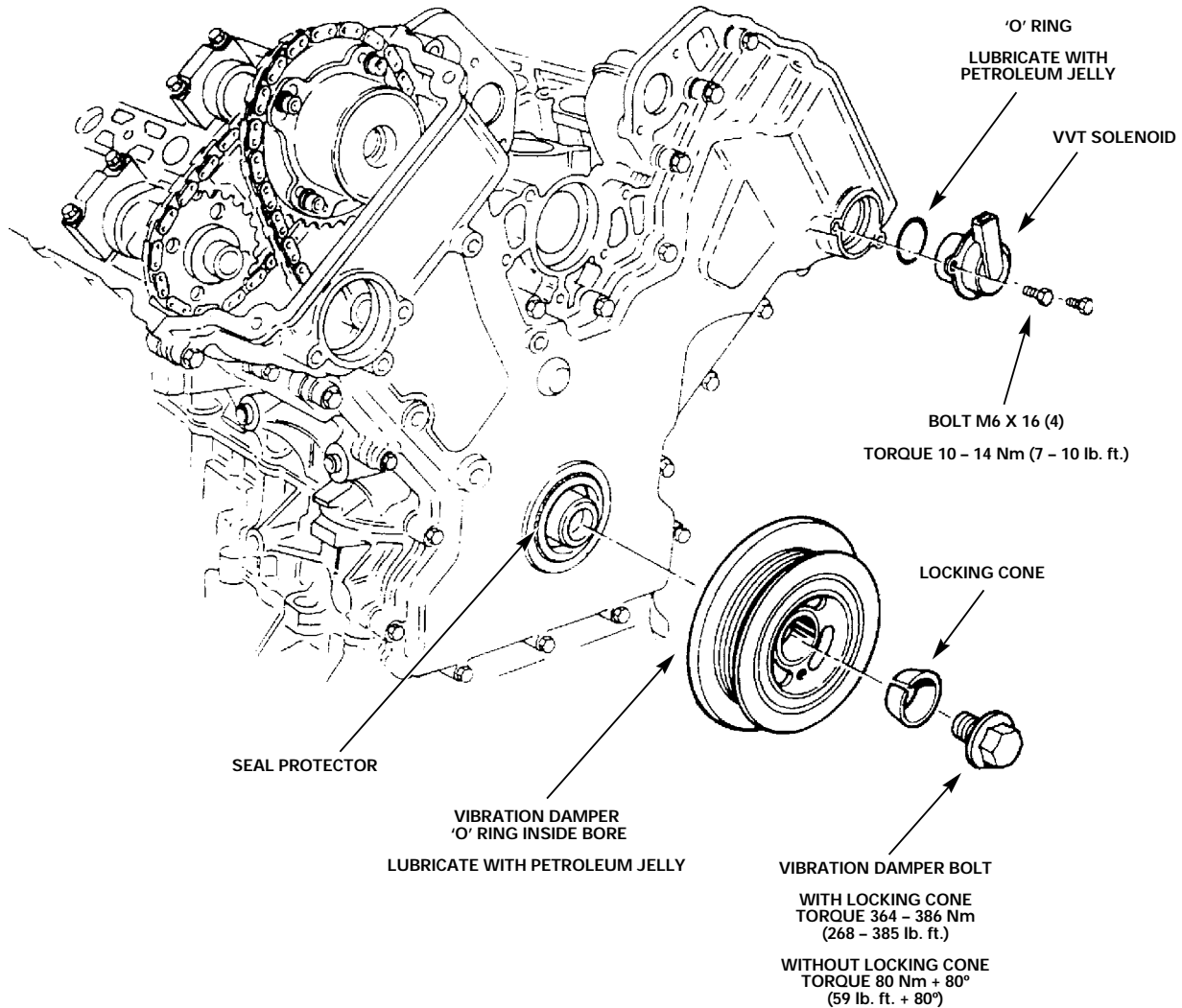
Remove the front seal protector.

Lubricate the 'O' ring and install in the damper bore..

Install the damper and center bolt. Install the 18G-1437 crankshaft locking tool with the 18G-14372 adapter to the damper.

Torque the center bolt to 364 – 386 Nm (268 – 385 lb ft).

### CRANKSHAFT VIBRATION DAMPER AND VVT SOLENOID INSTALLATION



T180/2.40

## Valve Adjustment

Rotate the engine with the crankshaft damper bolt at least 3 revolutions in the normal direction of rotation. Install a JD 216 drive plate locking pin to position the crankshaft at 45° ATDC and recheck the camshaft timing using a JD 215 locking bar to be sure that the camshaft flats are parallel with the top face of the cylinder heads. Remove the JD 215 and check/adjust the valves as described below.


