

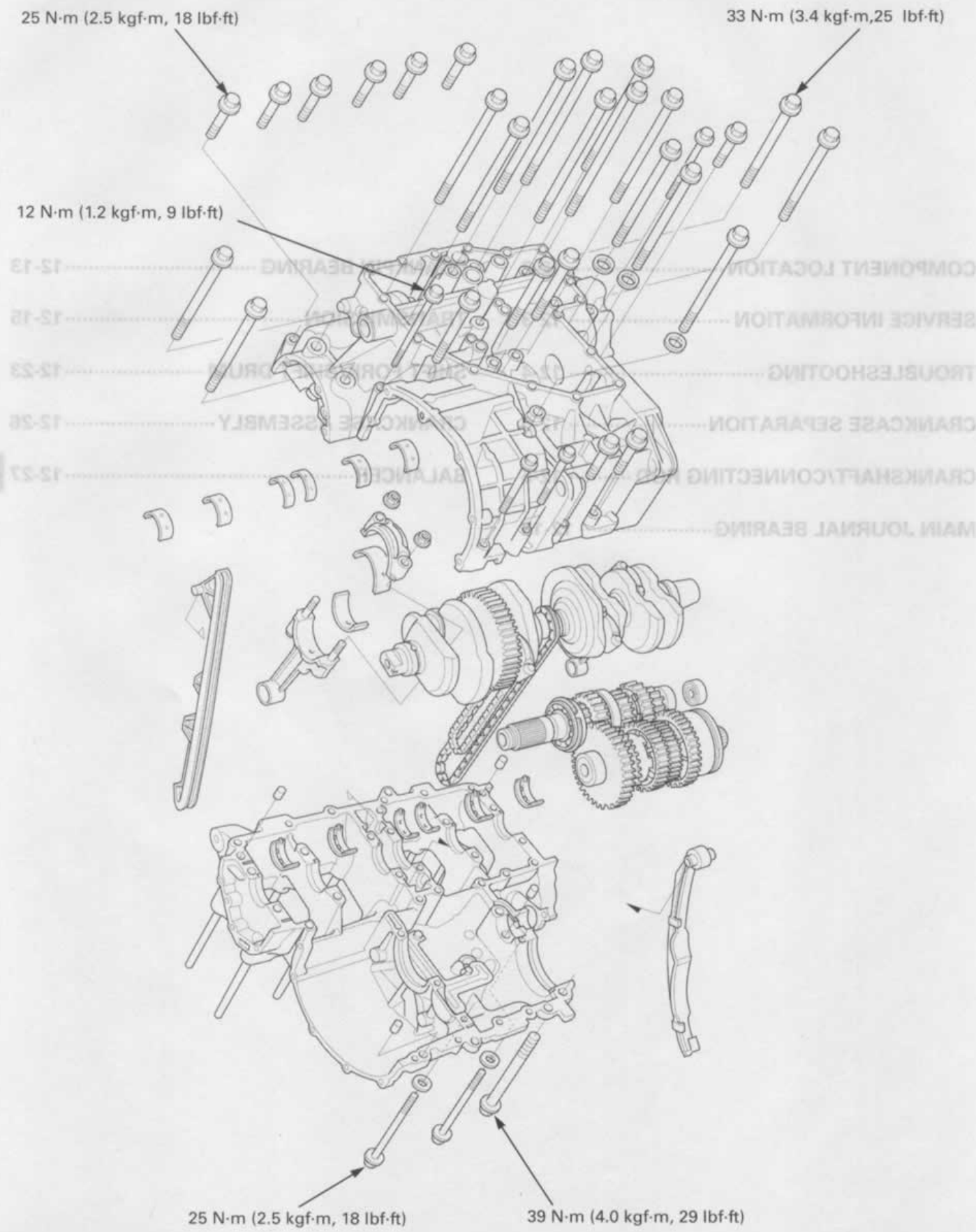
# 12. CRANKSHAFT/TRANSMISSION/BALANCER

COMPONENT LOCATION

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COMPONENT LOCATION





# SERVICE INFORMATION

## GENERAL

- The crankcase must be separated to service the following:
  - Transmission (page 12-15)
  - Crankshaft (page 12-5)
  - Connecting rod (page 12-5)
- The following components must be removed before separating the crankcase:
  - Alternator (page 11-4) / flywheel (page 11-6)
  - Clutch (page 10-16) / gearshift linkage (page 10-25)
  - Cylinder head (page 9-20)
  - Engine (page 8-5)
  - Oil pan (page 5-6), oil pump (page 5-9) and oil cooler (page 5-14)
  - Starter motor (page 18-6)
  - Water pump (page 7-15)
- Mark and store the connecting rods, bearing caps and bearing inserts to be sure of their correct locations for reassembly.
- The crankpin and main journal bearing inserts are select fit and are identified by color codes. Select replacement bearings from the code tables. After selecting new bearings, recheck the oil clearance with a plastigauge. Incorrect oil clearance can cause major engine damage.
- Be careful not to damage the crankcase mating surfaces when servicing.
- Prior to assembling the crankcase halves, apply sealant to their mating surfaces, Wipe off excess sealant thoroughly.

## SPECIFICATIONS

Unit: mm (in)

ITEM			STANDARD	SERVICE LIMIT
Crankshaft	Connecting rod side clearance		0.05 – 0.20 (0.002 – 0.008)	0.30 (0.012)
	Crankpin bearing oil clearance		0.028 – 0.052 (0.0011 – 0.0020)	0.08 (0.003)
	Main journal bearing oil clearance		0.016 – 0.040 (0.0006 – 0.0016)	0.08 (0.003)
	Runout		–	0.03 (0.001)
Shift fork, fork shaft	I.D.		14.000 – 14.021 (0.5512 – 0.5520)	14.04 (0.553)
	Claw thickness		5.93 – 6.00 (0.233 – 0.236)	5.9 (0.23)
	Shift fork shaft O.D.		13.957 – 13.968 (0.5495 – 0.5499)	13.90 (0.547)
Transmission	Gear I.D.	M4, M5	31.000 – 31.025 (1.2205 – 1.2215)	31.05 (1.222)
		C1	26.007 – 26.028 (1.0239 – 1.0247)	26.04 (1.025)
		C2, C3	33.000 – 33.025 (1.2992 – 1.3002)	33.05 (1.301)
	Gear busing O.D.	M4, M5	30.975 – 30.985 (1.2195 – 1.2199)	30.93 (1.218)
		C2	32.955 – 32.980 (1.2974 – 1.2984)	32.93 (1.296)
		C3	32.950 – 32.975 (1.2972 – 1.2982)	32.93 (1.296)
	Gear-to-bushing clearance	M4, M5	0.025 – 0.075 (0.0010 – 0.0030)	0.11 (0.004)
		C2	0.020 – 0.070 (0.0008 – 0.0028)	0.11 (0.004)
		C3	0.025 – 0.075 (0.0010 – 0.0030)	0.11 (0.004)
	Gear bushing I.D.	M4	28.000 – 28.021 (1.1024 – 1.1032)	28.04 (1.104)
		C2	29.985 – 30.006 (1.1805 – 1.1813)	30.02 (1.182)
	Mainshaft O.D.	at M4	27.980 – 27.993 (1.1016 – 1.1021)	27.97 (1.101)
	Countershaft O.D.	at C2	29.950 – 29.975 (1.1791 – 1.1801)	29.94 (1.179)
	Bushing-to-shaft clearance	M4	0.007 – 0.041 (0.0028 – 0.0016)	0.08 (0.003)
		C2	0.010 – 0.056 (0.0004 – 0.0022)	0.10 (0.004)

## TOEQUE VALUES

Crankcase main journal 9 mm bolt	33 N·m (3.4 kgf·m, 25 lbf·ft)	Apply molybdenum disulfide oil (after removing anti-rust oil additive)
Crankcase bolt, 10 mm	39 N·m (4.0 kgf·m, 29 lbf·ft)	
8 mm	25 N·m (2.5 kgf·m, 18 lbf·ft)	
6 mm	12 N·m (1.2 kgf·m, 9 lbf·ft)	
Lower crankcase socket bolt, 20 mm	29 N·m (3.0 kgf·m, 22 lbf·ft)	Apply a locking agent
Lower crankcase socket bolt, 10 mm	12 N·m (1.2 kgf·m, 9 lbf·ft)	Apply a locking agent
Connecting rod nut	41 N·m (4.2 kgf·m, 30 lbf·ft)	Apply oil to the threads
Lower crankcase socket bolt, 10 mm	12 N·m (1.2 kgf·m, 9 lbf·ft)	
Balancer shaft special bolt	12 N·m (1.2 kgf·m, 9 lbf·ft)	
Oil pass pipe plate bolt	12 N·m (1.2 kgf·m, 9 lbf·ft)	Apply a locking agent



## TOOLS



## SERVICE INFORMATION

### GENERAL

- \* The crankcase must be separated to service the following:
  - Transmission (page 12-18)
  - Crankshaft (page 12-19)
  - Connecting rod (page 12-20)
- \* The following components must be removed before separating the crankcase:
  - Alternator (page 11-4) / Flywheel (page 11-5)
  - Clutch (page 10-18) / Gearshift linkage (page 10-23)
  - Cylinder head (page 8-20)
  - Engine (page 8-8)
  - Oil pan (page 8-8) / oil pump (page 8-9) and oil cooler (page 1-14)
  - Starter motor (page 18-8)
  - Water pump (page 7-18)
- \* Mark and store the connecting rods.
- \* The crankpin and main journal bearing inserts are select fit and are identified by color codes. Select replacement parts from the code tables. After selecting new bearings, check the oil clearance.
- \* Be careful not to damage the crankcase mating surfaces when servicing.
- \* Prior to assembling the crankcase halves, apply sealant to their mating ends.

## TROUBLESHOOTING

### Hard to shift

- Improper clutch operation (page 10-16)
- Incorrect transmission oil weight
- Bent shift fork
- Bent shift fork shaft
- Bent shift fork claw
- Damaged shift drum cam groove
- Bent gearshift spindle

### Transmission jumps out of gear

- Worn gear dogs
- Worn gear shifter groove
- Bent shift fork shaft
- Broken shift drum stopper arm
- Broken shift drum stopper arm spring
- Worn or bent shift forks
- Broken gearshift spindle return spring

### Excessive engine noise

- Worn or damaged transmission gear
- Worn or damaged transmission bearings
- Worn main journal bearings
- Worn crankpin bearings

### Engine vibration

- Excessive crankshaft runout
- Incorrect balancer timing

## SPECIFICATIONS

ITEM	UNIT	CRANKSHAFT	TRANSMISSION
Connecting rod side clearance	mm	0.08 - 0.20 (0.003 - 0.008)	
Crankpin bearing oil clearance	mm	0.028 - 0.052 (0.001 - 0.002)	
Main journal bearing oil clearance	mm	0.015 - 0.040 (0.0006 - 0.0016)	
Runout	mm	0.05 - 0.10 (0.002 - 0.004)	
Shift fork I.D.	mm	14.000 - 14.021 (0.5512 - 0.5520)	
Shift fork O.D.	mm	13.987 - 13.988 (0.5507 - 0.5508)	
Shift fork shaft O.D.	mm	31.000 - 31.025 (1.2187 - 1.2199)	
Shift fork shaft I.D.	mm	26.007 - 26.025 (1.0243 - 1.0250)	
Shift fork shaft O.D.	mm	33.000 - 33.025 (1.2989 - 1.3000)	
Shift fork shaft I.D.	mm	30.975 - 30.985 (1.2156 - 1.2158)	
Shift fork shaft O.D.	mm	32.980 - 32.985 (1.2972 - 1.2973)	
Shift fork shaft I.D.	mm	0.028 - 0.035 (0.0010 - 0.0014)	
Shift fork shaft O.D.	mm	0.020 - 0.030 (0.0008 - 0.0012)	
Shift fork shaft I.D.	mm	0.025 - 0.035 (0.0010 - 0.0014)	
Shift fork shaft O.D.	mm	28.000 - 28.021 (1.1024 - 1.1032)	
Shift fork shaft I.D.	mm	29.000 - 29.025 (1.1417 - 1.1425)	
Shift fork shaft O.D.	mm	27.980 - 27.993 (1.1018 - 1.1021)	
Shift fork shaft I.D.	mm	28.980 - 28.993 (1.1371 - 1.1374)	
Shift fork shaft O.D.	mm	0.007 - 0.011 (0.0003 - 0.0004)	
Shift fork shaft I.D.	mm	0.010 - 0.015 (0.0004 - 0.0006)	

## TORQUE VALUES

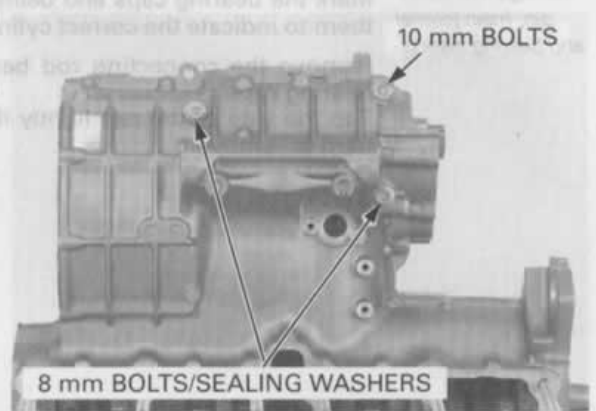
Crankcase main journal 8 mm bolt	33 N·m (3.8 kgf-m, 25 lbf-ft)
Crankcase bolt	38 N·m (4.0 kgf-m, 28 lbf-ft)
Lower crankcase socket bolt, 10 mm	25 N·m (2.8 kgf-m, 18 lbf-ft)
Lower crankcase socket bolt, 8 mm	12 N·m (1.2 kgf-m, 8 lbf-ft)
Lower crankcase socket bolt, 6 mm	12 N·m (1.2 kgf-m, 8 lbf-ft)
Lower crankcase socket bolt, 50 mm	28 N·m (3.0 kgf-m, 22 lbf-ft)
Lower crankcase socket bolt, 10 mm	12 N·m (1.2 kgf-m, 8 lbf-ft)
Connecting rod nut	41 N·m (4.2 kgf-m, 30 lbf-ft)
Lower crankcase socket bolt, 10 mm	12 N·m (1.2 kgf-m, 8 lbf-ft)
Balancer shaft special bolt	12 N·m (1.2 kgf-m, 8 lbf-ft)
Oil pump drive plate bolt	12 N·m (1.2 kgf-m, 8 lbf-ft)



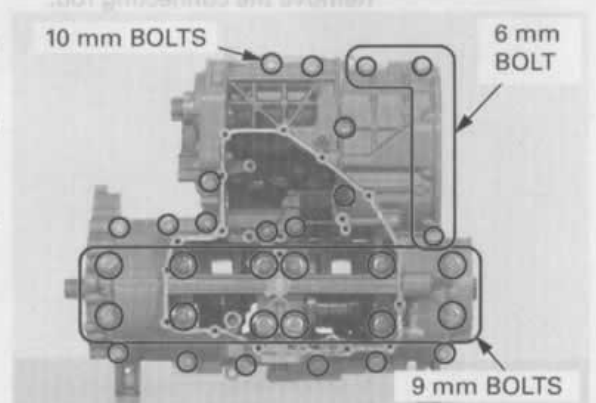
# CRANKCASE SEPARATION

Refer to Service Information (page 12-3) for removal of necessary parts before separating the crankcase.

