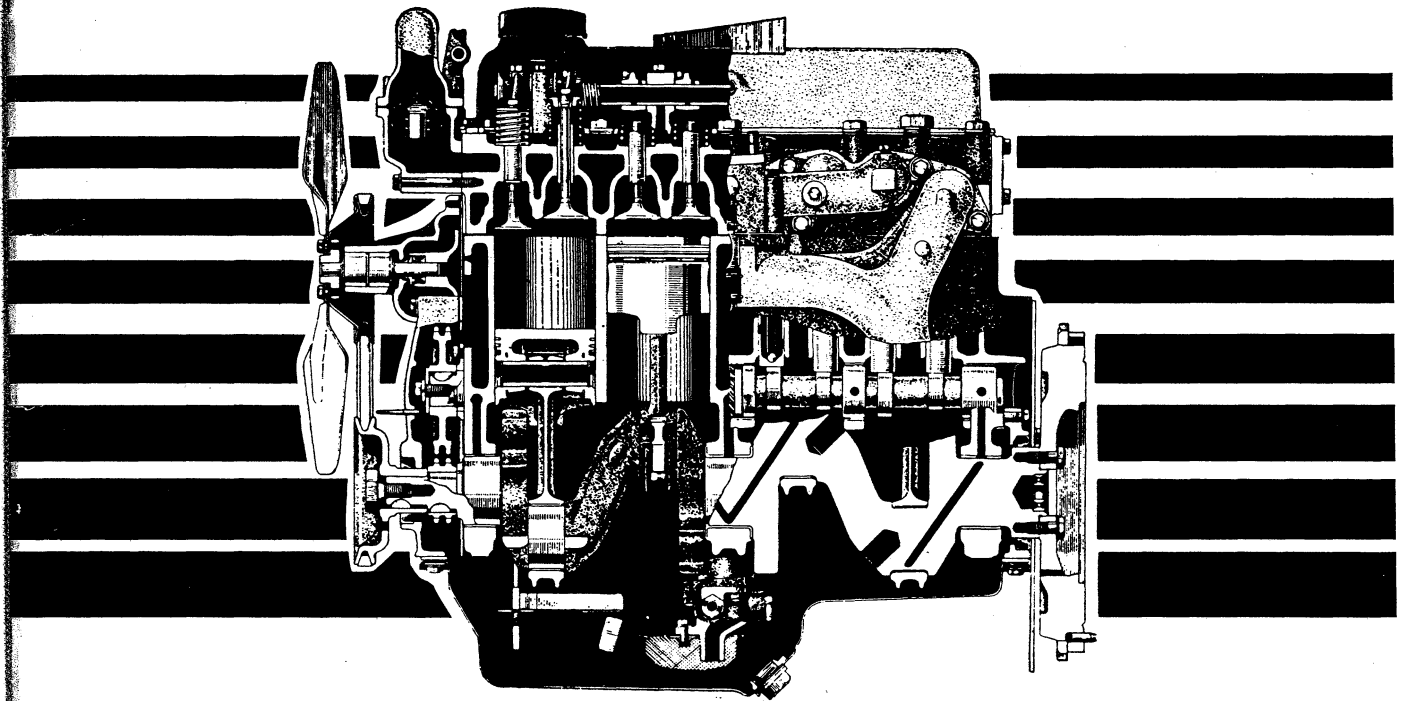


TOYOTA

3P, 4P, 5R and 4Y ENGINES



ENGINE TUNE-UP and TROUBLE SHOOTING GUIDE

March 1988

TOYOTA MOTOR SALES, U.S.A., INC.

Toyota Industrial Engine Operations, 19001 S. Western Avenue, Torrance, CA 90509, (213) 618-4000

FOREWORD

Thank you for purchasing a product powered by a Toyota Industrial Engine. You have chosen a product designed and built to deliver efficient, reliable and durable performance when given proper periodic maintenance and when used for its intended purpose.

This booklet covers trouble shooting and engine tune-up procedures on the Toyota engine and is provided to assist you in obtaining the satisfaction and performance desired. You must thoroughly read this booklet and any operator instructional, safety and maintenance manuals provided by or available from the equipment manufacturer before operating the engine or the equipment.

This booklet has been prepared with specific emphasis on trouble shooting and engine tune-up related to the engine and its accessory support systems. The information and instruction given on the accessory support systems such as cooling, air induction, exhaust, battery, instrumentation, electrical wiring, speed control devices etc. are consistent with Toyota's requirements and typical industry practice. However, since some or all of these accessory support systems are provided by the original equipment manufacturer, their prescribed instructions and procedures may differ slightly from those contained in this booklet due to their specific product characteristics. Accordingly, you must thoroughly read and understand any operator instructional, safety and maintenance manuals provided by or available from the equipment manufacturer.

