CONTINENTAL
DIESEL ENGINE TMDT

OPERATORS MAINTENANCE & OVERHAUL MANUAL

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USE IN CONJUNCTION WITH
TMD OPERATORS MAINTENANCE AND OVERHAUL
MANUAL TTP10148

IMPORTANT SAFETY NOTICE

Proper repair is important to the safe and reliable operation of an engine. This Service Manual outlines basic recommended procedures, some of which require special tools, devices or work methods.

Improper repair procedures can be dangerous and could result in injury or death.

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNINGS BEFORE PERFORMING REPAIRS ON THIS ENGINE

Warning labels have also been put on the engines to provide instructions and identify specific hazards which if not heeded could cause bodily injury or death to you or other persons. These labels identify hazards which may not be apparent to a trained mechanic. There are many potential hazards for an untrained mechanic and there is no way to label the engine against all such hazards. These warnings in the Service Manual and on the engine are identified by this symbol:

Operations that may result only in engine damage are identified in the Service Manual by the word **CAUTION**.

Wisconsin Motors, LLC cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this manual are therefore not all inclusive. If a procedure, tool, device or work method not specifically recommended by Wisconsin Motors, LLC is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the engine will not be damaged or made unsafe by the procedures you choose.

IMPORTATNT the information, specifications and illustrations in this book are on the basis of information available at the time it was written. The specifications, torques, pressures of operation, measurements adjustments, illustrations and other items can change at any time. These changes can effect the service given to the product. Get the complete and most current information before you start any job. Continental Distributors/Dealers have the most current information which is available. For a list of current Distributors/Dealers, refer to directory LIT1017 or www.wiscosninmotors.com.

⚠ WARNING

Most sub-systems used in conjunction with Wisconsin Motors, LLC industrial engines including, but not limited to, radiators, hoses, fans fuel tanks, fuel lines or other fuel systems components, hydraulic pumps and generators, are not supplied by Wisconsin Motors, LLC, but are provided by the manufacturer of the end item in which the eingine is used.

Some of the dangers assoicatied with servicing such items are generally mentioned in this manual; however, the appropriate handbooks and safety instructions procided by the manufactureer of the end item should always be consulted prior to undertaking any work on sub-systems attached to the engine, to avoid any hazards inherent to these sub-systems.

⚠ WARNING

Read and observe all individual safety warnings as you use this manual to operate, service or repair your engine.

Always exercise caution whenever working with an engine or any associated system.

Injuries may be caused by lack of care when working with, or near, moving parts, hot parts, pressurized systems, electrical equipment, or fuel systems.

Always wear eye and hearing protection when working on or near engines.

Improper attire such as loose clothing, ties, rings, soft shoes or bare feet could be hazardous and should be avoided when servicing engines.

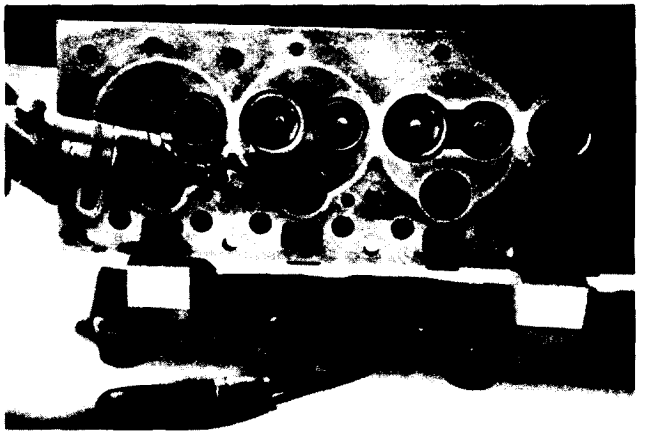
Use or service of the engine (including the use of modified parts or materials) not in accordance with manufacturer's specifications could damage your engine or cause personal injury.

⚠ WARNING

Starting fluids or aids such as ether or gasoline must not be used in a diesel engine air intake system. The use of these fluids will cause severe internal engine damage and/or bodily injury.

⚠ WARNING

Some equipment and materials used in the overhaul or maintenance of an engine such as machine tools, electrical equipment, compressed air, solvents, diesel, gasoline or other fuels may be dangerous and can cause injury. Always observe safety precautions associated with these items.



Cleaning Combustion Pocket

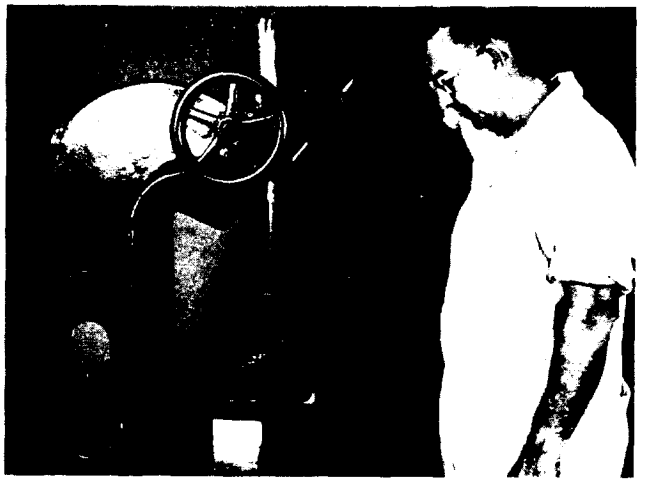
Clean insert and combustion pocket. Inspect carefully for cracks.

4. Remove all carbon from combustion areas using scraper and wire brush.

5. Clean the cylinder head thoroughly with a solvent or degreasing solution and blow it off with air pressure. Inspect carefully for cracks.

VALVE GUIDES

1. Clean the valve stem guides, removing lacquer or other deposits. Do not use tools that remove metal.
2. Check guides for wear by using a telescope gauge and 1" micrometer. Replace all guides that are worn bell-mouthed or have increased 0.038mm (.0015) in diameter. See Limits and Clearance Section for maximum diameter permissible to determine actual amount it has increased. Remove all valve guides when necessary by pressing them out from the combustion chamber side.
3. Replace worn guides as required by pressing in new guides to the correct depth as given in the valve guide data (TTP10148, page 42).



Removing Valve Guides from Combustion Chamber Side

CAUTION: When replacing guides do not ream since these are all pre-reamed before being ferrox coated—any further reaming will remove the coating.

SEE TTP10148 FOR ADDITIONAL INFORMATION

VALVE SEAT INSERTS

1. The valve seat inserts are held in place by a shrink fit.

   Inspect all valve inserts in the head and replace any that are loose, cracked or otherwise damaged. Use puller for removing faulty insert.

2. When required to replace with new insert, clean and counterbore for 0.25mm (.010") larger insert using counterbore tool with correct fitting pilot.

   When machining the counterbore, be sure to go deep enough with the tool to clean up the bottom so that the insert will have full contact to carry away the heat.

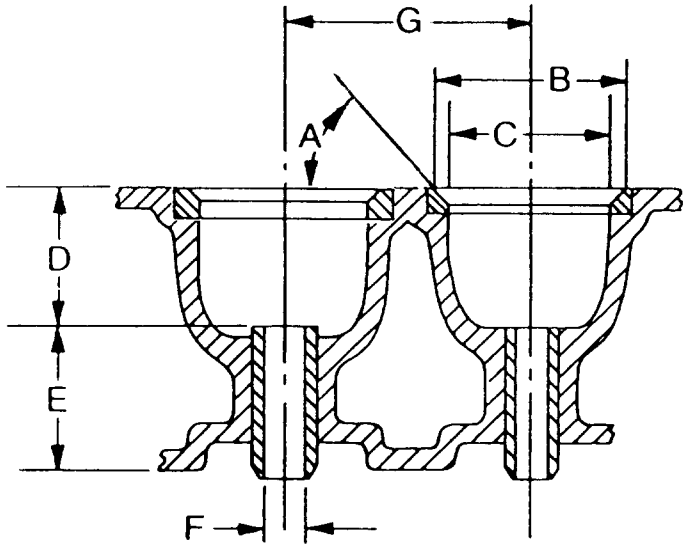
   Continental does not recommend installing new inserts having the same outside diameter as the one removed.

New insert installation must have a press fit. Chill insert in container with dry ice for 20 minutes before assembling.

Insert may then be installed in the counterbore using a piloted driver and arbor press, without the possibility of shearing the side walls. This assures it being seated firmly on the bottom of the counterbore.

3. Grind the intake and exhaust valve seats in the head in accordance with instructions in the Valve Guide Data (TTP10148, page 42). Before removing the arbor, indicate the seat. Total indicator reading of the run-out must not be more than 0.05mm (.002"). Use a pilot having a solid stem with a long taper, as all valve seats must be ground concentric and square with either new or worn valve stem guide holes.

VALVE GUIDE DATA



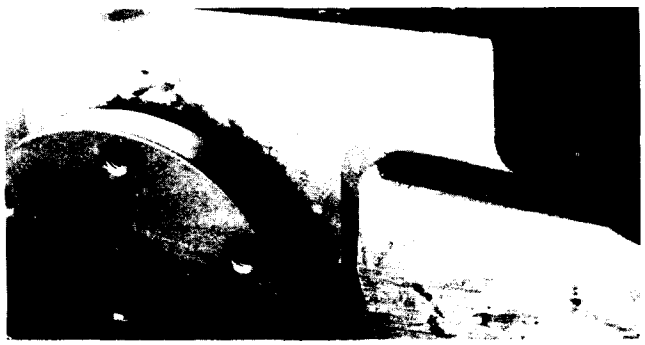
		Model TMDT	
		Intake	Exhaust
A	Valve Seat Angle	30°15'	45° 15'
B	Diameter of Seat	39.77 (1.566)	33.50 (1.319)
C	Diameter of Choke	35.0 (1.38)	29.0 (1.14)
D	Distance (From Bottom of Cylinder Head)	43.0 (1.69)	43.0 (1.69)
E	Length of Guide	60.4 (2.38)	60.4 (2.38)
F	Inside Diameter Guide	8.717/8.692 (.3432/.3422)	8.717/8.692 (.3432/.3422)
G	Distance Intake to Exhaust	47.65 (1.876)	—
Valve Seat Inserts	Outside Diameter of Insert (Free State)	44.013/43.987 (1.733/1.732)	36.713/36.687 (1.445/1.444)
	Inside Diameter of Counterbore	43.910/43.885 (1.729/1.728)	36.610/36.585 (1.441/1.440)

Crankshaft Oil Seal in Block

3. Apply a light coat of cement (national oil seal or EC-847) to the butting ends of the crankshaft oil seal halves. Allow to become tacky before assembling. Lightly coat the crankshaft contact edge of the seal with graphite grease to prevent damage prior to use.

