

Maintenance—Engine

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AIR CLEANER

A proper maintained air cleaner ensures that only clean, filtered air is supplied through the carburetor to the engine. If the air is supplied directly without filtering, dirt and dust from the air will clog carburetor passages causing the engine to run poorly. The dust that enters the engine will also act like grinding compound, wearing down the cylinders, pistons, and rings. If the air cleaner element is damaged, the result will be the same as if no element were used.

An air cleaner element clogged with dirt chokes the air supply to the engine, resulting in an overly rich fuel/air mixture and inefficient combustion. This in turn causes overheating from carbon build-up, and reduced engine power.

Cleaning and replacement

The air cleaner element must be cleaned periodically (Pg. 10). In extremely dry, dusty areas, the element will need to be cleaned more often. After riding through

rain or on muddy roads, the element should be cleaned immediately.

Remove the air cleaner element (Pg. 42). Clean it in a bath of a high flash-point solvent, and then dry it from the inside using compressed air. Since this is a dry-type element, do not use kerosene or any fluid which would leave the element oily.

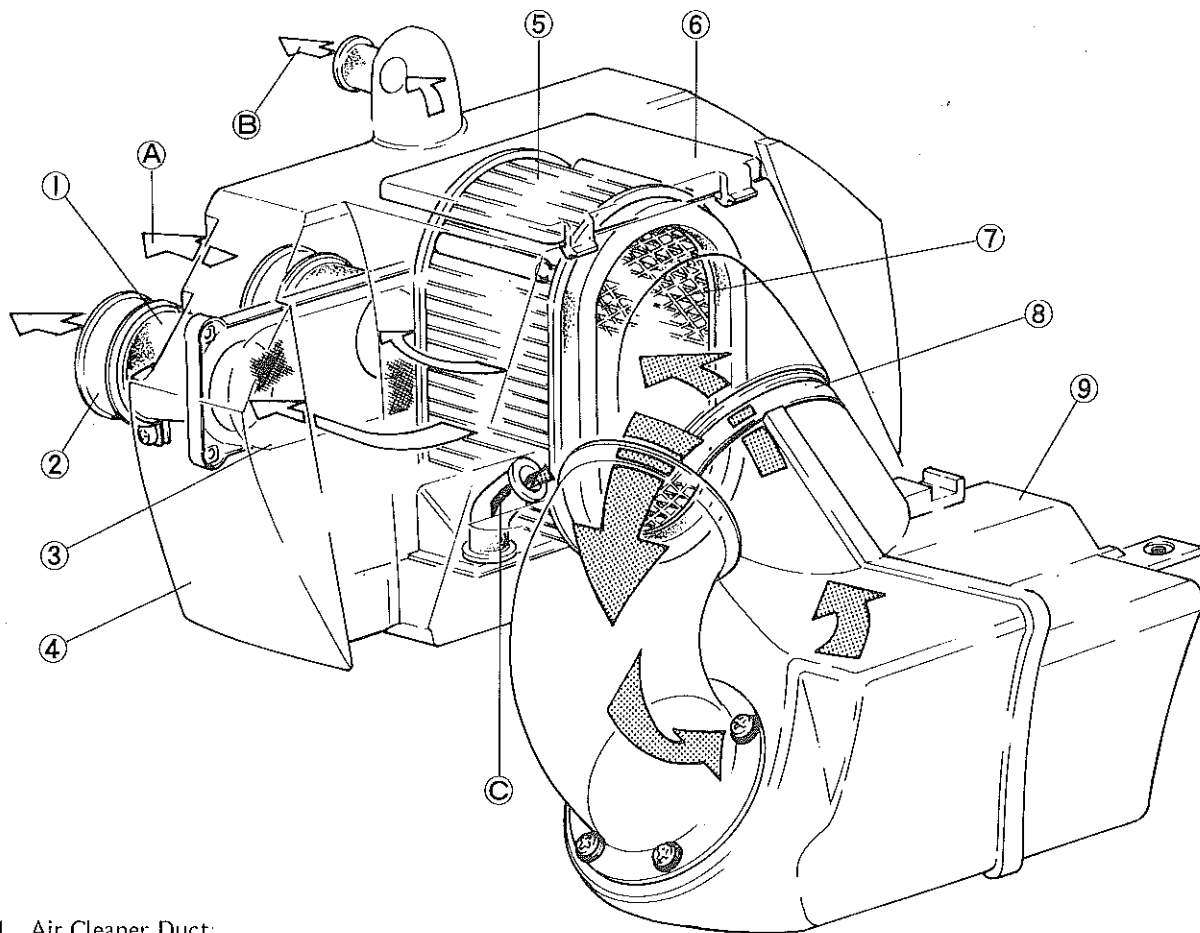
WARNING Clean the element in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. Because of the danger of highly flammable liquids, do not use gasoline or low flash-point solvents to clean the element.

If the sponge gaskets on the sides of the element come loose, stick them back on with an adhesive sealant. If the sponge or the element is damaged or holed, replace the element.

Since repeated cleaning opens the pores of the element, replace it with a new one in accordance with the Periodic Maintenance Chart (Pg. 10). Also, if there is a break in the element material or any other damage to the element, replace the element with a new one.

Air Cleaner

H1



1. Air Cleaner Duct
2. Clamp
3. Mesh
4. Air Cleaner Housing
5. Air Cleaner Element
6. Air Cleaner Cap

7. Air Cleaner Element Frame
8. Clamp
9. Air Cleaner Silencer

- A. To the Carburetor
- B. To the Vacuum Switch Valve
- C. From the Breather

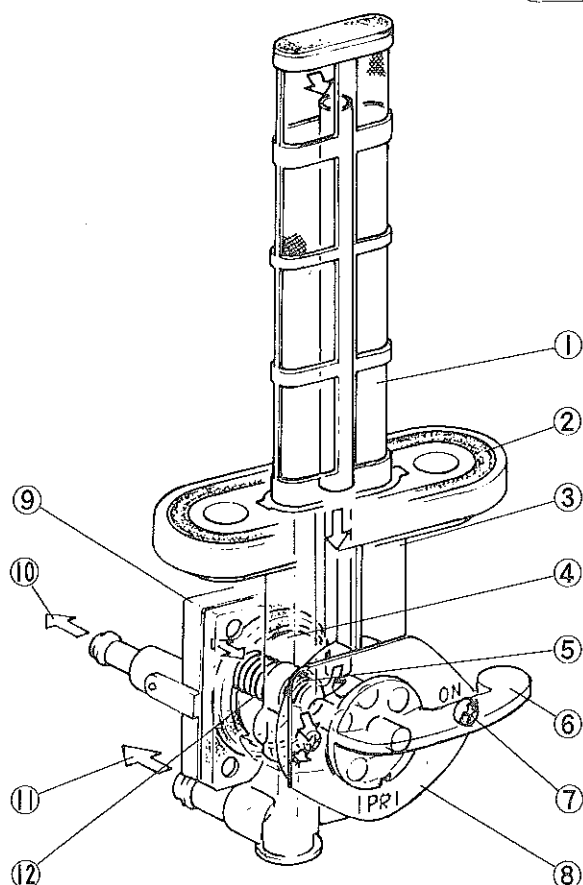
FUEL TANK, FUEL TAP

The fuel tank capacity is 18.2 liters, 2.3 liters of which form the reserve supply. A cap is attached to the top of the tank, and a fuel tap to the bottom. An air vent is provided in the cap to prevent an air lock, which would hinder fuel flow to the carburetors.

Fuel tap construction is shown in Fig. H2. The fuel tap is an automatic type which shuts off the fuel supply when the engine is stopped in the **ON** or **RES** position. The fuel tap has three positions: **ON**, **RES** (reserve), and **PRI** (prime). With the tap in the "On" position, fuel flows through the tap by way of the main pipe until only the reserve supply is left in the tank; with the tap in the "Reserve" position, fuel flows through the tap from the bottom of the tank. The "Pri" position bypasses the automatic control and is useful for priming the engine after running out of gas, or for completely draining the tank. The fuel tap contains a filter to filter out dirt.

Fuel Tap

H2



- | | |
|--------------|--------------------|
| 1. Filter | 7. Screw |
| 2. O Ring | 8. Holding Plate |
| 3. Tap Body | 9. Diaphragm Cover |
| 4. Diaphragm | 10. Vacuum |
| 5. O Ring | 11. Fuel |
| 6. Tap Lever | 12. Spring |

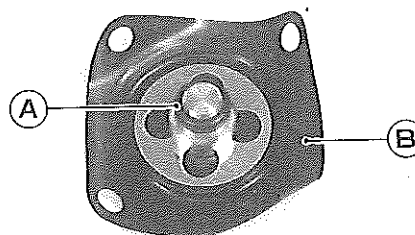
The automatic valve in the fuel tap operates as follows: When the engine is running, negative pressure (vacuum) is created at the carburetor due to engine intake. This engine intake vacuum is transmitted to the diaphragm vacuum chamber in the fuel tap through the vacuum hose and the check valve. The vacuum pulls the diaphragm (4) against its spring pressure, and the O ring (5) on the diaphragm assembly (4) is pulled out of its seat, permitting fuel to flow between the O ring and seat. When the engine stops and vacuum is lost, air enters the diaphragm vacuum chamber through the vacuum hose, bringing chamber pressure back up to atmospheric and allowing the diaphragm spring (12) to push the diaphragm back into place and hold the O ring against the seat.

The check valve in the diaphragm cover keeps the pressure in the diaphragm vacuum chamber negative in spite of the pulsation of the intake vacuum while the engine is running so that fuel flows smoothly.

Inspection and cleaning

If there is any doubt about the condition of the fuel tap, remove and disassemble the fuel tap (Pg. 41), and inspect the parts. Especially examine the diaphragm assembly. Make sure the O ring and its seat are clean and undamaged; if the O ring is prevented from seating properly or if it is damaged, fuel flow will not stop when the engine is stopped, and may overflow from the carburetors. Visually inspect the diaphragm. If there is any tear or other damage, the diaphragm assembly should be replaced.

H3



A. "O" Ring

B. Diaphragm

Clean the air and fuel passages by lightly applying compressed air to the passage openings.

CAUTION Do not use wire for cleaning as this could damage the check valve, O ring seat, and diaphragm mating surfaces.

CARBURETORS

The carburetors perform the function of mixing the fuel and air in the proportions necessary for good engine performance at varying speeds and loads. In order for

them to function satisfactorily, they must be properly adjusted and maintained. The throttle cable adjustment, idling adjustment, and synchronizing adjustment are covered in the Adjustment Section. The discussion here concerns the fundamentals of carburetor operation, fuel level adjustment, and cleaning and replacement of carburetor parts.

A linkage mechanism opens each carburetor throttle valve the same amount in response to throttle grip movement so that the carburetors operate in unison. As the throttle grip is turned counterclockwise, the throttle accelerator cable turns the carburetor pulley. Through the linkage mechanism the pulley opens the throttle valves. As the throttle grip is turned clockwise or is released, the linkage mechanism return spring, together with the throttle decelerator cable, closes the throttle valves.

One of the basic principles in carburetor operation is that the pressure exerted by a moving body of air is less than atmospheric pressure. As the engine draws air in through the carburetor bore, the air pressure in the carburetor bore is less than the air pressure in the float chamber, which is vented to the atmosphere. This difference in air pressure forces fuel up through passages into the carburetor bore, where it is atomized by the high-speed air flowing into the engine.

Another important principle is the Venturi Principle, which states that when an air passage narrows, moving air flows faster, exerting even less pressure. For example, especially at lower speeds the amount of the cutaway on the throttle valve makes use of this principle in determining the speed, and thus the pressure, of the air passing below it.

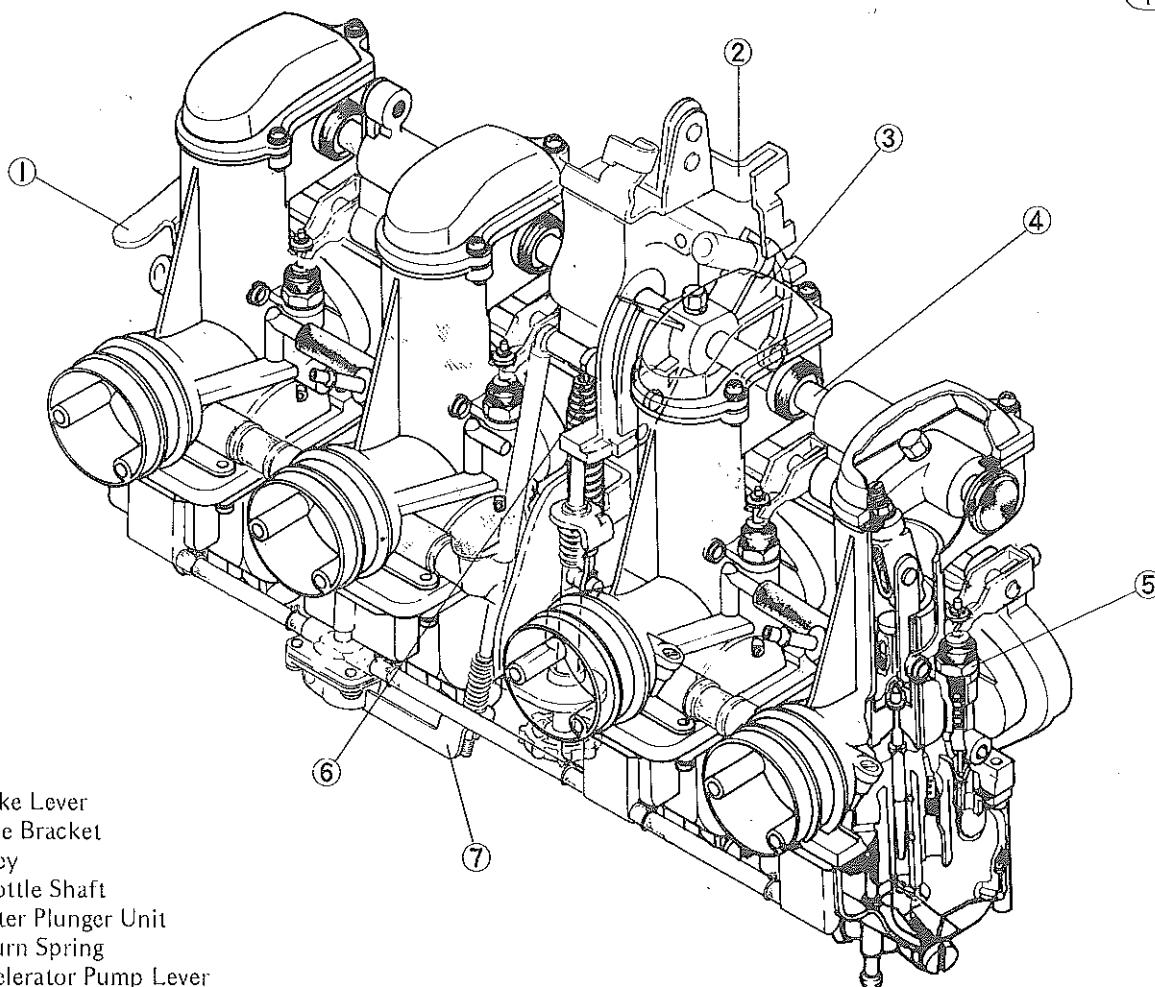
The amount of fuel passing through a jet depends both on the size of the jet and on the speed of the air flow over the jet. The speed of this air flow is in turn determined both by the engine rpm and by the dimensions of the passage (varied with the throttle valve) just above the jet. The size of the jet openings, the various dimensions of the air passages, and the engine rpm are correlated through carburetor design so that, when properly adjusted, the carburetor meters (measures) the fuel and air in the correct proportions at different throttle openings.

The ratio of fuel to air at different throttle openings is set through carburetor design by a number of interrelating factors.

0~1/8 throttle	air screw
1/8~1/4 throttle	throttle valve cutaway, air screw
1/4~3/4 throttle	jet needle position
3/4~1 throttle	main jet size

Carburetor (US model)

H4



1. Choke Lever
2. Cable Bracket
3. Pulley
4. Throttle Shaft
5. Starter Plunger Unit
6. Return Spring
7. Accelerator Pump Lever

The carburetor specifications have been chosen for best all around performance and ordinarily will not require any change.

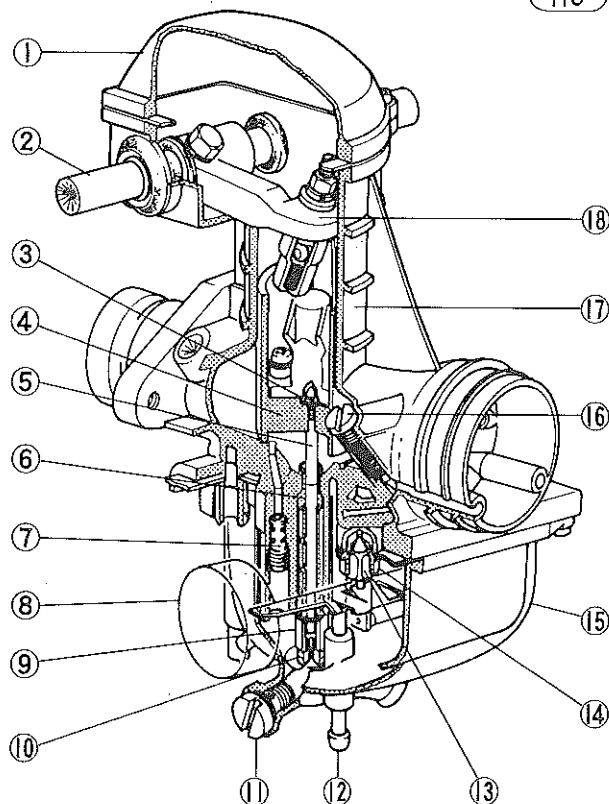
Carburetor trouble can be caused by dirt, wear, maladjustment, or improper fuel level in the float chamber. A dirty or damaged air cleaner can also alter the fuel-to-air ratio.

Table H1 Mixture Trouble Symptoms

Poor running
Overheating
Exhaust smokes excessively

Carburetor Construction

H5



- | | |
|-------------------|------------------------|
| 1. Top Cover | 10. Main Jet |
| 2. Throttle Shaft | 11. Drain Plug |
| 3. Clip | 12. Overflow Pipe |
| 4. Throttle Valve | 13. Float Valve Needle |
| 5. Jet Needle | 14. Float Valve Seat |
| 6. Needle Jet | 15. Float Bowl |
| 7. Pilot Jet | 16. Air Screw |
| 8. Float | 17. Carburetor Body |
| 9. Air Bleed Pipe | 18. Throttle Arm |

The following explanation of the functioning and maintenance of the carburetors covers the five main systems for fuel regulation and supply.

Table H4 Carburetor Specifications

Type	Main Jet	Needle Jet Badge #	Jet Needle	Pilot Jet	Throttle Valve Cutaway	Design Fuel Level	Service Fuel Level
VM28SS	110	O-4 © O-1	SCN17-3 © SCN15-3	15	2.0, © 1.75	33 ± 1 mm	4 ± 1 mm

© : Other than US model

Table H2 Carburetor Systems

System	Function
Starter System	Supplies the necessary rich mixture for starting a cold engine.
Pilot System	Supplies fuel at idling and low speeds.
Main System	Supplies fuel at medium and high speeds.
Accelerator Pump System*	Supplies additional fuel for sudden acceleration.
Float System	Maintains the fuel at a constant level in the float chamber.

* : US model only

- CAUTION**
1. To prevent damage or deterioration of the rubber or plastic parts, remove as many rubber or plastic parts from the carburetor (Table H3) as possible before cleaning the carburetor with a cleaning solution.
 2. Do not use wire for cleaning as this could damage the jets.
 3. To prevent damage to the float, remove the float bowl and the float when blowing the carburetor clean with compressed air.

Table H3 Carburetor Rubber Parts or Plastic Parts

Parts	Quantity	Removable
Link Shaft Dust Seal	6	Yes
Link Shaft End Cap	2	Yes
Throttle Valve Guide Pin	4	No
Air Screw O Ring	4	Yes
Starter Plunger Seat Rubber	4	No
Fuel Hose	1	Yes
Over Flow Tube	4	Yes
Breather Hose	2	Yes
Air Bleed Pipe O Ring	4	Yes
Starter Plunger Dust Seal	4	Yes
Starter Plunger Bush	4	Yes
Drain Plug O Ring	4	Yes
Accelerator Pump Nozzle O Ring*	4	Yes
Float	4	Yes

* : US model only

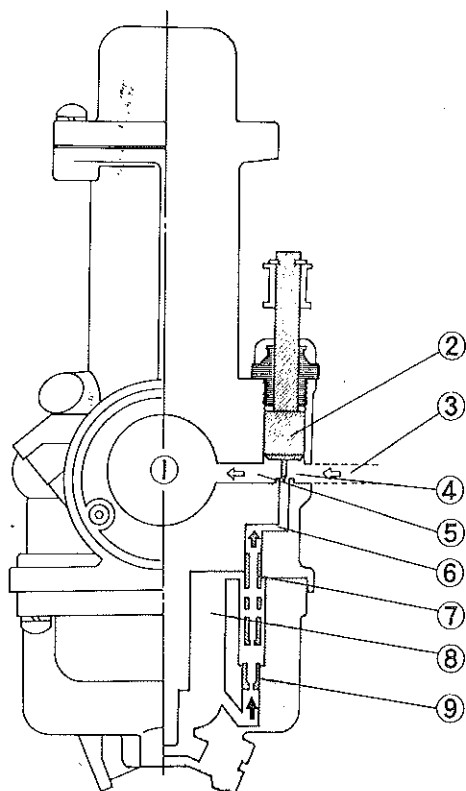
Starter System

Fig. H6 shows the starter system, which includes the starter jet ⑨, starter pipe ⑦, starter plunger ②, starter air passage ③, plunger chamber ④, and mixture passage ⑤.

The starter system provides the exceptionally rich fuel/air ratio that is necessary to enable easy starting when the engine is cold. When starting the engine, the throttle is left closed, and the starter plunger is pulled fully open by pulling up the choke lever. Since the throttle valve is closed, a high intake vacuum (suction

Starter System

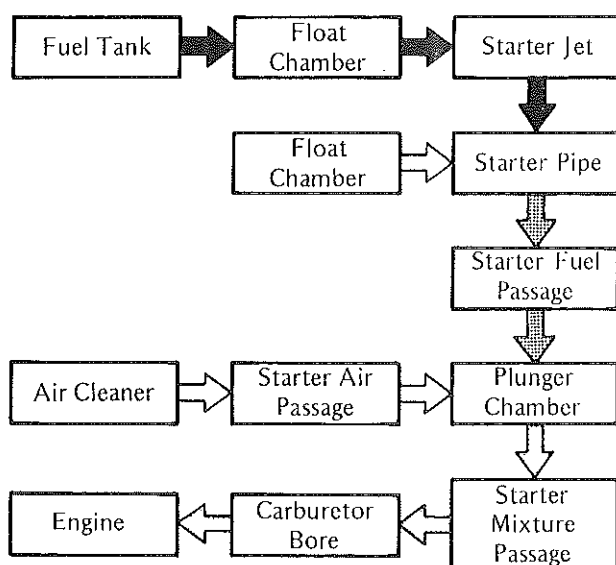
H6



- | | |
|----------------------------|-------------------------|
| 1. Carburetor Bore | 6. Starter Fuel Passage |
| 2. Starter Plunger | 7. Starter Pipe |
| 3. Starter Air Passage | 8. Float Chamber |
| 4. Plunger Chamber | 9. Starter Jet |
| 5. Starter Mixture Passage | |

Starter System Fuel and Air Supply

H7



or low pressure) is developed at the engine side of the carburetor bore. The starter plunger, when raised, opens up the starter fuel passage and an air passage so that they connect to the engine side of the carburetor bore. As the engine is cranked over, it draws in air through this air passage and fuel from the float chamber through the starter fuel passage. Fuel metered by the starter jet mixes with a small amount of air drawn in through air bleed holes in the starter pipe as it rises in the starter fuel passage. This small amount of air prepares the fuel for better atomization once it reaches the plunger chamber (the area just below the raised plunger) where the fuel mixes with the air drawn in through the air passage. Through the mixture passage, this mixture is then drawn into the carburetor bore where it, together with a small amount of mixture supplied by the pilot system, is drawn into the engine.

