368 AND 312 CUBIC INCH DISPLACEMENT ENGINES—DIAGNOSIS AND SPECIFICATIONS

TABLE OF CONTENTS

MANIFOLD VACUUM TEST

A test of manifold vacuum is a valuable aid in determining the condition of an engine and also in helping to locate the cause of poor engine performance. To test manifold vacuum:

1. Operate the engine for a minimum of 1/2 hour at 1200 R.P.M.
2. Install an accurate, sensitive vacuum gauge on the fuel pump end of the fuel pump vacuum line.
3. Run the engine at recommended idle R.P.M.
4. Check the vacuum reading on the gauge.

Test Conclusion

Manifold vacuum is affected by carburetor adjustment, valve timing, the condition of the valves, cylinder compression, and leakage of the manifold, carburetor, or cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors is at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough so as to indicate that the trouble has been corrected. It is important, therefore, that each cause of an abnormal reading be investigated and further tests conducted where necessary in order to arrive at the correct diagnosis of the trouble.

The following table lists various types of readings and their possible causes. This table is merely a guide, however, and not a firm standard.

NOTE: Allowance should be made for the affect of altitude on the gauge reading. The engine vacuum will decrease with an increase in altitude.

MANIFOLD VACUUM GAUGE READINGS

Gauge Reading	Engine Condition
18-19 inches 368 Cu. In. Engine 19-20 inches 312 Cu. In. Engine	Normal
Low and steady	Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings.
Very low	Manifold, carburetor, or cylinder head gasket leak.
Needle fluctuates steadily as speed increases	A partial or complete loss of power in one or more cylinders caused by a leaking valve, leaking head or manifold gasket, a defect in the ignition system, a weak valve spring.
Gradual drop in reading at engine idle	Restriction in the exhaust system.
Intermittent fluctuation	An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve.
Slow fluctuation or drifting of the needle	Improper idle mixture adjustment, carburetor or manifold gasket leak, or possibly late valve timing.

ENGINE COMPRESSION TEST

The compression test is made to determine the sealing condition of engine parts exposed to combustion pressure. This test should be performed during an engine tune-up or whenever engine performance or oil and fuel consumption complaints cannot be traced to other causes.

Before making a compression test; check oil level in crankcase; be sure that engine temperature is normal; check battery and starter to make certain they are in good condition to provide normal cranking speed for the duration of test.

NOTE: At altitudes above sea level, normal compression will be less than specified.

1. Operate engine until normal operating temperature is reached (approximately 1/2 hour at 1200 R.P.M.).
2. Turn ignition switch off. Remove spark plug wires and loosen all spark plugs one turn.
3. Reconnect spark plug wires. Start engine and operate it at approximately 1,000 R.P.M. for a few seconds to blow out any loose carbon particles or dirt.
   NOTE: This step is necessary to prevent loose carbon or dirt particles from lodging on valve seats during spark plug removal. Erroneous compression test readings would result from dirt or carbon on valve seats.
4. Remove all spark plugs and set throttle (primary throttle plates only) and choke to wide open position for the test.
5. Connect a "jumper" wire from the distributor primary terminal to a good engine ground. Connect a temporary starter switch from the large battery terminal of the starter to the "S" terminal on the solenoid.
6. Install pressure gauge fitting on pressure gauge.
7. Insert pressure gauge fitting in No. 1 spark plug hole; crank engine for at least four compression strokes. Note the readings of the first four strokes.
8. Repeat steps 5 through 7 on remaining seven cylinders.

Test Conclusions

1. The specified compression pressures are 170 P.S.I. for the 312 Cu. In. Engine and 160 P.S.I. for the 368 Cu. In. Engine. A variation of ±10 P.S.I. from specified pressure is satisfactory. However, the compression pressure of all cylinders should be uniform within 10 P.S.I. to maintain power balance and reduce vibration.
2. A reading of more than 10 P.S.I. above normal indicates excessive deposits in the cylinder.
3. A reading of more than 10 P.S.I. below normal indicates leakage at the cylinder head gasket, rings or valves.
4. A low even compression pressure reading below normal in two adjacent cylinders may indicate a head gasket leak. Proper torquing of the cylinder head bolts may correct the condition. This should be checked before condemning the piston rings or valves.
5. To determine whether the rings or valves are at fault, squirt the equivalent of a tablespoonful of heavy engine oil into the combustion chamber. Crank the engine several times to distribute the oil. Repeat the compression test. The oil will temporarily seal leakage past the piston rings. If approximately the same reading is obtained, the rings are satisfactory. If the compression pressure increased 10 P.S.I. or more over the original reading, there is leakage past the piston rings.
6. The first complete compression stroke of the test should give an indicated pressure gauge reading of approximately 90 to 100 P.S.I. A lower pressure indicates burnt or sticking valves.
7. During a compression test, if the pressure fails to climb steadily and remains the same during the entire test, it indicates a sticking or stuck valve and/or camshaft failure.

ENGINE TUNE-UP

Engine tune-up is a systematic procedure for testing and correcting various engine components to restore power, efficiency and performance that has been lost due to wear, corrosion, deterioration, or maladjustments.

It is seldom advisable to attempt an improvement in engine performance by correction of one or two items only. During normal engine operation, changes in the various component parts take place gradually thereby reducing their efficiency below recommended specifications. Lasting engine efficiency and performance is assured by following definite and thorough testing procedures to correct or prevent engine malfunction.