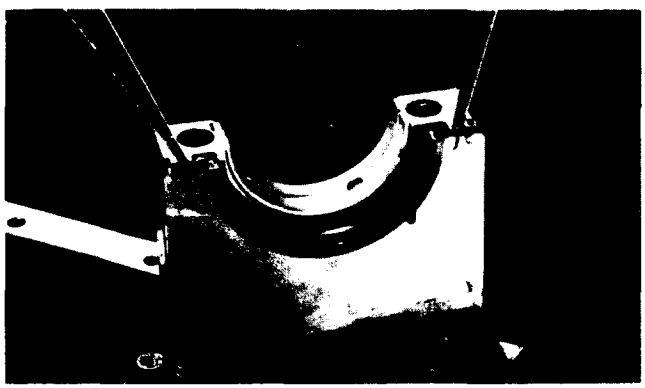
4. Install Crankshaft.

5. Apply a light coating of RTV Gasket Material to surface "B" and graphite grease to the oil seal lip. Carefully install the combination rear bearing cap and filler block on to the dowels. Insert the capscrews and torque to 150-162 Nm (110-120 Lb. Ft.)



Applying RTV to Rear Filler Block

6. After the rear cap is in place and torqued, inject RTV into each side seal slot "D" as shown in illustration. Force the RTV into the channels until a steady flow comes out the corner chamfers.



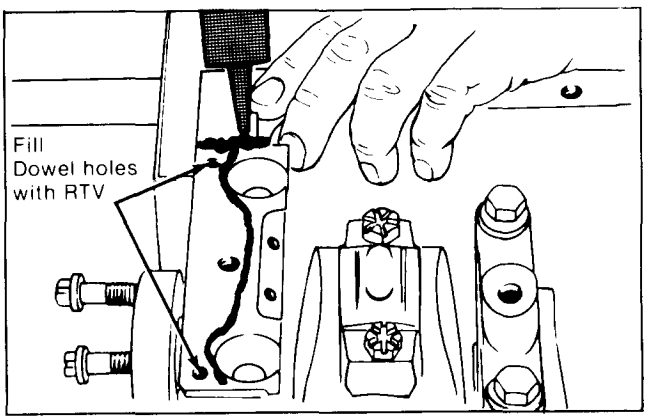
Installing RTV in Rear Filler Block Channels

NOTE: Oil leakage will occur if any voids are left along these slots.

7. Dip the curing insert in clean water. Install insert until approximately 5/8" protrudes from slot. Cut off flush with oil pan rail. This insert insures complete cure of the RTV.

Install Curing Insert

8. Prior to installing oil pan, apply a small bead of RTV material to the rear bearing cap and filler block as shown.



Applying RTV to Rear Bearing Cap and Filler Block

OIL PUMP

The oil pump is assembled to the front of the cylinder block and front main bearing cap and is held in place by capscrews.

The extended portion of the body acts as a pilot, fitting closely in a counterbore in the block and bearing cap; maintaining a definite relationship between the crankshaft and the oil pump assembly.

The pump is driven by a hardened key mounted in the crankshaft.

INSTALLING OIL PAN

Before assembling the oil pan make sure the contact surfaces are flat and clean of any gasket material or oil.

A form-in-place gasket material is used for sealing the engine oil pan to the crankcase. The form -in-place gasket should be applied to the oil pan and filler blocks as shown here.

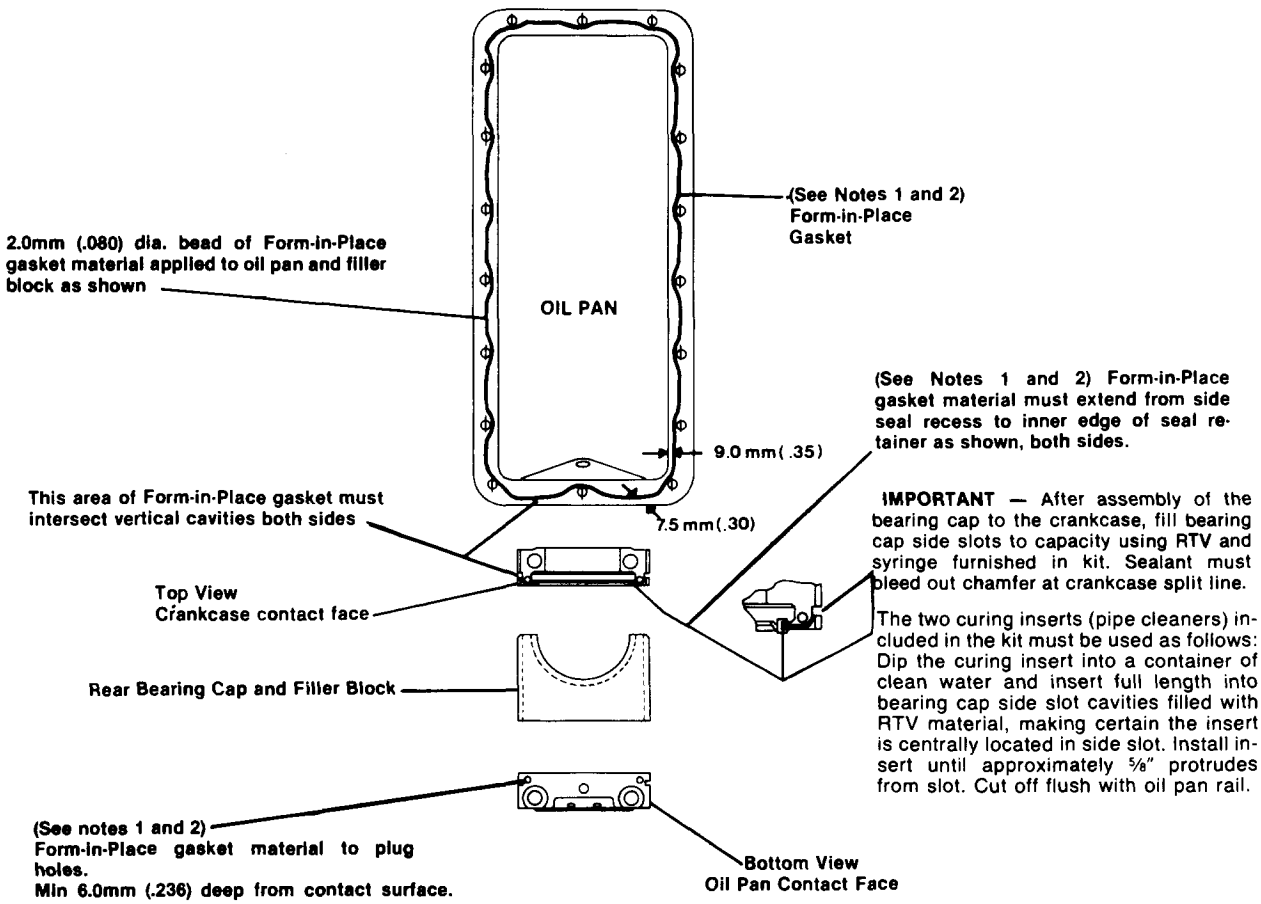
Tighten the screws in accordance with limits prescribed in the torque chart—to avoid looseness or overstressing.

NOTES:
1. **Parts must be assembled within 20 minutes after applying gasket material.**
2. **Caution must be used in handling the gasket materials. Read Labels.**

When engine is completely assembled and filled with proper oil, (See Lubrication Sec.) set tappets according to the following chart:

MODEL	INTAKE	EXHAUST
TMDT/TMD	0.36mm (.014")	0.46mm (.018")

Setting Tappets



Typical RTV Oil Pan Application for the Diesel Overhead Valve Engine.

TURBOCHARGER DESCRIPTION, OPERATION AND TROUBLESHOOTING

Garrett/AiResearch turbochargers are built for diesel and gasoline internal combustion engines. The turbocharger is composed of an exhaust-gas-driven turbine and a radial air compressor on a common shaft. The turbine and compressor wheels are mounted at opposite ends of the shaft, which is enclosed and supported by a center housing. The turbine and compressor wheels are enclosed by cast housings attached to the center housing.

The turbine is made up of a cast turbine wheel, a wheel shroud, and a housing that directs the flow of gas through the turbine. The inlet to the turbine is at the outer diameter of the housing. Exhaust gas flows inward, past the blades of the turbine wheel, and exits at the center of the housing's diameter. This means the turbine is a centripetal, or radial-inflow, machine. (See Figure 1.)

The compressor is made up of a cast compressor wheel, a backplate, and a housing that directs the flow of air through the compressor. The inlet to the compressor is at the center of the housing's diameter. Air flows outward, past the blades of the compressor wheel, and exits at the outer diameter of the housing. This means the compressor is a centrifugal, or radial-outflow, machine.