### Checking valve adjustment

Engine must be COLD.

- 1 Remove on-plug coils, note harness connections, and camshaft covers.
- 2 Rotate crankshaft in normal engine direction of rotation only with crankshaft vibration damper bolt (24 mm).
- 3 Measure and record all the existing valve clearances.
- 4 Calculate required shims.

### Adjusting valves

- 1 Fit the base plate of adjusting tool JD 232 to the cylinder head using bolts supplied.  
**NOTE:** If adjusting intake valves, slide tool fully down for max. clearance. Slide fully up for exhaust valve.
- 2 Rotate the crankshaft to position the required valves so that there is maximum clearance between camshaft and shim.
- 3 Set the fingers of adapter to the fully unscrewed position using knurled bolts.
- 4 Fit adapter to base plate adjacent to the valves which require adjustment.
- 5 Tighten the winged bolts.
- 6 Position the fingers onto the outer edges of the valve lifter. Each finger must locate on the edge of the lifter.
- 7 Tighten the knurled bolts to compress the valve springs, until a firm resistance is felt.
- 8 The tool fingers must touch the lifter only, leaving the shim clear.
- 9 Remove excess oil on the lifter and shim.

 **WARNING: THE FOLLOWING OPERATIONS REQUIRE THE USE OF COMPRESSED AIR. ALWAYS WEAR EYE PROTECTION.**

- 10 Surround the immediate working area with a clean rag to contain any loose objects and shims displaced by the compressed air.
- 11 Aim the fan nozzle air gun, JD 233, at the edge of the shim and blow the shim from the lifter.
- 12 Clean and measure the thickness of the shim.
- 13 Calculate the shim required to correct the valve clearance.
- 14 Lubricate the selected shim with engine oil and install with the size marking facing the lifter.
- 15 Loosen the knurled screws on JD 232 attachment to allow the valve springs to return to their normal position.
- 16 When all valves have been adjusted, rotate the engine three times to settle all the valves in.
- 17 Recheck the valve clearances, adjust as required.

## Valve Adjustment (continued)

### Valve adjusting shims

| Thickness: | mm   | (in.)    | Part Number   |
|------------|------|----------|---------------|
|            | 2.18 | (0.0858) | NCA 2542DA 1  |
|            | 2.20 | (0.0866) | NCA 2542DA 2  |
|            | 2.22 | (0.0874) | NCA 2542DA 3  |
|            | 2.24 | (0.0882) | NCA 2542DA 4  |
|            | 2.26 | (0.0890) | NCA 2542DA 5  |
|            | 2.28 | (0.0898) | NCA 2542DA 6  |
|            | 2.30 | (0.0906) | NCA 2542DA 7  |
|            | 2.32 | (0.0913) | NCA 2542DA 8  |
|            | 2.34 | (0.0921) | NCA 2542DA 9  |
|            | 2.36 | (0.0929) | NCA 2542DA 10 |
|            | 2.38 | (0.0937) | NCA 2542DA 11 |
|            | 2.40 | (0.0945) | NCA 2542DA 12 |
|            | 2.42 | (0.0953) | NCA 2542DA 13 |
|            | 2.44 | (0.0961) | NCA 2542DA 14 |
|            | 2.46 | (0.0969) | NCA 2542DA 15 |
|            | 2.48 | (0.0976) | NCA 2542DA 16 |
|            | 2.50 | (0.0984) | NCA 2542EA 1  |
|            | 2.52 | (0.0992) | NCA 2542EA 2  |
|            | 2.54 | (0.1000) | NCA 2542EA 3  |
|            | 2.56 | (0.1008) | NCA 2542EA 4  |
|            | 2.58 | (0.1016) | NCA 2542EA 5  |
|            | 2.60 | (0.1024) | NCA 2542EA 6  |
|            | 2.62 | (0.1031) | NCA 2542EA 7  |
|            | 2.64 | (0.1039) | NCA 2542EA 8  |
|            | 2.66 | (0.1047) | NCA 2542EA 9  |
|            | 2.68 | (0.1055) | NCA 2542EA 10 |
|            | 2.70 | (0.1063) | NCA 2542EA 11 |
|            | 2.72 | (0.1071) | NCA 2542EA 12 |
|            | 2.74 | (0.1079) | NCA 2542EA 13 |
|            | 2.76 | (0.1087) | NCA 2542EA 14 |
|            | 2.78 | (0.1094) | NCA 2542EA 15 |
|            | 2.80 | (0.1102) | NCA 2542EA 16 |
|            | 2.82 | (0.1110) | NCA 2542FA 1  |
|            | 2.84 | (0.1118) | NCA 2542FA 2  |
|            | 2.86 | (0.1126) | NCA 2542FA 3  |
|            | 2.88 | (0.1134) | NCA 2542FA 4  |
|            | 2.90 | (0.1142) | NCA 2542FA 5  |



## Camshaft Covers

### Camshaft Cover Installation

Insert and fully seat the camshaft cover and spark plug in-groove gaskets in the cover.