Loosen the 10 mm bolt and two 8 mm bolts in a crisscross pattern in 2 or 3 steps.  
Remove the bolts and sealing washers.



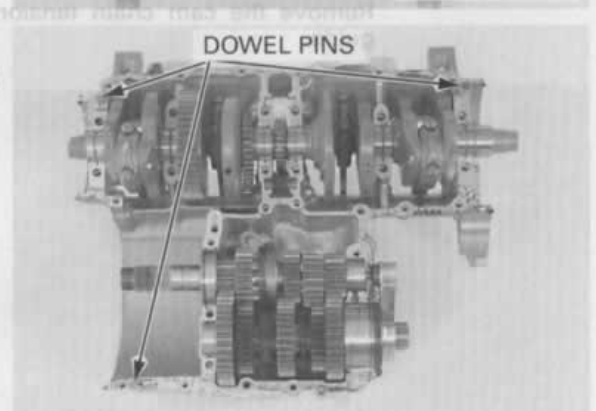
Place the engine with the upper side down.  
Loosen the three 6 mm bolt and sixteen 8 mm bolts in a crisscross pattern in 2 or 3 steps.  
Remove the bolts and sealing washers.  
Loosen the twelve main journal 9 mm bolts in a crisscross pattern in 2 or 3 steps.  
Remove the main journal bolts.



Separate the lower crankcase from the upper crankcase.

Remove the three dowel pins.

Clean any sealant off from the crankcase mating surface.



# CRANKSHAFT/CONNECTING ROD

Separate the crankcase halves (page 12-5).

## SIDE CLEARANCE INSPECTION

Measure the connecting rod side clearance.

**SERVICE LIMIT: 0.30 mm (0.012 in)**

If the clearance exceeds the service limit, replace the connecting rod.  
Recheck and if still out of limit, replace the crankshaft.





Be careful not to damage the crankpin, main journal and bearing inserts.

## REMOVAL

Mark the bearing caps and bearings as you remove them to indicate the correct cylinder for reassembly.

Remove the connecting rod bearing cap nuts and bearing caps.

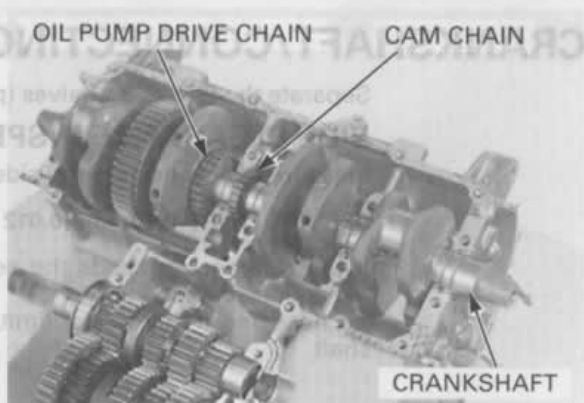
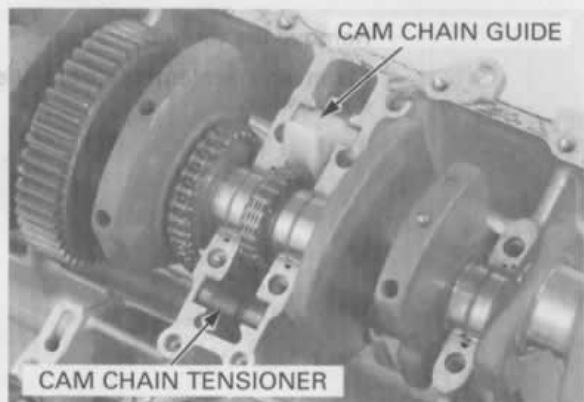
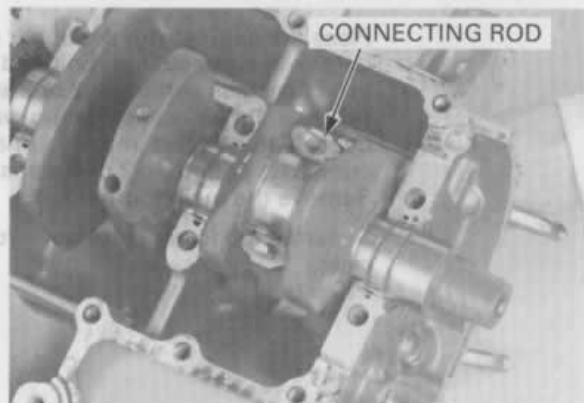
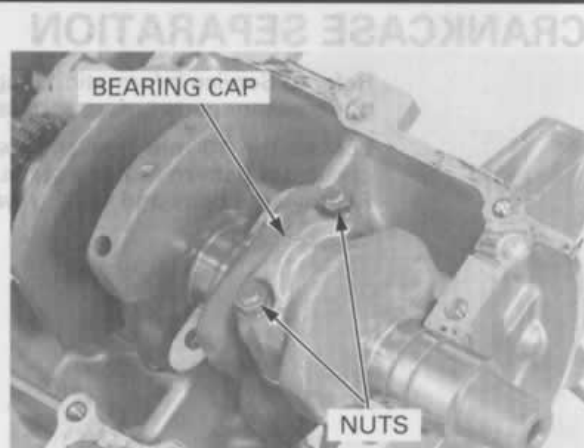
Tap the side of the cap lightly if the bearing cap is hard to remove.

Remove the connecting rod.

Remove the cam chain tensioner and cam chain guide.

Remove the crankshaft from the upper crankcase.

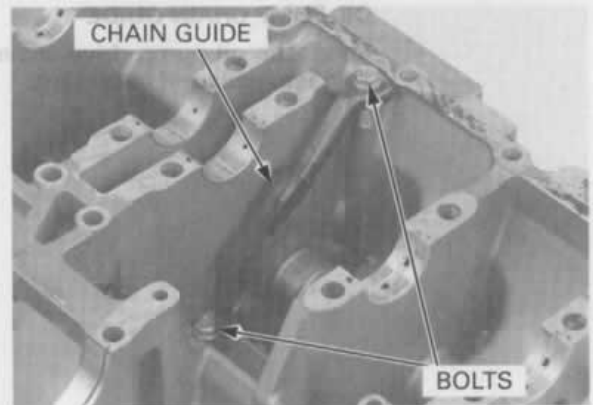
Remove the oil pump drive chain and cam chain from the crankshaft.



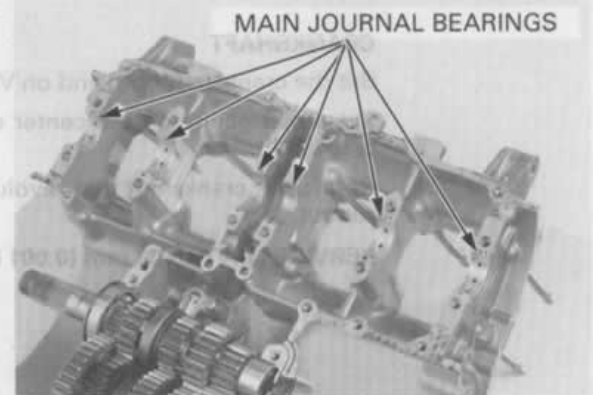
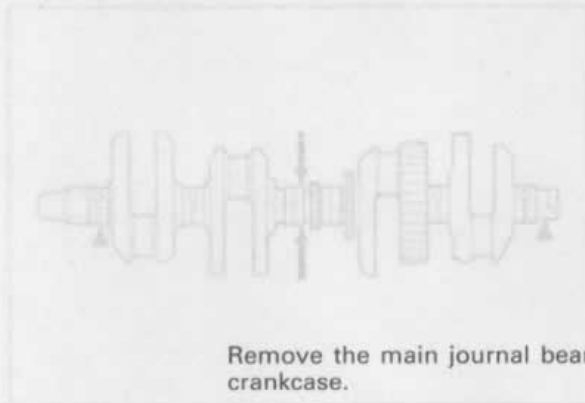


Remove the bolts and oil pump drive chain guide.

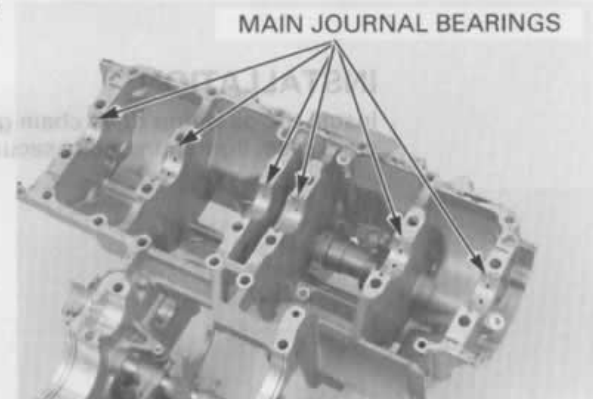
CHAIN GUIDE



Remove the main journal bearings from the upper crankcase.



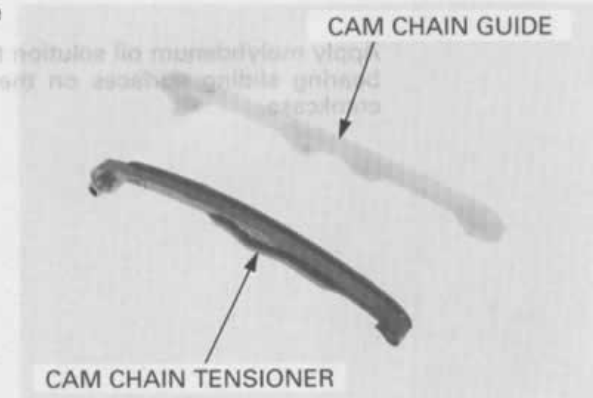
Remove the main journal bearings from the lower crankcase.



## INSPECTION

### CAM CHAIN TENSIONER/CAM CHAIN GUIDE

Check the cam chain tensioner and cam chain guide for wear or damage, replace if necessary.

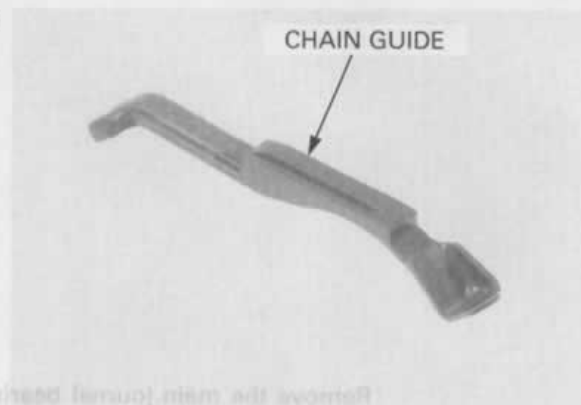
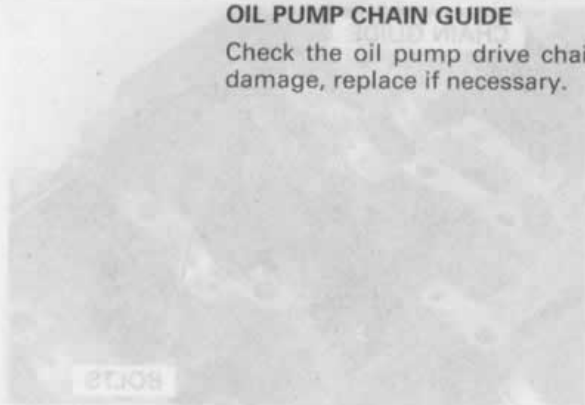




## CRANKSHAFT/TRANSMISSION/BALANCER

### OIL PUMP CHAIN GUIDE

Check the oil pump drive chain guide for wear or damage, replace if necessary.