In order for the starter system to work properly, the throttle must be kept closed so that sufficient vacuum can be built up at the starter outlet. Also, the choke lever must be pulled up fully so that the starter plunger will fully open the air and starter fuel passages to the carburetor bore. Clogged starter pipe air bleed holes will cause insufficient atomization, thus impairing starter system efficiency. Fuel mixture trouble results if the plunger does not seat properly in its rest position after the choke lever is returned. This may be caused by dirt, gum, a defective spring, a deformed plunger chamber bore, or a damaged plunger seat rubber.

Cleaning (See caution on Pg. 157)

Remove the float bowl. Blow the starter pipe, starter air passage, mixture passage, and starter jet clean with compressed air.

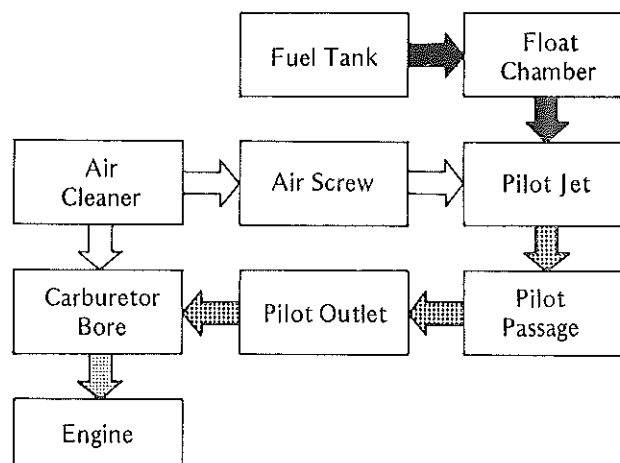
Remove the starter plunger, and clean it with a high flash-point solvent.

Pilot System

Fig. H9 shows the pilot system, which includes the pilot jet ④, pilot air passage ②, air screw ①, and pilot outlet ⑥. The flow of fuel and air in the pilot system is shown in Fig. H8.

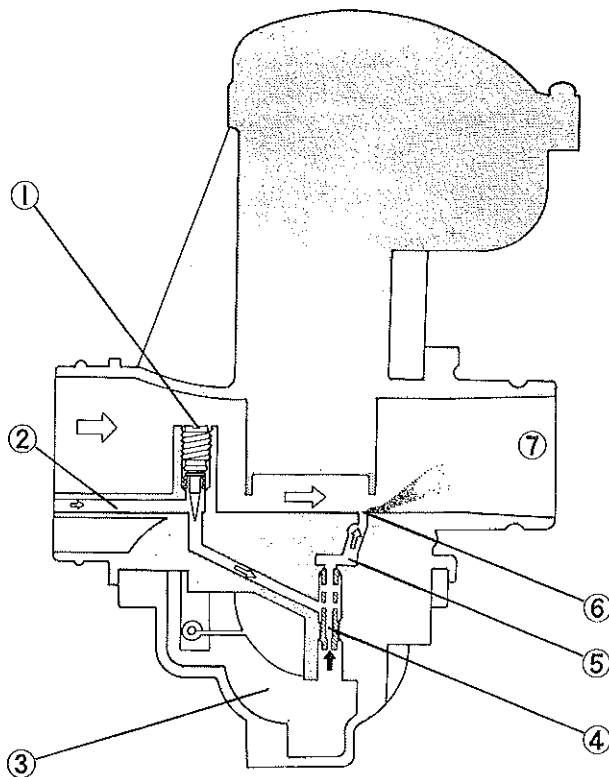
Pilot System Fuel and Air Supply

H8



Pilot System

H9



1. Air Screw
2. Pilot Air Passage
3. Float Chamber
4. Pilot Jet
5. Pilot Passage
6. Pilot Outlet
7. Carburetor Bore

The pilot system determines the operation of the carburetor from 0 to $\frac{1}{4}$ throttle opening. At small throttle openings, almost no fuel is drawn through the main system due to insufficient air flow past the needle jet. Instead, the fuel is drawn through the pilot jet as a result of the low pressure (suction) caused by the engine's demand for air and the small, but relatively fast flow of air past the pilot outlet. The low position of the throttle valve restricts the carburetor bore air flow, preventing it from relieving the low pressure around the pilot outlet created by the engine's suction, while the venturi effect (i.e., the narrower the air passage, the faster the flow of air) at the engine side of the throttle valve further reduces the low pressure.

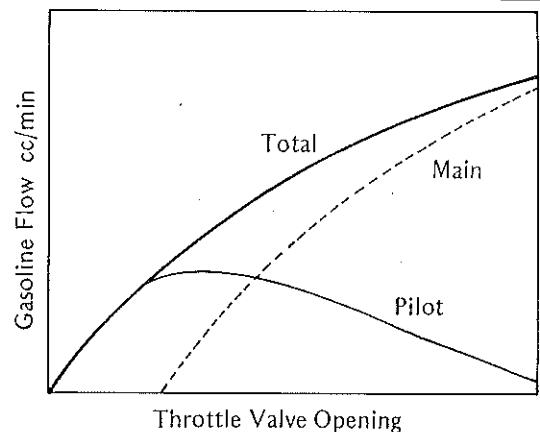
As fuel is drawn out of the pilot jet, and through the pilot passage, it mixes with air drawn in through the air-screw-controlled air passage. Once the throttle valve rises, it no longer concentrates the low pressure area around just the pilot outlet.

The purpose of the pilot system is to provide the rich fuel/air mixture necessary at low engine speed. The pilot system mixture consists primarily of the fuel measured out by the pilot jet and the air let in past the air screw. Since the size of the pilot jet opening is fixed, the fuel to air ratio is controlled by the position of the air screw.

Fig. H10 shows throttle valve opening versus fuel flow for the main and pilot systems. If trouble occurs in the pilot system, not only are starting and low speed running affected, but the transition from pilot to main system is not smooth as the throttle is opened, causing a drop in acceleration efficiency. Pilot system trouble might be due to maladjustment; a dirty or loose pilot jet; or clogging of the pilot jet passage, or air-screw-controlled air passage.

Flow Characteristic

H10



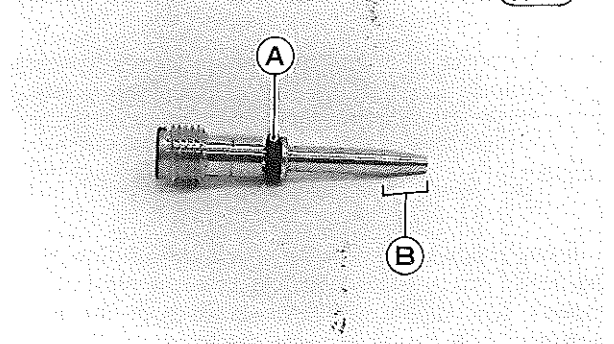
Cleaning and replacement

(See caution on Pg. 157)

Remove the float bowl, float, pilot jet, and valve needle. Wash the pilot jet with a high flash-point solvent, and blow it clean with compressed air. Also use compressed air to clean the pilot outlet, pilot jet passage, and air screw air passage. If necessary, use a bath of automotive-type carburetor cleaner.

Remove the air screw, and check that the tapered portion is not worn or otherwise deformed. If it is, replace the air screw. If the screw O ring is damaged, replace the O ring.

H11



A. "O" Ring

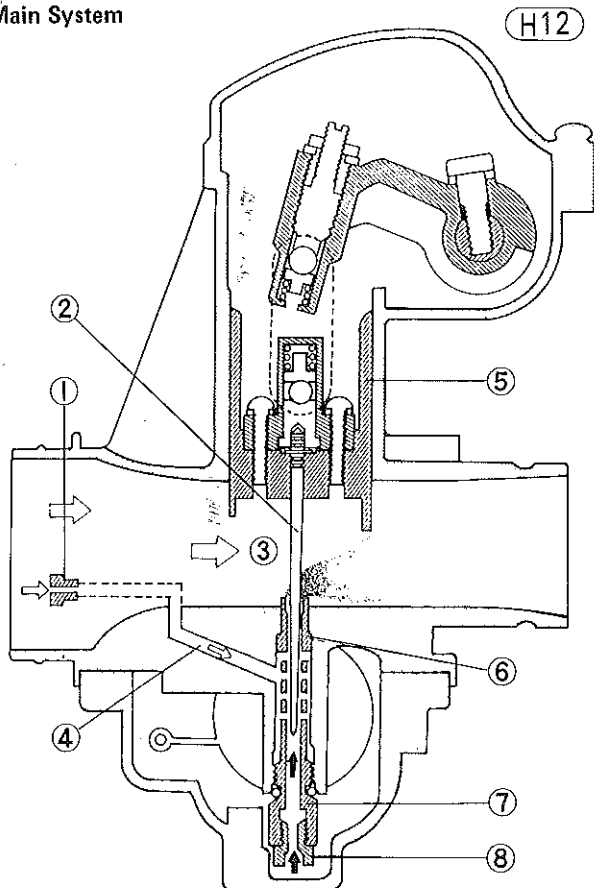
B. Tapered Portion

Main System

Fig. H12 shows the main system, which consists of the main jet (8), bleed pipe (7), needle jet (6), jet needle (2), throttle valve (5), and air jet (1).

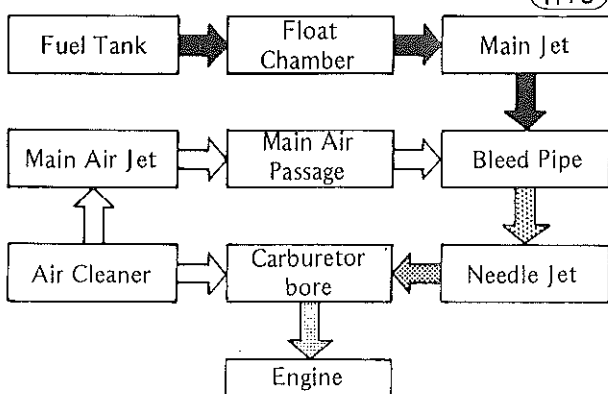
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Main System



- | | |
|---------------------|-------------------|
| 1. Main Air Jet | 5. Throttle Valve |
| 2. Jet Needle | 6. Needle Jet |
| 3. Carburetor Bore | 7. Bleed Pipe |
| 4. Main Air Passage | 8. Main Jet |

Main System Fuel and Air Supply



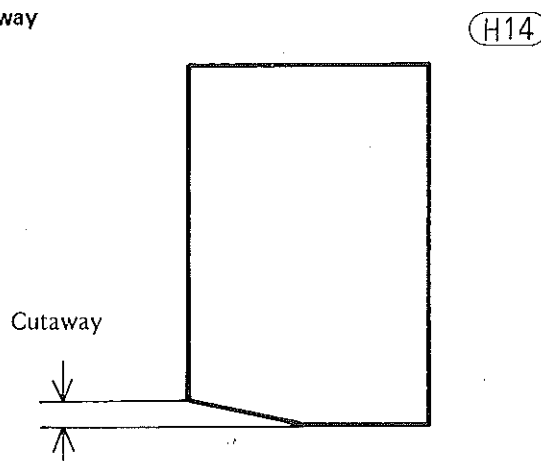
From about $\frac{1}{4}$ throttle opening, the air flow past the needle jet outlet is sufficient to cause most of the engine's fuel supply to be drawn through the main system. Fuel passes through the main jet and the bleed pipe, through the space in the needle jet around the jet needle, and into the carburetor bore, where it is atomized by the air flow to the engine.

The bleed pipe has holes to admit the air metered by the main air jet. This air mixes with the fuel in the needle jet to prepare the fuel for better atomization in the carburetor bore.

The lower part of the jet needle is tapered and extends down into the needle jet. It is fixed to the throttle valve, and thus rises up in the needle jet as the throttle valve rises. As $\frac{1}{4}$ throttle opening, the tapered portion of the needle starts coming up out of the jet, which increases needle-to-jet clearance and thereby increases the amount of fuel that can pass up through the jet.

The amount of fuel drawn out of the needle jet is also influenced, particularly at lower speeds, by the amount of cutaway on the throttle valve. The amount of this cutaway, which is on the intake side of the throttle valve, helps define the size of the air passage directly above both the pilot outlets and needle jet outlet.

Cutaway



At near full throttle openings, the cross-sectional area of the needle to jet clearance becomes greater than the cross-sectional area of the main jet. At these openings, the fuel drawn up into the carburetor bore is limited by the size of the main jet rather than the needle to jet clearance.

Trouble in the main system is usually indicated by poor running, or lack of power at high speeds. A dirty or clogged main jet will cause the mixture to become too lean. An overly rich mixture could be caused by clogging of the air jet, its air passage, or the air holes in the bleed pipe; by needle jet or needle wear (increasing clearance); by a loose main jet; or by a loose bleed pipe.

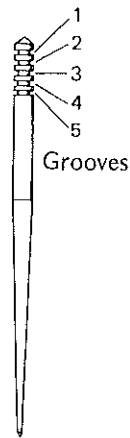
Cleaning (See caution on Pg. 157)

Disassemble the carburetor and wash the main jet, bleed pipe, needle jet, jet needle, air jet, and air passage with a high flash-point solvent, blowing them clean with compressed air. If necessary, use a bath of automotive type carburetor cleaner. A worn needle jet or jet needle should be replaced.

NOTE: The last number of the jet needle number ("3" of 5CN17-3) is not stamped on the needle, but is the number of the groove in which the clip must be installed. The groove numbers are counted from the topmost groove, 5 being the lowest groove.

CAUTION If the clip is put in any but the specified groove, exhaust emission will be increased, and the engine may suffer serious damage which could result in a crash.

Jet Needle



H15

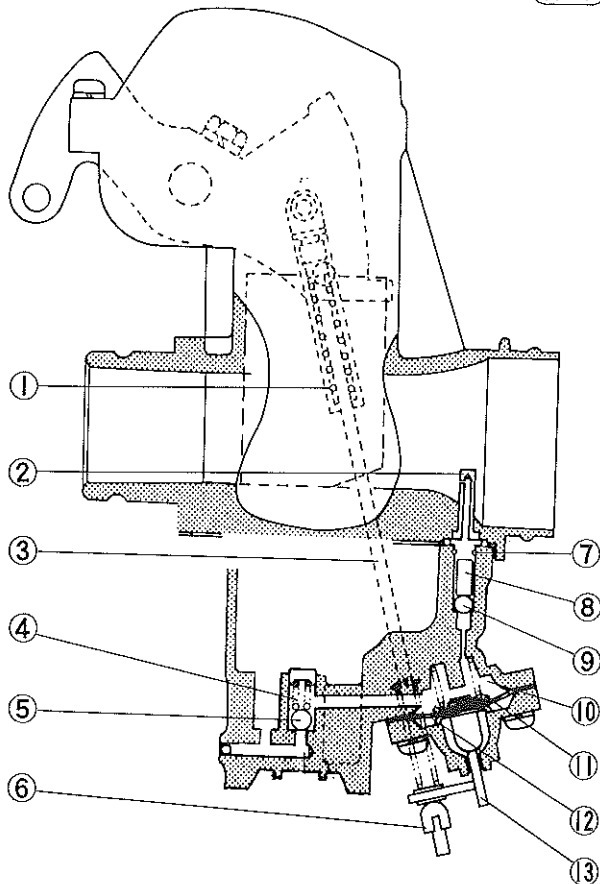
This system temporarily supplies additional fuel to the engine to make up for a too lean mixture which is momentarily caused by sudden acceleration. When the throttle is opened quickly to accelerate suddenly, the flow of fuel lags behind the flow of air because the fuel has greater inertia than the air, and the fuel/air mixture tends to become too lean. The accelerator pump is controlled by the motion of the throttle via the pump rod and lever to supply additional fuel. The pump rod operates the pump diaphragm from about 0 to 1/4 throttle opening. If the pump diaphragm is operated, the fuel in the pump chamber is ejected into each carburetor bore from the pump nozzle through the outlet check valve. The fuel from the pump is delivered to the other carburetors through hoses which connect the float bowls.

Accelerator Pump System (on US Model)

Fig. H16 shows the accelerator pump system which consists of the accelerator pump chamber (10), pump nozzle (2), outlet check valve (9), and return check valve (5).

Accelerator Pump

H16

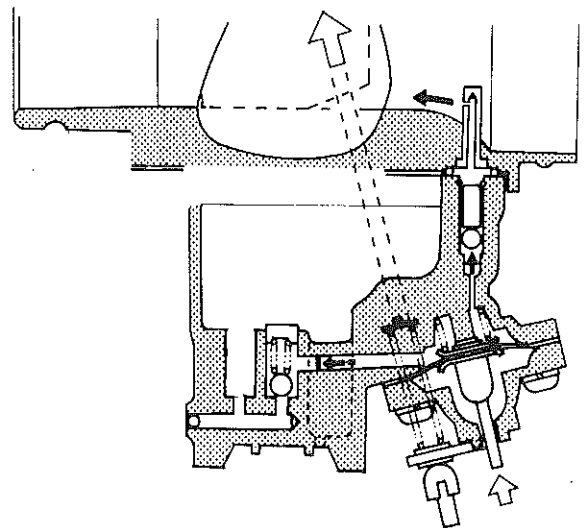


- | | |
|-----------------------|-----------------------|
| 1. Spring | 8. Valve Weight |
| 2. Pump Nozzle | 9. Outlet Check Valve |
| 3. Pump Push Rod | 10. Pump Chamber |
| 4. Spring | 11. Return Spring |
| 5. Return Check Valve | 12. Pump Diaphragm |
| 6. Adjusting Nut | 13. Pump Lever |
| 7. Clip | |

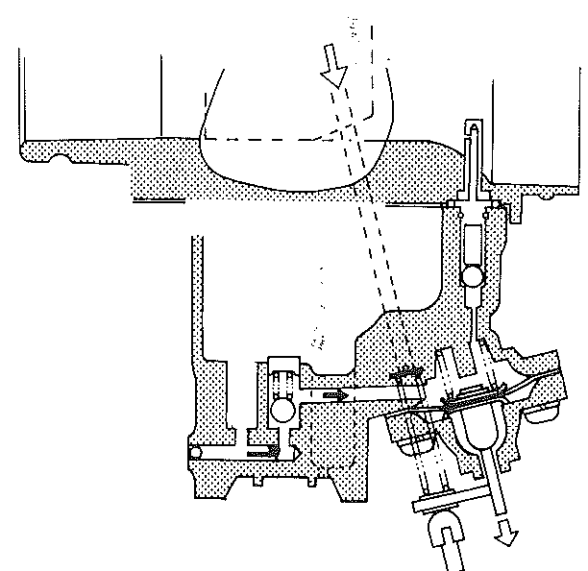
Accelerator Pump Operation

H17

Throttle opening



Throttle closing



Inspection

The accelerator pump should eject fuel from the pump nozzle.

To check that the accelerator pump system is working properly, remove the carburetors from the engine and operate the accelerator pump as following:

- Remove the carburetors (Pg. 44).
- Supply fuel to the carburetors. Turn the pulley quickly to operate the accelerator pump and check that fuel squirts from each pump nozzle. The fuel must squirt directly into each carburetor bore without hitting the jet needle or the carburetor bore wall. The quantity of fuel eject from each pump nozzle must be the same. If no fuel is ejected at all, the accelerator pump is defective. If any one of the pump nozzles ejects less fuel than the others or none at all, the nozzle or passage is clogged and must be cleaned.

Cleaning and replacement

Disassemble the carburetors, and blow the passages clean with compressed air. Check that the diaphragm and return spring are not damaged or otherwise deformed. If the accelerator pump assembly is replaced with a new one, it must be installed and adjusted referring to the assembly notes (Pg. 47).

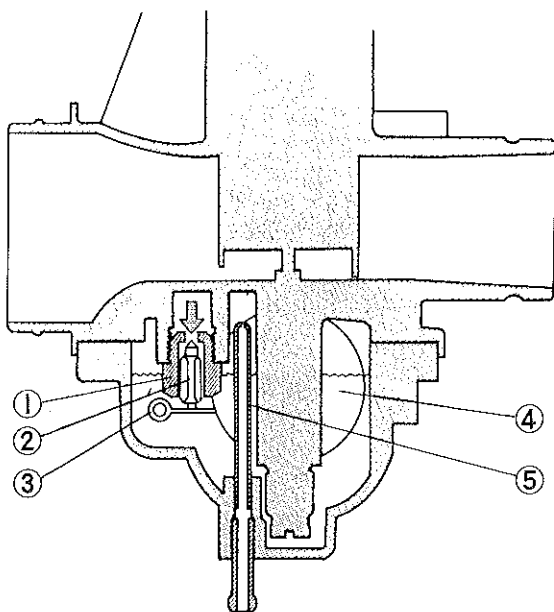
CAUTION Never blow out the passages with compressed air while the diaphragm assembled, or the diaphragm will be damaged and require replacement.

Float System

Fig. H18 shows the float system which consists of the float ④, float valve needle ②, float valve seat ①, and overflow pipe ⑤.

Float System

(H18)



1. Float Valve Seat
2. Float Valve Needle
3. Float Pin

4. Float
5. Overflow Pipe

The float system serves to keep a relatively constant level of fuel in the carburetor float chamber at all times so that the fuel supply to the engine will be stable. If the fuel level in the float chamber is set too low, it will be more difficult for fuel to be drawn up into the carburetor bore, resulting in too lean a mixture. If the level is set too high, the fuel can be drawn up too easily, resulting in too rich a mixture.

The design fuel level is defined as the vertical distance from the center of the carburetor bore to the surface of the fuel in the float chamber. The fuel level is maintained at a constant value by the action of the float valve, which opens and closes according to the fuel level. As fuel flows through the float valve into the chamber, the fuel level rises. The float, rising with the fuel level, pushes up on the needle. When the fuel reaches a certain level, the needle is pushed completely into the valve seat, which closes the valve so that no more fuel may enter the chamber. As the fuel is drawn up out of the float chamber, the fuel level drops, lowering the float. The needle no longer blocks the float valve, and fuel once again flows through the float valve into the chamber.

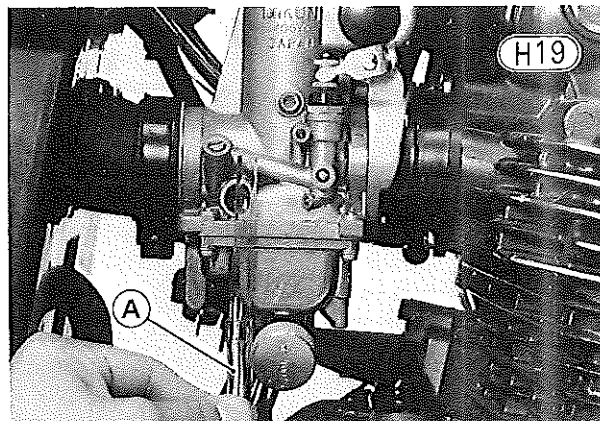
NOTE: It is impractical to measure the actual design fuel level. Service fuel level is defined as the vertical distance from the bottom edge of the carburetor body to the surface of the fuel in the float chamber. Measuring the service fuel level is an indirect method of inspecting for correct design fuel level.

Service fuel level measurement and adjustment

If the motorcycle exhibits symptoms of improper fuel mixture, measure the service fuel level.

Secure the motorcycle in a true vertical position. Turn the fuel tap to the "ON" or "RES" position, and remove the drain plug from the bottom of the float bowl. Install the fuel level gauge (special tool). Hold the plastic tube against the side of the carburetor so that the "0" line is even with the bottom edge of the carburetor body. Turn the fuel tap to the "PRI" position. Read the service fuel level in the plastic tube.

NOTE: Measure the fuel level keeping the carburetor fully perpendicular to the ground.

