M. I. 315

*Rev. D .

ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

SERVICE DEPARTMENT *MAINTENANCE INSTRUCTION*

CRANKCASE LOWER DECK REPAIR

INTRODUCTION

The following procedures will ensure satisfactory field repair of engines which have damaged lower crankcase bores. Original dimensions are restored by building up damaged bores with weld and reboring. Boring bars are available from the Electro-Motive Division on a rental basis. This procedure may be used when it has been determined that only a small percentage of bores in a crankcase need repair. It can be employed with the engine in place unless other damage requires removal of crankcase from oil pan. Crankcases with excessive lower bore damage (50% or more cylinders), should be altered to receive 1.52 mm (.060") oversize outside diameter lower liner inserts. See Service Data. These liner inserts are to be installed in full engine sets only and require that the engine be removed to be rebored. Use of the portable lower deck boring bar is not recommended in this case.

All crankcases containing any oversize parts, including lower liner inserts, must be identified by a revised engine data plate 8163005 mounted to the right bank side of the crankcase.

PREPARATION FOR REPAIR

1. Remove the complete cylinder assemblies from the damaged bore and from both adjacent bores in that bank. Remove the cylinder assembly directly opposite the damaged bore.

2. Remove lower liner insert from damaged bore. Refer to Engine Maintenance Manual.

3. Clean engine and oil pan throughout.

4. Make light gauge sheet metal covers for rear stress plate inspection holes and for liner deck plate holes where assemblies have been removed.

5. Mask off area so that no foreign material can get into adjoining liner ports of cylinder assemblies remaining in the engine.

6. Be sure crankshaft journals of all removed cylinder assemblies are protected from weld spatter and chip damage by wrapping them with clean towels and covering them with sheet metal.

7. Make a sheet metal chute to go under the liner plates where welding and boring will be done.

WELDING PROCEDURE

WARNING: To provide adequate fire protection, fire extinguishers must be available near the repair area. A person should be on hand at all times to act as fire watch.

It is suggested that all persons concerned with the procedures given in this instruction be familiar with general engine crankcase welding and repair.

CAUTION: Never ground welding circuit through moving parts of the engine. Ground welding circuit as close as possible to the work. This will eliminate possible arcing through bearings and moving parts of the engine.

1. Pack area adjacent to repair area with wet rags to conduct heat, but do not allow them to contact the weld. The rags should not be so wet that water will come in contact with weld material. Every effort should be taken to minimize the heat of welding. After each weld, cool area with water. With the exception of the first bead, following weld buildup should be peened to relieve stresses.

NOTE: Weld repair of the cylinder lower pilot bores or insert bores of the crankcase due to wear or minor damage does not require furnace stress relief. However, furnace stress relief is required for multiple power assembly failure damage with damaged stress plates and/or base rails. Crankcases requiring furnace stress relief should be returned to Electro-Motive for remanufacture.

*Information contained herein is applicable to equipment being produced as of the date of publication.

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2. Thoroughly clean and dry surface to be welded.

3. Build up the damaged areas by electric welding; using Class E-6012 electrode, 3.18 mm (1/8") diameter only, with straight polarity DC or AC.

4. If any scarfing is necessary, it should be done by grinding or chipping. Use of a cutting torch is not recommended. Nicks in the "A" frame or stress plates should be dimpled out with a grinding wheel. Care should be taken to smooth out all sharp edges.

5. Using a series of unbroken stringer beads, apply a 7.93 mm (5/16") weld bead at the upper and lower edges of the lower pilot bore and around the center of the bore.

6. The very first weld metal applied around the circumference of the repair area is the metal that will be bored for the finished job. If there is any question of the quality of weld deposit, it should be removed immediately and rewelded. This will eliminate removal of the boring bar to reweld later.

BORING BAR APPLICATION

CAUTION: The boring bar is a precision tool. Due care must be exercised in its handling and use.