SAFETY PROCEDURES

FIRE AND EXPLOSION

- A. Shut off the engine and allow it to cool. Then keep sparks, flames and other sources of ignition away and do not permit smoking in the vicinity when adding fuel, or when checking or adding electrolyte to batteries, or when checking or adding oil.
- B. Clean up spills of fuel, oil, battery electrolyte, or coolant immediately when such spills occur.
- C. Refuel at a service station or from a fuel tank designed for its intended purpose. If this is not possible, ground the engine or machine to the dispenser prior to refueling.
- D. Disconnect the grounded (negative) battery connection prior to attempting any repairs or cleaning inside the engine enclosure. Tag the battery connection so others will not unexpectedly reconnect it.
- E. Keep electrical wiring, including the battery terminals and other terminals, in good condition. Replace any wiring that has cracked, cut, abraded or otherwise degraded insulation; or terminals that are worn, discolored or corroded. Keep all terminals clean and tight.
- F. Turn off battery charger before making or breaking connections to the battery.
- G. Keep grounded conductive objects such as tools away from exposed live electrical parts such as terminals to avoid arcing which might serve as a source of ignition.
- H. Replace damaged fuel tanks or lines immediately rather than attempting to weld or otherwise repair them. Do not store or attempt to operate the engine or machine with any known leaks in the fuel system. Tag the engine or machine and render it inoperative until repairs can be made.
- I. Keep a suitable fully charged class BC or ABC fire extinguisher or extinguishers nearby when servicing and operating the engine.
- J. Open all access doors and allow the enclosure to ventilate prior to attempting to start the engine.
- K. Do not operate engine under low overhanging leaves or permit such leaves to contact hot exhaust system surfaces when operating in forested areas.
- L. Do not attempt to use ether as a starting aid in gasoline engines or diesel engines with glow plugs as serious personal injury or property damage may result.

MOVING PARTS

- A. Keep hands, arms and other parts of the body and also clothing away from belts, pulleys and other moving parts.
- B. Do not attempt to operate the engine with guards removed.
- C. Wear snug fitting clothing and confine long hair when working around the engine especially when exposed to hot or moving parts inside the enclosure.
- D. Keep engine compartment access doors closed except when making repairs or adjustments, performing servicing or when starting or stopping the engine.
- E. Make sure all personnel are out of and clear of the engine compartment prior to attempting to start or operate the engine.
- F. Shut off engine before adding fuel, oil, coolant, lubricants, or battery electrolyte.
- G. Disconnect the grounded (negative) battery connection to prevent accidental engine operation prior to attempting repair or adjustments. Tag the battery connection so others won't unexpectedly reconnect it.
- H. Make adjustments only when the engine is shut off. When necessary, make adjustment, then start engine to check adjustment. If adjustment is incorrect, shut off engine, readjust, then restart engine to recheck adjustment.
- I. Keep hands, feet, floors, controls and walking surfaces clean and free of oil, water, antifreeze or other liquids to minimize possibility of slips and falls.

HOT SURFACES, SHARP EDGES AND SHARP CORNERS

- A. Avoid bodily contact with hot oil, hot coolant, hot surfaces and sharp edges and corners.
- B. Keep all parts of the body away from hot exhaust gases.
- C. Wear personal protective equipment including gloves and head covering when working on or around the engine.
- D. Keep a first aid kit handy. Seek medical assistance promptly in case of injury. Don't ignore small cuts and burns as they may lead to infection.

TOXIC AND IRRITATING SUBSTANCES

- A. Operate the engine only in open or well ventilated areas.
- B. If the engine is operated indoors discharge engine exhaust fumes outdoors.

CONTENTS

Engine Tune-Up	1-1
Engine Oil Inspection	1-1
Collant Inspection	1-1
V-belt Inspection	1-2
Fuel Filter Inspection	1-2
Spark Plug Inspection	1-3
Distributor Inspection	1-4
Cam Dwell Angle Inspection (point type)	1-5
Resistive Cord Inspection	1-5
Ignition Timing Inspection	1-6
Valve Clearance Inspection & Adjustment	1-7
Carburetor Inspection & Adjustment	1-7
Compression Measurement	1-8
Road Test	1-9
Trouble Shooting	2-1

ENGINE TUNE-UP

DESCRIPTION

To maintain the engine always in satisfactory operating condition, and to produce its performance sufficiently, periodic engine-up required.

Also, if the engine malfunctions, diagnose the conditions, and correct properly in accordance to engine tune-up sequences.

Due to technical progress of recent engine, the compression ratio is increased, and together with the usage of numerous electrical items, parts and mechanism, correct adjustment of these parts and mechanism are of necessity.

For this reason, it is essential to perform the adjustment perfectly by utilizing the tune-up tester and other instruments for engine tune-up.

The engine tune-up procedures can be divided into visual inspection and with the testers.

As the following described inspection and adjustment procedures are related, do not complete only with one paragraph, and the tune-up result will appear finally when several paragraphs or all paragraphs are parallelly performed.

For this reason, it is of necessity to perform the procedures by considering the relation between each paragraph.

Also, when utilizing the special testers, perform the operation in accordance to the instructions furnished with these testers.

ENGINE TUNE-UP ITEMS

Inspection of engine in stalled condition

1. Inspect engine oil
2. Inspect coolant
3. Inspect V-belt
4. Inspect fuel filter
5. Inspect air cleaner element
6. Inspect battery
7. Inspect spark plugs
8. Inspect distributor
9. Inspect resistive cords

To perform the operation efficiently, inspect the following while warming the engine.

10. Inspect cam dwell angle
11. Inspect ignition timing.

Inspection after warming the engine.

12. Inspect valve clearance
13. Inspect carburetor
14. Inspect compression

If the engine still malfunctions even performing the inspection and adjustment.

15. Road test

ENGINE OIL INSPECTION

Oil quality inspection

Pull out the oil level gauge, and inspect the oil deposited on the graduation.

It is satisfactory if discoloration and deterioration are not visible. When deteriorated, the viscosity will be lost, and discoloration are extreme.

Causes of oil discoloration.

- Gray: Lead ingredient mixed (bearing particles)
- Milky: Moisture mixed
- Black: Carbon, dust and dirt mixed due to long usage

Caution:

Detergent oil will blacken rapidly, but this is normal.

Oil volume inspection & replenishment

The oil volume is satisfactory if it is up-to the F line of the level gauge.