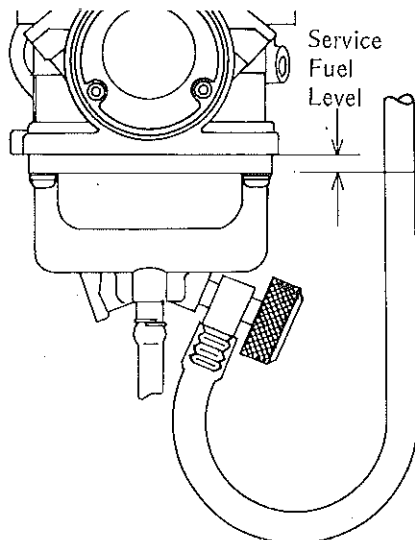


A. Fuel Level Gauge (57001-208)

Table H5 Service Fuel Level

Standard
3 ~ 5 mm from the edge of the carburetor body to the fuel level

Fuel Level Measurement



H20

If the fuel level is incorrect, remove the carburetor, and then remove the float bowl and float. Bend the tang on the float a very slight amount to change the fuel level. Bending it up closes the valve sooner and lowers the fuel level; bending it down raises the level.

After adjustment, measure the service fuel level again, and readjust if necessary.

Cleaning and replacement

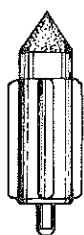
(See caution on Pg. 157)

If dirt gets between the needle and seat, the float valve will not close and fuel will overflow. Overflow can also result if the needle and seat become worn. If the needle sticks closed, no fuel will flow into the carburetor.

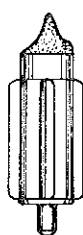
Remove the carburetor, and take off the float bowl and float. Wash the bowl and float parts in a high flash-point solvent. Use carburetor cleaner if necessary on the float bowl and metal parts only. Blow out the fuel overflow pipe with compressed air.

Examine the float, and replace if damaged. If the needle is worn as shown in the diagram, replace the needle and seat as a set.

Valve Needle



Good



Bad

H21

CAMSHAFTS

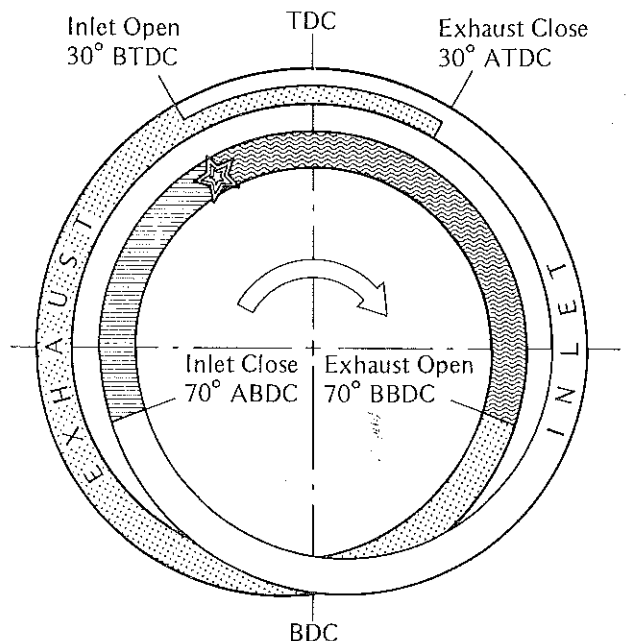
Since this engine is the DOHC (Double Over Head Camshaft) type, there are two camshafts mounted in the top of the cylinder head. One is the inlet camshaft, and is manufactured with four cam lobes, one to open the inlet valve for each cylinder. The other is the exhaust camshaft, and has four cam lobes to open the exhaust valves. There is a sprocket at the center of the crankshaft and at the center of each camshaft. A chain placed over these sprockets enables the crankshaft to turn both camshafts so that the valves will be opened and closed at the proper times during each rotation of the engine.

Each sprocket has marks so that valve timing (the time that each valve is opened) can be reset correctly any time the camshafts are removed for inspection or repairs (See Pg. 54).

However, since the time, amount, and duration that each valve is opened (valve timing) changes with cam wear, journal wear, and camshaft runout (bend); the camshafts should be inspected. If the valves do not open at the right times or if they do not open the correct amount or duration, there will be a decrease in combustion efficiency, causing a loss of engine power and leading to serious engine trouble.

Valve Timing

H22



Cam Wear

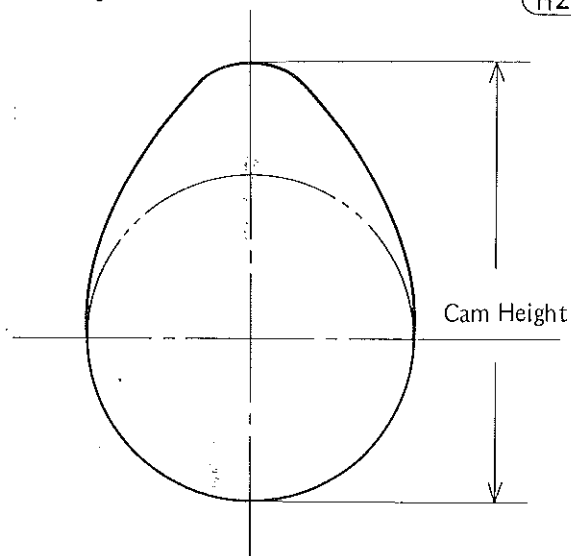
Remove the camshafts, and measure the height of each cam with a micrometer. If the cams are worn down past the service limit, replace the camshafts.

Table H6 Cam Height

	Standard	Service Limit
Inlet	36.21 ~ 36.39 mm	36.12 mm
Exhaust	35.71 ~ 35.89 mm	35.62 mm

Cam Height Measurement

H23

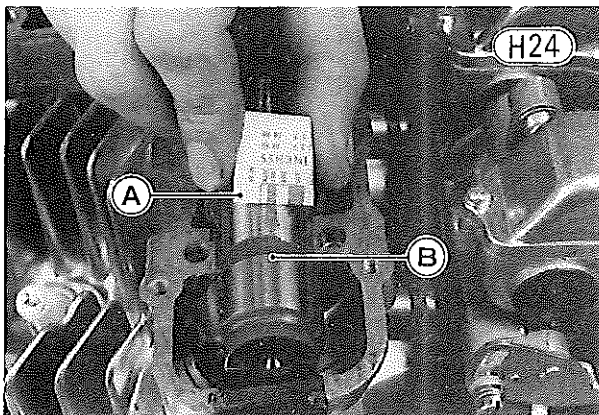
*Journal, bearing wear*

The journal wear is measured using plastigauge (press gauge), which is inserted into the clearance to be measured. The plastigauge indicates the clearance by the amount it is compressed and widened when the parts are assembled.

Remove the camshaft, and wipe each journal and bearing insert surface clean of oil. Cut strips of plastigauge to journal width. Place a strip on the lower half of each bearing insert parallel to the camshaft, and so that the plastigauge will be compressed between the journal and the bearing insert.

Now fit the chain over the camshaft sprocket so the shaft won't turn, and install the camshaft, tightening the bolts in the correct sequence with the specified torque (Pg. 52).

CAUTION Install the camshaft while maintaining correct valve timing (according to the marks) (Pg. 54). If it is installed incorrectly, valve may be bent.



A. Plastigauge

B. Camshaft

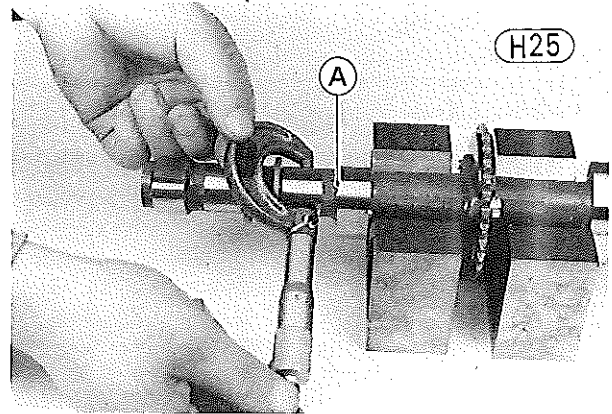
Next, remove the camshaft again, and measure the plastigauge width to determine the clearance between each journal and bearing insert. If any clearance exceeds

the service limit, replace all either bearing inserts for that camshaft.

Table H7 Camshaft Journal/Bearing Insert Clearance

Standard	Service Limit
0.020 ~ 0.070 mm	0.16 mm

Measure the diameter of each camshaft journal with a micrometer. If a diameter is less than the service limit, replace the camshaft.



A. Camshaft

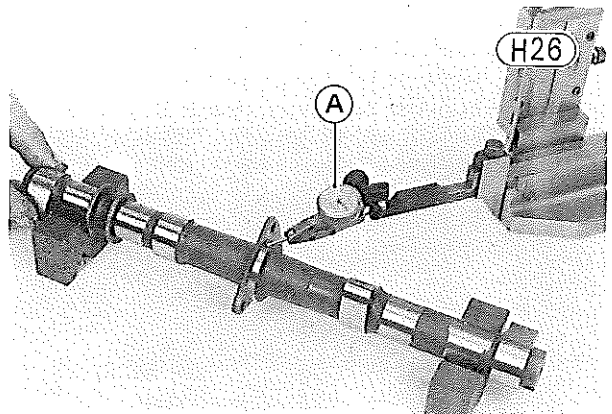
Table H8 Camshaft Journal Diameter

Standard	Service Limit
24.459 ~ 24.480 mm	24.42 mm

Camshaft runout

Remove the camshaft and take the sprocket off the shaft.

Suspend the shaft in V blocks at the points on the shaft where the bushings seat. Measure runout with a dial gauge set to the sprocket mounting location, and replace the shaft if runout exceeds the service limit.



A. Dial Gauge

Table H9 Camshaft Runout

Standard	Service Limit
under 0.02 mm	0.10 mm

CAMSHAFT CHAIN, GUIDES

The camshaft chain, which is driven by the crankshaft sprocket, drives the two camshafts at one-half crankshaft speed. For maximum durability, it is an endless-type chain with no master link.

When the chain can no longer be adjusted enough to stop it from making noise, remove the guides for inspection.

Camshaft chain wear

Hold the chain taut with a force of about 5 kg in some manner, and measure a 20-link length. Since the chain may wear unevenly, take measurements at several places. If any measurement exceeds the service limit, replace the chain.

Camshaft Chain Measurement

H27

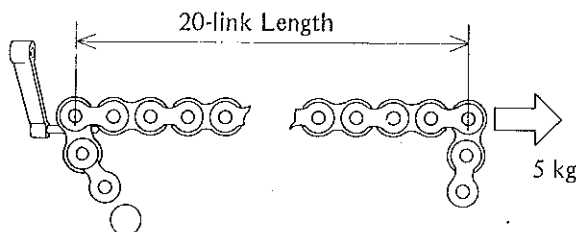
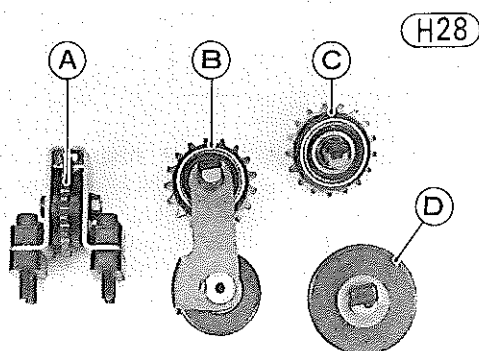


Table H10 Camshaft Chain 20-link Length

Standard	Service Limit
155.48 ~ 155.71 mm	157.8 mm

Chain guide wear

Remove all the chain guides, and inspect them visually. Replace them if the rubber or any other portion shows wear or damage.



- A. Upper Guide Sprocket
- B. Tensioner Guide Sprocket
- C. Front Guide Sprocket
- D. Guide Roller

CYLINDER HEAD, VALVES

The valves are mounted in the head; they are pushed open by the cams, and closed by the valve springs.

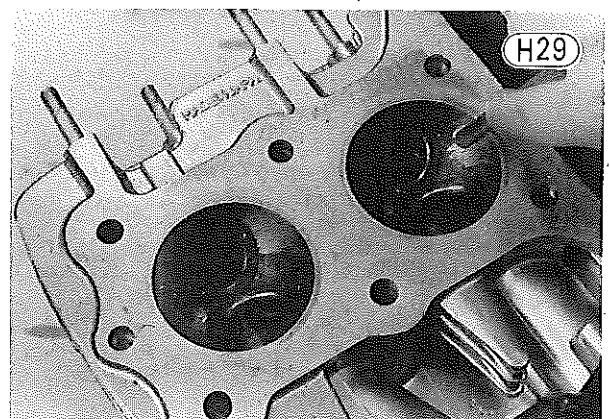
Valve guides are pressed into the cylinder head, and the valve seats are cast in. The valve seat, which is cut to the angles shown in Fig. H43, prevents compression leakage by fitting snugly against the valve. It also prevents the valve from overheating by allowing efficient heat transfer.

Cylinder Head

The cylinder head is made of aluminum alloy, used for its high heat conductivity, and is finned on the outside to aid dissipation of the heat generated in the combustion chambers. Carbon built up inside the combustion chambers interferes with heat dissipation and increases the compression ratio; which may result in preignition, detonation, and overheating. Trouble can also arise from improper head mounting or mounting torque, which may cause compression leakage.

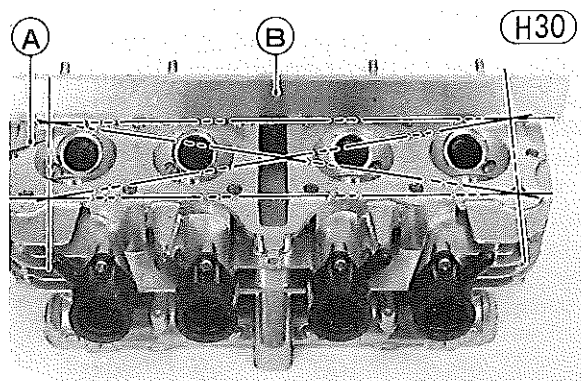
Cleaning and inspection

Remove the cylinder head (Pg. 54) and valves (Pg. 55). Scrape out any carbon, and wash the head with a high flash-point solvent.



Cylinder head warp

Lay a straightedge across the lower surface of the head at several different points, and measure warp by inserting a thickness gauge between the straightedge and the head. If warp exceeds the service limit, repair the mating surface. Replace the cylinder head if the mating surface is badly damaged.



A. Thickness Gauge

B. Straightedge

Table H11 Cylinder Head Warp

Service Limit
under 0.05 mm

Combustion chamber volume measurement

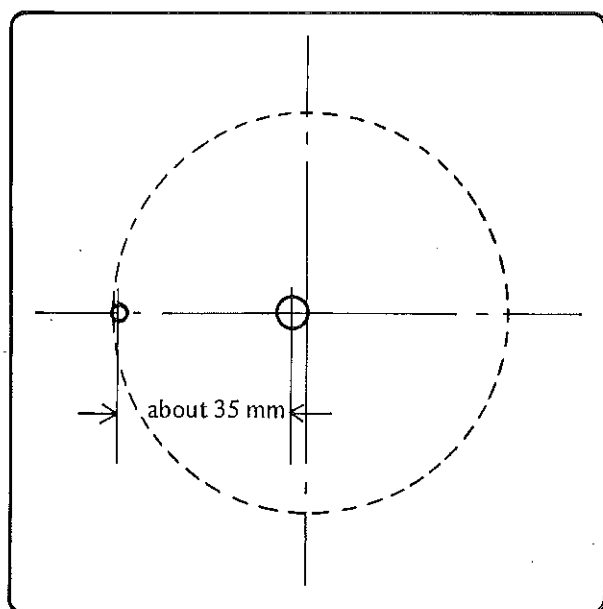
The combustion chamber volume should be measured anytime that compression measurement results in compression pressures well below or above the standard.

NOTES:

1. One more person will be needed to help expel air bubbles out of the cylinder head combustion chamber.
2. Prepare a piece of transparent plastic plate which has a flat surface and has two holes about 35 mm apart in its center portion. One is a large hole (about 6 mm in diameter), the other is small hole (about 3 mm in diameter). This plate must be oil resistant, about 120 mm square, and at least 3 mm thick.

Measuring Plastic Plate

(H31)



3. Obtain a burette or syringe which is calibrated at one-cc or smaller graduations. Fill it with thin oil.

Prior to the combustion chamber volume measurement, clean off any carbon on the combustion chamber, and remove any gasket flakes on the cylinder head mating surface. The standard spark plug should be installed in the chamber to be measured.

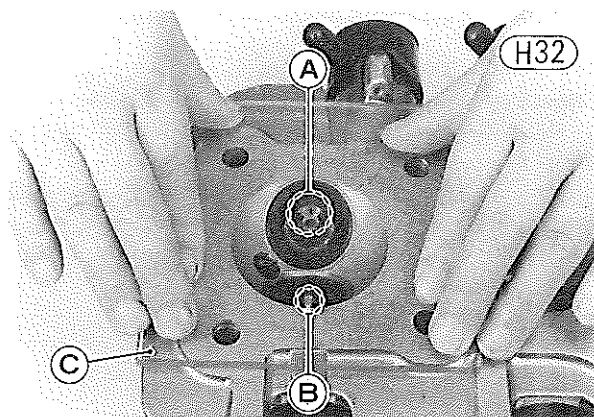
NOTE: The valves must seat well to prevent the oil from leaking out.

Apply a thin coat of grease to the cylinder head mating surface and place the plastic plate over the cylinder head combustion chamber, fitting its small hole within the circumference of the combustion chamber.

Place the cylinder head on a level surface. Through the large hole, fill the combustion chamber with light oil until the chamber is completely filled but not overflowing. Tilt the cylinder head slightly so that air

bubbles come out through the small hole. The oil should just rise to the bottom edge of the holes in the plate.

The amount of oil used to fill the chamber is the combustion chamber volume.



A. Large Hole

B. Small Hole

C. Plastic Plate

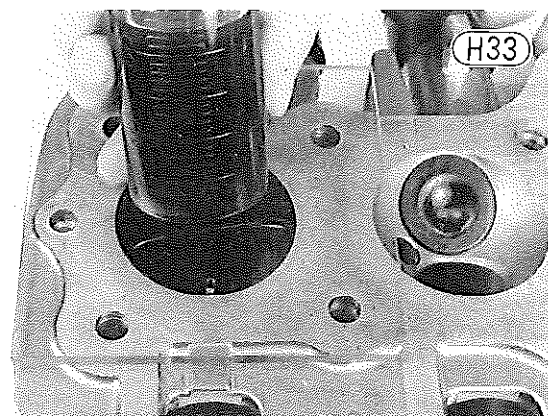


Table H12 Combustion Chamber Volume

Standard
34.3 ~ 35.1 cc

If the combustion chamber volume is too small, it is possible that the cylinder head was modified for higher compression. Make sure that all carbon deposits have been cleaned out of the chamber.

If the combustion chamber volume is too large, it is possible that the valves and valve seats have been resurfaced so much that the volume is increased. Make sure that the spark plug is the standard type and that it is fully tightened.

Valve, Valve Guide, Valve Seat

Valve face deformation or wear, stem bending, or wear, and valve guide wear can cause poor valve seating. Poor seating can also be caused by the valve seat itself, if there is heat damage or carbon build-up. The result of poor valve seating is compression leakage and a loss of engine power.

In addition, valve and valve seat wear causes deeper valve seating and a decrease in valve clearance. Insufficient clearance upsets valve timing and may eventually prevent the valve from seating fully. So that wear never progresses this far, adjust the valve clearance in accordance with the Periodic Maintenance Chart (Pg. 10).

Valve inspection

Visually inspect the valve face, and replace the valve if it shows deformation or uneven wear.

Measure the thickness of the valve head using vernier calipers, and replace the valve if the thickness is under the service limit.

Valve Shape

H34

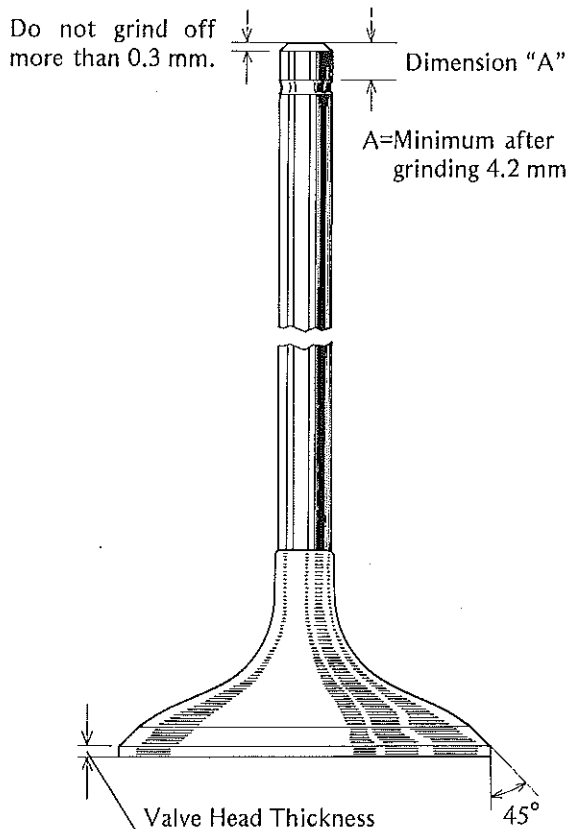


Table H13 Valve Head Thickness

Standard	Service Limit
0.85~1.15 mm	0.5 mm

If the seating surface of the valve or the end of the valve stem is damaged or badly worn, repair the valve with a valve refacer. The angle of the seating surface is 45°.

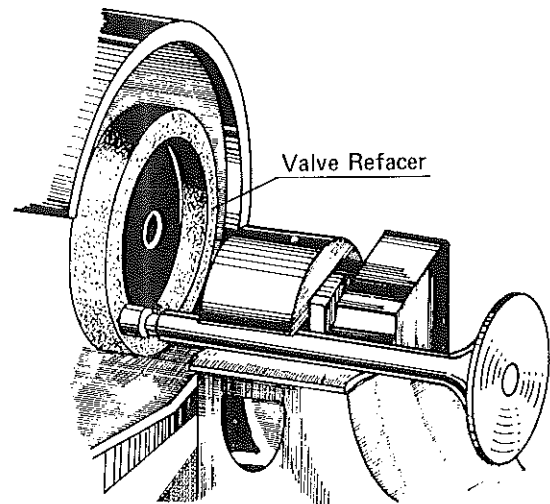
The valve stem end may be ground to permit additional valve clearance, use a refacing grinder to assure a flat, square surface.

CAUTION If the valve's Dimension "A" is less than specified, the valve lifter may contact

the valve spring retainer during operation, allowing the keepers to loosen. Consequently, the valve may drop into the engine, causing serious damage.

Valve Stem Grinding

H35



Hold the valve at both ends of the straight stem portion, and set a dial gauge against the center of the stem. One example is shown in Fig. H36.

Turning the valve, read a variation in the dial gauge. Replace the valve if it is bent over the service limit.