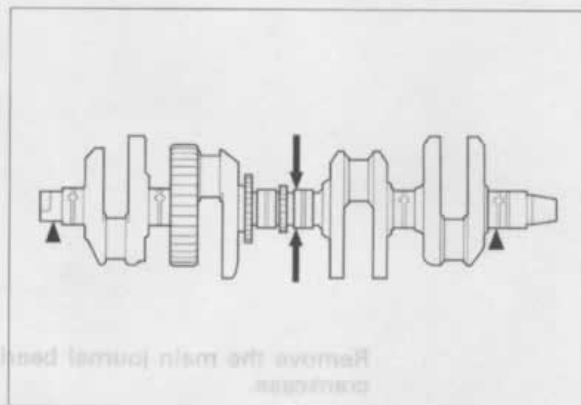
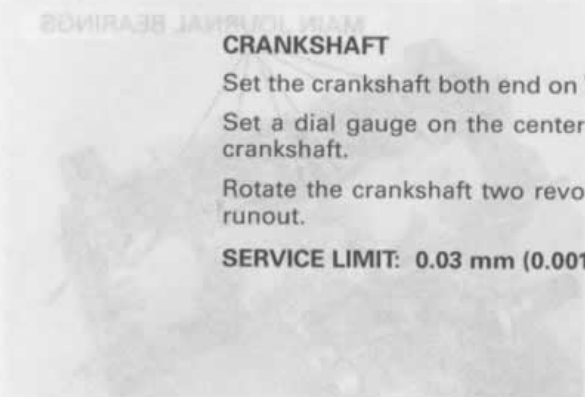
### CRANKSHAFT

Set the crankshaft both end on V-blocks.

Set a dial gauge on the center main journal of the crankshaft.

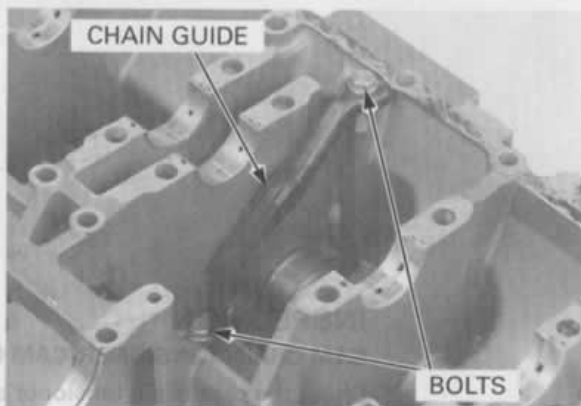
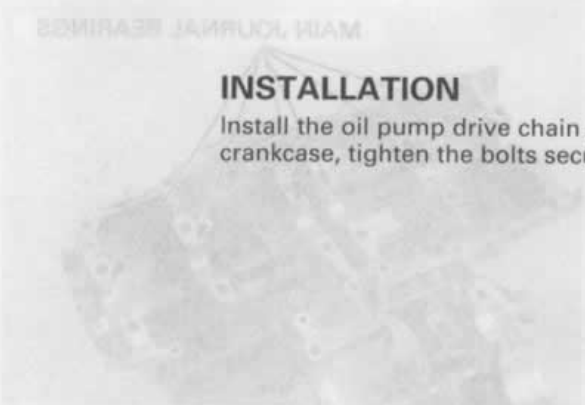
Rotate the crankshaft two revolutions and read the runout.

**SERVICE LIMIT: 0.03 mm (0.001 in)**

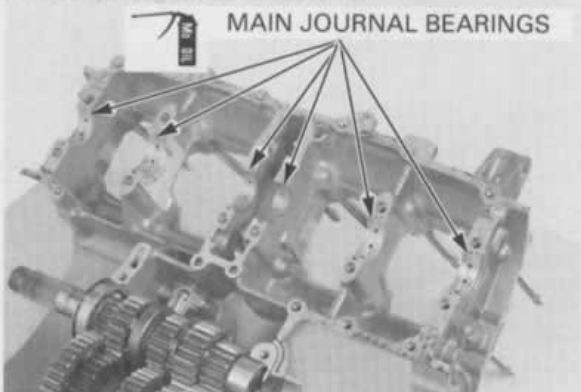
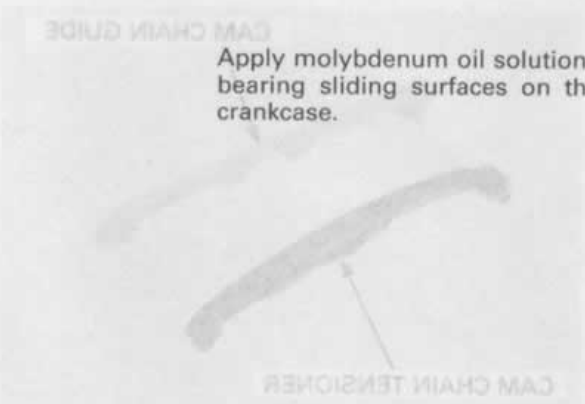


### INSTALLATION

Install the oil pump drive chain guide into the lower crankcase, tighten the bolts securely.



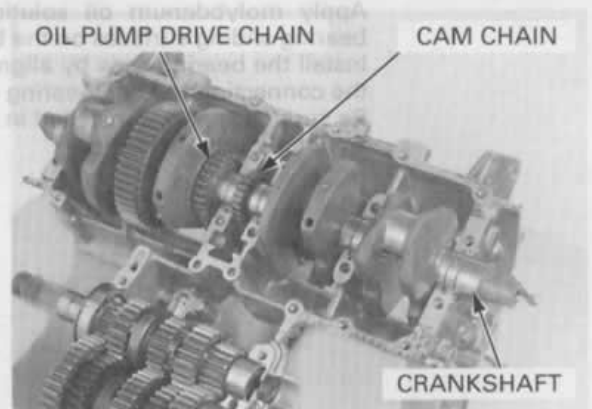
Apply molybdenum oil solution to the main journal bearing sliding surfaces on the upper and lower crankcase.



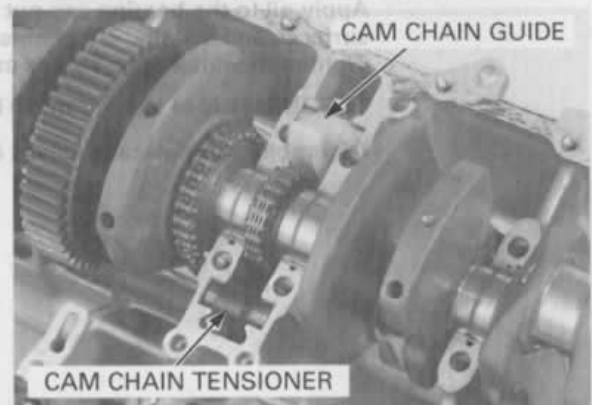


Install the oil pump drive chain and cam chain onto the crankshaft.

Install the crankshaft onto the upper crankcase.



Install the cam chain tensioner and cam chain guide into the upper crankcase grooves.

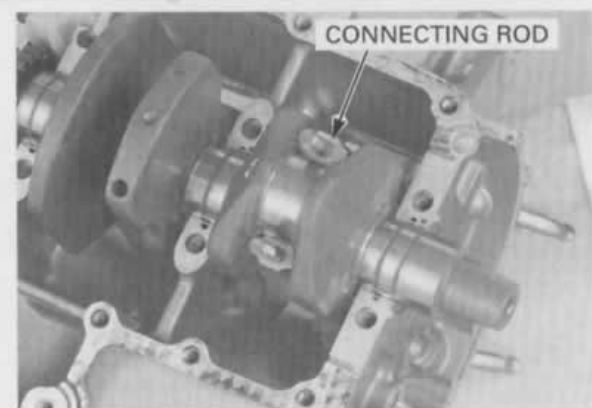


Do not get the molybdenum oil solution to the connecting rod bolts and bearing cap nuts. It may fail to tighten the cap nuts for correct torque values.

Apply molybdenum oil solution to the crankpin bearing sliding surfaces on the connecting rods.



Insert the connecting rod from the cylinder side.





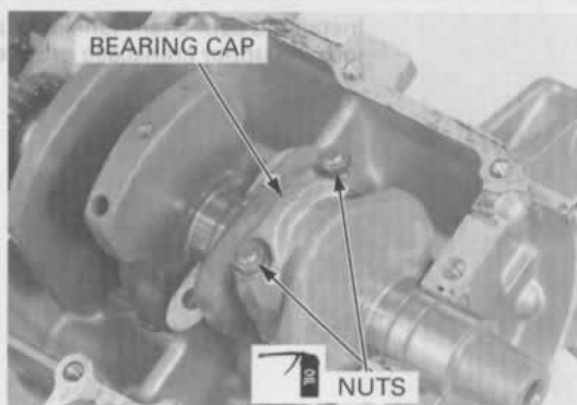
Apply molybdenum oil solution to the crankpin bearing sliding surfaces on the bearing caps. Install the bearing caps by aligning the I.D. code on the connecting rod and bearing cap. Be sure each part is installed in its original position, as noted during removal.



Apply oil to the bearing cap nut threads and seating surfaces and install the cap nuts. Tighten the nut in 2 or 3 steps and torque them.

**TORQUE: 41 N·m (4.2 kgf·m, 30 lbf·ft)**

Assemble the crankcase halves (page 12-26).



## MAIN JOURNAL BEARING

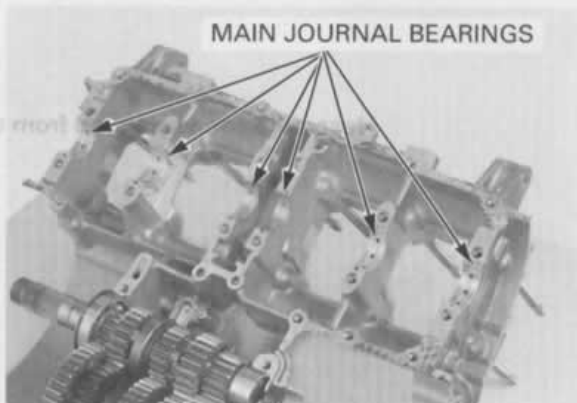
### NOTICE

*Do not interchange the bearing inserts. They must be installed in their original locations or the correct bearing oil clearance may not be obtained, resulting in engine damage.*

Remove the crankshaft (page 12-5).

### BEARING INSPECTION

Inspect the main journal bearing inserts on the upper and lower crankcase for unusual wear or peeling. Check the bearing tabs for damage.

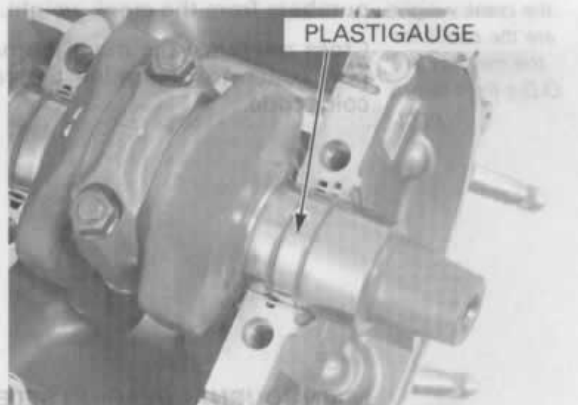




Do not rotate the crankshaft during inspection.

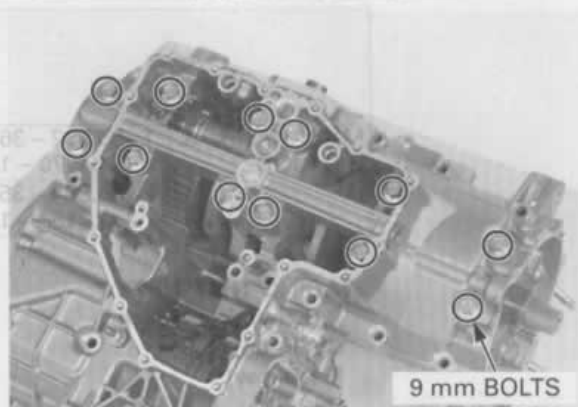
## OIL CLEARANCE INSPECTION

Clean off any oil from the bearing inserts and main journals.  
Install the crankshaft onto the upper crankcase.  
Put a strip of plastigauge lengthwise on each main journal avoiding the oil hole.



Install the dowel pins.  
Carefully install the lower crankcase on the upper crankcase.  
Apply molybdenum disulfide oil to the main journal 9 mm bolts.  
Install and tighten the main journal 9 mm bolts in a crisscross pattern in 2 or 3 steps.

**TORQUE: 33 N·m (3.4 kgf·m, 25 lbf·ft)**



Remove the 9 mm bolts and lower crankcase.  
Measure the compressed plastigauge at its widest point on each main journal to determine the oil clearance.

**SERVICE LIMIT: 0.08 mm (0.003 in)**

If main bearing clearance exceeds the service limit, select the correct replacement bearings.



## BEARING SELECTION

Record the crankcase bearing support I.D. code letters from the pad on the left side of the upper crankcase as shown.

Letters (A, B or C) on the left side of upper crankcase are the codes for the bearing support I.D.s from left to right.



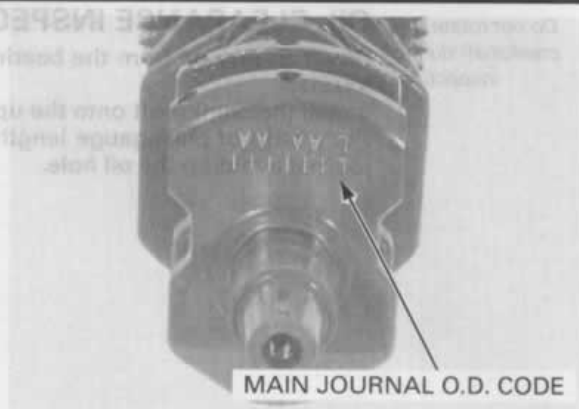


# CRANKSHAFT/TRANSMISSION/BALANCER

Numbers (1 or 2) on the crank weight are the codes for the main journal O.D.s from left to right.

Record the corresponding main journal O.D. code numbers from the crank weight.

Cross reference the main journal and bearing support codes to determine the replacement bearing color code.