If insufficient, replenish up-to the F line.

Caution:

- (1) Due to the inclination of the vehicle, the level gauge reading may vary, therefore, inspect in level condition.
- (2) When inspecting immediately after stopping the engine, inspect within 3 ~ 5 minutes. As the oil is accumulated in different locations and will flow out completely, the reading will not be correct because the oil pan oil volume is not to specified volume.

COOLANT INSPECTION

Cooling system inspection

It is satisfactory if following defects are not present.

1. If water drain cock does not leak due to looseness.
2. If it does not leak from water pump.

Coolant quality inspection

It is satisfactory if there is no excessive rust around the radiator cap and radiator filler neck, and if the coolant is not mixed with red rust and oil.

Caution:

If rust preventive is mixed, the coolant may look contaminated and this may be mistaken for being dirty.

V-BELT INSPECTION

Exterior visual inspection

It is satisfactory if following defects are not visible.

1. If the belt is not cracked, deteriorated, stretched or worn.

Caution:

Inspect not only the exterior, but also inspect the interior.

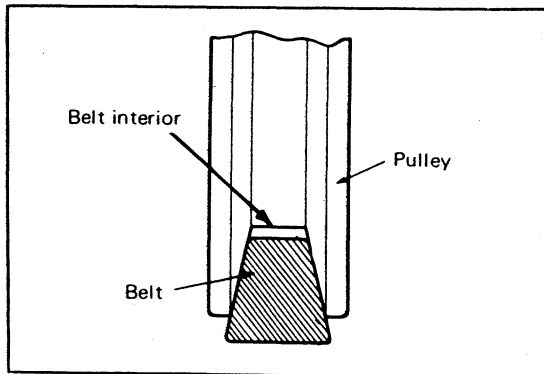


Fig. 1-1 Contacting Condition between Pulley & Belt

2. Deposit of oil
If oil is deposited, it will result slippage.
3. Contacting condition between pulleys and belt.
The belt is driven by the frictional force between the pulley side surfaces, and when it is worn and contacts the bottom surface, slippage will result due to loss of frictional force.
4. Abnormal wear will result if the pulleys centers are not in the same plane, due to twisting of the belt.

Belt tension inspection & adjustment

When the belt is pushed with the specified pressure (normally with about 10 kg (22 lb)), the belt deflection should be 8 ~ 13 mm (0.32 ~ 0.51 in.). If the belt tension is too tight, it will quicken the bearings damage, and if the tension is too loose, it will cause slippage.



Fig. 1-2 Belt Tension Inspection

FUEL FILTER INSPECTION

It is satisfactory if following defects are not visible.

1. If the filter body is not cracked or damaged.
2. As the filter is of throw-away type, replace periodically.

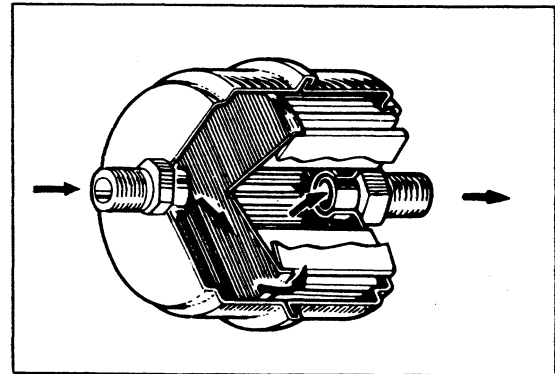


Fig. 1-3 Fuel Filter Sectional View

SPARK PLUG INSPECTION

Removal

1. When removing the spark plug, do not slant the plug wrench or slip it to prevent the plug insulator from damaging.
2. After removing the spark plug, do not forget to remove the gasket remaining on the cylinder head.
3. Be careful not to allow dirt to enter into the cylinder head from the plug hole.

Caution:

If the spark plug is tight, after removal, inspect the spark plug and cylinder head threads.

Installation

Screw in the spark plug into the cylinder head first with the fingers, and then properly tighten with the spark plug wrench.

If the inspection includes the distributor, install after inspecting and adjusting the distributor.

Visual inspection

It is satisfactory if following defects are not visible.

1. If threads and insulator are not cracked or damaged.
2. If the gas does not leak from the caulking between the insulator and plug housing.
3. If the electrodes are not worn.
4. If the gasket is not damaged.
5. Burning conditions of insulator and carbone deposited conditions.

Grayish: Engine condition is normal with correct heat range spark plug.

Whitish: Possibility of engine over-heating and air-fuel mixture too lean with low heat range spark plug.

Blackish: Air-fuel mixture too rich, intake air (dry) insufficient, self-igniting with high heat range spark plug.

Blackish: Oil present in combustion chamber (wet) due to pumping oil.

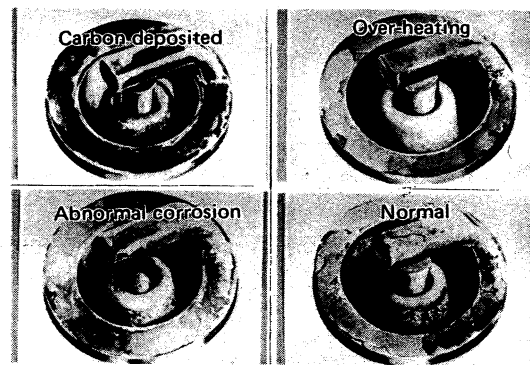


Fig. 1-4 Spark Plug Conditions

Cleaning

1. Utilize the spark plug cleaner for short period. If the plug cleaner is utilized for long period, the insulator and electrodes will be sand blasted.



