Power Products

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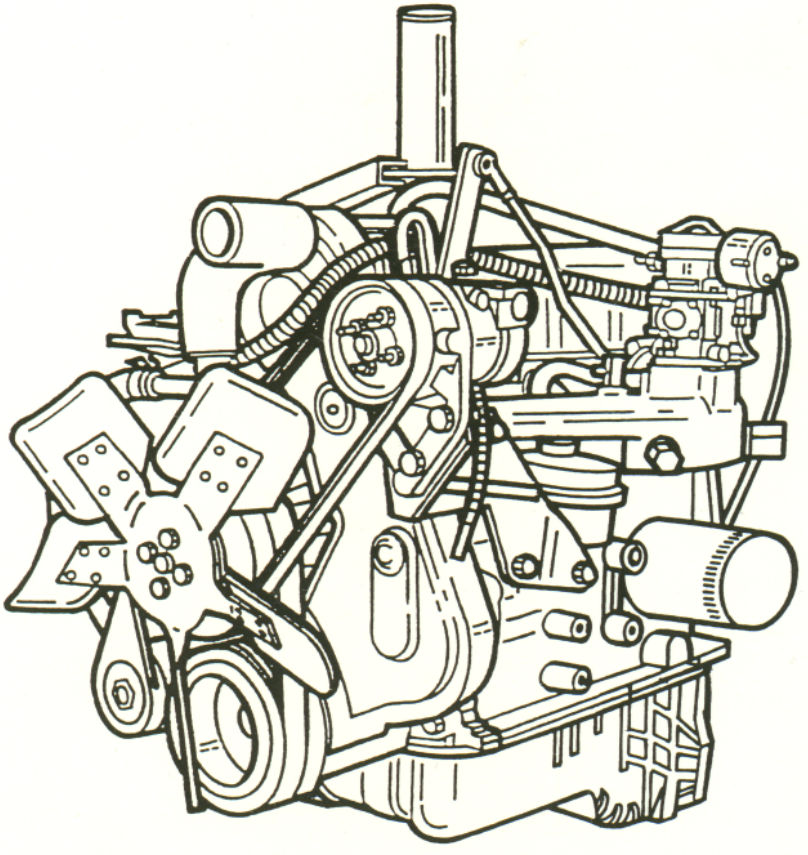
LRG-423 2.3 LITRE INDUSTRIAL ENGINE SERVICE MANUAL



IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

NOTES, CAUTIONS, AND WARNINGS

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK unless instructed otherwise for a specific operation. If you have a manual transmission, it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific operation. Place wood blocks (4" x 4" or larger) to the front and rear surfaces of the tires to provide further restraint from inadvertent vehicle movement.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind the head.
- Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in underhood temperatures, even though the ignition is in the OFF position. Therefore, care should be taken to ensure that the electric cooling fan is completely disconnected when working under the hood.

⚠ WARNING: ⚠

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

Introduction

In general, this manual covers the servicing of the engine and associated standard equipment. In many cases, engines are supplied with accessories and equipment that are unique to the application. If service information is ever required on such unique accessories or equipment it is suggested that Power Products Division/GRI be contacted. The proper information will either be forwarded or the Service Technician will be advised where it can be obtained.

The information in this manual is grouped in sections according to the type of work being performed. The various sections are indicated in the index. In addition, each section is subdivided to include topics such as diagnosis and testing, cleaning and inspection, overhaul, removal and installation procedures, disassembly and assembly procedures, and service specifications.

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POWER PRODUCTS DIVISION/GRI
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SOUTHFIELD, MICHIGAN 48034

The descriptions and specifications contained in this manual were in effect at the time the book was released for printing. Power Products Division/GRI reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring obligation.

NOTE: *The recommendations and suggestions contained in this publication are made to assist the distributor in improving his distributorship parts and/or service department operations. These recommendations and suggestions do not supersede or override the provisions of the Warranty and Policy Manual and in any cases where there may be a conflict, the provisions of the Warranty and Policy Manual shall govern.*

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DESCRIPTION AND OPERATION

Introduction

This section covers various engine tests, adjustments, service procedures and cleaning/inspection procedures. Engine assembly and service specifications appear at the end of Section 02.

For engine disassembly, assembly, installation, adjustment procedures and specifications, refer to Section 02.

The 2.3L engine incorporates a closed-type crankcase ventilation system. Other than the crankcase ventilation system there are no exhaust emission controls or engine/emission control systems used with industrial versions of this engine.

To maintain the required performance level, the fuel system, ignition system and engine must be kept in good operating condition and meet recommended adjustment specifications.

Before replacing damaged or worn engine components such as the crankshaft (6303), cylinder head (6049), valve guide (6510), valves, camshaft (6251) or cylinder block (6010), make sure part(s) is not serviceable.

