E6/672 C.I.D. DIESEL ENGINE 2VH

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5-672 SERIES 100.1

Figure 1 -- Naturally Aspirated Version

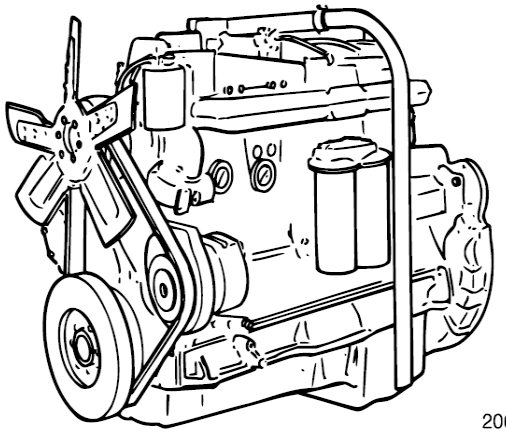


Figure 2 -- Charge Air Cooling Version

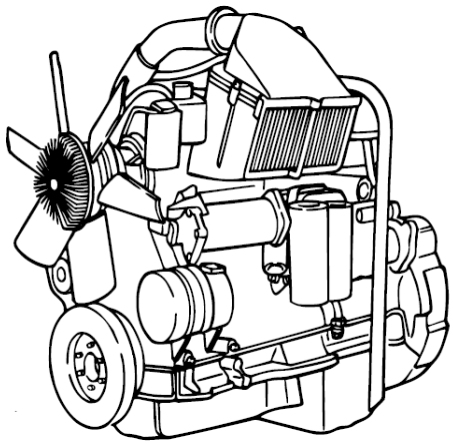


Figure 3 -- Turbocharged Version

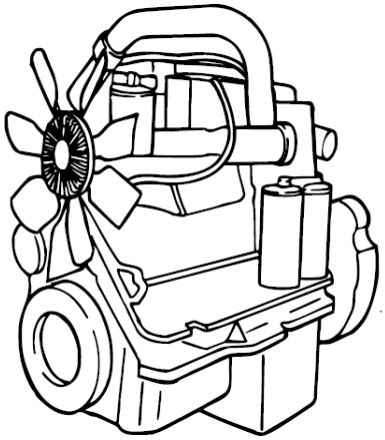
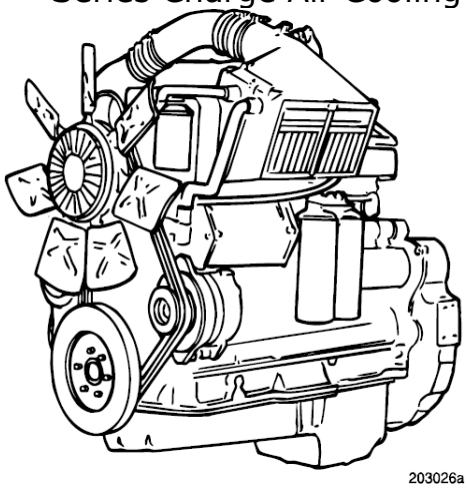


Figure 4 -- Series Charge Air Cooling Version



ENGINE REMOVAL FROM VEHICLE

Details of this procedure will vary from one vehicle to another. However, the following steps will be necessary:

NOTE

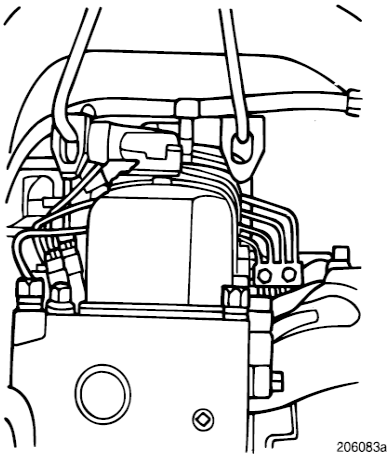
It is good maintenance practice before disassembly, and periodically, to steam clean the engine to remove road grime, grease and oil. This will provide a clean work area, which will permit more detailed inspection and better workmanship.

1. Set auxiliary spring brakes or vehicle hand brake, block wheels, and observe all safety precautions.
2. Drain cooling system.
3. Drain engine lubricating oil.
4. Disconnect battery leads at battery.
5. Mark and disconnect electrical leads, fuel lines, all linkages, air lines, oil lines and heater hoses from engine.
6. Remove radiator hoses. In some vehicles it may be necessary to remove radiator and radiator bracing assembly.
7. Remove air cleaner to engine hose and disconnect air control linkage. In some vehicles it may be necessary to remove the air cleaner as an assembly.
8. Position a jack or blocks under the transmission.
9. Install lifting eyes and suitable sling to engine. Using a suitable hoist, apply a slight strain on sling. See Figure 2-1. Engine Lifting Arrangement.
10. Separate engine from transmission.
11. Remove engine mounting bolts and use hoist to remove engine from vehicle.
12. Remove external accessories as required and install engine in overhaul stand.

    Typical stand available from:

    Kiene Diesel Accessories, Inc. Model 900 Rebuild Stand and Adapter No. 915 for six cylinder engines or similar.
13. Remove hoist sling and lifting eyes from engine.

Figure 2-1. Engine Lifting Arrangement



ENGINE DISASSEMBLY

Mack Diesel engines are easily disassembled, overhauled an reassembled with a minimum of special tools; however, there are a few special items that should be highlighted.