MAIN JOURNAL BEARING SELECTION TABLE:

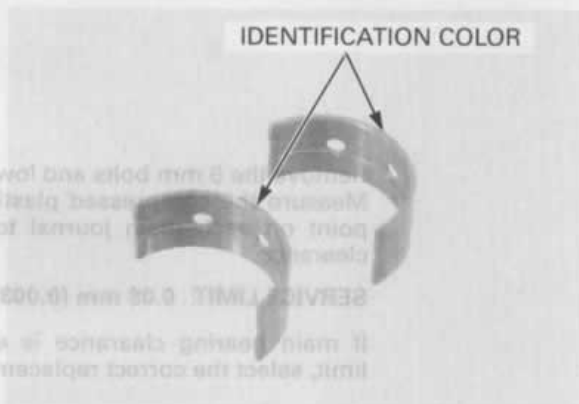
			BEARING SUPPORT I.D. CODE		
			A	B	C
MAIN JOURNAL O.D. CODE	1	35.992 – 36.000 mm (1.4170 – 1.4173 in)	39.000 – 39.007 mm (1.5354 – 1.5357 in)	39.008 – 39.015 mm (1.5357 – 1.5360 in)	39.016 – 39.024 mm (1.5361 – 1.5364 in)
			E (Pink)	D (Yellow)	C (Green)
	2	35.984 – 35.991 mm (1.4167 – 1.4170 in)	D (Yellow)	C (Green)	B (Brown)

## BEARING THICKNESS:

B (Brown): Thick  
C (Green):  
D (Yellow):  
E (Pink): Thin

## NOTICE

After selecting new bearings, recheck the clearance with a plastigauge. Incorrect clearance can cause severe engine damage.



## BEARING INSTALLATION

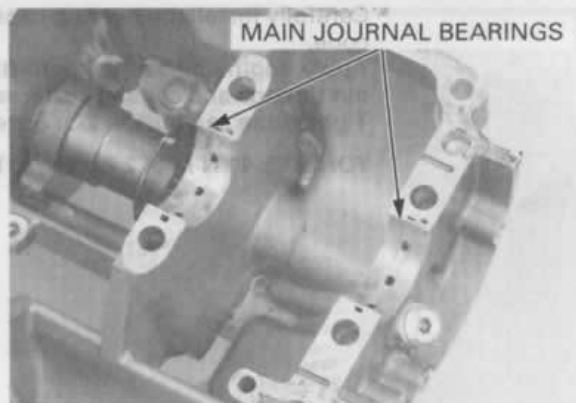
Clean the bearing outer surfaces and crankcase bearing supports.

Install the main journal bearing inserts (non-groove) onto the center crankcase bearing supports, aligning each tab with each grooves.





Install the main journal bearing inserts (with groove) onto the side crankcase bearing supports, aligning each tab with each groove.



MAIN JOURNAL BEARINGS

## CRANKPIN BEARING

### NOTICE

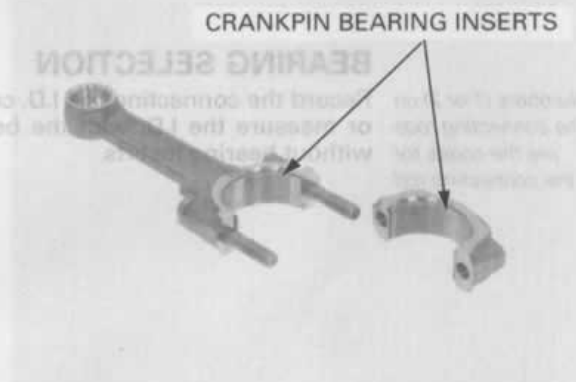
*Do not interchange the bearing inserts. They must be installed in their original locations or the correct bearing oil clearance may not be obtained, resulting in engine damage.*

Remove the crankshaft (page 12-5).

### BEARING INSPECTION

Check the bearing inserts for unusual wear or peeling.

Check the bearing tabs for damage.



CRANKPIN BEARING INSERTS

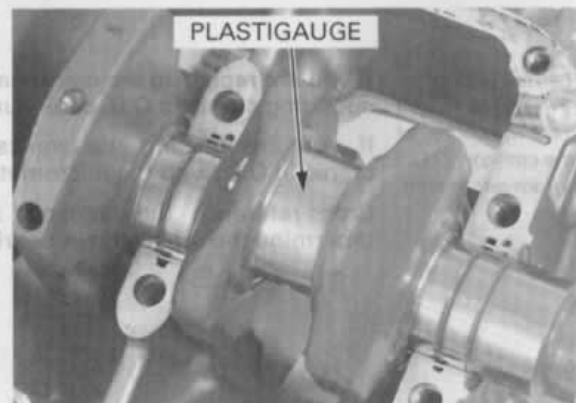
### OIL CLEARANCE INSPECTION

Clean off any oil from the bearing inserts and crankpin.

Carefully install the crankshaft onto the upper crankcase.

Set the connecting rods onto the crankpin.

Put a strip of plastigauge lengthwise on the crankpin avoiding the oil hole.



PLASTIGAUGE

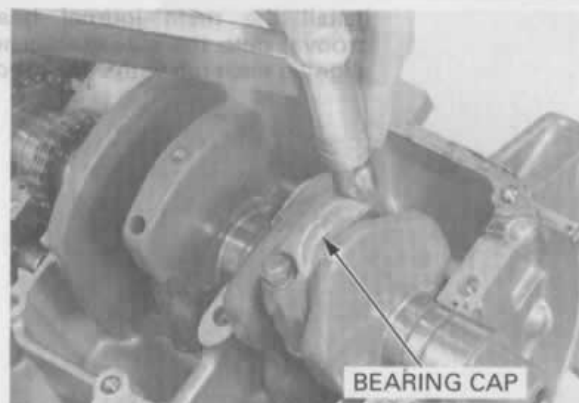


## CRANKSHAFT/TRANSMISSION/BALANCER

Carefully install the bearing caps by aligning the I.D. code.

Apply engine oil to the connecting rod bearing cap nut threads and seating surfaces and install them. Tighten the cap nuts in 2 or 3 steps.

**TORQUE: 41 N·m (4.2 kgf·m, 30 lbf·ft)**



Remove the nuts and bearing cap. Measure the compressed plastigauge at its widest point on the crankpin to determine the oil clearance.

**SERVICE LIMIT: 0.08 mm (0.003 in)**

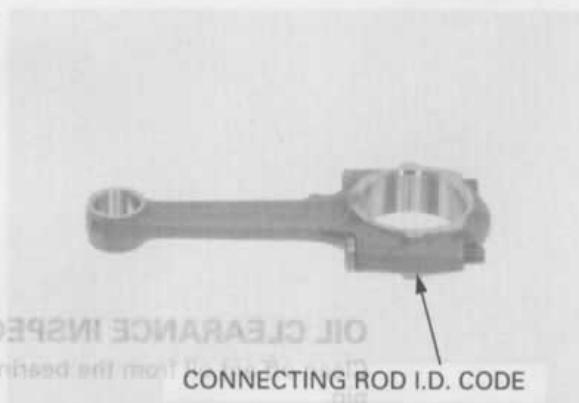
If the oil clearance exceeds the service limit, select the correct replacement bearings.



### BEARING SELECTION

Numbers (1 or 2) on the connecting rods are the codes for the connecting rod I.D.

Record the connecting rod I.D. code number (1 or 2) or measure the I.D. with the bearing cap installed without bearing inserts.

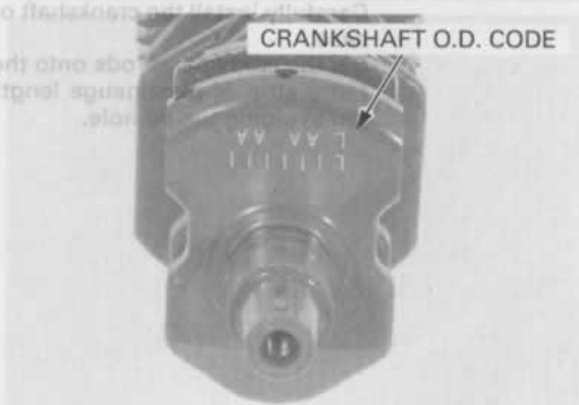


Letters (A or B) on the crank weight are the codes for the crankpin O.D.s from left to right.

If you are replacing the crankshaft, record the corresponding crankpin O.D. code number (A or B).

If you are reusing the crankshaft, measure the crankpin O.D. with the micrometer.

Cross-reference the crankpin and rod codes to determine the replacement bearing color.





CRANKPIN BEARING SELECTION TABLE:

CRANK PIN O.D.CODE			Connecting ROD I.D.CODE	
			1	2
			39.995 – 40.003 mm (1.5746 – 1.5749 in)	39.987 – 39.994 mm (1.5743 – 1.5746 in)
	A	43.000 – 43.007 mm (1.6929 – 1.6932 in)	C (Yellow)	B (Green)
	B	43.008 – 43.016 mm (1.6932 – 1.6935 in)	B (Green)	A (Brown)

**BEARING THICKNESS:**

A (Brown): Thick  
B (Green):  
C (Yellow): Thin

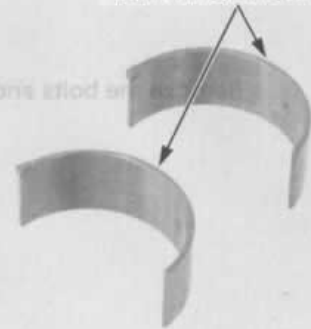
**NOTICE**

After selecting new bearings, recheck the clearance with a plastigauge. Incorrect clearance can cause severe engine damage.

**BEARING INSTALLATION**

Clean the bearing outer surfaces, bearing cap and connecting rod.  
Install the crankpin bearing inserts onto the bearing cap and connecting rod, aligning each tab with each groove.

**IDENTIFICATION COLOR**



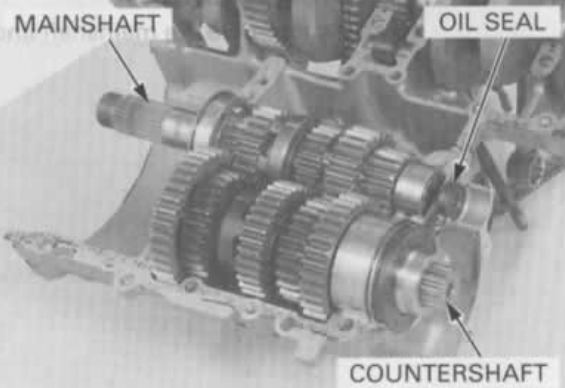
**CRANKPIN BEARING INSERTS**



**TRANSMISSION**

**REMOVAL**

Separate the crankcase halves (page 12-5).  
Remove the mainshaft oil seal.  
Remove the mainshaft and countershaft assemblies.

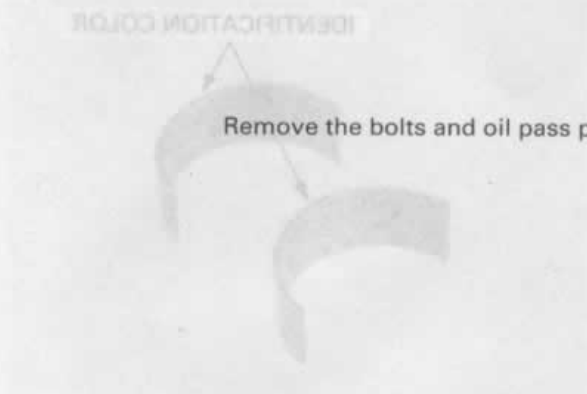
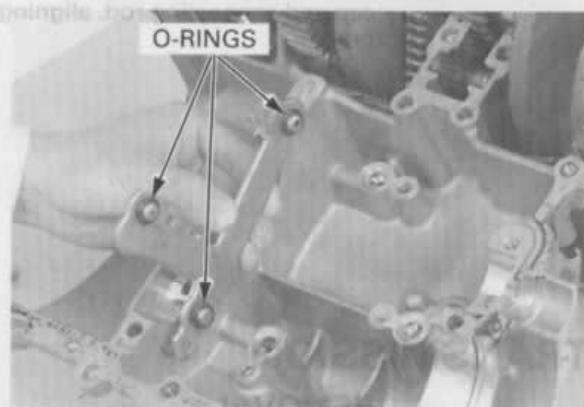
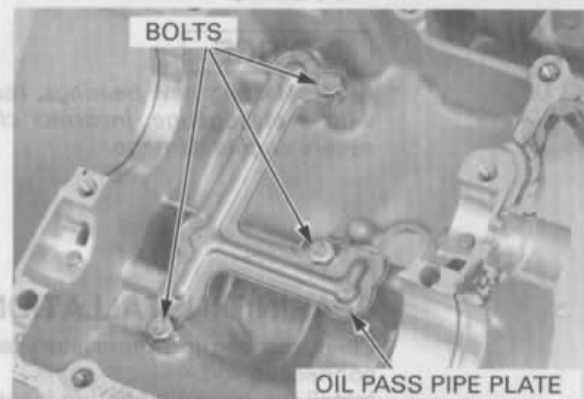
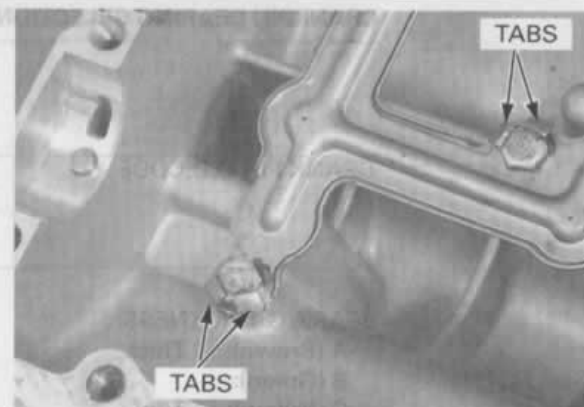




# CRANKSHAFT/TRANSMISSION/BALANCER

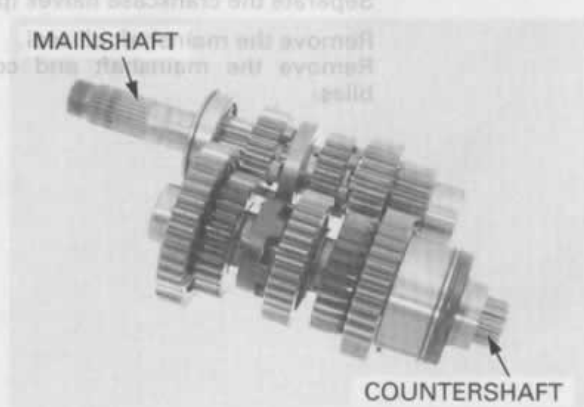
Bend the tabs of the oil pass pipe plate.