Fig. 1-5 Plug Cleaning

2. Thoroughly blow off the cleaning compound and carbon deposited on the thread with compressed air.
3. Remove the dirt from the insulator surface.

Gap adjustment

Inspect the plug gap with the plug gap gauge, and adjust by bending the ground electrode if the gap is not within the specified gap.

Specified gap: 0.7 ~ 0.8 mm (0.028 ~ 0.032 in.)

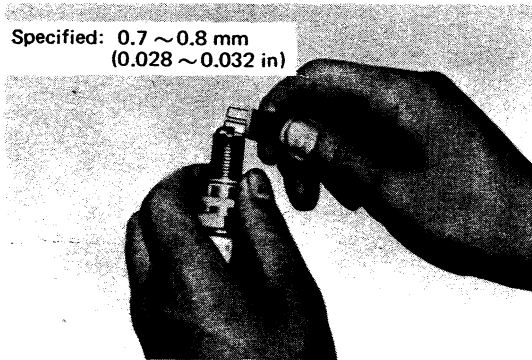


Fig. 1-6 Plug Gap Adjustment

Caution:

When replacing with a new plug, for confirmation, check the gap.

DISTRIBUTOR INSPECTOR**Distributor cap inspection**

It is satisfactory if following defects are not visible.

1. If the distributor cap and rubber caps are not cracked or damaged.
2. If spark plug cords and coil cord terminals, resistors and cap cord inserting retainers are not rusted, burnt or loosened.
3. If the segments are not burnt.
4. If center carbon is not worn or spring is not weakened.

Governor operation inspection

1. Turn the rotor clockwise, and it is satisfactory if it returns lightly when the fingers are released.

If the rotor movement is tight, the rotor will not advance, therefore, disassemble and correct.

2. It is satisfactory if there is no excessive play with the rotor. (Turn the rotor clockwise and counterclockwise to confirm the play.)

If excessive play is present, this may be due to worm cam, governor weights, spiral gear and camshaft gear which drives the distributor.

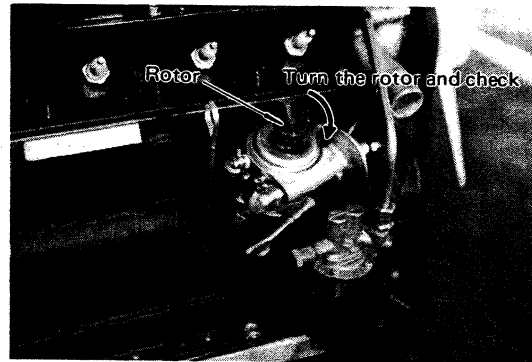


Fig. 1-7 Rotor Inspection

Rotor inspection

1. Replace if the rotor is cracked or damaged.
2. Replace if the electrode is dirty or burnt.

Point contacting surfaces inspection

It is satisfactory if the contacting surfaces are not rough, burnt, colored, and if the breaker arm lead wire, rubbing block and bushing are properly installed.

1. If roughness is slight, dress the point surfaces with an oil stone, and replace if correction is impossible.
2. If roughness is excessive, inspect the condenser.

Apply distributor grease onto the breaker arm sliding portion, rubbing block and cam.

Point gap adjustment (Point type)

1. Check whether the contact point surface alignment is proper or not.

If the alignment is defective, tighten the point securing screws, and correct by bending the contact point.

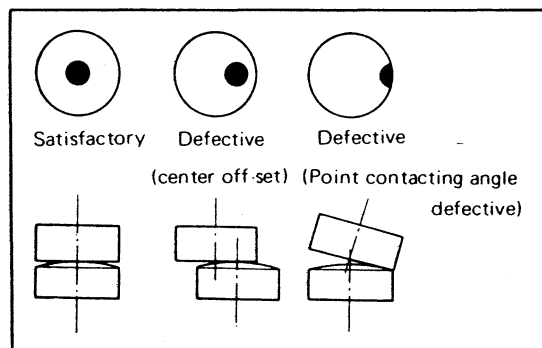


Fig. 1-8 Point Alignment

2. Crank the engine until the breaker arm rubbing block reaches the top of the cam.
3. Adjust the point gap to 0.4 ~ 0.5 mm (0.016 ~ 0.02 in.). If the points are replaced with new points, there is initial wear of the rubbing block to be considered, therefore, set the point gap at 0.5 mm (0.02 in.).

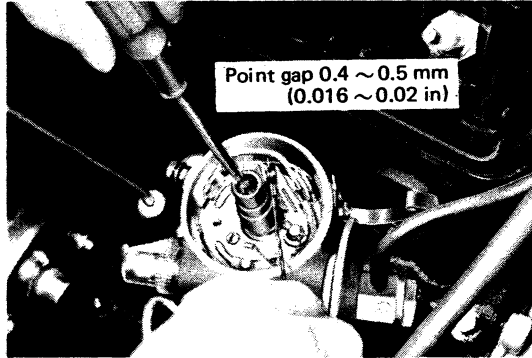


Fig. 1-9 Point Gap Inspection

- (1) If point gap is wide.

The point closing time will be shorter, and as the current flowing into the primary circuit becomes insufficient, the secondary voltage will be low, thus, the ignition spark will be weak especially at high speed.

- (2) If point gap is narrow.

As the point closing time will be too long, the ignition spark created during dwell will be too long, thus, points burning will be quicker and secondary voltage will be low.

4. Wipe the point surfaces with trichloroethylene.

As the trichloroethylene affects bakelite and painted surface, carefully handle upon usage.