1. Remove fuel injection nozzle and holder assemblies before removing cylinder heads. The nozzle tips protrude beyond the cylinder deck and could be damaged if cylinder head is placed on bench with cylinder head deck down.
2. Remove the fuel injection pump, governor, and adapter from the engine as an assembly. Do not remove fuel injection pump from the engine at the adapter.
3. Before removing piston and connecting rod assemblies, clean carbon from upper inside wall of each cylinder.

   On engines which have piston cooling, carefully guide the connecting rod end to prevent damage to piston cooling oil spray nozzles.
4. Remove cylinder liners using tool J-25065.

CLEANING (INTERNAL)

When the engine has been disassembled and all core hole plugs and oil passage plugs have been removed, the block and cylinder head can be degreased in a heavy duty alkaline soak cleaner for a period of one to two hours. This will loosen scale, sludge and rust deposits so that a thorough flushing will clean the area to the bare metal. Thorough flushing with air and suitable solvent is necessary to prevent clogging of water and oil passages by the loosened particles after the engine is reassembled.

Look into water passages of block and head to be sure they are clean and unobstructed. Ream or drill out if necessary to dislodge any deposits. Be sure holes for water circulation between block and head are open. Check to see that there are no casting fins obstructing water flow. Remove any such fins with a pry bar.

Run a wire brush in oil passages to determine they are all open. Flush out with air and solvent to complete cleaning and insure free flow.

NOTE

When checking or assembling engine components, the dimensions and torque settings are found in FITS AND LIMITS CHART and Table 1 -- Fits and Limits Chart.

ENGINE OVERHAUL

CYLINDER BLOCK

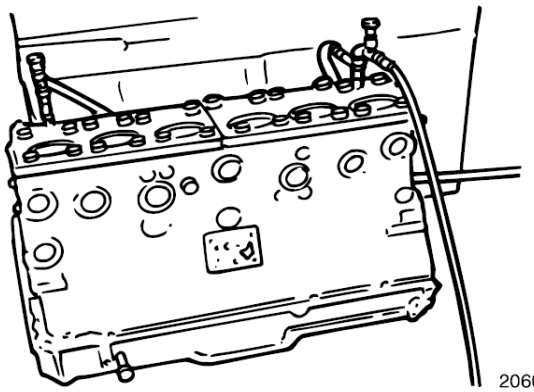
INSPECTION

Check cylinder block for any indications of external cracking or water leakage. If any defects are suspect, use dye penetrant procedure to locate affected areas. Check condition of threaded holes and mounting flanges.

Install O-ring on threaded plugs and assemble to engine. Apply Permatex Super 300 sealer, or equivalent, to cup plugs and assemble to engine. For camshaft hole cup plug, use Installation Tool J-25064.

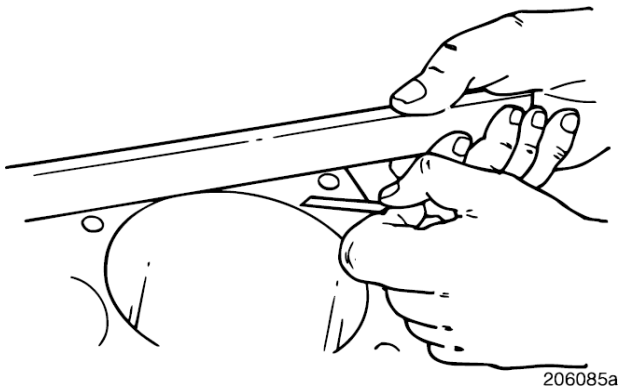
Pressure check block to ensure that no leakage appears. See Figure 2-2. Pressure Checking Cylinder Block.

Figure 2-2. Pressure Checking Cylinder Block



Using a straight edge and feeler gage, check the cylinder block deck surface for warpage, or fretting wear. See Figure 2-3. Checking Deck Surface for Warpage.

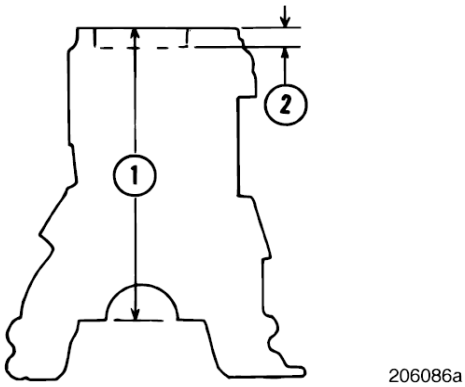
Figure 2-3. Checking Deck Surface for Warpage



If warpage or fretting is above limits, be sure that the maximum amount of material removed does not go below the minimum dimensions shown in Figure 2-4. Main Bearing

Bore to Cylinder Deck Dimension.

Figure 2-4. Main Bearing Bore to Cylinder Deck Dimension



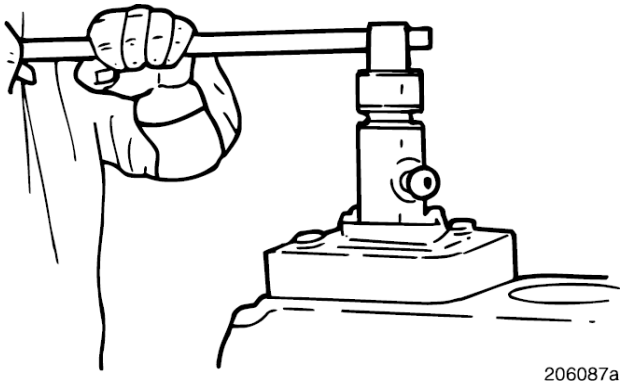
1. Minimum dim. 17.363 (Standard Dim. 17.377 to 17.373)

2. Counterbore Dim. 0.187 to 0.184. This dim. must be maintained to provide proper liner to deck extension.

CYLINDER LINER COUNTERBORE

If the cylinder block deck is resurfaced, the cylinder liner counterbore depth must be re-cut to specifications. Typical tool used is a B.K. Sweeney Universal Cylinder Block Counterboring Tool 6092-1, with Adapter 6360-100 and Tool holder 6360-1500. See Figure 2-5. Re-Cutting Cylinder Liner Counterbore.