Replace the camshaft cover bolt seals.

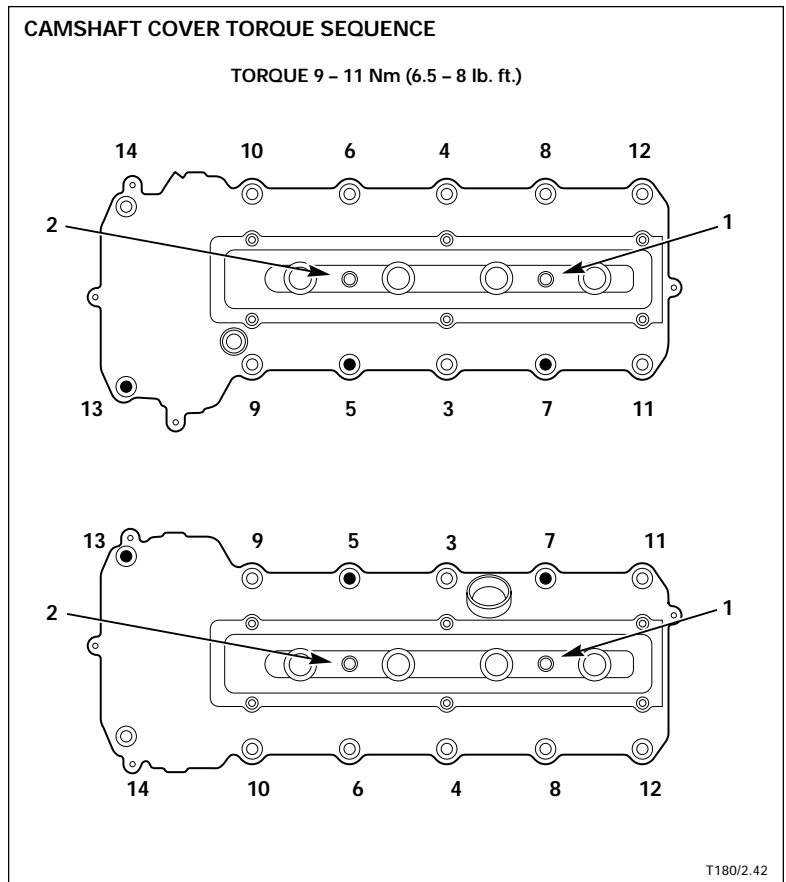
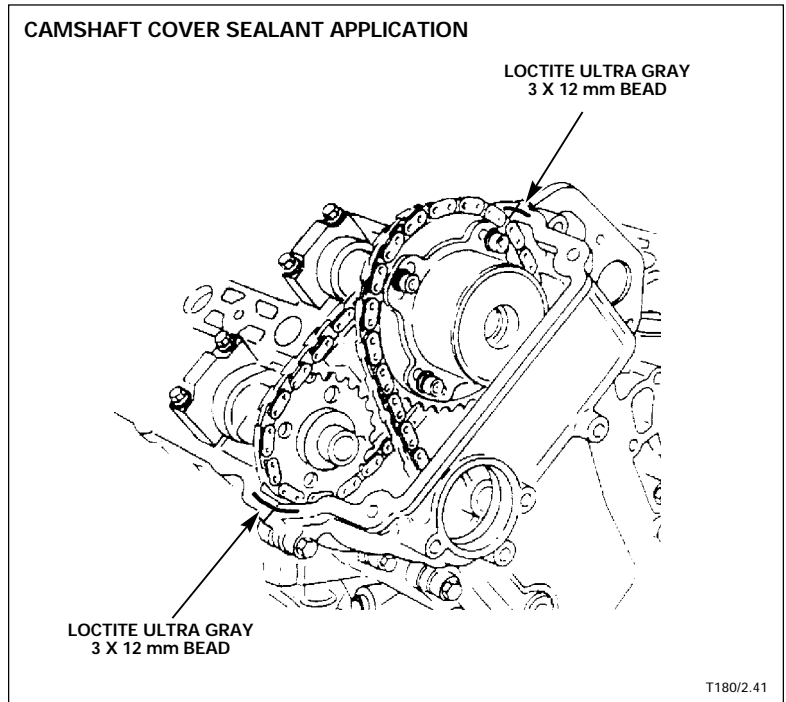
Apply a 12 mm long, 3 mm diameter bead of Loctite Ultra Gray 5699 RTV sealant to the areas indicated.