Before placing the boring fixture in the cylinder, clean the cylinder head retainer thoroughly. Wire brush the interior to remove any loose carbon and clean the cylinder head seat ring seating surface.

The boring bar is designed to be used with a cylinder head seat ring. A new seat ring should be used, since a worn seat ring would lower the horizontal cuts to the extent of the reduction of seat ring thickness.

When using boring bar assembly, check to see that the pilot ring is applied to the bar. Also check that the centering bracket fixture is applied to the head of the bar. When the centering bracket is properly entered in the water hole, and the fixture torqued, the bar will seat correctly on the seat ring.

Lift the fixture by the eye bolts provided, and lower fixture into cylinder bore. Be sure the fixture is properly seated in the retainer before applying the cylinder head crabs. A special machined thin crab nut is furnished for the right-hand crab to allow enough crab bolt threads to protrude through it to apply the air motor stop, Fig. 1. This stop acts as an anchor for the air motor, preventing it from revolving. Tighten each crab nut to a torque value of 135.5 N-m (100 ft-lbs).

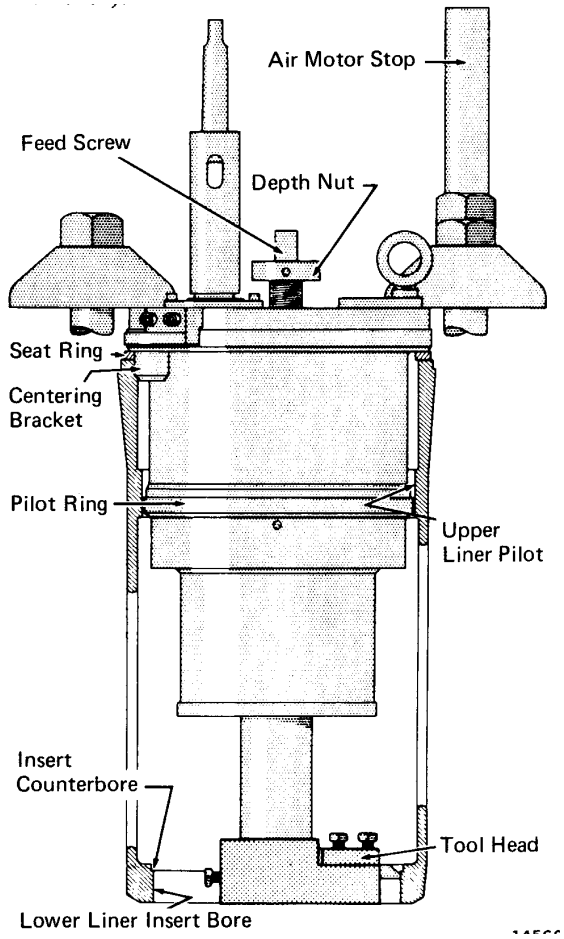

Fig. 1 - Boring Bar Application

Fig. 2 shows the feed screw depth nut gauge and its application. This gauge is used to check the location of the feed screw depth nut in relation to the top of the feed screw and is furnished as a means of checking setup of the fixture. The feed screw depth nut adjustment should not change, as it is pinned to the feed screw, but should be checked.

It is imperative that a multivane non-reversible air motor be used for this work. Never use a piston type motor because the pulsation between each power stroke will make the cutting tool chatter. NOTE: When lubrication of the boring bar is required, apply Texaco Marfax Heavy Duty No. 3 grease to all gears and bearings.