WARNING: TO AVOID THE POSSIBILITY OF PERSONAL INJURY OR DAMAGE, DO NOT OPERATE THE ENGINE UNTIL THE FAN BLADE (8600) HAS FIRST BEEN EXAMINED FOR POSSIBLE CRACKS OR SEPARATION.

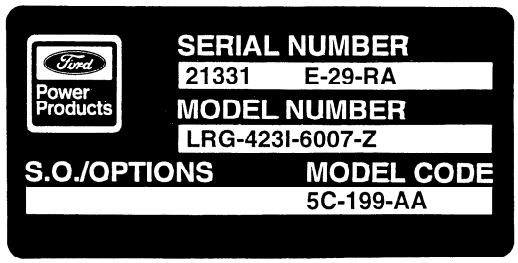
CAUTION: Use of abrasive grinding discs to remove gasket material from the engine sealing surfaces during repair procedures can contribute to engine damage and wear. Airborne debris and abrasive grit from the grinding disc may enter the engine through exposed cavities causing premature wear and eventual engine damage.

Ford Motor Company does not recommend using abrasive grinding discs to remove engine gasket material. Use manual gasket scrapers for removing gasket material from the engine sealing surfaces.

Take added care to prevent scratching or gouging aluminum sealing surfaces.

Engine Identification Nameplate

For quick engine identification, refer to the Engine Identification Nameplate. The nameplate lists engine information required for proper servicing of the engine. The Engine Identification Nameplate and identification label provide information pertaining to engine displacement, serial number, model number, S.O./ Options, and model code.



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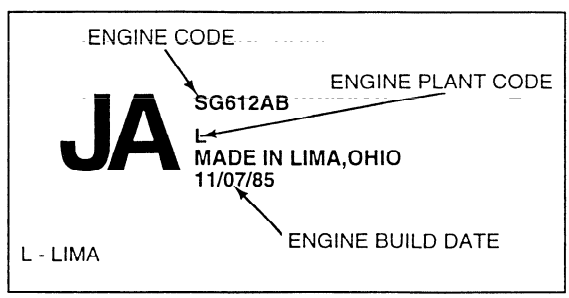
An engine code decal is attached to the engine front cover. The symbol code on the decal identifies each engine for determining parts usage.



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DIAGNOSIS AND TESTING

Inspection

1. Inspect to determine if any of the following mechanical concerns apply:
   - Engine oil leaks.
   - Damaged and/or severely worn parts.
   - Loose mounting bolts, studs and nuts.