Figure 2-5. Re-Cutting Cylinder Liner Counterbore



If cylinder block deck is not resurfaced, but there is excessive pitting or erosion of cylinder liner counterbore flange mounting surface, recut the counterbore as required. Shims are available to re-establish the correct flange height. (For checking cylinder liner bore, see CYLINDER LINERS.)

CRANKSHAFT MAIN BEARING BORE

If there is any indication that the bearing shells have turned in the block, check the bore surface to make certain they are not excessively damaged. (If main bearings have turned in bore, it will be necessary to line bore cylinder block for oversize bearings.) Then replace

main bearing caps and tighten capscrews to specified torque. Measure I.D. of bore to make certain that correct size is maintained. Also check alignment of the bores.

CAMSHAFT BUSHING

Whenever the cylinder block is being worked on, and all component parts have been removed, thoroughly check the camshaft bushings. Check the I.D. of the bushings with a telescoping gage or inside micrometer. If the bore size exceeds the tolerance, or if there is any evidence of scratched or scored bushings, it is recommended that all bushings be replaced.

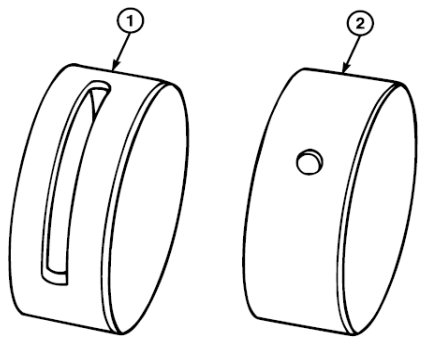
Use tool J-21428-01 to remove bushings. If there is any indication that bushing has turned in block, check bushing bore diameter and finish in the block.

There are two camshaft bushing widths. The front camshaft bushing is the wider bushing; the other bushings are of a narrower width.

There are also two types of bushings for the no. 2 and no. 5 locations. The earlier bushing has an elongated slot to provide an oil supply to the rocker arm assembly. See Figure 2-6. Camshaft Bushings.

The current blocks have a cast groove in the no. 2 and no. 5 bushing bore, and the elongated slot is no longer required, and is replaced by a single hole. See Figure 2-6. Camshaft Bushings.

Figure 2-6. Camshaft Bushings



1. Bushing with elongated slot.
2. Bushing with single oil hole.

⚠ CAUTION

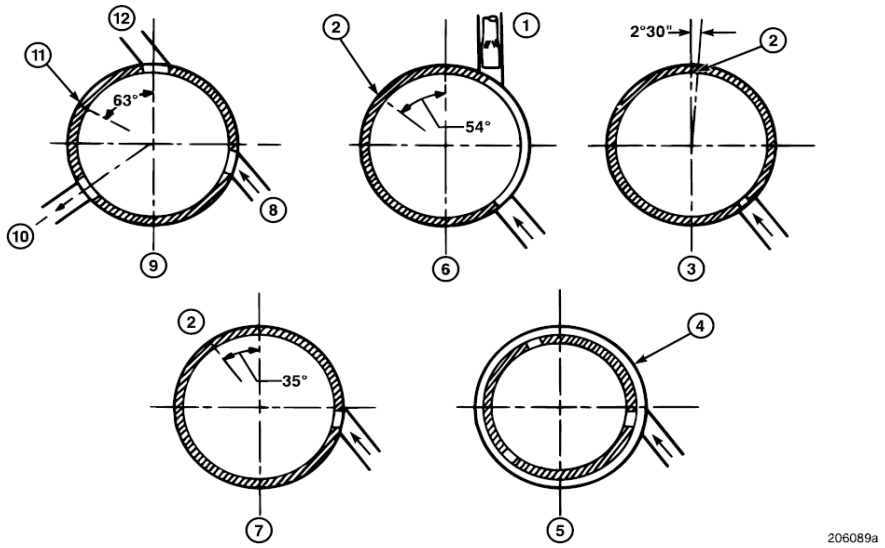
Always use the correct camshaft bushing. check the camshaft bushing bore at no. 2 and no. 5. If the bores do not have cast grooves, the bushing with the elongated slot must be used, see Figure 2-7. Camshaft Bushing Arrangement (Non-Current).

If the bores have a cast groove, the bushing with the single hole is used. See Figure 2-8.

Current Production Camshaft Bushing Arrangement.