Valve Stem Bend

H36

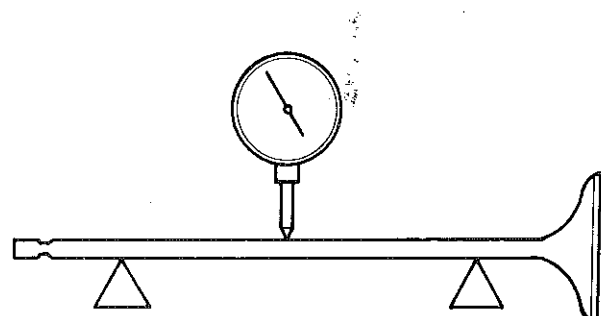
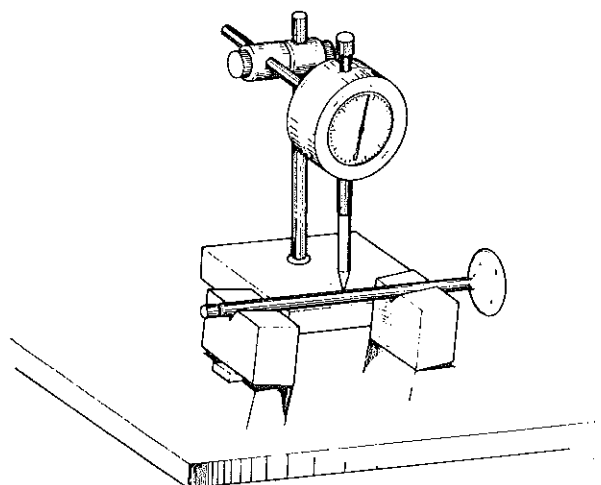
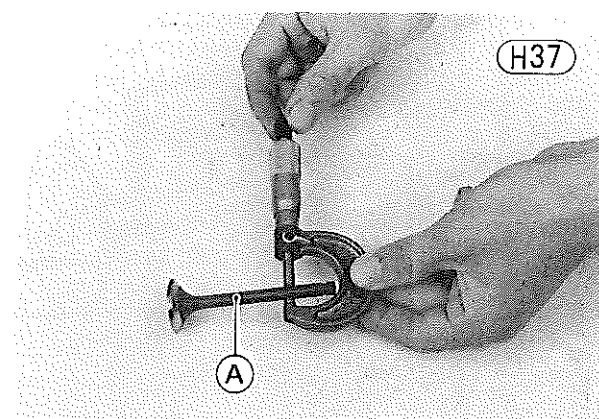


Table H14 Valve Stem Bend

Standard	Service Limit
under 0.01 mm	0.05 mm

Measure the diameter of the valve stem with a micrometer. Since the stem wears unevenly, take measurements at four places up and down the stem, keeping the micrometer at right angles to the stem.

Replace the valve if the stem is worn to less than the service limit.



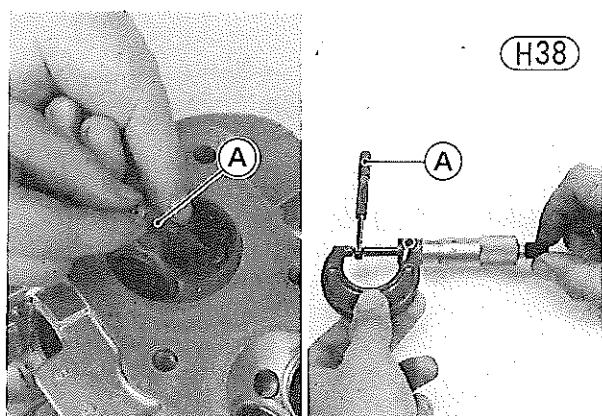
A. Valve Stem

Table H15 Valve Stem Diameter

	Standard	Service Limit
Inlet	6.965 ~ 6.980 mm	6.90 mm
Exhaust	6.955 ~ 6.970 mm	6.90 mm

Valve guide inspection

Remove the valve, and measure the inside diameter of the valve guide using a small bore gauge and micrometer. Since the guide wears unevenly, measure the diameter at four places up and down the guide. If any measurements exceeds the service limit, replace the guide.



A. Small Bore Gauge

Table H16 Valve Guide Inside Diameter

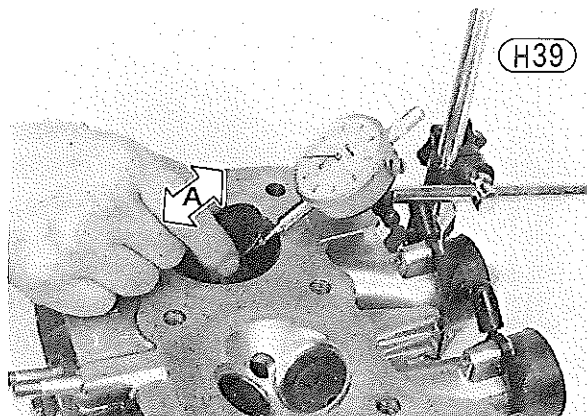
Standard	Service Limit
7.000 ~ 7.015 mm	7.08 mm

If a small bore gauge is not available, inspect the valve guide wear by measuring the valve to valve guide clearance with the wobble method, as indicated below.

Insert a new valve into the guide and set a dial gauge against the stem perpendicular to it as close as possible to the cylinder head mating surface. Move the stem back and forth to measure valve/valve guide clearance. Repeat the measurement in a direction at a right angle to the first.

If the reading exceeds the service limit, replace the guide.

NOTE: The reading is not actual valve/valve guide clearance because the measuring point is above the guide.



A. Move the valve.

Table H17 Valve/Valve Guide Clearance (Wobble Method)

	Standard	Service Limit
Inlet	0.050 ~ 0.124 mm	0.25 mm
Exhaust	0.071 ~ 0.142 mm	0.24 mm

Valve seat repair

The valve must seat in the valve seat evenly around the circumference over the specified area. If the seat is too wide, the seating pressure per unit of area is reduced, which may result in compression leakage and carbon accumulation on the seating surface. If the seating area is too narrow, heat transfer from the valve is reduced and the valve will overheat and warp. Uneven seating or seat damage will cause compression leakage.

Valve Seating Width

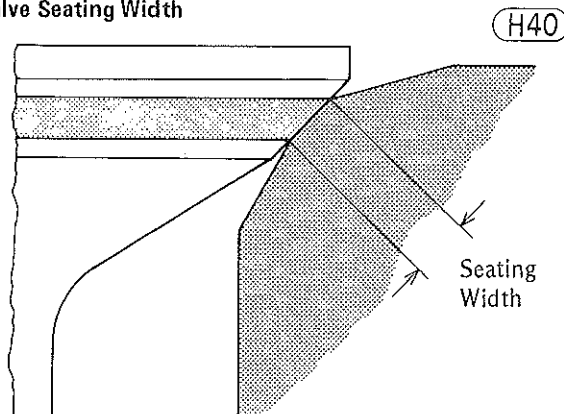
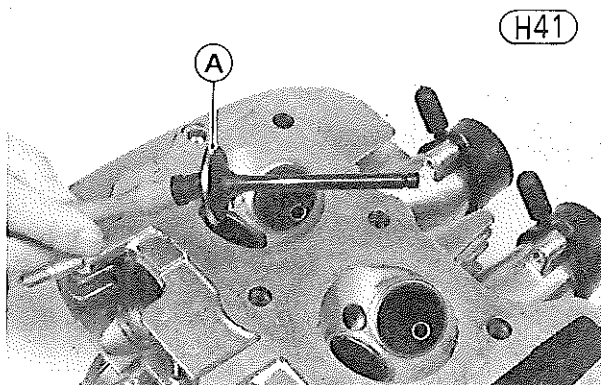


Table H18 Valve Seat Width

Standard
0.8 ~ 1.2 mm

To determine whether or not the valve seat requires repair, first remove the valve, apply machinist's dye to the valve seat, and then use a lapper to tap the valve lightly into place. Remove the valve, and note where the dye adheres to the valve seating surface. The valve seating surface should be in the middle of the valve face (Fig. H40). The distribution of the dye on the seating surface gives an indication of seat condition (Fig. H45).

NOTE: The valve and valve guide must be in good condition before this check will give an accurate indication of valve seat condition.



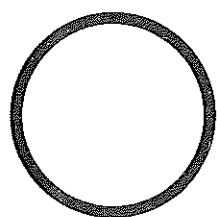
A. Machinist's Dye

A valve seat which requires repair is cut with a set of valve seat cutters (special tools). Four cutters are required for complete repair; one 30° (inlet valve seat only); one 45°; and two 60° cutters, one for the inlet and the other for the exhaust.

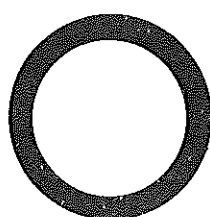
First, cut the seating surface of the valve seat with the 45° cutter. Cut only the amount necessary to make a good surface; overcutting will reduce the valve clearance, possibly making it no longer adjustable.

Next, use the 30° cutter (inlet valve seat only) to cut the surface inside the seating surface, and then use the 60° cutter to cut the outermost surface. Cut these two surfaces so that the seating surface will have the specified width.

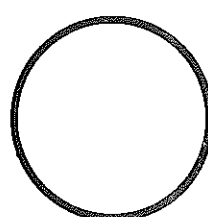
Valve/Valve Seat Contact Area



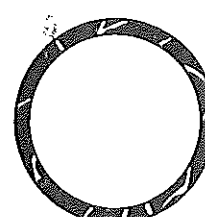
Good



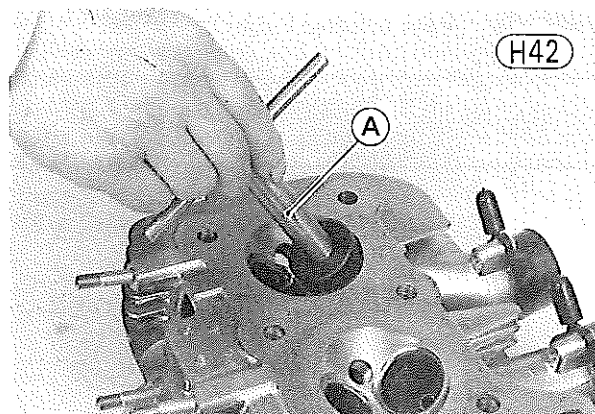
Too Wide



Too Narrow

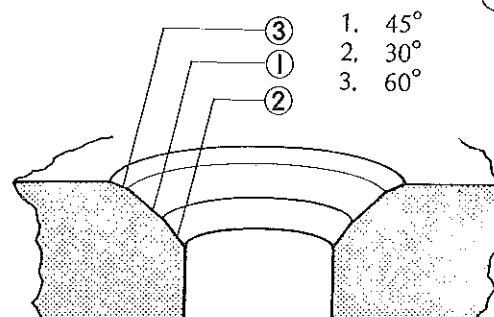


Uneven



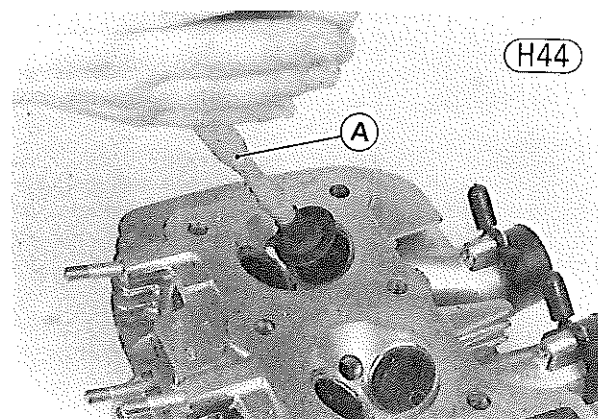
A. Valve Seat Cutter Holder (57001-106)

Cutting Angle of Valve Seat



After cutting, lap the valve to properly match the valve and valve seat surfaces. Start off with coarse lapping compound, and finish with fine compound.

Apply compound to the valve seat, and tap the valve lightly into place while rotating it with a lapper, repeating this until a smooth, matched surface is obtained.



A. Valve Lapper

H45

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Table H19 Valve Installed Height Procedure

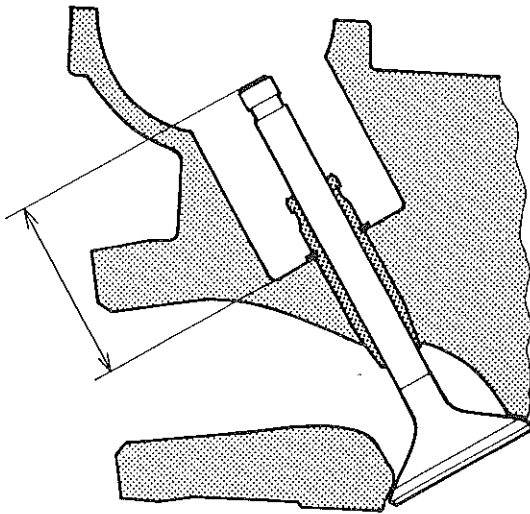
Measurement	Probable Cause	Recommendation	
Less than 37.12 mm	Valve stem ground previously	1. Check to be sure to leave at least 4.2 mm of stem end above the wide groove portion. See Pg. 167. 2. Interchange valve to deeper cut valve seat. Remeasure. 3. Grind valve face to drop it further into valve seat. Remeasure. 4. Replace valve. Remeasure.	
37.12~37.16 mm 37.17~37.21 37.22~37.26 37.27~37.31 37.32~37.36 37.37~37.41 37.42~37.46 37.47~37.51 37.52~37.56 37.57~37.61 37.62~37.66 37.67~37.71 37.72~37.76 37.77~37.81 37.82~37.86 37.87~37.91 37.92~37.96 37.97~38.01 38.02~38.06	Normal/acceptable	Assembly with this shim:	After checking valve clearance, final shim may be in this range:
		2.85 mm	2.85~3.20 mm
		2.80	2.80~3.20
		2.75	2.75~3.20
		2.70	2.70~3.15
		2.65	2.65~3.10
		2.60	2.60~3.05
		2.55	2.55~3.00
		2.50	2.50~2.95
		2.45	2.45~2.90
		2.40	2.40~2.85
		2.35	2.35~2.80
		2.30	2.30~2.75
		2.25	2.25~2.70
		2.20	2.20~2.65
		2.15	2.15~2.60
		2.10	2.10~2.55
		2.05	2.05~2.50
		2.00	2.00~2.45
		2.00	2.00~2.40
38.07~38.37 mm	Wear or grinding of valve face and valve seat allowed valve to drop too far into valve seat.	1. Interchange valve to shallowest cut valve seat. Remeasure. 2. Grind 0.3 mm maximum off valve stem. See CAUTION, Pg. 167. Remeasure.	
More than 38.37 mm	Valve face and valve seat worn out or excessively ground.	1. Replace valve. Remeasure. 2. Replace cylinder head. Remeasure.	

When lapping is completed, check the valve stem height and adjust if necessary.

After grinding the valves or valve seats and before assembling the cylinder head, measure the installed valve height from the bottom of the cylinder head lifter hole to the end of the valve stem with a vernier caliper. Refer to Table H19 for the recommended repair.

Valve Stem Height

H46



Be sure to mark each valve so it will be properly matched to its corresponding valve seat during assembly.

A selection of various thickness valve shims are available for adjusting the valve clearance. There is, however, a limit to the amount of adjustment possible using the shims. Resurfacing of the valve face and valve seat inevitably drops the valve deeper into the valve seat, allowing the valve stem end to come closer to the camshaft. Consequently, a thinner shim must be used to compensate for the reduced valve clearance.

Over a period of long use and repeated resurfacing, the valve may drop so far into the valve seat that even the thinnest shim cannot give adequate clearance. In this case, it is possible to grind the end of the valve stem to reduce the valve installed height and so gain the needed clearance (See Caution in Pg. 167).

If the valve drops so far into the valve seat that the installed height becomes quite large, either by a resurfacing error or heavy wear, it may be necessary to replace the valve and remeasure the installed height. If this is not successful, it will be necessary to replace the cylinder head. Replacement valve seats are not available.

Valve Springs

When the valve is not being pushed open by the cam, valve springs press the valve against the seat to prevent compression leakage. An inner spring is used with each outer spring to prevent spring surge, which may cause valve float at high rpm. If the springs weaken or break, compression leakage and valve noise will result, dropping engine power.

Spring Tension

Remove the springs, and set them one at a time, on a spring tension testing device. Compress the spring, and read the tension at the test length. If the spring tension at the specified length is weaker than the service limit, replace the spring.

Valve Spring Tension Measurement

H47

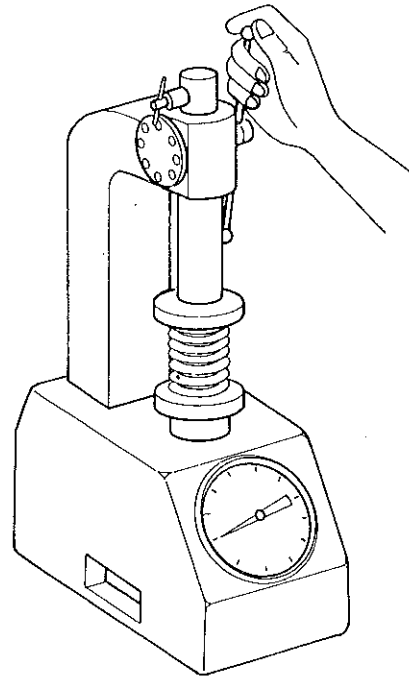


Table H20 Valve Spring Tension

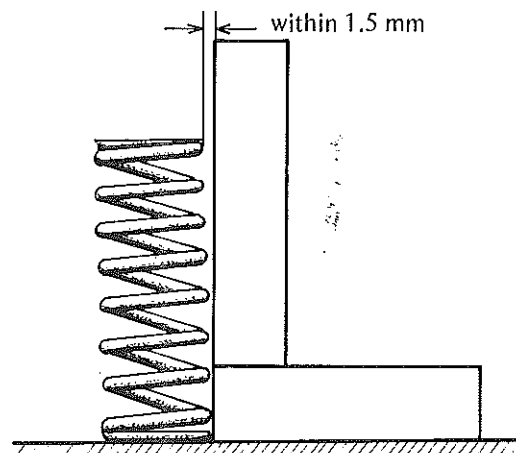
	Length	Standard	Service Limit
Inner	23.6 mm	26.20 ~ 28.96 kg	24.7 kg
Outer	25.6 mm	49.06 ~ 54.22 kg	46.2 kg

Squareness

Measure the squareness of each spring by standing each end on a surface plate and setting a square against it. Replace any spring for which the distance between the top of the spring and the square is greater than the service limit.

Valve Spring Squareness

H48



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Table H21 Valve Spring Squareness

Standard	Service Limit
under 1.0 mm	1.5 mm

Oil Seals

The oil seal around each valve stem prevents oil from leaking down into the combustion chamber. If an oil seal is damaged or deteriorated, oil consumption will increase, and carbon may build up in the combustion chambers. This may be indicated by white exhaust smoke.

If an oil seal appears damaged or deteriorated or if there is any doubt as to its condition, replace it with a new one.

AIR INJECTION SYSTEM (on US Model)

The secondary air injection system helps the fuel/air mixture burn more completely. Following the power stroke, the exhaust valve opens. As the burned fuel charge passes the exhaust valve, it is still hot enough to burn if air is supplied. By introducing a stream of fresh air into the hot exhaust gases just as they pass

the exhaust valve, the burning is both intensified and prolonged. This increased burning action tends to burn up a great deal of the normally unburned gases, as well as changing a significant portion of the positions carbon monoxide into harmless carbon dioxide.

The secondary air injection system consists of a vacuum switch valve, air suction valves, and air hoses. Without the use of an air pump, this system introduces fresh air into the exhaust system near the exhaust ports in response to pressure differentials generated by pulses in the exhaust.

Air Suction Valves

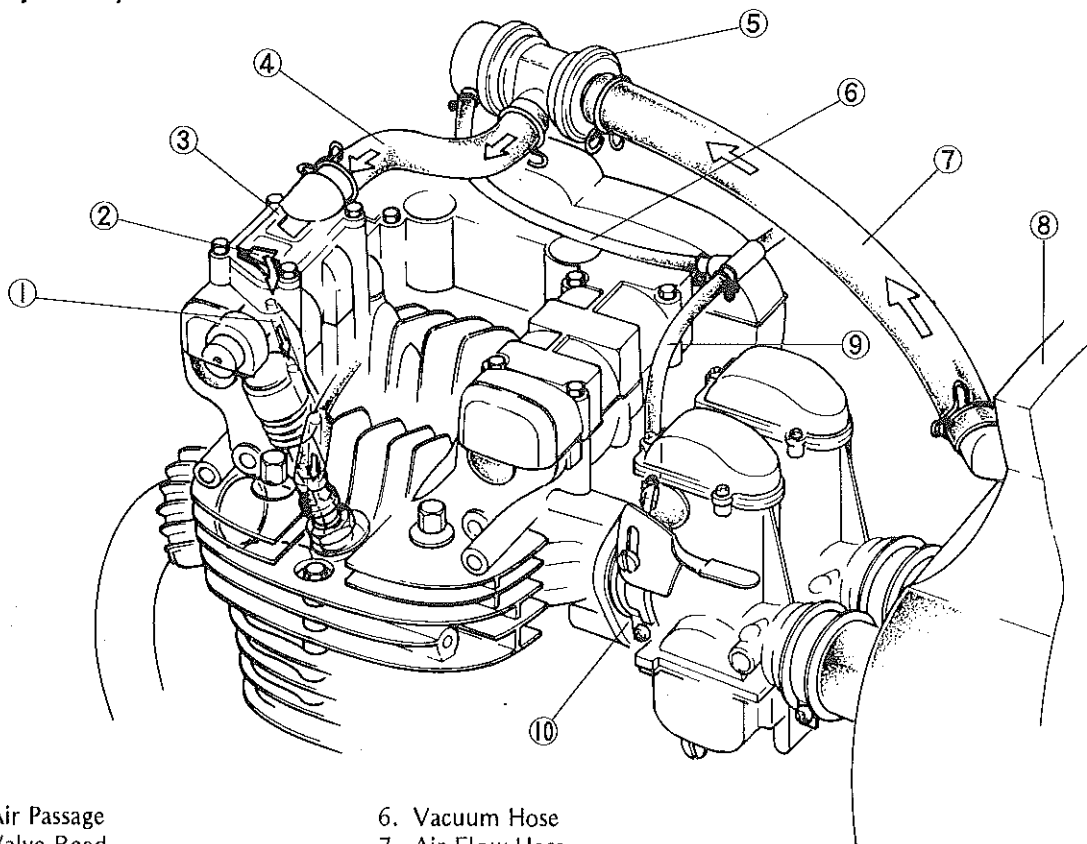
The air valve is essentially a check valve which allows fresh air to flow only from the air cleaner into the exhaust port. Any air that has passed the air suction valve is prevented from returning. Remove and inspect the air suction valves periodically (Pg. 10). Also, remove and inspect the air suction valves whenever the idle is unstable, engine power is greatly reduced, or there are abnormal engine noises.

Inspection

Visually inspect the reeds for cracks, folds, warping, heat damage, or other damage. If there is any doubt as to the condition of a reed, replace the air suction valve as an assembly.

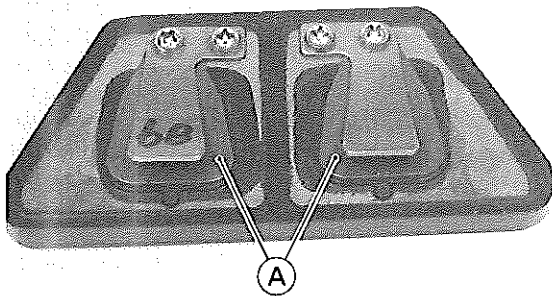
Air Injection System

(H49)



- | | |
|----------------------------|------------------------|
| 1. Air Passage | 6. Vacuum Hose |
| 2. Valve Reed | 7. Air Flow Hose |
| 3. Air Suction Valve Cover | 8. Air Cleaner Housing |
| 4. Air Flow Hose | 9. Vacuum Hose |
| 5. Vacuum Switch Valve | 10. Carburetor Holder |

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A. Reeds

Check the reed contact areas of the valve holder for grooves, scratches, any signs of separation from the holder, or heat damage. Check the sealing lip coating on the valve holder for the same signs. If there is any doubt as to the condition of the reed contact areas or the sealing lip, replace the air suction valve as an assembly.

If any carbon or other foreign particles have accumulated between the reed and the reed contact area, wash the valve assembly with a high flash-point solvent.

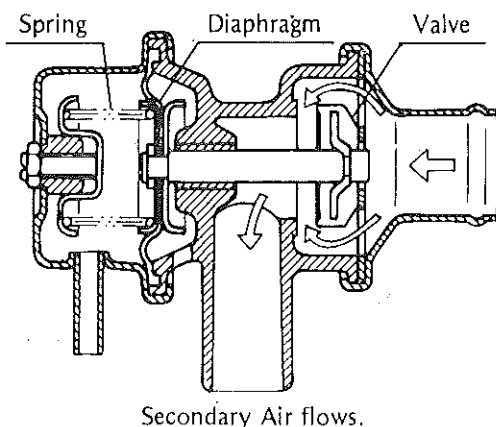
CAUTION Do not scrape off the deposits as this could damage the rubber, necessitating air suction valve assembly replacement.