The following tune-up procedure lists the various operations in the sequence in which they should be performed. For information in greater detail, refer to the section of the manual which describes the procedure to be followed for each respective operation.

Test Compression

1. Operate engine until normal operating temperature is reached (1200 R.P.M. for 30 minutes). Loosen spark plugs and start engine to blow out loose carbon. (Loose carbon could keep a valve off its seat and give false compression readings.)
2. Remove the spark plugs and test compression.
   a. Compression pressure should be within plus or minus ten pounds of specification. First stroke pressure should immediately come up to 90-100 P.S.I.
   b. Lower pressure indicates leaking valves or worn rings.

c. Low pressure in two adjacent cylinders may be caused by a leaking head gasket. If this is the case, proper torquing of the cylinder head bolts may correct the condition. Replace head gasket if necessary.
d. Excessive carbon deposits cause pressures above normal.

Spark Plugs

1. If the plugs are to be re-used:
   a. Use solvent to clean porcelain. Dirt provides a short cut for current flow.
   b. Sandblast to remove fouling deposits.
   c. File the center electrode. This will remove the glaze and give a flat surface.
   d. Set the gap, using a round wire gauge.
   e. Test before installing. Make sure the plug will perform under pressure.
   NOTE: BE SURE TO:
   Check gap on new plugs.
   Clean the plug seats in the cylinder head.
   Tighten the plugs to 15-20 lbs. ft. torque.

Check the Battery

1. Charge the battery according to recommended procedure if the specific gravity reading is below 1.225.
2. Clean battery top with a solution of baking soda in water. Rinse with clear water and dry.
3. Clean terminals and coat with petroleum jelly.
4. Check for plugged vents and cracked case.

Check the Charging System

1. Inspect the generator for worn, burned or greasy commutator, high mica or thrown solder. Tighten connections and check for frayed insulation.
2. Inspect the generator regulator and starter relay for loose mounting and loose connections.
3. Make any corrections necessary. A faulty charging system will not give the peak voltage required in today's engines.

Check Drive Belts

1. Inspect the generator, power steering and air conditioning belt for wear or oil soaking. Replace if necessary. Adjust to proper deflection (1/2 inch).

Check the Ignition System and Distributor Point Resistance

1. Tighten all connections and check for firm seating of all high tension terminals.
2. Check for frayed or broken wiring harness and for dirty distributor points.
3. Inspect primary wire in distributor housing for frayed insulation or poor connection at terminal lug. Check distributor primary resistance. If point resistance is high, remove oxidation with a fine stone or a point file and recheck. Excessively pitted or burned points should always be replaced.
   NOTE: Distributor point pitting will occur to some extent even with all ignition components standard. However, excessive pitting at relatively low mileage may be caused by distributor condenser. Check condenser and replace if necessary. Lubricate the distributor before replacing the cap.

Inspect the Carburetor and Fuel Pump

1. Inspect and adjust the throttle linkage, check the operation of the choke unloader and see that there is no sticking or binding. Check for proper setting of the choke if hard starting is reported.
2. Clean fuel pump bowl and inlet screen. Use a new gasket upon reassembling.
3. Check for fuel leaks.
4. Check all rubber connectors in the vacuum lines for brittleness and cracking.
5. If performance complaints exist, test fuel pump pressure and volume. Low volume may starve the engine for fuel at high speeds.
6. Make sure the EXHAUST CONTROL VALVE works freely. Check the spring tension. If the exhaust control valve is stuck open, the engine will be slow to warm up; if stuck closed, overheating and engine damage can result.

Check the Cooling System

1. Inspect all hoses for leaks, cracking and oil soaking. Tighten all clamps, then check for leaks with a pressure tester. Test the pressure cap for proper opening and closing.
2. Clean and service the air cleaner in accordance with instructions pertaining to particular type and clean oil filler cap. Disassemble the road draft tube and clean the filter.
3. Start the engine for warm-up. This period should also be utilized to check the operation of all lights and signals, horns, instruments, windshield wipers and washers, as well as brake and clutch pedal travel.
   NOTE: These checks take but little time and are a genuine service to the customer inasmuch as he can order any additional work to be performed at the same time as his tune-up, saving him an additional tie-up of his car.
4. When the temperature has stabilized, the following tests may be performed:

Cranking Voltage Test

With the engine at normal operating temperature, start the test of the engine electrical and ignition systems with a CRANKING VOLTAGE TEST.

1. With transmission in neutral, set parking brake and crank engine with starter for 15 seconds. Battery, starter, cables, switch and ignition circuit to coil are SATISFACTORY if voltage is 9.6 or more and cranking speed is normal.
2. If the meter reading is below 9.6 volts, check for a weak battery, defective cable connections, switch or starter or defective ignition circuit to the coil.
3. If the cranking speed is below 150 R.P.M., check for excessive resistance in the cables or starting motor or excessive mechanical drag in the engine. Uneven cranking speed may be caused by uneven compression, defective starter or starter drive.

Dwell Test

1. With the dwell meter lobe selector on the 8 lobe position, start engine and check for dwell reading of 26 to 28½ degrees at idle. Slowly increase engine speed to 1500 R.P.M. (turn switch to 5000 R.P.M. position momentarily). Dwell should change no more than 3 degrees from the reading at idle. Check again at idle.
2. If dwell change exceeds 3 degrees, check for worn distributor shaft, bushings and breaker plate or improper breaker point spring tension. If dwell at idle is outside the specification, check for incorrect point gap, misaligned points, worn point rubbing block or worn distributor cam.