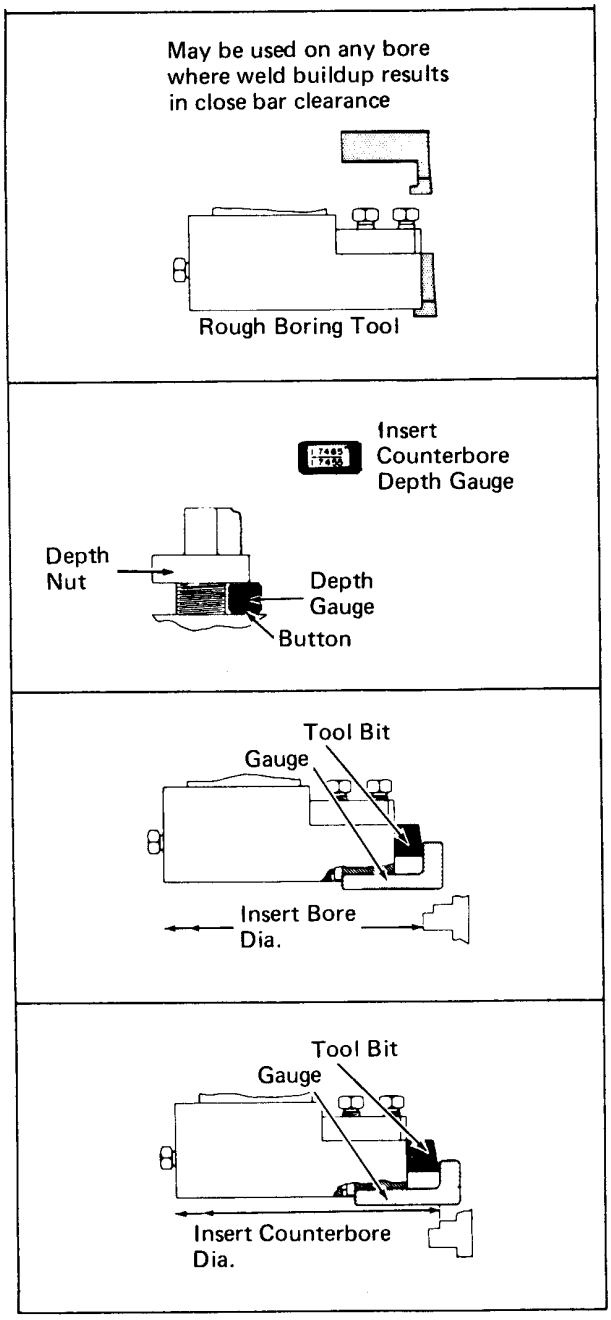

Fig. 2 - Lower Deck Boring Bar Machining Details

REBORING PROCEDURE

Before attempting to machine out the bore diameters, be sure the bore circumference has not been reduced by weld buildup so that the tool bit holder strikes the added metal.

A rough bore cutting tool, Fig. 2, has been developed for the purpose of cutting out this excess metal so the tool holder will clear it. Insert the cleanup cutter into the tool holder as far as it will go. It may be necessary to back off the tool bit feed screw to allow the tool bit to rest against the body of the tool holder. After the excess metal has been cut out, remove the rough bore cutting tool.

A rough or first cut should be made on each cutting application being sure to leave 0.38 mm (.015") for finish cut. After all rough cuts are made, a thorough inspection must be made of the machined surface. If any defects are found, remove the boring bar and completely grind out the defect. Reweld the affected area and reinstall the boring bar to make the finish cuts.

NOTE: All defects must be patched before the finish cut is made, as welding after the finish cut will draw the holes out of round.

Three sets each of the bore diameter and seat tool bits are standard equipment with boring bar assembly 8215546. However, as in any good machining operation, it is highly recommended that the rough cuts be made with one of these tool bits and finish cuts be made with another bit. This procedure, in conjunction with the use of a coolant while boring, will ensure a smooth and proper finish. See tool bit minimum grind length limits in Service Data at the back of this instruction.

ENGINE MACHINING

Machine the lower liner vertical bore first, then the lower liner counterbore.