Connecting ROD I.D. CODE		CRANKSHAFT I.D. CODE	
1	2	1	2
30.987 - 32.924 mm (1.2163 - 1.2962 in)	30.987 - 32.924 mm (1.2163 - 1.2962 in)	30.987 - 32.924 mm (1.2163 - 1.2962 in)	30.987 - 32.924 mm (1.2163 - 1.2962 in)
B (Green)	C (Yellow)	B (Green)	C (Yellow)
A (Brown)	B (Green)	A (Brown)	B (Green)



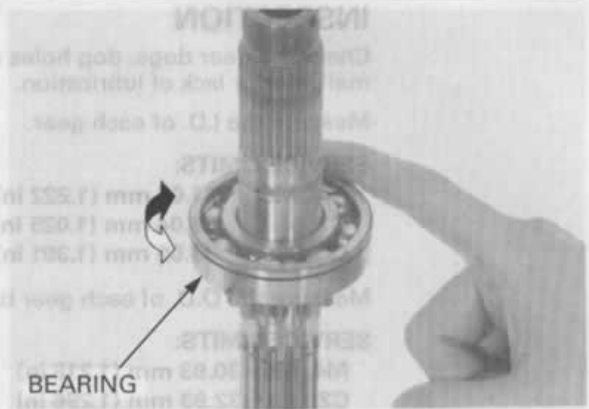
## DISASSEMBLY

Disassemble the mainshaft and countershaft.



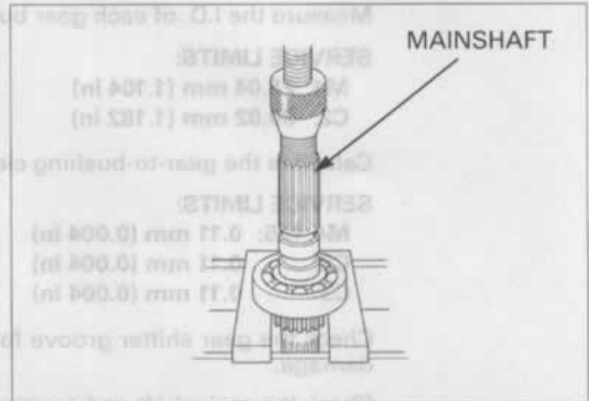


Turn the outer race of each bearing with your finger. The bearings should turn smoothly and quietly. Also check that the bearing inner race fits tightly on the shaft. Remove and discard the mainshaft bearing, if the race does not turn smoothly, quietly, or fits loosely on the mainshaft. Replace the countershaft, collar and bearing as an assembly, if the race does not turn smoothly, quietly, or fits loosely on the countershaft.



### MAINSHAFT BEARING REPLACEMENT

Press out the mainshaft from the bearing using a hydraulic press.



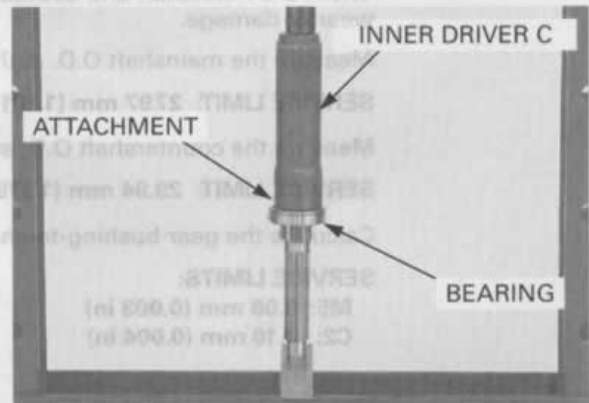
Install with the groove side facing up.

Install a new mainshaft bearing onto the mainshaft by pressing the mainshaft bearing inner race using the special tools.

#### TOOLS:

Inner driver C  
Attachment, 30 mm I.D.

07746-0030100  
07746-0030300





## INSPECTION

Check the gear dogs, dog holes and teeth for abnormal wear or lack of lubrication.

Measure the I.D. of each gear.

### SERVICE LIMITS:

M4, M5:	31.05 mm (1.222 in)
C1:	26.04 mm (1.025 in)
C2, C3:	33.05 mm (1.301 in)

Measure the O.D. of each gear bushing.

### SERVICE LIMITS:

M4, M5:	30.93 mm (1.218 in)
C2:	32.93 mm (1.296 in)
C3:	32.93 mm (1.296 in)

Measure the I.D. of each gear bushing.

### SERVICE LIMITS:

M4:	28.04 mm (1.104 in)
C2:	30.02 mm (1.182 in)

Calculate the gear-to-bushing clearance.

### SERVICE LIMITS:

M4, M5:	0.11 mm (0.004 in)
C2:	0.11 mm (0.004 in)
C3:	0.11 mm (0.004 in)

Check the gear shifter groove for abnormal wear or damage.

Check the mainshaft and countershaft for abnormal wear or damage.

Measure the mainshaft O.D. at the M4 gear.

**SERVICE LIMIT: 27.97 mm (1.101 in)**

Measure the countershaft O.D. at the C2 gear.

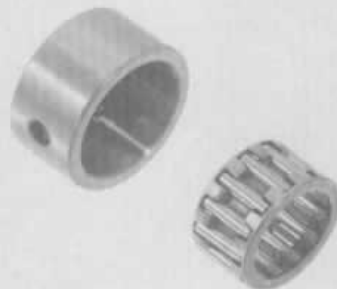
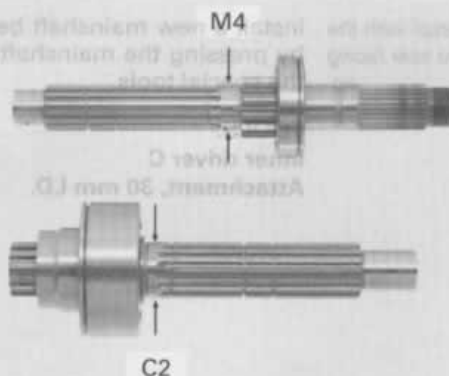
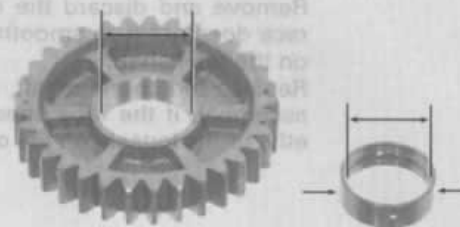
**SERVICE LIMIT: 29.94 mm (1.179 in)**

Calculate the gear bushing-to-shaft clearance.

### SERVICE LIMITS:

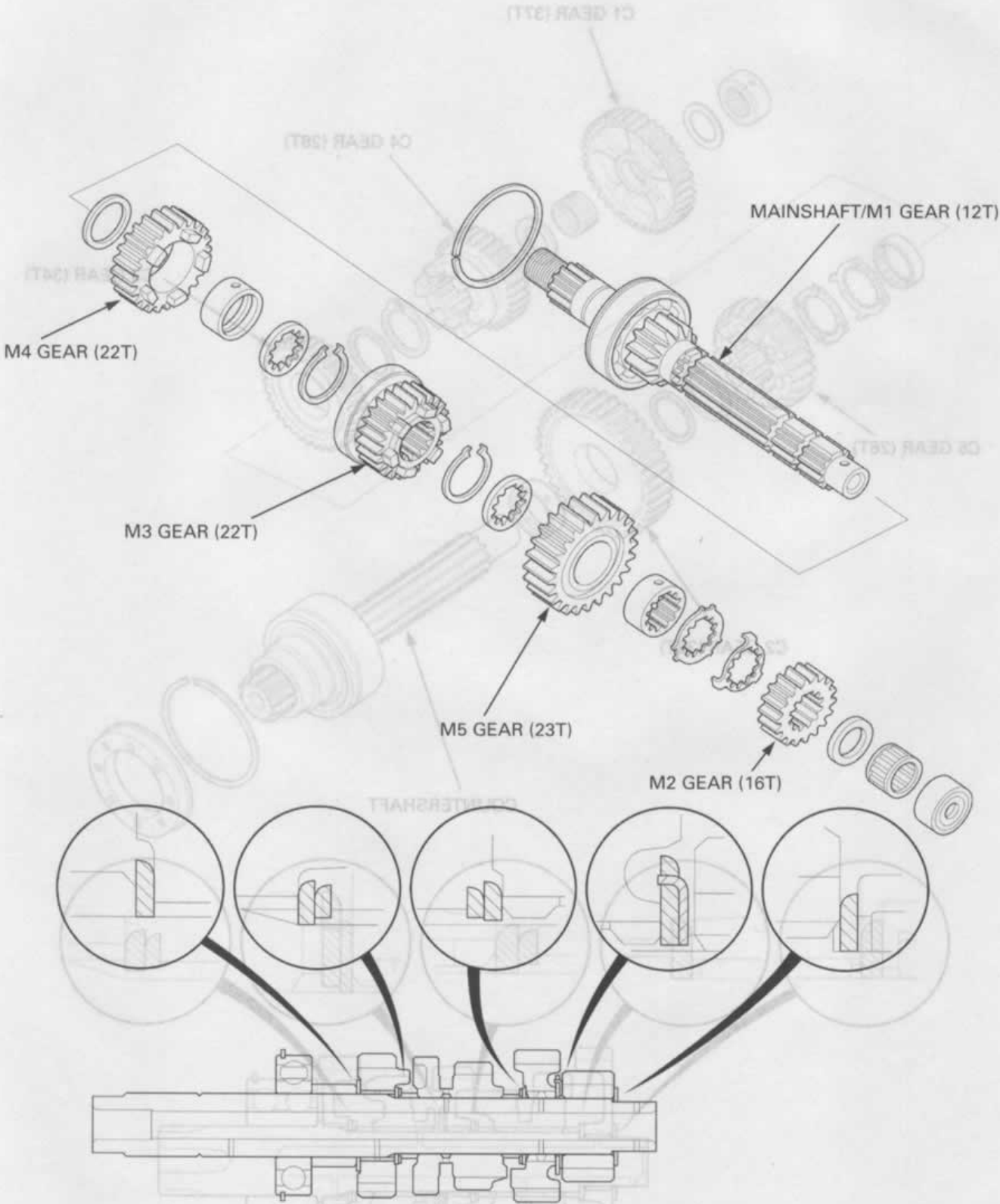
M5:	0.08 mm (0.003 in)
C2:	0.10 mm (0.004 in)

Check the needle bearing for wear or damage, replace if necessary.