Adjust Initial Ignition Timing and Test Advance

1. Disconnect distributor vacuum advance line and close outlet fitting with tape or set engine speed to obtain a manometer reading of "0" inches.
2. Connect timing light.
   NOTE: The timing marks are located on the crankshaft damper. Do not puncture spark plug nipple to connect timing light.
3. Advance engine speed and check total advance reading.
   a. If the total advance readings are not within the specified range of R.P.M. or VACUUM, the advance mechanism is faulty and should be corrected.
   b. If the position of the timing mark is not steady during either the timing or advance test, check for misaligned breaker points, incorrect breaker point spring tension, worn or loose breaker plate, worn distributor shaft or bushing.

   NOTE: Do not exceed 2500 engine R.P.M. during the tests.

Secondary Resistance and Polarity Test

1. Touch black lead of tester to each spark plug in turn and observe readings on the meter.
   NOTE: If meter reads off scale to the left with the red test clip grounded, the primary wire connections at the coil should be reversed.
   a. If all readings are lower than normal, check for a corroded coil tower terminal, poorly connected or broken coil wire, center cap electrode burned, burned rotor tip or open secondary in the coil.
   b. If one or more readings are lower than normal, check for broken or poorly connected spark plug wires, burned or corroded cap terminals or gouged electrodes inside cap.
   c. If the readings are higher than average from two or more plugs, check for cross fire in distributor cap or between spark plug cables concerned.

Secondary Efficiency Test

1. If all the readings are in the GOOD band, we know that both the ignition output and secondary insulation are good. If all the readings are low, or if the ignition test calibrator cannot be adjusted for SET LINE inspect for high resistance in the primary circuit, defective distributor points, defective coil or condenser, coil tower wire, rotor or distributor cap.
   If low readings are obtained only when certain plug wires are lifted off, inspect for defective insulation on those wires or for cracks or carbon tracks in the distributor cap.

Charging Voltage Test

1. Voltage should be between 14.6 and 15.4 for the 12 volt system.
   a. If the voltage is within the proper range and no electrical troubles have been reported, the charging system and voltage regulator are operating satisfactorily.
   b. If the charge voltage is BELOW the specified range, make additional checks for a defective generator or generator drive, defective or misadjusted voltage regulator or high resistance in the circuits.
   c. If the charging voltage is ABOVE the specified range, check for a defective or misadjusted voltage regulator or a defective field circuit.

   NOTE: This is not a complete charging circuit

test, but only an indication of charging voltage. If electrical troubles are reported, a complete check should be performed. Use the regulator temperature gauge when checking or adjusting generator regulator.

Idle Speed and Mixture Adjustments

Timing, idle speed and idle mixture are all interrelated and any change in one may affect the others. Smoothest idle is usually obtained with the mixture adjusting screws backed out between one and two turns from lightly seated position. After final adjustment, screws should be within one-quarter turn of each other. Adjustment of fast idle speed and dashpot setting should be made last.

Diagnosis

Make a stall test on automatic transmission equipped cars as an aid in determining engine and transmission performance and efficiency. The stall speed R.P.M. should be within the limits as follows:

1620-1820—312 cu. in. engine

1820-2020—368 cu. in. engine

A stall speed below specifications is indicative of sub-standard engine performance or a stator that is turning. A stall speed in excess of specifications indicates band or clutch slippage in the automatic transmission.

Other possible causes of improper vehicle operation are listed in the steps which follow. Inasmuch as most of these items are not completely tested during the standard tune-up procedure, the dynamometer or road test is necessary after a tune-up is performed to provide a basis for final approval. Engine performance should be observed at idle, low speed, high speed and during acceleration. Check for missing, stalling, surging or flat spots on acceleration.

NOTE: After the operational test described above, inspect engine, transmission and rear axle for oil or water leaks.

IGNITION SYSTEM

1. Recheck the ignition system for loose connections or poor grounds. Be sure to check the ignition resistor if the engine starts but stops as soon as the key is released from the start position. A resistor with too high a resistance will decrease coil output. A resistor with too low resistance has a tendency to burn distributor breaker points.

FUEL SYSTEM

1. Carburetor float level improperly adjusted or leaking intake needle.
2. Dirt or corrosion in carburetor fuel or air passages.
3. Fuel pump pressure and capacity out of specifications.
4. Carburetor accelerating pump improperly adjusted or leaking.

ENGINE COMPONENTS

1. Sticking valves due to varnish deposits, carbon or warped valve.
2. Weak or broken valve spring.
3. Cracked or burned valve.
4. Improperly adjusted valve tappets.
5. Sticking rocker arms.
6. Valve tappet stuck in block.
7. Bent or worn push rod.

MISCELLANEOUS CAUSES

1. Pre-ignition due to combustion chamber deposits.
2. Restriction in tail pipe or muffler.
3. Incorrect valve timing.
4. Worn or binding throttle linkage.
5. Manifold heat tube cracked or broken.

ENGINE ROUGH ON IDLE

An engine may perform well at HIGH speed and LOW speed driving, but will idle rough or even miss on one or more cylinders when permitted to idle a normal short period. This condition may be due to:

1. Spark plug has incorrect heat range.
2. Leak in intake manifold, gasket, crack, etc.
3. Varnish or carbon deposit around carburetor throttle plates and body.
4. Leak in floats causing flooding condition.
5. Idle jets clogged.
6. Worn or bent idle adjusting screw.
7. Improperly adjusted, sticking or poorly seated engine valve.
8. Secondary plates not fully closed.
9. Leaking or defective power valve.

