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## Section 04 ENGINE

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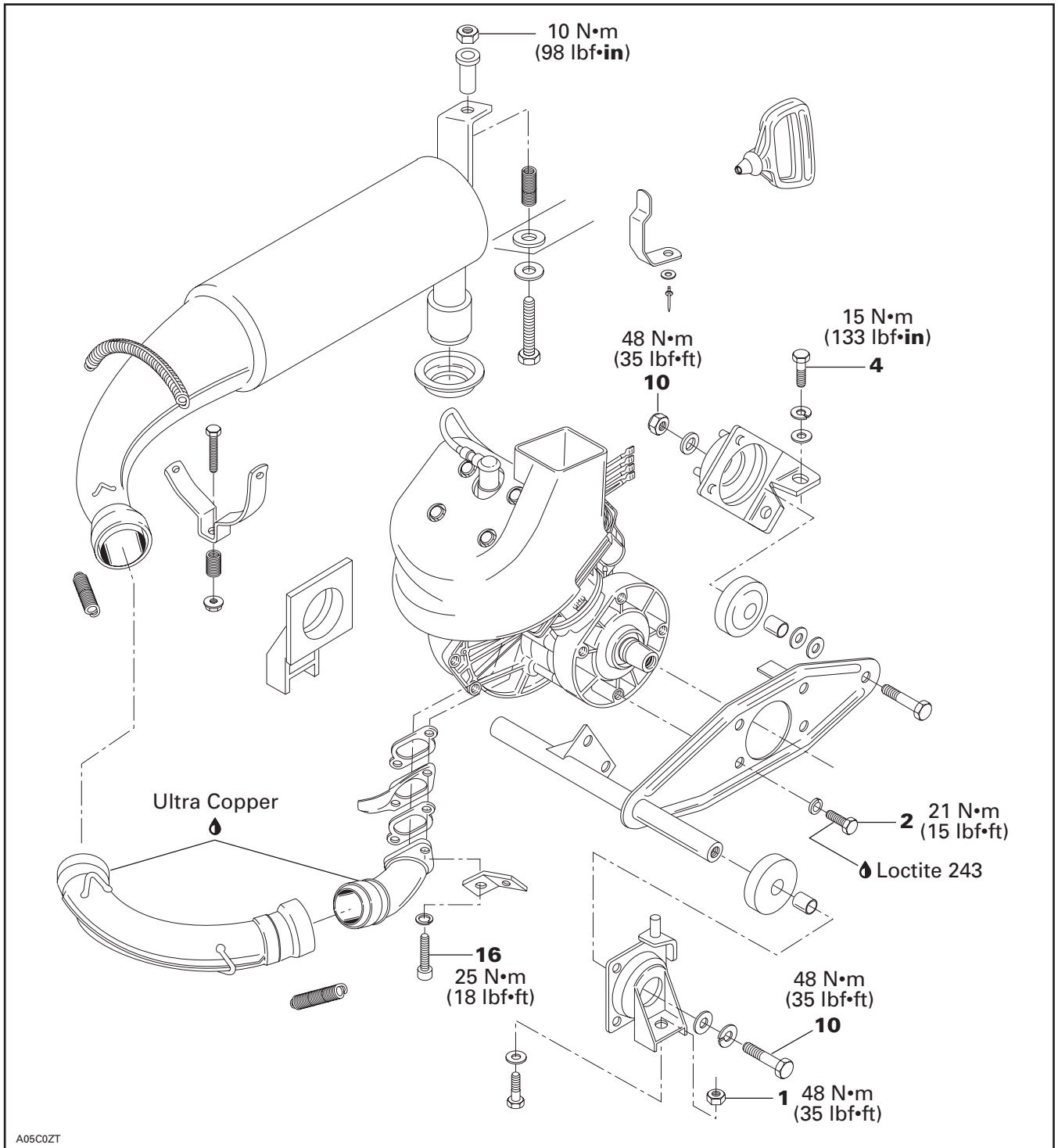
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# 277 ENGINE TYPE

## ENGINE REMOVAL AND INSTALLATION





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## Section 04 ENGINE

### Subsection 02 (277 ENGINE TYPE)

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## REMOVAL FROM VEHICLE

Remove or disconnect the following then lift engine from vehicle:

- guard
- drive belt
- muffler
- carburetor
- oil injection pump cable
- oil injection inlet line
- impulse line
- electrical connectors
- hood retaining cable
- engine mount nuts.

## ENGINE SUPPORT AND MUFFLER DISASSEMBLY AND ASSEMBLY

Torque the manifold screws **no. 16** to 25 N•m (18 lbf•ft).

Torque the support screws **no. 4** to 15 N•m (133 lbf•in) and nuts **no. 1** to 48 N•m (35 lbf•ft).

Torque the engine support screws and nut **no. 10** to 48 N•m (35 lbf•ft).

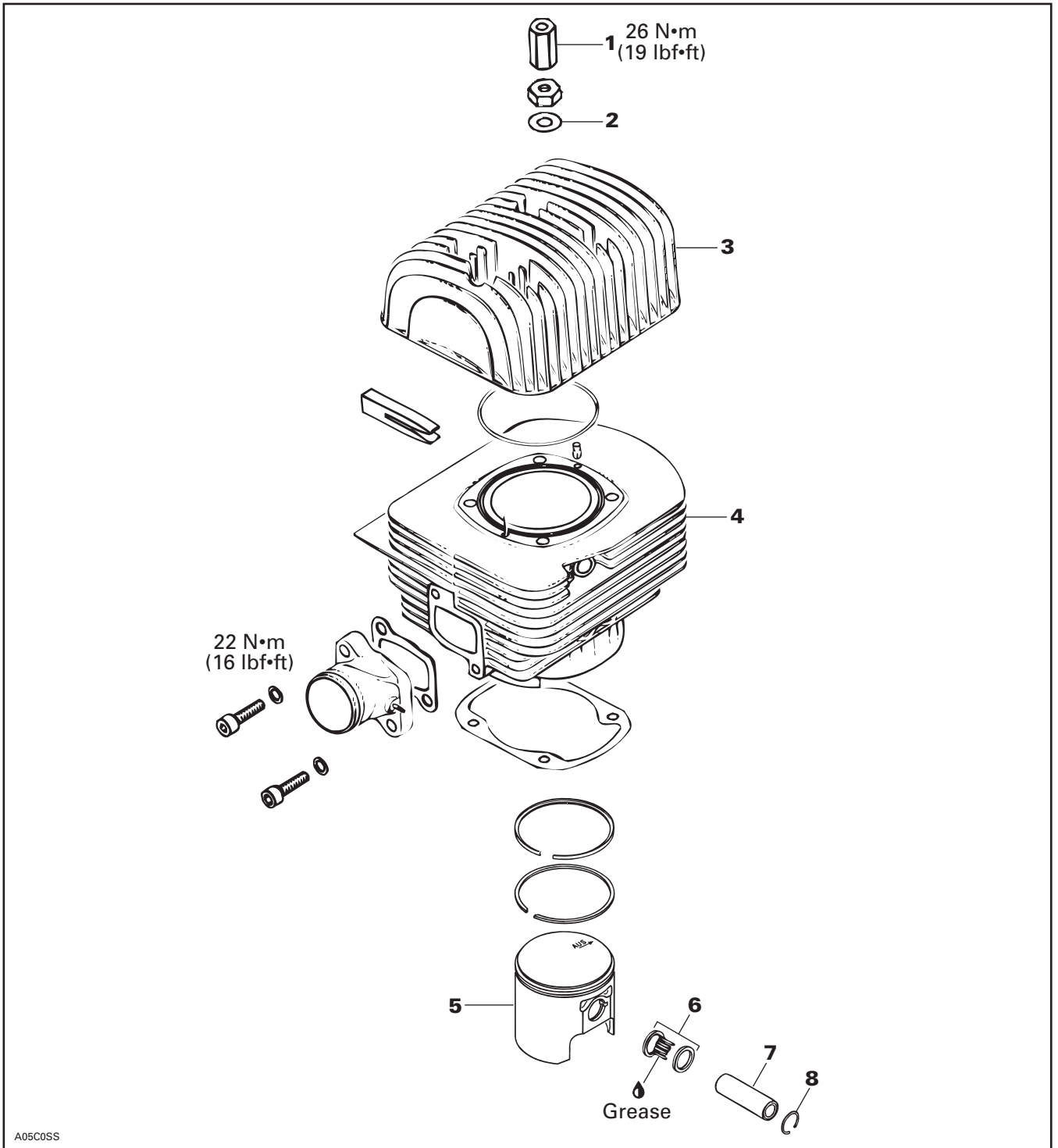
Apply Loctite 243 (P/N 293 800 005) on threads of screw **no. 2**. Torque screws **no. 2** retaining the engine support to engine crankcase to 21 N•m (15 lbf•ft).

## INSTALLATION ON VEHICLE

To install engine on vehicle, reverse removal procedure. However, pay attention to the following:

- Check tightness of engine mount nuts, and drive pulley screw.
- After throttle cable installation, check maximum throttle slide opening.
- Check pulley alignment and drive belt tension.
- Seal exhaust ball joints with Ultra Copper (P/N 413 710 300).

**TOP END**



## Section 04 ENGINE

### Subsection 02 (277 ENGINE TYPE)

## TROUBLESHOOTING

Before completely disassemble engine, check air-tightness. Refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT.

**NOTE:** The following procedures can be done without removing the engine from chassis.

## TOP END REMOVAL (without removing engine from chassis)

Remove the following then lift cylinder head **no. 3** and cylinder **no. 4**:

- belt guard
- carburetor
- exhaust system
- spark plug
- oil injection inlet
- fan cowl and hood cable
- cylinder head nuts **no. 1** and washers **no. 2**.

## CLEANING

Discard all gaskets.

Clean all metal components in a non-ferrous metal cleaner.

Scrape off carbon formation from cylinder exhaust port, cylinder head and piston dome using a wooden spatula.

**NOTE:** The letters "AUS" (over an arrow on the piston dome) must be visible after cleaning.

Clean the piston ring grooves with a groove cleaner tool, or with a piece of broken ring.

## DISASSEMBLY

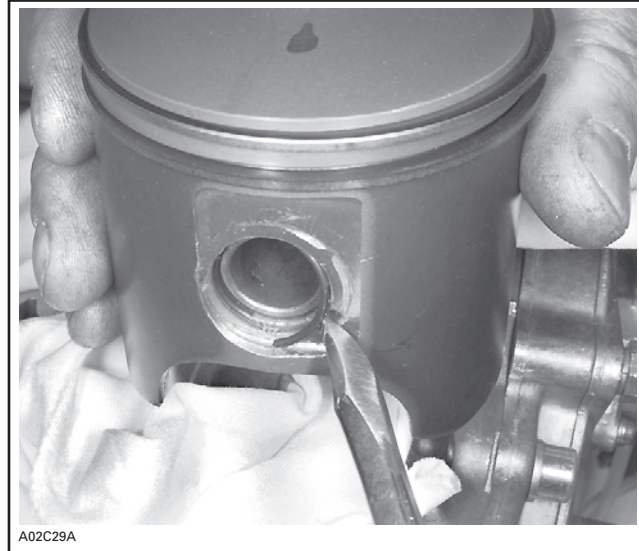
### 5, Piston

On this engine, piston pin needle bearing **no. 6** is mounted without a cage.

Use piston pin puller (P/N 529 035 503) along with 18 mm sleeve kit (P/N 529 035 541) and locating sleeve (P/N 529 023 800).

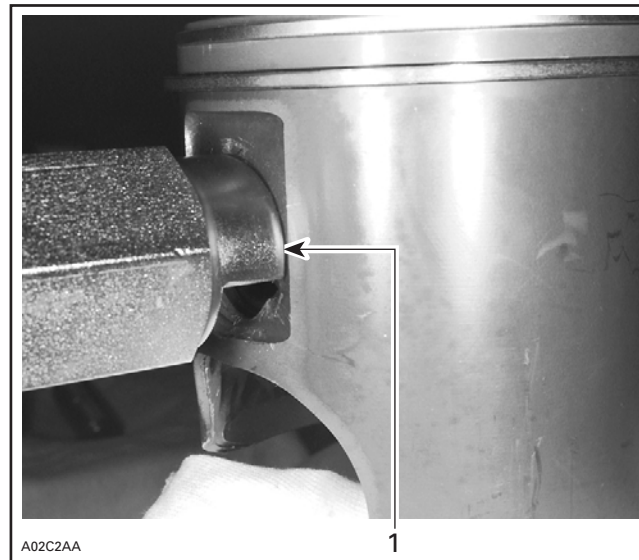
**NOTE:** The locating sleeve is the same that contains new cageless bearing.

Place a clean cloth or rubber pad (P/N 529 023 400) over crankcase to prevent circlips **no. 8** from falling into crankcase. Then with a pointed tool inserted in piston notch, remove both circlips from piston **no. 5**.



TYPICAL

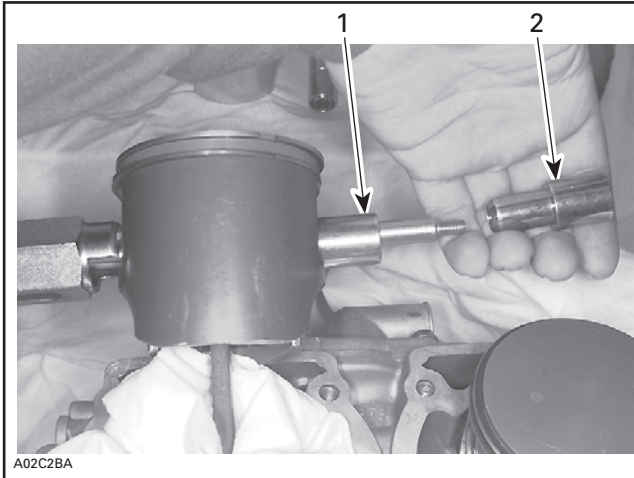
Insert piston pin puller (P/N 529 035 503) making sure it sits squarely against piston.



TYPICAL

1. Properly seated all around

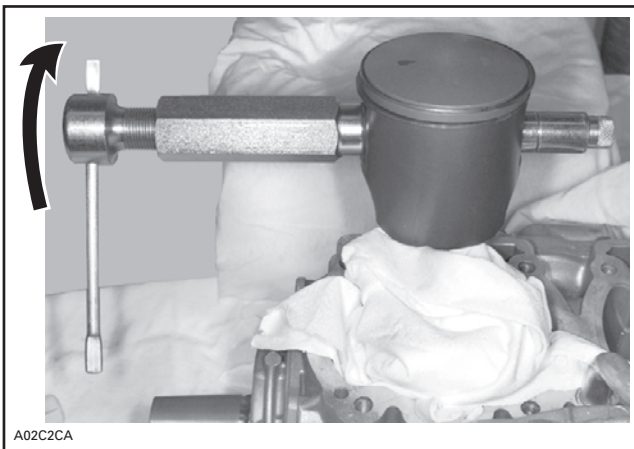
Install sleeve then shouldered sleeve over puller rod.



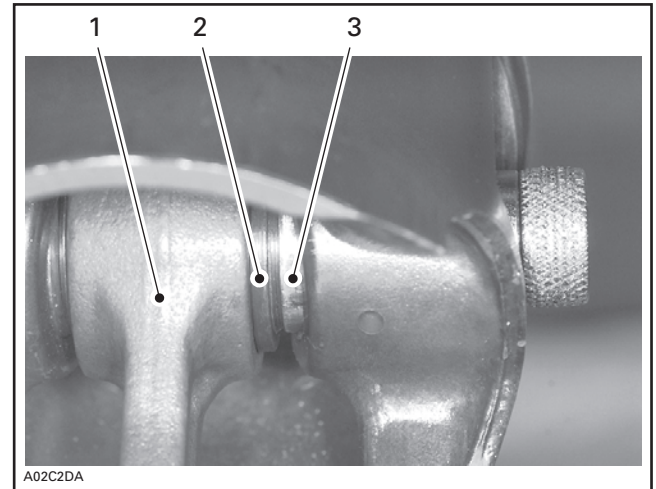
**TYPICAL — INSTALLATION OF SLEEVE KIT**

1. Sleeve
2. Shouldered sleeve

Pull out piston pin no. 7 by unscrewing puller until shouldered sleeve end is flush with thrust washer of piston pin bearing.



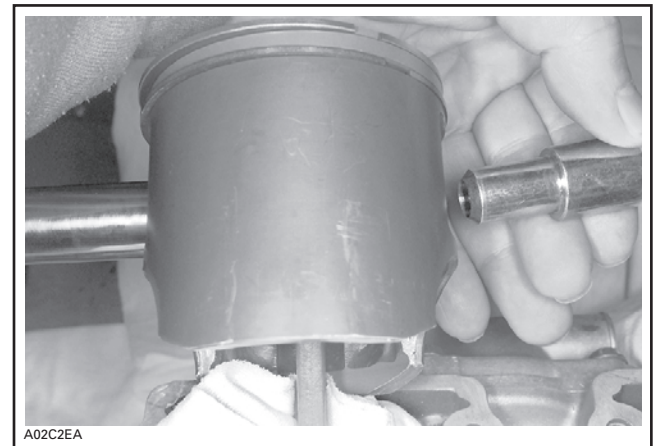
**TYPICAL — PISTON PIN EXTRACTION**



**TYPICAL**

1. Sleeve inside bearing
2. Thrust washer
3. Shouldered sleeve end

Remove puller. Pull out shouldered sleeve carefully.



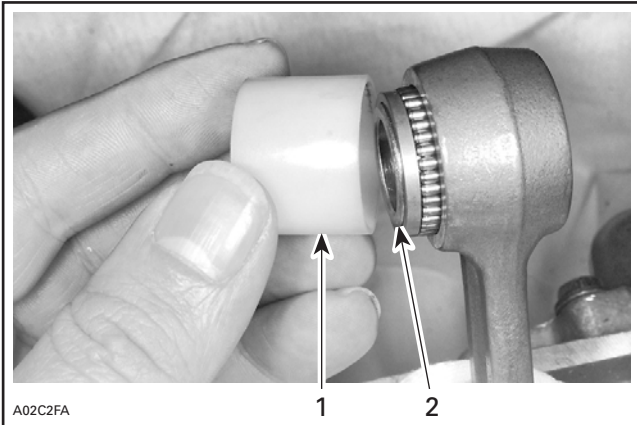
**TYPICAL**

Remove piston from connecting rod.

## Section 04 ENGINE

### Subsection 02 (277 ENGINE TYPE)

Install locating sleeve. Then push needle bearings along with thrust washers and sleeve.



#### TYPICAL

1. Locating sleeve
2. Sleeve

**NOTE:** 0.25 and 0.5 mm oversize pistons and rings are available if necessary.

Use a locking tie to fasten all needles and thrust washers along with locating sleeve.

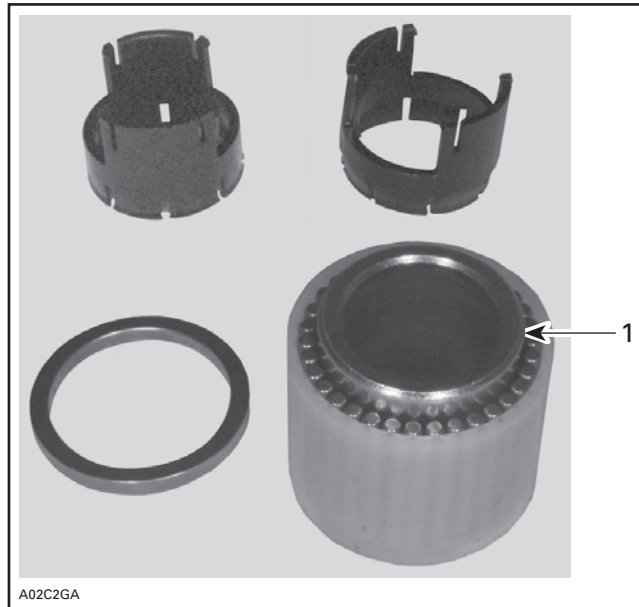
## INSPECTION

Refer to LEAK TEST AND ENGINE DIMENSIONS MEASUREMENT.

## ASSEMBLY

When reinstalling original needle bearings, make sure that 31 needles are inserted between sleeve and locating sleeve.

When installing a new cageless bearing, replace half plastic cages by sleeve.



#### TYPICAL

1. Sleeve

Grease thrust washers and install them on each end of needles.

Insert cageless bearing into connecting rod.



#### TYPICAL — CAGELESS BEARING AND SLEEVE INSTALLED

Mount piston over connecting rod with the letters "AUS" (over an arrow on the piston dome) facing in the direction of exhaust port.

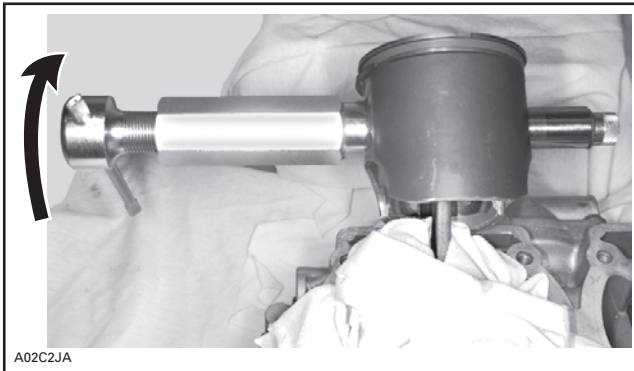


Install shouldered sleeve.



*TYPICAL — SHOULDERED SLEEVE INSTALLATION*

Install piston pin puller and turn handle until piston pin is correctly positioned in piston.

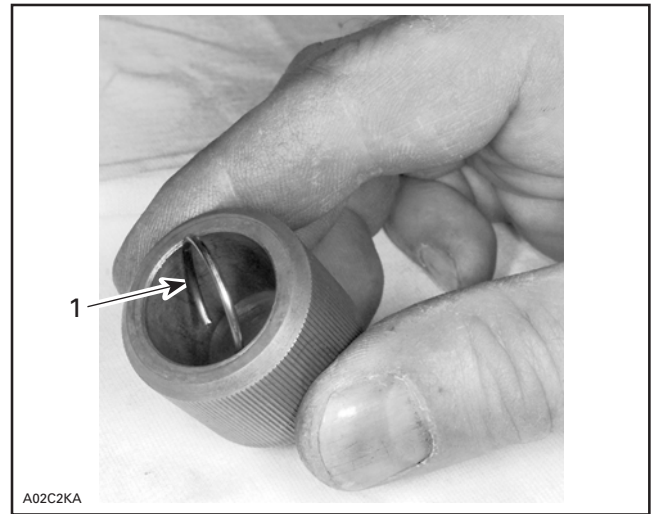


*TYPICAL*

Remove piston pin puller and sleeve kit.

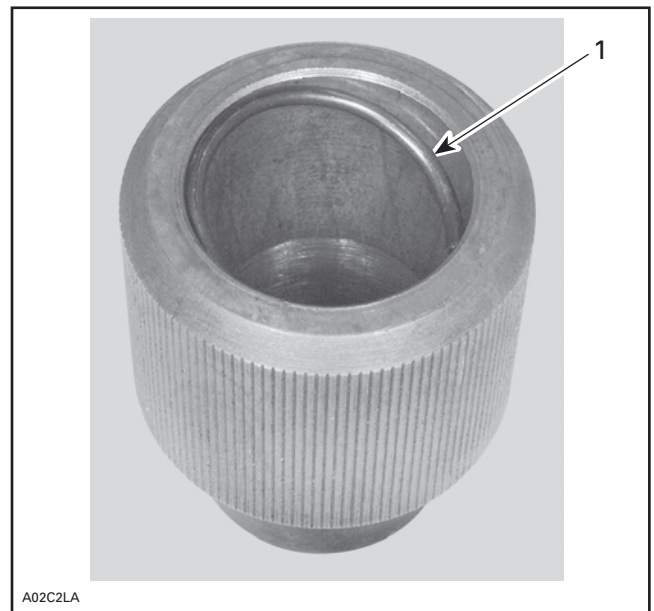
To minimize the effect of acceleration forces on circlip, install each circlip so the circlip break is at 6 o'clock as illustrated. Use piston circlip installer (P/N 529 035 561).

Insert circlip in tool at an angle.



1. Circlip

Square it up using a finger.



1. Circlip

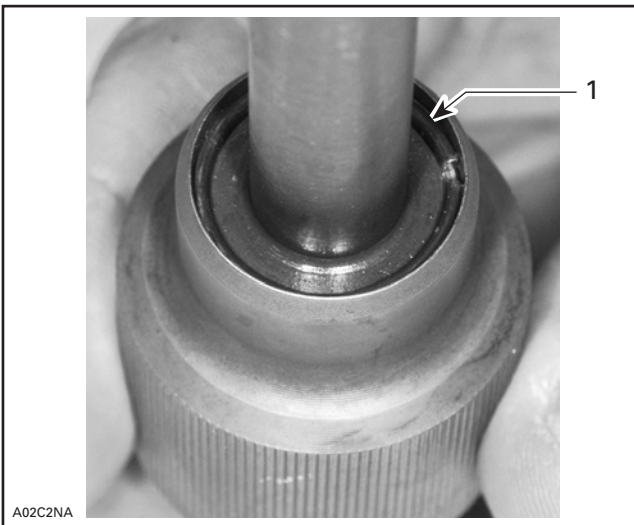
## Section 04 ENGINE

### Subsection 02 (277 ENGINE TYPE)

Continue to square it up using round end of circlip installer.

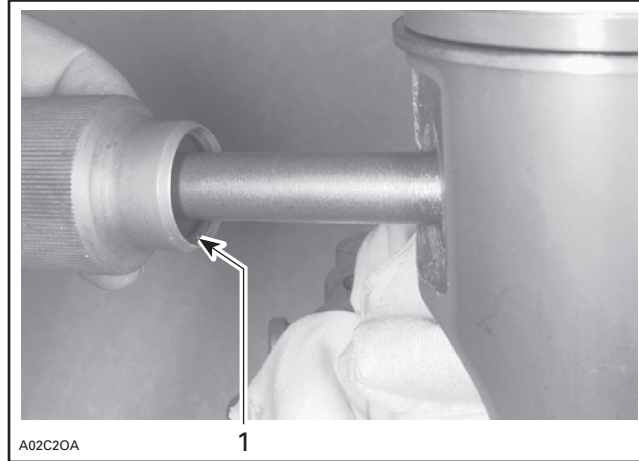


Using square end of tool, push circlip in until it rests in groove.



1. Circlip in groove

Mount tool in piston making sure that circlip break is facing down.



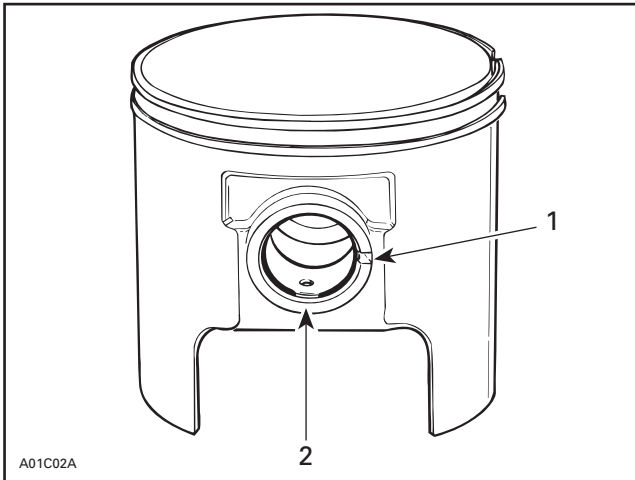
**TYPICAL**

1. Circlip break facing down

Hold tool firmly against piston then strike on round end of tool. Circlip will move from tool groove to piston groove.



**TYPICAL**



1. *Piston notch*
2. *Circlip break*

**CAUTION:** Circlips must not move freely in the groove after installation. If so, replace them.

Before inserting piston in the cylinder, lubricate the cylinder with new injection oil or equivalent.

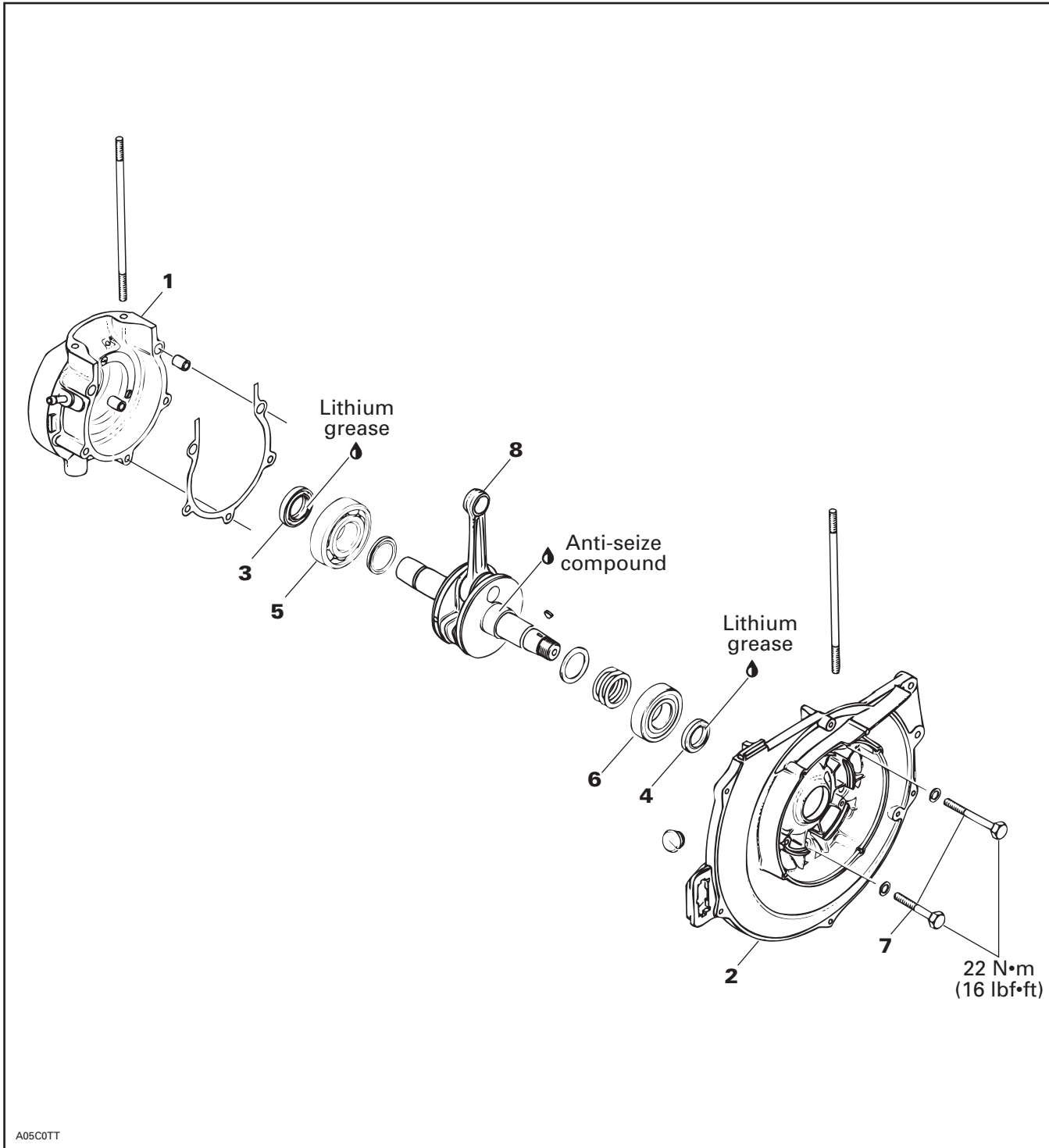
Position cylinder head on cylinder with fins in line with crankshaft center line. Cross torque retaining nuts to 26 N•m (19 lbf•ft).



## Section 04 ENGINE

### Subsection 02 (277 ENGINE TYPE)

## BOTTOM END



**NOTE:** Engine must be removed from chassis to perform the following procedures.

## CLEANING

Discard all oil seals and gaskets.

Clean all metal components in a non-ferrous metal cleaner.

## DISASSEMBLY

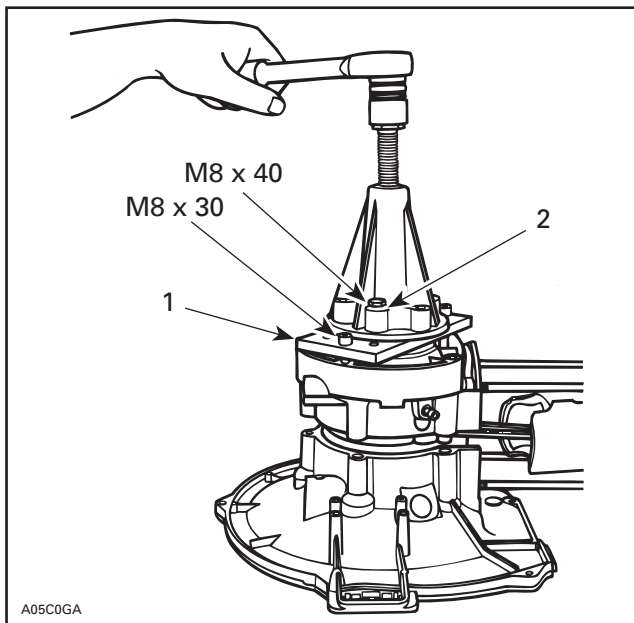
### General

To remove drive pulley, refer to DRIVE PULLEY.

To remove magneto, refer to MAGNETO.

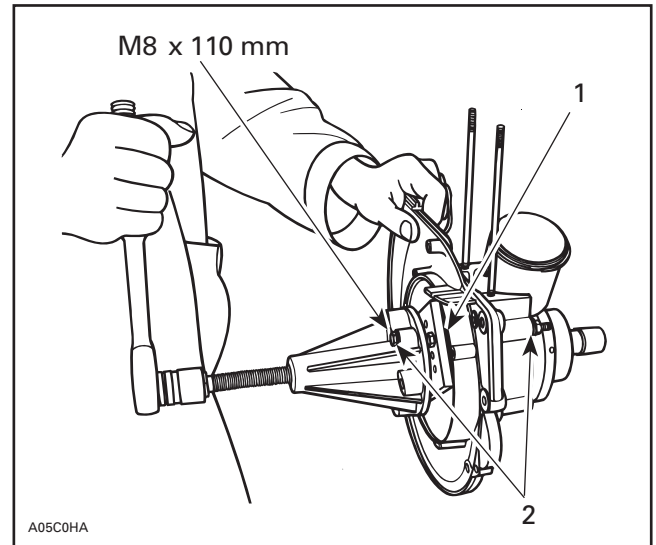
### 2,6, Crankcase Half

Heat to 110 - 120°C (230 - 248°F) all around bearing seat on PTO side. Install puller (P/N 420 876 298) to plate (P/N 529 024 900) with flat washer under screw heads and extract PTO side crankcase half **no. 1**.