Caution:

Also wipe the new point surfaces when replaced.

RESISTIVE CORD INSPECTION

Resistance inspection

Measure the resistance between both terminals of resistive cord with the circuit tester.

If the resistance exceeds the limit, replace as the cord is open-circuited.

- Limit: 25K Ω per meter
- Specified resistance: 16K Ω per meter

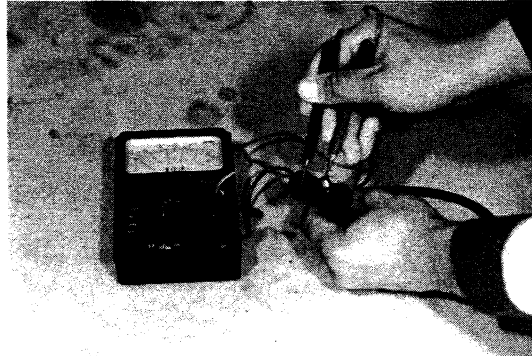


Fig. 1-10 Resistive Cord Resistance Inspection

Caution:

For measurement, connect the circuit tester prongs onto the ends of the cord, and while holding the center with the fingers, inspect the conductance.

It is normal if the indicator does not vibrate when the cord is shaken.

Installation

1. If the cord insertion is loose, install after correcting with pliers.
2. Confirm the installation of the primary wire on the distributor and ignition coil.

CAM DWELL ANGLE INSPECTION (Point type)

Caution:

Before inspection, set the engine at idle revolution.

1. The cam dwell angle inspection is to inspect whether it is within the specified value or not at low revolution.
2. Accelerate the engine from low to intermediate then to high revolution, and inspect the variation of cam dwell angle.

Adjustable range: 50 ~ 54°

- (1) If larger than specified range.

The distributor point gap is narrow.

- (2) If smaller than specified range.
The distributor point gap is wide.
- (3) If dwell angle varies.
The distributor cam is worn.
The breaker arm is defective (spring weak).

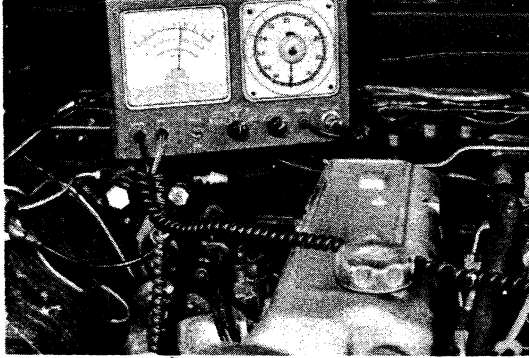


Fig. 1-11 Cam Dwell Angle Inspection

IGNITION TIMING INSPECTION

Caution:

Set the octane selector at standard position. To adjust the timing, rotate the distributor assembly, and do not perform with the octane selector.

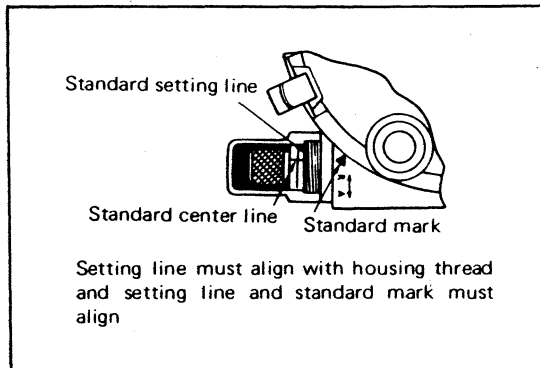


Fig. 1-12 Octane Selector Standard Position

Timing inspection

Inspect with the timing light, and it is satisfactory if the ignition timing marks align during engine idle revolution.

If the timing is incorrect, loosen the distributor clamp, and adjust by rotating the distributor assembly to counter-clockwise or clockwise direction.

If the timing pointer and timing ball or slot are misaligned in the same direction as pulley rotation, the timing is advanced, therefore, rotate the distributor clockwise.

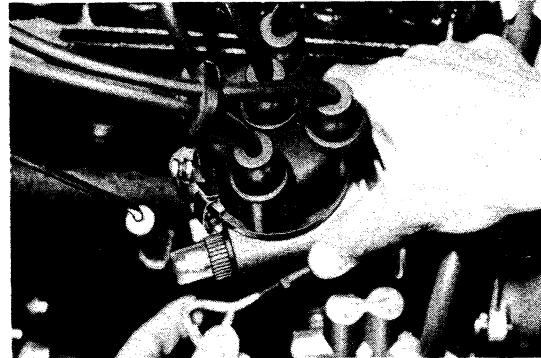


Fig. 1-13 Timing Adjustment

Advancement inspection

While observing the timing ball or slot, it is satisfactory if it advances at the same time when the engine is accelerated.

If it does not advance, the vacuum controller diaphragm is defective or vacuum pipe is clogged, therefore, inspect the governor operation.

If the timing ball or slot moves in the opposite direction of pulley rotation, the vacuum controller and governor are operating properly.

Adjustment for gasoline octane rating.

Depending on the gasoline octane rating, adjust the adequate of the ignition timing with the octane selector.

For adjustment, drive the vehicle in top speed, and accelerate from permissible low speed. Slight "ping" will be produced, and this "ping" will disappear gradually.

If the "ping" is loud, rotate toward R direction. If there is no "ping", rotate toward A direction.