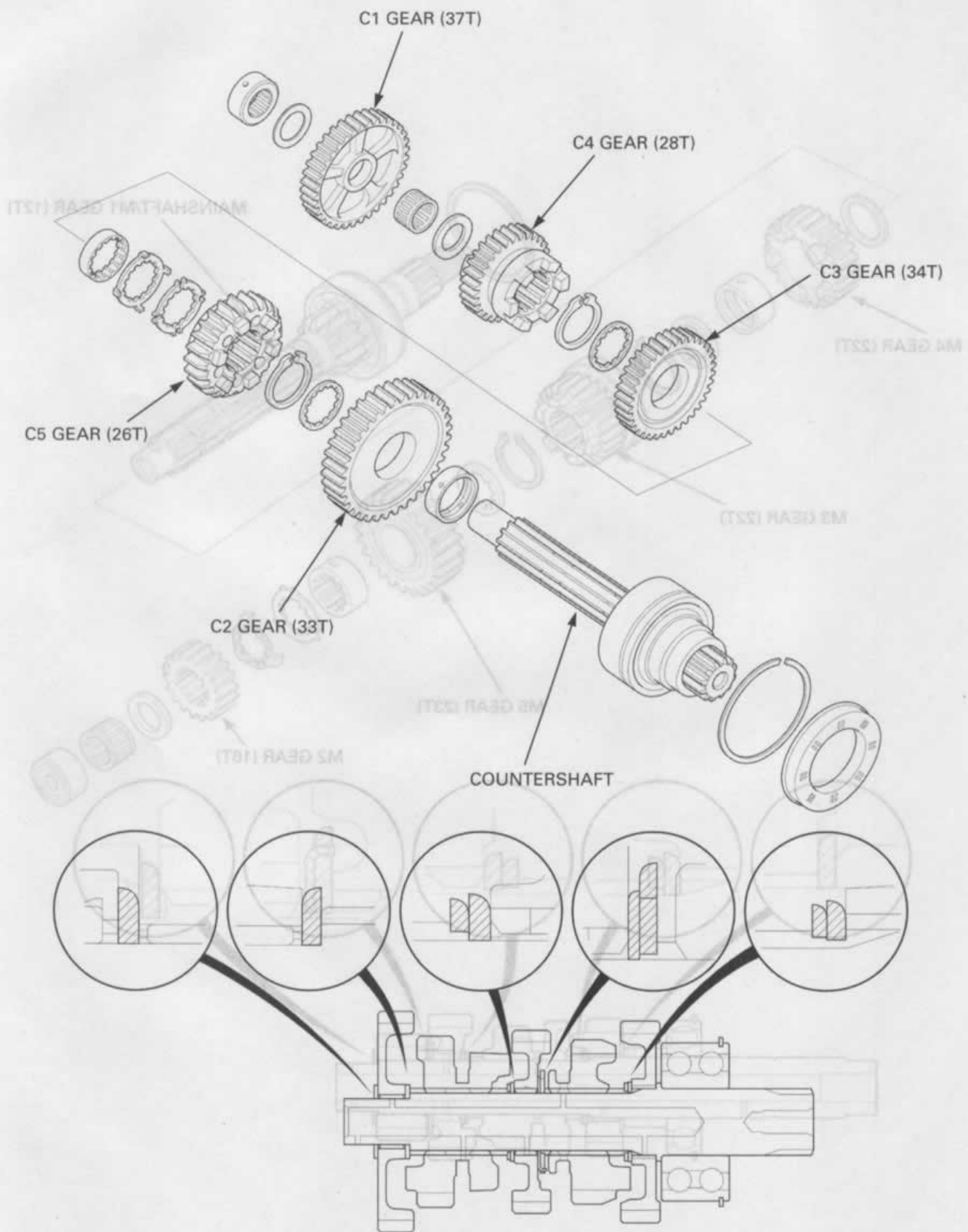




ASSEMBLY

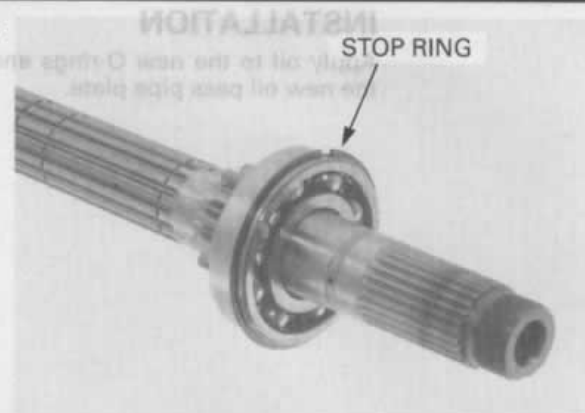




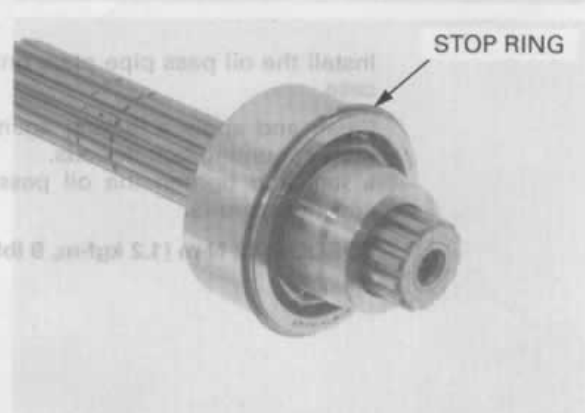




Install the stop ring into the groove of the mainshaft bearing.

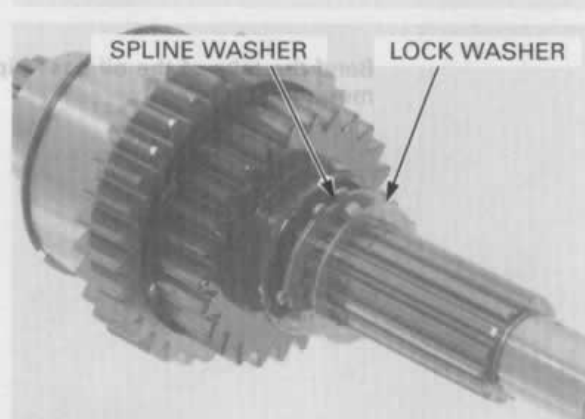


Install the stop ring into the groove of the countershaft bearing.



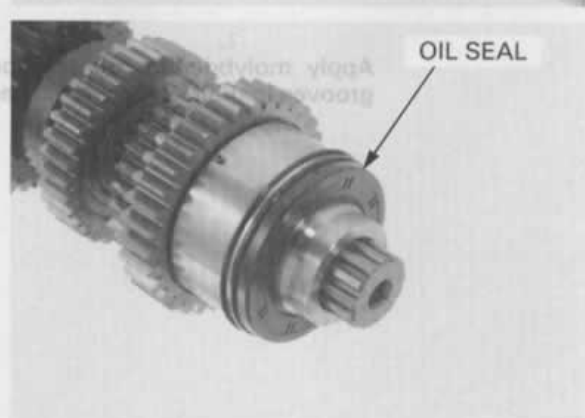
Coat each gear with clean engine oil and check for smooth movement.  
Assemble the transmission gear and shafts.

- Align the lock washer tabs with the spline washer grooves.
- Always install the thrust washer and snap ring with the chamfered (rolled) edge facing away from the thrust load.
- Install the snap ring so that its end gap aligns with the groove in the splines.
- Make sure that the snap ring is fully seated in the shaft groove after installing it.



Check the countershaft oil seal for wear or damage, replace if necessary.

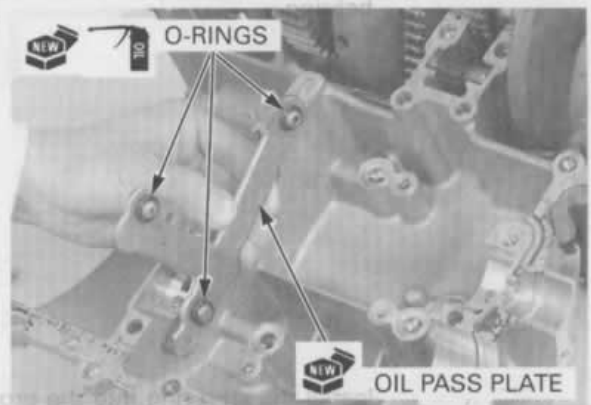
Install the countershaft oil seal.





## INSTALLATION

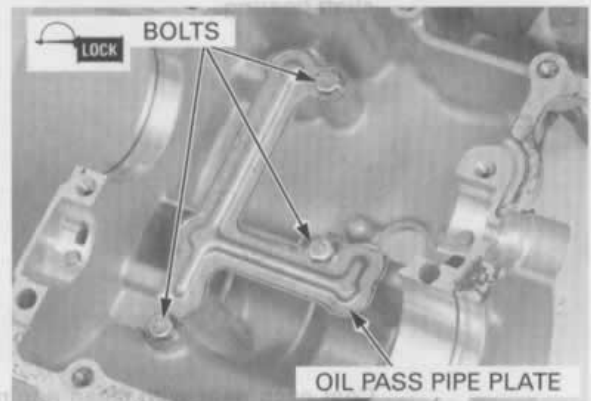
Apply oil to the new O-rings and install them onto the new oil pass pipe plate.



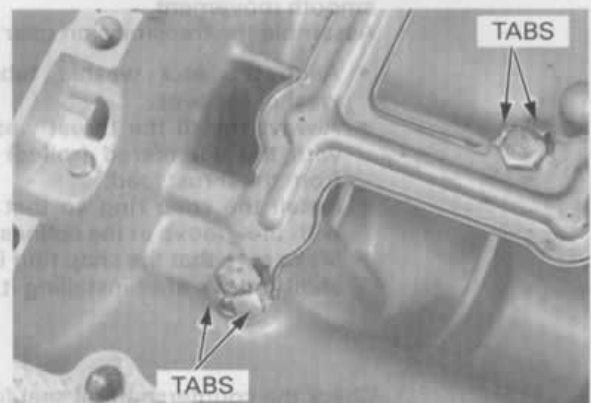
Install the oil pass pipe plate onto the upper crankcase.

Clean and apply a locking agent the oil pass pipe plate mounting bolt threads. Install and tighten the oil pass pipe plate to the specified torque.

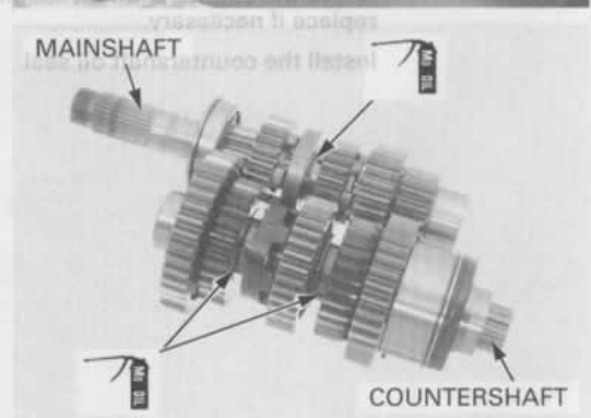
**TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)**



Bend the tabs of the oil pass pipe plate against the mounting bolts.



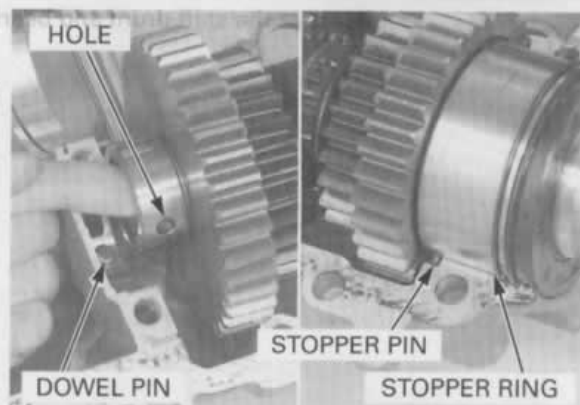
Apply molybdenum oil solution to the shift fork grooves in the M3, C4 and C5 gear.





Install the countershaft assembly onto the upper crankcase.

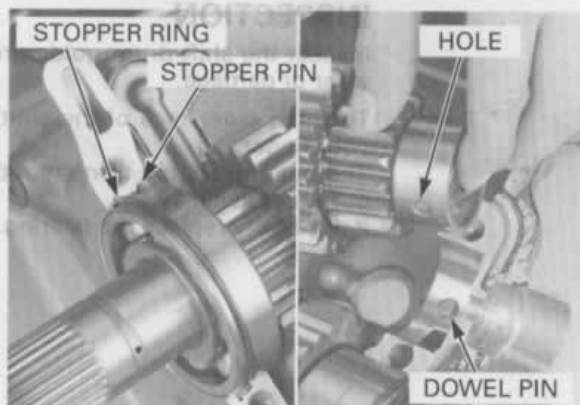
- Align the needle bearing case hole with the dowel pin on the upper crankcase.
- Align the stopper ring on the countershaft bearing with the groove of the upper crankcase.
- Install the stopper pin on the countershaft bearing with the groove of the upper crankcase.



Install the mainshaft assembly onto the upper crankcase.

- Align the needle bearing case hole with the dowel pin on the upper crankcase.
- Align the stopper ring on the mainshaft bearing with the groove of the upper crankcase.
- Install the stopper pin on the mainshaft bearing with the groove of the upper crankcase.

Assemble the crankcase (page 12-26).

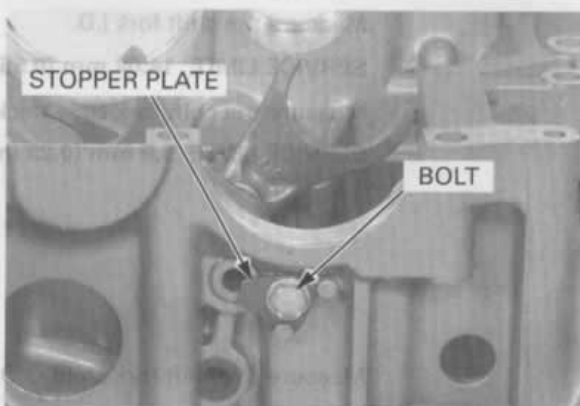


## SHIFT FORK/SHIFT DRUM

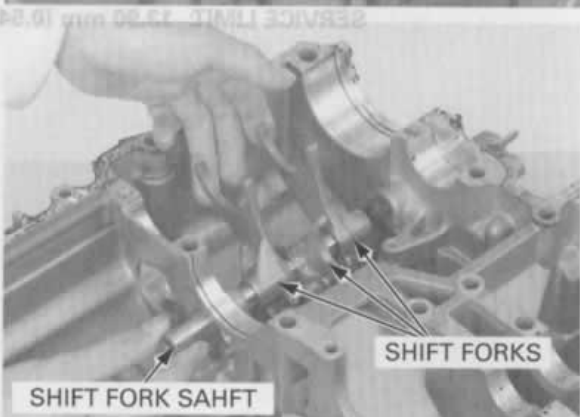
### REMOVAL

Separate the crankcase halves (page 12-5).

Remove the bolt and shift fork shaft stopper plate.

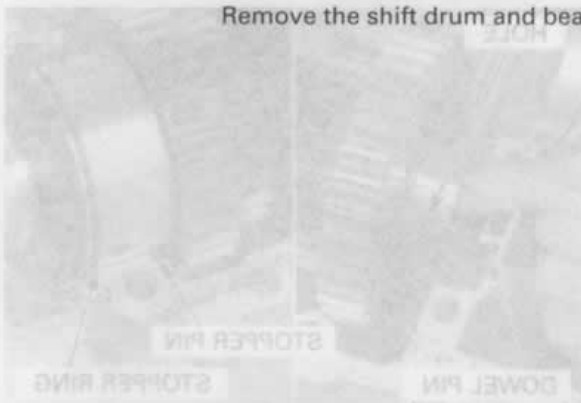


Remove the shift fork shaft and shift forks.





Remove the shift drum and bearing as an assembly.