ENGINE STALLS ON IDLE

Correct engine idle speed is important to assure good engine idle operation. An engine that idles slower than standard specifications will contribute to stalling. Check the following:

1. Flooding of carburetor.
2. Clogged choke passage in choke housing.
3. Cracked heat tube in manifold. (Indicated by choke piston excessively carboned.)
4. Leaking or defective power valve.

ENGINE SURGES OR CUTS OUT

At times a surge or cut-out of the engine may be noticeable. This is usually noticed when the accelerator

is held in a steady position.
Surging or cutting out can be due to:
1. Plugged fuel line.
2. Plugged gas tank vent.
3. Air leak at fuel pump bowl gasket.
4. Leak in fuel line between gas tank and fuel pump.
5. Lean carburetor adjustments.
6. Leaking or defective power valve.

POOR ACCELERATION

Performance (acceleration) is dependent on the proper amount of fuel to satisfy the engine's demand when the throttle is opened rapidly. Also, the correct heat must be applied to the manifold. Poor acceleration can be caused by:
1. Incorrect setting of the accelerator pump.
2. Worn throttle linkage or carburetor linkage.
3. Heat valve sticking.
4. Clogged heat passage in choke housing.
5. Heat tube in manifold cracked or broken.
6. Improperly calibrated or inoperative distributor advance.
7. Defective power valve.

TUNE-UP SPECIFICATIONS

312 Cu. In. Engine

CENTRIFUGAL ADVANCE

Distributor R.P.M.	Vacuum Inches Hg.	Distr. Advance Degrees
*400	0	0
*450	0	1/2-1½
*550	0	3-4
**850	0	5-6
**1325	0	8-9
**2000	0	12-13

VACUUM ADVANCE

	+ 5	0-1
	+10	5-7
	+15	11-13
	+20	11-13

368 Cu. In. Engine

CENTRIFUGAL ADVANCE

Distributor R.P.M.	Vacuum Inches Hg.	Distr. Advance Degrees	
		Early Production	Late Production (With Modified Weight Springs)
*300	0	0-1/2	0-1/2
*400	0	1½-2½	—
*500	0	4-5	3-4
**875	0	6-7	7-8
**1325	0	8-9½	9-10
**2000	0	12-13	12-13

VACUUM ADVANCE

	Early Production	Late Production (With Modified Diaphragm)
— 5	0-1	0-1/2
—10	4-6	1-3
—13	7-9	4-6
—20	7-9	4-6

—During Test, Distributor R.P.M. must be Maintained Constant

	312 CU. IN. ENGINE	368 CU. IN. ENGINE
Spark Plug Gap	.032"-.036"	.032"-.036"
Torque (Lbs. Ft.)	15-20	15-20
Distributor Point Gap	.014"-.016"	.014"-.016"
Dwell Angle	26°-28½°	26°-28½°
Breaker Arm Tension (Oz.)	17-20	17-20
Condenser Capacity (Mfds.)	.21-.25	.21-.25
Ignition Resistor (Ohms @ 75 F.)	1.30-1.40	1.30-1.40
Ignition Timing (BTDC)		
Standard or Overdrive	3° (6° Max.)	
Merc-O-Matic	6°	5° (8° Max.)
Fan Belt or Belts — Adj.	1/2" Defl.	1/2" Defl.
Starting Motor Cranking Speed R.P.M.	150-180	150-180
Engine Idle		
Standard or Overdrive	475-500	
Merc-O-Matic	425-450 in "D"	425-450 in "D"
Compression Ratio	9.75:1	9.75:1
Compression Pressure (P.S.I.)	170	160
Fuel Pump Pressure	4.0-6.5 P.S.I. @ 500 R.P.M.	4.5-6.5 P.S.I. @ 500 R.P.M.
Fuel Pump Volume	1 Pt. in 20 Sec. @ 500 R.P.M.	1 Pt. in 20 Sec. @ 500 R.P.M.
Dashpot Adjustment		
Carter Carb.	7/16"	
Holley Carb.	.045"-.064"	.067"
Power Valve Vacuum		
Primary	8"-9" Hg.	
Secondary (Except Carter)	10"-11"	

*Primary Spring Tension Adjustment
**Secondary Spring Tension Adjustment

ENGINE SPECIFICATIONS

NOTE: All specifications are given in inches unless otherwise noted.