1. Plate
2. Flat washer

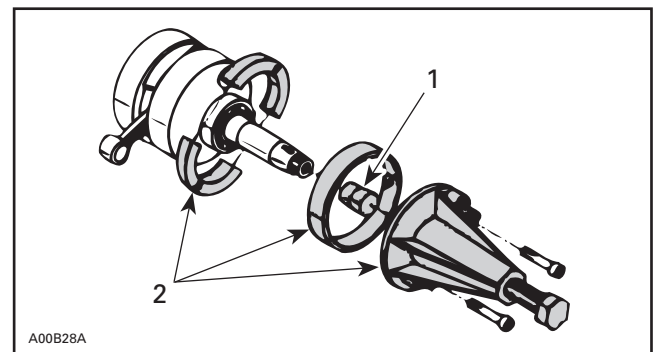
Heat to 110 - 120°C (230 - 248°F) all around bearing seat on MAG side. Install puller with plate, long bolts M8 x 110 mm and flat washers. Extract MAG side crankcase half **no. 2**.



1. Plate
2. Flat washers

To remove seals **nos. 3** and **4**, push from outside the crankcase towards the inside.

To remove bearings **nos. 5** and **6** from crankshaft use a protective cap and special puller as illustrated.



1. Protective cap
2. Special puller

## INSPECTION

Refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT.

## ASSEMBLY

Install connecting rod with its lubrication slot on big end facing exhaust side.

Smear anti-seize lubricant (P/N 413 701 000) on part of crankshaft where bearing fits.

Prior to installation, place bearings into an oil container and heat the oil to 75°C (167°F) for 5 to 10 min. This will expand bearings and ease installation.

## Section 04 ENGINE

### Subsection 02 (277 ENGINE TYPE)

Install bearings with groove outward.

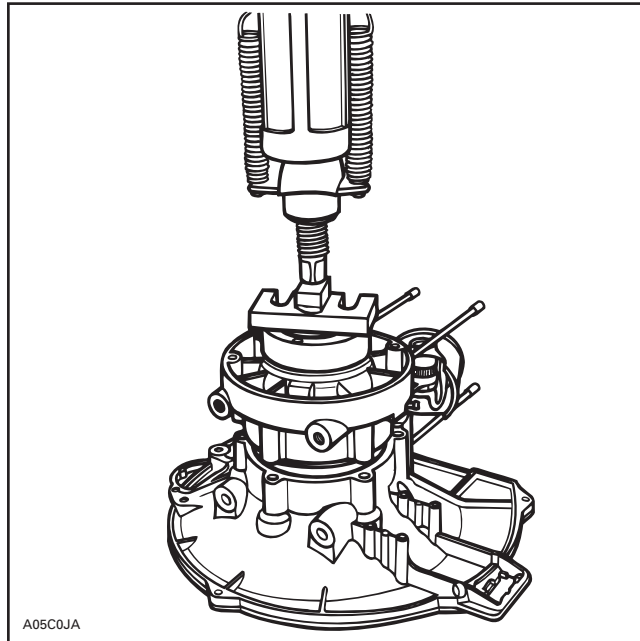
**NOTE:** Crankshaft end play requires adjustment only when crankshaft and/or crankcase is replaced. Prior to magneto side bearing installation, determine crankshaft end play and install required shim(s) on crankshaft extension. For the crankshaft end play adjustment procedure, refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT.

Prior to crankcase adjoining, install a protector sleeve on each crankshaft extension to prevent oil seal damage. Apply a light coat of lithium grease on seal lip. Spray some new injection oil on all moving parts of the crankshaft.

Install crankshaft seals with pusher (P/N 420 277 875) for MAG side seal no. 4 and (P/N 420 876 660) for PTO side seal no. 3.

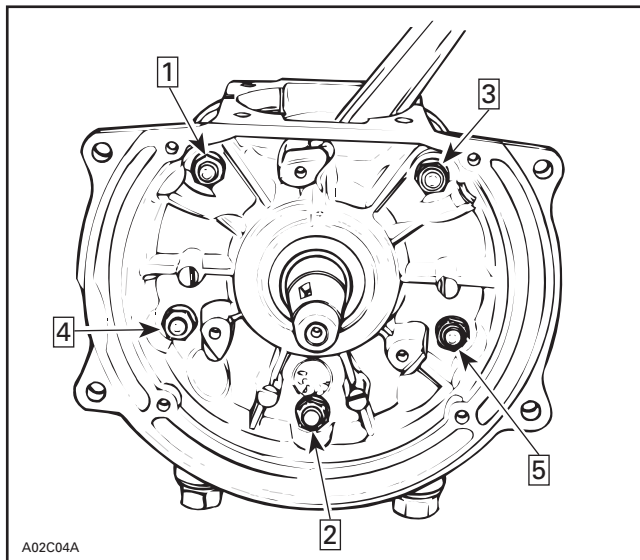
**CAUTION:** To ensure appropriate crankshaft bearing lubrication, seal outer surface must be pressed against seal crankcase shoulder.

Using a press, install crankshaft into MAG side crankcase half.

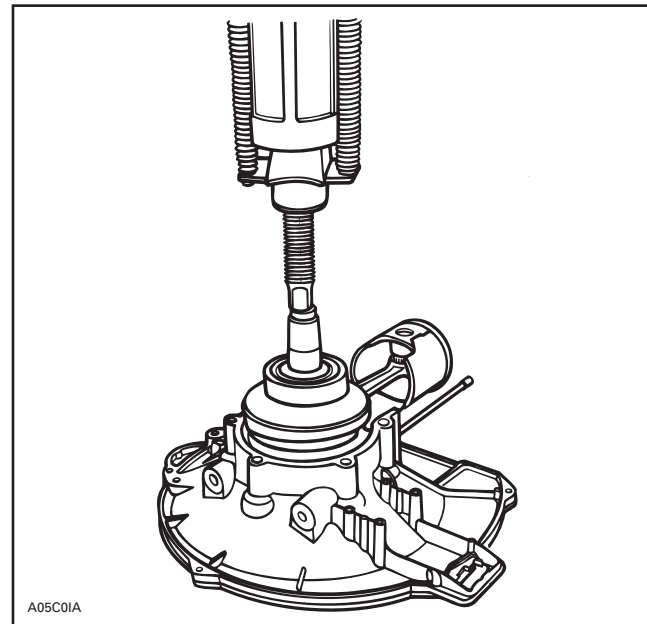


A05C0JA

Torque the screws no. 7 to 22 N•m (16 lbf•ft) following illustrated sequence.



A02C04A



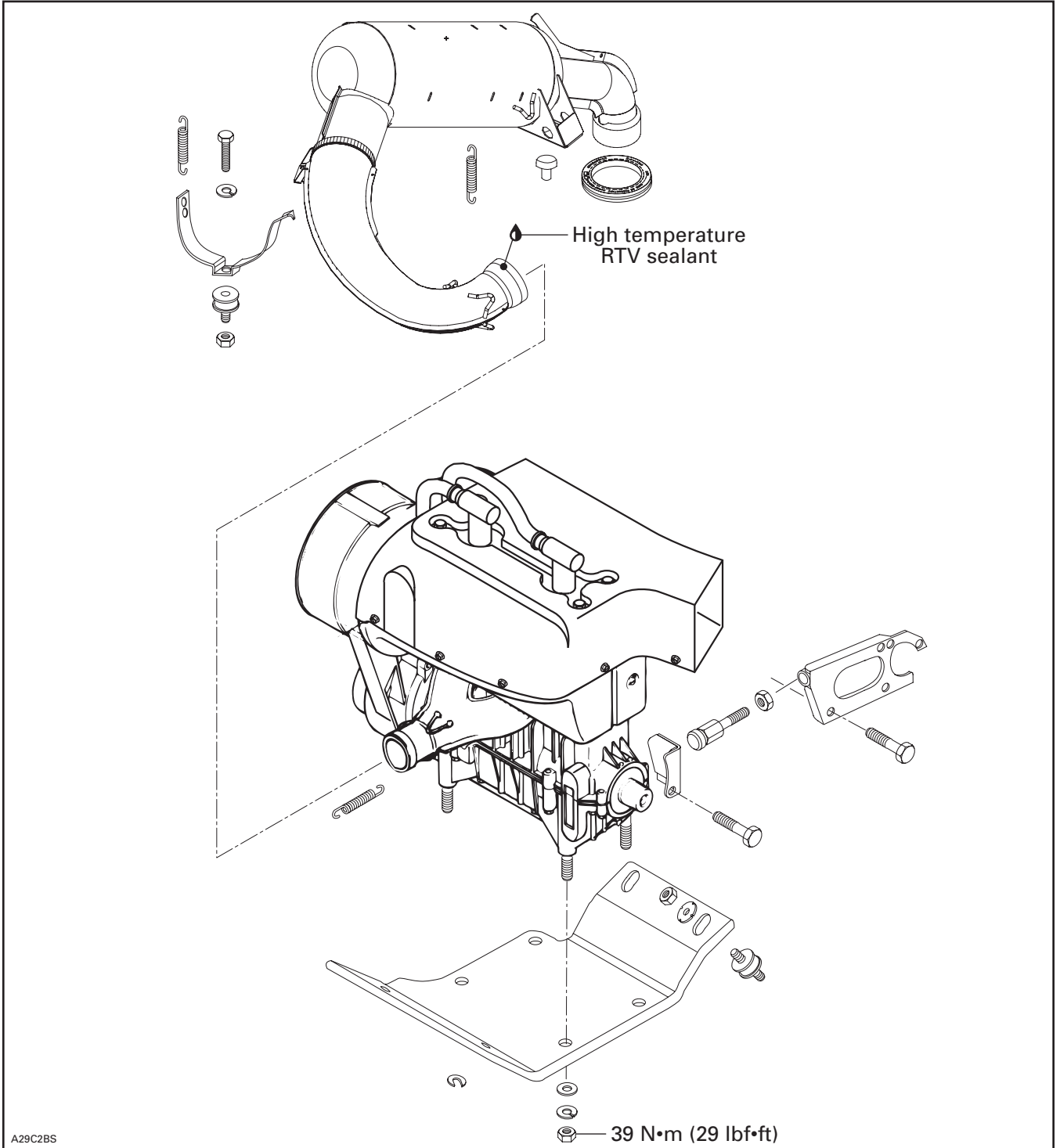
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Press down PTO side crankcase half onto crankshaft using appropriate spacer(s).

# 443 AND 503 ENGINE TYPES

## ENGINE REMOVAL AND INSTALLATION

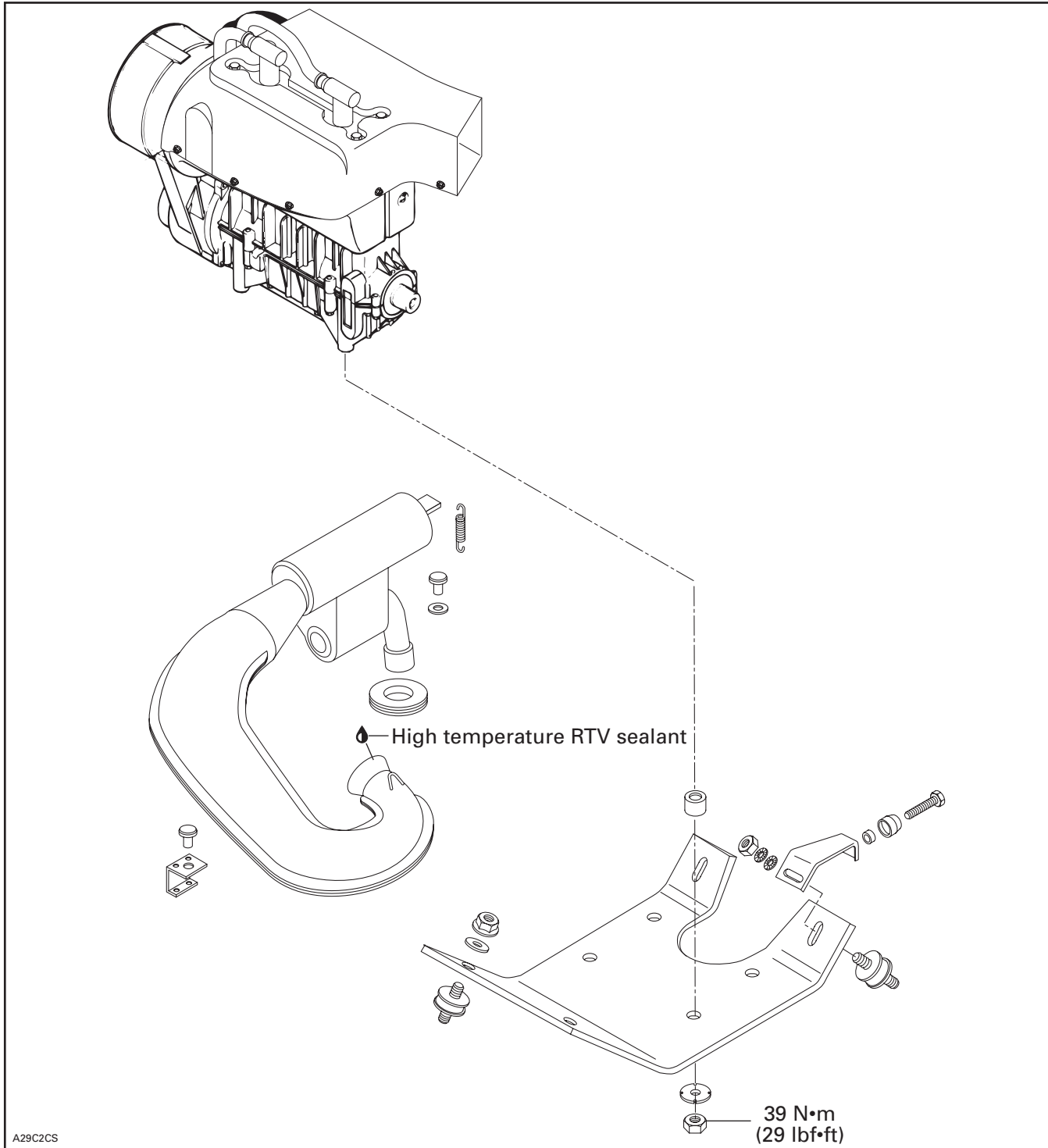
*Skandic LT 443 Engine Type*



## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

#### Skandic WT/SWT 503 Engine Type



## ENGINE REMOVAL AND INSTALLATION

Disconnect or remove the following:

**⚠ WARNING**

Before disconnecting any electrical wire in starter system always first disconnect the **BLACK** negative battery cable (on electric starting models).

- negative cable from battery  
(on electric starting models)
- guard
- drive belt
- drive pulley using appropriate puller, refer to  
DRIVE PULLEY
- air silencer and carburetors
- impulse line from engine crankcase
- electrical connector housings
- exhaust pipe
- oil pump inlet line and plug it
- oil pump cable
- rewind cable: tie a knot near rewind housing  
and remove starting grip.

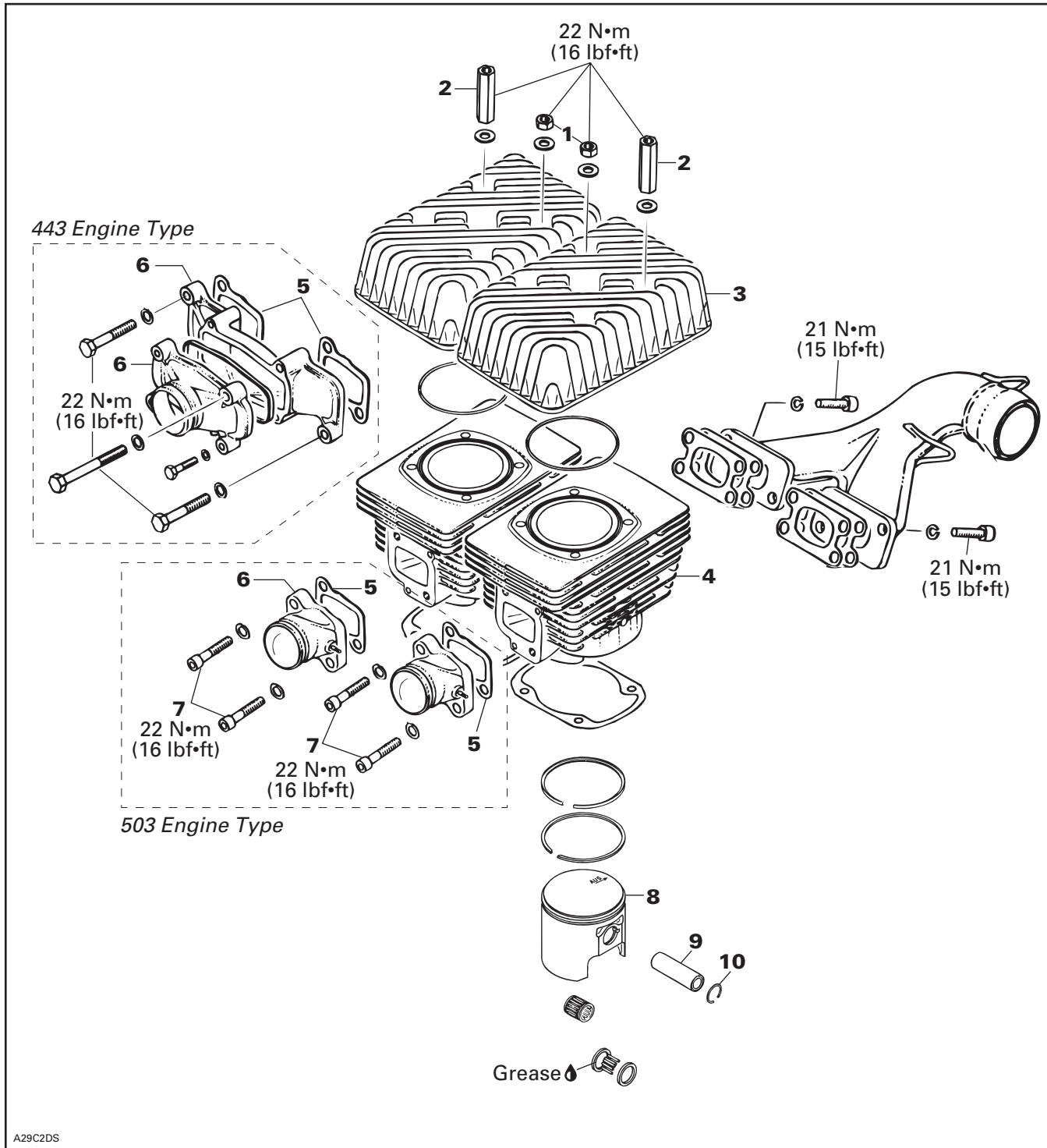
Tighten fasteners to recommended torque in appropriate exploded view.

Apply high temperature RTV sealant (P/N 293 800 090) on metal-to-metal exhaust joints.

## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

## TOP END



A29C2DS

## TROUBLESHOOTING

Before completely disassemble engine, check air-tightness. Refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT.

**NOTE:** The following procedures can be done without removing the engine from chassis.

## CLEANING

Discard all gaskets. Use Gasket Remover (P/N 413 708 500) to clean mating surfaces.

Clean all metal components in a non-ferrous metal cleaner.

Scrape off carbon formation from cylinder exhaust port, cylinder head and piston dome using a wooden spatula.

**NOTE:** The letters "AUS" and arrow on the piston dome must be visible after cleaning.

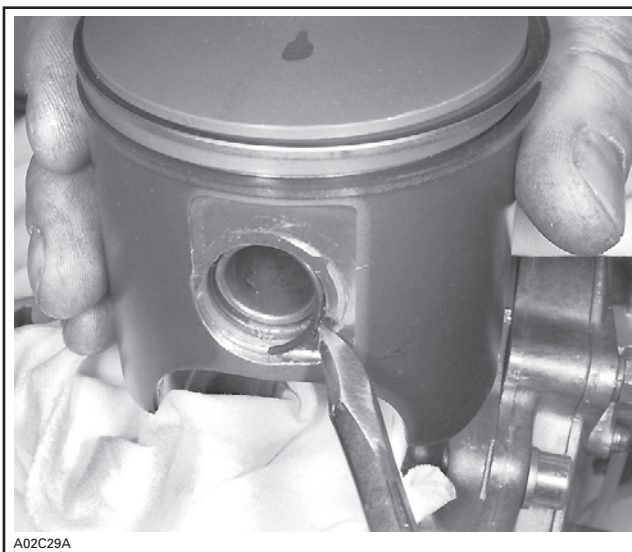
Clean the piston ring grooves with a groove cleaner tool, or with a piece of broken ring.

## DISASSEMBLY

Remove top fan cowl, intake sockets and lower fan cowl.

Remove cylinder heads.

Place a clean cloth or rubber pad (P/N 529 023 400) over crankcase to prevent circlips **no. 10** from falling into crankcase. Then with a pointed tool inserted in piston notch, remove both circlips from piston **no. 8**.



TYPICAL

### 443 and 503 Engines

On these engines, piston pin needle bearing is mounted without a cage.

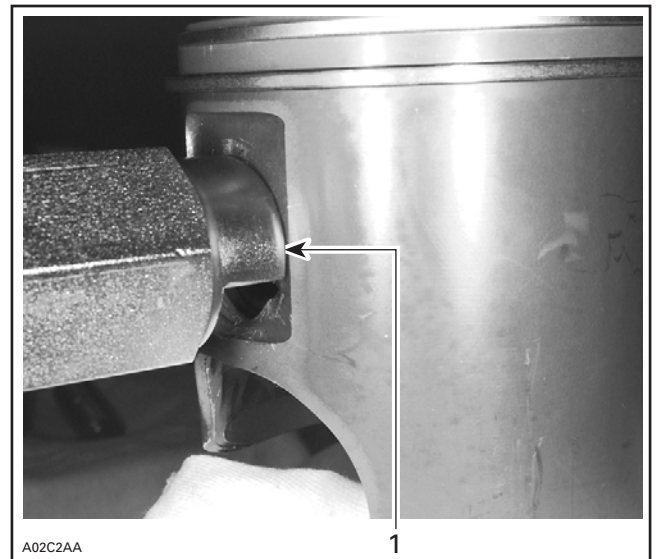
**NOTE:** The PTO cylinder or fan housing have to be removed to give access to MAG piston pin with the puller.

Use piston pin puller (P/N 529 035 503) along with 18 mm sleeve kit (P/N 529 035 541) and locating sleeve (P/N 529 023 800).

**NOTE:** The locating sleeve is the same that contains new cageless bearing.

Place a clean cloth or rubber pad (P/N 529 023 400) over crankcase to prevent circlips **no. 10** from falling into crankcase. Then with a pointed tool inserted in piston notch, remove both circlips from piston **no. 8**.

Insert piston pin puller (P/N 529 035 503) making sure it sits squarely against piston.



TYPICAL

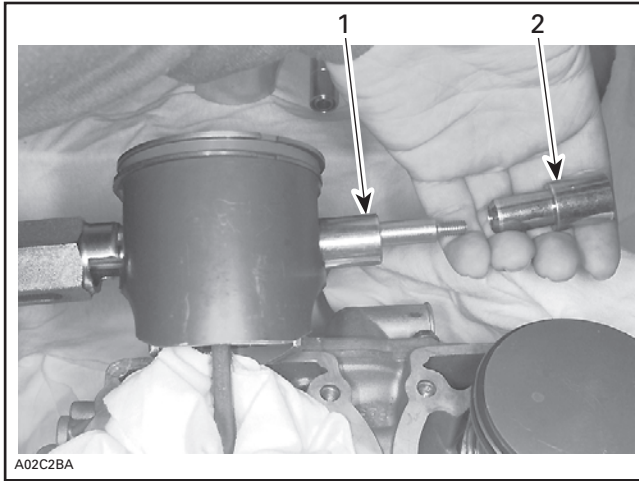
1. Properly seated all around



## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

Install sleeve then shouldered sleeve over puller rod.



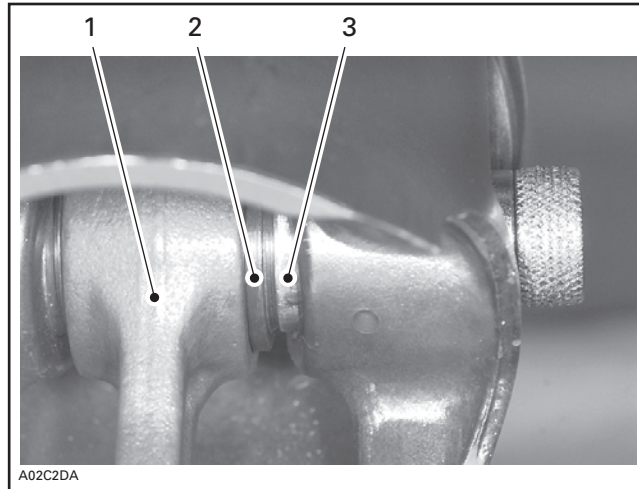
**TYPICAL — INSTALLATION OF SLEEVE KIT**

1. Sleeve
2. Shouldered sleeve

Pull out piston pin no. 10 by unscrewing puller until shouldered sleeve end is flush with thrust washer of piston pin bearing.



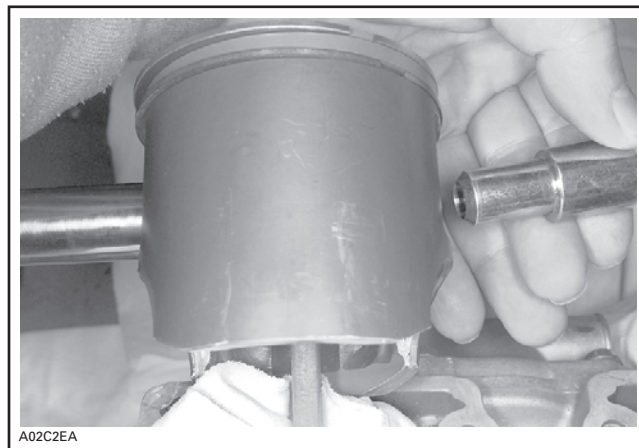
**TYPICAL — PISTON PIN EXTRACTION**



**TYPICAL**

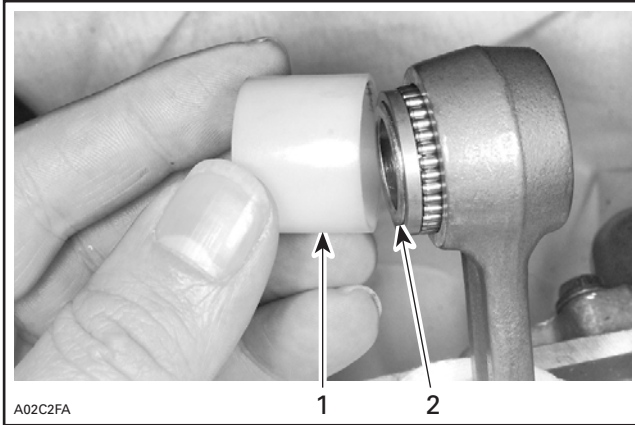
1. Sleeve inside bearing
2. Thrust washer
3. Shouldered sleeve end

Remove puller. Pull out shouldered sleeve carefully.



**TYPICAL**

Remove piston from connecting rod.  
Install locating sleeve. Then push needle bearings along with thrust washers and sleeve.



**TYPICAL**

- 1. Locating sleeve
- 2. Sleeve

**NOTE:** 0.25 and 0.5 mm oversized piston and rings are available if necessary.

Use a locking tie to fasten all needles and thrust washers along with locating sleeve.

**INSPECTION**

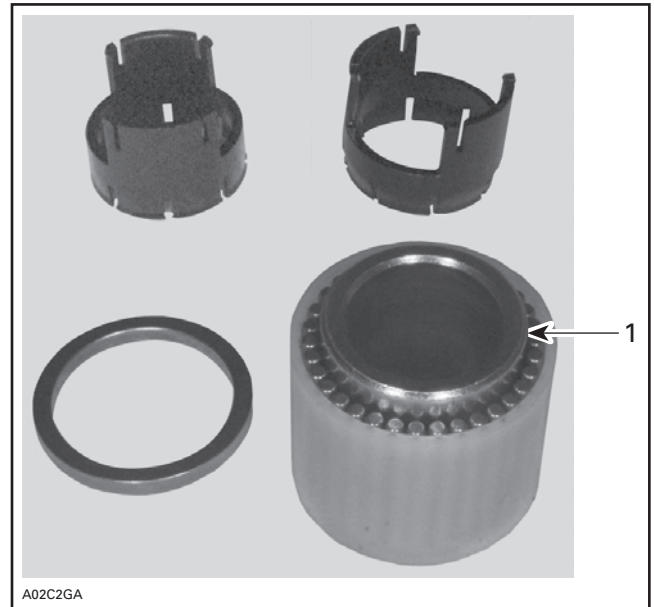
Refer to ENGINE DIMENSION MEASUREMENT.

**ASSEMBLY**

**443 and 503 Engines**

When reinstalling original needle bearings, make sure that 31 needles are inserted between sleeve and locating sleeve.

When installing a new cageless bearing, replace half plastic cages by sleeve.



**TYPICAL**

- 1. Sleeve

Grease thrust washers and install them on each end of needles.

Insert cageless bearing into connecting rod.

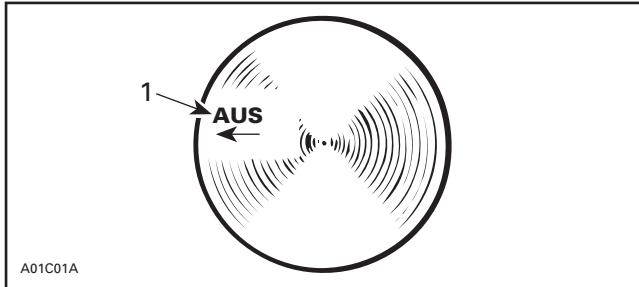


**TYPICAL — CAGELESS BEARING AND SLEEVE INSTALLED**

## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

Mount piston over connecting rod with the letters "AUS" (over an arrow on the piston dome) facing in the direction of exhaust port.



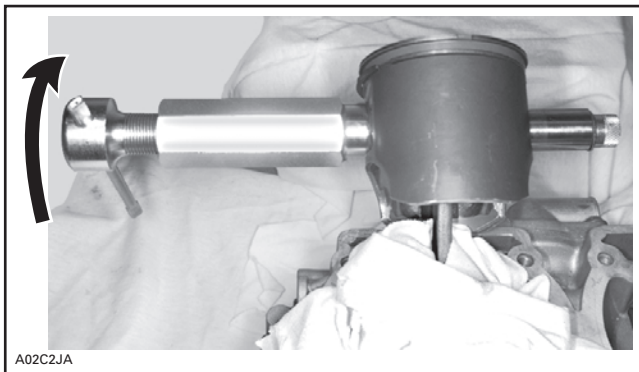
1. Exhaust

Install shouldered sleeve.



*TYPICAL — SHOULDERED SLEEVE INSTALLATION*

Install piston pin puller and turn handle until piston pin is correctly positioned in piston.



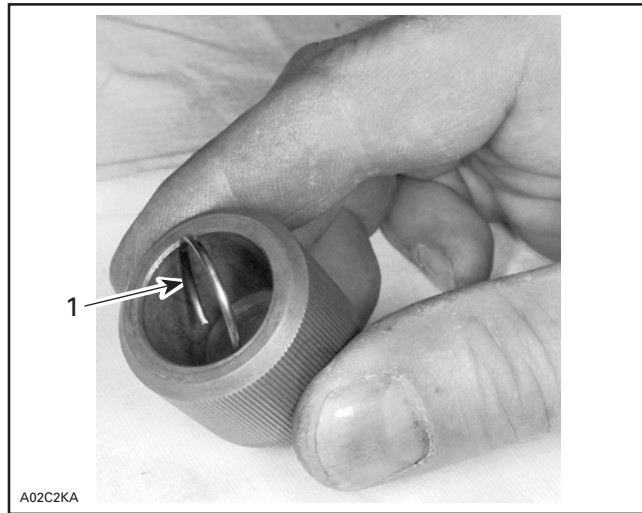
*TYPICAL*

– Remove piston pin puller and sleeve kit.

#### **All Models**

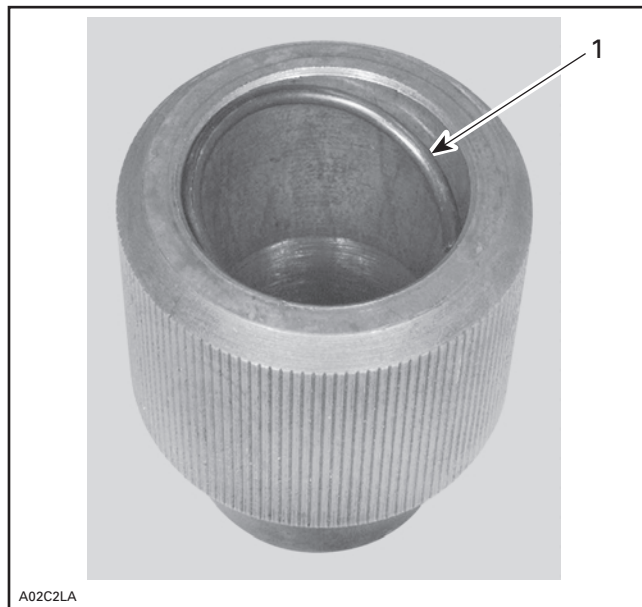
To minimize the effect of acceleration forces on circlip, install each circlip so the circlip break is at 6 o'clock as illustrated. Use piston circlip installer (P/N 529 035 561).

Insert circlip in tool at an angle.



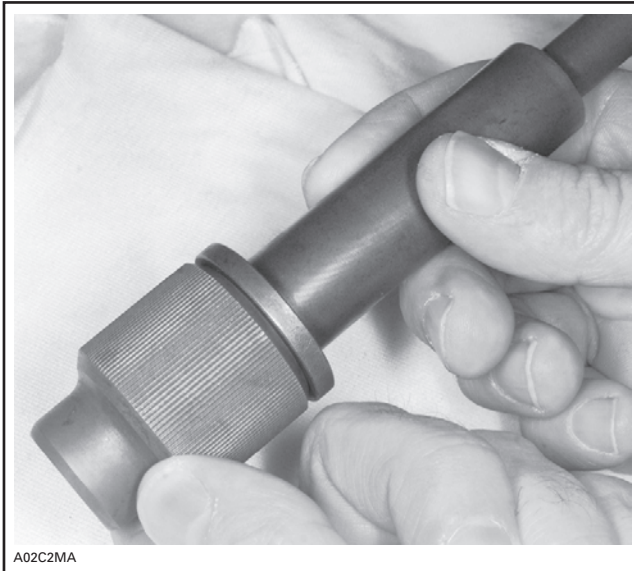
1. Circlip

Square it up using a finger.