The center housing supports the compressor and turbine wheel shaft in a pair of floating journal bearings. (See Figure 2.) Passages drilled in the center housing direct oil (from the engine lubricating system) from the inlet port to oil grooves machined in the center

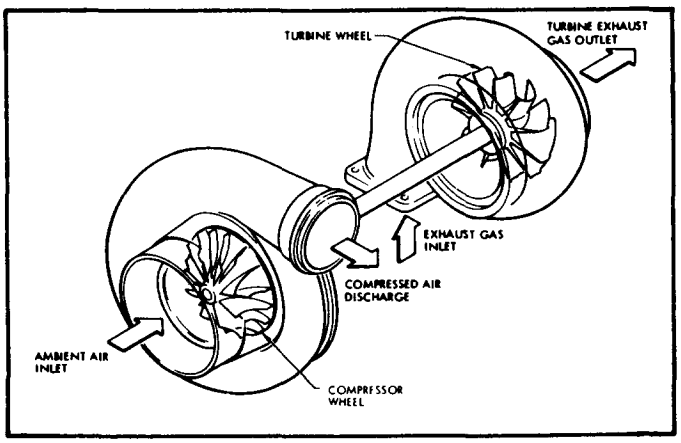


Figure 1 Turbine and Compressor Operation

housing bearing bores. These grooves align with holes in the journal bearings. Oil flows through the holes in the bearings to lubricate and cool the bearing bores and shaft journals. Oil is also directed from the inlet port through a passage in the backplate to the thrust bearing. Oil drains from the center housing by gravity.

Seals are installed at each end of the shaft between the journal bearing and the adjacent wheel to prevent lubricating oil from entering the compressor and turbine areas and to reduce the flow of gases from the compressor and turbine into the center housing. Figure 2 shows a sectional view of a typical turbocharger.

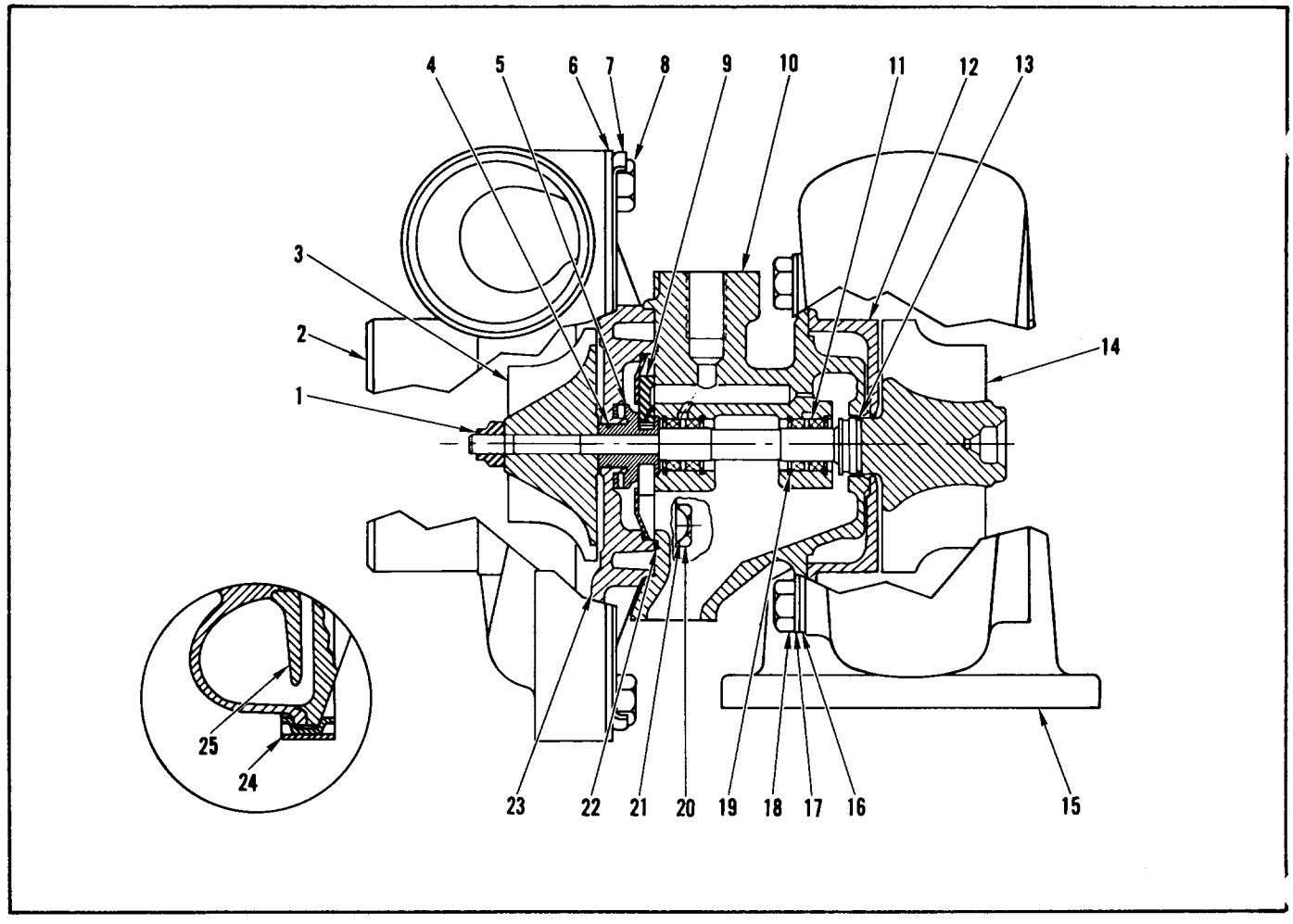


Figure 2. Sectional View of Typical Turbocharger

ITEM	NOMENCLATURE
1.	SELF-LOCKING HEXAGON NUT
2.	COMPRESSOR HOUSING
3.	COMPRESSOR WHEEL
4.	PISTON RING
5.	THRUST COLLAR
6.	CLAMP
7.	LOCK PLATE
8.	MACHINE BOLT
9.	THRUST BEARING
10.	CENTER HOUSING ASSY
11.	JOURNAL BEARING
12.	WHEEL SHROUD
13.	PISTON RING

ITEM	NOMENCLATURE
14.	TURBINE WHEEL ASSY
15.	TURBINE HOUSING
16.	CLAMP
17.	LOCK PLATE
18.	MACHINE BOLT
19.	RETAINING RING
20.	MACHINE BOLT
21.	LOCK PLATE
22.	SEAL RING
23.	BACKPLATE ASSY

THEORY OF OPERATION

During operation of a turbocharged engine, exhaust gas from the engine exhaust manifold flows into the turbine. (See Figure 3.) The exhaust gas pressure and the heat energy extracted from the gas cause the turbine wheel to rotate which, in turn, causes the compressor wheel to rotate.

The cooled and expanded exhaust gas leaving the turbine wheel is directed by the turbine housing to the engine exhaust system, which expels it to the atmosphere.

Rotation of the compressor wheel draws ambient air through the engine air cleaner into the compressor housing, where it is compressed and directed through ducting to the engine intake manifold. The increased density of the air delivered to the engine cylinders permits a corresponding increase in the amount of fuel that can be delivered to the cylinders while maintaining the air-fuel ratio required for proper combustion. Because engine power output changes with the amount of fuel burned, the increase in the amount of fuel delivered results in an increase in engine power output.

Shaft rotation also activates the turbocharger oil seals. At the oil slinger groove, there is a difference in tip speed between the bottom of the groove and the larger diameter of the shaft. Centrifugal force throws the oil outward to the walls of the center housing. Oil is not allowed past the groove to the turbine or compressor areas while the shaft is rotating.

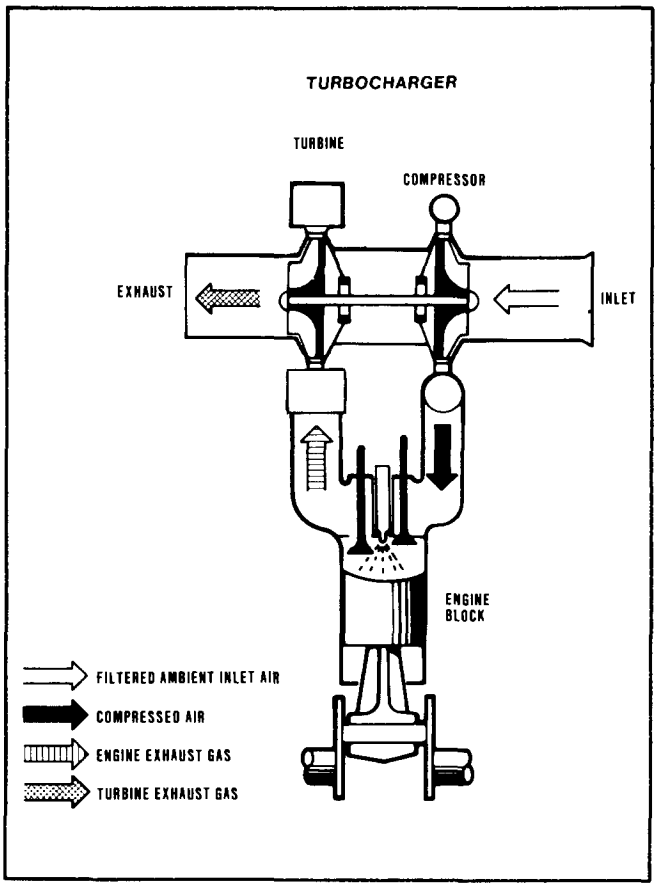


Figure 3. Turbocharger and Engine Operation

PREVENTIVE MAINTENANCE

Since no calibration or adjustment procedures are possible on in-service turbochargers, and since all lubrication requirements are supplied by the engine on which the turbocharger is mounted, no periodic maintenance in the usual sense is required on a Garrett/AiResearch turbocharger. In addition, due to the wide variation in operating modes and conditions to which turbochargers are subjected, maintenance procedures based upon specific numbers of engine operating hours, vehicle miles, or calendar periods are not practicable.