Install the cover. Avoid smearing the sealant.

Finger tighten all of the cover bolts and torque to 9 – 11 Nm (6.5 – 8 lb ft) within 20 minutes. Follow the torque sequence shown in the illustration.

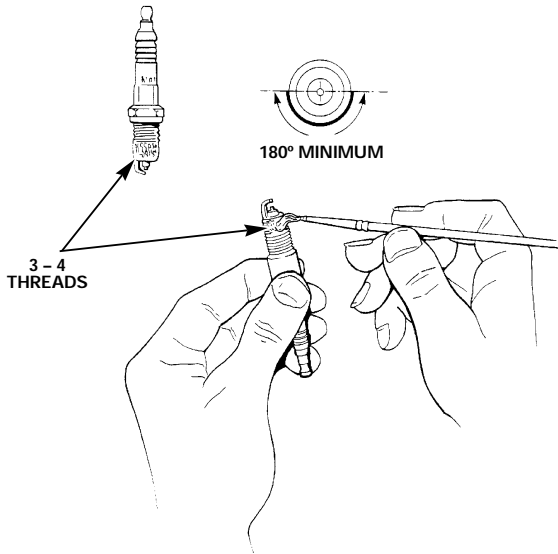
**NOTE:** Bolts 5, 7, and 13 have posts to attach the engine cover.

#### NOTES



## Spark Plugs and Ignition Coils

### SPARK PLUG LUBRICANT APPLICATION



T180/2.43

### Spark Plug Installation

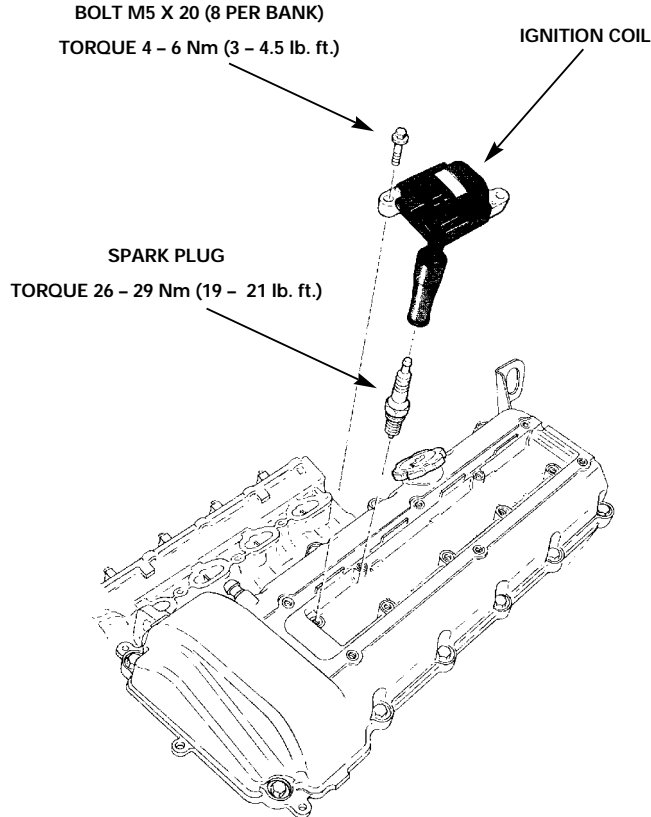
Apply 'Neverseez' to the 3 - 4 threads next to the spark plug electrodes. Fill to full thread depth for 180° of thread circumference.

**⚠ CAUTION:** Do not contaminate the spark plug electrodes.

Torque spark plugs to 25 - 29 Nm (18.5 - 21 lb ft).