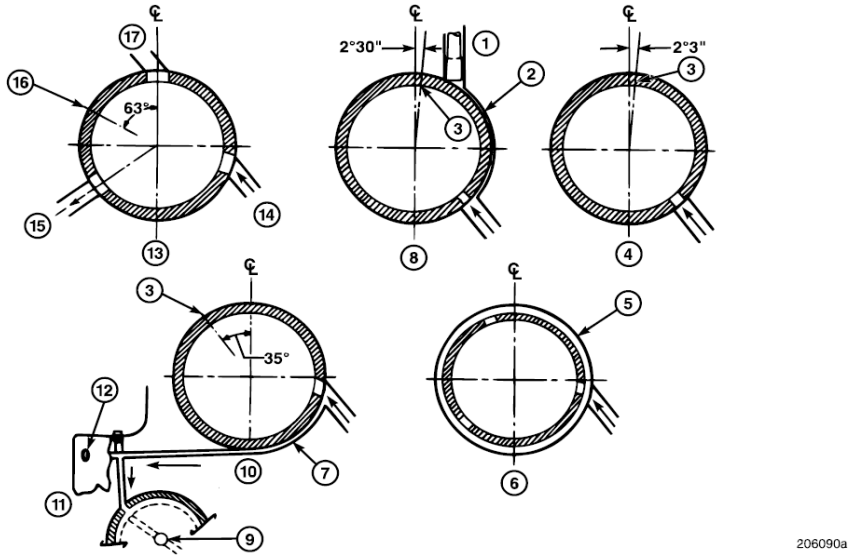
The current blocks also have a cast groove in the no. 4 bushing bore. This design provides filtered oil from the crankshaft main bearing to the auxiliary driveshaft rear bushing, air compressor, and also to a boss in the auxiliary drive housing. See Figure 2-8. Current Production Camshaft Bushing Arrangement.

Figure 2-7. Camshaft Bushing Arrangement (Non-Current)



1. Rocker Arm Oil Tube	7. Location 4 (Center)
2. Joint	8. From Main Bearing
3. Locations 3 – 6	9. Location 1 (Front)
4. Annular Oil channel On Back Of Bushing	10. Aux. Drive
5. Location 7 (Rear)	11. Clincher Butt Joint
6. Locations 2 & 5	12. Optional

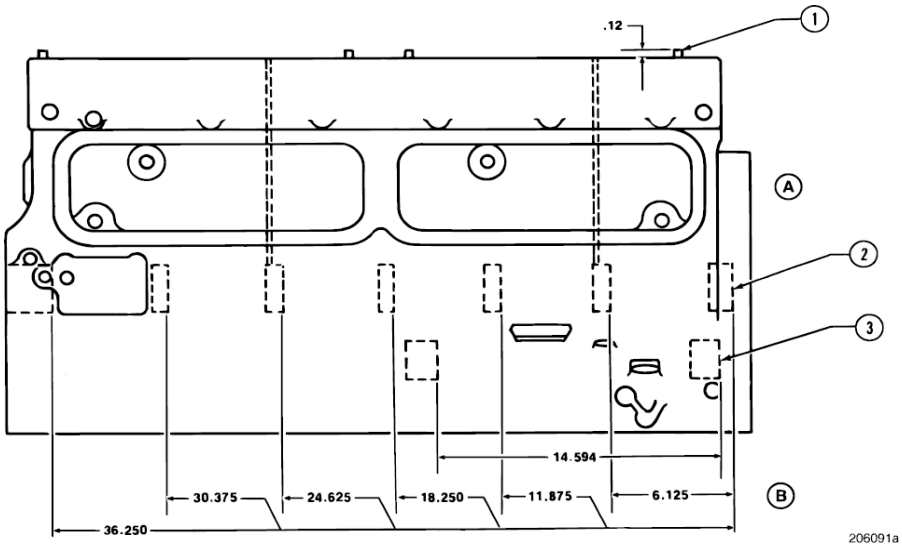
Figure 2-8. Current Production Camshaft Bushing Arrangement



1. Rocker Arm Oil Tube	10. Location 4 (Center)
2. Cast In Oil Groove	11. Rear Aux. Shaft Bushing
3. Joint	12. Oil To Inj. Pump
4. Locations 3 – 6	13. Location 1 (Front)
5. Annular Oil Channel On Back Of Bushing	14. From Main Bearing
6. Location 7 (Rear)	15. Aux. Drive
7. CAST In Oil Groove	16. Clincher Butt Joint
8. Locations 2 & 5	17. Optional
9. Feed To Air Compressor Crankshaft	

All bushings are located at set distances measured from the thrust washer mounting surface to the forward edge of the bushings. Thrust washer must be removed when locating bushings. See Figure 2-9. Camshaft and Auxiliary Shaft Bushing Installation Dimensions.

Figure 2-9. Camshaft and Auxiliary Shaft Bushing Installation Dimensions



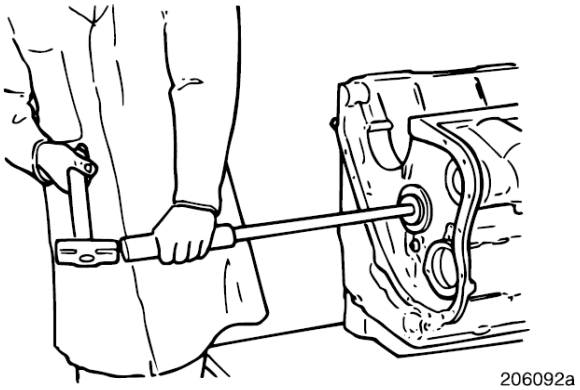
1. Cylinder Head Gasket Locating Pins (four)	A. Front
2. Camshaft Bushings (seven)	B. Right Side View
3. Auxiliary Drive Shaft Bushings (two)	

NOTE

The oil supply holes in the block must align with the oil holes in the bushings.