Therefore, preventive maintenance of a turbocharger consists primarily of ensuring that the integrity of the turbocharger and engine as a system is maintained, and that the engine is not operated in a manner that is detrimental to the turbocharger.

CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

PROPER OPERATING PROCEDURES

Turbocharger operation is entirely automatic. No special procedures beyond those listed below are required. As engine power output increases and decreases, the turbocharger responds to deliver the required amount of air. To ensure maximum turbocharger service life, observe the following precautions:

CAUTION:

1. Do not operate the engine above idle before normal engine oil pressure has been established. Applying full throttle immediately upon initial start-up can operate the turbocharger at excessive speed before the bearings receive adequate lubrication (this is referred to as "oil lag"). Operation of the turbocharger without a sufficient oil supply for a period as short as 5 seconds can cause bearing failure.

2. During exposure to temperatures low enough to congeal engine oil, or following long periods of nonoperation crank the engine without starting until normal oil pressure has been established. Then start the engine and run at idle speed for a few minutes before operating at higher rpm.

3. After an engine oil change or any service that involves oil drainage, pre-oil the turbocharger by cranking the engine as above until normal oil pressure has been established. Then start the engine and run at idle speed for a few minutes before operating at higher rpm.

4. Before engine shut-down, operate the engine at low idle speed for a few minutes to allow the turbocharger to decelerate. Shutting the engine down from a high operating speed can cause the turbocharger to continue to rotate after engine oil pressure has dropped to zero, damaging the turbocharger bearings.

ON-ENGINE TROUBLESHOOTING

The most common symptoms of turbocharger failure are related to engine performance:

- Lack of power
- Excessive exhaust smoke
- Unusual noise
- Excessive oil or fuel consumption.

Of course, any of these symptoms could be the result of an internal engine problem, and might not involve the turbocharger at all.

Before the turbocharger is removed from the engine, the turbocharger and its installation should be examined. In many cases, the brief troubleshooting procedure outlined in this section will help to determine whether the turbocharger is at fault in the complaint. Also, external or engine-related causes of turbocharger failure may be found. Such problems must be corrected before another turbocharger is installed, or the new unit will fail just as the old one did.

The troubleshooting procedure contains these four steps:

1. Examine the exterior of the turbocharger and its installation.

2. Examine the turbine wheel and housing.

3. Examine the compressor wheel and housing.

4. Check the rotating assembly for noise or excessive play.

The following detailed explanations of these steps tell how to make the inspection and what the results mean. Remember, these steps are to be taken before the turbocharger is removed from the engine. Any external or engine-related faults found must be corrected before a replacement turbocharger is installed.

1. EXAMINE THE TURBOCHARGER EXTERIOR AND INSTALLATION

Visually check for:

- Missing or loose nuts and bolts
- Loose or damaged intake and exhaust ducting
- Damaged oil supply and drain lines
- Cracked or deteriorating turbocharger housings
- External oil or coolant leakage.

Correct any installation problems. If turbocharger parts are damaged, the unit should be overhauled after completion of the remainder of this troubleshooting procedure.

2. INSPECT TURBINE WHEEL AND HOUSING

⚠ WARNING

OPERATION OF THE TURBOCHARGER WITHOUT THE INLET DUCT AND AIR FILTER CONNECTED CAN RESULT IN PERSONAL INJURY AND DAMAGE TO EQUIPMENT FROM FOREIGN OBJECTS ENTERING THE TURBOCHARGER.

OPERATION OF A TURBOCHARGER WITH DAMAGED COMPONENTS MAY RESULT IN SERIOUS INJURY. DUE TO VERY HIGH ROTATION SPEEDS, SMALL IMBALANCES MAY CAUSE DISINTEGRATION OF TURBOCHARGER UNIT.

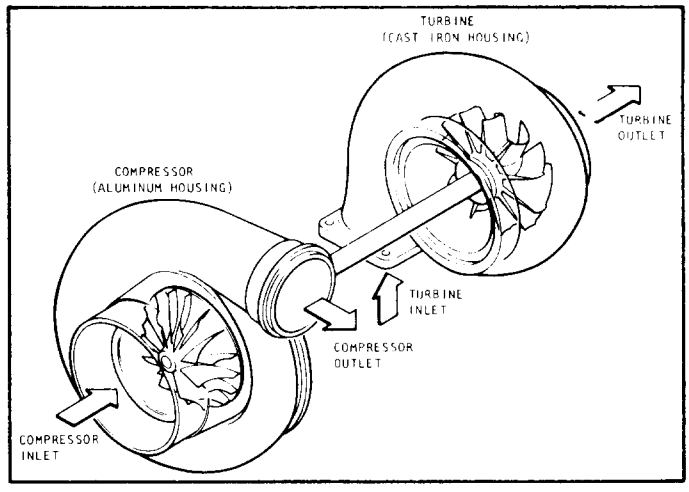


Figure 4. Turbine and Compressor Inlet and Outlet Identification

Figure 5. Turbine Wheel-to-Housing Rub

Remove the ducting from the turbine outlet (Figure 4). Using a flashlight, check the turbine for wheel-to-housing rub (Figure 5), evidence of oil leakage (Figure 6), or foreign object damage. Foreign object damage to the turbine is not usually visible through the turbine outlet unless the damage is severe.

Figure 6. Turbine Oil Leakage

Wheel-to-Housing Rub

If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.

Oil Leakage

If oil deposits are found, determine whether the oil has come from the engine exhaust or from the turbocharger center housing.

If the oil has come from the engine, consult the engine service manual and correct the problem. If oil deposits on the wheel are heavy, the turbocharger should be removed and serviced by an authorized service center.

Try to avoid long periods of idle. Continued low pressure exhaust gasses and low turbocharger rotation speed may allow oil to seep past the shaft seal.

Make sure to properly maintain the engine lubrication system, as outlined in the service manual. Contaminated oil can restrict the turbocharger oil drain line and force oil past the shaft seal.

- Other possible causes of oil on the turbine:
  - oil drain line damage
  - engine crankcase pressurization caused by restricted breather or excessive blowby
  - over filled crankcase

Foreign Object Damage

⚠ WARNING

OPERATION OF THE TURBOCHARGER WITHOUT THE INLET DUCT AND AIR FILTER CONNECTED CAN RESULT IN PERSONAL INJURY AND DAMAGE TO EQUIPMENT FROM FOREIGN OBJECTS ENTERING THE TURBOCHARGER.

If foreign object damage to the turbine is visible, the turbocharger must be overhauled. Such damage destroys the wheel's balance and causes internal damage to the seal bores and journal bearings. Be sure to find the source of the foreign object. In many cases, the object has come out of the engine, and there may be engine damage as well.

3. EXAMINE COMPRESSOR WHEEL AND HOUSING.

⚠ WARNING

OPERATION OF THE TURBOCHARGER WITHOUT THE INLET DUCT AND AIR FILTER CONNECTED CAN RESULT IN PERSONAL INJURY AND DAMAGE TO EQUIPMENT FROM FOREIGN OBJECTS ENTERING THE TURBOCHARGER.

OPERATION OF A TURBOCHARGER WITH DAMAGED COMPONENTS MAY RESULT IN SERIOUS INJURY. DUE TO VERY HIGH ROTATION SPEEDS, SMALL IMBALANCES MAY CAUSE DISINTEGRATION OF TURBOCHARGER UNIT.

Remove the ducting from the compressor inlet (Figure 4). Using a flashlight, check the compressor for wheel-to-housing rub (Figure 7), evidence of oil leakage (Figure 8), or foreign object damage (Figure 9).