Vacuum Switch Valve

Although the vacuum switch valve usually permits secondary air flow, it shuts off the air flow when a high vacuum (low pressure) is developed at the engine side of the carburetor bores during engine braking. This is to prevent explosions in the exhaust ports which might be caused by extra unburned fuel in the exhaust during deceleration, if fresh air were injected into the exhaust ports. These explosions or "backfiring" in the exhaust system could damage the air suction valves.

Regular inspection of the vacuum switch valve is not needed. If backfiring occurs frequently in the exhaust system during engine braking or if there are abnormal engine noises, check the vacuum switch valve as follows:

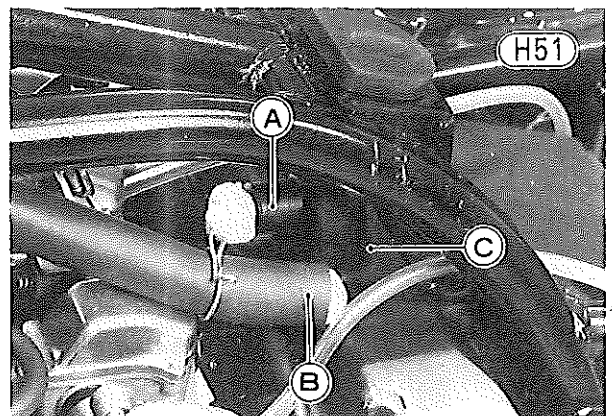
Vacuum Switch Valve Operation



Secondary Air flows.

Inspection

- Be certain that all the hoses are routed without being flattened or kinked, and are connected correctly to the air cleaner housing, vacuum switch valve, #1 and #4 carburetor holders, and air suction valve covers. If they are not, correct them or replace them if damaged.
- Warm up the engine thoroughly.
- Note the frequency and the loudness of backfiring in the exhaust system which takes place when the throttle valves are quickly opened and then closed. Rev the engine to about 4,000 rpm. To low a speed does not generate a high enough vacuum to operate the vacuum switch valve, and too high a speed is not necessary and may be harmful to the engine.
- Stop the engine.
- At the air cleaner housing, disconnect the hose which connects the air cleaner housing and the vacuum switch valve.
- Plug the hose fitting on the air cleaner housing so that unfiltered air does not enter the air cleaner housing through the hose fitting. Plug the hose that is disconnected so that no air can flow to the air suction valves through the vacuum switch valve.



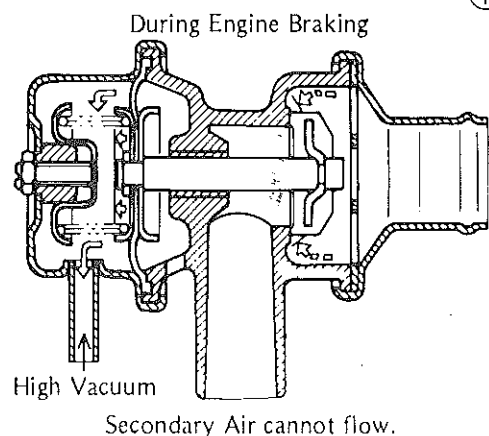
A. Plug the hose fitting.

B. Plug the hose.

C. Air Cleaner Housing

- Start the engine, and note the frequency and loudness at the backfiring as before.
- If the backfiring occurs in the same manner in both cases, the vacuum switch valve works properly. If

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Secondary Air cannot flow.

the backfiring is different the second time, the vacuum switch valve is defective and must be replaced with a new one. Vacuum switch adjustment is not permitted.

CYLINDER BLOCK, PISTONS

The cylinder block is subjected to extremely high temperatures. Since excessive heat can seriously distort the shape of a cylinder or cause piston seizure, the cylinder block is made of aluminum alloy for good heat conduction and the outside is finned to increase the heat-radiating surface for better cooling efficiency. To minimize distortion from heat and to maximize durability, a wear resistant iron sleeve is cold-pressed into each cylinder.

Each piston is made from an aluminum alloy, which expands and distorts slightly from heat during engine operation. So that the piston will become cylindrical after heat expansion, it is designed such that, when cold, it is tapered in towards the head and is elliptical rather than perfectly round. The piston diameter is made so that there is enough clearance between the piston and cylinder to allow for expansion.

Three rings are fitted into grooves near the top of each piston to prevent compression leakage into the crankcase and to stop oil from getting up into the combustion chambers. The top two rings are compression rings, and the bottom ring is an oil ring.

The full floating type of piston pin is used to connect each piston to its connecting rod. The middle part of the piston pin passes through the small end of the connecting rod, and a snap ring is fitted at each end of the piston pin in a groove to prevent the pin from coming out. Since the pin is the full floating type, a small amount of clearance exists between the piston pin and the piston when the engine is at normal operating temperatures.

Proper inspection and maintenance of the cylinder block and the pistons include checking the compression; removing carbon from the piston heads, piston ring grooves, and cylinder head exhaust ports; and checking for wear and proper clearance during top end overhaul.

A worn cylinder, worn piston, or worn or stuck piston rings may cause a loss of compression from gas blowby past the rings. Blowby may result in difficult starting, power loss, excessive fuel consumption, contaminated engine oil, and possibly engine destruction. Oil leakage into the combustion chambers causes carbon to build up on top of the pistons; which may result in preignition, overheating, and detonation. A worn piston pin causes piston slap, which may cause accelerated piston and cylinder wear. It is evidenced by a knocking sound in the engine.

Engine problems may be caused not only by carbon deposits and wear or damage to the engine itself; but also by poor quality fuel or oil, improper oil, improper fuel/air mixture, improper supply of oil, or incorrect ignition timing. Whenever knocking, pinging, piston slap, or other abnormal engine noise is heard; the cause

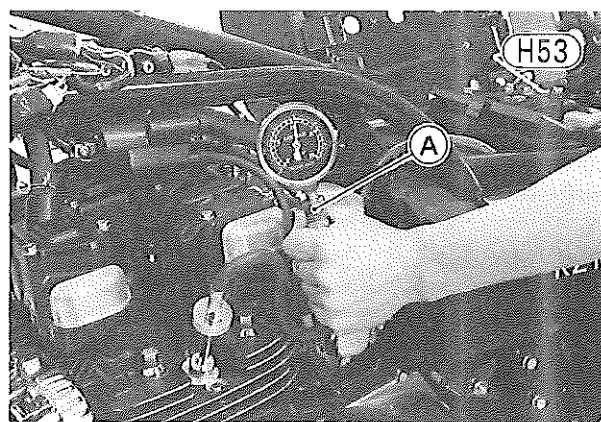
should be determined as soon as possible. Neglect of proper maintenance will result in reduced engine power and may lead to accelerated wear, overheating, detonation, piston seizure, and engine destruction.

Compression measurement

A compression test is useful in determining the condition of the engine. Low compression may be due to cylinder wear; worn piston ring grooves; worn, broken, or sticking piston rings; poor valve seating; cylinder head leaks; or damage to the engine such as piston seizure. Too high compression may be due to carbon build-up on the piston heads and cylinder head. Difference in compression between the cylinders may cause poor running.

Before measuring compression, check that the cylinder head is tightened down with the specified torque (Pg. 55) and that the battery is fully charged (Pg. 218), and thoroughly warm up the engine so that engine oil between the pistons and cylinder walls will help seal compression as it does during normal running. While the engine is running, check that there is no gas leakage from around the cylinder head gasket and from the spark plugs.

Stop the engine, remove the spark plugs, and attach the compression gauge (special tool) firmly into one spark plug hole. Using the starter motor, turn the engine over with the throttle fully open until the compression gauge stops rising; the compression is the highest reading obtainable. Repeat the measurement for the other cylinder.



A. Compression Gauge (57001-123)

Table H22 Cylinder Compression†

Standard	Service Limit
9 ~ 11 kg/cm ² (128 ~ 156 psi)	7 kg/cm ² (100 psi), or more than 1 kg/cm ² (14 psi) difference between the cylinders

† Engine hot, all spark plugs removed, throttle fully opened, cranking the engine with the starter motor.

If cylinder compression is higher than the standard value, check the following:

1. Carbon build-up on the piston head and cylinder head — clean off any carbon on the piston head and cylinder head.

2. Cylinder head gasket, cylinder base gasket — use only the proper gasket for the cylinder head. The use of a gasket of incorrect thickness will change the compression.
3. Valve stem oil seals and piston rings — rapid carbon accumulation in the combustion chambers may be caused by damaged valve stem oil seals and/or damaged piston oil rings. This may be indicated by white exhaust smoke.
4. Cylinder head combustion chamber volume (Pg. 166).

If cylinder compression is lower than the service limit, check the following:

1. Leakage around the cylinder head — replace the head gasket and check the cylinder head warp (Pg. 165).
2. Condition of the valve seating (Pg. 168).
3. Valve clearance — if a valve requires an unusually thick shim to obtain proper clearance, the valve may be bent, and not seating completely.
4. Piston/cylinder clearance, piston seizure
5. Piston ring, piston ring groove

Cylinder, piston wear

Since there is a difference in cylinder wear in different directions, take a side-to-side and a front-to-back measurement at each of the 3 locations (total of 6 measurements) shown in Fig. H54. If any of the cylinder inside diameter measurements exceeds the service limit, the cylinder will have to be bored to oversize and then honed. However, if the amount of boring necessary would make the inside diameter greater than 71 mm, the cylinder block must be replaced.

Cylinder Diameter Measurement

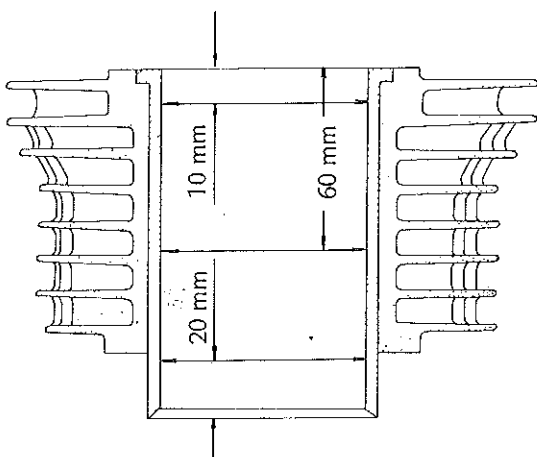
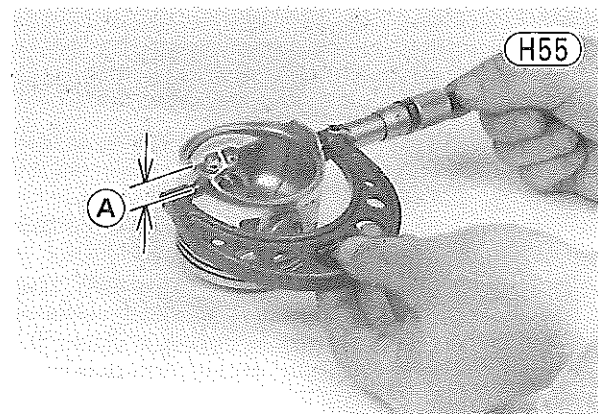


Table H23 Cylinder Inside Diameter

Standard	Service Limit
70.000 ~ 70.012 mm, and less than 0.01 mm difference between any two measurements	70.10 mm, or more than 0.05 mm difference between any two measurements

Measure the outside diameter of each piston 5 mm up from the bottom of the piston at a right angle to the direction of the piston pin. If the measurement is under the service limit, replace the piston.

NOTE: Abnormal wear such as a marked diagonal pattern across the piston skirt may mean a bent connecting rod or crankshaft.



A. 5 mm

Table H24 Piston Diameter

Standard	Service Limit
69.942 ~ 69.957 mm	69.80 mm

Table H23 applies only to a cylinder that has not been bored to oversize, and Table H24 applies only to the standard size piston. In the case of a rebored cylinder and oversize piston, the service limit for the cylinder is the diameter that the cylinder was bored to plus 0.1 mm and the service limit for the piston is the oversize piston original diameter minus 0.15 mm. If the exact figure for the rebored diameter is unknown, it can be roughly determined by measuring the diameter at the base of the cylinder.

NOTE: Whenever a piston or cylinder block has been replaced with a new one, the motorcycle must be broken in the same as with a new machine.

Piston/cylinder clearance

The piston-to-cylinder clearance is measured whenever a piston or the cylinder block is replaced with a new one, or whenever a cylinder is rebored and an oversize piston installed. The standard piston-to-cylinder clearance must be adhered to whenever the cylinder block is replaced or a cylinder rebored. If only a piston is replaced, the clearance may exceed the standard slightly. But it must not be less than the minimum, in order to avoid piston seizure.

The most accurate way to find the piston clearance is by making separate piston and cylinder diameter measurements and then computing the difference between the two values. Measure the piston diameter as just described, and measure the cylinder diameter at the very bottom of the cylinder.

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Table H25 Piston/Cylinder Clearance

Standard
0.043 ~ 0.070 mm

Boring, honing

When boring and honing a cylinder, note the following:

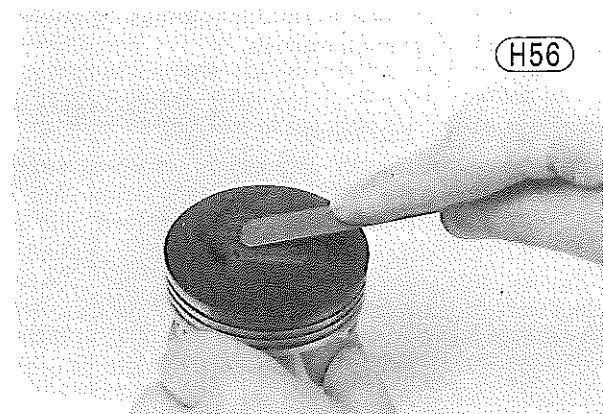
1. Before boring a cylinder, first measure the exact diameter of the oversize piston, and then, in accordance with the standard clearance given in Table H25, determine the diameter of the rebore.
2. To avoid cylinder distortion due to unbalanced metal temperatures, bore the cylinders in 2-4-1-3 or 3-1-4-2 order.
3. Cylinder inside diameter must not vary more than 0.01 mm at any point.
4. Be wary of measurements taken immediately after boring since the heat affects cylinder diameter.
5. There are two sizes of oversize pistons available: 0.5 mm and 1.0 mm. Oversize pistons require oversize rings.

Piston/cylinder seizure

Remove the cylinder block and pistons to check the damage. If there is only slightly damage, the piston may be smoothed with #400 emery cloth, and any aluminum deposits removed from the cylinder with either #400 emery cloth or light honing. However, in most cases, the cylinder will have to be bored to oversize and honed, and an oversize piston installed.

Piston cleaning

Built-up carbon on the piston head reduces the cooling capability of the piston and raises compression leading to overheating which could possibly even melt the top of the piston. To decarbonize the piston head, remove the piston (Pg. 59), scrape off the carbon, and then lightly polish the piston with fine emery cloth.



Carbon accumulated in the piston ring grooves can cause the rings to stick. Remove the rings, and clean out any carbon deposits using an end of a broken piston ring or some other suitable tool.



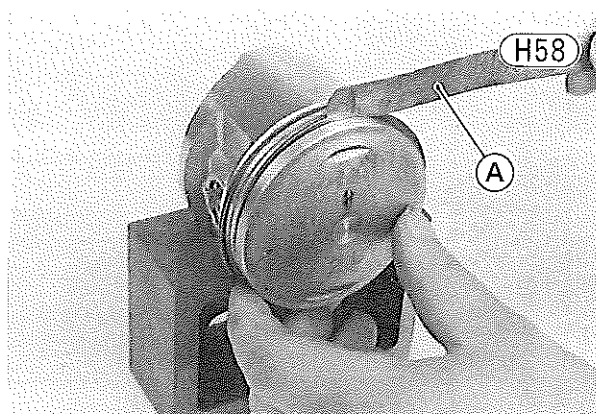
CAUTION

1. When removing carbon, take ample care not to scratch the side of the piston, or the piston ring grooves.
2. Never clean the piston heads with the engine assembled. If the carbon is scraped from the piston heads with the cylinder left in place, carbon particles will unavoidably drop between the pistons and cylinder walls onto the rings and eventually find their way into the crankchamber. Carbon particles, which are very abrasive, drastically shorten the life of the rings, pistons, cylinders, crankshaft bearings, and oil seals.

Piston ring, piston ring groove wear

Visually inspect the piston rings and the piston ring grooves. If the rings are worn unevenly or damaged, they must be replaced. If the piston ring grooves are worn unevenly or damaged, the piston must be replaced and fitted with new rings.

With the piston rings in their grooves, make several measurements with a thickness gauge to determine piston ring/groove clearance. If the clearance exceeds the service limit, measure the thickness of the piston rings and the width of the ring grooves. If the ring has worn down to less than the service limit, replace the ring; if the groove width exceeds the service limit, replace the piston.



A. Thickness Gauge

Table H26 Piston Ring/Groove Clearance

	Standard	Service Limit
Top	0.040 ~ 0.080 mm	0.15 mm
2nd	0.030 ~ 0.070 mm	0.15 mm

Table H27 Piston Ring Thickness

	Standard	Service Limit
Top and 2nd	1.170 ~ 1.190 mm	1.10 mm

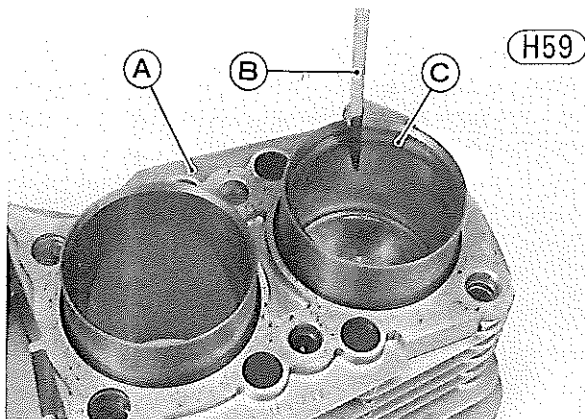
Table H28 Piston Ring Groove Width

	Standard	Service Limit
Top	1.23 ~ 1.25 mm	1.33 mm
2nd	1.22 ~ 1.24 mm	1.32 mm
Oil	2.51 ~ 2.53 mm	2.60 mm

When new rings are being fitted into a used piston, check for uneven groove wear by inspecting the ring seating. The rings should fit perfectly parallel to the groove surfaces. If not, the piston must be replaced.

Piston ring end gap (top, second)

Place the piston ring inside the cylinder, using the piston to locate the ring squarely in place. Set it close to the bottom of the cylinder, where cylinder wear is low. Measure the gap between the ends of the ring with a thickness gauge. If the gap is wider than the service limit, the ring is worn and must be replaced.



A. Cylinder Block
B. Thickness Gauge
C. Piston Ring

Table H29 Ring End Gap

	Standard	Service Limit
Top and 2nd	0.30 ~ 0.50 mm	0.80 mm

Piston, piston pin, connecting rod wear

Measure the diameter of the piston pin with a micrometer, and measure the inside diameter of both piston pin holes in the piston. If the piston pin diameter is less than the service limit at any point, replace the piston pin. If either piston pin hole diameter exceeds the service limit, replace the piston.

Measure the inside diameter of the connecting rod small end. If the diameter exceeds the service limit, replace the connecting rod.

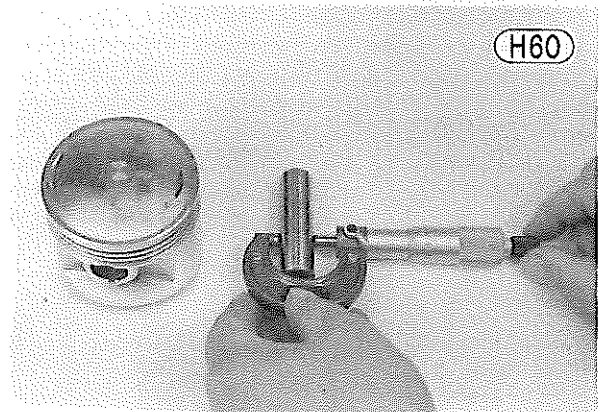


Table H30 Piston Pin, Piston Pin Hole Small End Diameter

	Standard	Service Limit
Piston Pin	16.995 ~ 17.000 mm	16.96 mm
Pin Hole	17.004 ~ 17.011 mm	17.08 mm
Small End	17.003 ~ 17.014 mm	17.05 mm

NOTE: When a new piston or pin is used, also check that piston-to-pin clearance is 0.004 ~ 0.016 mm, and that pin to small end clearance is within 0.003 ~ 0.019 mm.

CRANKSHAFT, CONNECTING RODS

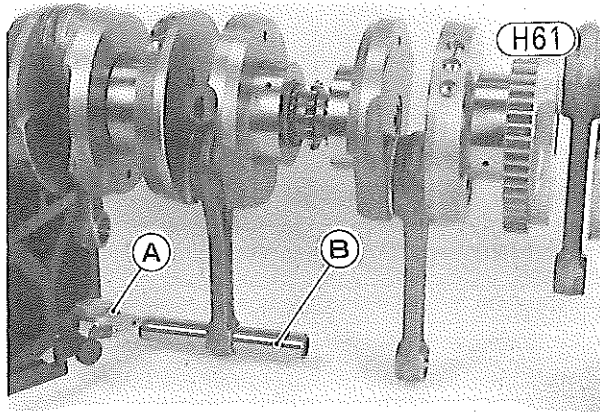
The crankshaft changes the reciprocating motion of the pistons into rotating motion, which is transmitted to the rear wheel when the clutch is engaged. The connecting rods connect the pistons to the crankshaft. Crankshaft or connecting rod trouble, such as worn crankshaft journals or a bent connecting rod, will multiply the stress caused by the intermittent force on the pistons. This results in not only rapid crankshaft bearing wear; but also noise, power loss, vibration, and shortened engine life. A defective crankshaft or connecting rod should always be detected at an early stage and then replaced immediately.

This manual lists some of the more common crankshaft troubles and the method for detecting them; it does not explain crankshaft disassembly. Crankshaft disassembly requires exacting tolerances and highly specialized equipment; when the crankshaft becomes defective for one or more reasons, it should be replaced as an assembly, or rebuilt by a properly equipped Kawasaki rebuilding station.

NOTE: The crankshaft bearing caps are machined assembled with the crankcase, and if the caps are damaged during repairs or otherwise, the caps and crankcase must be replaced as a machine-matched set.

Connecting rod bending or twisting

Remove the bearing from each end of the crankshaft and set the crankshaft in V blocks on a surface plate. Select an arbor of the same diameter as the piston pin and of optional length, and insert it into the small end of the connecting rod. Use a height gauge or dial gauge and measure the difference in height over a 100 mm length to determine the amount the connecting rod is bent.



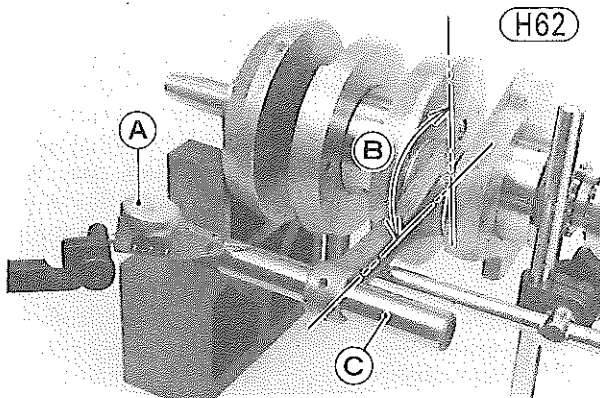
A. Height Gauge B. Arbor

Table H31 Connecting Rod Bend/100 mm

Standard	Service Limit
under 0.05 mm	0.20 mm

Using the arrangement and arbor shown below, measure the amount that the arbor varies from being parallel with the crankshaft, over a 100 mm length of the arbor.