### NOTES

### SPARK PLUG AND IGNITION COIL INSTALLATION



T180/2.44

## Cooling System

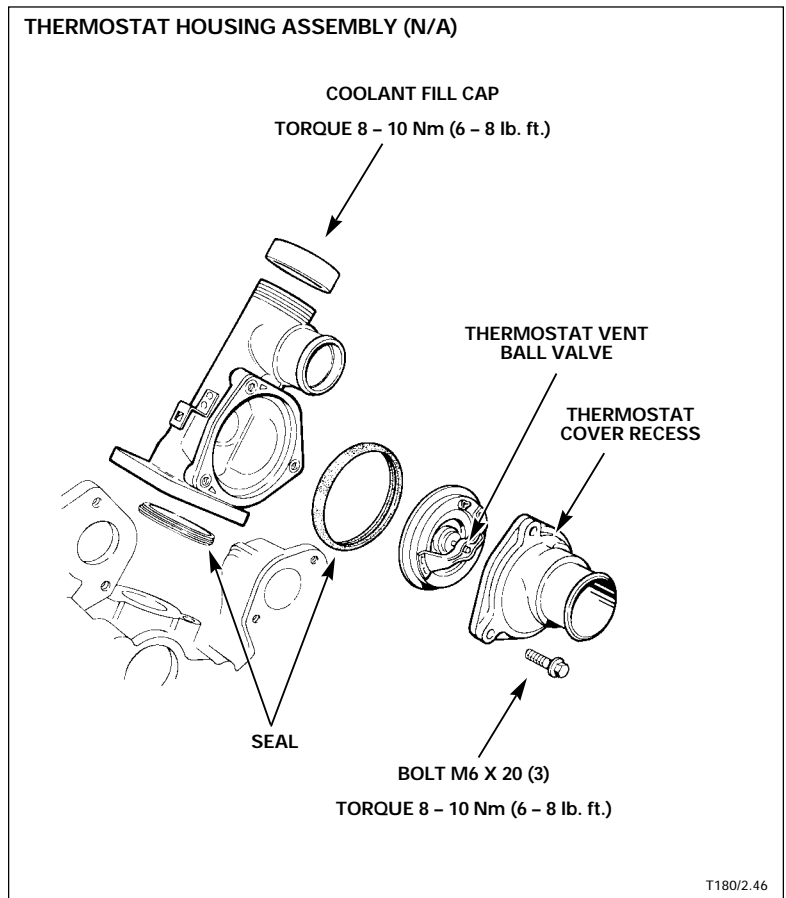
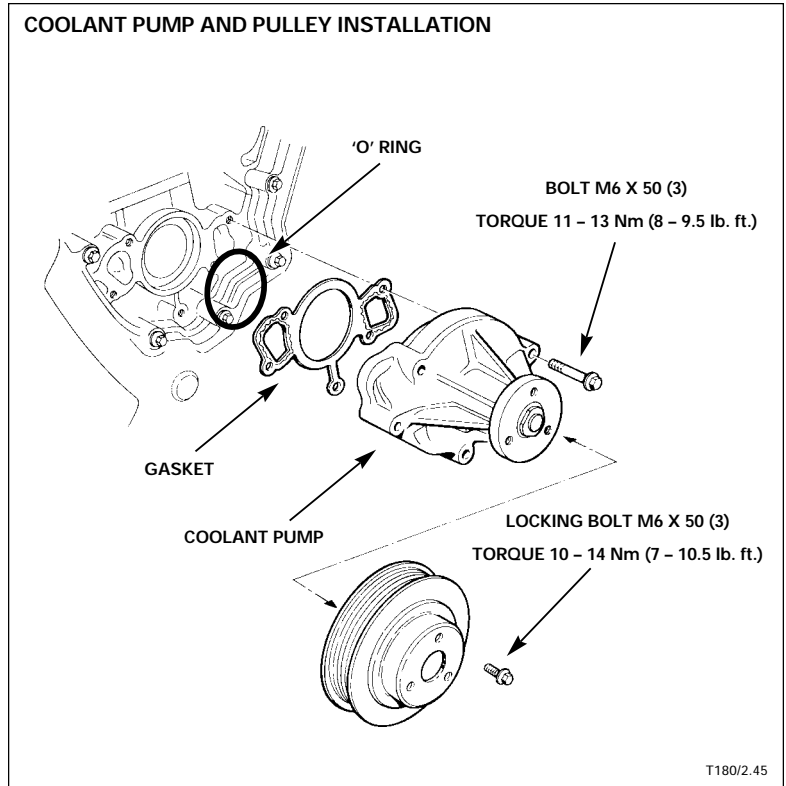
### Coolant Pump and Pulley Installation

Lubricate the coolant pump 'O' ring with petroleum jelly. Install the coolant pump gasket dry.

### N/A Thermostat Housing Installation

The thermostat seal may be fitted either way. The thermostat vent ball valve must locate in the cover recess. Lubricate the seals with recommended antifreeze or water only.