Symptom Chart

ENGINE DIAGNOSIS

CONDITION	POSSIBLE SOURCE	ACTION
• Difficult Starting	• Burnt valve. • Worn piston. • Worn piston ring(s). • Worn cylinder. • Damaged cylinder head gasket. • Malfunctioning or damaged fuel system. • Malfunctioning or damaged ignition system.	• REPLACE valve. • REPLACE piston. • REPLACE piston ring(s). • SERVICE or REPLACE cylinder block. • REPLACE cylinder head gasket. • REFER to section on Fuel System. • REFER to section on Ignition System.
• Poor Idling	• Damaged hydraulic valve tappet. • Damaged hydraulic valve tappet guide. • Improper valve-to-valve seat contact. • Damaged cylinder head gasket. • Malfunctioning or damaged fuel system. • Malfunctioning or damaged ignition system.	• REPLACE hydraulic valve tappet. • REPLACE hydraulic valve tappet guide. • REPLACE valve and/or valve seat. • REPLACE cylinder head gasket. • REFER to section on Fuel System. • REFER to section on Ignition System.
• Abnormal Combustion	• Damaged hydraulic valve tappet. • Damaged hydraulic valve tappet bore. • Burnt or sticking valve. • Weak or broken valve spring. • Carbon accumulation in combustion chamber. • Malfunctioning or damaged fuel system. • Malfunctioning or damaged ignition system.	• REPLACE hydraulic valve tappet. • REPLACE cylinder block. • SERVICE or REPLACE valve. • REPLACE valve spring. • ELIMINATE carbon buildup. • REFER to section on Fuel System. • REFER to section on Ignition System.
• Excessive Oil Consumption	• Worn piston ring groove. • Sticking piston ring(s). • Worn piston or cylinder. • Worn valve stem seal. • Worn valve stem or valve guide. • Leaking oil. • Worn piston rings. • Plugged PCV system.	• REPLACE piston. • SERVICE or REPLACE piston ring(s). • SERVICE and/or REPLACE piston or cylinder block. • REPLACE valve stem seal. • REPLACE valve stem and guide. • SERVICE oil leakage. • REPLACE piston rings. • SERVICE PCV System.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
• Engine Noise	• Excessive main bearing oil clearance.	• ADJUST clearance or REPLACE crankshaft main bearing.
	• Seized or heat damaged crankshaft main bearing.	• REPLACE crankshaft main bearing.
	• Excessive crankshaft end play.	• ADJUST end play or REPLACE crankshaft.
	• Excessive connecting rod bearing oil clearance.	• ADJUST clearance or REPLACE connecting rod.
	• Heat damaged connecting rod bearing.	• REPLACE connecting rod bearing.
	• Damaged connecting rod bushing.	• REPLACE connecting rod bushing.
	• Worn cylinder.	• SERVICE or REPLACE cylinder block.
	• Worn piston or piston pin.	• REPLACE piston or piston pin.
	• Damaged piston ring(s).	• REPLACE piston ring(s).
	• Bent connecting rod.	• REPLACE connecting rod.
	• Malfunctioning hydraulic valve tappet.	• REPLACE hydraulic valve tappet.
	• Excessive hydraulic valve tappet clearance.	• ADJUST clearance or REPLACE hydraulic valve tappet.
	• Broken valve spring.	• REPLACE valve spring.
	• Excessive valve guide clearance.	• SERVICE clearance or REPLACE valve guide/stem.
	• Malfunctioning or damaged cooling system.	• REFER to section on Cooling System.
	• Malfunctioning or damaged fuel system.	• REFER to section on Fuel System.
	• Leaking exhaust system.	• SERVICE exhaust leakage.
	• Improper drive belt tension.	• REFER to section on Access ry Drivebelts.
	• Malfunctioning generator bearing.	• REFER to section on Chargi :g System.
	• Loose timing belt.	• ADJUST or REPLACE timing belt.
	• Damaged timing belt tensioner.	• REPLACE timing belt tensioner.
	• Malfunctioning water pump bearing.	• REFER to section on Cooling System.
• Insuff icient Power	• Malfunctioning hydraulic valve tappet.	• REPLACE hydraulic valve tappet.
	• Damaged hydraulic valve tappet bore.	• REPLACE cylinder block.
	• Seized valve stem.	• SERVICE or REPLACE valve, valve seat and/or cylinder head.
	• Weak or broken valve spring.	• REPLACE valve spring.
	• Damaged cylinder head gasket.	• REPLACE cylinder head gasket.
	• Cracked or distorted cylinder head.	• REPLACE cylinder head.
	• Damaged, worn or sticking piston ring(s).	• SERVICE or REPLACE piston ring(s).
	• Worn or damaged piston.	• REPLACE piston.
	• Malfunctioning or damaged fuel system.	• REFER to section on Fuel System
	• Malfunctioning or damaged ignition system.	• REFER to section on Ignition System.

SERVICE PROCEDURES

Positive Crankcase Ventilation (PCV) System Closed-Type

A malfunctioning closed crankcase ventilation system may be indicated by loping or rough engine idle. Do not attempt to compensate for this idle condition by disconnecting the crankcase ventilation system and making an air bypass or idle speed adjustment. **The removal of the crankcase ventilation system from the engine will adversely affect fuel economy and engine crankcase ventilation with resultant shortening of engine life.**

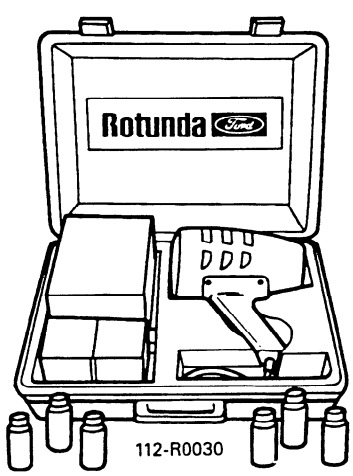
Engine Oil Leaks

NOTE: Due to their remote location, rear engine oil leaks may be very difficult to pinpoint. This area is also very difficult to clean. Make sure to eliminate all other possibilities before removing the engine to repair a suspected leak in this area.

When diagnosing engine oil leaks, it is important that the source and location of the leak be positively identified prior to service. There are two methods of diagnosing engine oil leaks. The following procedure has been found to be very effective and requires only a minimum of equipment. Prior to using this procedure, it is important to clean the cylinder block (6010), cylinder heads (6049), valve covers (6582), oil pan (6675) and flywheel housing areas with a suitable solvent to remove all traces of oil.

Fluorescent Oil Additive Method

To perform oil leak diagnosis using Rotunda Oil Leak Detector Kit 112-R0030, or equivalent, perform the following procedure.