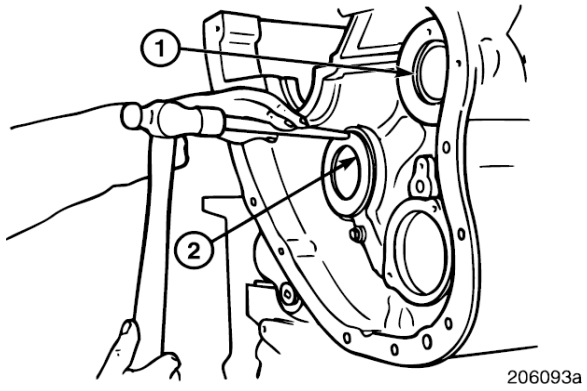
Use tool J-21428 to install new bushings. See Figure 2-10. Camshaft Bushing Installation.

Figure 2-10. Camshaft Bushing Installation



After bushings are in place, measure I.D. to ensure they are not undersize because of burrs on O.D. caused by installation. Install the thrust washer at front of block with retaining pins in the cleaned counterbore. Make certain that pins do not protrude above surface of thrust washer. See Figure 2-11. Camshaft and Auxiliary Shaft thrust Washer Installation.

Figure 2-11. Camshaft and Auxiliary Shaft thrust Washer Installation



1. Auxiliary Shaft Thrust Washer
2. Camshaft Thrust Washer

AUXILIARY SHAFT BUSHINGS

Check I.D. of auxiliary shaft bushing with a telescoping gage or inside micrometer. If the bore size exceeds the tolerance, or if there is any evidence of scratched or scored bushings, it is recommended that both bushings be replaced.

Use tool J-21428-01 to remove bushings. If there is any indication that bushing had turned in block, check bushing bore diameter in block. (Refer to FITS AND LIMITS CHART.)

Use tool J-21428-01 to install bushings.

Install the front auxiliary shaft bushing with the forward edge flush or slightly below the machined surface of the auxiliary thrust washer mounting face. (To assemble the front bushings properly, the oil hole is positioned toward the front of engine.) The rear bushing is located at a set dimension from the thrust washer mounting face. See Figure 2-9. Camshaft and Auxiliary Shaft Bushing Installation Dimensions. (The oil hole in the rear bushing is centrally located. Make certain clinch butt joint is properly located.)

When assembling, the clinch butt joint must be positioned as shown in Figure 2-12. Oil Hole and Clinch Butt Joint Location.

To facilitate locating hole for alignment of rear bushing during installation, mark the edge of the bushing and maintain hole position with oil hole in block. See Figure 2-13. Marking Auxiliary Shaft Bushing.

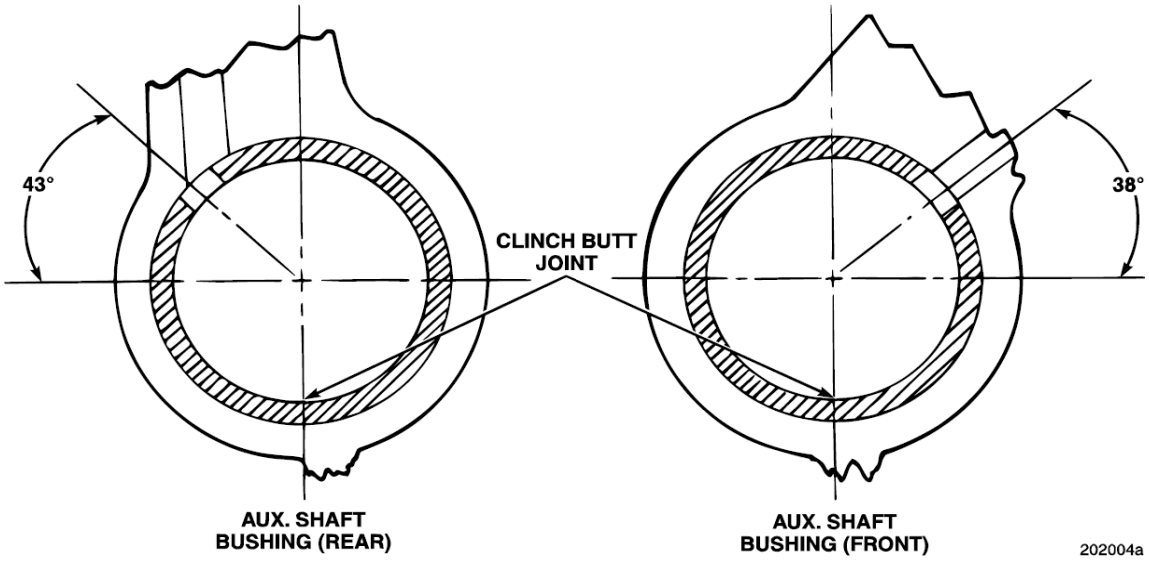
After bushings are in place, install the thrust washer with the retaining pins in the cleaned counterbore. Make certain that the pins do not protrude above the surface of the thrust washer. See Figure 2-11. Camshaft and Auxiliary Shaft thrust Washer Installation.

NOTE

There are two types of front auxiliary drive shaft bushing in use. The original type has an oil groove on the I.D. of the bearing which extends for a length of approximately 100° from the oil hole. The current type has a longer oil groove which extends for approximately 140° from

the oil hole. See Figure 2-14. Original Auxiliary Shaft Front bushing (100° Oil Groove Length) and Figure 2-15. Current Auxiliary Drive Shaft Front Bushing (140° Oil Groove Length).