If either of the above measurements exceeds the service limit, the crankshaft assembly should be replaced.



A. Height Gauge B. 90° C. Arbor

Table H32 Connecting Rod Twist/100 mm

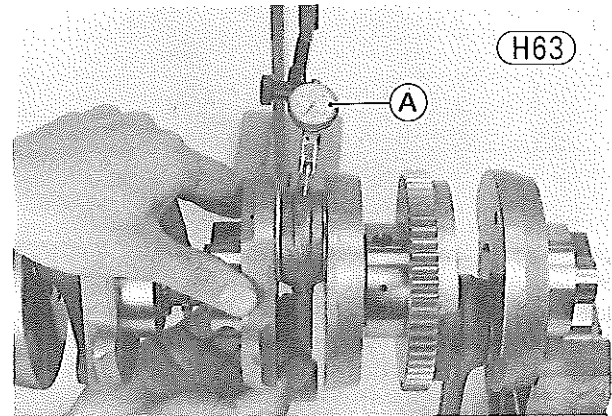
Standard	Service Limit
under 0.05 mm	0.20 mm

Connecting rod big end radial clearance

Remove the bearing from either end of the crankshaft and suspend it in V blocks. Set a dial gauge against the

big end of the connecting rod, and first push the connecting rod toward the gauge and then in the opposite direction. The difference between the two gauge readings is the radial clearance.

If radial clearance exceeds the service limit, the crankshaft should be replaced.



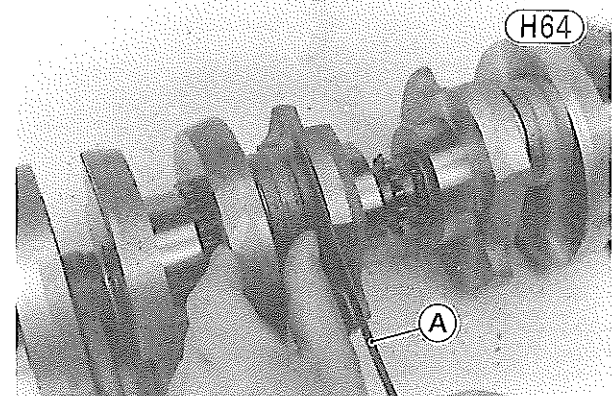
A. Height Gauge

Table H33 Connecting Rod Big End Radial Clearance

Standard	Service Limit
0.016 ~ 0.030 mm	0.08 mm

Connecting rod side clearance

Measure the side clearance of the connecting rod with a thickness gauge as shown. Replace the crankshaft if the clearance exceeds the service limit.



A. Thickness Gauge

Table H34 Connecting Rod Big End Side Clearance

Standard	Service Limit
0.3 ~ 0.4 mm	0.6 mm

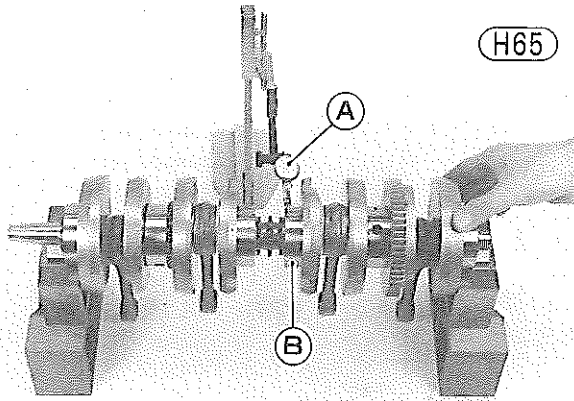
Crankshaft runout

With the six crankshaft bearings in place, set the crankshaft in V blocks, suspending it at the both end bearing outer races.

Set a dial gauge against each of the other bearings and turn the crankshaft slowly. The difference between the

highest and lowest dial gauge reading for the bearing is the runout.

If runout measured at any bearing exceeds the service limit, the crankshaft should be replaced.



A. Dial Gauge B. Bearing

Table H35 Crankshaft Runout

Standard	Service Limit
under 0.04 mm	0.10 mm

Main bearing wear

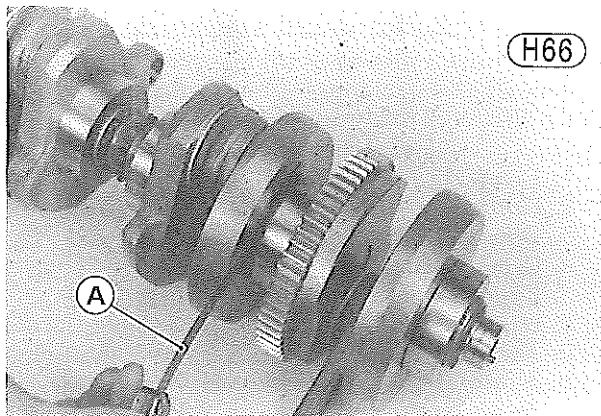
The crankshaft bearings are made to very close tolerance, and bearing play would be difficult to measure even if all the bearings could be removed. The worth of the bearing, therefore, must be judged by feel.

Wash the bearings in a high flash-point solvent, blow them dry (**DO NOT SPIN THEM**), and lubricate them. Turn each bearing over by hand and see that it makes no noise, turns smoothly, and has no rough spots. If either of the two end bearings is defective, that bearing can be replaced, but the other four bearings can be replaced only as an assembly with the crankshaft.

Bearing outer race side clearance

The No. 5 bearing outer race works not only as a bearing outer race but also as a stopper of crankshaft axial movement (thrust bearing).

Measure the clearance with a thickness gauge as shown. Replace the crankshaft, if the clearance exceeds the service limit.



A. Thickness Gauge

Table H36 Bearing Outer Race Side Clearance

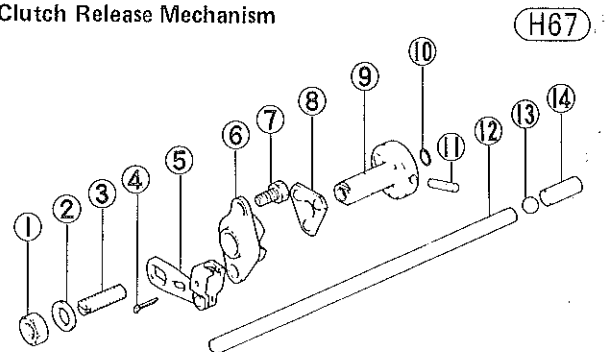
Standard	Service Limit
0.2~0.3 mm	0.5 mm

CLUTCH

Fig. H68 shows the construction of the clutch, which is a wet, multi-plate type with 9 friction plates (29) and 8 steel plates (29). The friction plates are made of cork, used for its high coefficient of friction, bonded to a steel core, which provides durability and warp resistance. The clutch hub (14) has a cam damper to absorb shock from the drive train. The clutch housing (16) has a reduction gear (1) on one side and contains springs (15) to absorb shock from the drive train.

The clutch release mechanism is shown in Fig. H67. When the clutch release lever (5) turns, the release shaft (9) rides on the steel balls (12), and pushes the push rod (12) toward the clutch. The clutch adjusting screw (3) is installed in the release shaft.

Clutch Release Mechanism



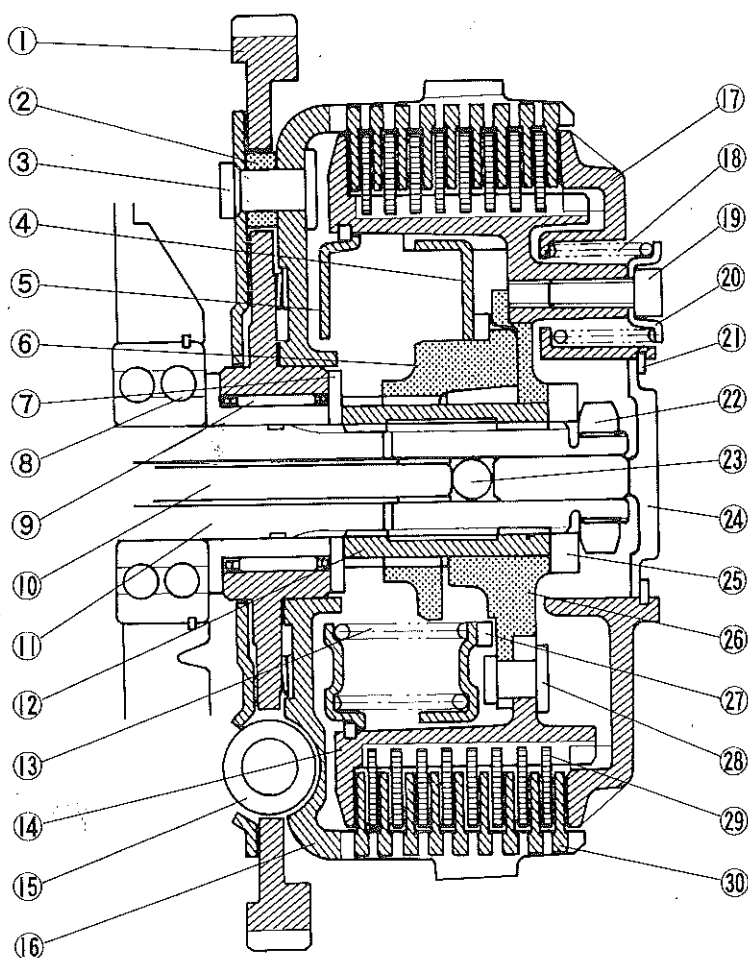
- | | |
|-------------------------|------------------|
| 1. Locknut | 8. ball Assembly |
| 2. Flat Washer | 9. Release Shaft |
| 3. Adjusting Screw | 10. O Ring |
| 4. Cotter Pin | 11. Knock Pin |
| 5. Clutch Release Lever | 12. Push Rod |
| 6. Ball Ramp | 13. Steel Ball |
| 7. Allen Bolt | 14. Push Rod |

The friction plates are keyed to the clutch housing by tangs on the outer circumference of each plate. Since the clutch housing is gear driven directly from the crankshaft, these plates are always turning any time the engine is running. The steel plates have a toothed inner circumference and mesh with the splines in the clutch hub. The hub is mounted on the drive shaft, so that the drive shaft and steel plates always turn together.

One end of each clutch spring forces against its washer and bolt, which is threaded into the clutch

Clutch

(H68)



1. Clutch Housing Gear
2. Collar
3. Rivet
4. Spring Seat
5. Damper Spring Plate
6. Damper Cam Follower
7. Thrust Washer
8. Ball Bearing
9. Needle Bearing
10. Push Rod
11. Drive Shaft
12. Splined Collar
13. Damper Spring
14. Clutch Hub
15. Spring
16. Clutch Housing
17. Spring Plate
18. Spring
19. Allen Bolt
20. Washer
21. Circlip
22. Hub Nut
23. Steel Ball
24. Spring Plate Pusher
25. Splined Washer
26. Damper Cam
27. Seat Stop
28. Rivet
29. Steel Plate
30. Friction Plate

hub. The other end forces against the spring plate. When the clutch is left engaged, the springs force the spring plate, friction plates, steel plates, and clutch hub tightly together so that the friction plates will drive the steel plates and transmit power to the transmission drive shaft.

When the clutch lever is pulled to release (disengage) the clutch, the clutch cable turns the clutch release shaft in towards the clutch. The clutch adjusting screw, assembled inside the clutch release shaft, then pushes the long push rod, which through the steel ball, short push rod, and spring plate pusher pushes the spring plate. Since the spring plate moves the same distance that the release shaft moves and the clutch hub remains stationary, the springs are compressed and pressure is taken off the clutch plates. Because the plates are no longer pressed together, power transmission from the crankshaft to the transmission drive shaft is interrupted. As the clutch lever is released, the clutch springs return the spring plate and once again force the spring plate, plate assembly, and clutch hub tightly together.

The cam damper includes the damper cam, cam follower, and damper springs. The cam follower is splined and able to move sideways (axially) on the drive shaft. The damper cam is fixed in the clutch hub. The damper springs press the cam follower against the cam.

Normally the cam and cam follower turn together and work as a coupling.

When the cam damper receives a shock, the cam follower slides on the curve of the cam and moves sideways on the shaft to compress the damper springs. The cam and cam follower are twisted momentarily by the shock. Therefore the cam damper changes the shock from the rotating force to the sliding movement sideways on the shaft and absorbs the shock.

A clutch that does not properly disengage will cause shifting difficulty and possible transmission damage. On the other hand, a slipping clutch will reduce power transmission efficiency and may overheat and burn out. A clutch that does not properly disengage may be caused by:

1. Excessive clutch lever play.
2. Clutch plates that are warped or too rough.
3. Uneven clutch spring tension.
4. Deteriorated engine oil.
5. Engine oil viscosity too high.
6. Engine oil level too high.
7. The clutch housing frozen on the drive shaft.
8. A defective clutch release mechanism.
9. An unevenly worn clutch hub or housing.
10. Missing parts.

A slipping clutch may be caused by:

1. No clutch lever play.
2. Worn friction plates.
3. Weak clutch springs.
4. The clutch cable not sliding smoothly.
5. A defective clutch release mechanism.
6. An unevenly worn clutch hub or housing.

Clutch noise may be caused by:

1. Too much backlash between the primary gear and the clutch gear.
2. Damaged gear teeth.
3. Too much clearance between the friction plate tangs and the clutch housing.
4. Needle bearing worn or damaged.
5. Weak or damaged damper spring(s).
6. Metal chips jammed into the clutch housing gear teeth.

Clutch spring tension

Remove the springs, and set them, one at a time, on a spring tension testing device as shown in Fig. H47. Compress the spring, and read the tension at the test length. If the spring tension at the specified length is weaker than the service limit, replace the spring.

Table H37 Clutch Spring Tension

Length	Standard	Service Limit
22.1 mm	19.1~22.5 kg	17.5 kg

Friction plate wear, damage

Visually inspect the friction plates to see whether or not they show any signs of seizure, overheating, or uneven wear. Measure the thickness of the plates with vernier calipers.

If any plates show signs of damage, or if they have worn past the service limit, replace them with new ones.

Friction Plate Measurement

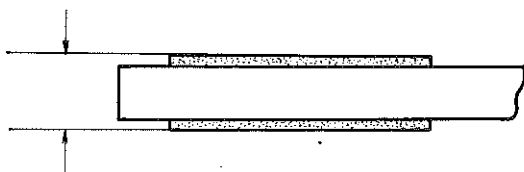


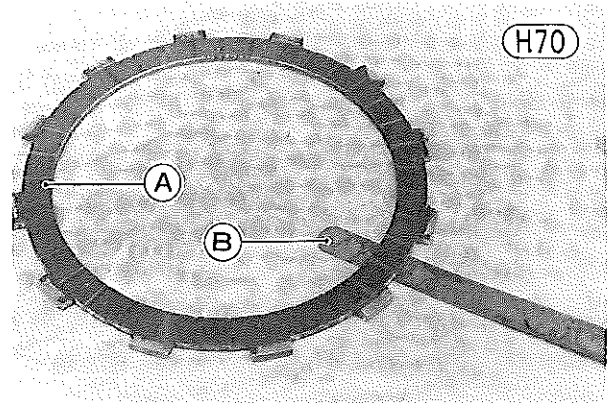
Table H38 Friction Plate Thickness

Standard	Service Limit
2.9~3.1 mm	2.7 mm

Clutch plate warp

Place each clutch plate on a surface plate, and measure the gap between each clutch plate and the surface plate. This gap is the amount of clutch plate warp.

Replace any plates warped over the service limit.



A. Clutch Plate

B. Thickness Gauge

Table H39 Clutch Plate Warp

Standard	Service Limit
under 0.20 mm	0.35 mm

Friction plate/clutch housing clearance

Measure the clearance between the tangs on the friction plates and the fingers of the clutch housing. If this clearance is excessive, the clutch will be noisy.

If the clearance exceeds the service limit, replace the friction plates. Also, inspect the fingers of the housing where the tangs of the friction plates hit them. If they are badly worn or if there are grooves cut where the tangs hit, replace the clutch housing.

Friction Plate/Clutch Housing Clearance

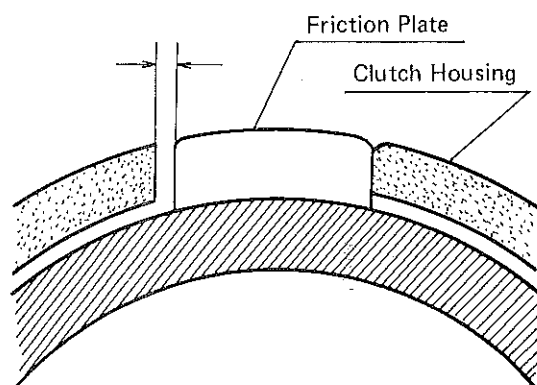


Table H40 Friction Plate/Clutch Housing Clearance

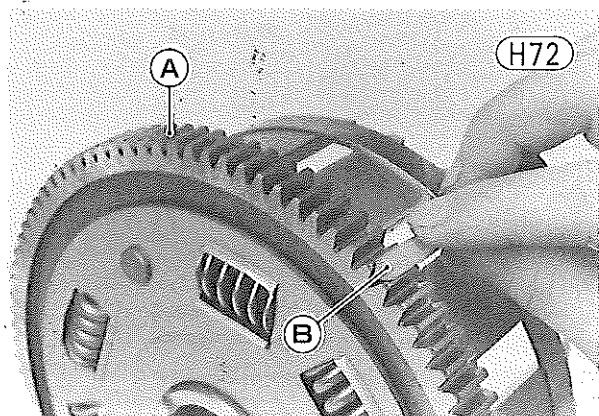
Standard	Service Limit
0.04~0.30 mm	0.5 mm

Clutch housing gear damage

Inspect the teeth on the clutch housing gear. Any light damage can be corrected with an oilstone, but the clutch housing must be replaced if the teeth are badly damaged. Damaged teeth on the clutch housing gear indicate that the primary gear, by which it is driven, may also be damaged. At the same time that

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the clutch housing gear is repaired or replaced, the primary gear should be inspected. If it is damaged, the crankshaft must be replaced.

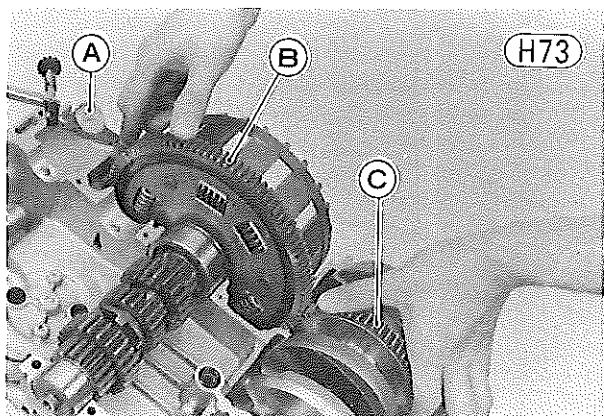


A. Clutch Housing Gear

B. Oilstone

Clutch housing/primary gear backlash

Split the crankcase. Leaving the drive shaft and crankshaft in place, measure the backlash between the clutch housing gear and the primary gear. To measure the backlash, set a dial gauge against the teeth of one gear, and move the gear back and forth while holding the other gear steady. The difference between the highest and the lowest gauge reading is the amount of backlash. Replace both the clutch housing and the crankshaft whenever the amount of backlash exceeds the service limit.



A. Dial Gauge

B. Clutch Housing Gear

C. Primary Gear

Table H41 Clutch Housing/Primary Gear Backlash

Standard	Service Limit
under 0.06 mm	0.11 mm

Clutch housing/drive shaft sleeve wear

Measure the diameter of the drive shaft sleeve with a micrometer. Replace the drive shaft sleeve if the diameter is less than the service limit. Measure the inside

diameter of the clutch housing with a cylinder gauge. Replace the clutch housing if the diameter exceeds the service limit. When replacing the clutch housing and/or drive shaft sleeve, replace the clutch housing needle bearing also.

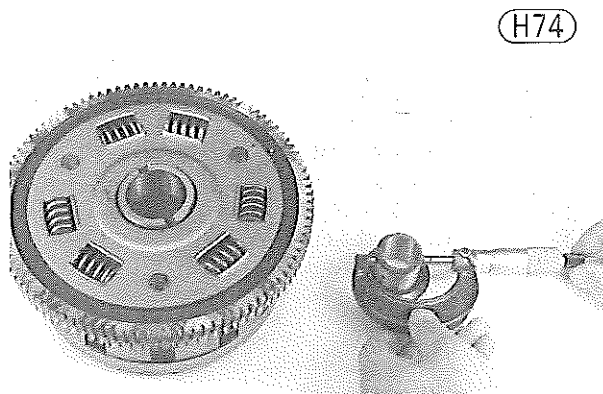


Table H42 Clutch Housing, Drive Shaft Sleeve, Clutch Hub, Splined Collar Diameter

	Standard	Service Limit
Housing I.D.	37.000~37.016 mm	37.03 mm
Sleeve O.D.	31.980~31.995 mm	31.96 mm
Hub I.D.	32.000~32.025 mm	32.04 mm
Collar I.D.	31.950~31.975 mm	31.94 mm

Needle bearing wear

The rollers in the needle bearing wear so little that the wear is difficult to measure. Instead, inspect the needle bearing for abrasion, color change, or other damage. If there is any doubt as to its condition, replace the needle bearing.

Clutch hub damage

Inspect the clutch hub splines where the teeth on the steel plates wear against the splines of the clutch hub. If there are notches worn into the splines, replace the clutch hub.

Clutch release mechanism wear

Visually inspect the clutch release lever, balls, and ball ramp for damage or excessive wear. If there is any damage or excessive wear, replace the clutch release lever, balls, and ball ramp as a set.

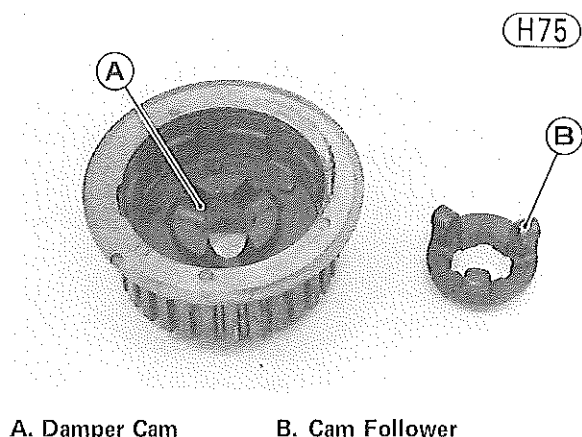
Lubrication

Lubricate the clutch release lever, balls, and ball ramp with grease.

Cam damper inspection

Disassemble the clutch hub, and inspect the damper cam and cam follower.

Replace the damper if it appears damaged.



A. Damper Cam

B. Cam Follower

Cam damper spring tension

Remove the damper springs, and set them, one at a time, on a spring tension testing device. Compress the spring, and read the tension at the test length. If the spring tension at the specified length is weaker than the service limit, replace the spring.

Table H43 Cam Damper Spring Tension

Length	Standard	Service Limit
20.0 mm	32.5~38.5 kg	29.5 kg

TRANSMISSION

The transmission is a 5-speed, constant mesh, return shift type. Its cross section is shown in Fig. H76, and the external shift mechanism is shown in Fig. H77. For

simplicity, the drive shaft gears in the following explanation are referred to as "D" (e.g., D1=drive shaft 1st gear) and the output shaft gear as "O".

Gears D3, O4, and O5 are all splined to, and thus rotate with their shafts. During gear changes, these gears are moved sideways on their shafts by the 3 shift forks, one for each gear. Gears D4, D5, O1, O2, and O3 rotate free of shaft rotation, but cannot move sideways. Gears D1 and D2 rotate with the shaft and are unable to move sideways.