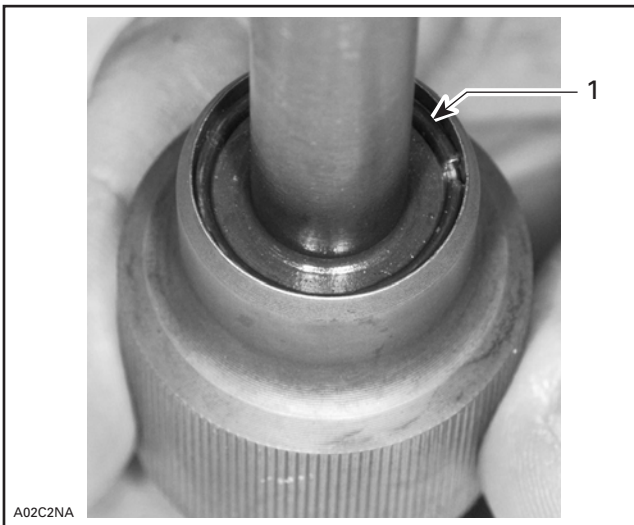


1. Circlip

Continue to square it up using round end of circlip installer.

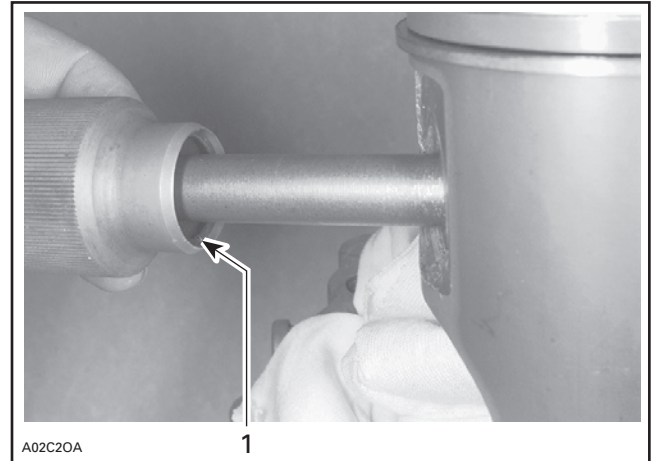


Using square end of tool, push circlip in until it rests in groove.



1. Circlip in groove

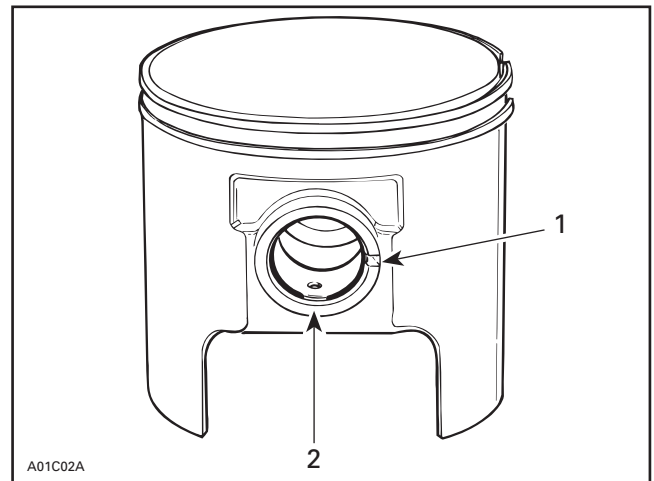
Mount tool in piston making sure that circlip break is facing down.



**TYPICAL**

1. Circlip break facing down

Hold tool firmly against piston then strike on round end of tool with a plastic hammer. Circlip will move from tool groove to piston groove.



1. Piston notch  
2. Circlip break at 6 o'clock

**CAUTION:** Circlips must not move freely in the groove after installation. If so, replace them.

**NOTE:** Be sure to restore the chamfer around all cylinder sleeve port openings.

Before inserting piston in cylinder **no. 4**, lubricate the cylinder with new injection oil or equivalent.



## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

Install proper ring compressor on piston assembly.

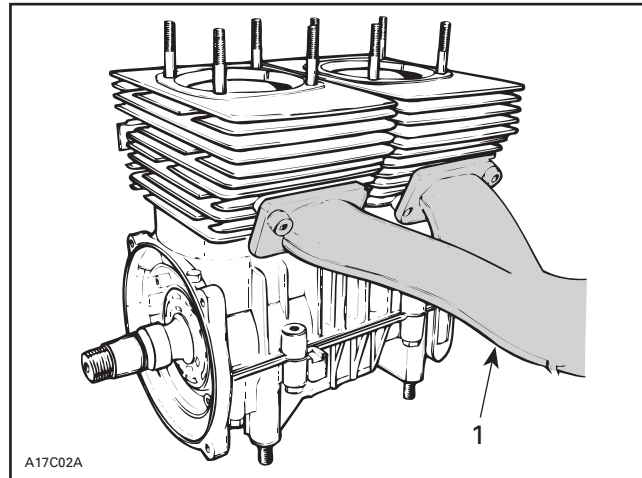
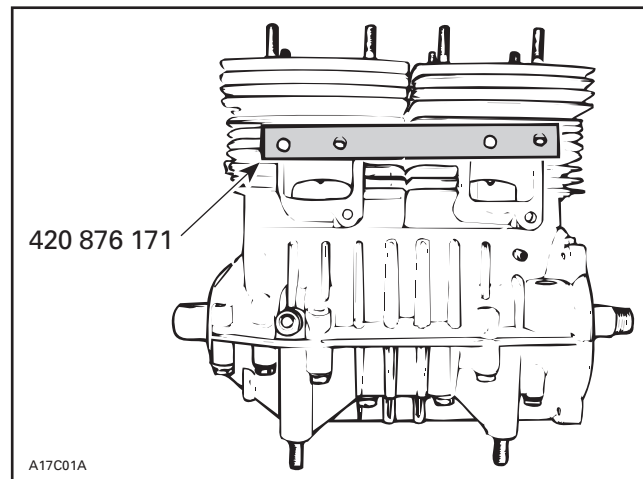
ENGINE TYPE	RING COMPRESSOR P/N
443	420 876 090
503	420 876 970

**NOTE:** The ring compressor will not fit on over size pistons.

Check flatness of intake sockets **no. 6**. Refer to ENGINE DIMENSION MEASUREMENT and look for **Checking Surface Flatness**.

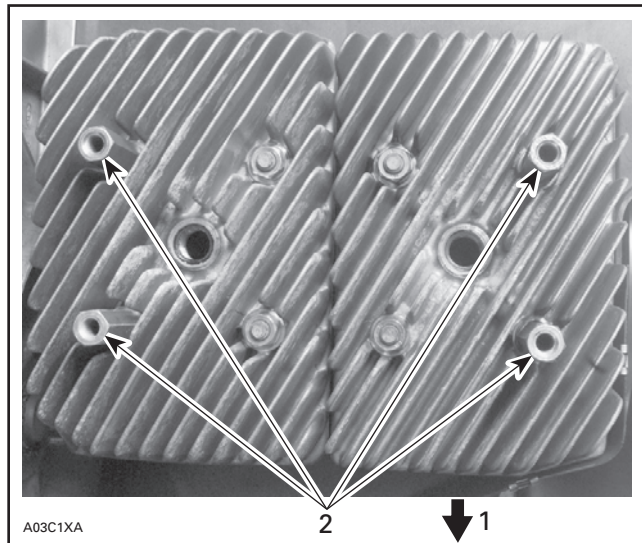
At cylinder **no. 4** and/or cylinder head **no. 3** installation, use aligning tool or exhaust manifold itself to ensure sealing of intake manifold and exhaust before tightening cylinder head nuts.

ENGINE TYPE	ALIGNING TOOL P/N
443 and 503	420 876 171



1. Or use exhaust manifold to align cylinders

Position distance nuts **no. 2** as per photo.



1. Exhaust  
2. Distance nuts

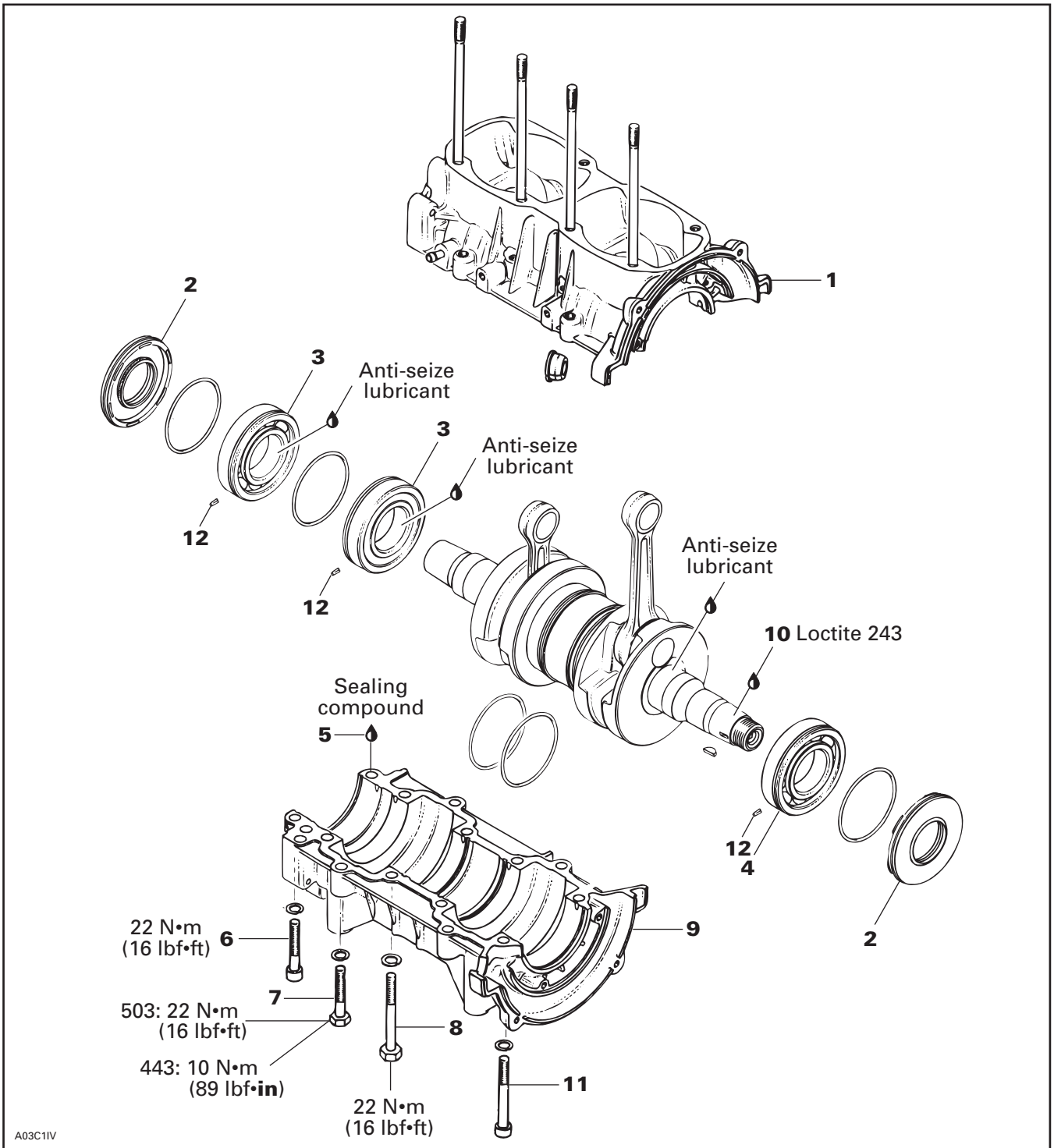
Cross torque cylinder head nuts **nos. 1** and **2** to 22 N•m (16 lbf•ft); torque each cylinder head individually.

Install armature plate, fan housing and then air deflector.

Install a gasket on each side of the air deflector.

Torque intake socket bolts to 22 N•m (16 lbf•ft).

**BOTTOM END**



## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

**NOTE:** Engine must be removed from chassis to perform the following procedures.

Remove engine from chassis.

Remove fan guard, rewind starter, starting pulley, trigger coil wire from 4-connector housing, mag-neto flywheel then fan housing.

Remove stator plate.

## CLEANING

Discard all seals, gaskets and O-rings.

Clean all metal components in a non-ferrous metal cleaner. Use gasket remover (P/N 413 708 500) accordingly.

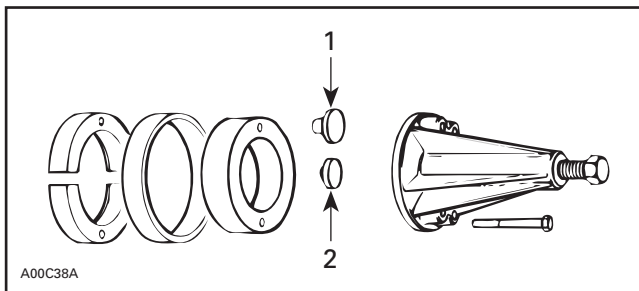
Remove all trace of Loctite 243 from crankshaft taper.

Remove old sealant from crankcase mating surfaces with Bombardier gasket remover (P/N 413 708 500).

**CAUTION:** Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase sealing.

## DISASSEMBLY

To remove bearings nos. 3 and 4 from crankshaft, use a protective cap and a special puller, as illustrated.



1. PTO side
2. MAG side

## INSPECTION

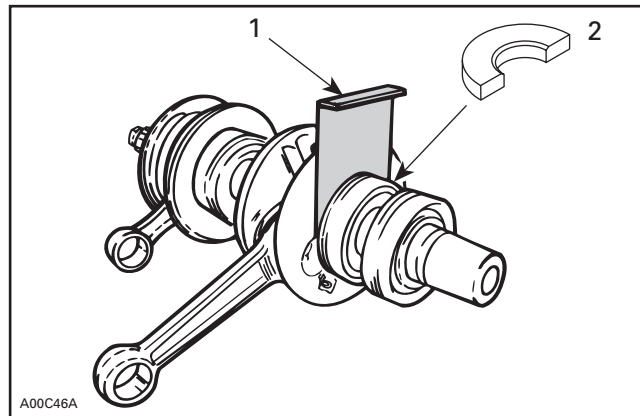
Refer to ENGINE DIMENSIONS MEASUREMENT.

## ASSEMBLY

Smear anti-seize lubricant (P/N 413 701 000) on part of crankshaft where bearing fits.

To check proper clearance between bearing no. 3 and counterweight, use feeler gauge (P/N 420 876 620).

Mount second bearing with distance gauge (P/N 420 876 822) for 443 and (P/N 420 876 824) for 503 for proper positioning.



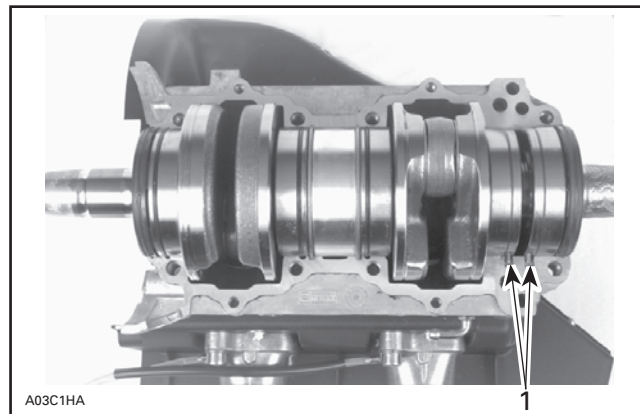
1. Feeler gauge
2. Distance gauge

Prior to installation, place bearings into an oil container filled with oil heated to 75°C (167°F).

This will expand bearings and ease installation. Install bearings with groove as per exploded view.

Bearings are pressed on crankshaft until they rest against radius. These radius maintain the gap needed for bearings lubrication.

When installing crankshaft, position drive pins no. 12 as illustrated.



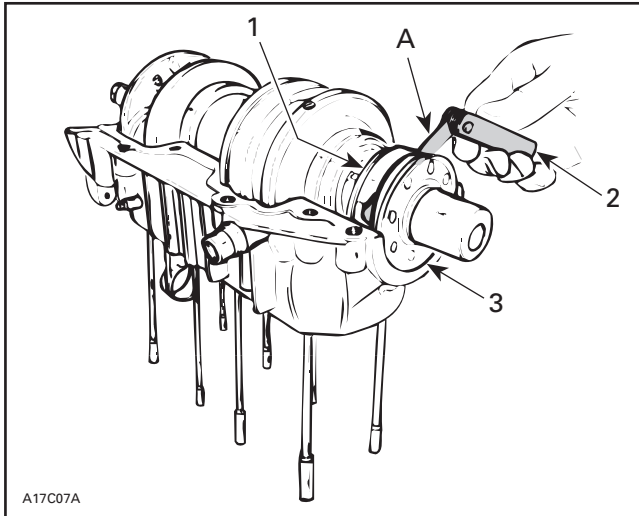
**TYPICAL**

1. Drive pins

At seal no. 2 assembly, apply a light coat of lithium grease on seal lip.

For bearing lubrication purpose, a gap of 1.0 mm (.040 in) must be maintained between seals and bearings.

When installing plain oil seals (seal without locating ring or without spacing legs), ensure to maintain 1.0 mm (.040 in) gap.



- 1. Bearing
- 2. Feeler gauge
- 3. Plain oil seal
- A. 1 mm (.040 in)

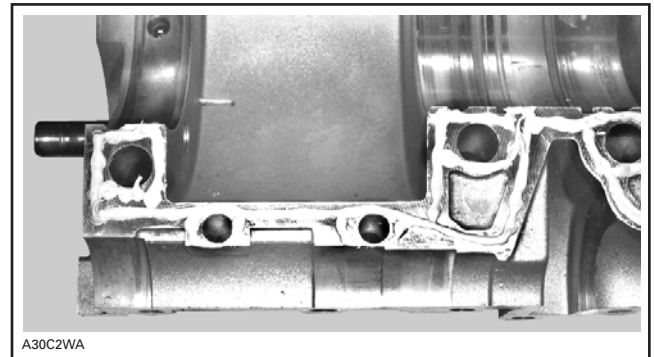
Crankcase halves nos. 1 and 9 are factory matched and therefore, are not interchangeable as single halves.

**Crankcase Assembly**

**IMPORTANT:** The total assembly sequence, including sealing compound spreading, screwing and torquing of bolts according to the proper sequence must be performed within 10 minutes.

Before screwing both parts of crankcase, seal it with a sealing compound (P/N 420 297 906). Make sure surfaces are clean and degreased before applying sealing compound.

Spread a seam of 1.2 mm (1/16 in) maximum in diameter on surface of lower crankcase half.



*TYPICAL*

As far as possible, sealing compound must be applied in one run to avoid any risks of leaking through the crankcase.

Align both crankcase halves before tightening screws.

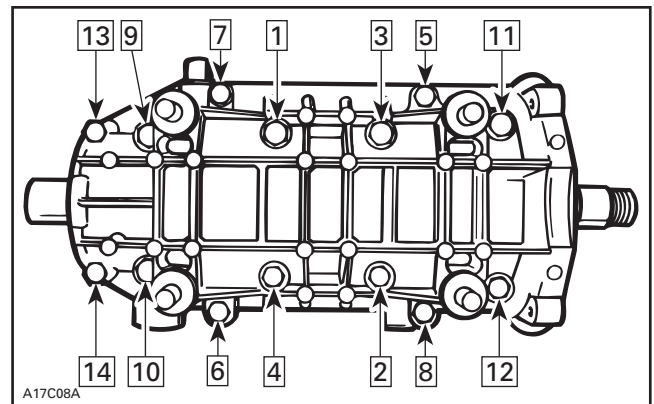
Position the crankcase halves together and tighten bolts by hand then install and tighten armature plate on magneto side to correctly align the crankcase halves.

Screw the 4 central bolts (bolts nos. 1 to 4 in the torquing sequence) to squeeze compound between crankcase halves before it starts to dry.

**NOTE:** Sealing compound spreading plus screwing of engine four central bolts must be performed within 2 minutes to ensure a good sealing and avoid linking.

Screw all crankcase bolts in place in the following sequence and to the appropriate torque through a two steps torquing: first, screw bolts up to 60% of the final torque (13 N•m (115 lbf•in) for M8 bolts), then, tighten to the required torque (i.e. 22 N•m (16 lbf•ft)).

**503 Engine Type**



*TIGHTENING SEQUENCE FOR 503 ENGINE TYPE*



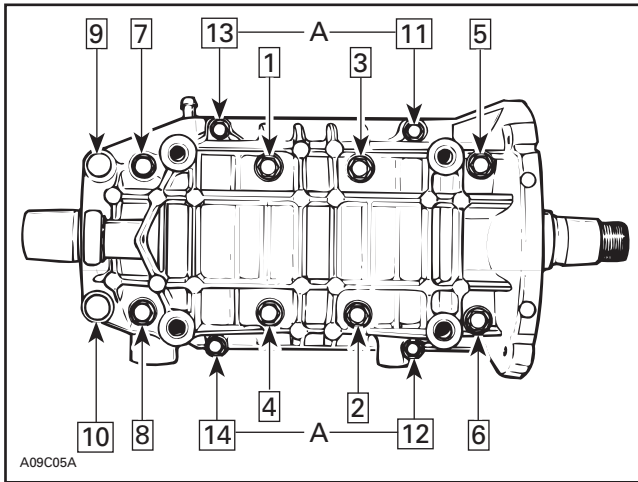
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## Section 04 ENGINE

### Subsection 03 (443 AND 503 ENGINE TYPES)

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#### 443 Engine Type



#### TIGHTENING SEQUENCE FOR 443 ENGINE TYPE

A. 10 N•m (89 lbf•in)

All the other screws are torqued to 22 N•m (16 lbf•ft)

#### All Engines

To install magneto, refer to CDI MAGNETO.

#### BREAK-IN

After rebuilding an engine always observe a break-in period as described in *Operator's Guide*.

# 593 ENGINE TYPE

## *Skandic WT LC*

### REMOVAL FROM VEHICLE

Open hood.

Remove tuned pipe and muffler.

Drain engine coolant.

Remove or unplug the following then lift off engine from engine compartment.

**NOTE:** Use of a hoist is recommended.

- guard
- air silencer
- drive belt
- rewind starter handle
- drive pulley (not necessary if engine has not to be disassemble)
- hood
- carburetors
- impulse hose and electrical connectors
- oil injection inlet line at oil injection pump, install hose pincher
- oil pump cable
- coolant hoses between cylinder head and radiator
- coolant by-pass hose
- coolant hose at front of coolant reservoir
- engine support screws
- engine stopper (left rear of engine).

### INSTALLATION ON VEHICLE

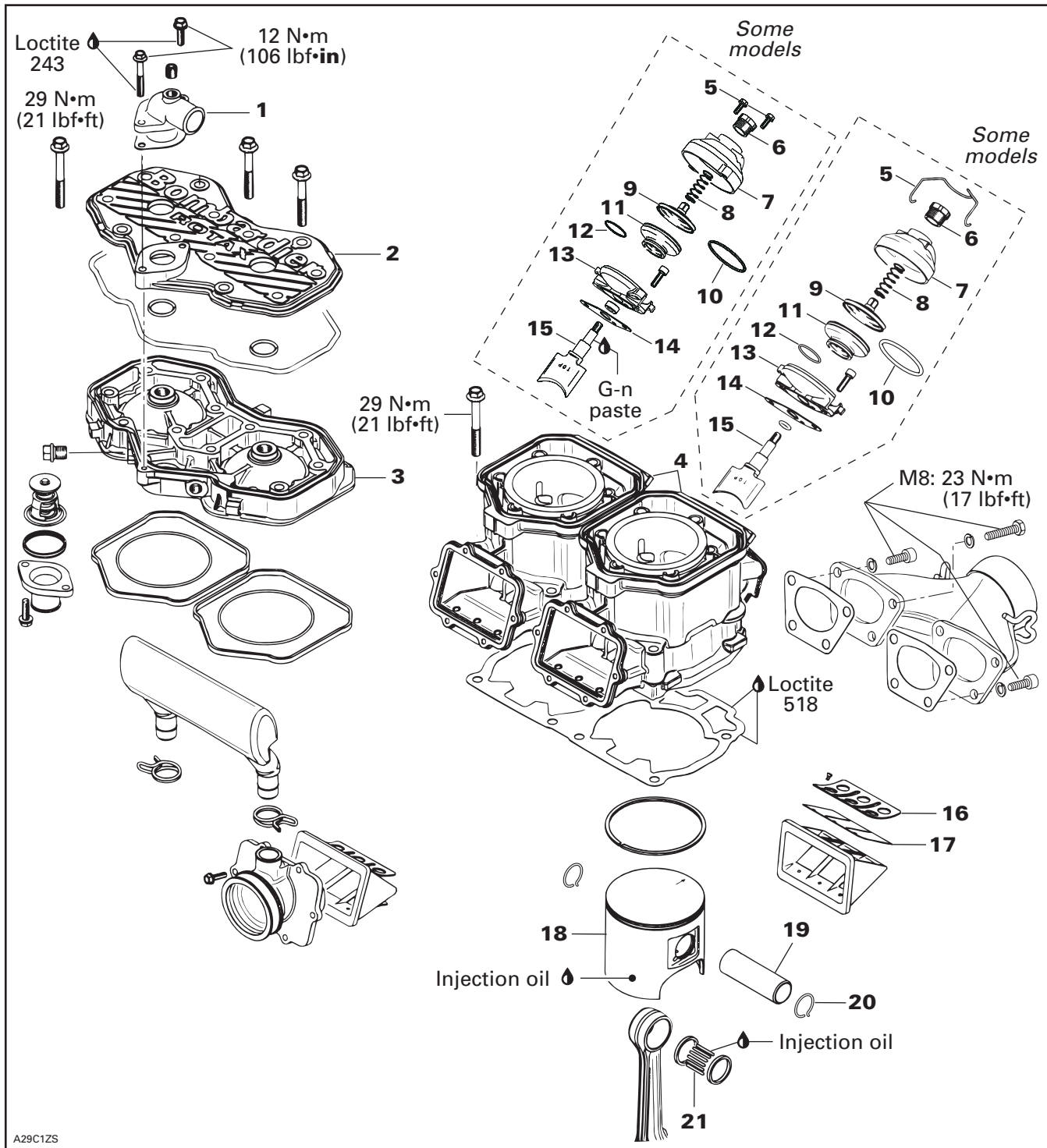
To install engine on vehicle, reverse removal procedure. However, pay attention, to all appropriate component/system reinstallation procedures described throughout this *Shop Manual* and to the following:

- After throttle cable installation, check carburetor maximum throttle opening and oil injection pump adjustment.
- Check pulley alignment and drive belt tension.
- Seal exhaust ball joints with Ultra Copper (P/N 413 710 300).

# Section 04 ENGINE

## Subsection 04 (593 ENGINE TYPE)

### TOP END



A29C1ZS

## COMPONENT REMOVAL

Most engine components can be removed with engine on vehicle such as:

- cylinder head
- piston(s)
- cylinder(s)
- rewind starter
- oil pump
- water pump
- magneto flywheel
- RAVE valve(s)
- reed valve(s).

## CLEANING

Discard all gaskets and O-rings.

Clean all metal components in a non-ferrous metal cleaner.

Scrape off carbon formation from cylinder exhaust port cylinder head and piston dome using a wooden spatula.

**NOTE:** The letters "AUS" (over an arrow on the piston dome) must be visible after cleaning.

Clean the piston ring groove with a groove cleaner tool or with a piece of broken ring.

## DISASSEMBLY

### RAVE System

**NOTE:** RAVE stands for Rotax Adjustable Variable Exhaust.

Remove spring clip or screws **no. 5**, cover **no. 7** and spring **no. 8**.

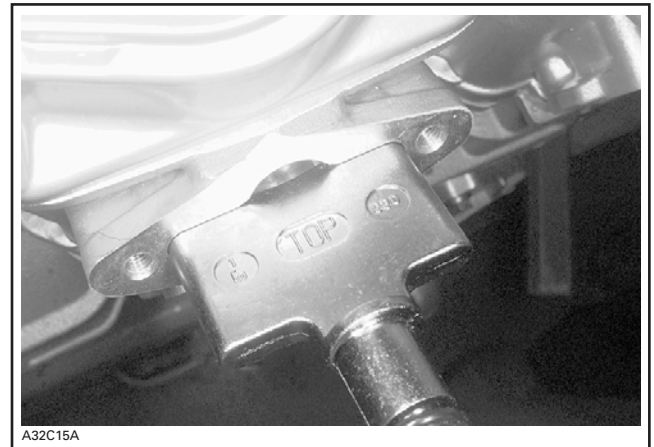
Remove spring **no. 10**.

Unscrew valve piston **no. 9**.

Remove bellows **no. 11** and spring **no. 12**.

Remove cylindrical screws. Remove valve housing **no. 13**.

Pull out exhaust valve **no. 15**.



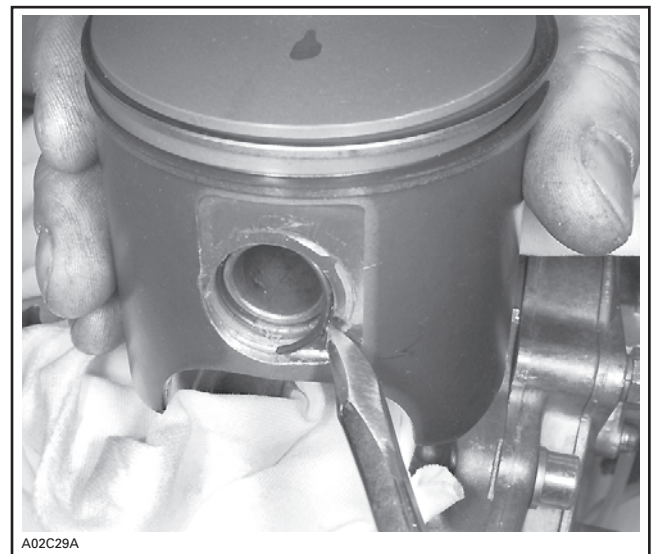
*RAVE VALVE PARTIALLY REMOVED*

### 2, Cylinder

Remove spark plugs, coolant outlet **no. 30**. Unscrew cylinder head cover **no. 2** then cylinder head **no. 3**.

### 18, Piston

Place a clean cloth or rubber pad (P/N 529 023 400) over crankcase. Then with a pointed tool inserted in piston notch, remove both circlips **no. 20** from piston **no. 18**.

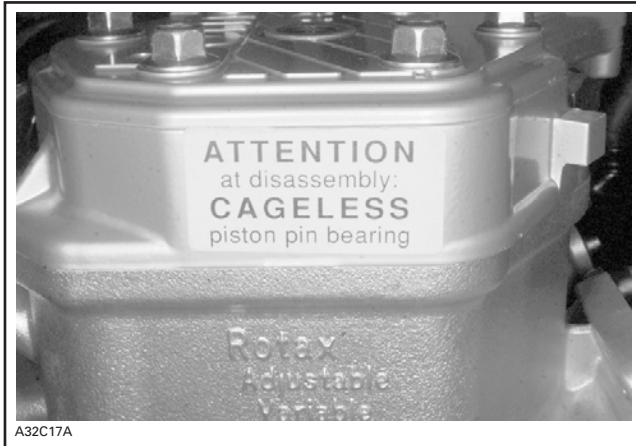


*TYPICAL*

## Section 04 ENGINE

### Subsection 04 (593 ENGINE TYPE)

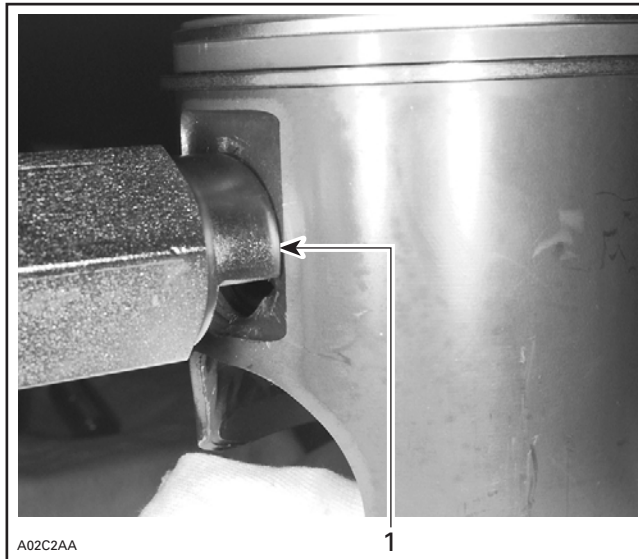
This engine is equipped with cageless piston pin bearings.



Use piston pin puller (P/N 529 035 503) along with 20 mm sleeve kit (P/N 529 035 542) and locating sleeve.

**NOTE:** The locating sleeve is the same that contains new cageless bearing.

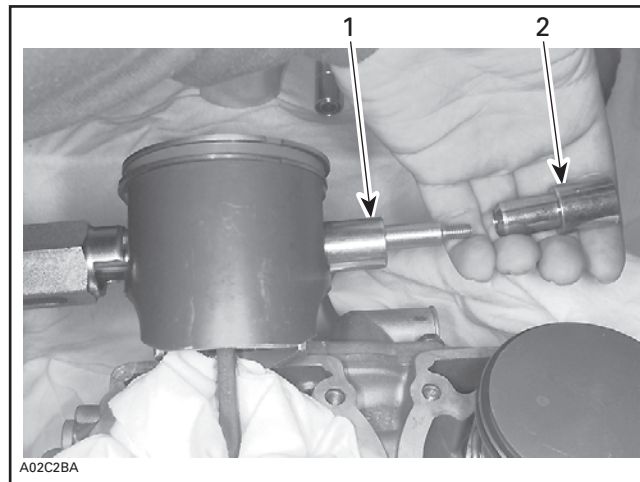
Insert piston pin puller (P/N 529 035 503) making sure it sits squarely against piston.



**TYPICAL**

1. Properly seated all around

Install sleeve then shouldered sleeve over puller rod.