Figure 2-12. Oil Hole and Clinch Butt Joint Location



1. Clinch Butt Joint
2. Aux. Shaft Bushing (Front)
3. Aux. Shaft Bushing (Rear)

Figure 2-13. Marking Auxiliary Shaft Bushing

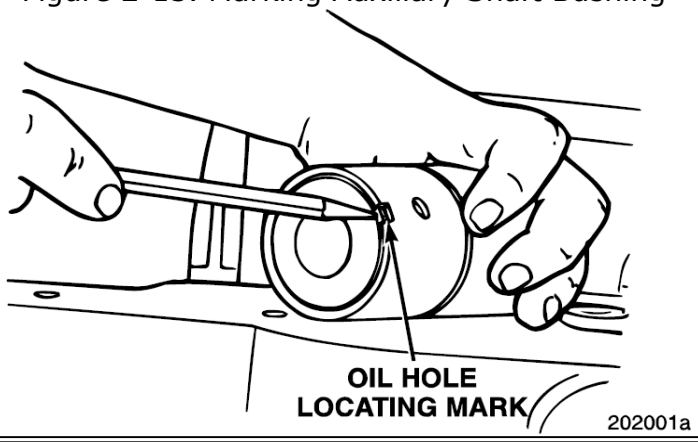
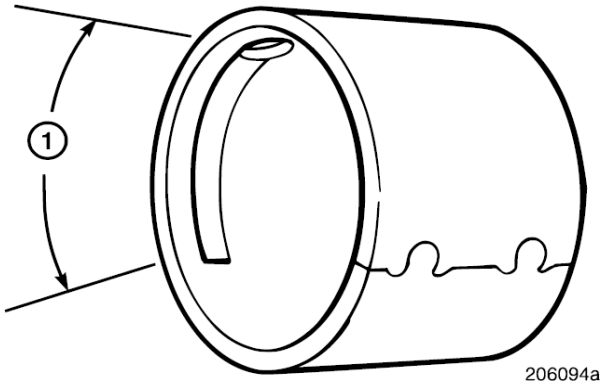
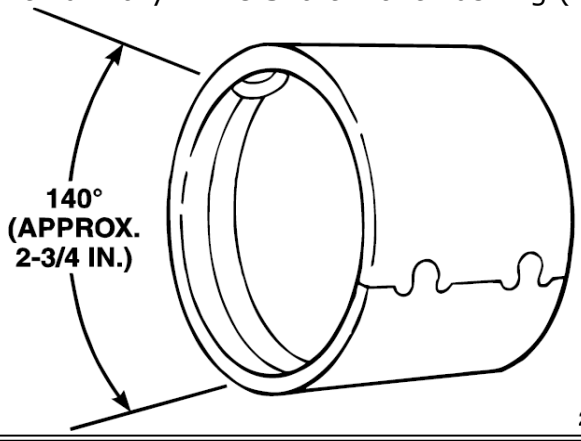


Figure 2-14. Original Auxiliary Shaft Front bushing (100° Oil Groove Length)



100° (Approx. 2 in.)

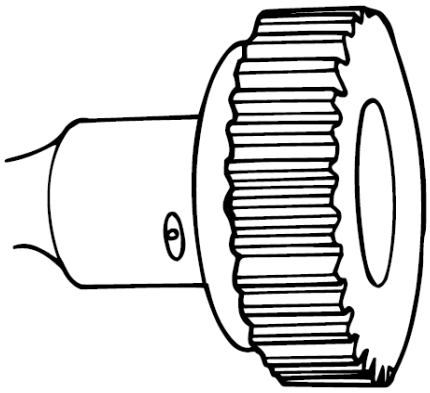
Figure 2-15. Current Auxiliary Drive Shaft Front Bushing (140° Oil Groove Length)



140° (Approx. 2-3/4 in.)

The bushing with the shorter groove length (100°) was used with the initial production auxiliary shaft, which had a notch machined across the oil hole. See Figure 2-16. Original Auxiliary Drive Shaft with Machined Notch Across Oil Hole.

Figure 2-16. Original Auxiliary Drive Shaft with Machined Notch Across Oil Hole

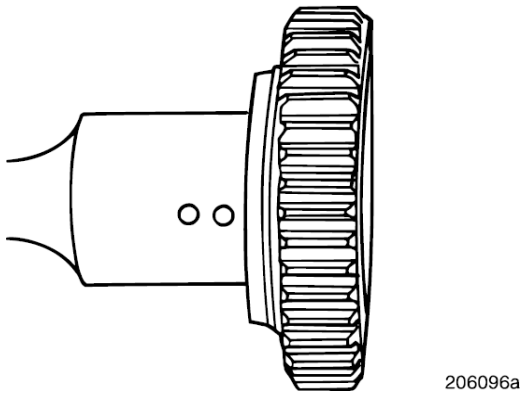


This notch in the shaft allowed pressurized oil from the bushing to be in contact with the oil hole in the shaft for a sufficient length of time to provide adequate lubrication to the front

thrust washer.

The bushing with the longer groove (140°) is required with the current production shaft which has only a hole, no notch. See Figure 2-17. Current Auxiliary Drive Shaft Having Oil Hole (No Notch).

Figure 2-17. Current Auxiliary Drive Shaft Having Oil Hole (No Notch)



The bushing with the longer groove is required, (with the shaft having the oil hole without the notch), so that pressurized oil from the bushing will be in contact with the oil hole in the shaft or a sufficient length of time to provide adequate lubrication to the thrust washer.

⚠ CAUTION

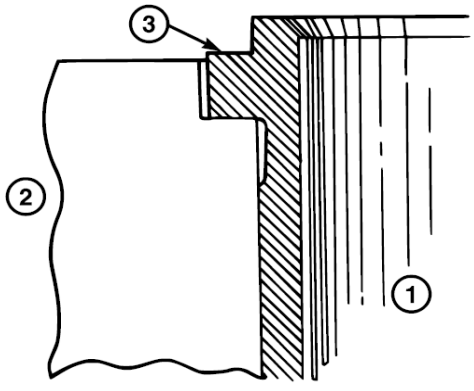
The bushing with the longer groove can be used with either shaft; however, the bushing with the shorter groove can only be used with the shaft having the notch machined across the oil hole.