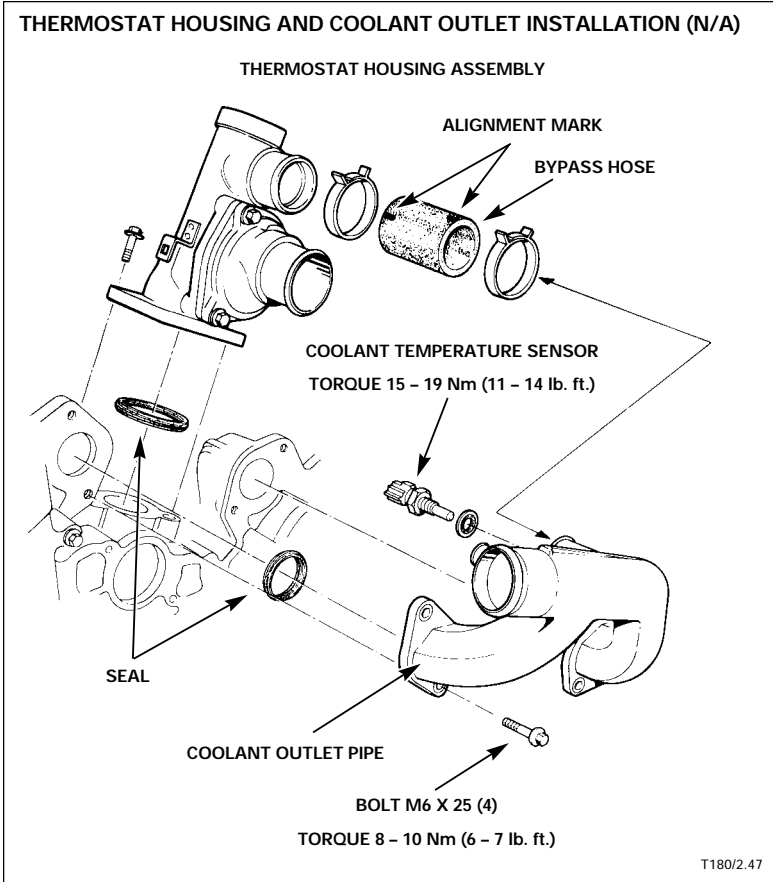
#### NOTES



## Cooling System (continued)

### Thermostat Housing and Coolant Outlet Pipe Installation

Use only water or recommended antifreeze to lubricate cooling system seals and hoses.



Install the bypass hose to the thermostat housing with the hose alignment marks facing up.

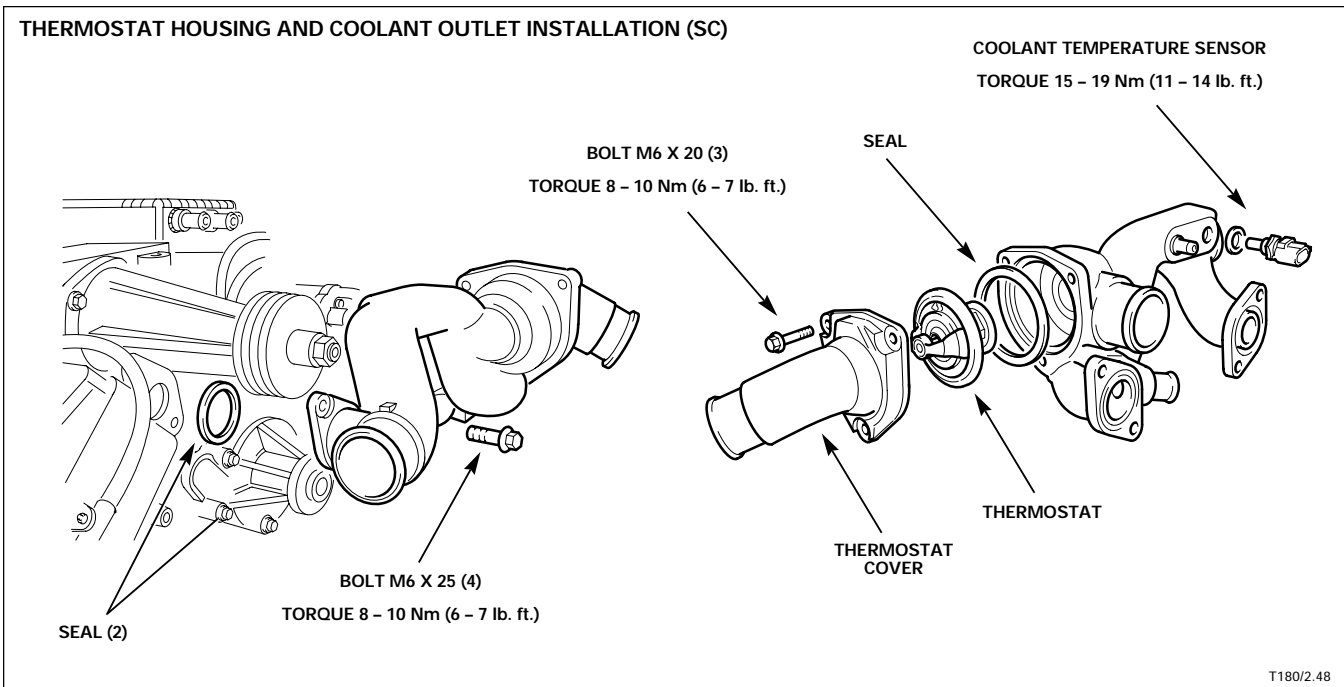
Install both bypass hose clamps. Position the thermostat housing clamp over the alignment mark. Position the coolant outlet pipe clamp in the middle of the hose.