GENERAL SPECIFICATIONS	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
Cylinder and Valve Arrangement	8 Cylinder 90° "V" O.H.V.	8 Cylinder 90° "V" O.H.V.
Firing Order	15486372	15486372
Bore and Stroke – inches	3.80 x 3.44	4.00 x 3.66
Piston Displacement (Cubic Inch)	312	368
Horsepower – Taxable – SAE	46.00	51.2
Compression Ratio (Standard)	9.75:1	9.75:1
Engine Fuel Requirements	Premium	Premium
Compression Pressure ± 10 P.S.I. – Sea Level. (Allowable Tolerance between cylinders – 10 P.S.I.)	170	160
Engine Idle R.P.M.:		
Transmission in Neutral	475-500	475-500
Automatic Transmission (Drive Range)	425-450	425-450
Engine Idle Manifold Vacuum: @ Specified Neutral Idle R.P.M.	19-20	18-19
Ignition Timing B.T.D.C.:		
Standard and Overdrive Transmission	3°	
Standard and Overdrive Transmission (Maximum)	6°	
Automatic Transmission	6°	5°
Automatic Transmission (Maximum)	6°	8°
Engine Oil:		
Capacity – Quarts (Add one additional quart when changing filter.)	5	5
Pressure @ 2000 R.P.M. (HOT)	45-50	45-50
Minimum A.P.I. Classification Lubricating Oils	MS	MS
Viscosity @ Specified Temperatures		
SAE 20-20W	Above +32° F	Above +32° F
SAE 10-10W	+32° F to −10° F	+32° F to −10° F
SAE 5W	Below −10° F	Below −10° F
Change – Normal Operation – Miles	1st at 1000, 2nd at 4000, and Each 4000, or 4 Months Thereafter.	1st at 1000, 2nd at 4000, and Each 4000, or 4 Months Thereafter.
Filter Change – Normal Operation – Miles	1st at 1000, 2nd at 4000, and Each 4000 Thereafter.	1st at 1000, 2nd at 4000, and Each 4000 Thereafter.
Clean Engine Crankcase Ventilating System Normal Operation – Miles	4000	4000
Cooling System		
Less Heater	20 qts.	23 qts.
With Heater	21 qts.	24 qts.

ENGINE SPECIFICATIONS—(continued)

	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
CYLINDER BLOCK		
Bore Diameter – Standard Bore:		
Minimum	3.8000	4.0000
Maximum	3.8024	4.0024
Bore:		
Out of Round Maximum (New Bore)	0.0005	0.0005
Out of Round – Wear Limit	0.005	0.005
Taper Maximum (New Bore)	0.001	0.001
Taper Maximum – Wear Limit	0.008	0.008
Main Bearing Bore:		
Diameter – Color Coded		
Red	2.8160-2.8164	2.8160-2.8164
Blue	2.8164-2.8168	2.8164-2.8168
Thrust Bearing:		
Face Runout T.I.R. – Maximum	0.001	0.001
Cam Bearing Bore:		
Diameter – All Journals	2.0575-2.0585	2.2495-2.2505
Tappet Bore:		
Diameter	0.500-0.501	0.875-0.876
Crankshaft to Rear Face of Block Runout:		
T.I.R. – Maximum	0.005	0.005
Crankshaft to Rear Face of Flywheel Housing		
T.I.R. – Maximum	0.012	
Head Gasket Surface:		
Flatness	0.002 in any 6" or 0.004 overall	0.002 in any 6" or 0.004 overall
Valve Guide Bore:		
Intake – Diameter Standard	0.3433-0.3440	0.3433-0.3440
Exhaust – Diameter Standard	0.3433-0.3440	0.3433-0.3440
Valve Seat:		
Intake – Width	0.060-0.080	0.060-0.080
Exhaust – Width	0.070-0.090	0.070-0.090
Intake and Exhaust – Angle	45°	45°
Runout T.I.R. – Maximum	0.002	0.002
Runout T.I.R. – Wear Limit	0.0025	0.0025
CRANKSHAFT AND CRANKSHAFT BEARINGS		
Main Bearing Journal:		
Diameter – Color Coded:		
Red	2.6239-2.6243	2.6239-2.6243
Blue	2.6235-2.6239	2.6235-2.6239
Runout:		
Maximum – T.I.R.	0.001	0.001
Wear Limit	0.003	0.003
Out of Round:		
Maximum	0.00025	0.00025
Wear Limit	0.0005	0.0005
Thrust Face Runout T.I.R. – Maximum	0.001	0.001
Main and Rod Bearing Journal:		
Taper – Maximum	0.0005	0.0005
Taper – Wear Limit	0.001	0.001

	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
Connecting Rod Journal:		
Diameter – Color Coded		
Red	2.1884-2.1888	2.2486-2.2490
Blue	2.1880-2.1884	2.2482-2.2486
Rod Journal:		
Out of Round – Maximum	0.00025	0.00025
Out of Round – Wear Limit	0.0005	0.0005
End Play:		
Free	0.002-0.006	0.004-0.008
Wear Limit	0.010	0.012
Flywheel:		
Contact Face Runout T.I.R. – Maximum	0.002	0.002
Assembled Flywheel:		
Clutch Face Runout T.I.R. – Maximum	0.010	
Crankshaft Main Bearing (Copper Lead):		
To Crankshaft Actual Clearance	0.0008-0.0026	0.0008-0.0026
To Crankshaft Actual Clearance – Wear Limit	0.0036	0.0036
Wall Thickness – Color Coded:		
Red	0.0951-0.0956	0.0951-0.0956
Blue	0.0955-0.0960	0.0955-0.0960
PISTON		
Diameter Standard – 2 Grades Available for Service (Piston Diameter Measured at Bottom of Skirt):		
Grade No. 2	3.7987-3.7990	3.9988-3.9991
Grade No. 6	3.7999-3.8002	4.0000-4.0003
To Cylinder Bore Clearance:		
Selective Fit	0.0012-0.0018	0.0012-0.0018
Wear Limit	0.0045	0.0045
Ring Groove Width – Compression:		
Upper	0.080-0.081	0.0795-0.0805
Lower	0.095-0.096	0.0945-0.0955
Oil	0.1880-0.1890	0.1880-0.1890
Ribbon Pull:		
New Piston in New Bore – 0.002 x 0.5 Gage	5-10 lbs.	5-10 lbs.
New Piston in Used Bore – 0.0025 x 0.5 Gage	5-10 lbs.	5-10 lbs.
Used Piston in New Bore – 0.003 x 0.5 Gage	5-10 lbs.	5-10 lbs.
Used Piston in Used Bore – 0.003 x 0.5 Gage	5-10 lbs.	5-10 lbs.
PISTON PIN		
Diameter:		
Standard – Color Coded Green	0.9120-0.9123	0.9120-0.9123
0.001 Oversize – Color Coded Blue	0.9130-0.9133	0.9130-0.9133
0.002 Oversize – Color Coded Yellow	0.9140-0.9143	0.9140-0.9143
Length:	3.016-3.030	3.162-3.176
To Piston Clearance:		
Loose	0.0001-0.0003	0.0001-0.0003
Wear Limit (Loose)	0.0008	0.0008