**TYPICAL — INSTALLATION OF SLEEVE KIT**

1. Sleeve
2. Shouldered sleeve

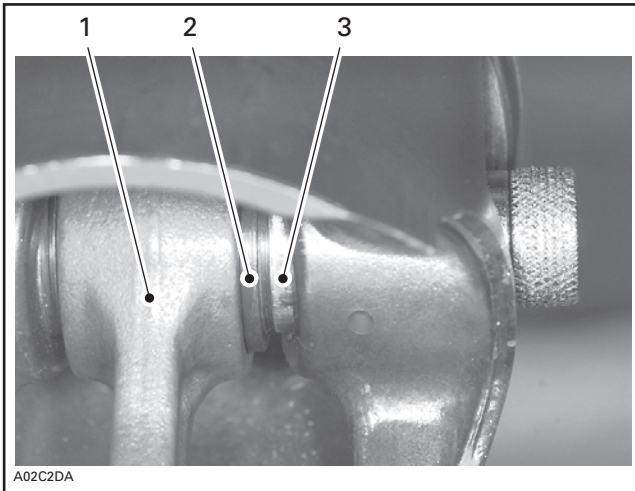
Screw (LH threads) extracting nut.

Pull out piston pin no. 19 by unscrewing puller until shouldered sleeve end is flush with thrust washer of piston pin bearing.



**TYPICAL — PISTON PIN EXTRACTION**

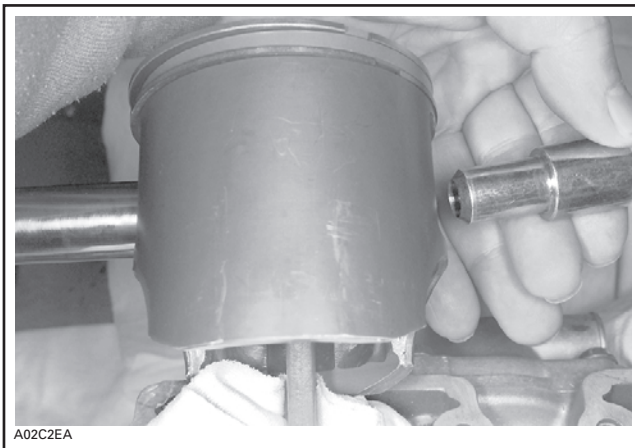




**TYPICAL**

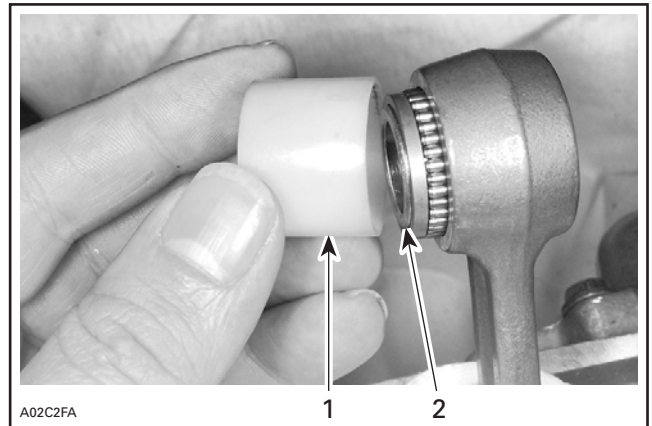
1. Sleeve inside bearing
2. Thrust washer
3. Shouldered sleeve end

Remove puller. Pull out shouldered sleeve carefully.



**TYPICAL**

Remove piston from connecting rod.  
 Install locating sleeve. Then push needle bearings along with thrust washers and sleeve.



**TYPICAL**

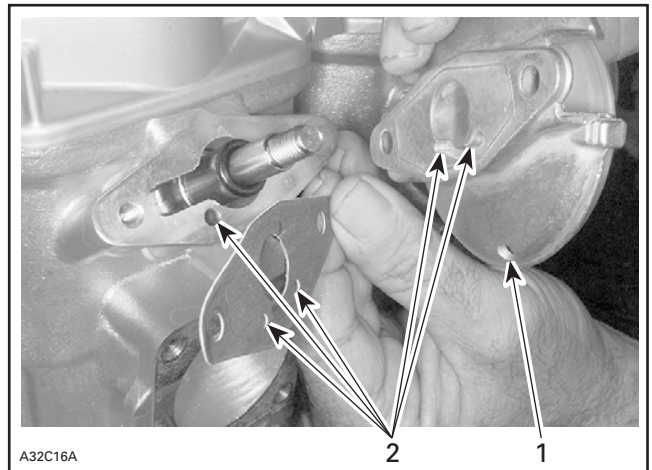
1. Locating sleeve
2. Sleeve

## INSPECTION

**NOTE:** Refer to LEAK TEST AND ENGINE DIMENSIONS MEASUREMENT.

## RAVE System

Check valve rod housing and cylinder for clogged passages.



1. Draining hole
2. Passages

**NOTE:** Oil dripping from draining hole indicates a loosen spring or damaged bellows.

## Section 04 ENGINE

### Subsection 04 (593 ENGINE TYPE)

#### 11, Bellows

Check for cracked, dried or perforated bellows.

#### 8, Spring

Engine type		593
Spring	P/N	420 239 948
Wire diameter	mm (in)	1.0 (.039)
Free length	mm (in)	38.0 (1.50)
Preload in N (lbf) at compressed length of 14 mm (.551 in)		19.5 (4.38)

## ASSEMBLY

### RAVE System

Install RAVE valve with its mention top as illustrated in the removal photo. Tighten red cap no. 6 screw to bottom.

### 4,18, Cylinder and Piston

Be sure to restore the chamfer around all cylinder sleeve port openings.

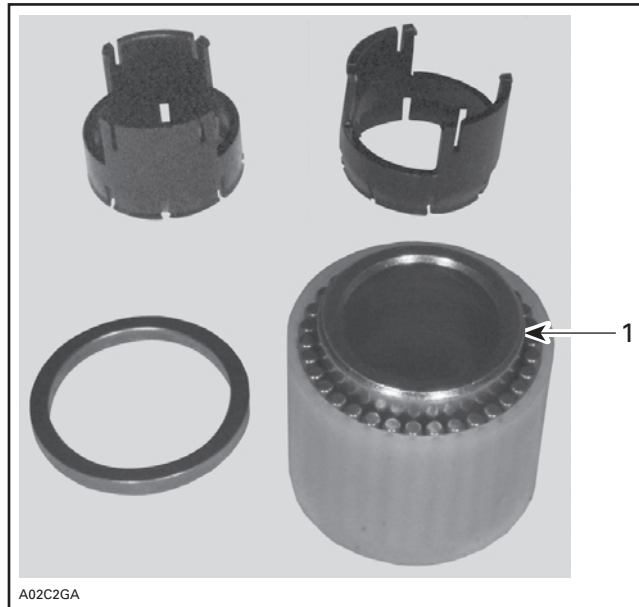
Before inserting piston in cylinder, lubricate the cylinder with new injection oil or equivalent.

### 2,3,4, Cylinder Head Cover, Cylinder Head and Cylinder

Check flatness of part sealing surfaces. Refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT and look for **Checking Surface Flatness**.

When installing a new cageless bearing, replace half plastic cages with sleeve.

**NOTE:** 593 engine cageless bearings have 28 needles.



#### TYPICAL

##### 1. Sleeve

Oil needle bearing with injection oil. Grease thrust washers and install them on each end of needles.

Insert cageless bearing into connecting rod.



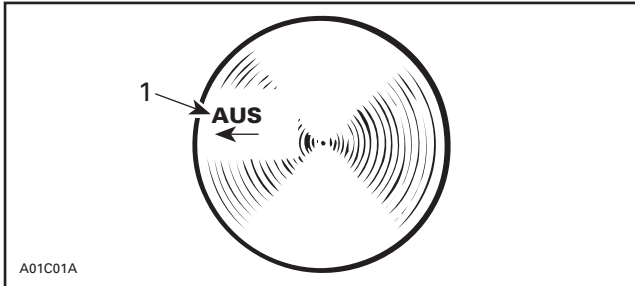
#### TYPICAL — CAGELESS BEARING AND SLEEVE INSTALLED

Heat piston with a 100 W lamp or a heat gun before piston installation.

**CAUTION:** Piston temperature must not exceed 46°C (115°F). Never use direct flame to heat the piston and never freeze the pin.

**Section 04 ENGINE**  
Subsection 04 (593 ENGINE TYPE)

At assembly, place the pistons over the connecting rods with the letters "AUS" (above the arrow on the piston dome) facing in direction of the exhaust port.



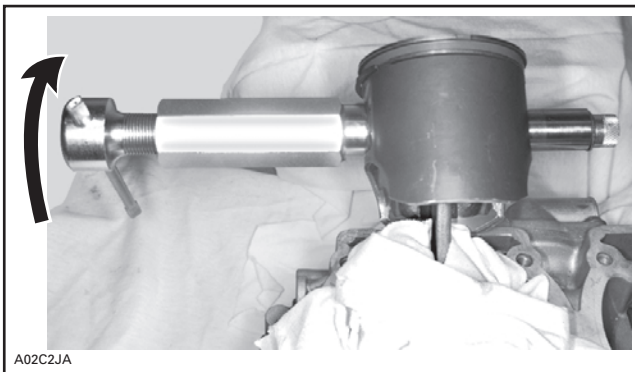
1. Exhaust

Install shouldered sleeve.



*TYPICAL — SHOULDERED SLEEVE INSTALLATION*

Install piston pin puller and turn handle until piston pin is correctly positioned in piston.



*TYPICAL*

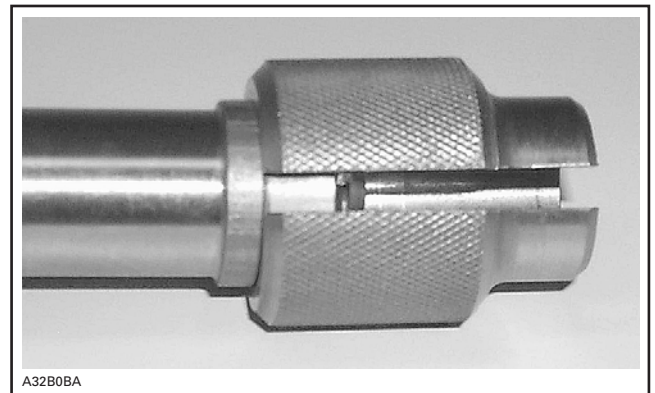
ENGINE TYPE	PISTON CIRCLIP INSTALLER (P/N)
593	529 035 686

Use circlip installer (P/N 529 035 686) to install new mono-hook circlips no. 20.

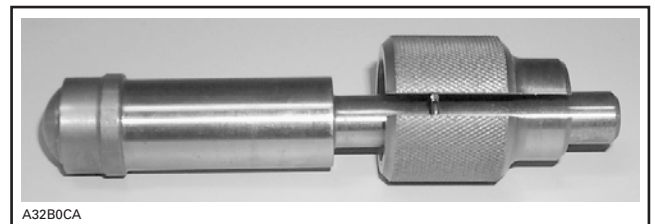
Insert circlip into support in such a way that when installed in piston groove, the tab will face upward.



With round end of pusher, position circlip perpendicular to the support axis.



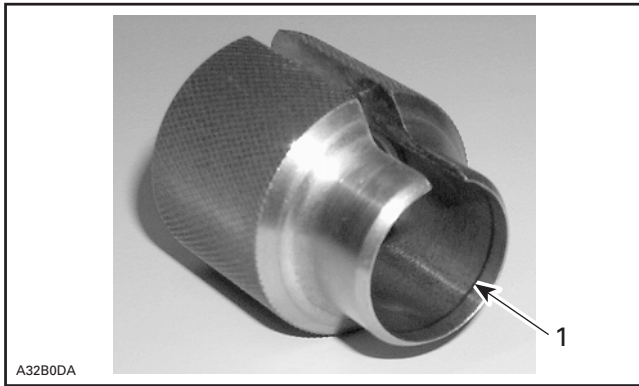
With the other end of the pusher, push circlip into the support groove.





## Section 04 ENGINE

### Subsection 04 (593 ENGINE TYPE)

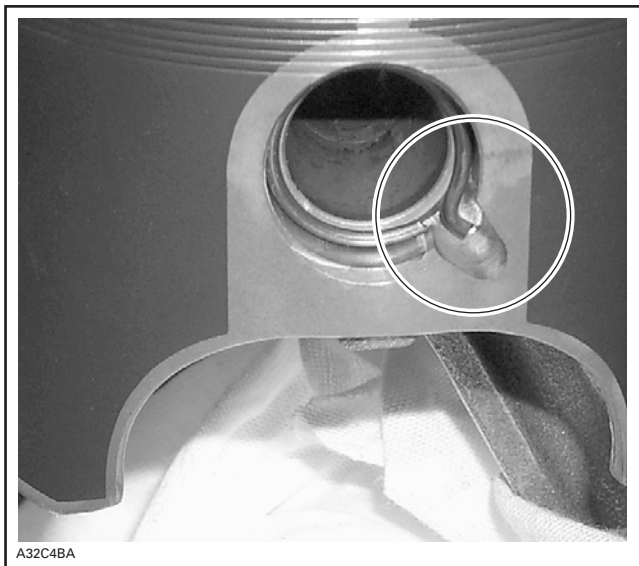


1. Groove



CIRCLIP READY TO BE INSTALLED ON PISTON

Using a plastic hammer, tap pusher to insert circlip in place. Take care to install new circlips with tab toward top as per following photo.



TAB TOWARD TOP

**CAUTION:** Always install new mono-hook circlips. If circlip installation fails at the first attempt, always retry with a new one as on a second attempt circlip will lose its normal retaining capabilities.

**CAUTION:** Circlips must not move freely after installation; if so, replace them.

Clean cylinders and crankcase mating surfaces with Loctite Chisel (P/N 413 708 500).

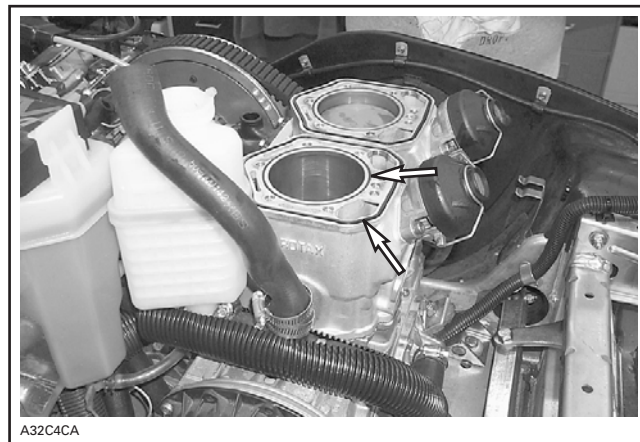
Coat crankcase mating surface with Loctite 518 (P/N 293 800 038). Choose the right gasket thickness according to combustion chamber volume. Refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT. Install it on crankcase. Coat gasket with Loctite 518.

**CAUTION:** Always install a gasket of the proper thickness. Failure to do so may cause detonation and severe engine damage.

Before inserting piston in cylinder, lubricate the cylinder with new injection oil or equivalent.

Install cylinders. Do not tighten.

Install new rubber ring and round O-rings on each cylinder.



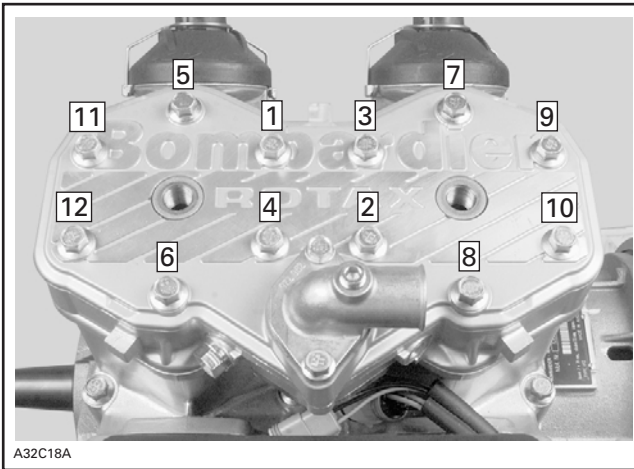
TYPICAL

**NOTE:** Carefully clean screws before reinstallation, specifically under screw head.

Install exhaust manifold with gaskets. Do not tighten yet.

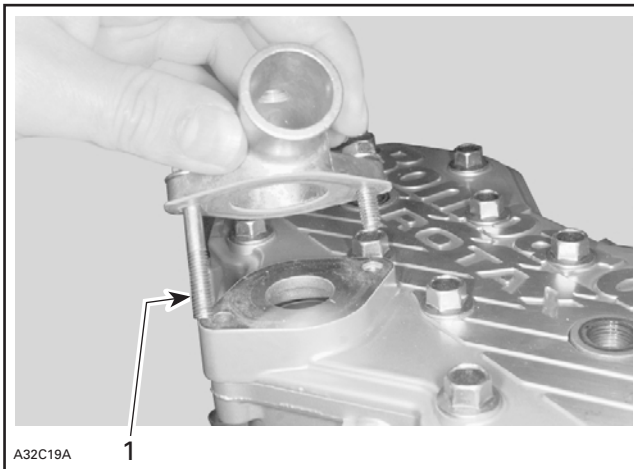
At assembly, torque cylinder head screws to 29 N•m (21 lbf•ft) in the following illustrated sequence.

Tighten exhaust manifold bolts to 23 N•m (17 lbf•ft) in a criss-cross sequence.



**TYPICAL**

Apply Loctite 243 (P/N 293 800 060) on screws threads. Install outlet socket and tighten screws to 12 N•m (106 lbf•in). Note position of longer screw.



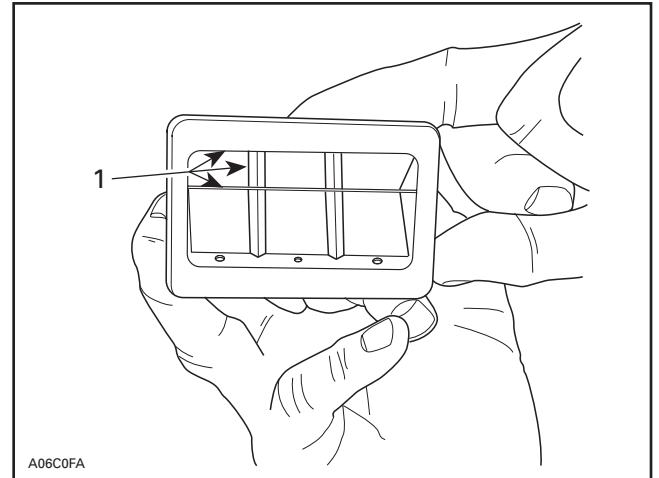
1. Longer screw

## 17, Reed Valve

Blades have a curved shape. Install with their curve facing reed block.

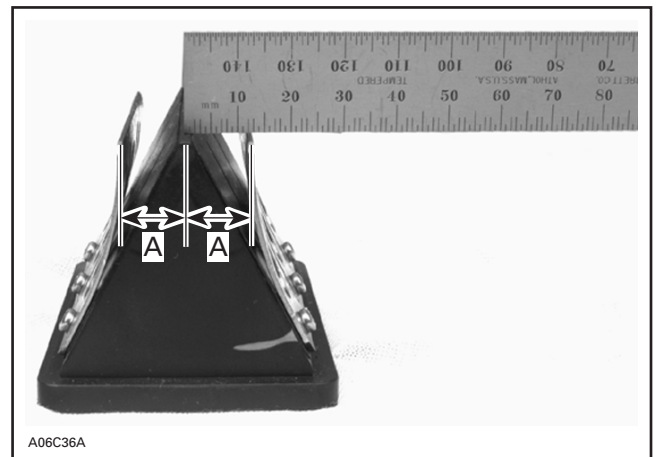
With blade stopper no. 16 removed, check reed valve for proper tightness. There must be no play between blade and valve body when exerting a finger pressure on blade at blade stopper location.

In case of a play, turn blade upside down and recheck. If there is still a play, replace blade and/or valve body.



1. No play

Check distance from blade stopper outer edge and distance from center of reed valve block.



**TYPICAL**

A. 17.0 - 0, + 0.75 mm (.669 - 0, + .030 in)

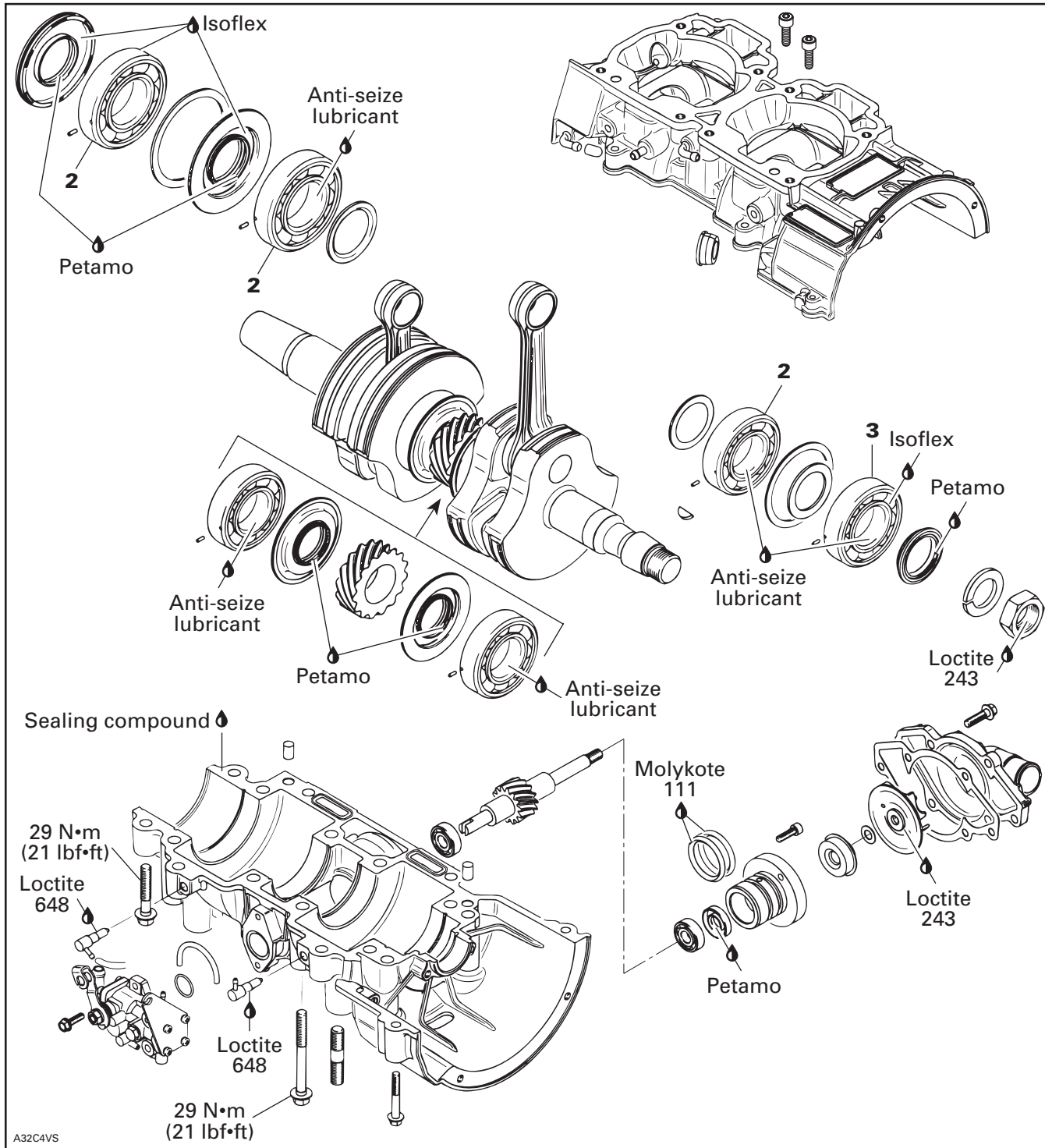
Bent blade stopper as required to obtain the proper distance.

Blade stoppers may slightly interfere with cylinder during installation. Adjusted distance will be reduced automatically upon installation.

# Section 04 ENGINE

## Subsection 04 (593 ENGINE TYPE)

### BOTTOM END



**NOTE:** Engine must be removed from chassis to perform the following procedures.

## CLEANING

Discard all oil seals, gaskets, O-rings and sealing rings.

Clean all metal components in a non-ferrous metal cleaner. Use Gasket remover (P/N 413 708 500) accordingly.

Remove old paste gasket from crankcase mating surfaces with Gasket remover (P/N 413 708 500).

**CAUTION:** Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase sealing.

## DISASSEMBLY

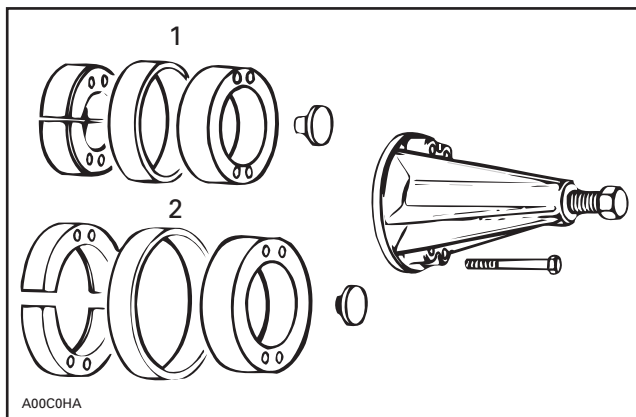
### General

To remove drive pulley, refer to DRIVE PULLEY.

To remove magneto, refer to CDI SYSTEM.

### 2,3, Crankshaft Bearing

To remove bearings from crankshaft, use a protective cap and special puller, as illustrated.



1. PTO side
2. MAG side

## INSPECTION

**NOTE:** Refer to LEAK TEST AND ENGINE DIMENSIONS MEASUREMENT.

## ASSEMBLY

Coat lip of all seals with Petamo grease (P/N 420 899 271).

## 2, Crankshaft Bearing

Smear anti-seize lubricant (P/N 413 701 000) on part of crankshaft where bearing fits.

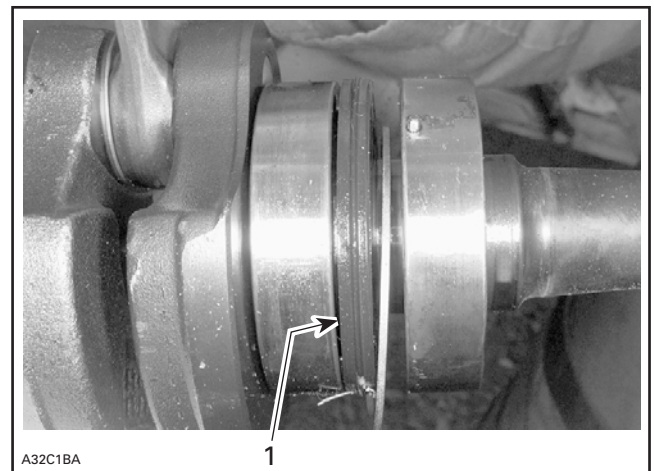
Prior to installation, place bearings into an oil container filled with injection oil previously heated to 75°C (167°F). This will expand bearing and ease installation.

Some bearings must be lubricated with Isoflex grease (P/N 293 550 021).

**CAUTION:** Use only the recommended Isoflex grease. Make sure not to push Isoflex grease between outside bearing race and half crankcase.

**NOTE:** The 50 g tube corresponds to 50 cc of grease.

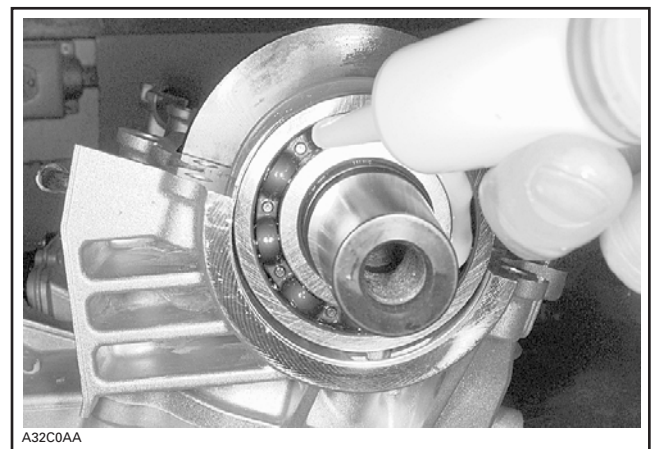
Fill PTO side inner seal with Isoflex grease.



1. PTO side inner seal filled with Isoflex grease

Put 35 to 40 mL of grease in a syringe.

With the syringe, fill the outer ball bearing with grease.



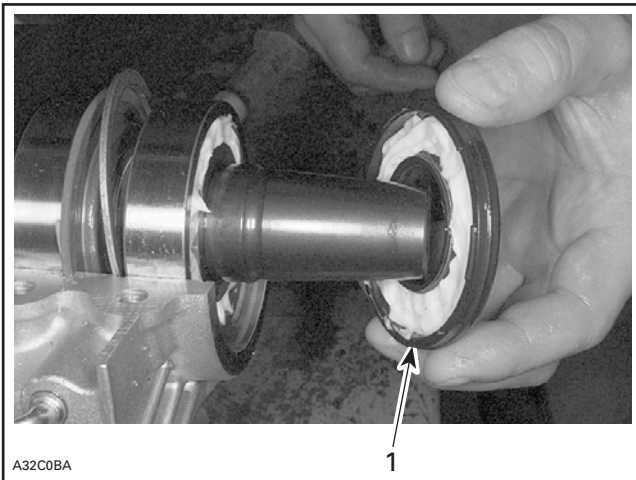
**BALLS COATED WITH A SEAM OF GREASE**



## Section 04 ENGINE

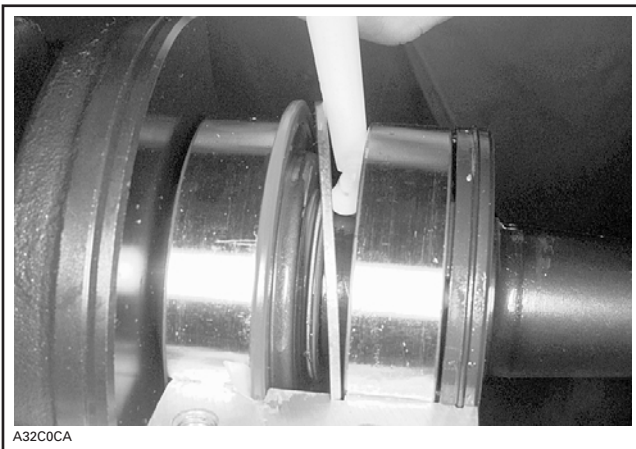
### Subsection 04 (593 ENGINE TYPE)

Coat inner side of seal and set it in place.

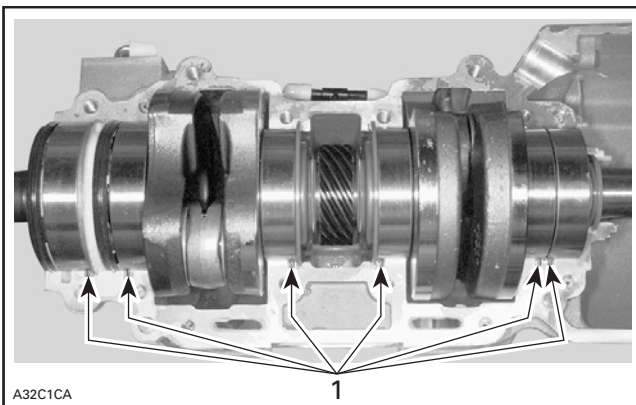


1. Fill with grease and set in place

Use the remaining grease to coat the inner side of the ball bearing.

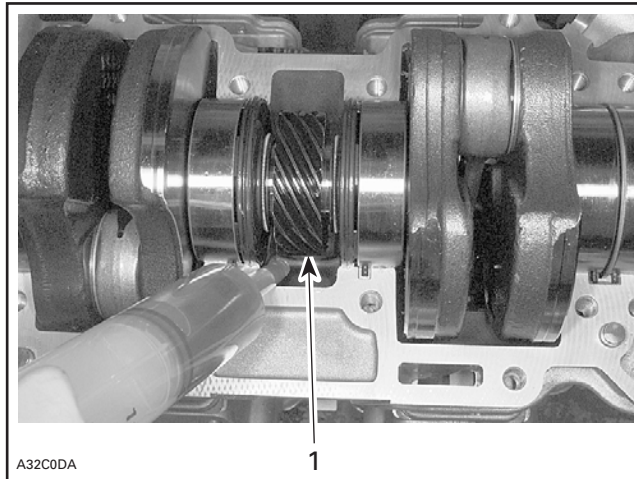


Apply 20 mL of grease to MAG side outer bearing. At crankshaft installation, position drive pins as illustrated.



1. Position pins

Drop 50 mL (2 U.S. oz) of injection oil in the pan under central gear to lubricate pump gearing as per photo.



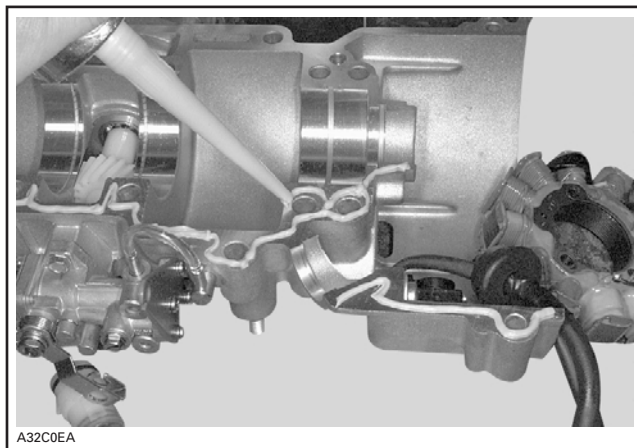
1. Oil bath

#### Crankcase Assembly

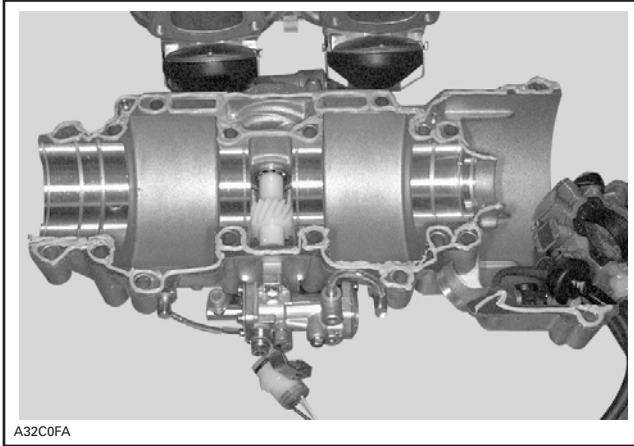
**IMPORTANT:** The total assembly sequence, including sealing compound spreading, screwing and torquing of bolts according to the proper sequence must be performed within 10 minutes.

Before screwing both parts of crankcase, seal it with a sealing compound (P/N 420 297 905). Make sure surfaces are clean and degreased before applying sealing compound.