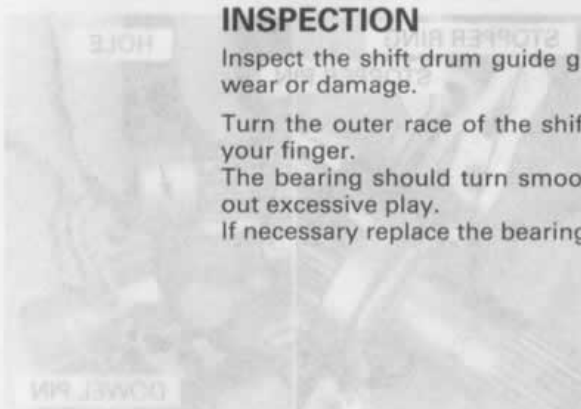
## INSPECTION

Inspect the shift drum guide grooves for abnormal wear or damage.

Turn the outer race of the shift drum bearing with your finger.

The bearing should turn smoothly and freely without excessive play.

If necessary replace the bearing.



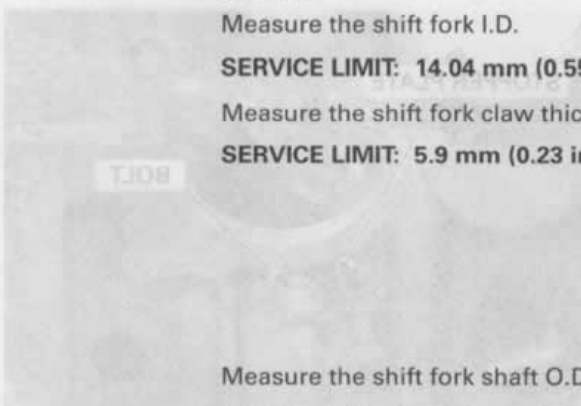
Check the shift fork guide pin for abnormal wear or damage.

Measure the shift fork I.D.

**SERVICE LIMIT: 14.04 mm (0.553 in)**

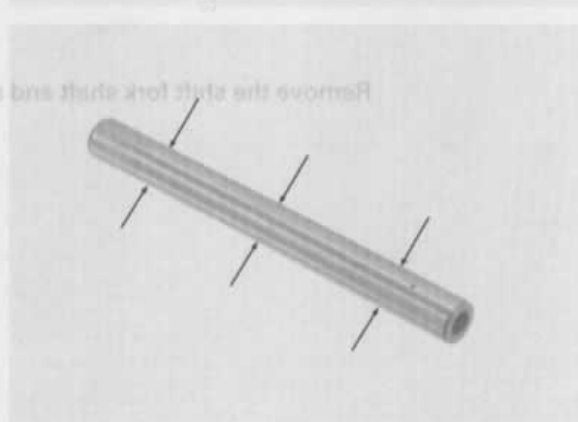
Measure the shift fork claw thickness.

**SERVICE LIMIT: 5.9 mm (0.23 in)**



Measure the shift fork shaft O.D.

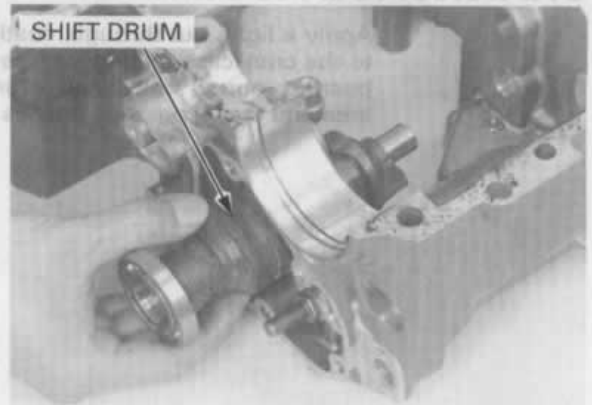
**SERVICE LIMIT: 13.90 mm (0.547 in)**





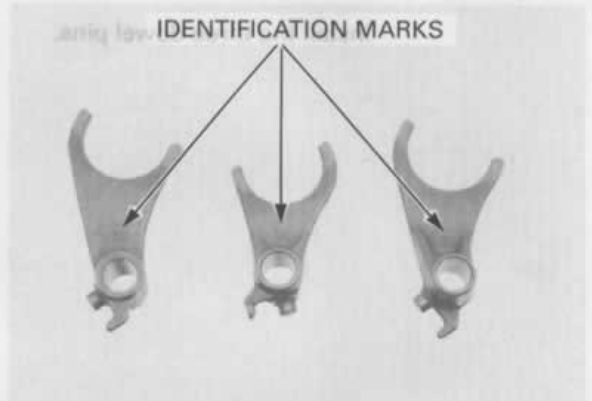
## INSTALLATION

Install the shift drum/bearing assembly into the lower crankcase.

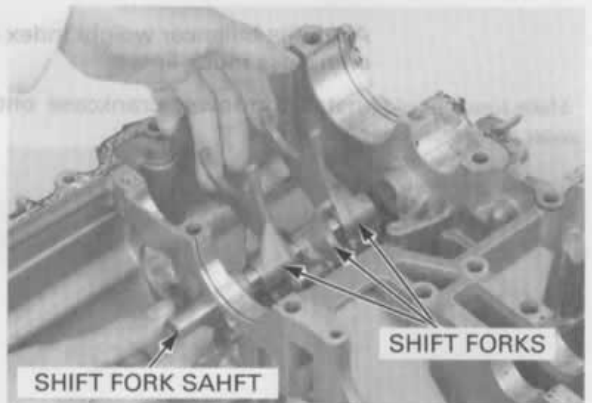


The shift forks have location marks:

- "R" for right
- "L" for left
- "C" for center



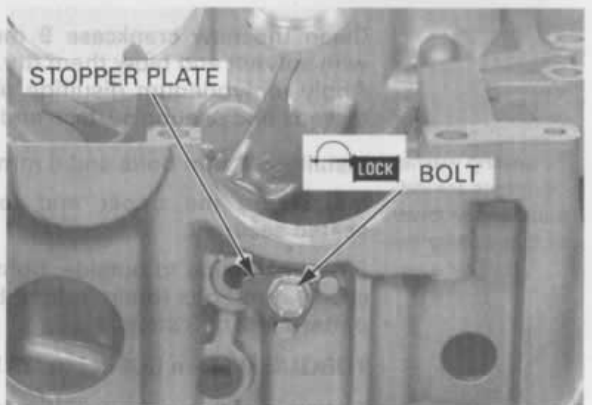
Install the shift forks into the shift drum guide groove with the identification marks facing toward the right side of the engine and insert the fork shaft.



Apply a locking agent to the threads of the shift fork shaft stopper plate bolt. Install the stopper plate, tighten the bolt to the specified torque.

**TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)**

Assemble the crankcase halves (page 12-22).





# CRANKCASE ASSEMBLY

Apply a light, but thorough, coating of liquid sealant to the crankcase mating surface except to the main bearing journal bolt (lower crankcase bolt, 8 mm) area and the oil passage area as shown.



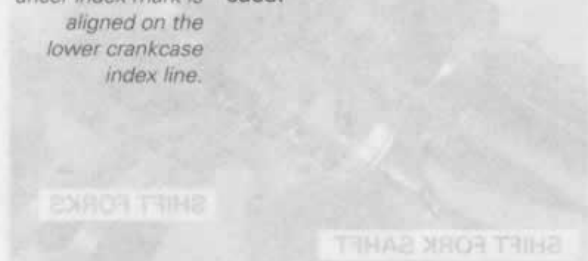
Install the three dowel pins.



Make sure the balancer index mark is aligned on the lower crankcase index line.

Align the balancer weight index mark with the lower crankcase index line.

Install the lower crankcase onto the upper crankcase.



The sealing washer locations are indicated on the lower crankcase using the "△" mark.

Clean the new crankcase 9 mm bolts thoroughly with solvent and blow them dry. Apply molybdenum disulfide oil to the 9 mm bolt threads and seating surface and install them.

Install the 8 mm bolts and 6 mm bolts.

Make sure the upper and lower crankcase are seated securely.

From the inside to outside, tighten the lower crankcase 9 mm bolts (main journal bolts) in a crisscross pattern in 2 or 3 steps.

**TORQUE: 33 N·m (3.4 kgf·m, 25 lbf·ft)**

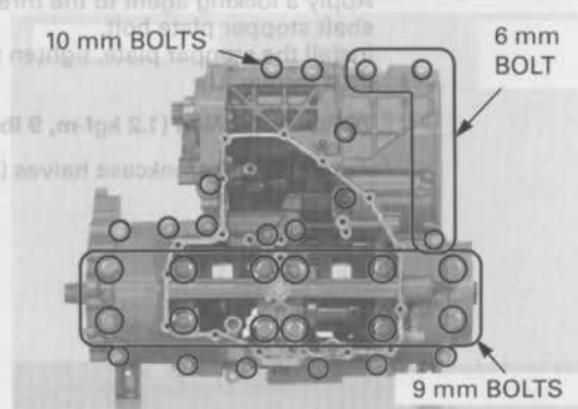
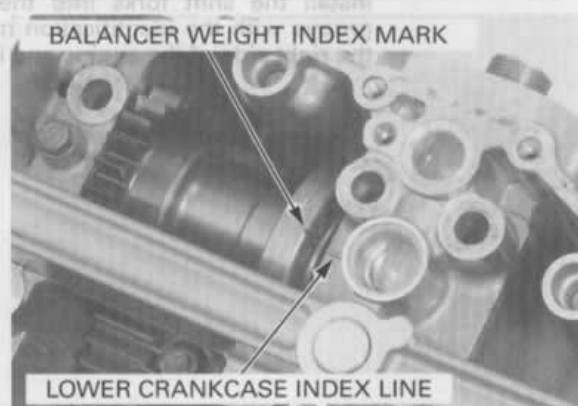
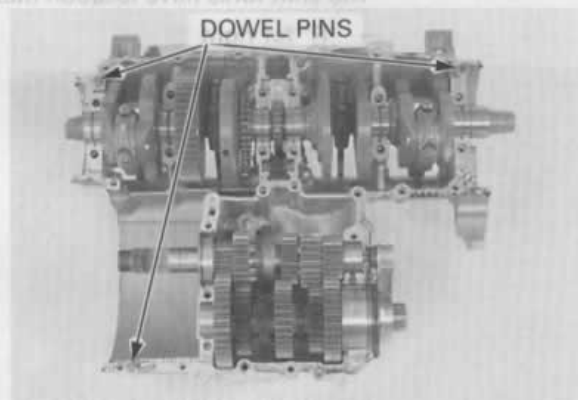
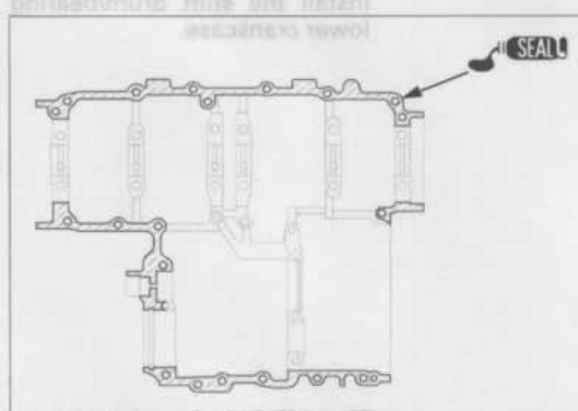
Tighten the 8 mm bolt to the specified torque, and then tighten 6 mm bolts.

**TORQUE:**

8 mm bolt: 25 N·m (2.5 kgf·m, 18 lbf·ft)

6 mm bolt: 12 N·m (1.2 kgf·m, 9 lbf·ft)

## INSTALLATION





The sealing washer locations are indicated on the upper crankcase using the "△" mark.

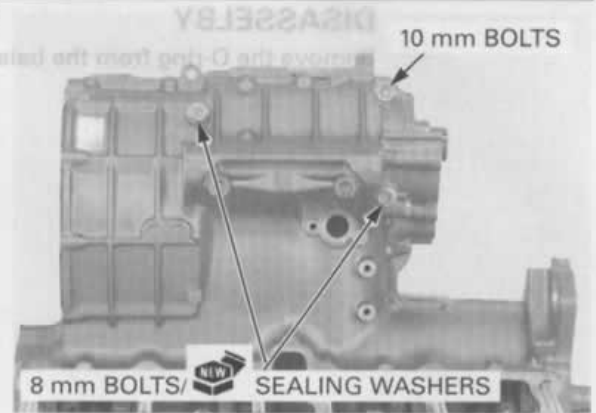
Install the upper crankcase 10 mm bolt and two 8 mm bolts with new sealing washers.

Tighten the 10 mm bolt to the specified torque.

**TORQUE: 39 N·m (4.0 kgf·m, 29 lbf·ft)**

Tighten the 8 mm bolts alternately.

**TORQUE: 24 N·m (2.5 kgf·m, 18 lbf·ft)**



## BALANCER

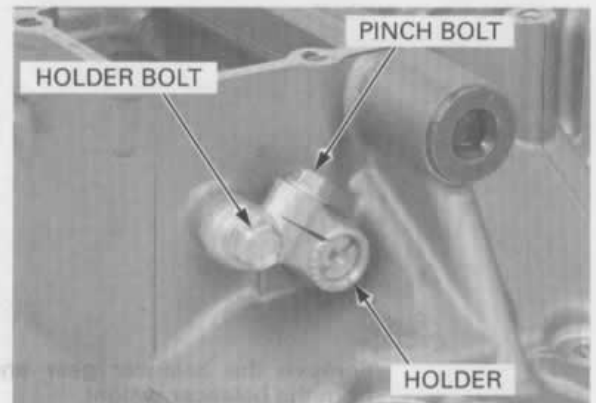
### REMOVAL

Separate the crankcase halves (page 12-5).