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1. Clean engine with a suitable solvent to remove all traces of oil.
2. Drain engine oil from crankcase and refill with recommended oil, premixed with Rotunda Fluorescent Oil Additive 112-R0015, or equivalent. Use 29.6ml (1 fluid ounce) of fluorescent additive. If oil is not premixed, fluorescent additive must be added to crankcase first.
3. Run engine for 15 minutes. Stop engine and inspect all seal and gasket areas for leaks using Rotunda Oil Leak Detector Y112-R0021 (part of 112-R0030 Kit) Lamp or equivalent. A clear bright yellow or orange area will identify leak. For extremely small leaks, several hours may be required for the leak to appear.
4. If necessary, pressurize main oil gallery system to locate leaks due to improperly sealed, loose or cocked plugs. If flywheel bolts leak oil, look for sealer on threads.
5. Service all leaks as required.

Pressure Method

As an alternative testing procedure, the crankcase can be pressurized, not to exceed 27 kPa (4 psi), to locate oil leaks. The following materials are required to fabricate the tool to be used.

- Air supply and air hose.
- Air pressure gauge that registers pressure in increments of one psi.
- Air line shutoff valve.
- Appropriate fittings to attach the above parts to oil fill, PCV grommet holes and PCV fresh air hose tube.
- Appropriate plugs to seal any openings leading to crankcase.
- A solution of liquid detergent and water to be applied with a suitable type applicator such as a squirt bottle or brush.

Fabricate the air supply hose to include the air line shutoff valve and the appropriate adapter to permit the air to enter the engine through the rocker arm cover tube. Fabricate the air pressure gauge to a suitable adapter for installation on the engine at the oil fill opening.

Testing Procedure

1. **CAUTION: Use extreme caution when pressurizing crankcase. Applying air pressure above specified pressure risks damage to seals, gaskets and core plugs. Under no circumstances should pressure be allowed to exceed 27 kPa (4 psi).**

   Open air supply valve until pressure gauge maintains 20 kPa (3 psi).
2. Inspect sealed and/or gasketed areas for leaks by applying a solution of liquid detergent and water over areas for formation of bubbles, which indicates leakage.

SERVICE PROCEDURES (Continued)

Leakage Points

Examine the following areas for oil leakage.

- Rocker cover sealant or gaskets
- Intake manifold gaskets/end seals
- Cylinder head gaskets
- Oil bypass filter (6714)
- Oil level indicator (dipstick) tube connection
- Oil pressure sensor (9278)
- Cup plugs and/or pipe plugs at end of oil passages
- Oil pan gasket (6710)
- Oil pan front and rear end seals
- Crankshaft front seal (6700)
- Crankshaft rear oil seal (6701)
- Oil pump
- Crankshaft rear oil seal (6701)

Air leakage in area around a crankshaft rear oil seal (6701) does not necessarily indicate a rear seal leak. However, if no other cause can be found for oil leakage, it can be assumed that rear seal is the cause of the oil leakage.

- Rear main bearing cap parting line.
- Rear main bearing cap and seals.
- Flywheel mounting bolt holes.
- Rear cup plugs and/or pipe plugs at the end of oil passages.

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when pressurizing the crankcase.

Light foaming equally around rocker arm cover bolts and crankshaft seals is not detrimental and no corrections are required in such cases.

Compression Test

Compression Gauge Check

1. Make sure oil in crankcase is of the correct viscosity and at proper level, and battery (10655) is properly charged. Operate the engine until it is at normal operating temperature. Turn off ignition switch (11572), then remove all spark plugs (12405).
2. Set throttle plates in wide-open position.
3. Install a compression gauge such as Rotunda Compression Tester 059-R0009, or equivalent, in No. 1 cylinder.
4. Install an auxiliary starter switch in starting circuit. With ignition switch (11572) in the OFF position, and using auxiliary starter switch, crank engine at least five compression strokes and record highest reading. Note the approximate number of compression strokes required to obtain the highest reading.
5. Repeat test on each cylinder, cranking the engine approximately the same number of compression strokes.

Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is within 75 percent of the highest. Refer to the chart below.

Compression Pressure Limit Chart

Maximum psi	Minimum psi	Maximum psi	Minimum psi	Maximum psi	Minimum psi	Maximum psi	Minimum psi
134	101	164	123	194	145	224	168
136	102	166	124	196	147	226	169
138	104	168	126	198	148	228	171
140	105	170	127	200	150	230	172
142	107	172	129	202	151	232	174
144	108	174	131	204	153	234	175
146	110	176	132	206	154	236	177
148	111	178	133	208	156	238	178
150	113	180	135	210	157	240	180
152	114	182	136	212	158	242	181
154	115	184	138	214	160	244	183
156	117	186	140	216	162	246	184
158	118	188	141	218	163	248	186
160	120	190	142	220	165	250	187
162	121	192	144	222	166		