Spread a seam of 1.2 mm (1/16 in) maximum in diameter on surface of lower crankcase half.



As far as possible, sealing compound must be applied in one run to avoid any risks of leaking through the crankcase.

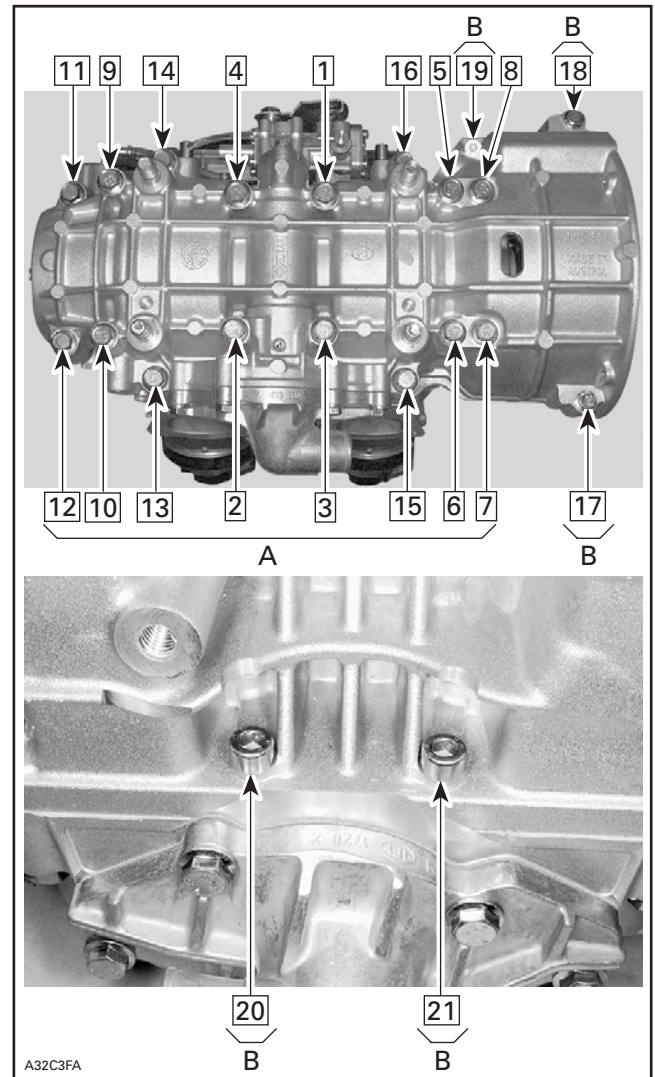


**SEAMING COMPLETED — CONTACT SURFACES COVERED AND SCREW HOLES SURROUNDED**

Screw the 4 central bolts to squeeze compound between crankcase halves before it starts to dry.

**NOTE:** Sealing compound spreading plus screwing of engine central four bolts must be performed within 2 minutes to ensure a good sealing and avoid linking.

Screw all crankcase bolts in place in the following sequence and to the appropriate torque through a two steps torquing: first, screw bolts up to 60% of the final torque (18 N•m (13.5 lbf•ft) for most of the bolts), then, tighten to the required torque (i.e. 29 N•m (21 lbf•ft)).



A. Torque bolts 1 through 16 to 29 N•m (21 lbf•ft)  
 B. Torque bolts 17 through 21 to 9 N•m (80 lbf•in)

## BREAK-IN

After rebuilding an engine always observe a break-in period as described in *Operator's Guide*.



# LEAK TEST AND ENGINE DIMENSION MEASUREMENT

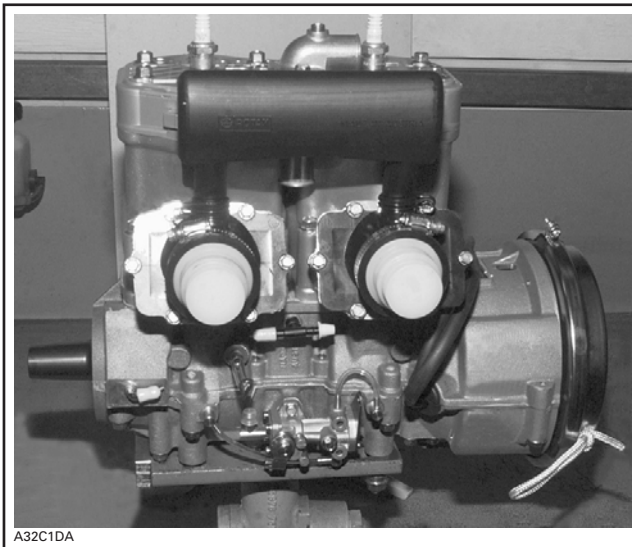
## LEAK TEST

The following gives verification procedures for liquid cooled engines though it also applies to fan cooled engines. For FC engines, do not consider information pertaining to coolant system and pump shaft oil gear reservoir.

On FC twin-cylinder engines, each cylinder cannot be verified individually due to leakage from one cylinder to the other through labyrinth sleeve in center of crankshaft.

## PREPARATION

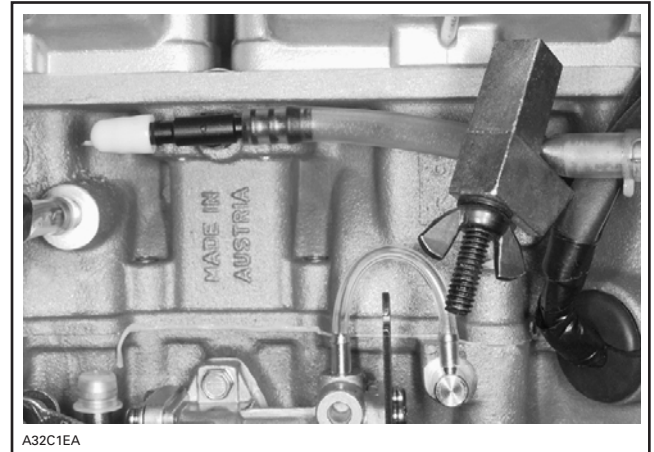
1. Remove tuned pipe.
2. Install plug over exhaust manifold.
3. Remove carburetors.
4. Insert plugs in intake rubber boots. Tighten with clamps already there.



A32C1DA

5. Using a hose pincher (P/N 295 000 076), block impulse hose.

6. Using hose pinchers (P/N 295 000 076), block pump shaft oil hose and lubrication nipple on PTO side.

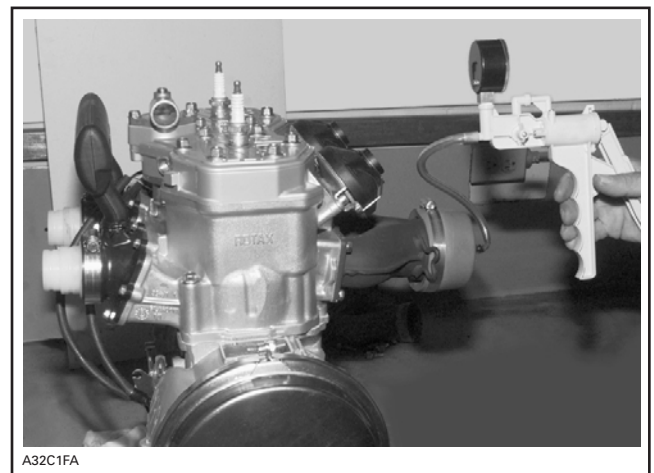


A32C1EA

7. Install air pump on exhaust plug.

**NOTE:** If necessary, lubricate air pump piston with mild soap.

**CAUTION:** Using hydrocarbon lubricant (such as engine oil) will damage rubber seal of pump piston.



A32C1FA

## Section 04 ENGINE

### Subsection 05 (LEAK TEST AND ENGINE DIMENSION MEASUREMENT)

8. Activate pump and pressurize engine to 34 kPa (5 PSI). Do not exceed this pressure.
9. Engine must stand this pressure during 3 minutes. If pressure drops before 3 minutes, check tester kit by spraying a soapy solution on pump cylinder, all plugs and fittings.
  - If tester kit is leaking, bubbles will indicate where leak comes from.
  - If tester kit is not leaking, check engine as per following procedure.

## PROCEDURE

**NOTE:** A flow chart has been prepared as a visual reference. See last page of this chapter.

Using flow chart and following text, pressurize area to be tested and spray soapy solution at the indicated location.

**TEST PRESSURE: 34 kPa (5 PSI)  
FOR 3 MINUTES**

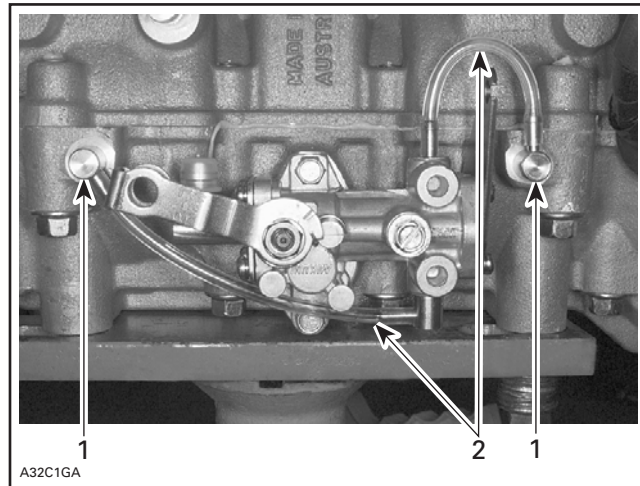
- If there is a leak at the tested location, it is recommended to continue testing next items before overhauling engine. There is a possibility of more than one leak.
- If there is no leak at the tested location, continue pumping to maintain pressure and continue with next items until leak is found.

## Engine

Check the following:

1. All jointed surfaces and screw/stud threads of engine:
  - spark plug base, insulator
  - cylinder head
  - RAVE valve bellows, piston and housing
  - cylinder
  - crankcase halves (joint)
  - oil injection pump mounting flange (O-ring, seal)
  - coolant pump housing
  - bleed screws/plugs.

2. Small injection oil lines coming from pump.



1. Injection nipples
2. Small injection oil lines

Check for air bubbles or oil column going toward pump. It indicates defective check valve in injection nipples.

3. Remove cooling system cap.

Check for air bubbles in antifreeze. It indicates defective cylinder head O-ring or cylinder base gasket.

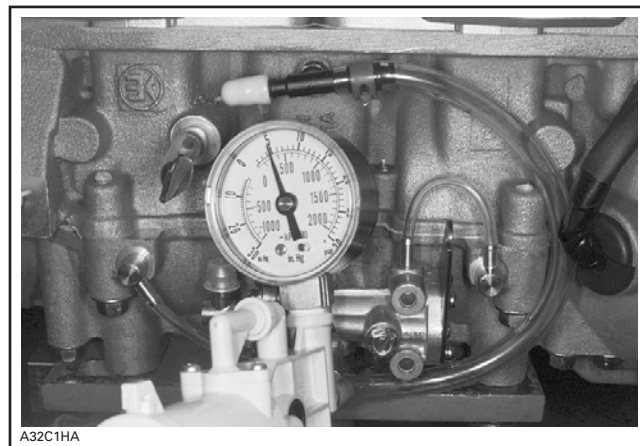
4. Remove drive pulley then check crankshaft outer seal.

5. Remove rewind starter and magneto system then check crankshaft outer seal.

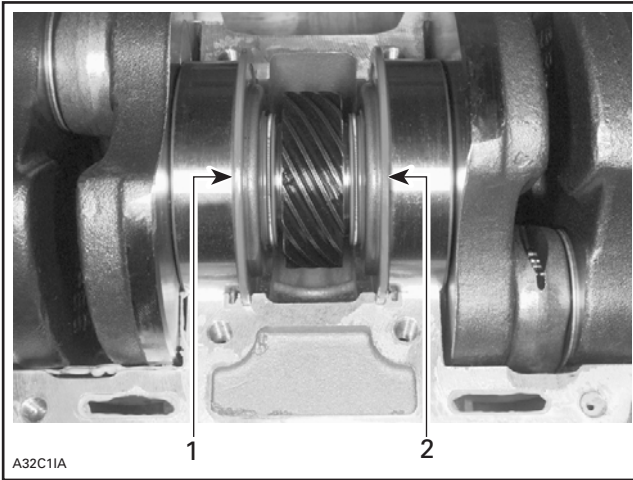
6. Check pump shaft gear oil reservoir.

## Pump Shaft Oil Gear Reservoir

Install air pump on adapter and pressurize as before.



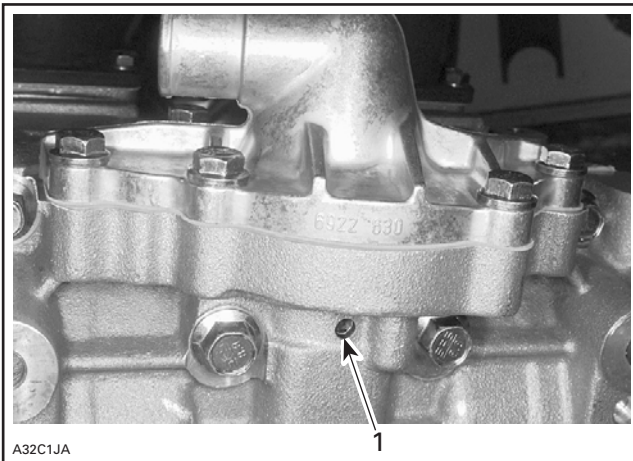
If pressure drops, it indicates a defective crankshaft inner seal.



**CRANKSHAFT INSTALLED IN UPPER HALF CRANKCASE**

- 1. Crankshaft inner seal on PTO side
- 2. Crankshaft inner seal on MAG side

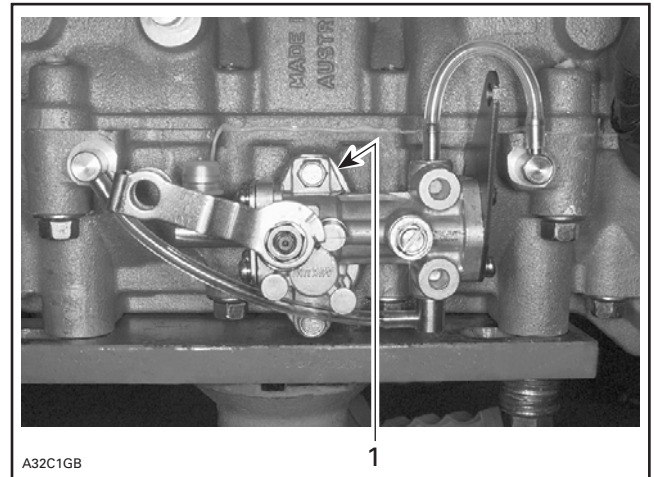
- 1. Check leak indicator hole below coolant pump housing with soapy water.



- 1. Leak indicator hole

If there is a leak, it indicates defective seal of pump shaft (oil seal beside coolant ceramic seal).

- 2. Leaks can be also on oil pump side. Check mounting area for leaks.



- 1. Check mounting area

- 3. If leak still persists, it indicates a defective casting somewhere in engine.

Disassemble engine and carefully check for defects in castings. Pay attention to tapped holes which may go through engine sealed area and thus lead to leakage.

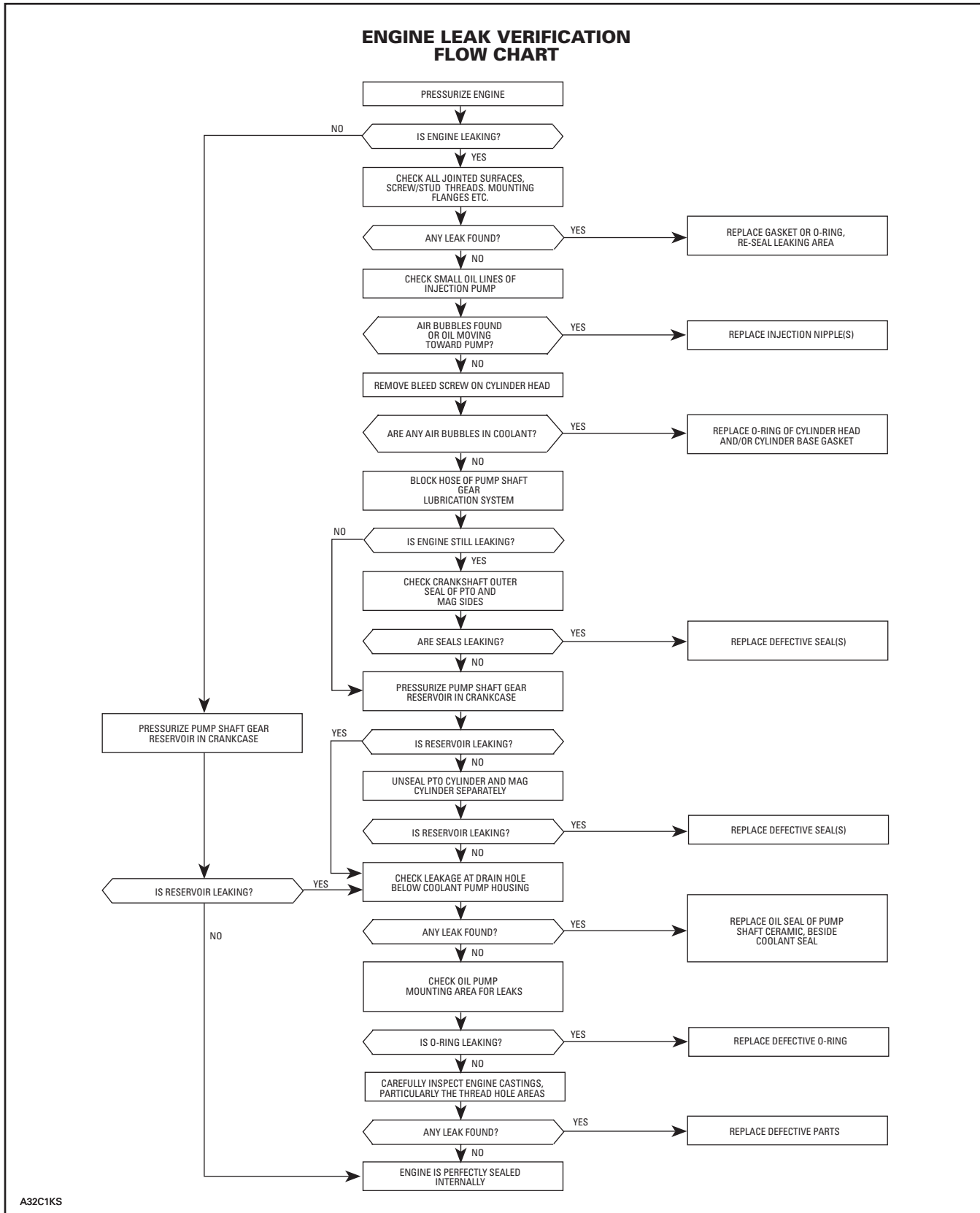
## FINALIZING REASSEMBLY

After reassembling engine, always recheck for leakage.

## Section 04 ENGINE

### Subsection 05 (LEAK TEST AND ENGINE DIMENSION MEASUREMENT)

## ENGINE LEAK VERIFICATION FLOW CHART



## ENGINE DIMENSION MEASUREMENT

This section covers all engine types.

### CYLINDER HEAD WARPAGE

ENGINE TYPE	MAXIMUM
All	0.05 mm (.002 in) per 50 mm (2 in) of surface
	0.5 mm (.020 in) for total length of cylinder head

Check gasketed surface of the cylinder head with a straightedge and a feeler gauge.

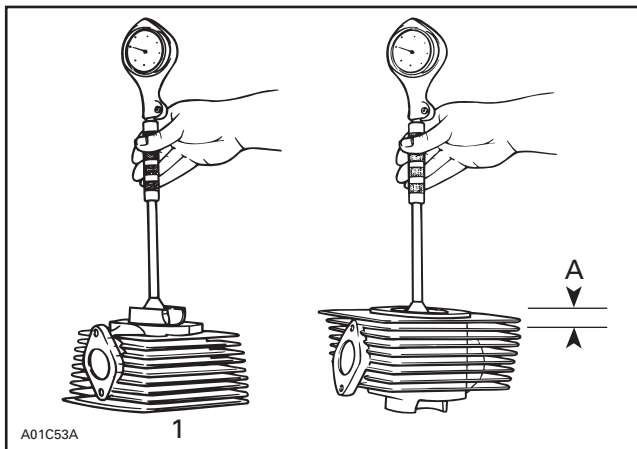
### CYLINDER TAPER

ENGINE TYPE	MAXIMUM
All	0.10 mm (.004 in)

Compare cylinder diameter 16 mm (5/8 in) from top of cylinder to just below its intake port area.

If the difference exceeds the specified dimension the cylinder should be rebored and honed or should be replaced.

**NOTE:** Be sure to restore the chamfer around all cylinder sleeve port openings.



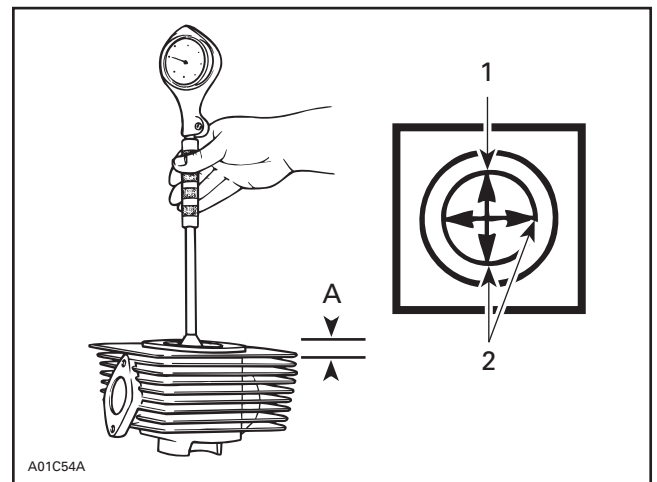
1. Below the intake port  
A. 16 mm (5/8 in) from top

### CYLINDER OUT OF ROUND

ENGINE TYPE	MAXIMUM
All	0.08 mm (.003 in)

Measuring 16 mm (5/8 in) from top of cylinder with a cylinder gauge, check if the cylinder out of round is more than the specified dimension. If larger, cylinder should be rebored and honed or should be replaced.

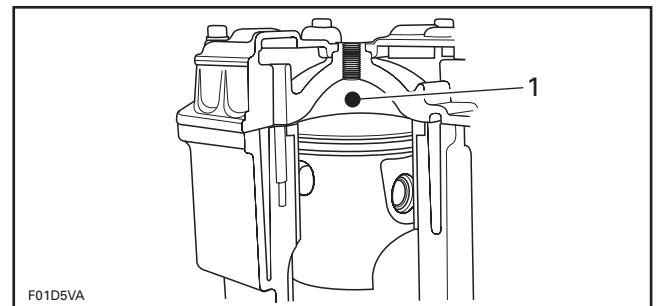
**NOTE:** Be sure to restore the chamfer around all cylinder sleeve port openings.



1. Piston pin position  
2. Measures to be compared  
A. 16 mm (5/8 in)

### COMBUSTION CHAMBER VOLUME MEASUREMENT

The combustion chamber volume is the region in the cylinder head above the piston at Top Dead Center. It is measured with the cylinder head installed on the engine.



1. Combustion chamber

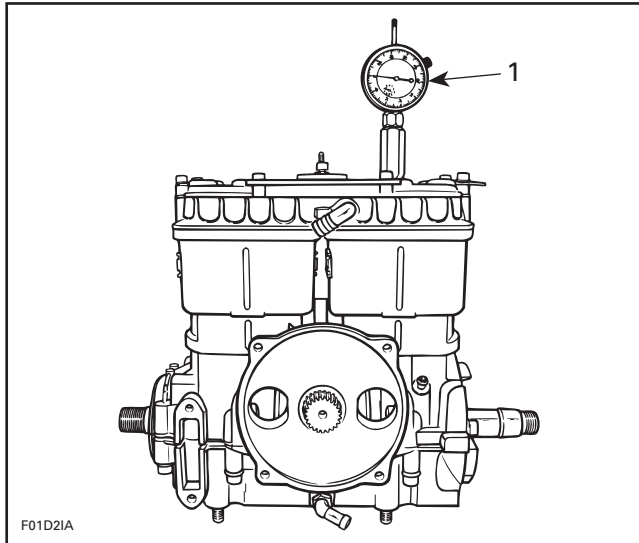


## Section 04 ENGINE

### Subsection 05 (LEAK TEST AND ENGINE DIMENSION MEASUREMENT)

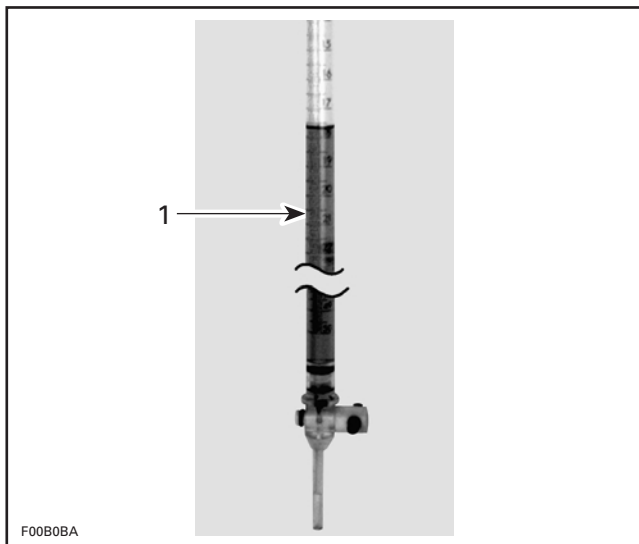
**NOTE:** When checking the combustion chamber volume, engine must be cold, piston must be free of carbon deposit and cylinder head must be leveled.

1. Remove both spark plugs and bring one piston to Top Dead Center using a TDC gauge.



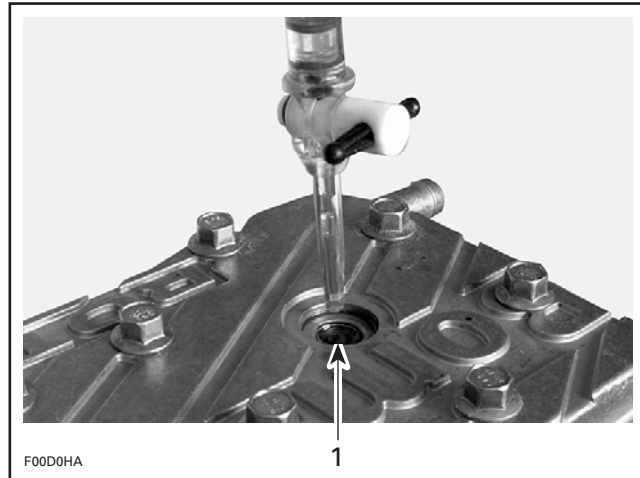
1. Bring piston to TDC

2. Obtain a graduated burette (capacity 0-50 cc) and fill with an equal part (50/50) of gasoline and injection oil.



1. Graduated burette (0-50 cc)

3. Open burette valve to fill its tip. Add liquid in burette until level reaches 0 cc.
4. Inject the burette content through the spark plug hole until liquid touches the top spark plug hole.



1. Top of spark plug hole

**NOTE:** The liquid level in cylinder must not drop for a few seconds after filling. If so, there is a leak between piston and cylinder. The recorded volume would be false.

5. Let burette stand upward for about 10 minutes, until liquid level is stabilized.
6. Read the burette scale to obtain the quantity of liquid injected in the combustion chamber.

**NOTE:** When the combustion chamber is filled to top of spark plug hole, it includes an amount of 2.25 cc corresponding to the spark plug tip.

7. Repeat the procedure for the other cylinder.

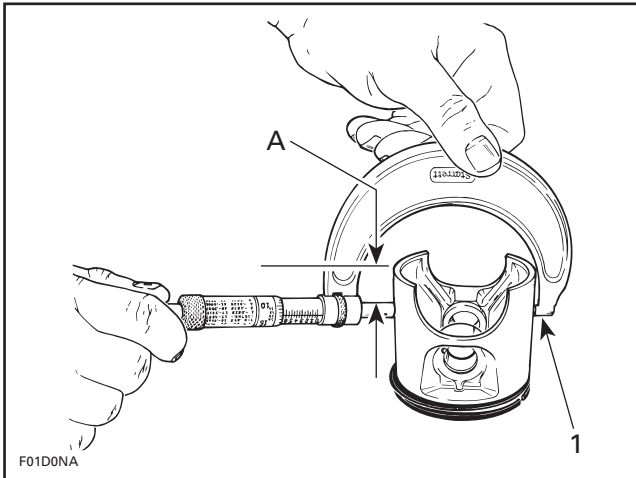
ENGINE TYPE	COMBUSTION CHAMBER VOLUME (cc) (up to top thread of spark plug hole)
443	24.0 ± 1.0
503	27.5 ± 1.2
593	29.9 ± 1.2

Install a thicker or thinner cylinder/crankcase gasket (refer to *Parts Catalogs*) in order to obtain the specified combustion chamber volume.



**USED PISTON MEASUREMENT**

Using a micrometer, measure piston at A perpendicularly (90°) to piston pin.



1. Measuring perpendicularly (90°) to piston pin axis  
A. 15 mm (.590 in)

ENGINE TYPE	MAXIMUM PISTON SKIRT WEAR mm (in)
All	0.15 (.006)

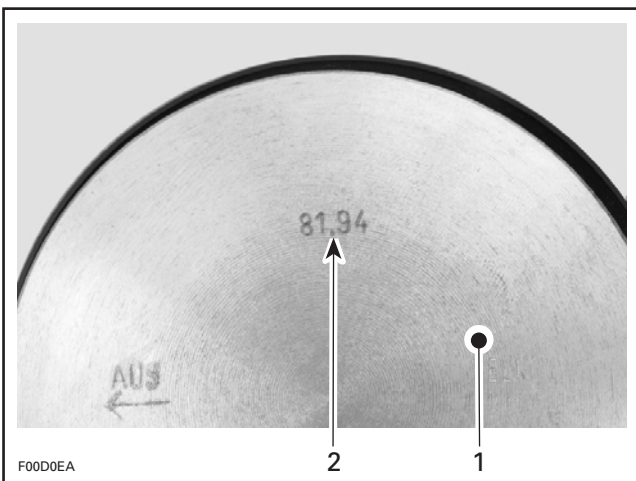
The measured dimension must not be less than 0.15 mm (.006 in) of the one scribed on piston dome. Otherwise, install a new piston.

**CYLINDER/PISTON CLEARANCE**

Used and New Pistons

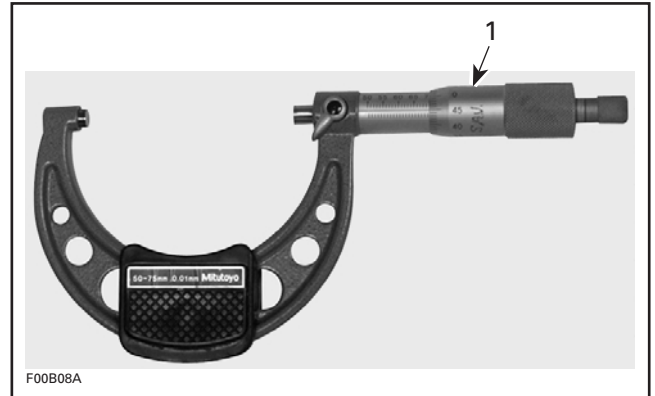
**NOTE:** Make sure used piston is not worn. See USED PISTON MEASUREMENT above.

Take the measurement on the piston dome.



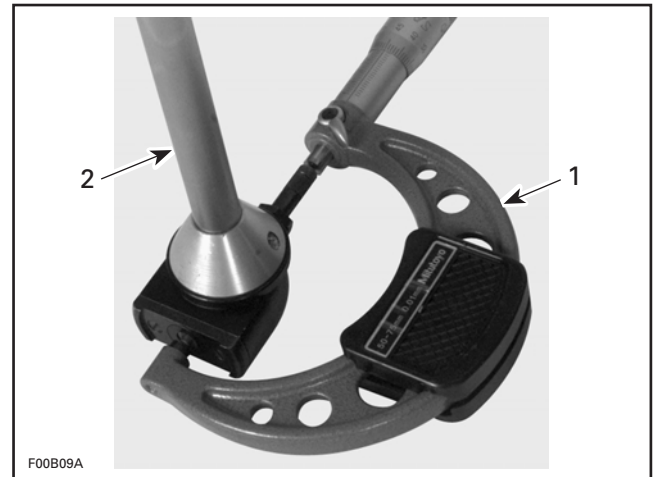
1. Piston dome  
2. Piston measurement

Adjust and lock a micrometer to the specified value on the piston dome.

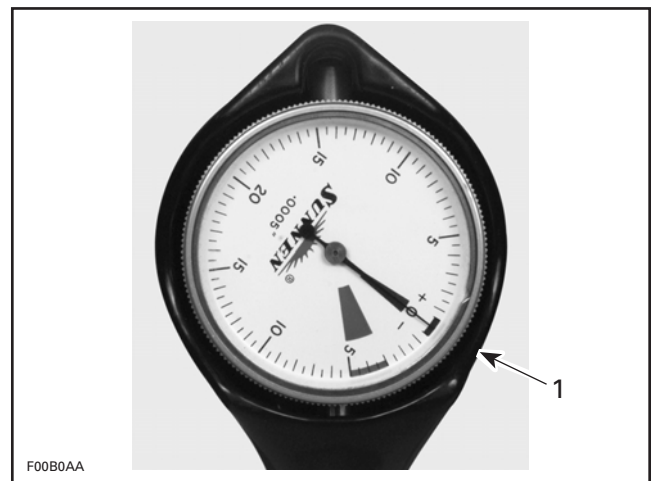


1. Micrometer set to the piston dimension

With the micrometer set to the piston dimension, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0.



1. Use the micrometer to set the cylinder bore gauge  
2. Dial bore gauge

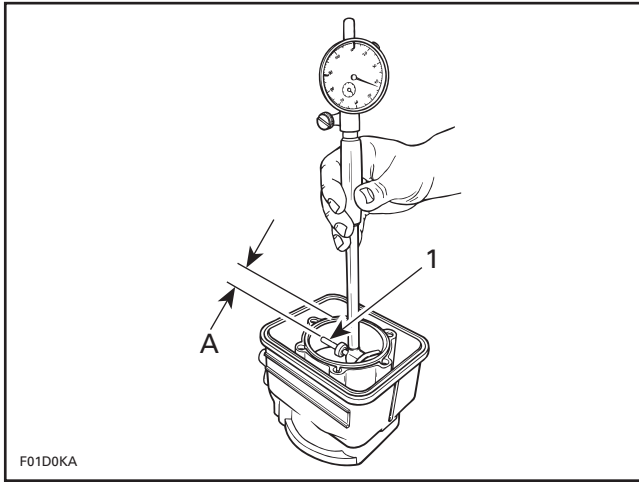


1. Indicator set to 0 (zero)

## Section 04 ENGINE

### Subsection 05 (LEAK TEST AND ENGINE DIMENSION MEASUREMENT)

Position the dial bore gauge at 16 mm (5/8 in) below cylinder top edge.