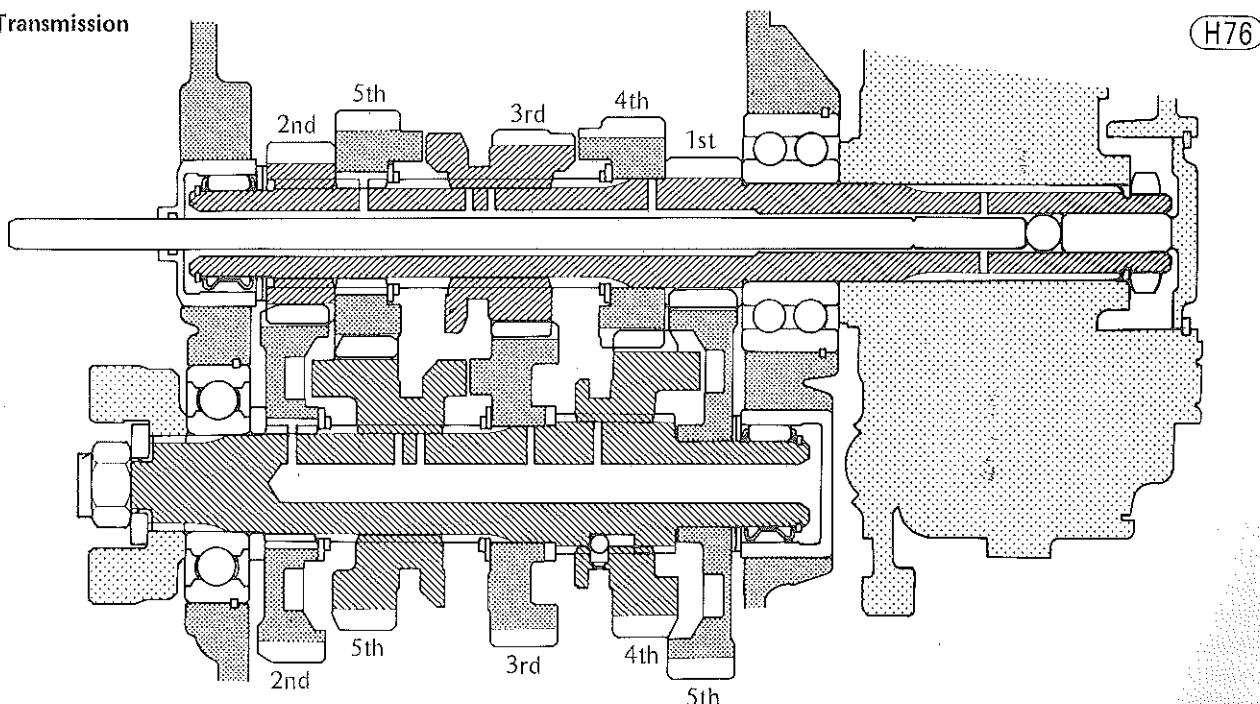
Shift Mechanism

When the shift pedal ① is raised or lowered, the shift shaft ⑦ turns, a pawl on the shift arm ⑤ catches on one of the shift drum pins ⑩; and the shift drum ⑨ turns. At the same time, the overshift limiter ⑥ on the shift lever ⑧ catches another pin as shown in Fig. H78. As the shift drum turns, the shift fork guide pins (3), each riding in a groove in the shift drum, change the position of one or another of the shift forks ⑪, ⑫, ⑬, in accordance with the winding of the grooves. The shift fork ears then determine the position of gears D3 ⑩, O4 ⑬, and/or O5 ⑭. Refer to Fig. H79 to H84 for the gear position and drive path for neutral and each of the 5 gears. A pawl spring ④ is fitted on the external shift mechanism to keep the shift arm and overshift limiter pressed against the shift drum pins to ensure proper pawl and pin contact.

When the shift pedal is released after shifting, the return spring ⑨ returns the shift lever and shift pedal back to their original positions. So that the transmission will remain where it was shifted, the detent arm spring ⑭ pushes the gear position detent arm ⑮ against the shift drum pins.

The transmission neutral position is located halfway between 1st and 2nd gears, and shifting into neutral is done by moving the shift pedal a half-stroke from either

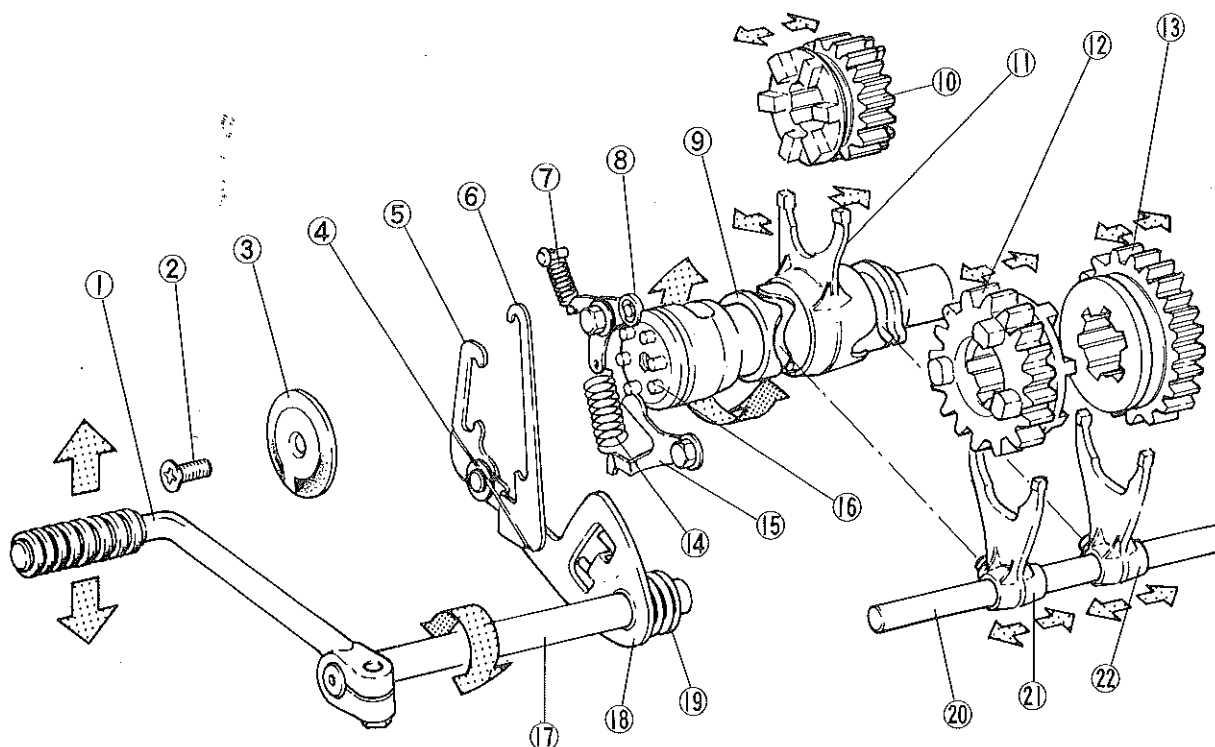
Transmission



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Shift Mechanism

(H77)



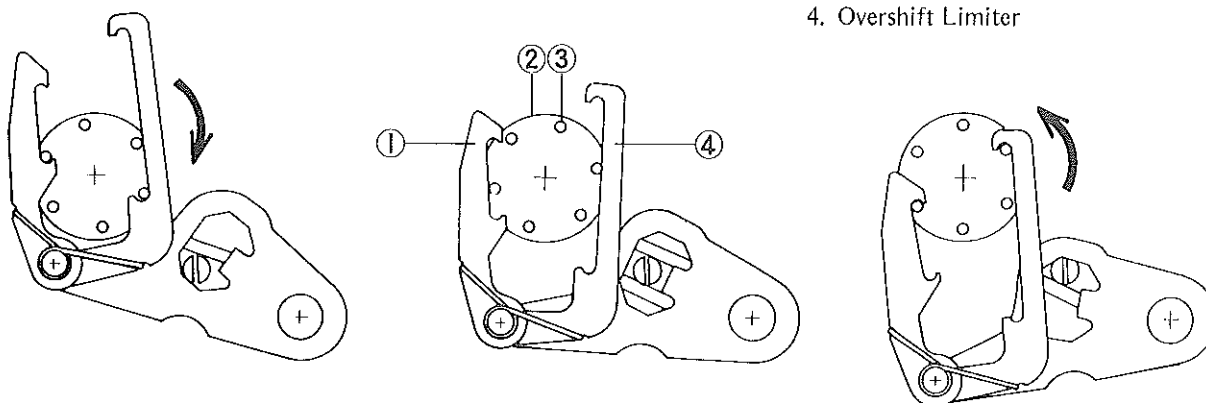
1. Shift Pedal
2. Screw
3. Pin Plate
4. Spring
5. Shift Arm
6. Overshift Limiter
7. Spring
8. Neutral Detent Arm

9. Shift Drum
10. Drive 3rd Gear
11. Shift Fork (4th/5th)
12. Output 5th Gear
13. Output 4th Gear
14. Spring
15. Gear Detent Arm
16. Shift Drum Pin

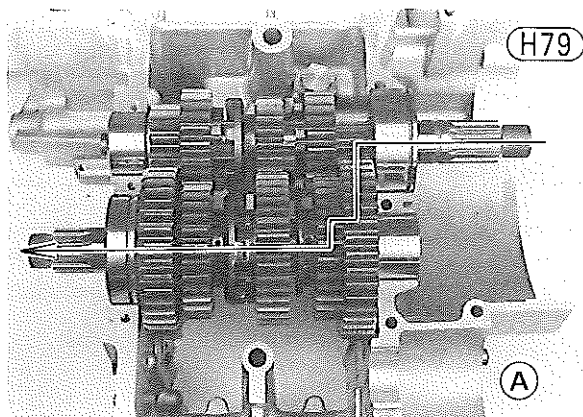
17. Shift Shaft
18. Shift Lever
19. Return Spring
20. Shift Rod
21. Shift Fork (2nd/3rd)
22. Shift Fork (1st)

Shift Arm and Overshift Limiter Operation

(H78)

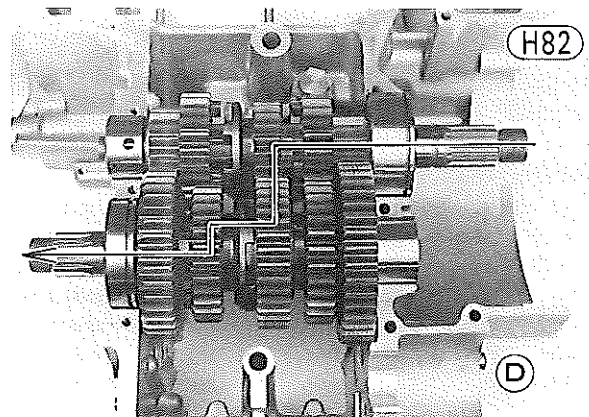


1. Shift Arm
2. Shift Drum
3. Shift Drum Pin
4. Overshift Limiter



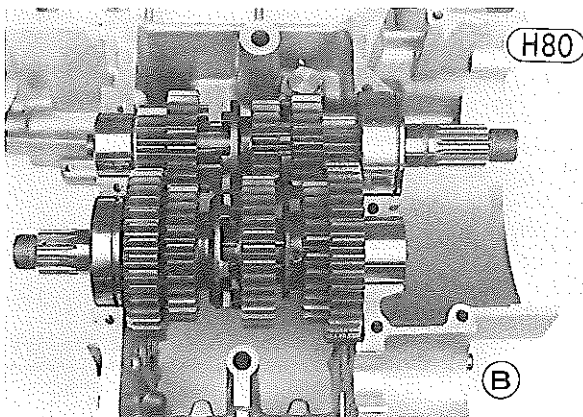
H79

A



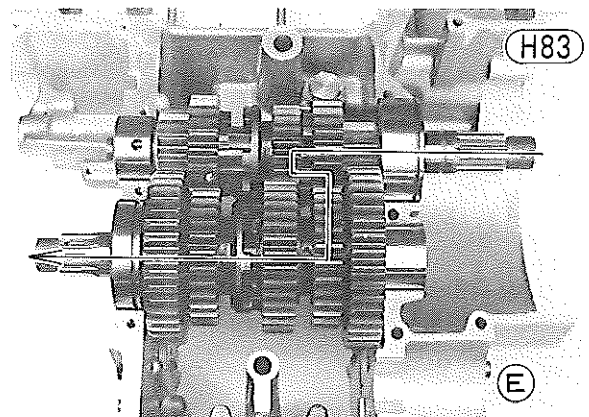
H82

D



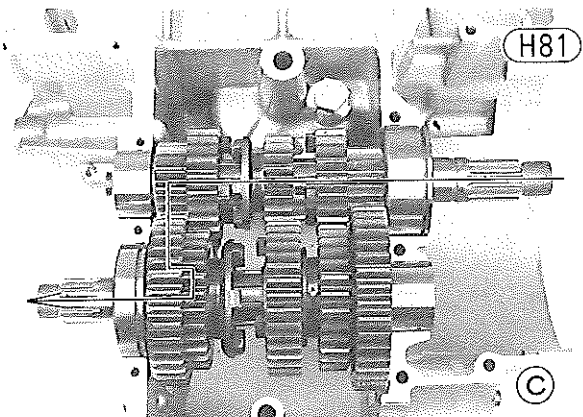
H80

B



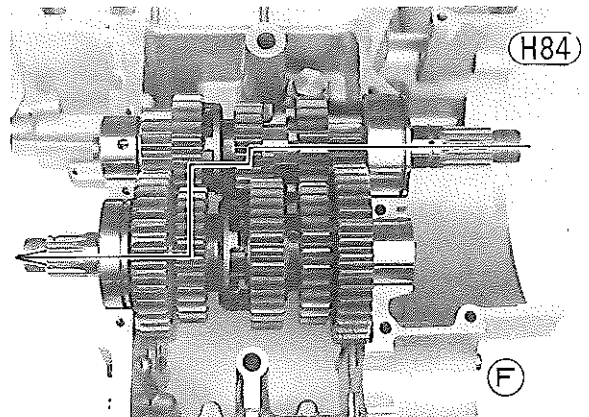
H83

E



H81

C



H84

F

A. 1st

B. Neutral

C. 2nd

D. 3rd

E. 4th

F. 5th

1st or 2nd gear. When the transmission is shifted into a gear other than neutral, the gear position detent arm keeps the shift drum in place; but since neutral is between gears, the same detent arm will not help position the drum or keep it in place when neutral is selected. Instead, the neutral detent arm ⑧ is pushed against the circumference of the shift drum by the detent arm spring ⑦, and drops into a depression in the circumference when the drum is turned to the neutral position.

The return spring pin on the side of the crankcase passes through a cutout on the shift mechanism lever. This pin engages between the two ends of the shift mechanism return spring. At the end of a full upshift or downshift stroke, the return spring pin makes contact with the cutout on the shift lever to limit the shift lever's range of movement.

Overshift Limiter

Each time that the shift pedal is operated, the overshift limiter interlocks with the shift drum pins to prevent overshifting. On a full upshift or downshift stroke, the limiter "hooks" catch the shift drum pins to keep the inertia of the heavy shift drum from allowing it to rotate beyond the intended gear position, particularly on a fast shift.

Neutral Locator

Inside gear O4 three steel balls are located 120° apart, and serve to facilitate neutral location when shifting from first gear. When the motorcycle is stopped and the output shaft is not turning, one or two of these balls falls down into its respective groove in the output shaft. When the shift pedal is operated to shift from first toward second, gear O4 starts moving, but halfway

toward its second gear position, the steel ball(s) hits the end of the groove(s) in the output shaft, stopping gear O4 from moving, stopping the shift drum from turning, and leaving the transmission gears in the neutral position.

Neutral Switch

A neutral indicator light is provided so that the rider can readily determine whether or not the transmission is in neutral. The neutral switch, installed in the front bevel gear case, consists of a spring loaded pin which contacts the metal part on the shift drum pin holder when the transmission is neutral. This completes the neutral indicator light circuit, which turns the neutral indicator light on.

Transmission or external shift mechanism damage, causing the transmission to misshift, overshift, and/or jump out of gear, brings about more damage to the transmission and also overrev damage to the engine itself. An improperly functioning transmission or external shift mechanism may be caused by the following:

1. Loose return spring pin, and/or broken or weakened return spring
2. Broken or weakened detent arm springs
3. Broken or weakened shift pawl spring
4. Damaged shift arm and/or overshift limiter
5. Loose shift drum guide bolt
6. Bent or worn shift fork(s)
7. Worn shift fork grooves on gears D3, O4, and/or O5
8. Worn shift fork guide pin(s)
9. Worn shift drum groove(s)
10. Worn or damaged gear dogs, gear dog holes, and/or gear dog recesses
11. Improperly functioning clutch or clutch release
12. Improper assembly or missing parts

Transmission noise results from worn or damaged shaft bearings, gear hubs or teeth, etc.

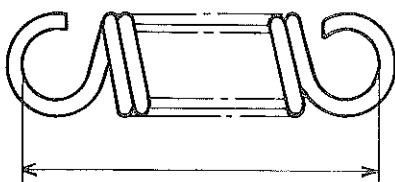
External shift mechanism inspection

Inspect the shift pawl spring, shift pawls, overshift limiter, and return spring. Replace any broken or otherwise damaged parts.

Measure the free length of the gear position detent arm spring. If it is longer than the service limit, it is weak and should be replaced.

Measure the free length of the neutral detent arm spring. If it is shorter than the service limit, replace it with a new one.

Spring Free Length

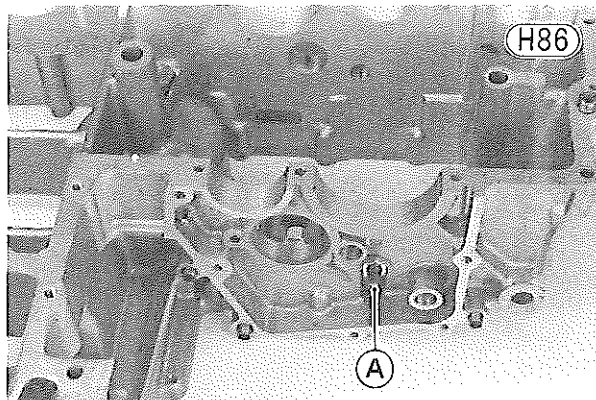


(H85)

Table H44 External Shift Mechanism
Spring Free Length

	Standard	Service Limit
Neutral	20.6 mm	21.6 mm
Gear Position	35.5 mm	37.3 mm

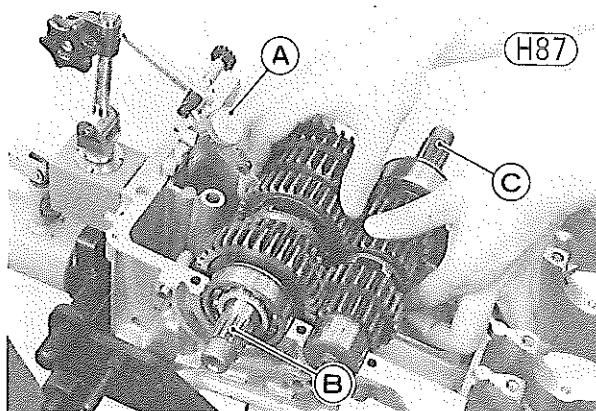
Check to see if the return spring pin is loose. If it is, remove it and apply a non-permanent locking agent to the threads. And then, tighten the pin.



A. Return Spring Pin

Gear backlash

Split the crankcase. Leaving the transmission in place, measure the backlash between gears O1 and D1, O2 and D2, O3 and D3, O4 and D4, O5 and D5. To measure the backlash, set a dial gauge against the teeth on one gear, and move the gear back and forth while holding the other gear steady. The difference between the highest and the lowest gauge reading is the amount of backlash. Replace both gears if the amount of backlash exceeds the service limit.



A. Dial Gauge

B. Output Shaft

C. Drive Shaft

Table H45 Gear Backlash

Standard	Service Limit
0.06 ~ 0.23 mm	0.30 mm

Shift fork bending

Visually inspect the shift forks, and replace any fork that is bent. A bent fork could cause difficulty in

shifting or allow the transmission to jump out of gear when under power.

Shift fork/gear groove wear

Measure the thickness of the ears of each shift fork, and measure the width of the shift fork grooves on gears D3, O4, and O5. If the thickness of a shift fork ear is under the service limit, the shift fork must be replaced. If a gear shift fork groove is worn over the service limit, the gear must be replaced.

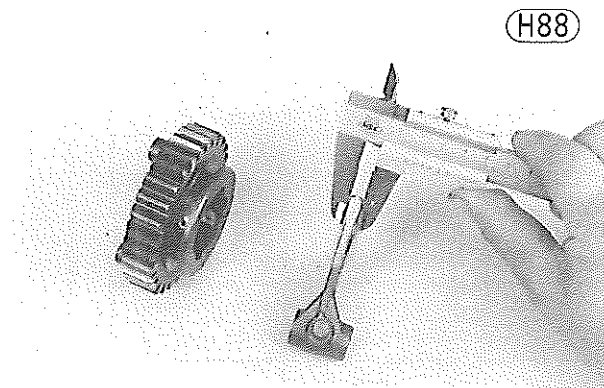


Table H46 Shift Fork Thickness

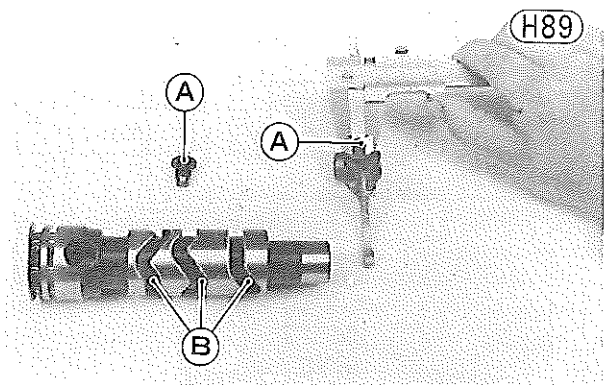
Standard	Service Limit
5.85 ~ 6.00 mm	5.70 mm

Table H47 Gear Shift Fork Groove Width

Standard	Service Limit
6.05 ~ 6.15 mm	6.25 mm

Shift fork guide pin/shift drum groove wear

Measure the diameter of each shift fork guide pin, and measure the width of each shift drum groove. Replace any shift fork on which the guide pin has worn past the service limit. If a shift drum groove is worn past the service limit, replace the shift drum.



A. Guide Pin B. Shift Drum Grooves

Table H48 Shift Drum Groove Width

Standard	Service Limit
8.05 ~ 8.20 mm	8.25 mm

Table H49 Shift Fork Guide Pin Diameter

	Standard	Service Limit
1st, 2nd/3rd	7.9 ~ 8.0 mm	7.85 mm
4th/5th	7.978 ~ 8.000 mm	7.92 mm

Gear dog, gear dog hole, gear dog recess damage

Visually inspect the gear dogs, gear dog holes, and gear dog recesses. Replace any gears that have damaged, unevenly or excessively worn dogs, dog holes, or dog recesses.

Gear/shaft clearance

Measure the diameter of each shaft and bushing with a micrometer, and measure the inside diameter of each gear listed below. Find the difference between the two readings to figure clearance, and replace any gear where clearance exceeds the service limit.

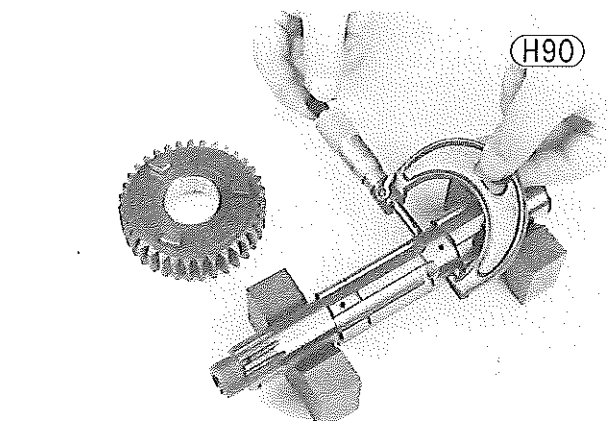


Table H50 Gear/Shaft, Gear/Bush Clearance

Gear	Standard	Service Limit
O1	0.027 ~ 0.061 mm	0.16 mm
O2, D5	0.025 ~ 0.075 mm	0.17 mm
O3, D4	0.020 ~ 0.062 mm	0.16 mm

Ball bearing wear, damage

Since the ball bearings are made to extremely close tolerances, the wear must be judged by feel rather than by measurement.