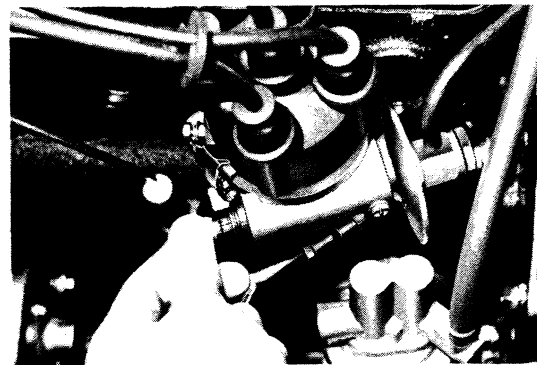


Fig. 1-14 Octane Selector Adjustment

Caution:

- (1) The timing will advance when the octane selector is turned to A direction, and will retard when turned to R direction.
- (2) The selector adjustable range is equivalent to 14 ~ 20° of crankshaft angle, and this has no relation with the vacuum advancer characteristics.

VALVE CLEARANCE INSPECTION & ADJUSTMENT

The valve clearances are required to prevent malfunction of valve timing due to over lifting of the valves from heat expansion of engine components.

Preparation

If required, tighten the following locations while hot.

- Cylinder head securing bolts
- Valve rocker supports securing bolts
- Intake manifold securing bolts

Inspection

Confirm that rocker arms and valve stems are lubricated, and it is satisfactory if the valve clearances are within the specified values with coolant temperature at 75 ~ 85°C (167 ~ 185°F) at engine idle revolution.

Valve clearances:

Intake: 0.20 mm (0.008 in.)

Exhaust: 0.36 mm (0.014 in.)

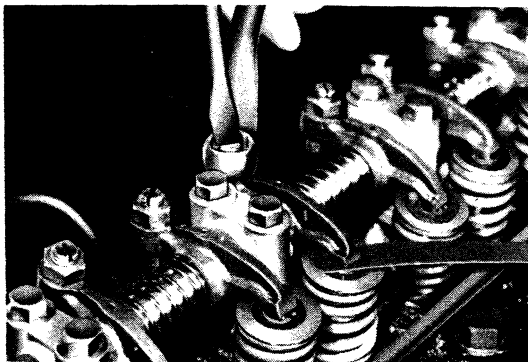


Fig. 1-15 Valve Clearance Adjustment

1. When too wide.
 - Will produce noise (will malfunction the intake and exhaust timing).
2. When too narrow.
 - Will reduce power due to over lifting of valves (will reduce compression pressure).

Caution:

- (1) Utilize specified thickness feeler gauge.
- (2) Do not utilize worn or extremely damaged gauge.
- (3) Do not force in the gauge into tight or narrow clearance.
- (4) During adjustment, carefully check so that splashed oil will not dirty the surrounding.
- (5) After inspection and adjustment, when installing the rocker arm cover, also inspect the gasket for deformation and damage.

CARBURETOR INSPECTION & ADJUSTMENT**Idle adjustment**

1. Remove the intake manifold suction hole plug, install the fitting for vacuum outlet, and connect the vacuum gauge.
2. Warm the engine until the coolant temperature reaches 75 ~ 85°C (167 ~ 185°F)
3. Connect the engine tachometer.
4. Turn the throttle adjusting screw until the engine operates smoothly at low revolution.
5. Turn the idle adjusting screw, and set at maximum vacuum reading.
6. Adjust the throttle adjusting screw and idle adjusting screw alternately with maximum vacuum reading.

Idle revolution: 650 ± 50 rpm

Idle vacuum: Over 400 mmHg (16 inHg)

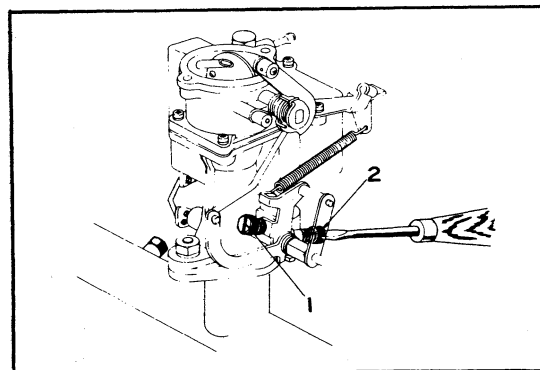


Fig. 1-16 Throttle Adjusting Screw Adjustment

Intermediate speed inspection

Gradually open the throttle valve, and inspect if the engine revolution increases smoothly in relation to valve opening angle.

Acceleration inspection

Open the throttle valve suddenly, and inspect if the engine revolution increases suddenly in relation to valve opening angle.

Accelerator pump operating condition inspection

Remove the air cleaner, stop the engine, and inspect if gasoline injects from the pump jet when the throttle valve is suddenly opened fully from fully closed position.

Choke system operating condition inspection

Confirm whether the valve opens and closes smoothly.

Install the air cleaner, disconnect the engine tachometer and vacuum gauge, and tighten the suction hole plug.

COMPRESSION MEASUREMENT

If the engine indicates power loss, excessive fuel consumption and excessive oil consumption, measure the compression if engine malfunction cannot be corrected by carburetor adjustment, ignition system adjustment and valve clearance adjustment.

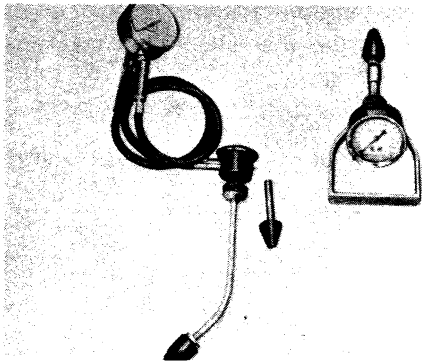


Fig. 1-17 Compression Gauges

Measurement

1. Warm the engine.
2. Remove all spark plugs.
3. Disconnect the coil cord from the ignition coil.
4. Insert the compression gauge properly into the spark plug hole.
5. Depress the accelerator pedal completely.
6. Operate the starter, and read the gauge indicator at maximum reading.