Install the thermostat housing to the block.

Slide the coolant outlet pipe into the bypass hose and install to the cylinder heads.

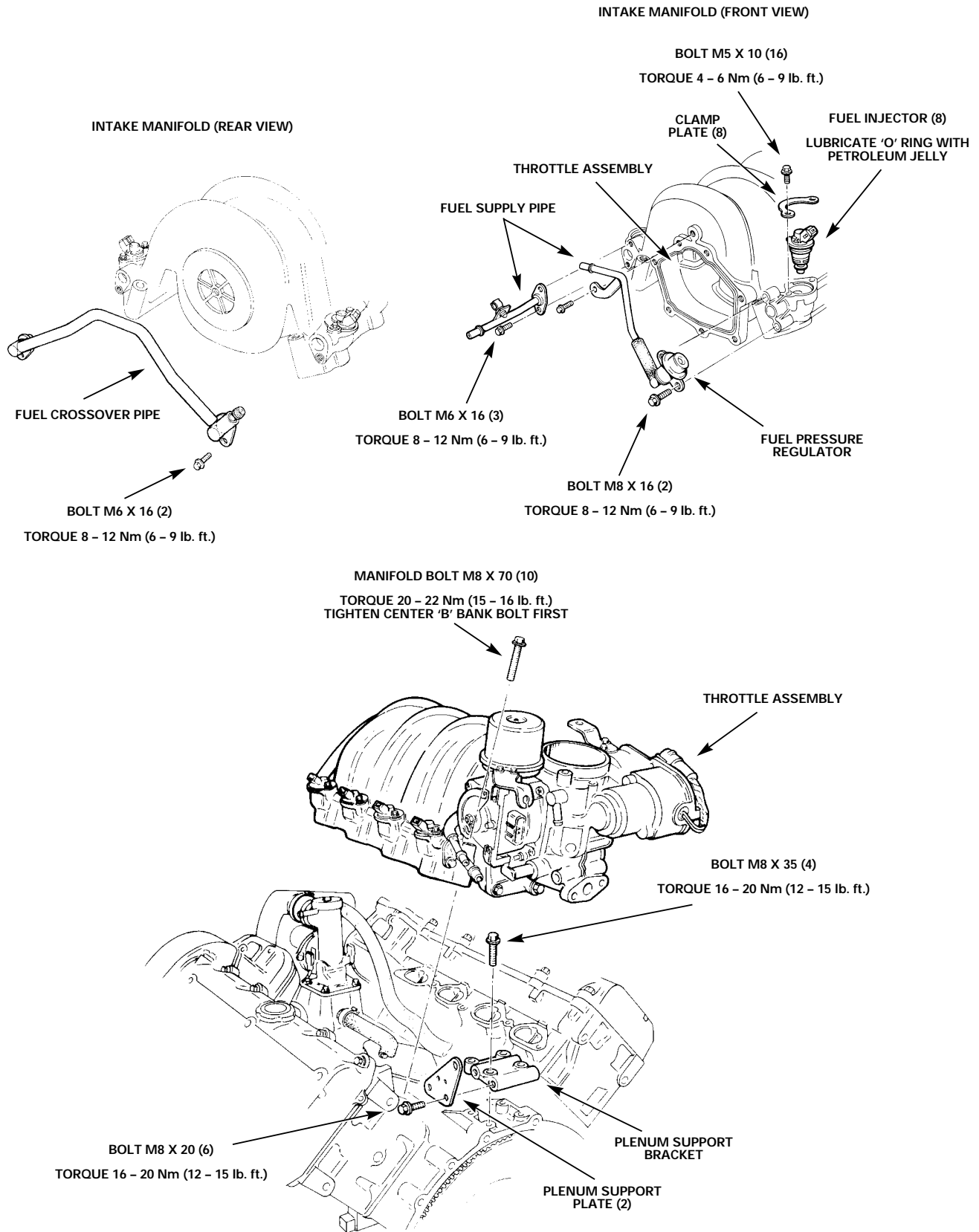
Position the hose clamp over the alignment mark.