LOWER LINER INSERT BORE

1. After making a cleanup pass through the bore, make sufficient rough cuts to leave approximately 0.38 mm (.015") for the finish cut.
2. To set the tool bit for the finish bore, apply an unused tool bit to the holder. Insert gauge in place in the slot at the bottom of the tool holder so the end contacts the locating pin as shown in Fig. 2. Carefully slide the tool bit out until it just contacts the radius of the inner face of the gauge. Tighten tool bit holding screws securely. This sets the tool bit for the finish diameter.

3. Make a trial finish cut slightly into the bore. This can be done since the counterbore is yet to be machined. Check the bore with an inside micrometer. If the diameter is correct, continue the finish bore, or reset the tool bit if required to obtain a finish diameter as specified in the Service Data.

INSERT COUNTERBORE

1. The insert counterbore is machined to the diameter specified in Service Data.

2. Depth of the counterbore is limited by using the depth gauge under the feed screw depth nut as shown in Fig. 2.

3. Make sufficient rough cuts on the diameter and depth to allow about 0.38 mm (.015") for the finish cut. To permit the 0.38 mm (.015") depth finish cut, place the depth gauge on the gauge button of the tool head, and using a 0.38 mm (.015") feeler gauge between the gauge button and depth gauge, feed down for the cut until the depth nut is just snug on the feeler gauge.

4. The finish cut is then made by feeding down until the depth nut contacts the depth gauge. For the finish diameter, the tool bit gauge is placed in the tool holder as shown in Fig. 2, and the tool bit is brought out to just contact the radius of the inner face of the gauge.

NOTE: The tool bit has the bottom of the shank ground flush with the cutting edge, to maintain correct depth when using the depth gauge.

PREPARING ENGINE FOR SERVICE

STRESS PLATE INSPECTION

Cleaning up damaged stress plates is very important, but an attempt should never be made to straighten bent stress plates. All ragged or torn metal and all sharp edges must be removed, and all nicks must be dimpled out. Be sure stress plate inspection holes have a smooth airflow contour. Any of these defects left uncorrected can eventually cause cracks to occur in the stress plates.

1. Clean engine thoroughly. It is imperative that all steel and carborundum residue be removed.

2. Spray wash and wipe engine.

3. Flush engine lubricating system in accordance with Maintenance Instruction 1757, using procedure given for flushing after a parts failure.

4. Install lower liner inserts and cylinder assemblies according to Engine Maintenance Manual recommendations.

CAUTION: Once the engine has been altered to accept oversize lower liner inserts, standard inserts must not be used.

5. Charge engine with recommended coolant and lube oil, and prelube as follows.

NOTE: On engines not equipped with a lube oil strainer housing, perform standard prelube procedure for the specific engine configuration.

   a. Remove the pipe plug at the main lube oil pump discharge elbow, and connect an external source of clean, warm oil at the discharge elbow. Prelube engine at a minimum of 69 kPa (10 psi) for a period of not less than three and not more than five minutes.

   b. Remove the pipe plug at the piston cooling oil pump discharge elbow and connect the external oil source at that opening. Check for unrestricted oil flow at each piston cooling tube.

   c. Disconnect the external oil source and replace the pipe plugs at the pump discharge elbows.

   d. Apply oil liberally at the engine top deck.

   e. On turbocharged engines, activate the auxiliary turbo lube oil pump motor. Look through a rear handhole for oil flow at the turbocharger end of the engine.

   f. Replace and securely close all handhole covers.

6. Engine starting procedure:

   a. Check oil level at the engine governor and at the square opening of the lube oil strainer. Make certain that the strainer housing is full.

   b. Check engine coolant level.

   c. Open cylinder test valves and bar over the engine at least one revolution; check for leakage from test valves. Close the test valves.

   d. Properly position operating controls and switches.

   e. Prime the fuel system. On units so equipped, check that fuel flows in the return fuel sight glass clear and free of bubbles.

f. Position the governor rack control lever (layshaft lever) at about one-third rack, then operate the engine start switch until the engine fires and speed increases.

g. Hold the rack control lever firm until the engine fires and comes up to idle speed.