It is satisfactory if the engine rotates over 250 rpm.

Compression:

Specified pressure: 11.0 kg/cm² (156.42 psi)

Limit: 8.0 kg/cm² (113.76 psi)

Difference between cylinders:

0.7 kg/cm² (9.954 psi) or less

If the battery is discharged, required revolution cannot be obtained, therefore carefully check the battery condition.

7. Properly perform the measurement at least twice.
8. It is satisfactory when the indicator reading is at maximum value.

ROAD TEST

After completing the engine components inspection, perform this test for general inspection and for confirmation.

Meters inspection	During driving, it is satisfactory if there is no malfunction of charge, oil pressure and coolant temperature indicators.
Re-inspection of engine	During driving, it is satisfactory if there is no noise from the engine components in low, high and acceleration without loss of power.
Timing adjustment in relation to gasoline octane rating	Drive in top speed at permissible low revolution, and it is satisfactory if engine "ping" is produced at the beginning and gradually disappears when the accelerator pedal is depressed suddenly. When engine "ping" is loud: Turn the octane selector toward R direction. When there is no engine "ping": Turn the octane selector toward A direction.
Leak inspection	After driving, it is satisfactory if there is no engine oil, coolant and fuel leak.

TROUBLE SHOOTING

The following list is consolidated with the probable causes and remedies of troubles which normally encounter on the engine. If symptoms of troubles are visible, immediate remedy is of necessity before the trouble becomes serious.

LOSS OF POWER

Symptoms & Probable Causes	Remedies
<p>Insufficient Compression</p> <ol style="list-style-type: none"> 1. Valve clearances incorrect 2. Compression leaks from valve seat 3. Valve stem seized 4. Valve spring weak or broken 5. Compression leaks from cylinder head gasket 6. Piston ring seized or broken 7. Piston rings or cylinders worn 8. Valve timing adjustment incorrect 	<p>Adjust valve clearances Lap valves Replace guide bushing & valve Replace spring Replace gasket Replace piston rings Disassemble & repair engine Adjust valve timing</p>
<p>Ignition System Adjustment Incorrect</p> <ol style="list-style-type: none"> 1. Ignition timing incorrect 2. Spark plugs defective 3. Distributor points defective (point type) 4. Octane selector adjustment incorrect 	<p>Adjust ignition timing Clean, adjust or replace spark plugs Correct or replace points & inspect condenser Adjust octane selector</p>
<p>Fuel Insufficient</p> <ol style="list-style-type: none"> 1. Carburetor clogged 2. Fuel pipe clogged 3. Fuel tank dirty 4. Air enters into fuel system 5. Fuel pump performance reduced 6. Fuel filter clogged 7. Air governor adjustment incorrect 	<p>Disassemble & repair carburetor Clean pipe Clean fuel tank Inspect connections & retighten Repair or replace pump Replace fuel filter Adjust or replace air governor</p>
<p>Carburetor Intake Air Insufficient</p> <ol style="list-style-type: none"> 1. Air cleaner clogged 2. Carburetor choke valve operates constantly 	<p>Clean or replace air cleaner element Repair or replace choke mechanism</p>
<p>Overheats</p> <ol style="list-style-type: none"> 1. Coolant insufficient 2. V-belt loose 3. V-belt worn or broken 4. Thermostat performance reduced 5. Water pump performance reduced 6. Radiator clogged or water leaks 7. Ignition timing incorrect 8. Oil pump for loading broken 	<p>Replenish coolant Adjust or replace Replace belt Replace thermostat Replace water pump Clean, repair or replace radiator Adjust ignition timing Repair or replace oil pump for loading</p>

EXCESSIVE ENGINE OIL CONSUMPTION

Symptoms & Probable Causes	Remedies
<p>Oil Leaks</p> <ol style="list-style-type: none"> 1. Oil pan drain plug loose 2. Oil pan securing bolts loose 3. Oil pan gasket loose 4. Timing gear cover loose or gasket broken 5. Oil seals defective 6. Cylinder head cover gasket broken 7. Fuel pump loose or gasket broken 8. Oil filter loose 	<p>Tighten drain plug Tighten securing bolts Replace gasket Tighten securing bolts or replace gasket Replace oil seals Replace gasket Tighten securing bolts or replace gasket Tighten</p>
<p>Pumping Oil</p> <ol style="list-style-type: none"> 1. Piston ring broken 2. Piston ring gaps incorrect 3. Piston rings worn or ring groove seized 4. Carbon deposited in oil ring return holes 5. Excessive wear of pistons & cylinders 	<p>Replace rings Adjust ring gap positions Replace rings or piston Replace rings Replace piston or hone cylinders</p>
<p>Sucking Oil</p> <ol style="list-style-type: none"> 1. Valve stem oil seal or "O" ring installation defective or broken 2. Valve and guide bushing worn 	<p>Replace oil seal or "O" ring Replace valve & guide bushings</p>