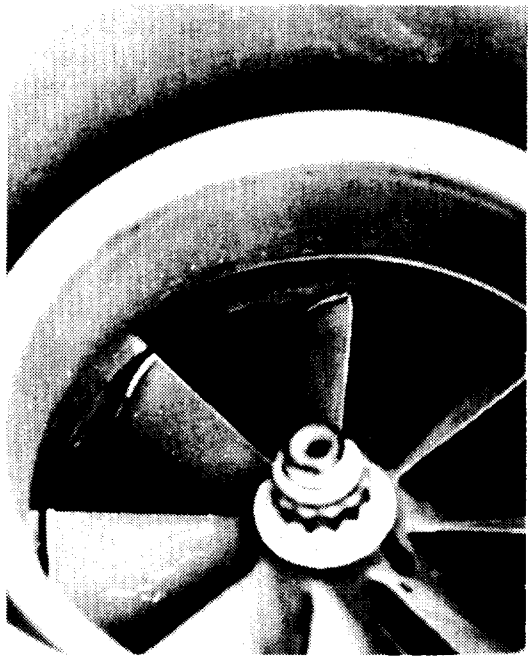


Figure 7. Compressor Wheel-to-Housing Rub

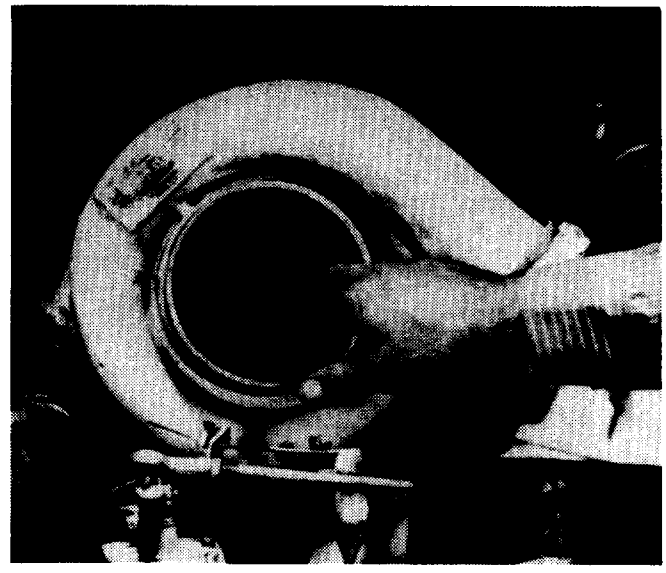


Figure 8. Compressor Oil Leakage

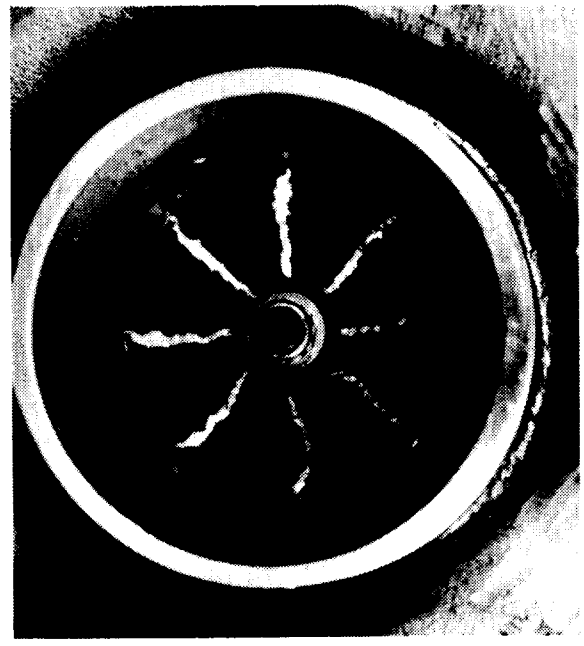


Figure 9. Compressor Foreign Object Damage

Wh el-to-H u ing Rub

If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.

Oil L akage

Oil leakage into the compressor can be caused by long periods of idling or a restricted oil drain line, as discussed in Step 2. Check the items listed there. Remember, if oil deposits are heavy, the unit should be removed and serviced. If the leakage was caused by a restricted drain line, the center housing may be full of sludged or coked oil and the unit may require overhaul. Be sure the cause of the leakage has been corrected before installing another turbocharger.

Oil leakage into the compressor can also be caused by a restricted air intake system. If the turbocharger cannot breathe freely, oil pressure in the center housing can exceed air pressure in the compressor housing. Oil will be forced past the seals into the compressor area. In this case, there is probably nothing mechanically wrong with the turbocharger. If oil deposits are heavy, the unit should be removed and serviced. Be sure to correct the air intake problem, which may have been caused by a dirty air cleaner or debris or damage in the intake ducting.

Finally, oil leakage into the compressor can be caused by frequent use of the engine as a brake; for example, descending a long grade with the transmission in low gear. During this type of operation, engine air demand can be high, but energy input to the turbine is low and so turbocharger rotating speed is low. The engine draws air through the compressor and creates a slight vacuum in the compressor housing, sucking oil from the center housing past the shaft seal and into the compressor housing. In this case, nothing is wrong with either the engine or the turbocharger, but frequent compressor wheel and housing clean-up is recommended.

Foreign Object Damage

⚠ WARNING

OPERATION OF A TURBOCHARGER WITH DAMAGED COMPONENTS MAY RESULT IN SERIOUS INJURY. DUE TO VERY HIGH ROTATION SPEEDS, SMALL IMBALANCES MAY CAUSE DISINTEGRATION OF TURBOCHARGER UNIT.

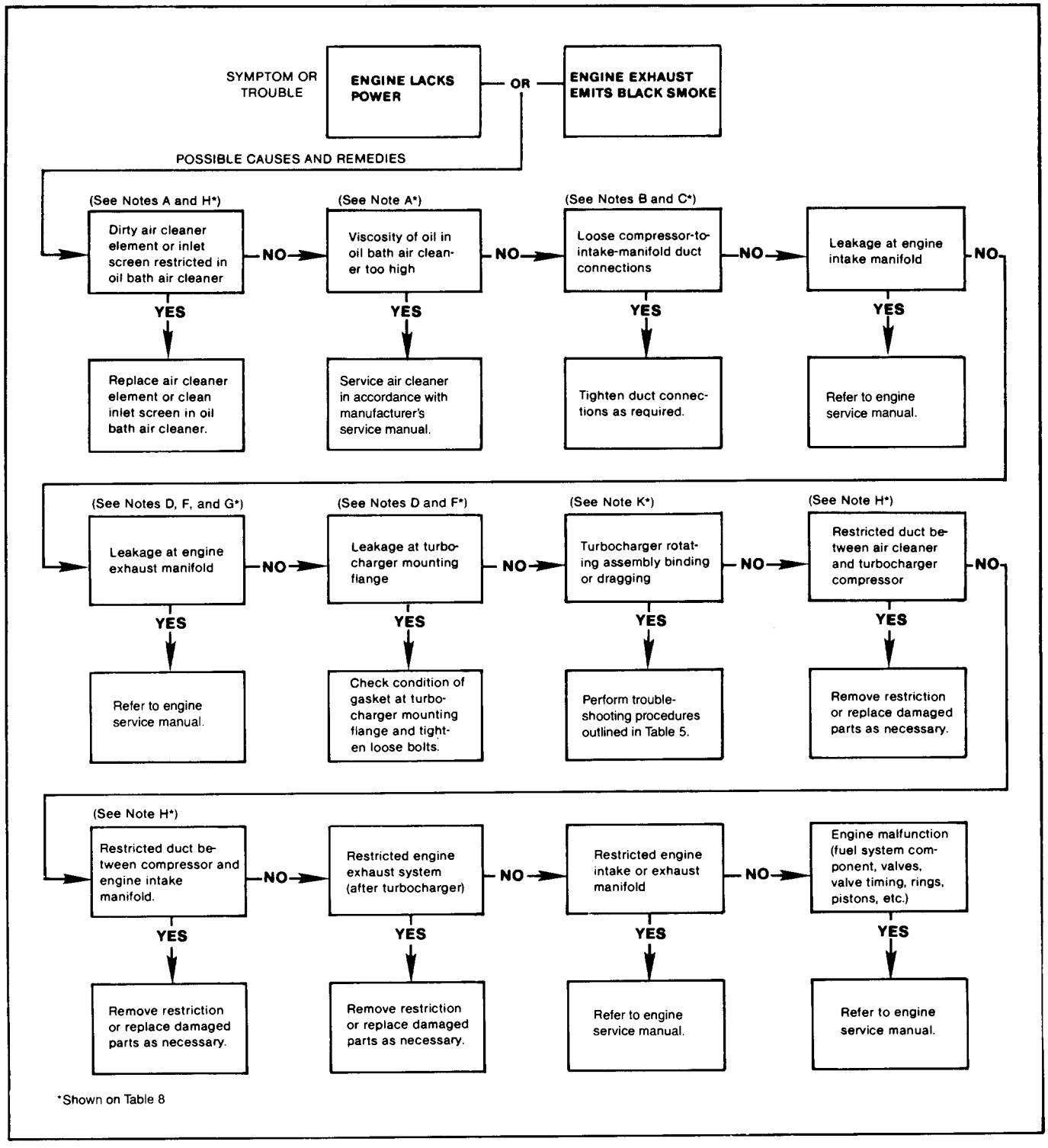
If the compressor wheel has been damaged by a foreign object, the turbocharger must be overhauled, as explained above. In most cases, the foreign object has come through the intake system. Check for loose ducting, or debris that may have been left in the system. The object or pieces of the wheel may have entered the intake manifold and engine, so be sure to check for engine damage before installing another turbocharger.

4. CHECK ROTATING ASSEMBLY FOR NOISE OR EXCESSIVE PLAY .

If no damage is visible in the turbine and compressor areas, spin the rotating assembly by hand. It should spin freely with no drag or grinding noises.

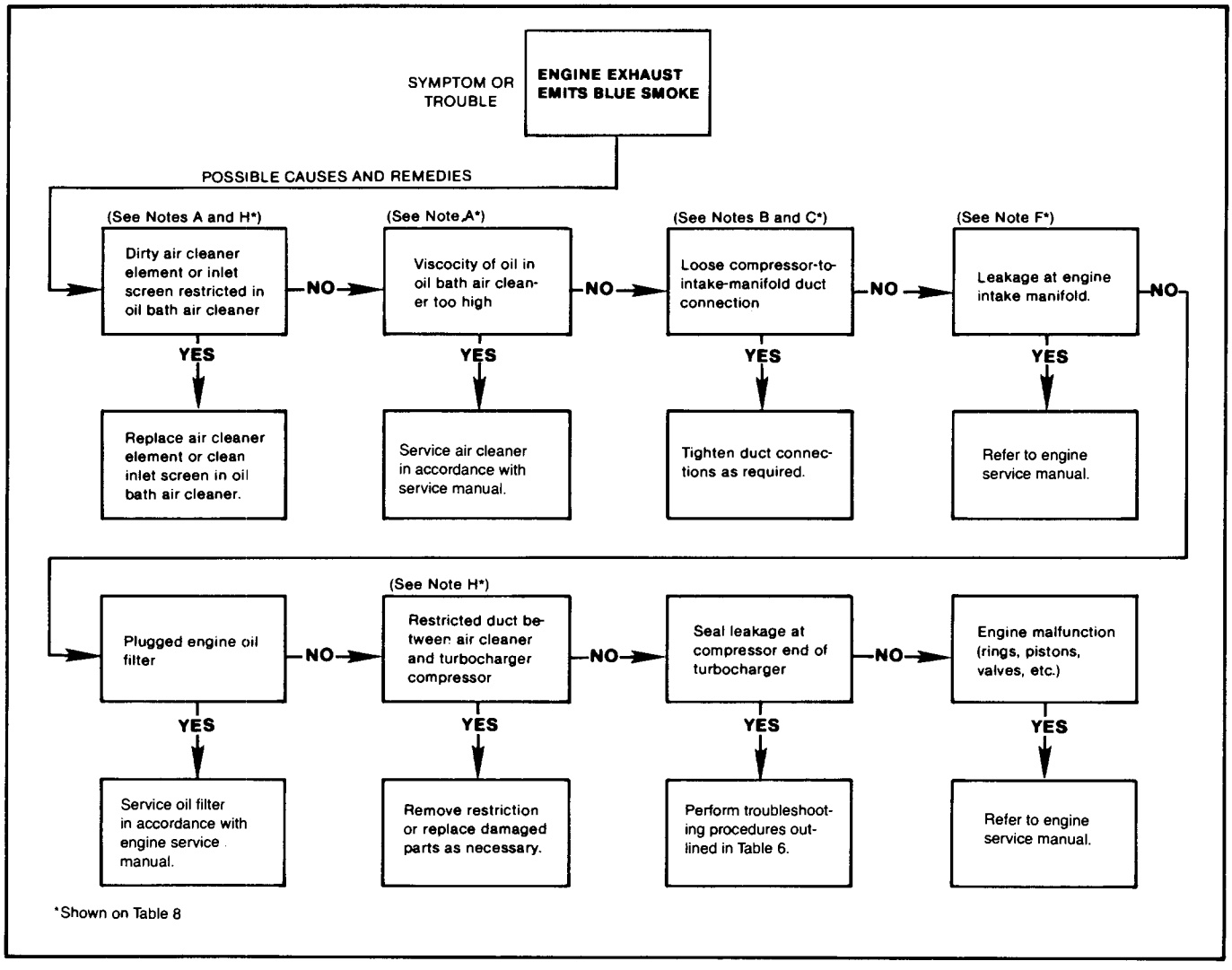
Side-load each wheel by hand while turning the assembly and check whether the wheels are contacting their housings. If contact is seen, the turbocharger is probably worn or damaged internally and must be overhauled.