#### NOTES



## Intake Manifold: Normally Aspirated

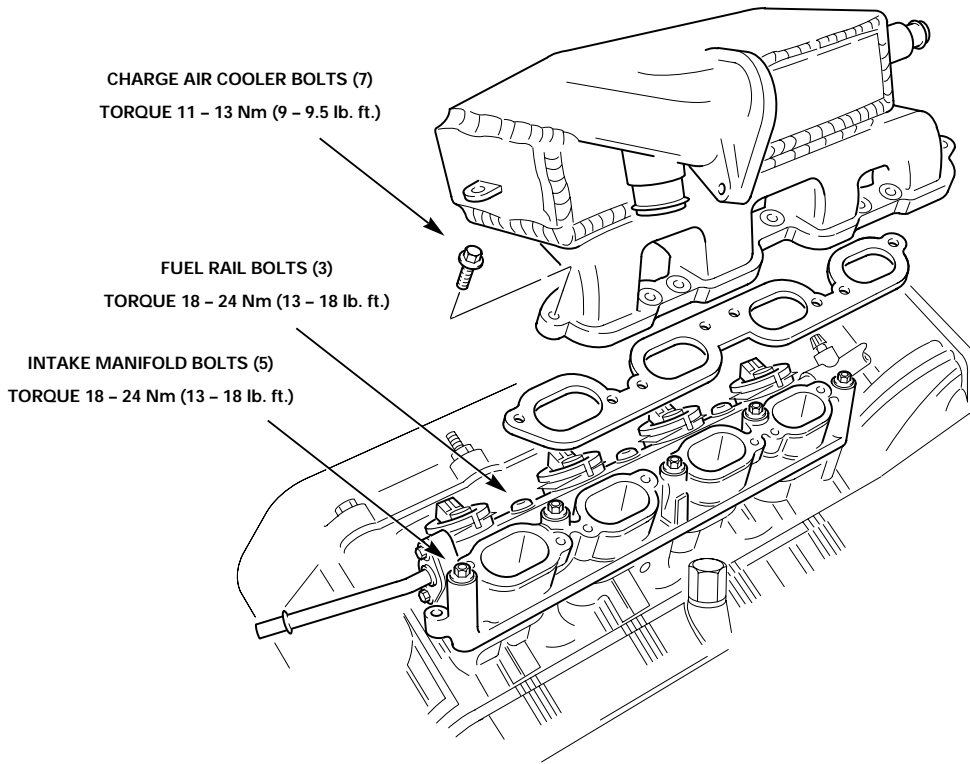
### INTAKE MANIFOLD INSTALLATION



T180/2.49 A, B & C

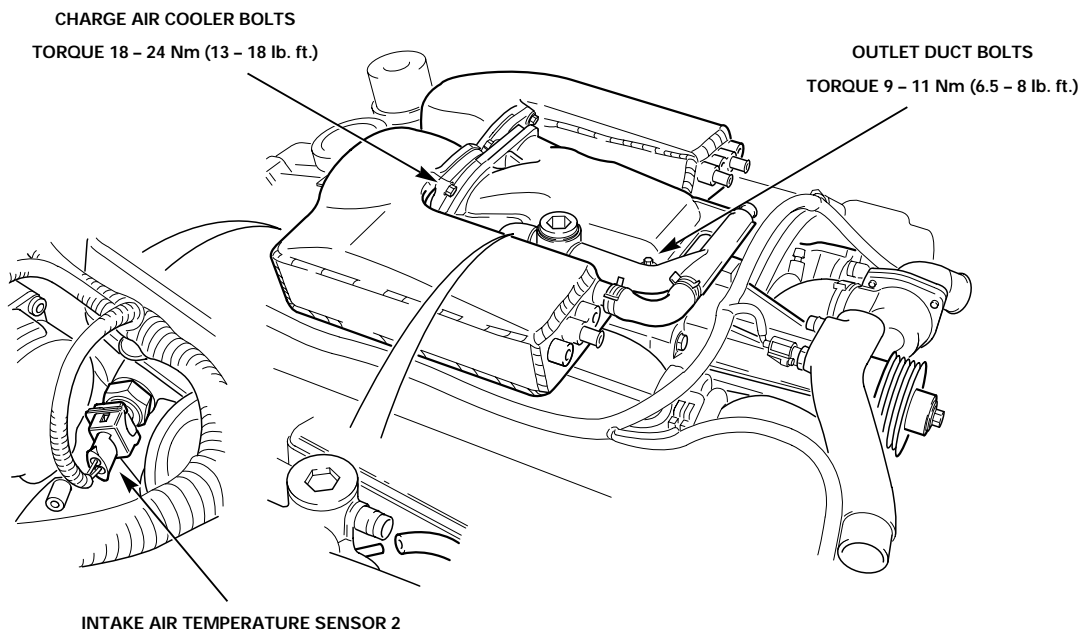
## Intake Manifold: Supercharged

### CHARGE AIR COOLER INSTALLATION



T180/2.50

### OUTLET DUCT INSTALLATION



T180/2.51

## Exhaust Manifolds

Tighten bolts following the torque sequence.

Bolts have a locking patch and must not be reused. If the manifold is removed, clean the manifold bolt hole threads using an M8 x 1.25 plug tap.