ENGINE SPECIFICATIONS – (continued)

	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
To Connecting Rod Bushing Clearance:		
Loose	0.0001-0.0003	0.0002-0.0004
Wear Limit (Loose)	0.0008	0.0008
PISTON RINGS		
Compression Ring:		
Width:		
Upper	0.0775-0.0780	0.0775-0.0780
Lower	0.0930-0.0940	0.0925-0.0935
Side Clearance:		
Upper	0.002-0.0035	0.0015-0.003
Lower	0.001-0.003	0.001-0.003
Side Clearance – Wear Limit:		
Upper and Lower	0.006	0.006
Gap Width:		
Upper and Lower Standard Bore	0.012-0.022	0.013-0.030
Oil Ring:		
Type	Segment	Segment
Gap Width – Standard Bore Steel Rail	0.015-0.062	0.015-0.062
CAMSHAFT AND CAMSHAFT BEARING		
Journal:		
Diameter – All Journals	1.9255-1.9265	2.1240-2.1247
Runout T.I.R. – Maximum	0.005	0.005
To Bearing Clearance	0.001-0.0025	0.0011-0.0028
To Bearing Clearance – Wear Limit	0.006	0.006
Out of Round		
Maximum	0.0007	0.0007
Maximum – Wear Limit	0.001	0.001
End Play	Free Floating	Controlled by a Spring and Oil Pressure
Lobe Lift:		
Intake	0.272	0.261
Intake – Wear Limit	0.267	0.256
Lobe Lift:		
Exhaust	0.285	0.261
Exhaust – Wear Limit	0.280	0.256
Intake Tappet Lift:		
Opens – B.T.D.C.	0.015 @ 18°	0.002 @ 18°
Closes – A.T.D.C.	0.015 @ 58°	0.004 @ 72°
Opens – A.T.D.C.	0.100 @ 22°	0.100 @ 36°
Closes – A.B.D.C.	0.100 @ 18°	0.100 @ 16°
Exhaust Tappet Lift:		
Opens – B.B.D.C.	0.013 @ 66°	0.002 @ 59°
Closes – A.T.D.C.	0.016 @ 10°	0.004 @ 31°
Opens – B.B.D.C.	0.100 @ 27°	0.100 @ 5°
Closes – B.T.D.C.	0.100 @ 29°	0.100 @ 25°
Intake Valve Lash:		
Preliminary – Cold	0.020	Hydraulic
Final (Engine Running Normal Operating Temperature)	0.019	Hydraulic

	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
Exhaust Valve Lash:		
Preliminary – Cold	0.020	Hydraulic
Final (Engine Running Normal Operating Temperature)	0.019	Hydraulic
Sprocket Face Runout:		
T.I.R. Assembled – Maximum	0.010	0.010
Chain Deflection – Maximum – Inches (Measured from a Straight Line Position Outward)	0.5	0.5
Camshaft Bearing:		
Inside Diameter – All Bearings	1.9275-1.9285	2.1263-2.1268
Location in Relation to Front Face of Block Cam Bearing Bore No. 1 Bearing Only (Distance Between Face and Bearing)	0.005-0.020	0.005-0.020
EXHAUST VALVES		
Valve Stem:		
To Guide Clearance	0.0023-0.0037	0.0023-0.0037
Wear Limit	0.006	0.065
Diameter:		
Standard	.3403-0.3410	0.3403-0.3410
0.003 Oversize	0.3433-0.3440	0.3433-0.3440
0.015 Oversize	0.3553-0.3560	0.3553-0.3560
0.030 Oversize	0.3703-0.3710	0.3703-0.3710
Head Diameter	1.505-1.515	1.630-1.640
Seat Angle	45°	45°
Exhaust Valve Face Runout T.I.R.:		
Maximum	0.0015	0.0015
Wear Limit	0.002	0.002
INTAKE VALVES		
Valve Stem:		
To Guide Clearance	0.0010-0.0024	0.0010-0.0024
Wear Limit	0.004	0.0045
Diameter:		
Standard	0.3416-0.3423	0.3416-0.3423
0.003 Oversize	0.3446-0.3453	0.3446-0.3453
0.015 Oversize	0.3566-0.3573	0.3566-0.3573
0.030 Oversize	0.3716-0.3723	0.3716-0.3723
Head Diameter	1.920-1.930	2.000-2.010
Seat Angle	45°	45°
Intake Valve Face Runout T.I.R.		
Maximum	0.0015	0.0015
Wear Limit	0.002	0.002
VALVE SPRINGS		
Free Length – Approximately	2.09	2.120
Out of Square – Maximum	0.062	0.062
Pressure @ Specified Length:		
New Spring (Lbs.)	71-79 @ 1.780	67-74 @ 1.800
Used Spring – Wear Limit	64 @ 1.780	60 @ 1.800
New Spring (Lbs.)	161-177 @ 1.390	183-202 @ 1.380
Used Spring – Wear Limit	145 @ 1.390	165 @ 1.380