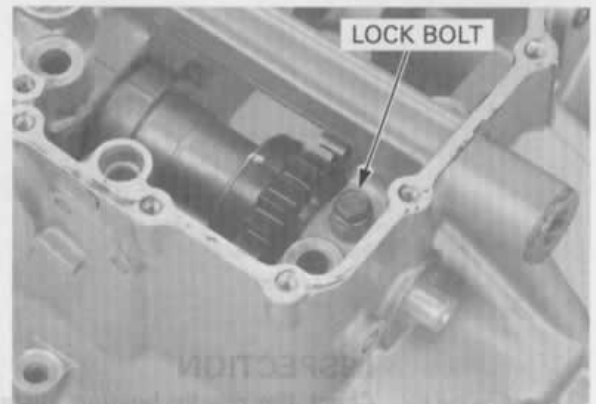
Remove the oil pump drive chain slider (page 12-7).

Loosen the balancer shaft pinch bolt.

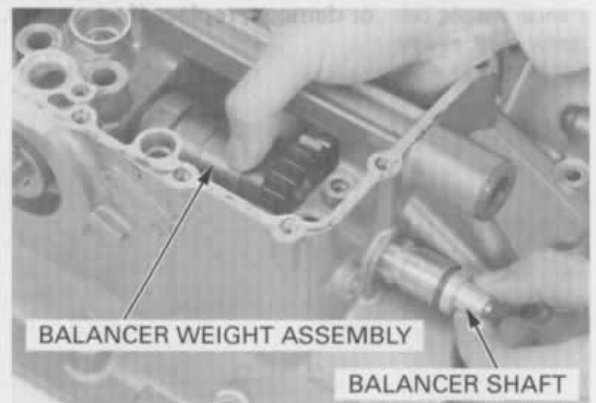
Remove the balancer shaft holder bolt and balancer holder.



Remove the balancer shaft lock bolt.



Remove the balancer shaft and balancer weight assembly.





## DISASSEMBLY

Remove the O-ring from the balancer shaft.

BALANCER SHAFT

O-RING

Remove the washers, needle bearings and distance collar from the balancer weight assembly.

WASHER

BALANCER WEIGHT/GEAR

DISTANCE COLLAR

NEEDLE BEARINGS

WASHER

Remove the balancer gear and damper rubbers from the balancer weight.

BALANCER GEAR

DAMPER RUBBERS

BALANCER WEIGHT

## INSPECTION

Replace the balancer weight, balancer shaft, needle bearing as a set

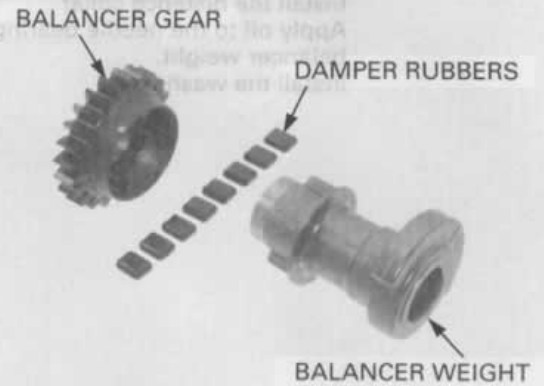
Check the needle bearing, distance collar for wear or damage, replace if necessary.

DISTANCE COLLAR

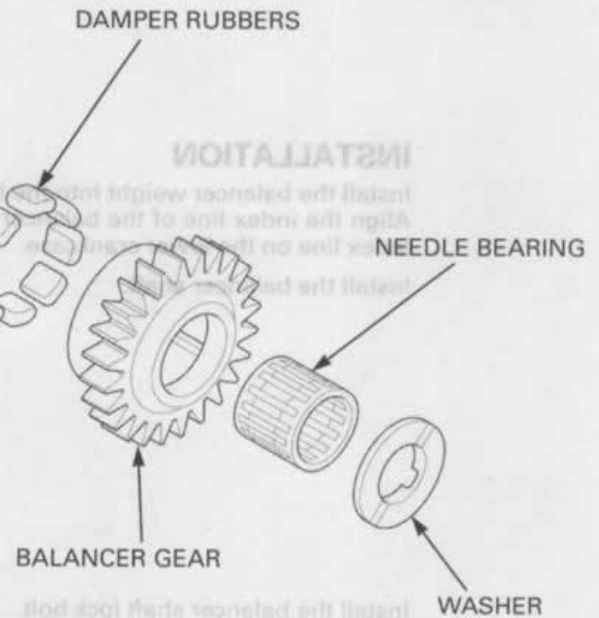
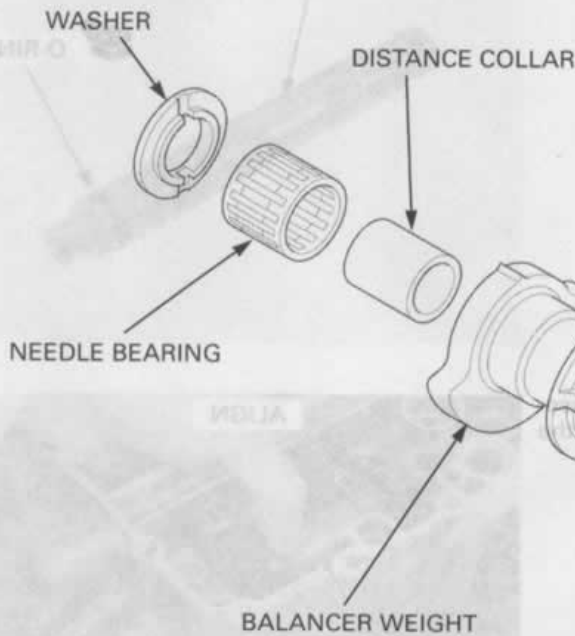
NEEDLE BEARINGS



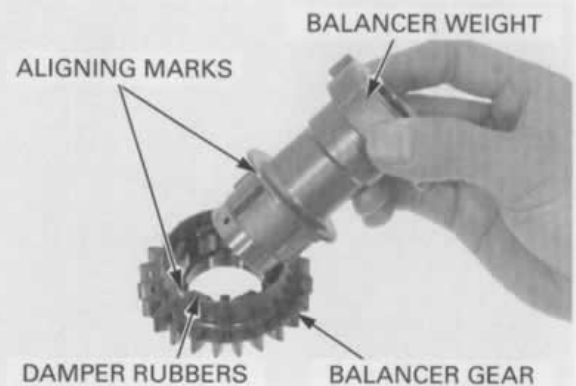
Check the balancer weight and gear for wear or damage.  
Check the damper rubbers for fatigue or damage, replace if necessary.



## DISASSEMBLY



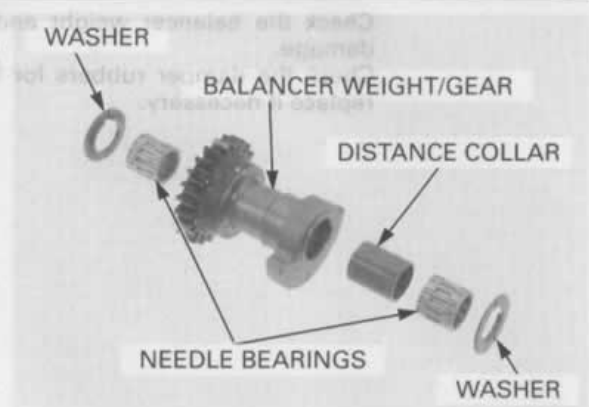
Install the damper rubbers into the balancer gear.  
Assemble the balancer gear and weight while aligning the aligning marks.



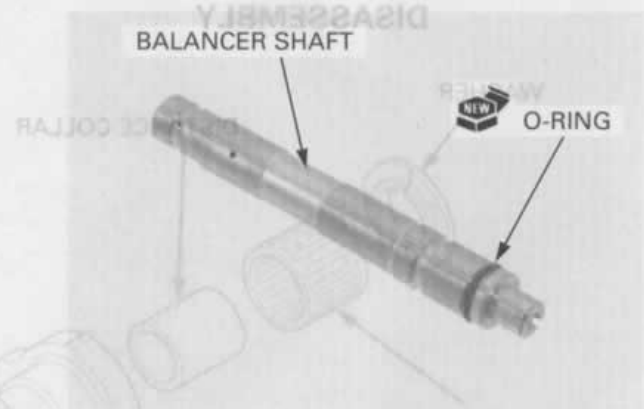


## CRANKSHAFT/TRANSMISSION/BALANCER

Install the distance collar.  
Apply oil to the needle bearing, install them into the balancer weight.  
Install the washers.



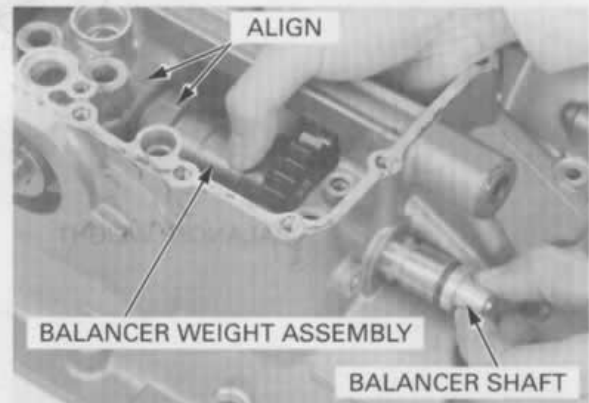
Install a new O-ring to the balancer shaft.



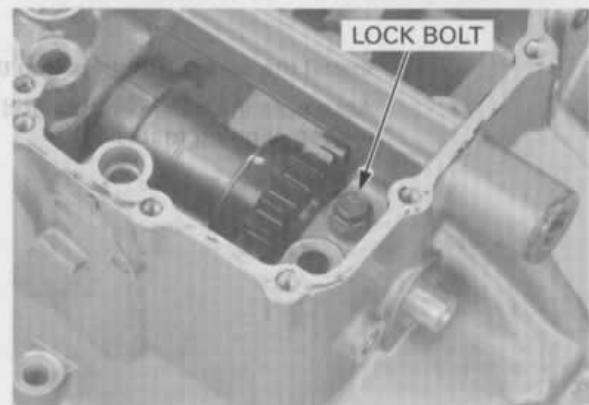
### INSTALLATION

Install the balancer weight into the lower crankcase.  
Align the index line of the balancer weight with the index line on the lower crankcase.

Install the balancer shaft.



Install the balancer shaft lock bolt.





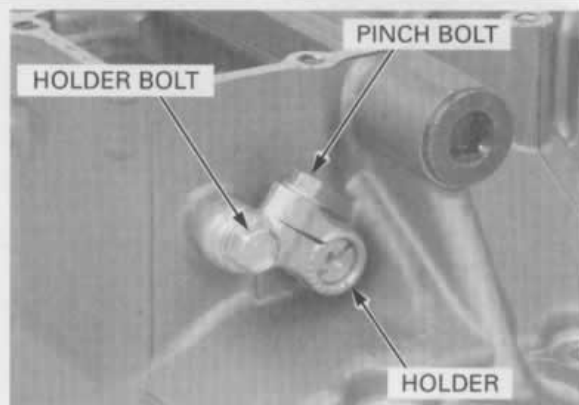
Install the balancer shaft holder.

Install the balancer holder bolt and balancer holder pinch bolt.

Tighten the balancer holder bolt to the specified torque.

**TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)**

Install the oil pump drive chain slider (page 12-7).

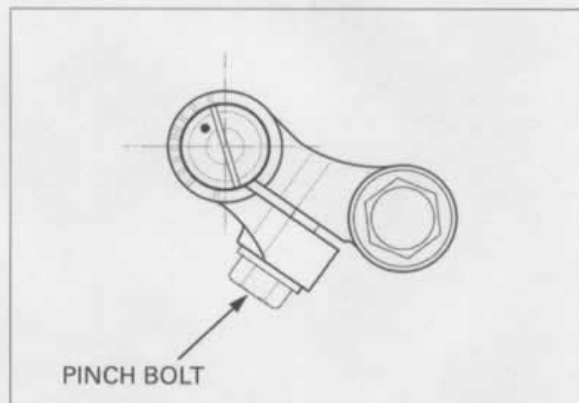


## BACKLASH ADJUSTMENT

Install the engine into the frame (page 8-8).

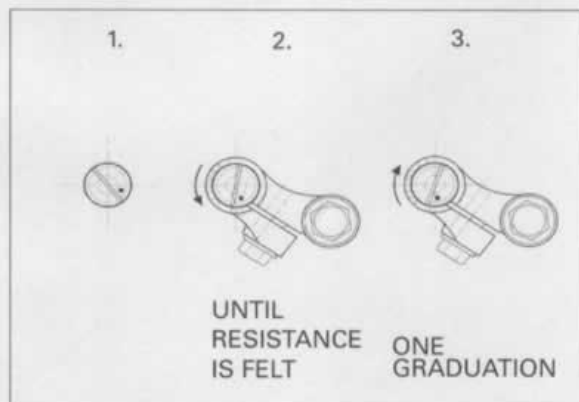
Loosen the balancer shaft holder pinch bolts.

*Adjust the backlash while the engine is cold (below 35°C/ 95°F) and the engine is not running.*



*Excessive force can cause balancer gear, bearing and shaft damage. Do not turn the shaft more than necessary.*

Turn the balancer shaft counterclockwise until resistance is felt, then back it off one graduation using the punch mark as a measure.



Warm up the engine and let it idle.

If the balancer gear noises are excessive, adjust the balancer backlash as follows:

Turn the balancer gear shaft counterclockwise until the gears begin to make a "whining" noise. Then turn the gear shaft clockwise until the gear "whining" noise disappears.

Tighten the balancer shaft pinch bolt.

After all gear backlash adjustments are done, snap the throttle and make sure the gear noises are not excessive.

If the gear "whine" noise is excessive, the backlash is too small.

If the gear "rattling" noise is excessive, the backlash is excessive.