STARTING DIFFICULT

Symptoms & Probable Causes	Remedies
<p>Cranking Speed Slow</p> <ol style="list-style-type: none"> 1. Engine oil viscosity too heavy 2. Battery discharged 3. Battery performance reduced 4. Battery terminal connection defective 5. Starter defective 	<p>Replace with adequate oil Charge battery Replace battery Clean terminal, retighten or replace cable Disassemble, repair or replace starter</p>
<p>Ignition System Defective</p> <ol style="list-style-type: none"> 1. Distributor points damaged (point type) 2. Point clearance incorrect (point type) 3. Spark plug gap incorrect 4. Spark plug cord loose or defective 5. Ignition coil defective 6. Primary wire connection defective 7. Condenser defective (point type) 	<p>Replace points Adjust point clearance Adjust gap Tighten spark cord, inspect or replace Replace coil Inspect & tighten connection Replace condenser</p>
<p>Engine Components</p> <ol style="list-style-type: none"> 1. Valve burnt 2. Air enters from manifold gasket 3. Pistons, piston rings & cylinders worn 4. Cylinder head gasket broken 	<p>Repair or replace valve or lap valves Tighten manifold securing bolts or replace gasket Disassemble & repair engine Replace gasket</p>
<p>Carburetor Components</p> <ol style="list-style-type: none"> 1. Choke valve operation defective 2. Idle adjustment incorrect 3. Carburetor dirty or clogged 	<p>Adjust or replace choke mechanism Adjust idle revolution Disassemble & clean carburetor</p>

Symptoms & Probable Causes	Remedies
4. Carburetor securing bolts loose 5. Over-flows	Tighten securing bolts Inspect, adjust or replace float & needle valve

ABNORMAL EXPLOSION

This states the condition when normal explosion cannot be obtained mainly due to incorrect ignition timing.

Normally the symptoms of spitting and backfire are included among these.

Symptoms & Probable Causes	Remedies
Ignition System 1. Ignition system connections loose 2. Spark plugs defective 3. Ignition timing incorrect 4. Heat range incorrect	Inspect & tighten connections Clean, adjust or replace spark plugs Adjust ignition timing Replace with correct heat range plugs
Carburetor Components 1. Carburetion lean 2. Carburetor dirty 3. Fuel tube dirty or clogged 4. Air enters from carburetor or intake manifold	Clean & adjust carburetor Clean carburetor Clean or replace fuel tube Tighten carburetor or manifold securing bolts or replace gasket
Valve Components 1. Valve clearances incorrect 2. Valve seized 3. Valve spring weak	Adjust valve clearances Disassemble, repair or replace Replace spring
Cylinder Head 1. Carbon deposited in combustion chambers 2. Cylinder head gasket blown out 3. Cylinder head water tube clogged	Remove carbon from cylinder head Replace gasket Clean or replace water tube

Trouble Shooting 2-4

IDLE INCORRECT

Symptoms & Probable Causes	Remedies
Carburetor Components 1. Idle adjustment incorrect	Adjust idle revolution
Governor Components 1. Governor adjustment incorrect	Adjust governor
Entry of Air 1. Air enters from heat insulator or intake manifold gasket	Tighten carburetor securing bolts or heat insulator or intake manifold gasket
Valve Components 1. Valve clearances incorrect 2. Valves & valve seats contact defective 3. Excessive clearance between valve stem and valve guide bushing	Adjust valve clearances Lap valves Replace valve and valve guide bushing
Cylinder Head 1. Cylinder head gasket blown out	Replace cylinder head gasket
Ignition Timing 1. Ignition timing incorrect	Adjust ignition timing

ENGINE MISSES DURING ACCELERATION

Symptoms & Probable Causes	Remedies
Carburetor 1. Carburetor acceleration system clogged 2. Intake mixture lean	Disassemble & repair carburetor Disassemble & repair carburetor
Ignition System 1. Spark plugs defective 2. Cords defective 3. Distributor points adjustment incorrect (point type) 4. Ignition coil performance reduced	Clean or replace plugs Replace cords Adjust or replace points Replace ignition coil
Engine Components 1. Valve burnt or adjustment incorrect 2. Compression pressure insufficient 3. Cylinder head gasket blown out	Adjust or replace valves Disassemble & repair engine Replace gasket

ENGINE NOISE

The engine noise is produced by the combination of the rotating and sliding components, thus, for remedy, the noise source must be diagnose.

Symptoms & Probable Causes	Remedies
<p>Crankshaft Bearings</p> <ol style="list-style-type: none"> 1. Excessive oil clearance due to wear of bearings 2. Crankshaft journals worn 3. Crankshaft bearing melted 	<p>Replace bearings & grind crankshaft Grind or replace crankshaft Replace bearings & inspect lubrication system</p>
<p>Connecting Rod & Connecting Rod Bearings</p> <ol style="list-style-type: none"> 1. Connecting rod bearings worn 2. Crankpins worn 3. Connecting rod bent 4. Connecting rod bearings melted 5. Connecting rod bushing worn 	<p>Replace bearings & grind crankshaft Grind or replace crankshaft Correct bend or replace Replace bearings & inspect lubrication system Replace bushing</p>
<p>Piston, Piston Pin & Piston Rings</p> <ol style="list-style-type: none"> 1. Excessive clearance due to worn cylinders 2. Piston or piston pin worn 3. Piston seized 4. Piston ring broken 	<p>Bore & hone cylinders & install oversize pistons Replace piston & piston pin Replace piston Replace piston rings</p>
<p>Others</p> <ol style="list-style-type: none"> 1. Excessive camshaft thrust clearance 2. Crankshaft thrust washer worn 3. Timing gears worn 4. Valve lifters worn 5. Valve clearances excessive 6. Engine oil insufficient 	<p>Replace camshaft thrust plate Replace thrust washer Replace timing gears Replace lifters Adjust valve clearance Replenish oil or disassemble & repair engine</p>