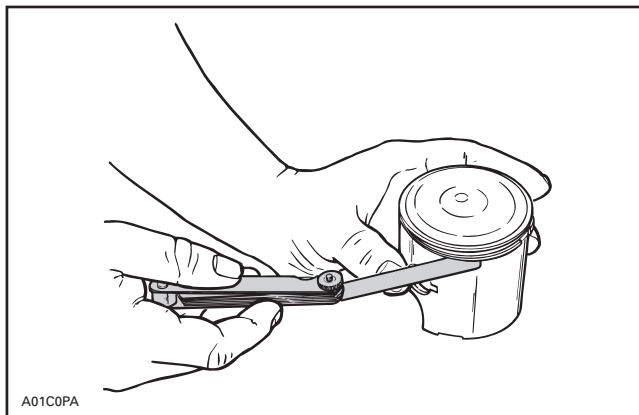
1. Measuring perpendicularly (90°) to piston pin axis  
A. 16 mm (5/8 in)

Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance. If clearance exceeds specified tolerance, replace cylinder or rebore. Refer to TECHNICAL DATA.

**NOTE:** Make sure the cylinder bore gauge indicator is set exactly at the same position as with the micrometer, otherwise the reading will be false.

## RING/PISTON GROOVE CLEARANCE

Using a feeler gauge check clearance between rectangular ring and groove. Replace piston if clearance exceeds specified tolerance. Refer to TECHNICAL DATA.

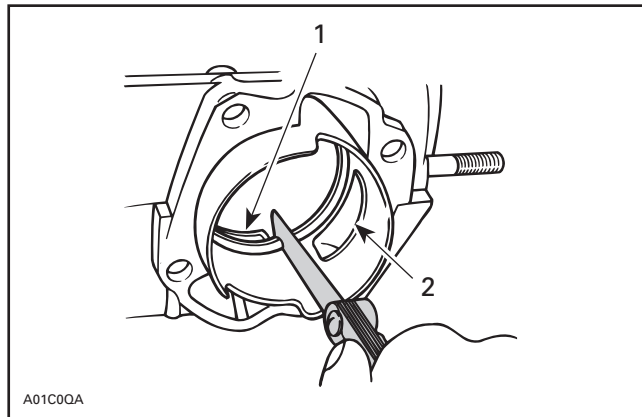


## RING END GAP

Position ring half-way between transfer ports and intake port.

**NOTE:** In order to correctly position the ring in the cylinder, use piston as a pusher.

Using a feeler gauge, check ring end gap. Replace ring if gap exceeds specified tolerance. Refer to TECHNICAL DATA.



1. Transfer port
2. Intake port

## CRANKSHAFT DEFLECTION

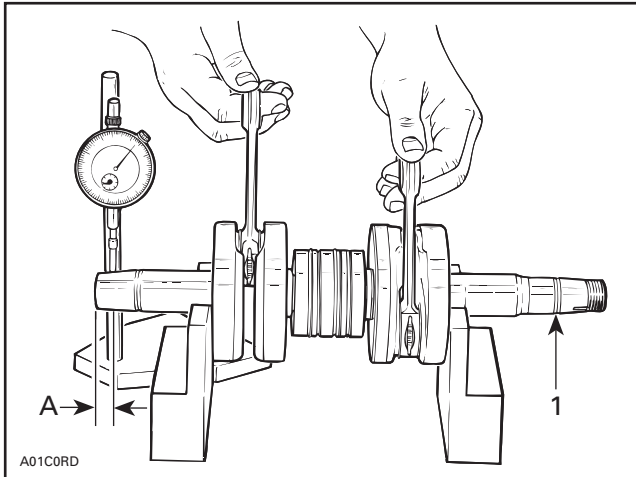
Crankshaft deflection is measured with a dial indicator.

### Measuring (in engine)

First, check deflection with crankshaft in engine. If deflection exceeds the specified tolerance, re-check deflection using V-shaped blocks to determine the defective part(s). See below.

**Measuring (on bench)**

Once engine is disassembled, check crankshaft deflection on V-shaped blocks. If deflection exceeds the specified tolerance, it can be worn bearings or a bent crankshaft. Remove crankshaft bearings and check deflection again on V-shaped blocks to determine the defective part(s). See measurement A in following illustration.



**TYPICAL**

1. Measure at mid point between the key and the first thread  
A. 3 mm (1/8 in)

**Crankshaft Deflection on PTO Side**

ENGINE TYPE	MAXIMUM ON PTO SIDE mm (in)
443	0.08 (.0031)
277 and 503	0.06 (.0024)
593	0.08 (.0031)

**Crankshaft Deflection on MAG Side**

ENGINE TYPE	MAXIMUM ON MAG SIDE mm (in)
443	0.06 (.0024)
277 and 503	0.03 (.0012)
593	0.06 (.0024)

**Crankshaft Deflection in Center of Crankshaft**

ENGINE TYPE	MAXIMUM IN CENTER OF CRANKSHAFT mm (in)
443	0.03 (.0012)
277 and 503	0.08 (.0031)
593	0.05 (.002)

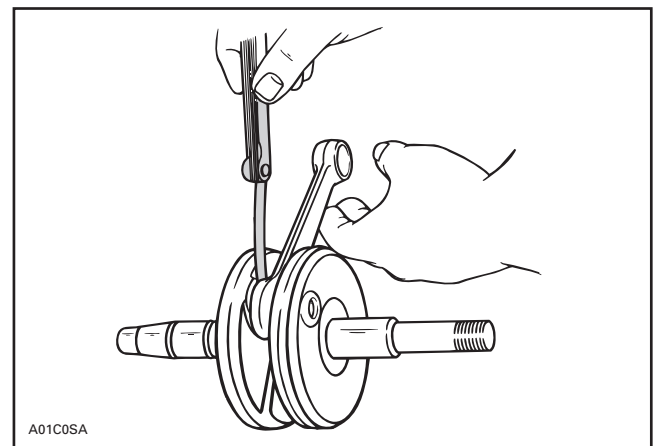
**NOTE:** Crankshaft deflection cannot be correctly measured between centers of a lathe.

If the deflection exceeds the specified tolerance, crankshaft should be repaired or replaced.

**CONNECTING ROD BIG END AXIAL PLAY**

ENGINE TYPE	NEW PARTS (min. - max.)	WEAR LIMIT
277, 443 and 503	0.20 - 0.53 mm (.008 - .021 in)	1.0 mm (.039 in)
593	0.39 - 0.74 mm (.015 - .029 in)	1.20 mm (.047 in)

Using a feeler gauge, measure distance between thrust washer and crankshaft counterweight. If the distance exceeds specified tolerance, repair or replace the crankshaft.



**TYPICAL**

## Section 04 ENGINE

### Subsection 05 (LEAK TEST AND ENGINE DIMENSION MEASUREMENT)

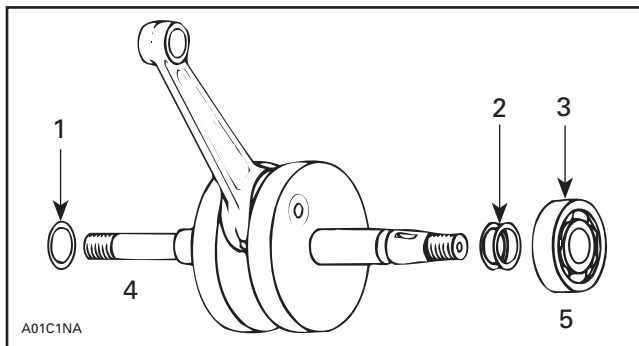
## CRANKSHAFT END-PLAY

### 277 Engine Type

ENGINE TYPE	MINIMUM	MAXIMUM
277	0.10 mm (.004 in)	.030 mm (.012 in)

### Adjustment

Crankshaft end-play is adjusted with shims located between crankshaft and magneto side bearing.



1. Distance ring
2. Shim location
3. Bearing
4. PTO
5. MAG

**CAUTION:** Always install end-play adjustment shims on the magneto side between bearing and crankshaft counterweight.

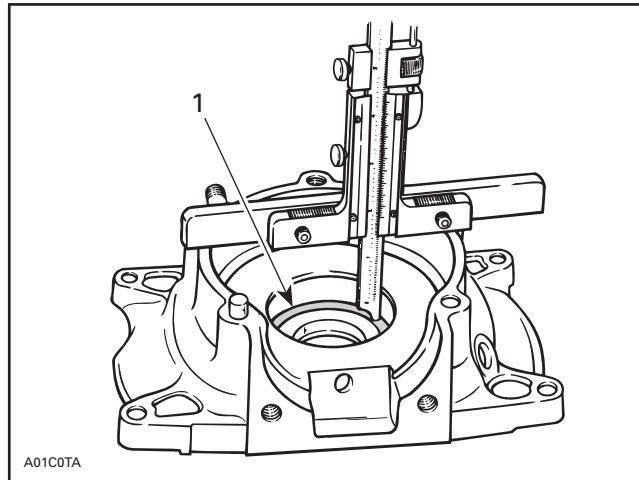
The following is required for the adjustment procedure:

- adjustment shims (refer to *Parts Catalog*)  
thicknesses available: 0.10 mm (.004 in)  
0.20 mm (.008 in)  
0.30 mm (.012 in)  
0.50 mm (.020 in)
- micrometer
- caliper.

Total shim thickness needed for the end-play adjustment is determined with the following procedure:

- a. Measure crankcase halves as illustrated ( $M_1$  and  $M_2$ ).

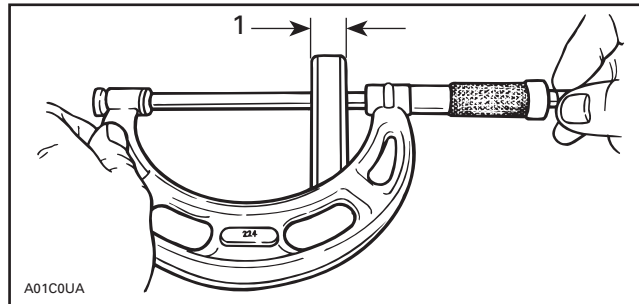
A standard compressed crankcase gasket will have a 0.30 mm (.012 in) thickness ( $M_3$ ). Add these measurements to obtain dimension A.



MEASURING  $M_1$  AND  $M_2$

1. Bearing seat

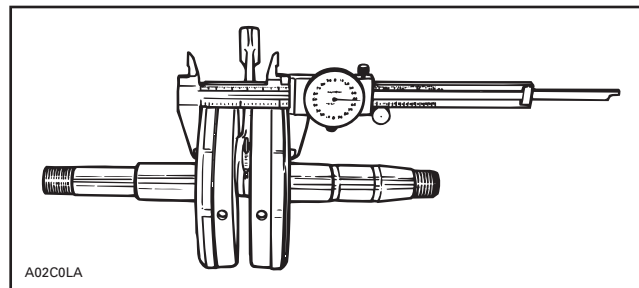
- b. Measure the thickness of each bearing ( $M_4$  and  $M_5$ ).



MEASURING  $M_4$  AND  $M_5$

1. Bearing thickness

- c. Measure distance between bearing shoulders on crankshaft ( $M_6$ ).



MEASURING  $M_6$

- d. Measure the distance ring ( $M_7$ ) and adjustment shims thickness ( $M_8$ ). Add these measurements to obtain dimension B.

e. From dimension A, subtract dimension B.

The result is the actual crankshaft end-play that must be within specification.

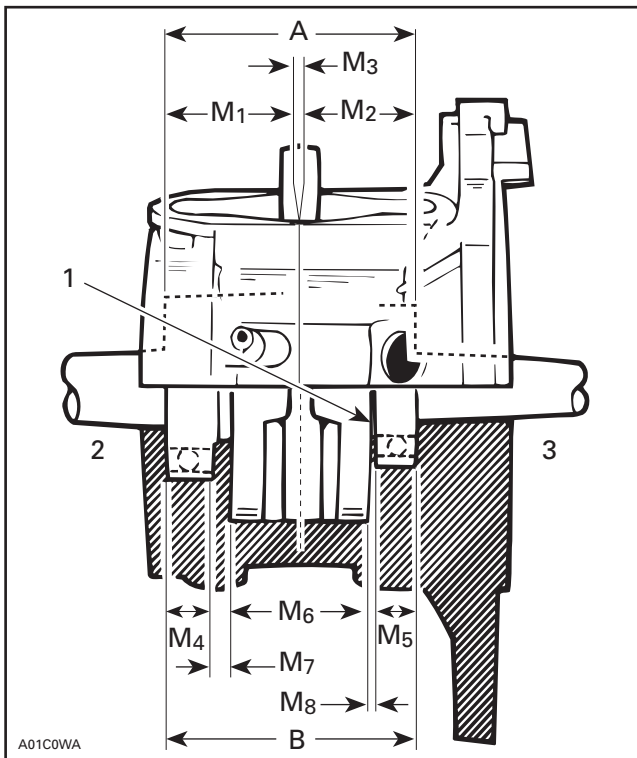
If the result is over specification, add adjustment shim(s) to reach this specification.

If the result is under specification, remove adjustment shim(s) to reach this specification.

**To Summarize**

A	=	$M_1 + M_2 + M_3$
B	=	$M_4 + M_5 + M_6 + M_7 + M_8$
A - B	=	Actual end-play that must be within specification.

$M_8$  is the dimension that must be adjusted to obtain the specified crankshaft end-play.



1. End-play is adjusted with shims
2. PTO
3. MAG

**377, 443, 503 and 593 Engine Types**

End-play is not adjustable but it should be between 0.10 - 0.30 mm (.004 - .012 in).

**CHECKING SURFACE FLATNESS**

Intake manifold, intake manifold cover can be checked for perfectly mating surfaces.

Lay part on a surface plate (marble, mirror or thick glass plate).

Holding down one end of part, try pushing down the other end.

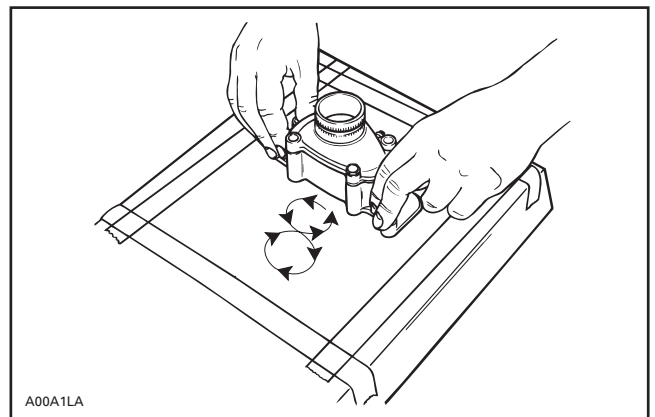
If any play is felt, part must be rectified.

**RECTIFYING SURFACES**

Stick a fine sand paper sheet on the surface plate then lightly oil the sand paper.

Rub part mating surface on sand paper using 8-figure movements.

Sand until mating surface is perfectly straight.



**CHECKING CRANKSHAFT ALIGNMENT**

Install a degree wheel (P/N 414 352 900) on crankshaft end.

Remove both spark plugs.

Install a TDC gauge (P/N 414 104 700) in spark plug hole on MAG side.

Bring MAG piston at top dead center.

Rotate degree wheel (not crankshaft) so that 360° mark aligns with center of crankcase. Scribe a mark on crankcase.

Remove TDC gauge and install it on PTO side cylinder.

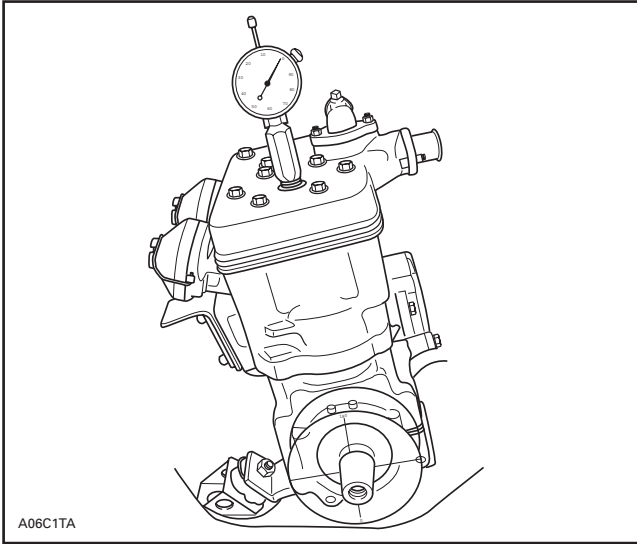
---

## Section 04 ENGINE

### Subsection 05 (LEAK TEST AND ENGINE DIMENSION MEASUREMENT)

---

Bring PTO piston to top dead center. Degree wheel must rotate with crankshaft.



*TYPICAL*

Interval between cylinders must be  $180^\circ \pm 0.5$ .  
Any other reading indicates a misaligned (twisted) crankshaft.



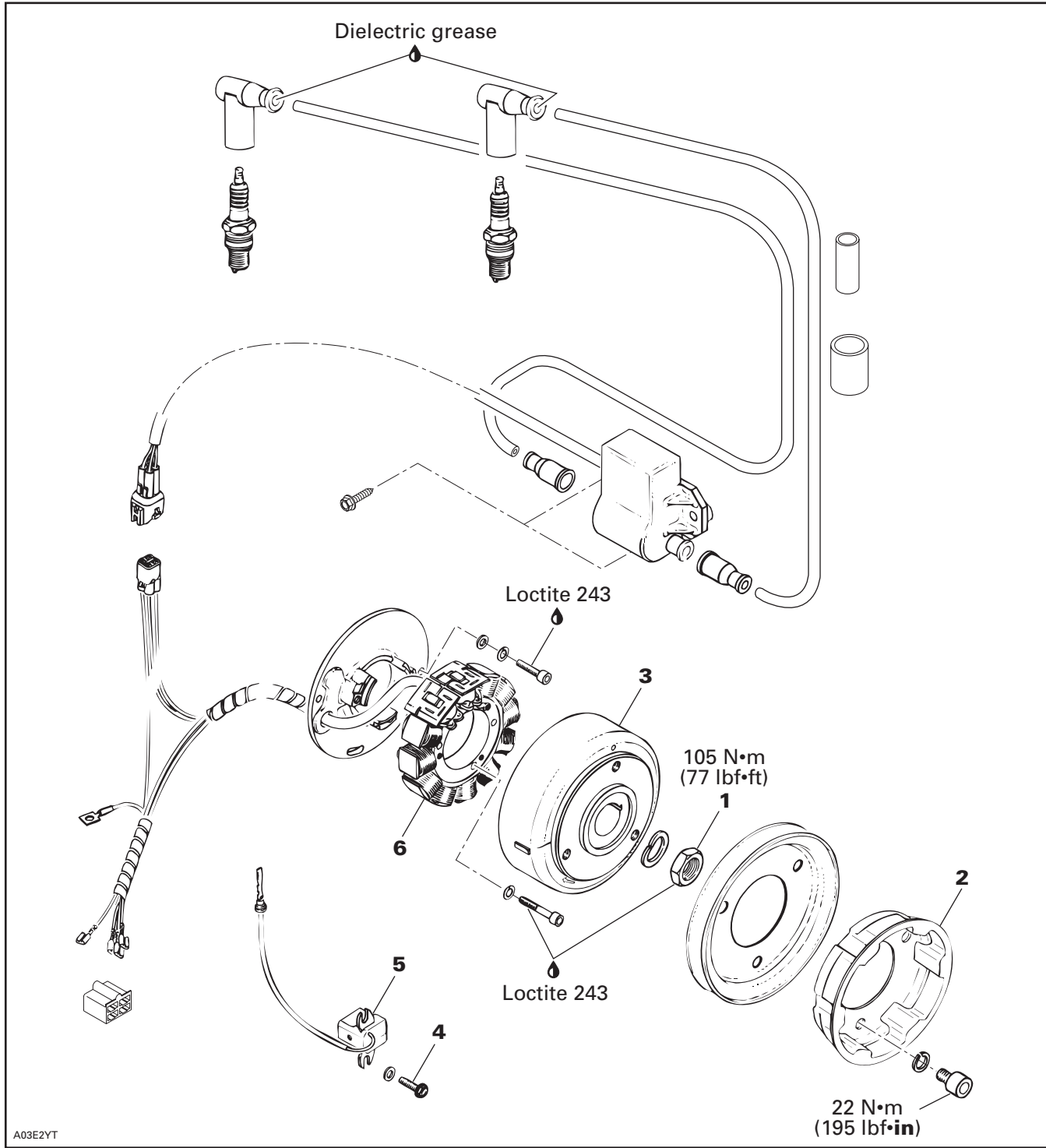


## Section 04 ENGINE

### Subsection 06 (CDI SYSTEM)

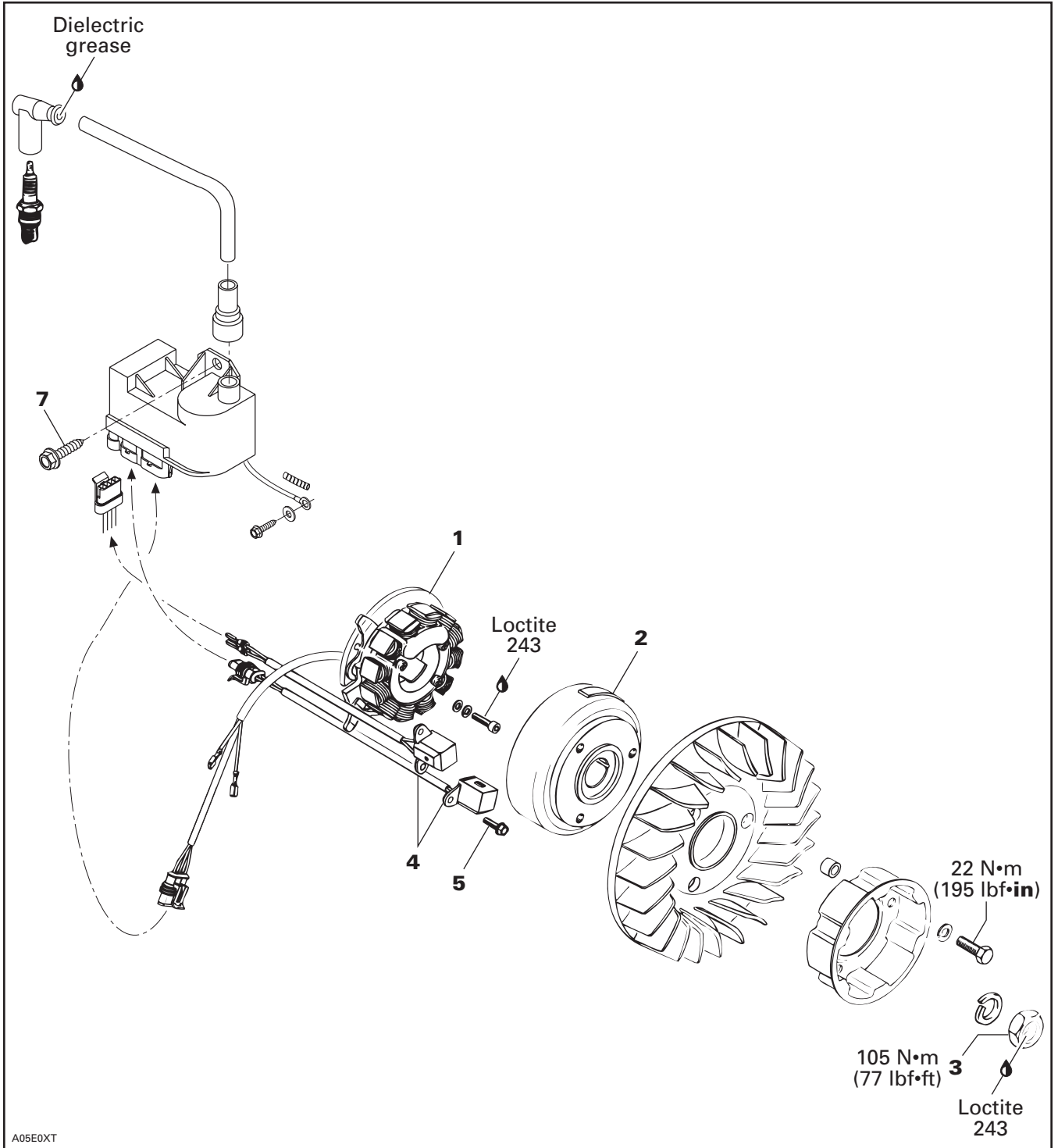
# DUCATI IGNITION SYSTEM

## Skandic WT/SWT



## RER IGNITION SYSTEM

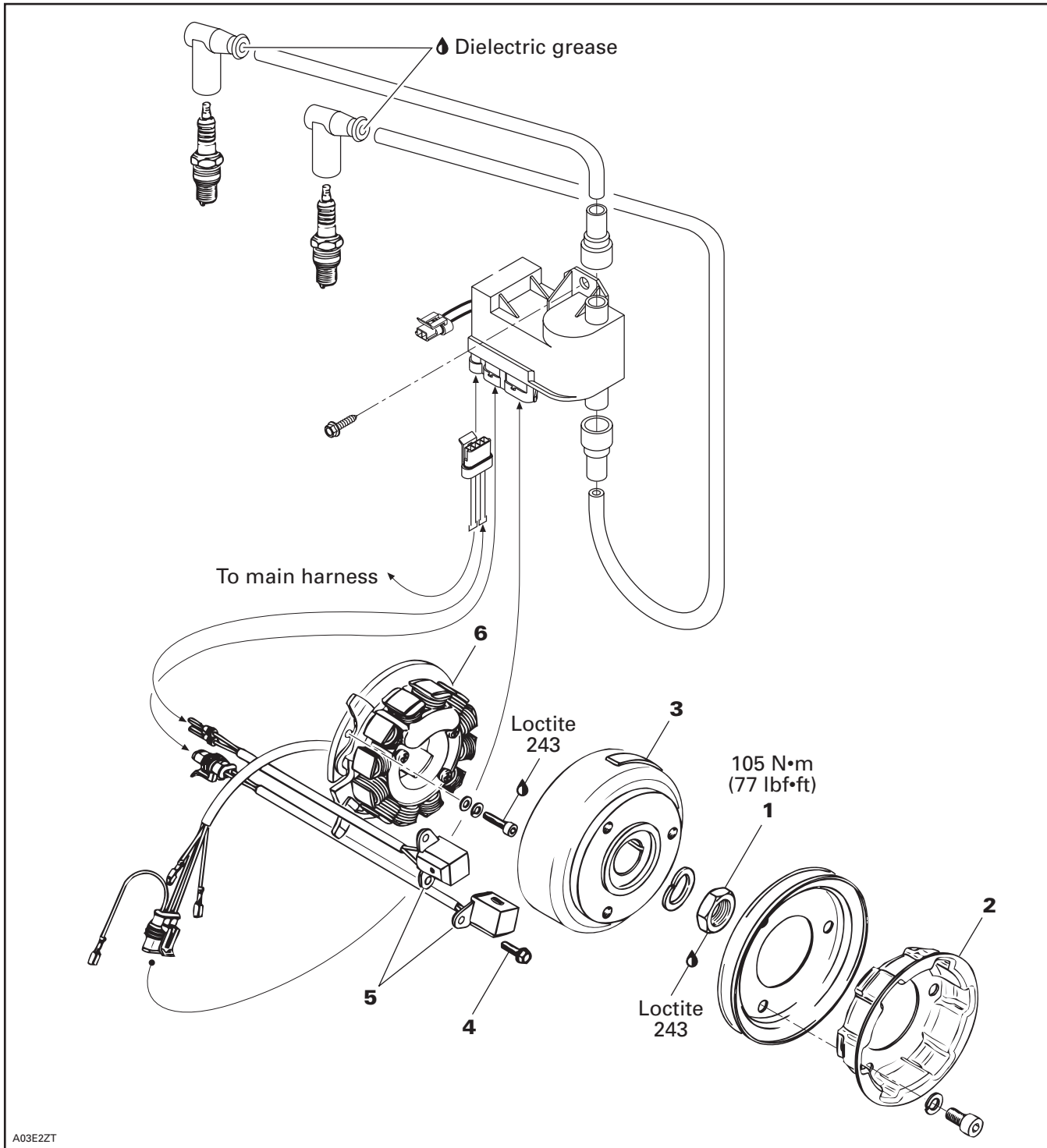
240 W on Tundra R



## Section 04 ENGINE

### Subsection 06 (CDI SYSTEM)

#### 240 W on Skandic LT



A03E2ZT

**NOTE:** The following procedures can be done without removing the engine from chassis. To facilitate magneto removal, hold drive pulley with proper holding tool.

CDI means Capacitor Discharge System.

## CLEANING

Clean all metal components in a non-ferrous metal cleaner.

**CAUTION:** Clean stator and magneto using only a clean cloth.

## DISASSEMBLY

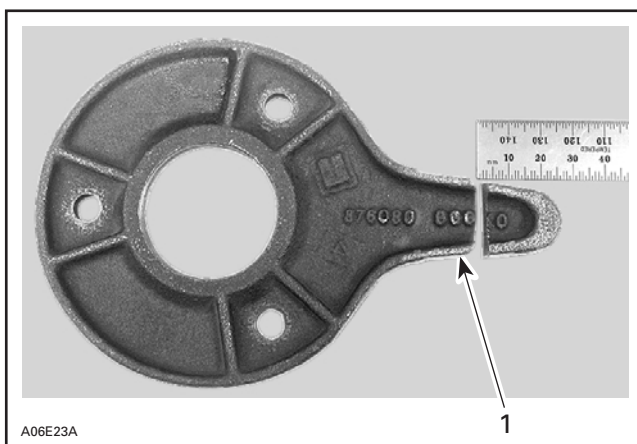
### 3, Magneto Flywheel

To gain access to magneto assembly, remove the following parts as needed on different engines:

- tuned pipe and muffler
- rewind starter
- starting pulley **no. 2**.

To remove magneto flywheel retaining nut **no. 1**:

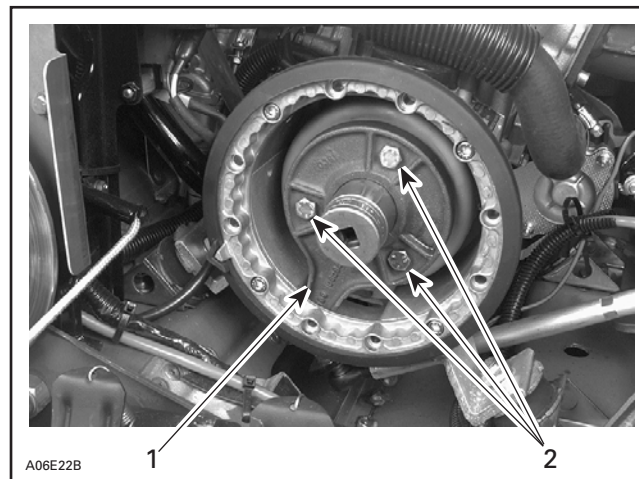
- Use magneto puller ring (P/N 420 876 080). Former puller has to be modified as shown.



1. Cut by 25 mm (1 in)

- Install puller with its tab in magneto housing opening.

**CAUTION:** Use only M8 x 20 mm screws to bolt puller to magneto.

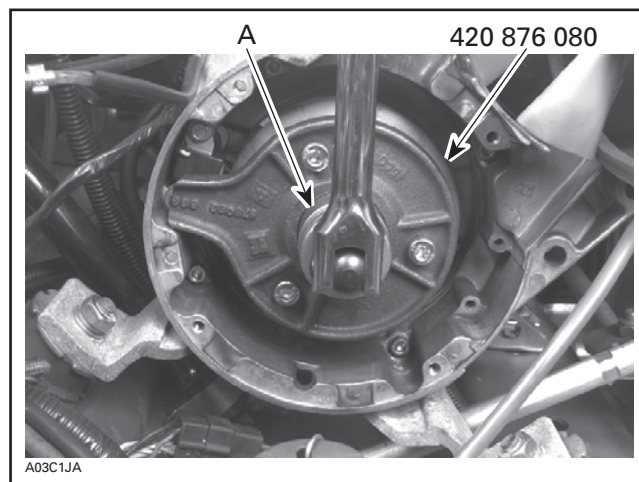


#### TYPICAL

1. Tab in magneto housing opening
2. M8 x 20 mm screws

- Remove magneto flywheel nut, using a 30 mm socket machined to 40 mm (1.580 in) outside diameter by 16 mm (5/8 in) long.

**NOTE:** To correctly remove a threadlocked fastener it is first necessary to tap on the fastener to break threadlocker bond. This will eliminate the possibility of thread breakage.



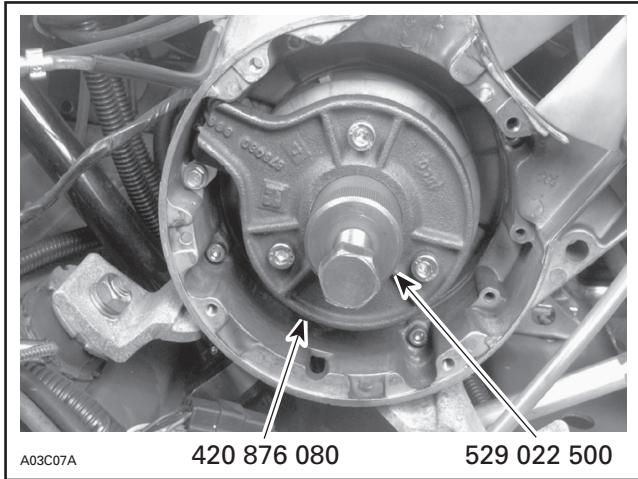
#### TYPICAL

- A. 30 mm socket

## Section 04 ENGINE

### Subsection 06 (CDI SYSTEM)

To remove magneto flywheel, install appropriate protective cap included in crankshaft bearing puller on crankshaft end. Screw puller (P/N 529 022 500) into puller ring.



TYPICAL

- Tighten puller bolt and at the same time, tap on bolt head using a hammer to release magneto flywheel from its taper.

### 5, Trigger Coil

Magneto and stator **no. 6** must be removed before trigger coil removal.