ENGINE SPECIFICATIONS – (continued)

	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
VALVE TAPPET		
Diameter	0.4989-0.4995	0.8740-0.8745
To Tappet Bore Clearance	0.0005-0.0021	0.0005-0.002
Wear Limit	0.0026	0.0025
Leak Down Rate in Seconds:		
New Tappets		10-45 Seconds
Wear Limit		6-45 Seconds
Plunger Travel (For Gauging Purposes)		.125
ROCKER ARM, SHAFT AND PUSHROD		
Rocker Arm Shaft Bore Diameter	0.783-0.784	0.783-0.784
Rocker Arm to Shaft Clearance	0.002-0.004	0.002-0.004
Wear Limit	0.006	0.006
Rocker Arm Shaft Diameter	0.780-.781	0.780-.781
Pushrod Runout T.I.R. – Maximum	0.020	0.020
CONNECTING ROD BEARING		
Bore Diameter – Color Coded:		
Red	2.3120-2.3124	2.4002-2.4006
Blue	2.3124-2.3128	2.4006-2.4010
Bore:		
Out of Round – Maximum	0.0004	0.0004
Length	0.871-0.873	0.9315-0.9335
Taper – Maximum	0.0004	0.0004
CONNECTING ROD		
Twist Total Difference – Maximum*	0.012	0.004
Bend Total Difference – Maximum*	0.004	0.004
*(Finished Piston Pin Bushing and Crankshaft Bearing Bore must be parallel and in the same vertical plane within the specified total difference at ends of eight (8) inches long bar measured four (4) inches of each side of Rod.)		
Side Clearance (Assembled to Crankshaft):	0.006-0.016	0.006-0.014
Wear Limit	0.019	0.017
Piston Pin Bushing		
Inside Diameter	0.9122-0.9125	0.9123-0.9126
Out of Round – Maximum	0.0003	0.0001
Taper – Maximum	0.0003	0.0001
CONNECTING ROD BEARING (COPPER LEAD)		
To Crankshaft:		
Actual Clearance	0.0008-0.0027	.0007-0.0026
Actual Clearance – Wear Limit	0.0037	0.0036
Wall Thickness – Color Coded:		
Red	0.0609-0.0614	0.0749-0.0754
Blue	0.0613-0.0618	0.0753-0.0758
OIL PUMP (ROTOR TYPE)		
Relief Valve Spring Tension		
@ Specified Length	9.8 lbs. @ 0.80 In.	7.83 lbs. @ 1.40 In.
Drive Shaft to Bearing Clearance	0.0015-0.0029	0.0015-0.0029
Relief Valve Clearance	0.002-0.004	0.002-0.004

	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
Rotor Assembly – End Clearance	0.001-0.0029	0.0015-0.0029
Drive Shaft Length Measured from Rotor to Shaft End	3.36-3.38	3.36-3.38
Outer Race to Housing Radial Clearance	0.006-0.009	0.006-0.009
WATER PUMP		
Drive Arrangement	Single Belt Drives Pump, Fan and Generator	Dual Belt Drives Pump, Fan and Generator
Pulley or Pulley Hub to Housing Face Dimension	4.480	5.340
Impeller to Housing Clearance	0.030-0.040	0.025-0.035
FAN BELT		
Belt Deflection:		
Between Fan and Crankshaft Pulley – Right Side	0.5″	0.5″
Between Crankshaft and Pump Pulley – Right Side	0.5″	0.5″
Between Generator and Pump Pulley – Right Side	0.5″	0.5″
THERMOSTAT		
Opening Temperature °F – Standard	157°-162°	158°-163°
Fully Opened °F – Standard	180°	173°
Opening Temperature °F – High	177°-182°	168°-173°
Fully Opened °F – High	200°	192°
COOLING SYSTEM CAPACITIES		
Less Heater	20 qts.	23 qts.
With Heater	21 qts.	24 qts.

ENGINE BOLT AND NUT TORQUE VALUES

APPLICATION	TORQUE – LBS. FT.		
	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)	
Main Bearing Cap Bolts	95-105	120-130	
Cylinder Head Bolts (Oiled Threads):		EAD	EAM – "FT." on Bolt Head
Initial – Cold Torque:			
Through Recommended Sequence	45-55	60-70	65-80
Second – Cold Torque:			
Through Recommended Sequence	55-65	70-80	80-95
Final – Hot Torque:			
Through Recommended Sequence	65-75	80-90	95-110
Oil Pan to Cylinder Block	12-15	12-15	
Flywheel to Crankshaft	75-85	75-85	
Exhaust Manifold to Cylinder Head	23-28	23-28	
Intake Manifold to Cylinder Head	23-28	23-28	
Oil Pump to Cylinder Block	12-15	12-15	

ENGINE BOLT AND NUT TORQUE VALUES — (continued)