Table 1. Troubleshooting—Engine Lacks Power or Engine Exhaust Emits Black Smoke



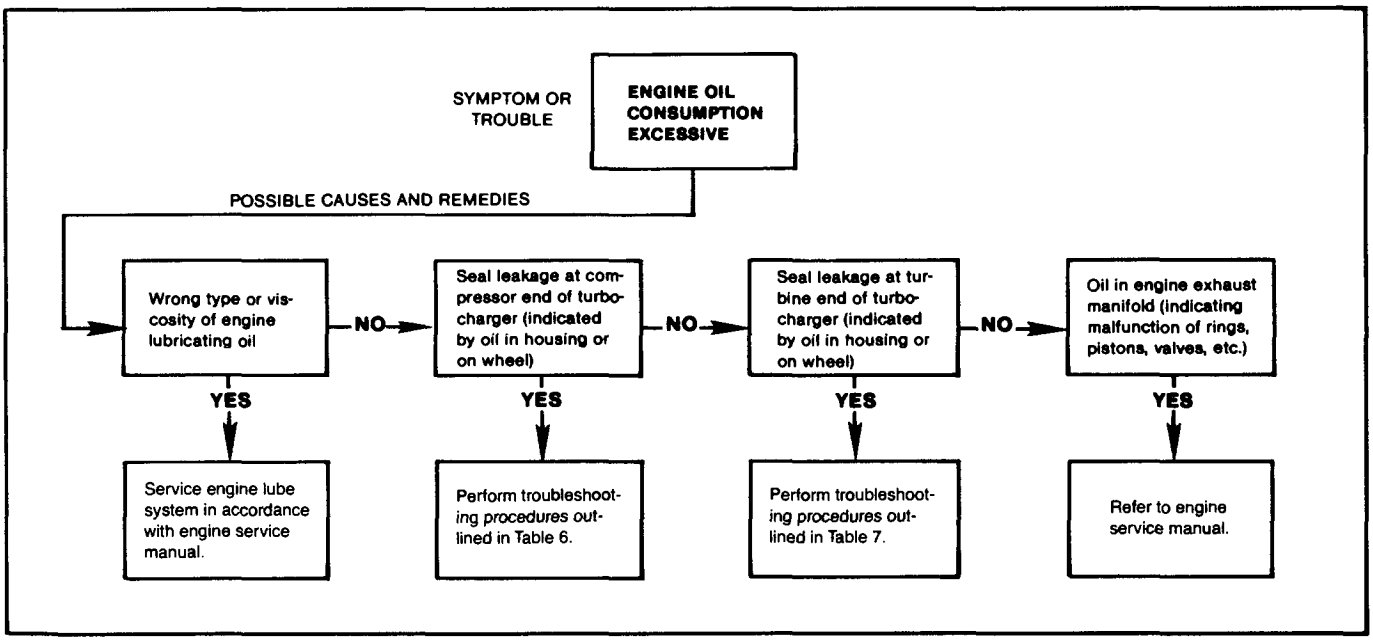
CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 2. Troubleshooting—Engine Exhaust Emits Blue Smoke



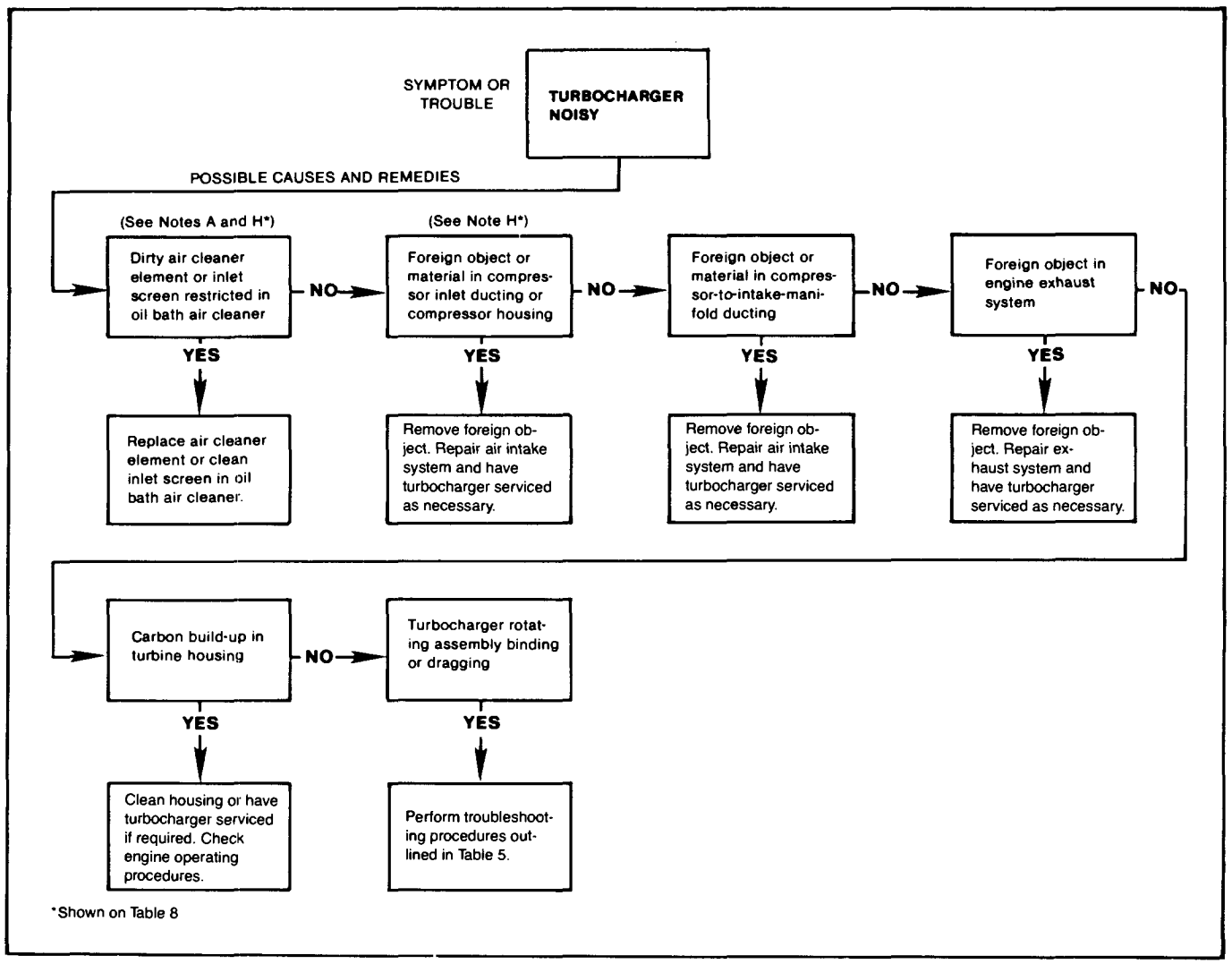
CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 3. Troubleshooting—Engine Oil Consumption Excessive