7. Run engine unloaded for 10 minutes at idle speed with top deck covers open to make certain that valve mechanism is operating properly and that there is sufficient lubrication. Shut engine down and inspect rod bearings and main bearings for excessive heat by feel. Run engine loaded for 30 minutes at one-quarter speed and once again shut down and inspect rod bearings and main bearings for overheating. Run with proper governor setting and at rated horsepower at approximately one-half, three-quarter, and full speed for 30 minutes at each speed. Shut engine down and check rod and main bearing temperatures.

8. Run engine one hour at full engine speed and rated load.

9. Inspect and clean lube oil suction screens. Renew lube oil filters.

10. Check governor settings, injector racks, injector timing, and engine speeds.

SERVICE DATA

SPECIFICATIONS

Standard lower liner insert (Fig. 3),

Bore finish diameter	280.97-281.13 mm (11.062"-11.068")
Counterbore - Preferred diameter . .	287.30-287.38 mm (11.311 "-11.314")
Nominal diameter	287.10-287.57 mm (11.302"-11.322")

Oversize lower liner insert (Fig. 3),

Bore finish diameter	282.49-282.66 mm (11.122"-11.128")
Counterbore - Preferred diameter	289.69-289.77 mm (11.405"-11.408")
Nominal diameter	289.45-289.96 mm (11.396"-11.416")

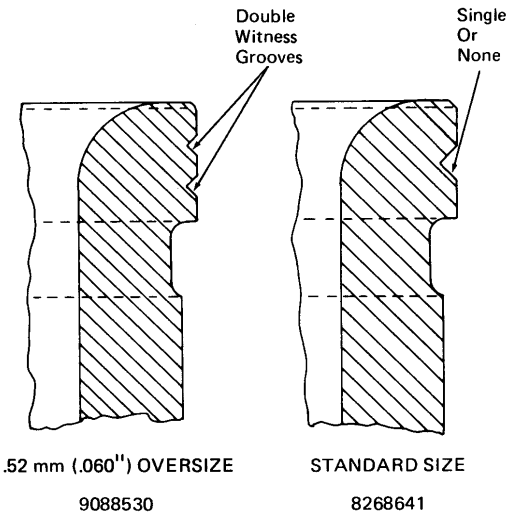

Fig. 3 - Identifying Grooves, Oversize And Standard Lower Liner Inserts

NOTE: Oversize lower liner inserts are installed in full engine sets only. Engine must be removed and bored to new oversize dimensions. Once the crankcase has been rebored to accept oversize inserts, standard inserts must not be used.

SERVICE DATA (Cont'D)

Minimum grind length for tool bits.

8089561	76.99 mm (3-1/32")
8089562	73.81 mm (2-29/32")
8102657	66.68 mm (2-5/8")

EQUIPMENT

Part No.	
*Tool bit 25.4 mm x 25.4 mm x 88.9 mm (1 " x I" x 3-1/2 for 287.30 mm (11.311 ") bore	8089561
*Tool bit 25.4 mm x 25.4 mm x 77.79 mm (I" x 1 " x 3 -1/16 1) for 280.97 mm (11.062") bore	8089562
*Tool bit for clean-up boring	8102657
Air motor stop	8152217
Crab nut	8190454
Lower deck boring bar assembly (complete)	8215546
*Lower deck boring bar	8215547
*Depth gauge 44.361 mm x 44.336 mm (1.7465"-1.7455") for insert counterbore	8215548
*Tool bit gauge for 287.38 mm (11.314") insert counterbore	8215550
*Tool bit gauge for 281.06 mm (11.065") insert bore	8215552
Pilot ring for 307.08 mm (12.090") upper pilot bore	8215554
*Eye bolt	8239466
Air motor, non-reversible, multivane	8359402

*Included in lower deck boring bar assembly 8215546
For rental information, contact your EMD District Representative.