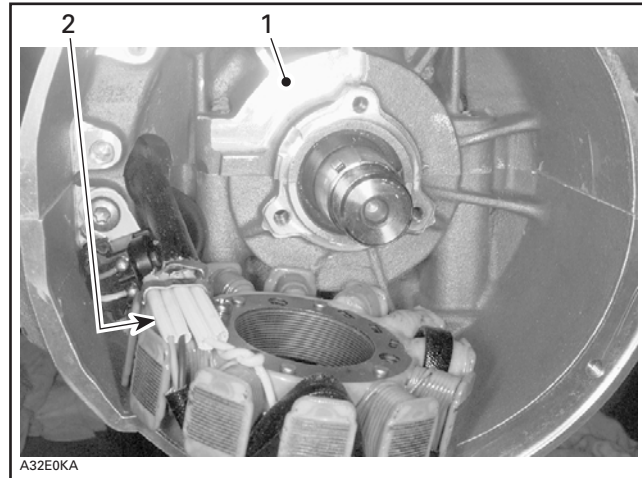
To replace trigger coil:

- Disconnect trigger coil connector housing.
- Remove grommet from crankcase where trigger coil wire exits magneto housing.
- Remove retaining screws **no. 4**.
- Remove trigger coil and carefully pull wires.
- Install new trigger coil and other parts removed.

## ASSEMBLY

### 6, Stator

Make sure to position stator in a way that its wire protectors are over recess of crankcase.



1. Crankcase recess
2. Wire protectors

### 3, Magneto Flywheel

Clean crankshaft extension (taper) and apply Loctite 243 (blue) on taper, then position Woodruff key, flywheel and lock washer on crankshaft.

Clean nut threads and apply Loctite 243 (blue) then tighten nut to 105 N•m (77 lbf•ft) for fan-cooled engines and to 125 N•m (92 lbf•ft) for 593 engine.

At reassembly coat all electric connections except Deutsch housings (waterproof gray housing) with silicone dielectric grease (P/N 293 550 004) to prevent corrosion or moisture penetration.

**CAUTION:** Do not use silicone “sealant”, this product will corrode contacts. Do not apply silicone dielectric grease on any Deutsch (gray) housing otherwise housing seal will be damaged.

### Ignition Timing

Check as described in IGNITION TIMING.



## ADJUSTMENT

### ***Skandic WT/SWT Only***

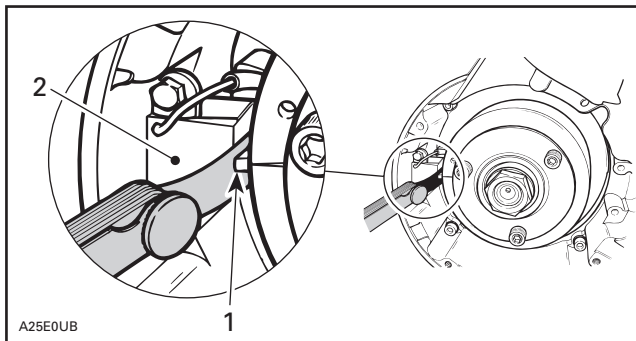
Whenever the trigger coil or the magneto flywheel is removed or replaced, the air-gap between the trigger coil and the flywheel protrusion must be checked and adjusted. The purpose of this adjustment is to obtain the minimum clearance between these parts — without touching at any RPM — so that the trigger coil produces its proper electrical output. Ignition timing must also be checked. Refer to IGNITION SYSTEM.

#### **Proceed as follows:**

1. Rotate flywheel so that one protrusion aligns with trigger coil.
2. Using a feeler gauge of 0.45 mm (.018 in) to 0.55 mm (.022 in) thick, check air-gap between center pole of trigger coil and flywheel protrusion.

**NOTE:** A non-ferrous feeler gauge, such as a stainless steel one, would be useful because it will not be attracted by flywheel magnets.

3. If necessary, adjust by slackening retaining screws and moving trigger coil toward or away of protrusion.
4. Retighten screws and recheck air-gap.



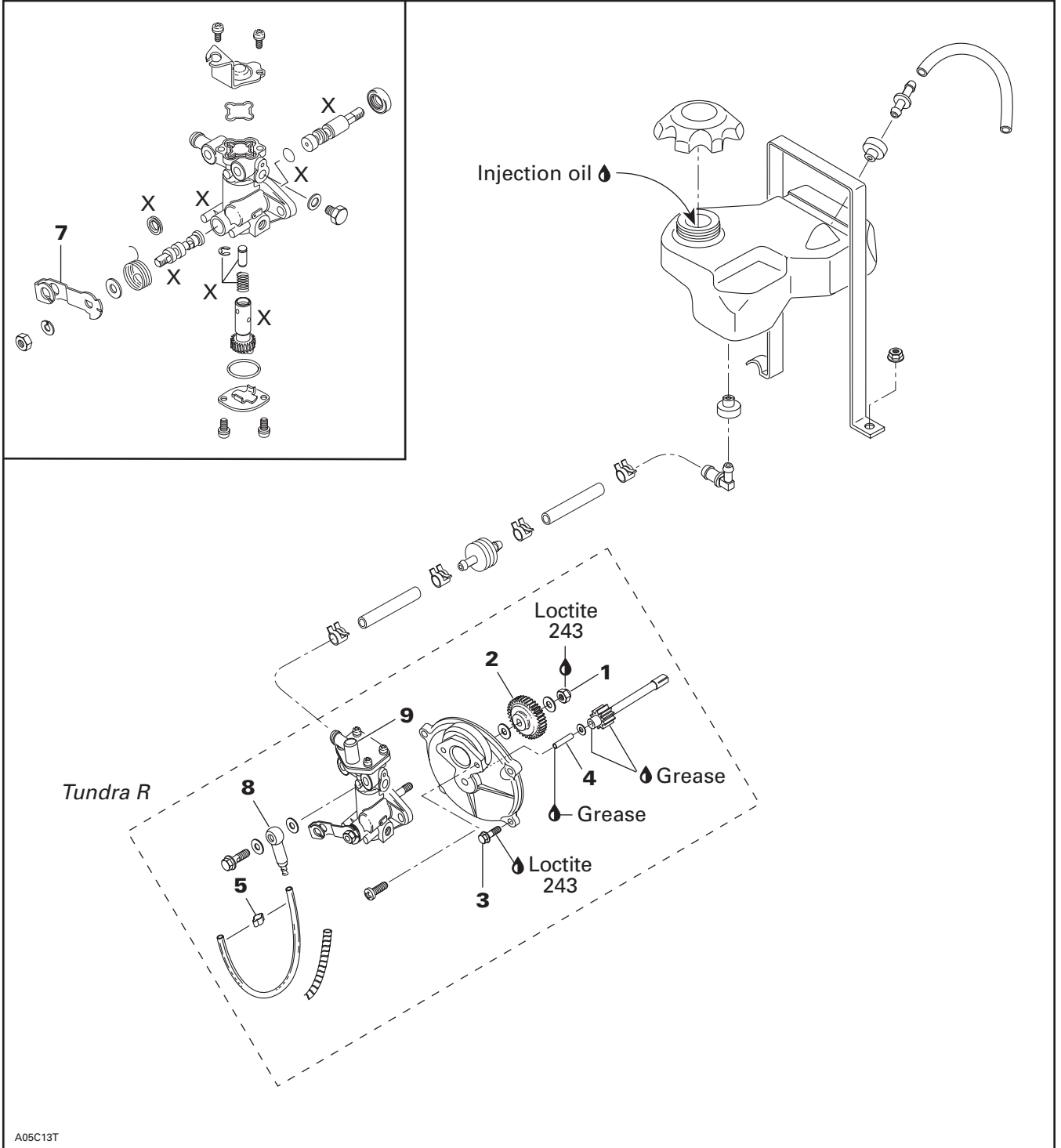
#### **ADJUSTING TRIGGER COIL AIR-GAP**

1. *Flywheel protrusion*
2. *Trigger coil*

# OIL INJECTION SYSTEM

## OIL INJECTION PUMP

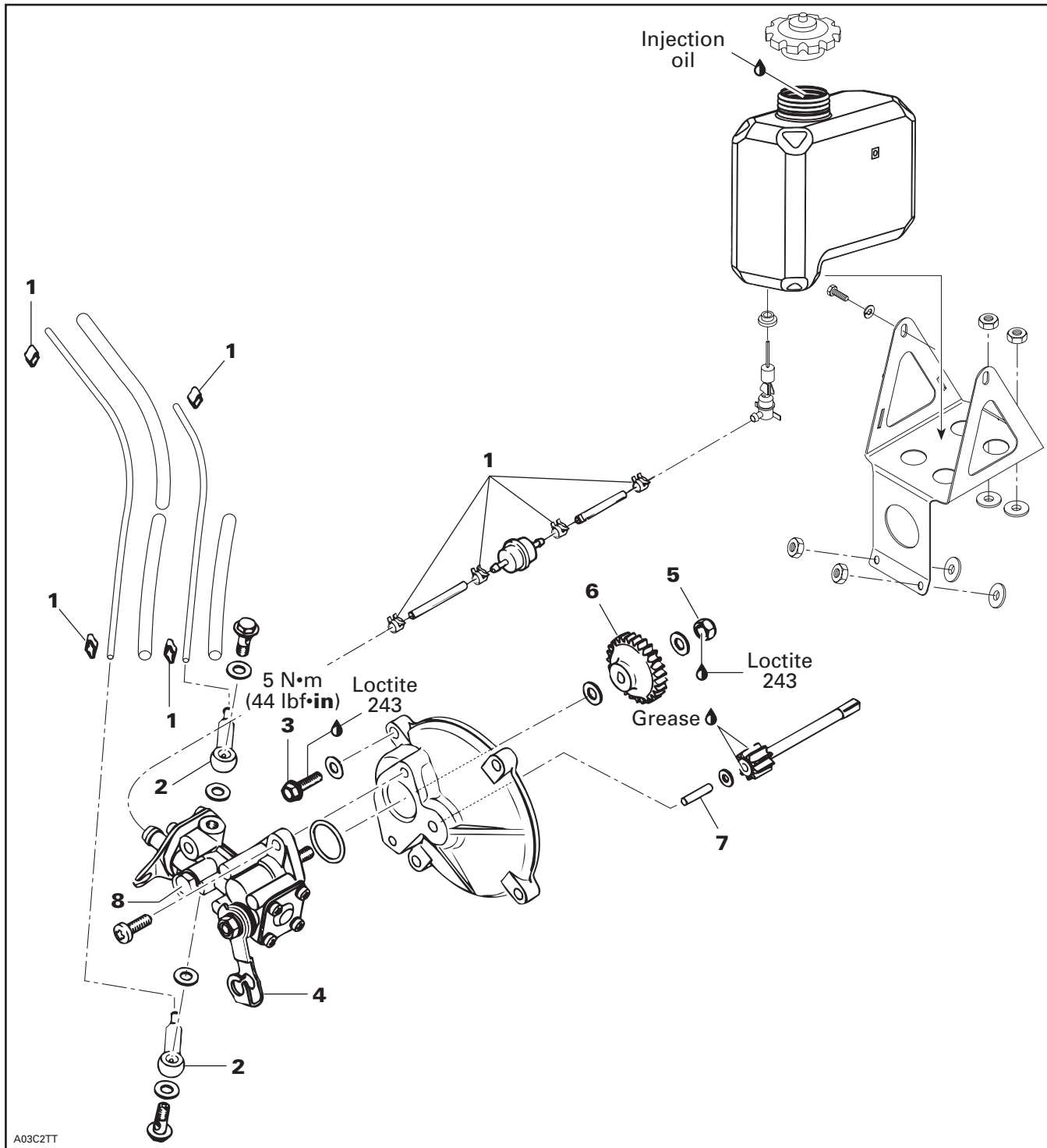
277 Engine



## Section 04 ENGINE

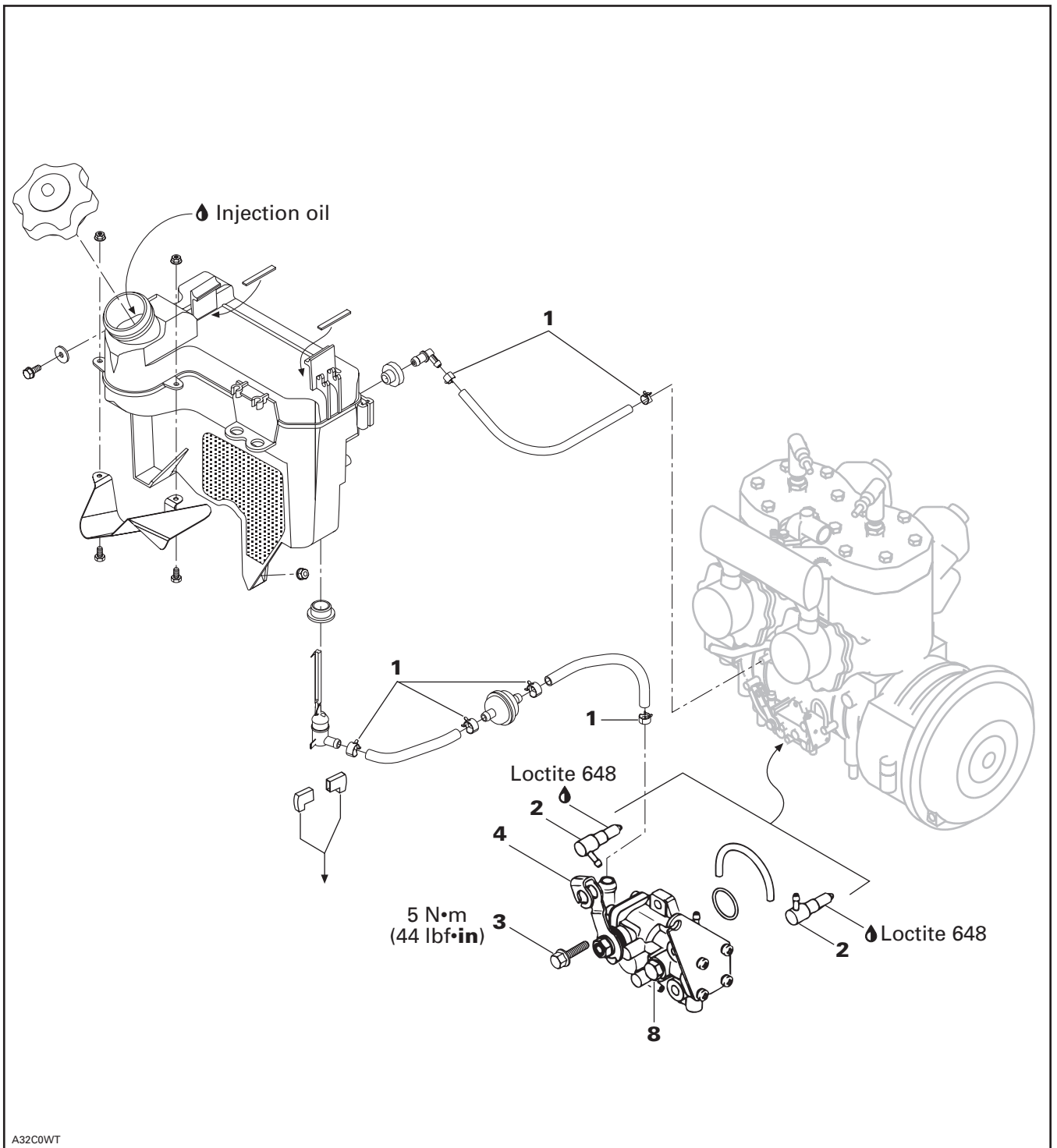
### Subsection 07 (OIL INJECTION SYSTEM)

#### 443 and 503 Engines on Skandic LT/WT/SWT



TYPICAL

**593 Engine on Skandic WT LC**



TYPICAL

## Section 04 ENGINE

### Subsection 07 (OIL INJECTION SYSTEM)

#### **WARNING**

Wipe off any oil spills. Oil is highly flammable.

## OIL TYPE

### All Models

Use recommended injection oil as per vehicle *Operator's Guide*.

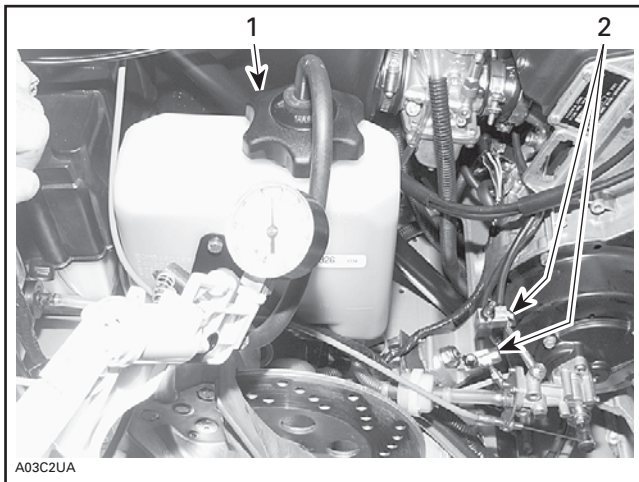
## OIL SYSTEM LEAK TEST

### All Models

The following test will indicate any leak from oil reservoir to the banjo fitting(s).

Install on oil reservoir special cap of leak testing kit (P/N 529 033 100).

Install hose pinchers (P/N 295 000 076) on outlet hoses.



#### TYPICAL

1. Special cap on reservoir
2. Hose pinchers on outlet hoses

Connect leak testing kit pump to special cap.

Pressurize oil system to 21 kPa (3 PSI). That pressure must not drop during 3 minutes.

If pressure drops, locate leak(s) and repair/replace leaking component(s).

## OIL PUMP IDENTIFICATION

### All Models

#### 4, Pump Lever

Different engines need different pumps. See identification on lever no. 4.

**CAUTION:** Always mount proper pump on engine.

ENGINE TYPE	OIL PUMP IDENTIFICATION
277	132K
443	L13
503	E8
593	L7

**NOTE:** The following procedures can be done without removing the engine from chassis.

## CLEANING

Clean all metal components in a non-ferrous metal cleaner.

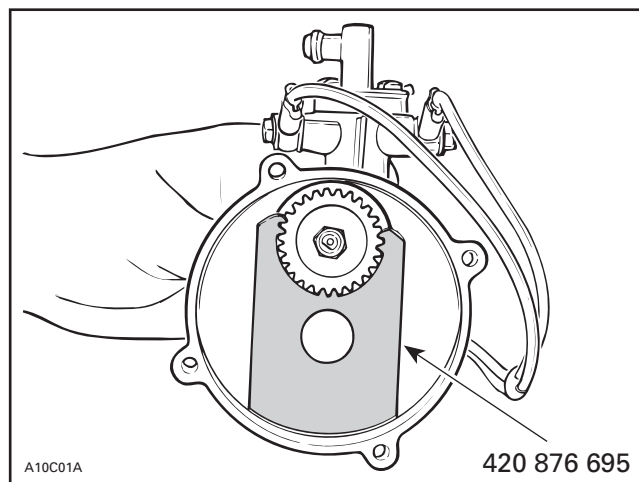
## DISASSEMBLY

**NOTE:** Some oil pump components are not available as single parts.

### 5,6, Gear Retaining Nut and Oil Pump Gear

To remove gear retaining nut, first extract the needle roller with pliers then lock gear in place using the following gear holder.

ENGINE TYPE	TOOL P/N
277/443/503	420 876 695





## ASSEMBLY

### 1, Spring Clip

Always check for spring clips tightness.

### 6, Oil Pump Gear

At gear assembly, apply a light coat of Molykote 111 (P/N 413 707 000) on gear teeth.

### 7, Needle Roller (fan cooled engine only)

The needle roller must be engaged as deep as possible in the pump mounting flange.

### 3, Screw

Torque to 5 N•m (44 lbf•in).

Cable plastic elbow must be fastened and fully inserted.

Make sure cable barrel is well seated in oil pump lever.

Secure barrel with plastic washer and circlip.

Install cable lock washer on lever side.

Verify cable and oil pump lever operation.

## ADJUSTMENT

### All Models

Prior to adjusting the pump, make sure all carburetor adjustments are completed.

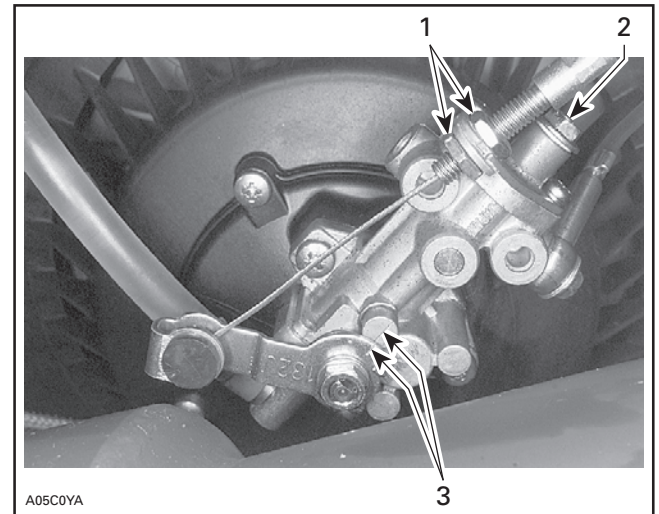
### Pumps Identified E8 and 132K

Eliminate the throttle cable free-play by pressing the throttle lever until a light resistance is felt, then hold in place.

The mark on the pump casting and on the lever must align. Width of lever mark is the tolerance.

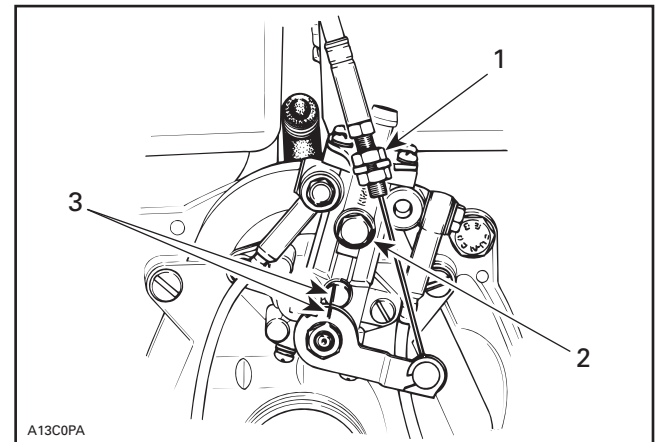
Loosen the adjuster nut and adjust accordingly.

Retighten the adjuster nut.



TYPICAL — TUNDRA R

1. Adjuster nuts
2. Bleeder screw
3. Marks



TYPICAL — SKANDIC WT/SWT

1. Adjuster nut
2. Bleeder screw
3. Marks

**CAUTION:** Proper oil injection pump adjustment is very important. Any delay in the opening of the pump can result in serious engine damage.

### Pump Identified L7

Do not touch throttle lever. The cable free-play must not be eliminated on this model.

Because the oil pump is mounted low on engine, it is very difficult to avoid parallax problem and set a good adjustment.

## Section 04 ENGINE

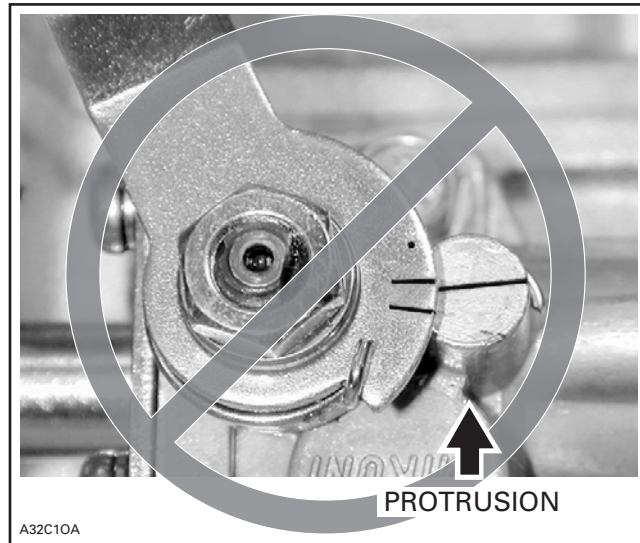
### Subsection 07 (OIL INJECTION SYSTEM)

#### Parallax Problem

When adjusting pump lever, since the mechanic can not view the pump perpendicularly, the adjustment will not be accurate. Following photos show three different views of the same properly adjusted pump.



*VIEW TOO HIGH — ADJUSTMENT SEEMS TO BE TOO RICH WHEN TOP OF BODY'S PROTRUSION CAN BE SEEN*



*VIEW TOO LOW — ADJUSTMENT SEEMS TO BE TOO LEAN WHEN BOTTOM OF BODY'S PROTRUSION CAN BE SEEN*

To avoid a bad adjustment, follow below procedure.

#### Procedure for Oil Pump Adjustment

Ensure carburetors are synchronized according to the technical specifications.

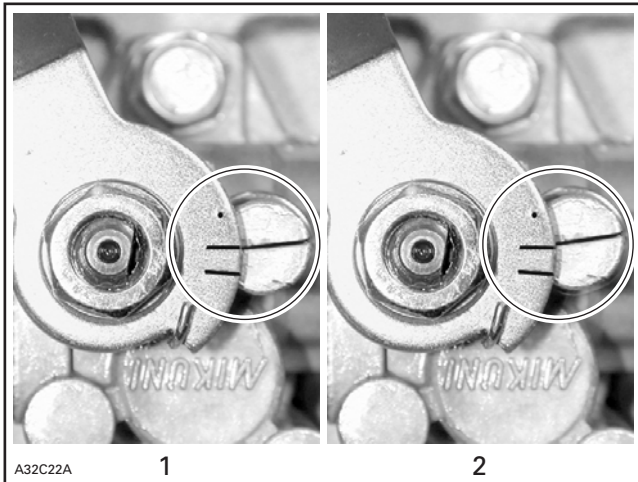
Remove air silencer. Carburetors may also be removed to improve visibility and ease adjustment of oil pump cable.

**NOTE:** Place carburetors on top of intake boots to keep cable routing near original location.

Use a small round or oblong mirror to see the marks.

The second mark on pump lever must be aligned or up to 1 mm (.039 in) below pump casting mark. If not, loosen the adjuster nut and adjust accordingly.

Retighten the adjuster nut.

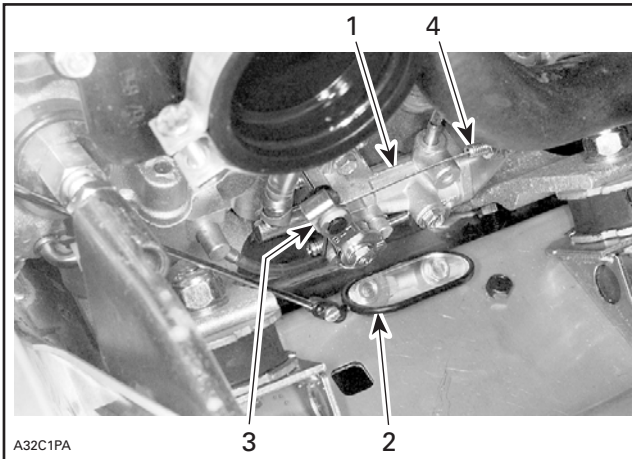


*VIEW STRAIGHT AHEAD — BODY'S PROTRUSION LOOKS LIKE A CIRCLE, MARK ON PUMP ALIGN WITH SECOND MARK ON LEVER (MARK ON DOT SIDE)*

1. Minimum setting
2. Maximum setting

## Section 04 ENGINE

### Subsection 07 (OIL INJECTION SYSTEM)

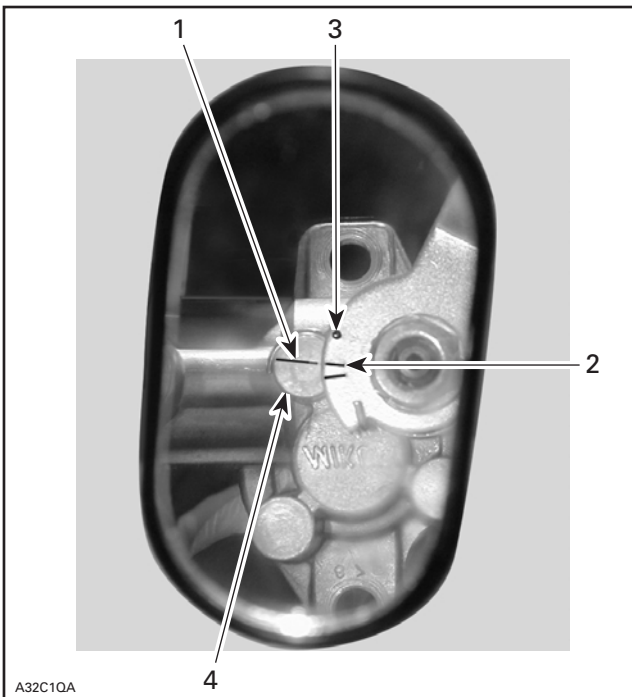


VIEW WITH AIR SILENCER, CARBURETORS AND FUEL PUMP REMOVED

1. Oil pump
2. Mirror
3. Lever
4. Adjustment screw

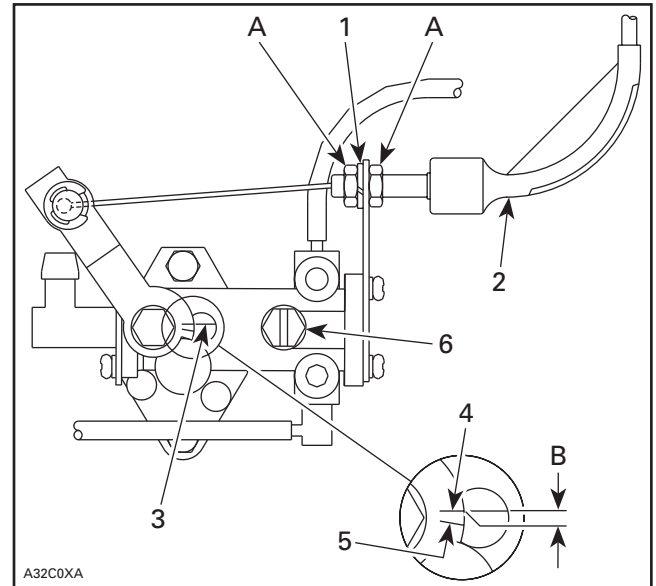
Make sure that view in mirror is straight ahead, without parallax problem.

Protrusion with fixed mark on pump must look like a full circle. See next photo.



VIEW FROM MIRROR SHOULD LOOK LIKE THIS

1. Mark on pump casting
2. Second mark on lever
3. Dot
4. Pump protrusion looks like a circle, not a cylinder



1. Lock washer
2. Plastic elbow fastened and fully inserted
3. Pump casting mark
4. Second mark aligned or below
5. First mark
6. Bleeder screw
- A. 5 N•m (44 lbf•in)
- B. 0 to 1 mm (0 to .039 in)

**CAUTION:** Proper oil injection pump adjustment is very important. Any delay in the opening of the pump can result in serious engine damage.

### BLEEDING

Bleed main oil line (between tank and pump) by loosening the bleeder screw until air has escaped from the line. Add injection oil as required.

Reinstall all parts.

Bleed the small oil lines between pump and engine by running engine at idle while holding the pump lever in fully open position.

**NOTE:** Make a J hook out of mechanical wire to lift the lever.

### WARNING

Ensure not to operate carburetor throttle mechanism. Secure the rear of the vehicle on a stand.

---

## Section 04 ENGINE

### Subsection 07 (OIL INJECTION SYSTEM)

---

## CHECKING OPERATION

### Oil Pump

#### On Vehicle

**NOTE:** Main oil line must be full of oil. See bleeding procedure above.

Lift rear of vehicle and support with a mechanical stand. Disconnect small oil lines from pump. Start engine and stop it as soon as it fires.

Check that oil in small oil lines has been sucked up (this will be indicated by a clear section of small oil lines). Repeat the procedure until this condition is attained.

Reconnect small oil lines, start engine and run at idle while holding the pump lever in fully open position. Oil columns must advance into small oil lines.

If not, remove pump assembly and check the pump gear and drive shaft (if applicable) for defects, replace as necessary. Test pump as describes below.

**NOTE:** Through normal use, oil level must not drop in small oil lines. If oil drops, verify check valve operation in injection nozzle. Replace as necessary.

#### Test Bench

Connect a hose filled with injection oil to supply line fitting. Insert other hose end in an injection oil container. Using a clockwise rotating drill, rotate pump shaft. Oil must drip from outer fittings while holding lever in a fully open position. If not replace pump.

## 2, Check Valve

Check valve is part (built-in) of injection nozzle.

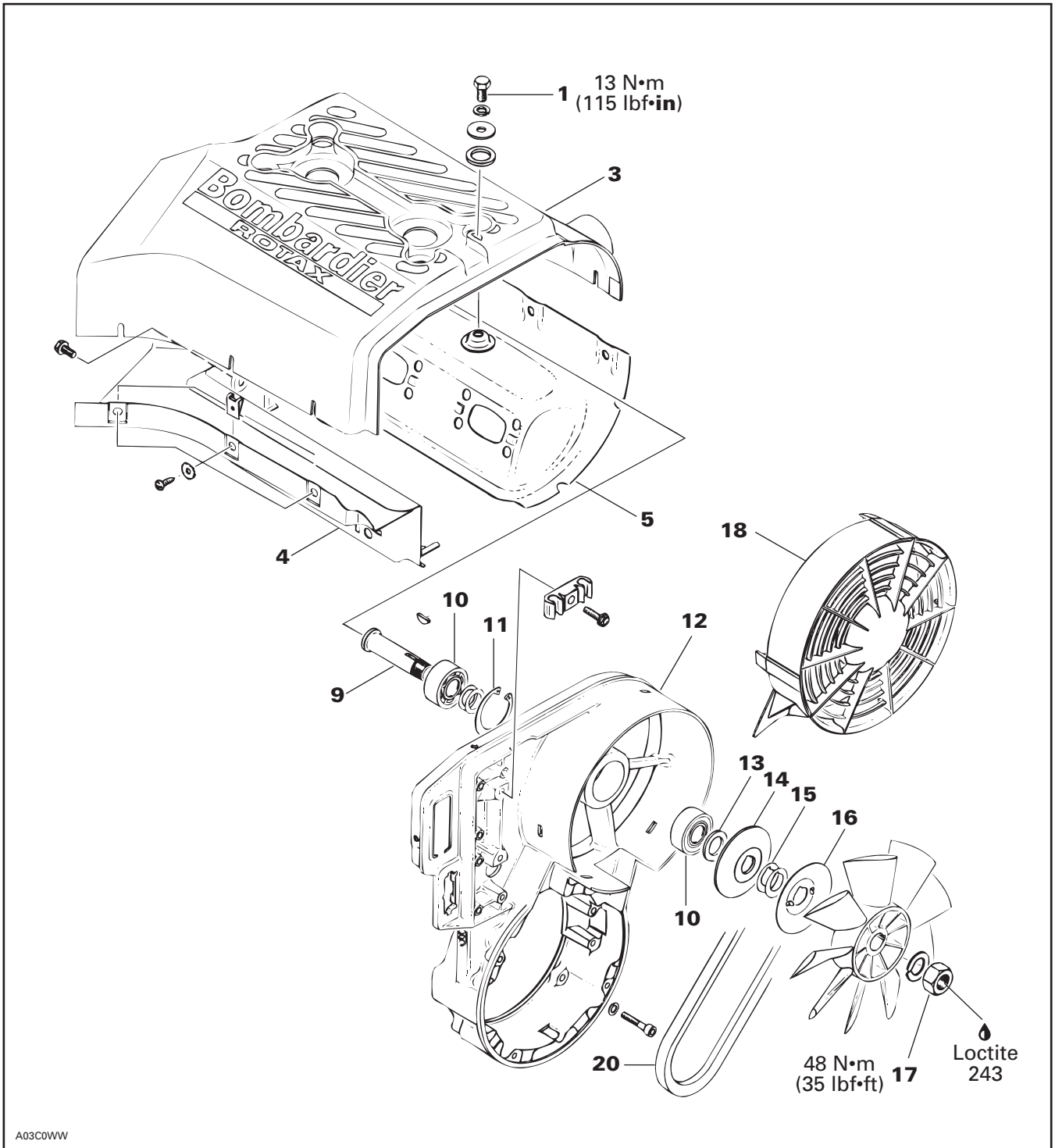
To verify this check valve, proceed the same as for checking pump operation on vehicle. First unplug oil line from injection nozzle. After restarting the engine, check that a clear section in small oil line is present. Reconnect oil line.