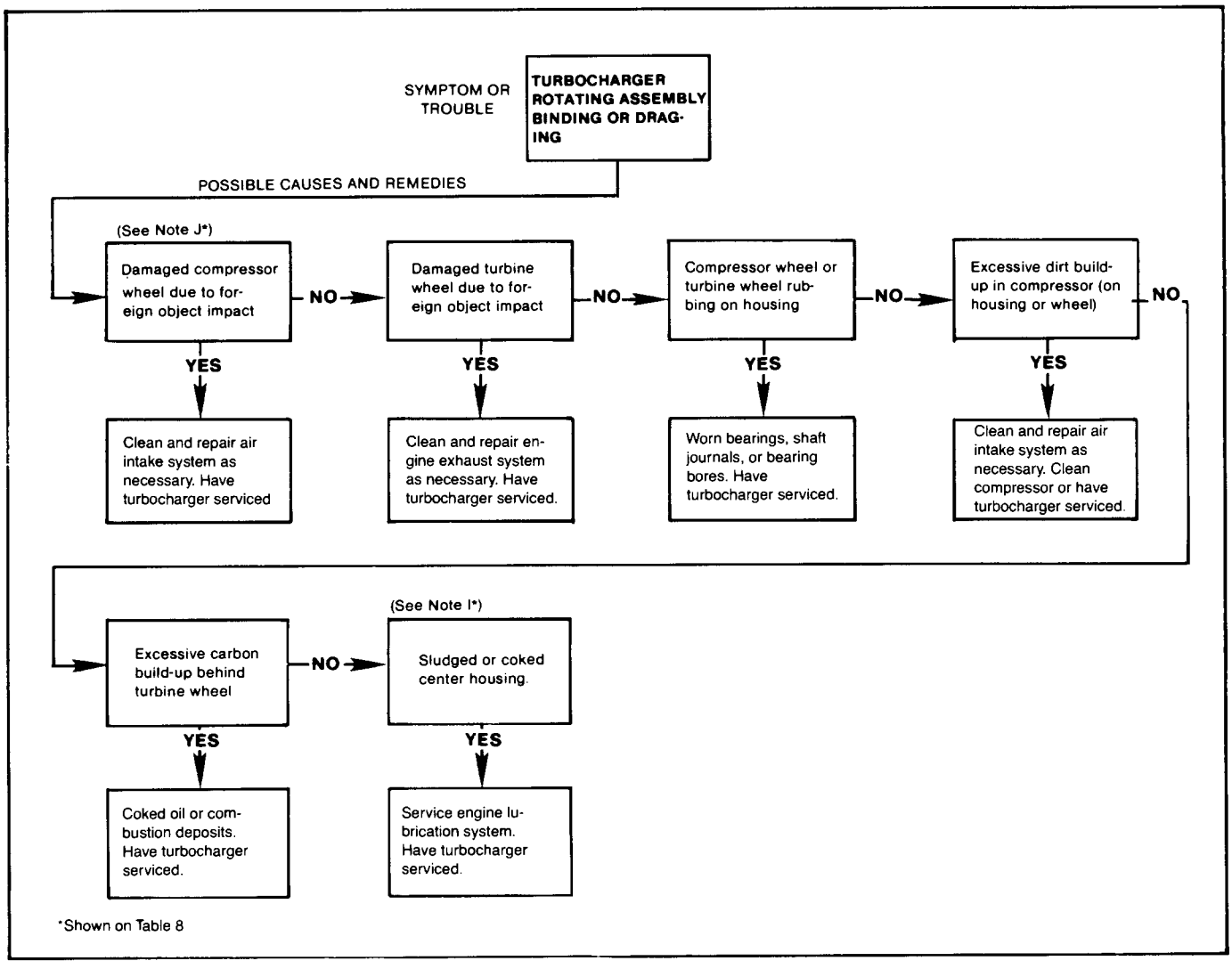
CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 4. Troubleshooting—Noisy Turbocharger



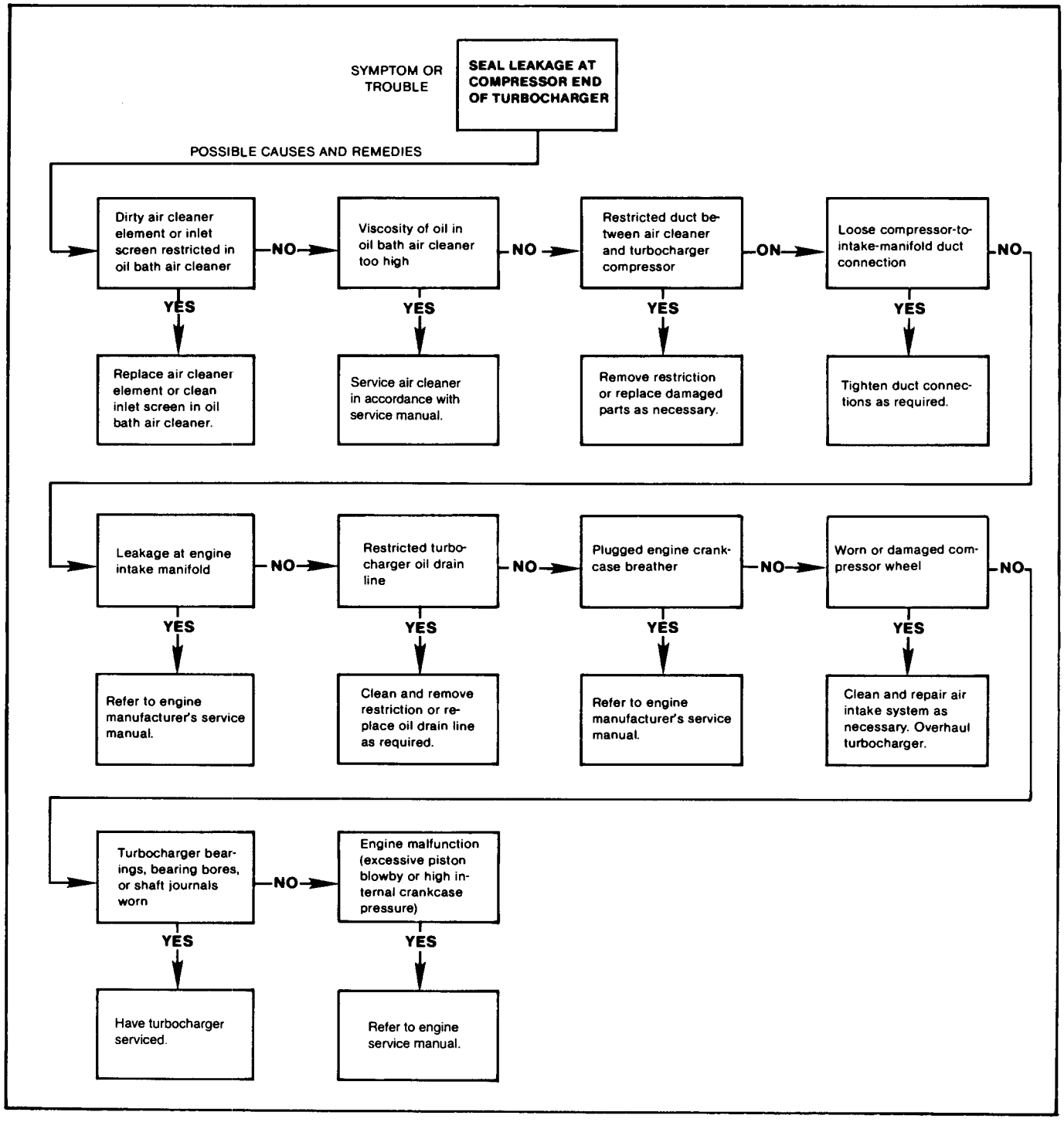
CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 5. Troubleshooting—Turbocharger Rotating Assembly Binding or Dragging



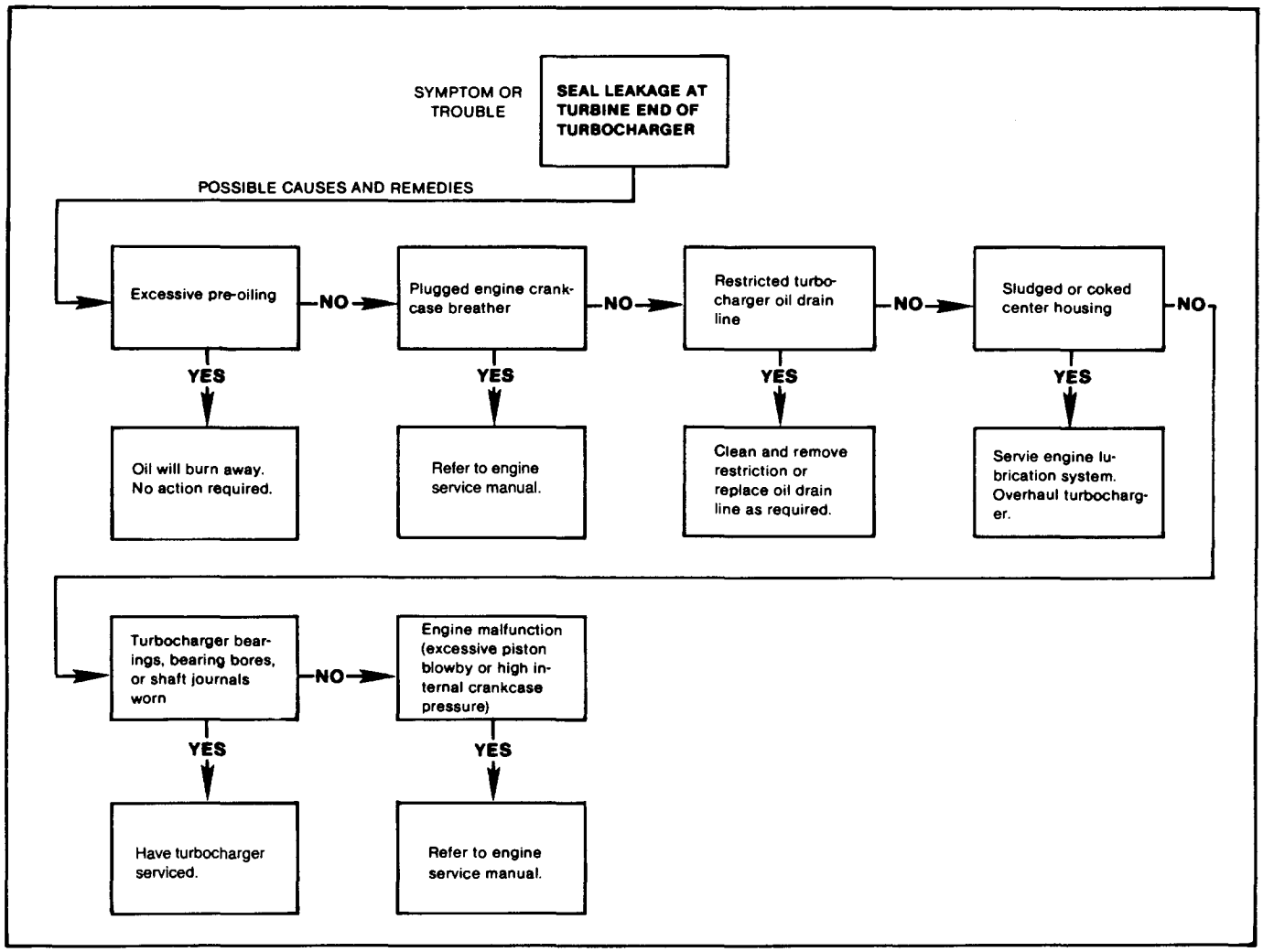
CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 6. Troubleshooting—Seal Leakage at Compressor End of Turbocharger



CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 7. Troubleshooting—Seal Leakage at Turbine End of Turbocharger



CAUTION: Do not attempt to dismantle the turbocharger. Service may only be performed by specially trained personnel. Improper torques, clearances, or adjustments can ruin the unit.