CYLINDER LINERS

Cylinder liners are of the dry type and are available in oversize outside diameters (oversizes are 0.002, 0.004, 0.006, 0.012, and 0.020 inches). The inside diameter of all liners is standard.

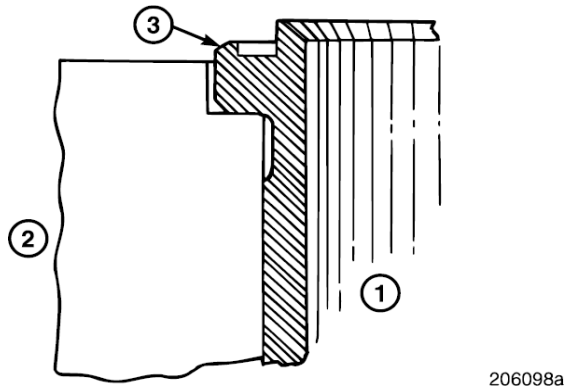
There are two basic types of cylinder liners currently being used during engine rebuild. Previous production engines used a cylinder liner with a "flat-flange", while current production liners have a "beaded-type" flange. See Figure 2-18. Flat-Flange Type Cylinder Liner (Non-Current), Figure 2-19. Beaded-Type Cylinder Liner (4-7/8 Inch Bore), and Figure 2-20. Beaded Type Cylinder Liner (5 Inch Bore - END707 and END711 Engines).

Figure 2-18. Flat-Flange Type Cylinder Liner (Non-Current)



1. Cylinder Liner
2. Cylinder Block
3. Flat Surface

Figure 2-19. Beaded-Type Cylinder Liner (4-7/8 Inch Bore)

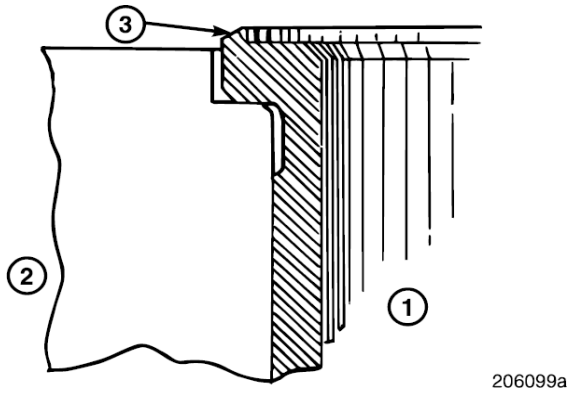


1. Cylinder Liner
2. Cylinder Block
3. Bead

NOTE

The flat-flange liner is used with the "folded-steel" type head gasket. The beaded-type liner is used with a "fire-ring" type gasket, and the cylinder head is grooved directly opposite the liner bead.

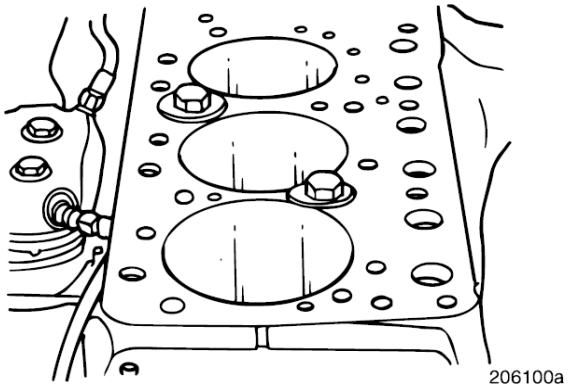
Figure 2-20. Beaded Type Cylinder Liner (5 Inch Bore - END707 and END711 Engines)



1. Cylinder Liner
2. Cylinder Block
3. Bead

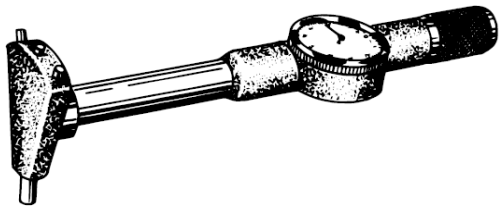
As soon as heads are removed use bolts and washers to retain the liners. These are required since liners can be a loose fit in the block and they will come out of the bore when crankshaft is rotated. See Figure 2-21. Method of Retaining Cylinder Liners.

Figure 2-21. Method of Retaining Cylinder Liners



Check cylinder liner out of round and taper. Use dial bore gage, tool J-5347-01, see Figure 2-22. Cylinder Liner Bore Measuring Tool, and measure each liner I.D.

Figure 2-22. Cylinder Liner Bore Measuring Tool



Take readings in two directions at each of at least three levels. See Figure 2-23. Checking Liner Bore and Figure 2-24. Liner Bore Checking Locations.