APPLICATION	TORQUE — LBS. FT.	
	"ECZ" (312 Cu. In.)	"ECU" (368 Cu. In.)
Oil Pump Cover Plate	12-15	12-15
Oil Filter to Cylinder Block	Hand Tight (Snug)	Hand Tight (Snug)
Oil Filter Insert to Cylinder Block	50-70	50-70
Cylinder Front Cover	23-28 (3/8" Bolt) 12-15 (5/16" Bolt)	23-28
Water Outlet Housing	12-15	23-28
Camshaft Sprocket to Camshaft	35-45	15-18
Damper or Pulley to Crankshaft	130-145	130-145
Connecting Rod Nuts	45-50	45-50
Connecting Rod (PAL) Nut	3-3.5	3-3.5
Rocker Shaft Support to Cylinder Head	12-15	22-23
Valve Rocker Arm Adjusting Screw Self-Locking — Minimum Torque to Rotate	3	3
Valve — Rocker Arm Clearance Adjustment Screw Lock Nut	30-35	30-35
Rocker Arm Chamber Cover	2.0-2.5	2.0-2.5
Water Pump to Cylinder Block or Front Cover	12-15	23-28
Oil Pick-Up Tube to Oil Pump	10-12	10-12
Oil Pick-Up Tube to Oil Pan	28-32	28-32
Crankcase Ventilation Outlet Filter Cover to Housing	3-5	
Crankcase Ventilation Adapter to Cylinder Block	12-15	
Valve Pushrod Chamber Cover	2.0-2.5	2.0-2.5
Fuel Pump to Cylinder Block or Front Cylinder Cover	23-28	23-28

CAUTION: *In the event that any of the below limits are in disagreement with any of those listed above, the above limits prevail.*

Size (Inches)	1/4-20	1/4-28	5/16-18	5/16-24	3/8-16	3/8-24
Torque (Foot-Pounds)	6-9	6-9	12-15	15-18	23-28	30-35
Size (Inches)	7/16-14	7/16-20	1/2-13	1/2-20	9/16-18	5/8-18
Torque (Foot-Pounds)	45-50	50-60	60-70	70-80	85-95	130-145

ENGINE SPECIAL TOOLS

TOOL NO.	DESCRIPTION	368	312
6000-BA	Engine Hoisting Sling	x	x
6000-BB	Hook Assembly (one pair)		x
6000-C	Hook Assembly (one pair)	x	
6011-A	Reamer — Cylinder Ridge	x	x
6015	Replacer — Cylinder Head and Oil Filter Dowel	x	x
6015-A	Replacer — Cylinder Block Core Plug	x	
6015-G	Replacer — Cylinder Block Frt. Oil Line Plug	x	
6015-H	Replacer — Cylinder Block Oil Rear Line Plug	x	

TOOL NO.	DESCRIPTION	368	312
6015-J	Replacer – Cylinder Block Core Plug		x
6051-A	Pilot Studs – Cylinder Head & Gasket Alignment	x	
6052	Replacer – Cylinder Head Water Outlet Plug		x
6059-A	Pilot – Cylinder Front Cover	x	x
6085	Valve Guide Reamer (3 Reamers)	x	x
6085-A	Overhaul Fixture – Cylinder Heads (2 sets)	x	
6085-C	Replacer – Cylinder Head Rear Plug	x	
6085-G	Overhaul Fixture – Cylinder Head (2 sets)		x
LM-6110-A	Cleaner – Piston Groove	x	x
FLM-6110-A	Scale – Piston Pull	x	x
6135-B	Reamer – Piston Pin	x	x
6135-C	Remover – Piston Pin		x
6149-6	Expander – Piston Ring		x
6149-13	Expander – Piston Ring	x	
6150	Compressor – Piston Ring		x
6150-A	Compressor – Piston Ring	x	
6261-D	Remover & Replacer – Camshaft Bearings	x	
6261-E	Adapters – Remove & Replace – Camshaft Bearings		x
6261-F	Remover & Replacer – Camshaft Bearings		x
6266-C	Replacer – Cam Bearing Bore Plug	x	
6306-AC	Replacer – Camshaft Damper and Gear	x	x
6316-FF	Remover – Crankshaft Damper	x	
6331	Remover and Replacer – Upper Main Bearing Insert	x	x
6335	Replacer – Pilot and Pilot Studs – Rear Bearing Cap and Seal		x
6500-C	Replacer – Hydraulic Tappet Clip	x	
6500-D	Remover – Solid Tappet		x
6500-E	Tester – Hydraulic Valve Tappet – (with 6500-ME Fluid)	x	
6500-F	Remover Tappet Plunger	x	
6505-E	Checking Tool – Valve Stem to Guide Clearance	x	x
6510-F	Cleaner – Valve Stem Guide	x	x
6513-H	Compressor – Valve Spring	x	x
LM-106	Tester – Valve Spring (6513-DD)	x	x
6518-AA	Replacer – Valve Spring Retainer	x	x
6549-C	Wrench – Tappet Adjusting	x	x
6565	Gauge – Cam Lobe Lift (use with 4201-D)	x	x
6700-B	Replacer – Crankshaft Front Oil Seal	x	x
6700	Forming Tool – Crankshaft Rear Seal	x	
6701-A	Forming Tool – Crankshaft Rear Seal		x
8501-DD-23	Ring – Plastic Impeller Replacing (Use with 8501-DD or DE)	x	x
8501-DD-25	Ring – Impeller Replacing (Use with 8501-DD or DE)	x	x
8501-DF	Water Pump Kit	x	x