Table 8. Troubleshooting Procedures Notes

A. Refer to the engine service manual for inspection requirements and replacement specifications.

B. With engine stopped, check duct clamping devices for tightness.

⚠ WARNING

"Starting fluid" should never be used to start an engine. Serious personal injury may result from improper use of such mixtures. Explosion may result from improper use. Use only for the diagnostic purpose outlined below. Never apply "starting fluid" or similar mixtures to hot surfaces.

C. With engine running at idle speed, lightly spray intake duct connections with "starting fluid." Leaks at connections will be indicated by an increase in engine speed due to the starting fluid being drawn into the compressor and pumped into the engine combustion chambers.

D. With engine running at idle speed, check exhaust duct connections for leaks by applying lightweight oil or liquid soap to areas of possible leakage and checking for bubbles. Exhaust gas leakage between the engine block and the turbocharger inlet will also create a noise level change.

E. With engine running at idle speed, check for unusual noise and vibration. If either condition is noted, shut down the engine immediately to protect the turbocharger and engine from further damage. With the engine stopped, check the turbocharger shaft wheel assembly for damage as outlined in Note I, below.

F. With engine running, a change in the noise level to a higher pitch can indicate air leakage between the air cleaner and the engine or a gas leak between the engine block and the turbocharger inlet.

G. Exhaust gas leakage may be indicated by heat discoloration in the area of the leak.

H. With the engine running, noise level cycling from one level to another can indicate a plugged air cleaner, a restriction in the air-cleaner-to-compressor duct, or a heavy build-up of dirt in the compressor housing or on the compressor wheel.

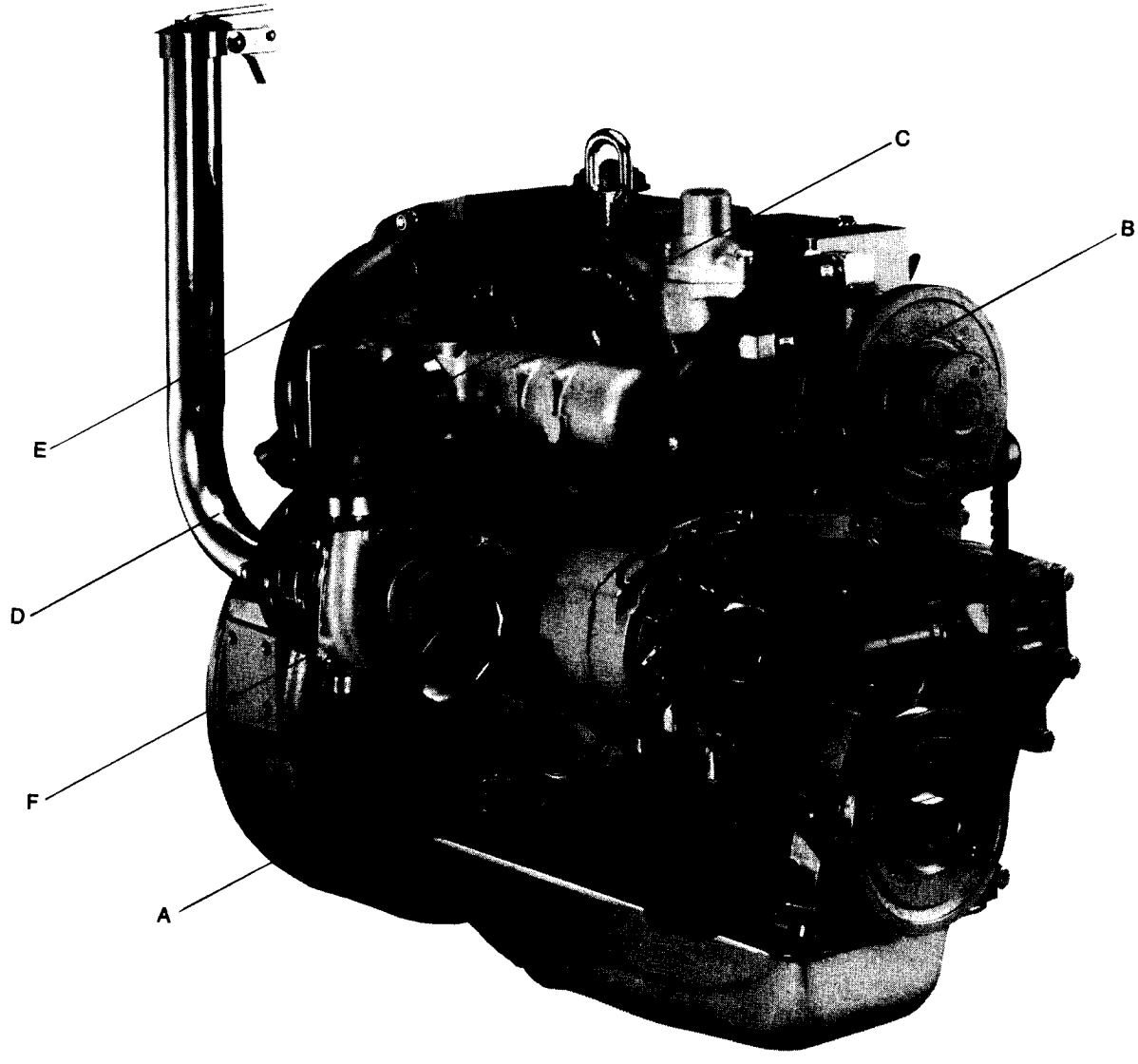
I. Internal inspection of the center housing can be accomplished by removing the oil drain line and looking through the oil drain opening. When a sludged or coked condition exists, a heavy sludge build-up will be seen on the shaft between the bearing journals and in the center housing from the oil drain opening back to the turbine end.

J. Thorough cleaning of the air intake system is essential following compressor wheel damage due to foreign object impact. In many cases, metal pieces from the wheel become imbedded in the air cleaner element. If the element is not changed, these metal pieces can be drawn into the replacement turbocharger and cause it to fail in the same manner as the original unit.

Table 8. Troubleshooting Procedures Notes (Continued)

K. With the air inlet and exhaust gas ducting removed from the turbocharger, examine both the compressor and turbine wheels for blade damage. Examine the outer blade tip edges for evidence of rubbing on housing surfaces.

Turn the rotating assembly by hand and feel for dragging or binding. Push the rotating assembly sideways while rotating to feel for wheel rub. If there is any indication of rubbing have the turbocharger serviced. If the rotating assembly rotates freely and there is no evidence of binding or rubbing, it can be assumed that the turbocharger is serviceable.



TURBOCHARGER REMOVAL

1. Disconnect oil drain line (A) at engine block and allow oil to drain.
2. Disconnect oil feed line (B) at engine block.
3. Remove air inlet ducting between turbocharger and air cleaner (not shown).
4. Remove compressor outlet hose (C) at intake manifold.
5. Disconnect exhaust pipe (D) from turbine outlet.
6. While supporting the entire turbocharger unit, disconnect turbine inlet pipe (E) at exhaust manifold and remove turbocharger assembly from the engine.
7. After the entire assembly is removed, disconnect all the above-mentioned hoses and lines (A,B,C,E) from the turbocharger. Also remove oil drain line flange (F).
8. Cover all turbocharger openings as soon as removal is complete.

TURBOCHARGER INSTALLATION

1. Remove all protective coverings from turbocharger openings.
   CAUTION: Do not allow any dirt or foreign matter to enter the openings during installation.
2. Using a new stainless steel gasket, mount the turbine inlet pipe (E) on the turbine housing flange. Use ⅜ grade 8 bolts and torque 40 ft. lbs.
3. Also using a new stainless steel gasket, mount the turbocharger assembly on the engine exhaust outlet flange. Use ⅜ grade 8 bolts and torque 40 ft. lbs.
4. Connect the compressor hose (C) between the compressor outlet and engine intake manifold. Be sure to tighten clamps.
5. Connect the oil feed line (B) from the engine to the oil inlet port of the turbocharger center housing.
   CAUTION: Do not use any type of pipe thread sealant at the oil inlet port. This material can clog internal oil passages.
6. Without allowing the engine to fire, crank the engine until a steady stream of oil is seen draining from the turbocharger center housing oil drain port.
7. Using a new gasket, connect the oil drain line flange (F) to the turbocharger oil drain outlet. Use ⅜-16×1 bolts and torque 25 ft. lb.
8. Connect oil drain line (A) between flange (F) and engine. Make sure the line slopes downward the full length of its course and has no sharp bends or kinks. Tighten clamps.
9. Using a new stainless steel gasket, connect the exhaust pipe (D) to the turbocharger.
10. Connect ducting between air cleaner and turbocharger compressor inlet.
11. Check all connections for leaks.

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WARNING

California Proposition 65

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

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