Figure 2-23. Checking Liner Bore

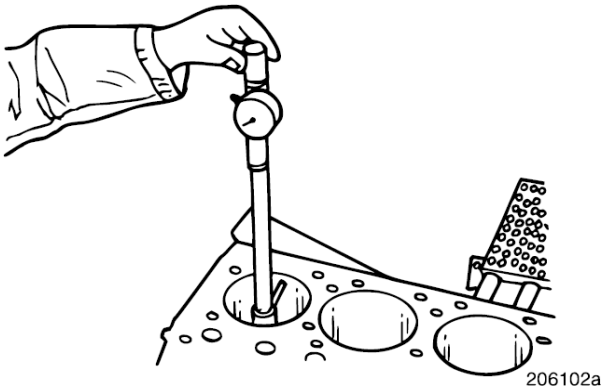
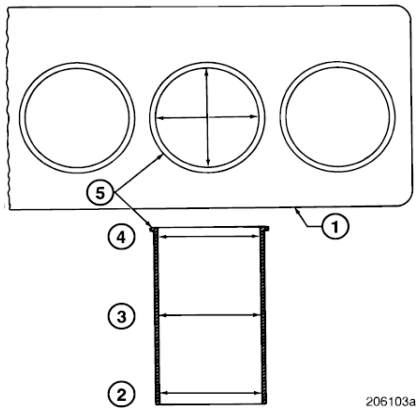


Figure 2-24. Liner Bore Checking Locations



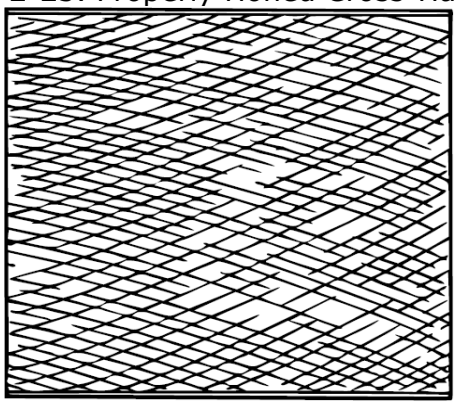
1. Cylinder Block	4. Top
2. Bottom	5. Cylinder Liner
3. Center	

If liner bore, when in place, does not exceed out-of-round and taper limit, "glaze-bust" the liner with a suitable hone, 150 to 250 grit, to produce a diamond criss-cross pattern surface

of 25 to 40 microinch rms. See Figure 2-25. Properly Honed Cross-Hatch Pattern.

After honing, wash liner with a solution of household laundry detergent (such as Tide), and scrub with a stiff bristle brush to remove as much of the honing debris as possible. Rinse with hot water and blow dry. After the bore is dry, coat the bore with clean SAE 10 or 20 lubricating oil. Wipe the lubricating oil from the liner bore with a clean white cloth or white paper towel. If the cloth or towel shows evidence of gray (or darker) stains, this is an indication that honing debris is still present on the cylinder wall. Repeat the oil application and wiping procedure until no evidence of stain appears on the cloth or towel.

Figure 2-25. Properly Honed Cross-Hatch Pattern



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⚠ CAUTION

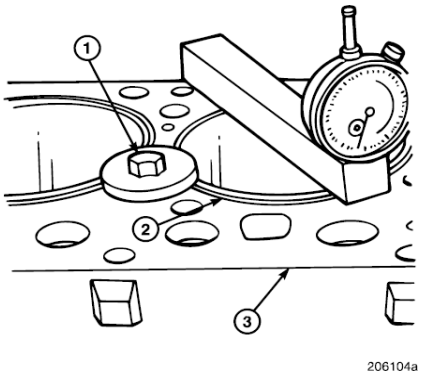
It is important that the liners are thoroughly cleaned as specified above to prevent premature ring, liner or bearing wear, and possible engine failure. Mineral spirits, etc., WILL NOT satisfactorily clean bore after honing.

Clean the liner flange using a brass wire rotating brush to ensure an accurate measurement of the flange height above the block deck. Use Sweeney gage #6020. See Figure 2-26. Checking Flange Height Above Block Deck and Figure 2-27. Cylinder Liner and Piston Relationship to Block. Extension of cylinder liner above cylinder block deck must not vary more than 0.001 inch under the same head.

NOTE

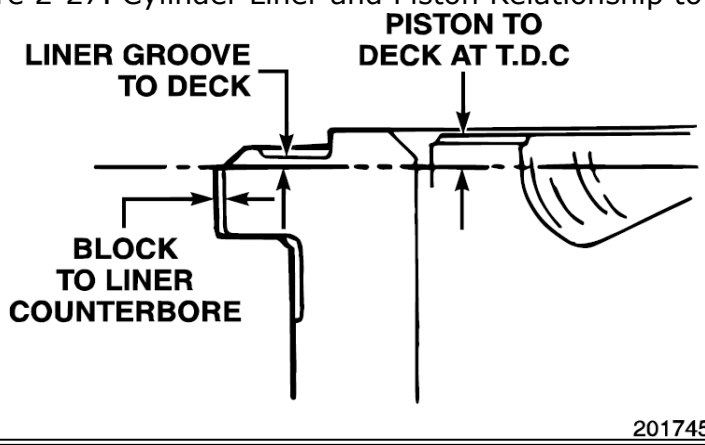
The cylinder liner flange dimension, (on the beaded-type cylinder-liner), is measured from the groove in the flange to the top deck of the block. See Figure 2-27. Cylinder Liner and Piston Relationship to Block.

Figure 2-26. Checking Flange Height Above Block Deck



1. Temporary Retainer
2. Groove
3. Deck Surface

Figure 2-27. Cylinder Liner and Piston Relationship to Block



1. Piston To Deck At T.D.C.
2. Block To Liner Counterbore
3. Liner Groove To Deck

On the flat-flange type liner, the dimension is measured from the top surface of the flange to the cylinder block. If the liner exceeds out-of-round or taper limits, or the flange height above the deck is not within specifications, remove the liner from the cylinder block using tool J-25605. See Figure 2-28. Cylinder Liner Removal Tool.

Figure 2-28. Cylinder Liner Removal Tool