Clean each bearing in a high flash-point solvent, dry it (do not spin it while it is dry), and oil it. Spin it by hand to check its condition. If it is noisy, does not spin smoothly, or has any rough spots, replace it.

Needle bearing wear, damage

The rollers in the needle bearings wear so little that the wear is difficult to measure. Instead, inspect the bearings for abrasions, color change, or other damage. If there is any doubt as to the condition of either bearing, replace it.

KICKSTARTER

Kickstarter construction is shown in Fig. H92. The kick gear is connected to the primary gear on the crankshaft through the output shaft 1st gear, drive shaft 1st gear, and clutch housing gear.

The kick gear ⑤, constructed with a ratchet on one side, is always meshed with the output shaft 1st gear and turns freely anytime the output shaft is turning. The ratchet gear ⑥, mounted on the splined portion of the kick shaft ②, turns with the kick shaft and can be moved sideways on the shaft. A spring ⑦ presses on the ratchet gear in the direction of the kick gear. But when the kick pedal ① is not being operated, an arm on the ratchet gear is caught on the stop ⑨, which prevents the ratchet gear from meshing with the ratchet on the kick gear.

When the kick pedal is operated, the ratchet gear arm is freed from the stop and the ratchet gear then meshes with the kick gear ratchet, rotating the kick gear. The gear train of the kickstarter system then cranks the engine. As the engine starts, the primary gear through the gear train turns the kick gear. But, since the kick gear rotates in the direction of arrow "A" as shown in Fig. H83, the kick gear ratchet doesn't catch on the ratchet gear.

When the kick pedal is released, the kick shaft is turned by the return spring, bringing the kick pedal to its original position. At the same time, the ratchet gear arm rides up the stop, breaking away from the kick gear. The kick gear now turns freely.

If the kick pedal return spring weakens or breaks, the kick pedal will not return completely or at all, and the kick gear and ratchet gear will stay partially meshed, making noise while the engine is running. Kick mechanism noise may also result when the kick gear, bushing, or kick shaft becomes worn.

If the ratchet gear or ratchet on the kick gear is worn or damaged, the kick gear will slip, and it will not be possible to kickstart the engine.

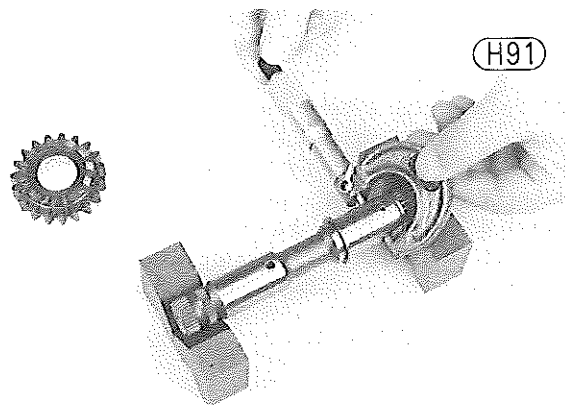


Table H51 Gear Inside Diameter

Standard	Service Limit
21.979 ~ 22.000 mm	22.05 mm

Table H52 Kick Shaft Diameter

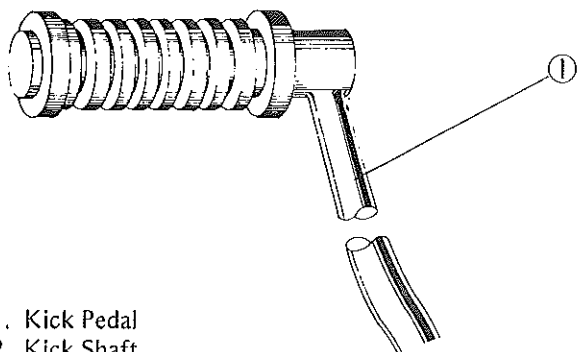
Standard	Service Limit
21.939 ~ 21.960 mm	21.91 mm

ENGINE LUBRICATION

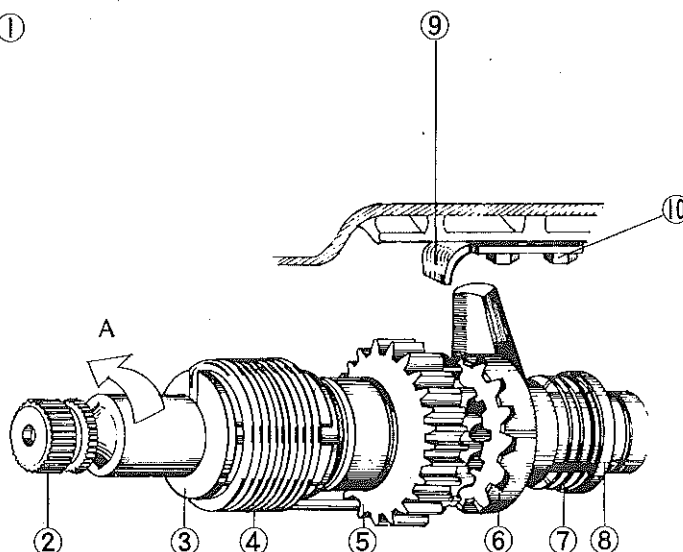
The engine lubrication system includes the oil screen, engine oil pump, oil filter, oil bypass valve, and oil passages. An oil pressure switch is provided to warn in case of insufficient oil pressure. An oil breather keeps crankcase pressure variations to a minimum and reduces emissions by recirculating blowby gas. The discussion here concerns how these parts work together, how the oil reaches the various parts of the engine, and how to check the oil pressure. Details on the engine oil pump, oil filter, and oil breather are given in the sections (Pgs. 191, 192) following engine lubrication.

Kickstarter

(H92)

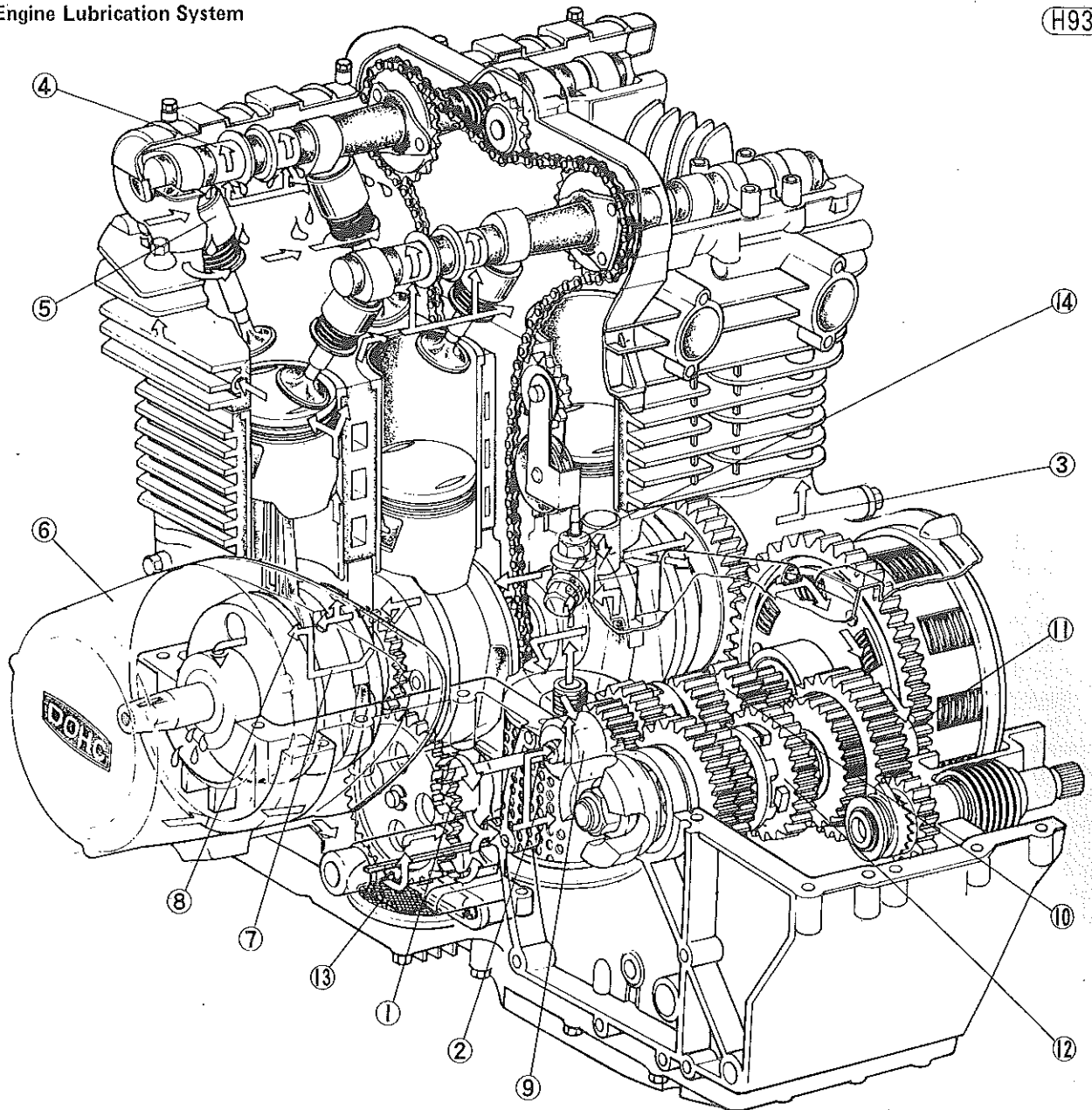


1. Kick Pedal
2. Kick Shaft
3. Spring Guide
4. Spring
5. Kick Gear
6. Ratchet Gear
7. Spring
8. Spring Seat
9. Stop
10. Bolts



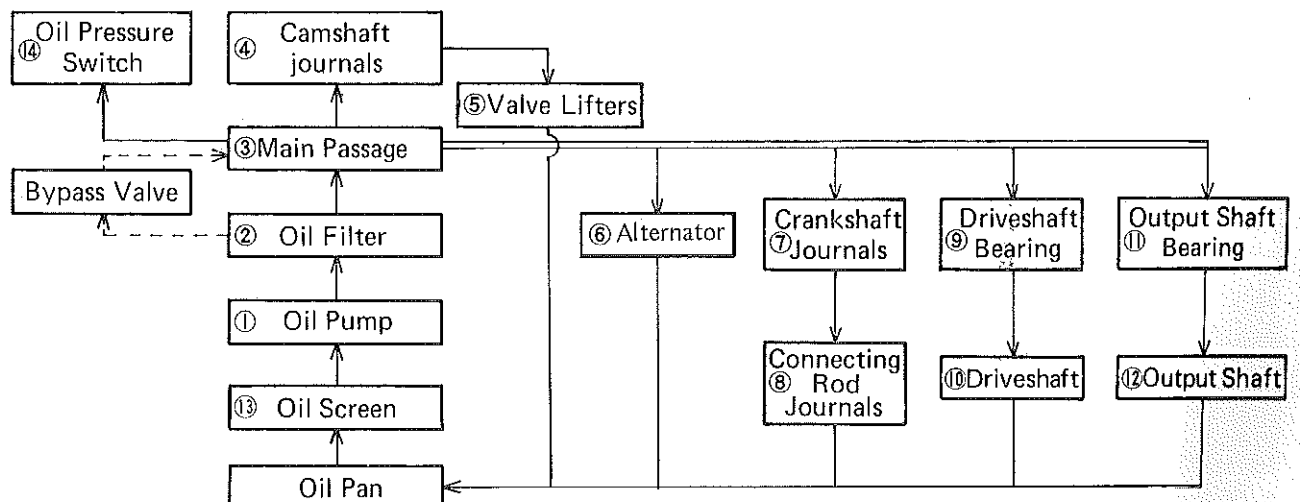
Engine Lubrication System

(H93)



Engine Oil Flow Chart

(H94)



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Since the engine lubrication system is the wet sump type, there is always supply of oil in the crankcase at the bottom of the engine. The oil is drawn through the wire screen into the oil pump as the pump gears turn. The pump is driven by a gear on the crankshaft. The screen removes any metal particles and other foreign matter which could damage the oil pump. From the pump the oil passes through the oil filter element for filtration. If the element is badly clogged, slowing the flow of oil through it, oil bypasses the element through a bypass valve in the lower crankcase half. After passing through the filter, the oil flows through the crankcase main oil passage to where it branches into three lubrication routes.

One of these routes is to the crankshaft main bearings, then to the crank pins and to the starter clutch gear. The cylinder walls, pistons, and piston pins are lubricated by splash from the spinning crankshaft. The oil then drops and collects at the bottom of the crankcase to be used again.

The second route for filtered oil is through the oil passage at each side of the cylinder block, up to the top of the cylinder head. After lubricating the camshaft journals, the oil flows out over the cams and down around the valve lifters to lubricate these areas. This oil returns to the sump via the oil return holes at the base of the valve lifters, and via the cam chain opening in the center of the head and cylinder.

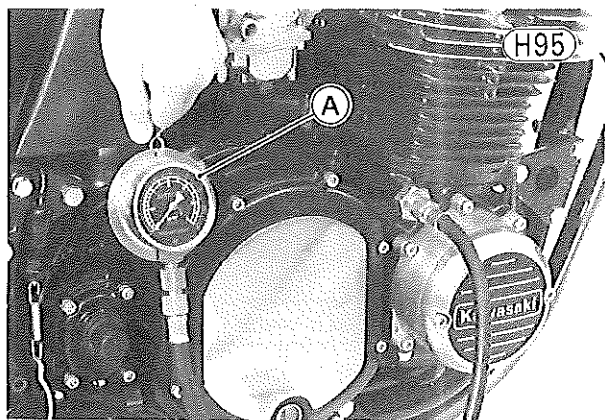
The oil pump also feeds filtered oil to the transmission. It exits from the oil passage at the needle bearings of the drive and output shafts, and drops down into the crankcase after lubricating the bearings and gears.

The oil pressure switch, mounted on the upper part of the crankcase, checks on the oil pressure in the main oil passage and lights the oil pressure warning light if the pressure falls below a safe level. If the oil pressure is insufficient, the oil pump is worn or malfunctioning or there is insufficient oil supply to the pump.

Oil pressure measurement

Warm up the engine. Stop the engine, remove the oil passage plug from the right side of the crankcase, and connect an oil pressure gauge (special tool) in its place to measure oil pressure.

Start the engine again. Run it at the specified speed (Table H52), and read the oil pressure gauge.



A. Oil Pressure Gauge (57001-125)

Table H53 Oil Pressure

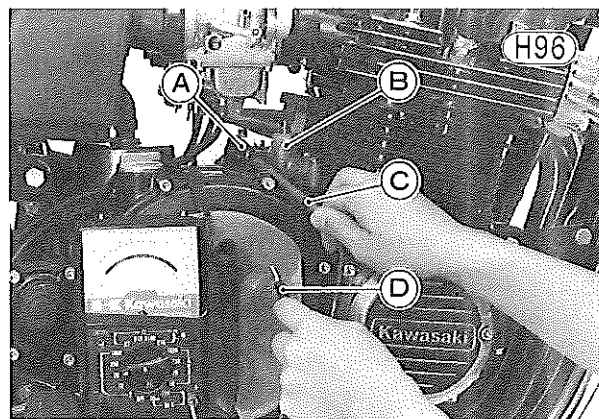
Oil Pressure @3,000 rpm, 60°C (140°F)
about 0.2 kg/cm ² (2.8 psi)

If the oil pressure is significantly below the standard pressure when the oil temperature is at or below 60°C (140°F), inspect the engine oil pump. If the pump is not at fault, inspect the rest of the lubrication system. **NOTE:** Apply a non-permanent locking agent to the oil passage plug threads. If the plug O ring is deteriorated or damaged, replace it with a new one.

Oil pressure switch inspection

The switch should turn on the warning light whenever the ignition switch is on with the engine not running.

If the light does not go on, disconnect the switch lead. Connect the positive lead of a 20V DC range voltmeter to the switch lead and ground the voltmeter negative lead to the engine. Turn the ignition switch to the "ON" position, and read the voltmeter. If the voltmeter does not indicate battery voltage, the trouble is either defective wiring or a burned-out indicator bulb.



A. Switch Lead

B. Oil Pressure Switch

C. Meter (+) Lead

D. Meter (-) Lead

If the voltmeter does indicate battery voltage, then the oil pressure switch may be defective. Use an ohmmeter to check for continuity between the switch terminal and the switch body. With the switch lead disconnected, and the engine stopped, any reading other than zero ohms indicates that the switch is at fault.

The switch should turn off the warning light whenever the engine is running faster than the specified speed. If the light stays on, stop the engine immediately, disconnect the lead from the switch, and connect the ohmmeter between the switch terminal and the engine (chassis ground). The meter should read zero ohms when the engine is off and infinity when the engine is running above the specified speed (Table H53). If the meter reads zero ohms when the engine is running at the specified speed, stop the engine and measure the oil pressure (Pg. 190). If the oil pressure is more than the specified value with the engine running at the specified speed, the oil pressure switch is defective, and must be replaced.

NOTE: When installing a new switch, tighten it with 0.60 kg-m (52 in-lbs) of torque.

Table H54 Oil Pressure Switch Inspection

Meter	Engine Speed	Oil Pressure Switch
x 1 Ω	Stopped	ON (Ohmmeter reads zero ohms)
	More than 1,300 rpm	OFF (Ohmmeter reads infinity)

Engine Oil Pump

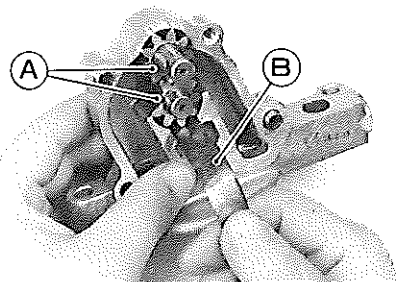
The oil pump, installed in the lower part of the crankcase, is a gear pump with two spur gears. The gear on the pump is driven in direct proportion to engine rpm by a gear on the crankshaft.

If the oil pump becomes worn, it may no longer be able to supply oil to lubricate the engine adequately.

Pump gear/pump body clearance

If pressure is low, remove and disassemble the oil pump, and re-assemble the internal gears in one side of the pump body. With thickness gauges, measure the minimum clearance between the each gear and the body. If the clearance is over the service limit or if the gears are damaged, replace the pump as an assembly.

(H97)



A. Pump Gears

B. Thickness Gauge

Table H55 Pump Gear/Pump Body Clearance

Standard	Service Limit
0.011 ~ 0.083 mm	0.14 mm

Pry out the O ring and inspect it. If it appears worn or damaged, replace it.

Check the screen filter at the oil pump inlet, and replace it if it is worn or damaged.

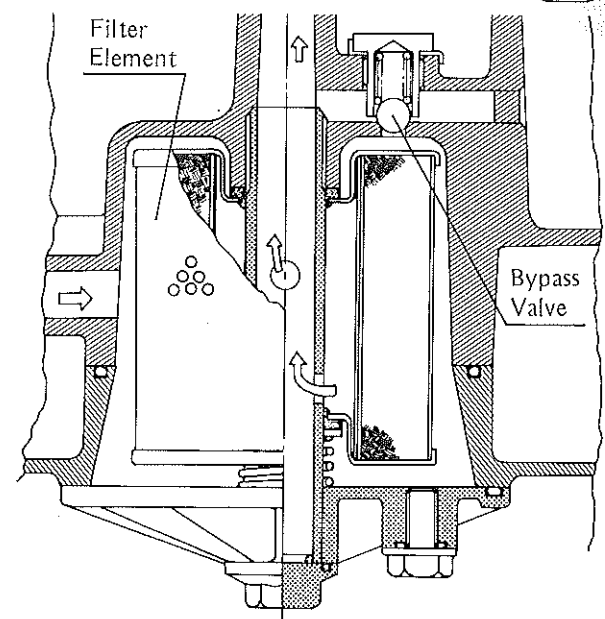
Oil Filter

The oil filter, located in the lower part of the crankcase, removes impurities from the oil.

As the filter element becomes dirty and clogged, its filtering efficiency is impaired. If it becomes so clogged

that it seriously impedes oil flow, a pressure-activated bypass valve in the crankcase opens so that sufficient oil will still reach the parts of the engine needing lubrication. When the filter becomes clogged such that the oil pressure difference between the inlet and outlet for the filter reaches a certain pressure, the oil on the inlet side pushing on the valve spring opens the valve, allowing oil to flow to the main oil passage, bypassing filtration.

Oil Filter



Never neglect the oil filter, or else metal particles or other foreign matter in the oil could reach the crankshaft and transmission, accelerating wear and shortening engine life.

Replace the filter element in accordance with the Periodic Maintenance Chart (Pg. 10) since it becomes clogged with metal filings from the engine and transmission especially during break-in. After break-in, replace the element at every other oil change. When the filter is removed for element replacement, wash the rest of the filter parts in a high flash-point solvent and check the condition of the O rings. If they are worn or deteriorated, replace them to avoid oil leakage.

Oil Breather

The oil breather is located on the top of the crankcase. The underside of the breather opens to the crankcase, while the upper part connects through the breather hose to the air cleaner. Its function is to minimize crankcase pressure variations caused by crankshaft and piston movement and to recycle blowby gas.

Gas blowby is the combustion chamber gas escaping past the rings into the crankcase. A small amount is unavoidable, but gas blowby increases as cylinder wall and piston ring wear progresses. If not efficiently removed, blowby gas will seriously contaminate the engine oil.

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Recycling blowby gas means more efficient combustion, but the oil mist resulting from transmission gear movement must first be removed. The mixture of blowby gas and oil mist passes through a maze in the breather, which separates most of the oil from the gas. The oil which is separated from the gas returns to the bottom of the crankcase. The gas is drawn through the breather hose into the air cleaner housing, and is drawn through the carburetors into the engine.

If the breather hose or the parts inside the breather become clogged, pressure may build up in the crankcase and cause oil leaks.

NOTE: If the engine is overfilled with engine oil, mist from the excess oil will go through the oil breather to clog the air cleaner and cause carburetion trouble. This is not the fault of the oil breather.

BALL, NEEDLE BEARINGS

Ball bearing wear, damage

Since the ball bearings are made to extremely close tolerances, the wear must be judged by feel rather than by measurement.

Clean each bearing in a high flash-point solvent, dry it (do not spin it while it is dry), and oil it. Spin it by hand to check its condition. If it is noisy, does not spin smoothly, or has any rough spots, replace it.

Needle bearing wear, damage

The rollers in the needle bearings wear so little that the wear is difficult to measure. Instead, inspect the bearings for abrasion, color change, or other damage. If there is any doubt as to the condition of either bearing, replace it.

OIL SEALS

The crankshaft oil seal in the right engine cover forms a seal between the crank chamber and the contact breaker point cavity. If this seal is damaged, oil will leak into the contact breaker point cavity, and foul the contact breaker points. Any damaged, hardened, or otherwise defective oil seal will allow oil to leak.

Oil seal damage

Inspect the oil seals, and replace any if the lips are misshapen, discolored (indicating the rubber has deteriorated), hardened, or otherwise damaged. Since an oil seal is nearly always damaged on removal, any removed oil seals must be replaced. When pressing in an oil seal which is marked, press it in with the mark facing out. Press the seal in so that the face of the seal is level with the surface of its hole.

MUFFLERS

The mufflers reduce exhaust noise and conduct the exhaust gases back away from the rider while keeping

power loss to a minimum. If much carbon is built up inside the mufflers, exhaust efficiency is reduced, which lowers the engine power output.

If there is any exhaust leakage where the mufflers connect to the cylinder head, or if the gaskets appear damaged, replace the gaskets. If either muffler is badly damaged, dented, cracked or rusted, replace it with a new one.