Run engine at idle. Oil column must advance. If the check valve is faulty, oil column will go back and forth. Replace if so.

# AXIAL FAN COOLING SYSTEM

443 and 503 Engines

NOTE: For 277 engine radial fan cooling system, refer to CDI SYSTEM.





## Section 04 ENGINE

### Subsection 08 (AXIAL FAN COOLING SYSTEM)

**NOTE:** The following procedures can be done without removing engine from chassis.

## REMOVAL

**NOTE:** To facilitate further disassembly, fan nut may be removed before removing fan housing.

Remove rewind starter, starting pulley, trigger coil wire from 4-connector housing then fan housing ass'y.

## CLEANING

Clean all metal components in a non-ferrous metal cleaner.

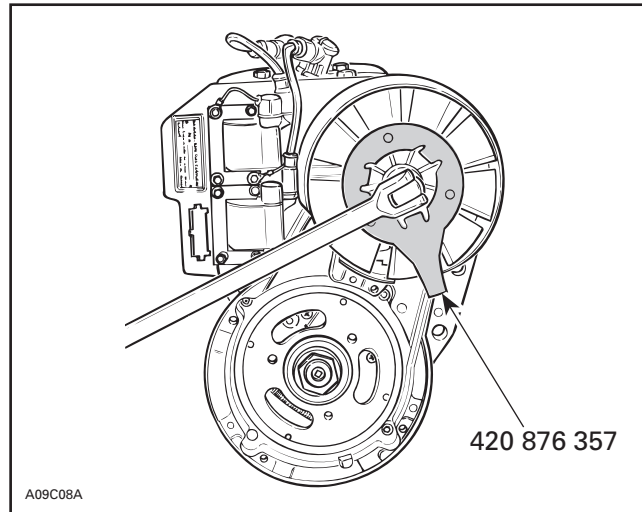
## DISASSEMBLY AND ASSEMBLY

Using a flat screwdriver, lift fan protector tabs as shown in the following photo, then remove fan protector.



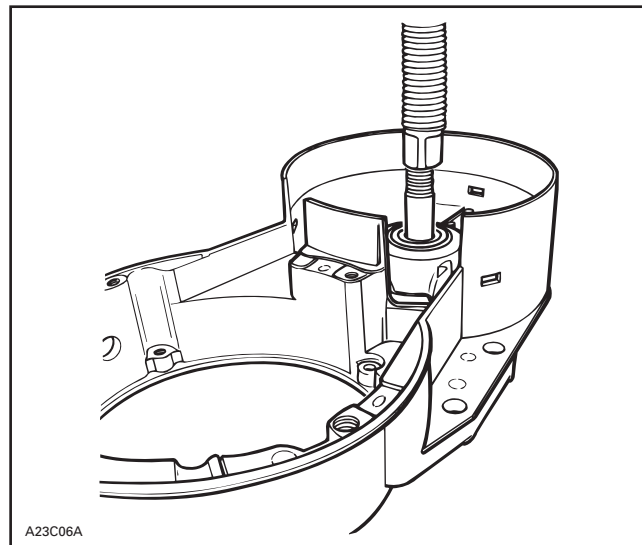
1. Lift tab and remove fan protector

To remove or install fan pulley retaining nut **no. 17**, lock fan pulley with special holder wrench (P/N 420 876 357). At assembly, torque nut to 48 N•m (35 lbf•ft).

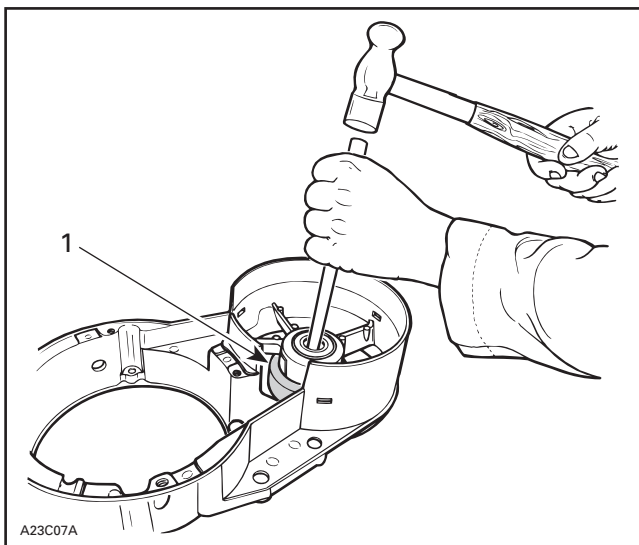


TYPICAL

Using a press, drive the fan shaft **no. 9** out.



Support fan housing no. 12 with a ring. With a punch, working all around bearing no. 10 inner race, drive bearing out of fan housing. Keep shims for installation.



1. Ring supporting fan housing

Remove circlip no. 11 then remaining bearing.

To install, press one bearing in place then install circlip and shims. Press the other bearing from opposite side until it is flush with housing. Press fan shaft from engine side of fan housing. Check for free rolling action.

## INSTALLATION

At assembly, apply a light coat of Loctite 243 (blue) on screw no. 1 threads.

A gasket must be placed on both sides (inner and outer) of intake and exhaust holes of cylinder cowl nos. 4 and 5.

Reinstall fan protector no. 18 properly.

### **⚠ WARNING**

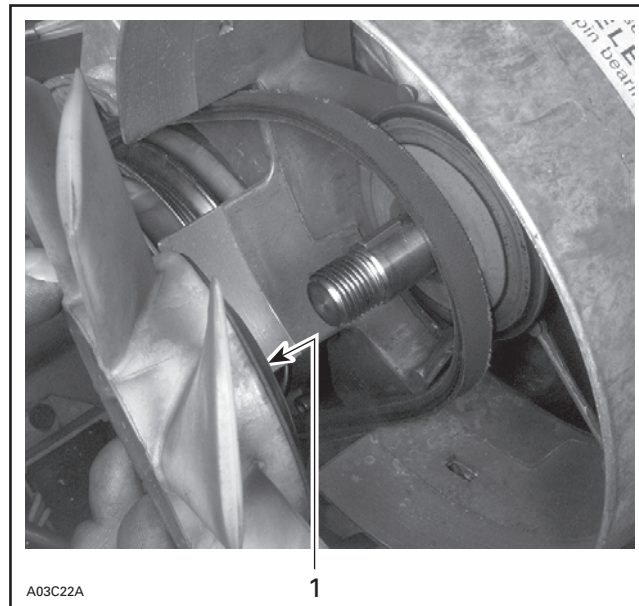
Always reinstall fan protector after servicing.

## FAN BELT REPLACEMENT AND DEFLECTION ADJUSTMENT

Remove muffler, rewind starter and on so equipped models connecting flange. Following procedure described above.

Using fan holder tool (P/N 420 876 357), remove fan nut.

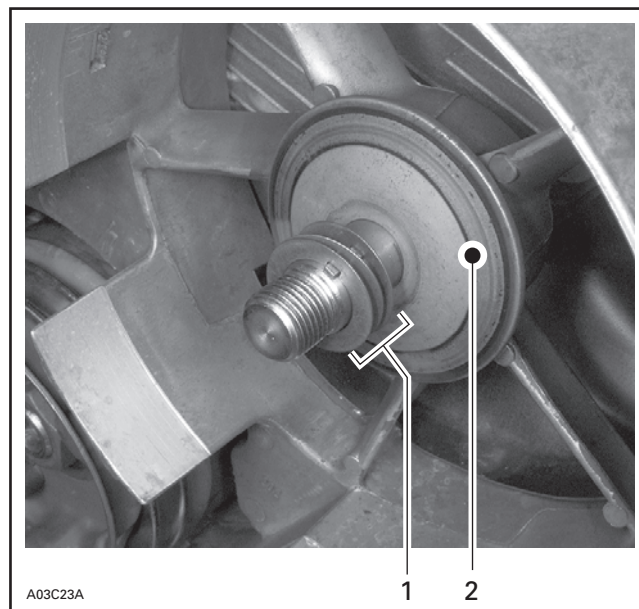
Remove fan with pulley half.



1. Remove fan with pulley half

Remove fan belt.

Leave shims and second half pulley in place. Refer to the following photo.



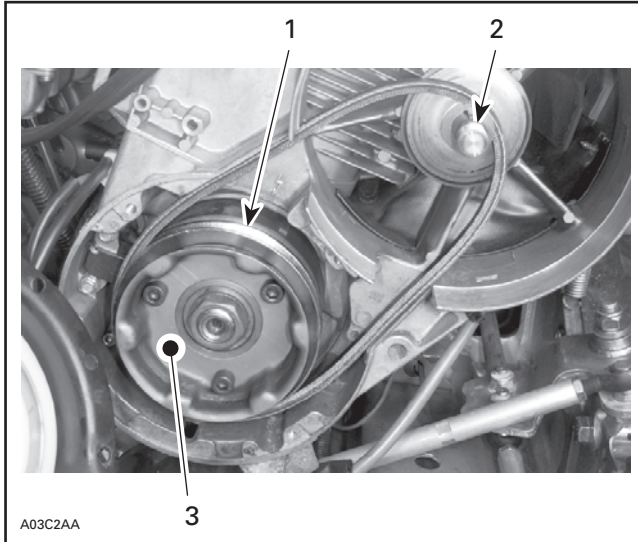
1. Keep shims  
2. Leave second half pulley in place

## Section 04 ENGINE

### Subsection 08 (AXIAL FAN COOLING SYSTEM)

#### Reassembly

Install fan belt on bottom pulley first then position onto fan shaft, as shown in the next photo.



**FAN BELT PROPERLY INSTALLED ON BOTTOM PULLEY AND FAN SHAFT**

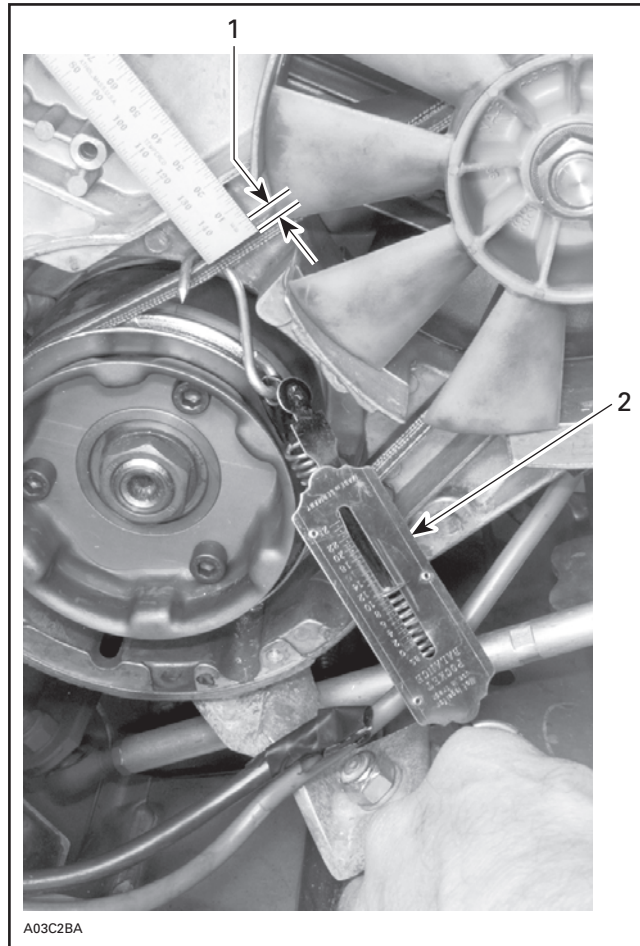
1. Bottom pulley
2. Fan shaft
3. Starting pulley

Reinstall fan assembly on fan shaft. Temporarily tighten fan nut.

**CAUTION:** When reinstalling fan assembly, ensure that key is properly positioned into fan shaft keyway.

#### Fan Belt Deflection Adjustment

Check fan belt deflection using a ruler and a fish scale positioned midway between pulleys as per following photo.



#### TYPICAL

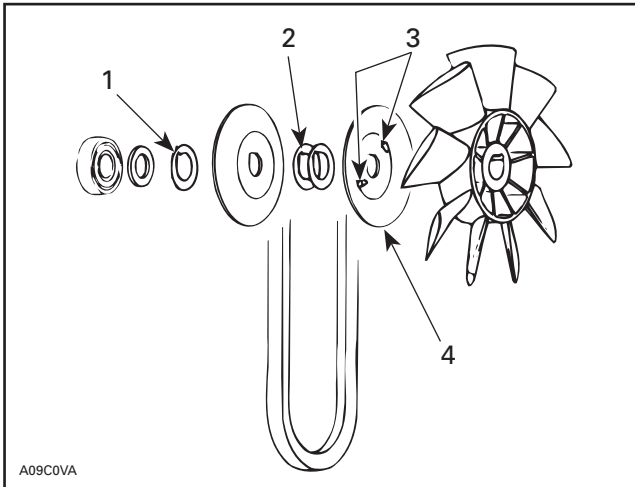
1. Measure deflection here
2. Fish scale

Belt deflection must be according to the following specifications:

ENGINE TYPE	BELT DEFLECTION	FORCE APPLIED
443 and 503	9.5 mm (3/8 in)	5 kg (11 lb)



To adjust deflection tension, add or remove shim(s) no. 15 between pulley halves nos. 14 and 16. Install excess shim(s) between distance sleeve no. 13 and pulley half no. 14 (housing side).



1. Unused shim(s) here
2. Adjust here
3. Positioning noses
4. Some engines only

Select pulley halves so that the one with 2 positioning noses will be on fan side. Ensure to insert these noses into fan notches.

Once fan belt is properly adjusted, torque fan nut to 48 N•m (35 lbf•ft) using holder wrench (P/N 420 876 357), as shown in the following photo.

**NOTE:** Apply Loctite 243 (blue) on fan nut threads.



**TORQUE FAN NUT USING HOLDER WRENCH**

**Finalizing Reassembly**

Reinstall rewind starter.

**CAUTION:** When installing rewind starter, ensure that oil pump shaft is properly positioned. Do not force shaft insertion. Turn fan until oil pump shaft slides in place, as shown in the following photo.



**TURN FAN TO SLIDE OIL PUMP SHAFT IN PLACE**

Secure rewind starter with original screws.

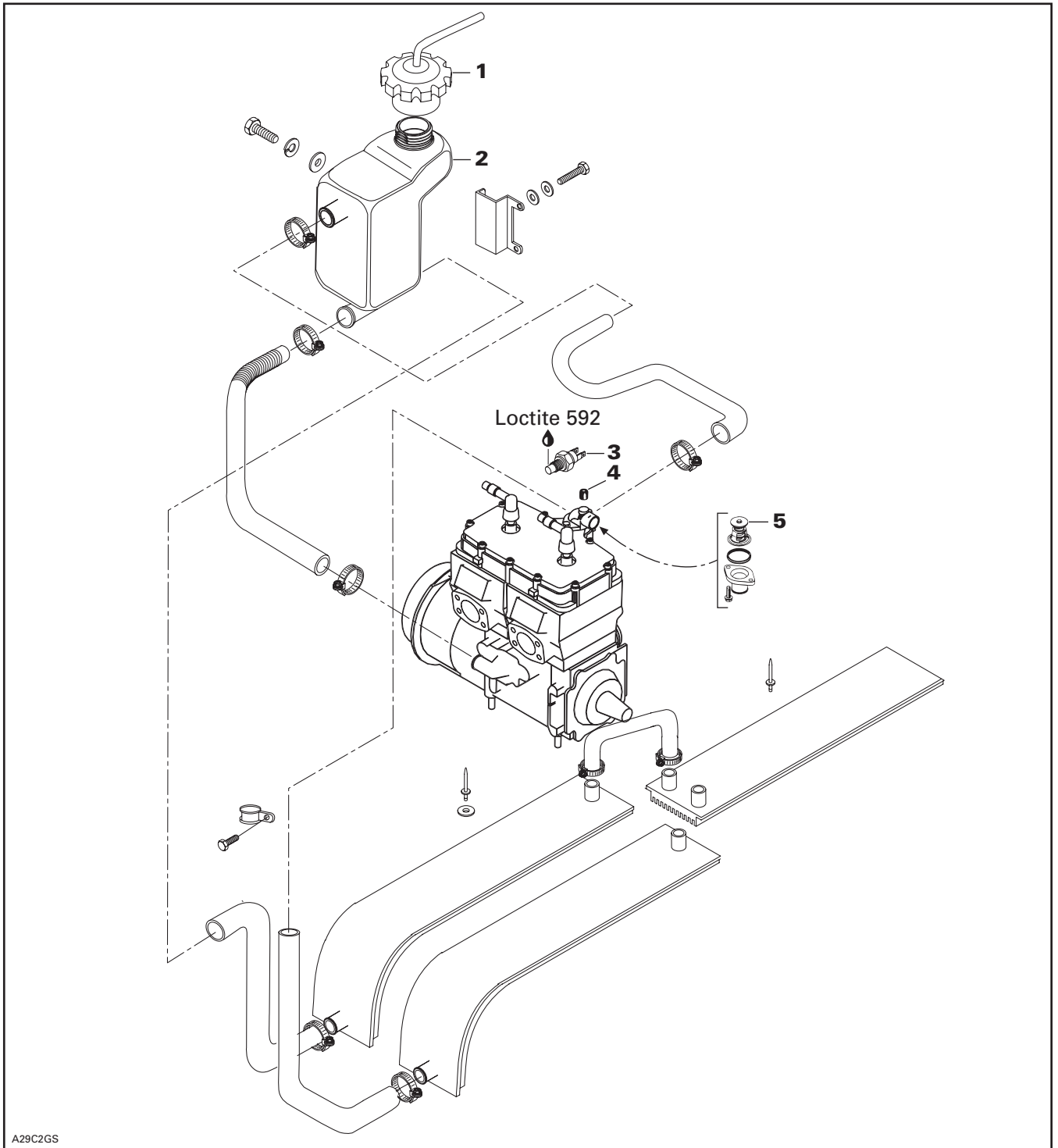
Reinstall fan protector no. 18 properly.

**⚠ WARNING**  
Always reinstall fan protector after servicing.

Reinstall muffler.

# LIQUID COOLING SYSTEM

593 Engine



TYPICAL



## Section 04 ENGINE

### Subsection 09 (LIQUID COOLING SYSTEM)

## INSPECTION

Check general condition of hoses and clamp tightness.

## DRAINING THE SYSTEM

### **⚠ WARNING**

Never drain or refill the cooling system when engine is hot.

To drain the cooling system, siphon the coolant mixture from the coolant tank. Disconnect hose at water pump.

## DISASSEMBLY AND ASSEMBLY

### 3,4, Sender and Plug

Apply Loctite 592 (P/N 413 702 300) thread sealant on sender and plug to avoid leaks.

### 1, Pressure Cap

Check if the cap pressurizes the system. If not, install a new 90 kPa (13 PSI) cap (do not exceed this pressure).

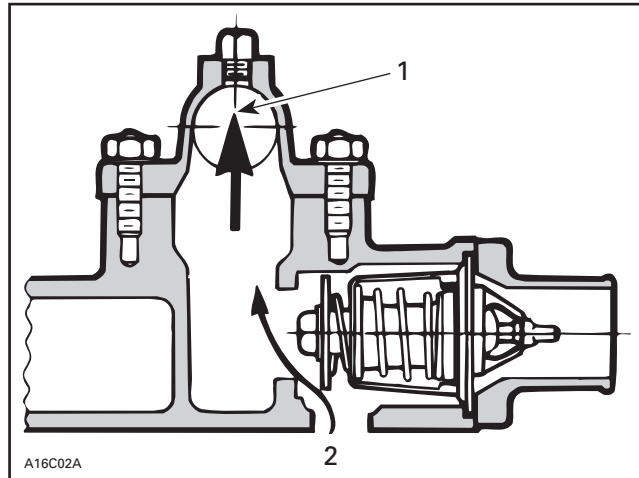
### 5, Thermostat

To check thermostat, put in water and heat water. Thermostat should start to open when water temperature reaches the following degree. It will be almost fully open at 50°C (122°F).

ENGINE	TEMPERATURE
593	42°C (108°F)

Thermostat is a double action type.

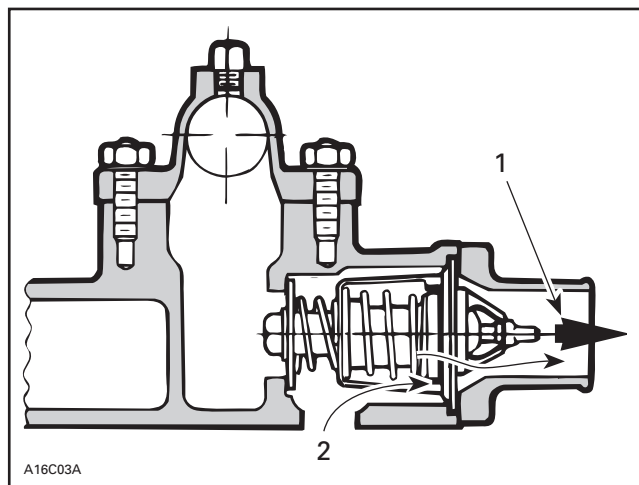
- Its function is to give faster warm up of the engine by controlling a circuit; water pump — engine — coolant tank. This is done by bypassing the radiator circuit.



TYPICAL — CLOSED THERMOSTAT, COLD ENGINE

- To reservoir
- From cylinders

- When the liquid is warmed enough, the thermostat opens progressively the circuit, water pump — engine — radiators — coolant tank to keep the liquid at the desired temperature. (See the diagram of the exploded view).



TYPICAL — OPEN THERMOSTAT, WARM ENGINE

- To radiators
- From cylinders

These 2 functions have the advantage of preventing a massive entry of cold water into the engine.

## COOLING SYSTEM REFILLING PROCEDURE

### Recommended Coolant

Use a blend of 50/50 distilled water and ethylene-glycol. That blend will protect the system from freezing as low as  $-37^{\circ}\text{C}$  ( $-35^{\circ}\text{F}$ ). Do not reinstall pressure cap.

**CAUTION:** To prevent rust formation or freezing condition, always replenish the system with recommended premixed coolant.

### System Capacity

Refer to TECHNICAL DATA.

### Refilling Procedure

Lift front of vehicle until the tunnel is horizontal. With engine cold, refill coolant tank **no. 2** up to cold level line. Wait a few minutes then refill to line. Start engine. Refill up to line while engine is idling until all air bubbles have escaped from system (about 4 to 5 minutes). Install pressure cap.

To make sure coolant flows through radiators, touch them by hand. They must feel warm.

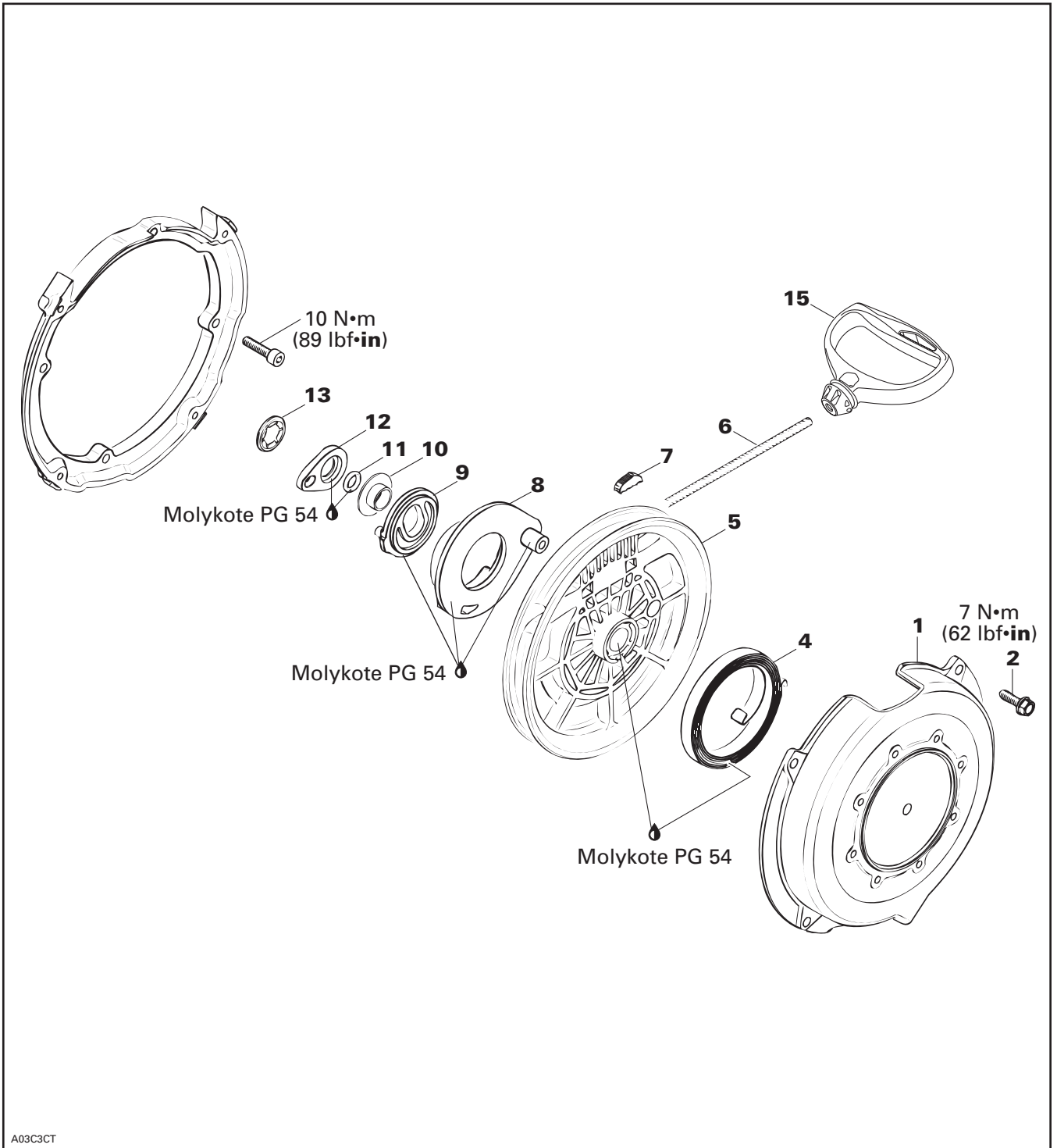
Put back front of vehicle on the ground.

When engine has completely cooled down, recheck coolant level in coolant tank and refill up to line.

Check coolant concentration (freezing point) with proper tester.

# REWIND STARTER

*Plastic Rewind Starter on All Models*



TYPICAL

## Section 04 ENGINE

### Subsection 10 (REWIND STARTER)

#### INSPECTION

**NOTE:** Due to dust accumulation, rewind starter must be periodically cleaned, inspected and lubricated.

**CAUTION:** It is of the utmost importance that the rewind starter spring be lubricated periodically using specific lubricant. Otherwise, rewind starter component life will be shortened and/or rewind starter will not operate properly under very cold temperatures.

Check if rope no. 6 is fraying, replace if so.

When pulling starter grip, mechanism must engage within 30 cm (1 ft) of rope pulled. If not, disassemble rewind starter, clean and check for damaged plastic parts. Replace as required, lubricate, reassemble and recheck. Always replace O-ring no. 11 every time rewind starter is disassembled.

When releasing starter grip, it must return to its stopper and stay against it. If not, check for proper spring preload or damages. Readjust or replace as required.

When pulling starter grip 10 times in a row, it must return freely. If not, check for damaged parts or lack of lubrication. Replace parts or lubricate accordingly.

#### REMOVAL

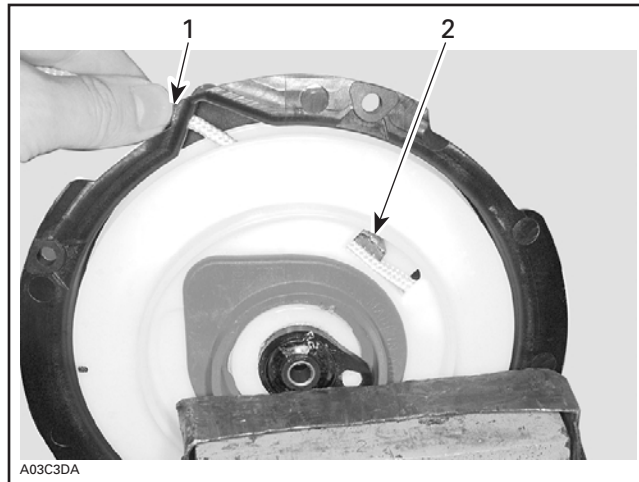
Using a small screwdriver, extract rope knot from starter grip no. 15. Cut rope close to knot. Tie a knot near starter.

Remove screws no. 2 securing rewind starter no. 1 to engine then remove rewind starter.

Remove pump from rewind starter cover.

#### ROPE REPLACEMENT

Completely pull out rope. Hold rewind starter in a vise.



1. Rope exit hole
2. Key to be removed

With a long thin pin punch inserted through rope exit hole, push key no. 7. Remove key and rope. Install a new rope and lock it using key no. 7.

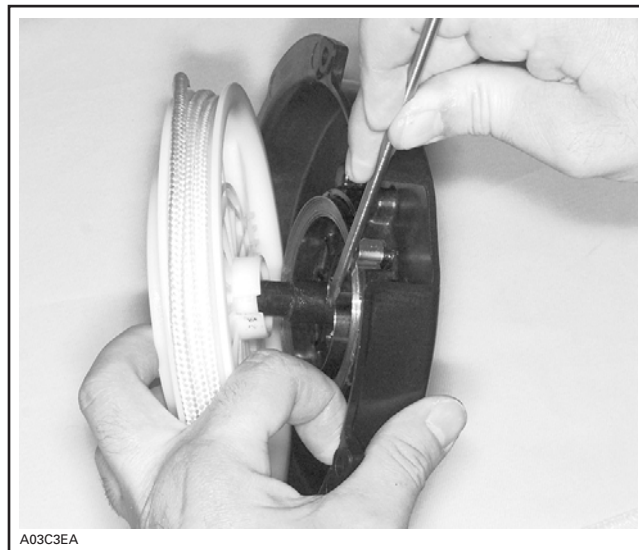
**NOTE:** When rope is completely pulled out, spring preload is 4-1/2 turns.

#### DISASSEMBLY

Undo knot previously tied at removal. Let sheave get free to release spring preload.

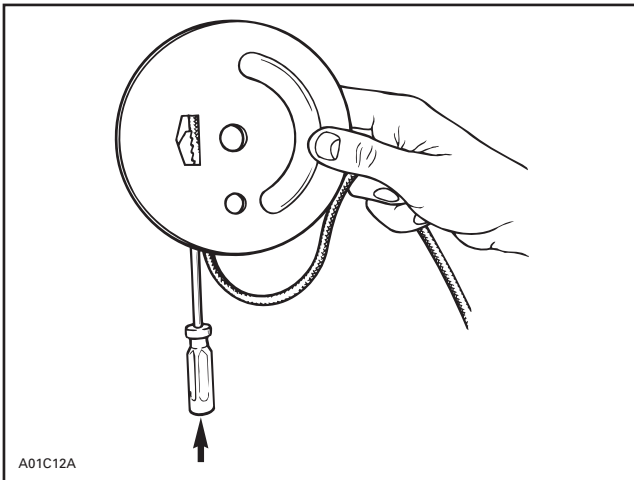
Cut push nut no. 13 and discard. Remove locking element no. 12, O-ring no. 11, step collar no. 10, pawl lock no. 9 and pawl no. 8.

Remove sheave no. 5 from starter housing no. 1. Hold spring with a screwdriver.



**Section 04 ENGINE**  
**Subsection 10 (REWIND STARTER)**

– Disengage key no. 7 and pull out rope no. 6.

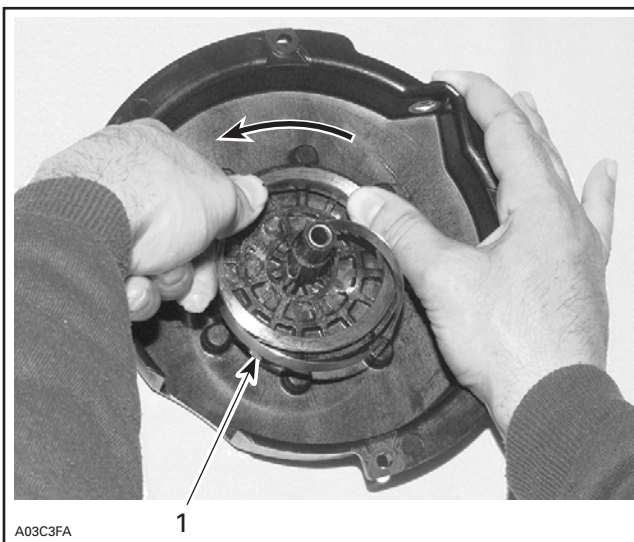


GENTLY TAP ON KEY

**ASSEMBLY**

At assembly, position spring no. 4 outer end into spring guide notch then wind the spring counter-clockwise into guide.

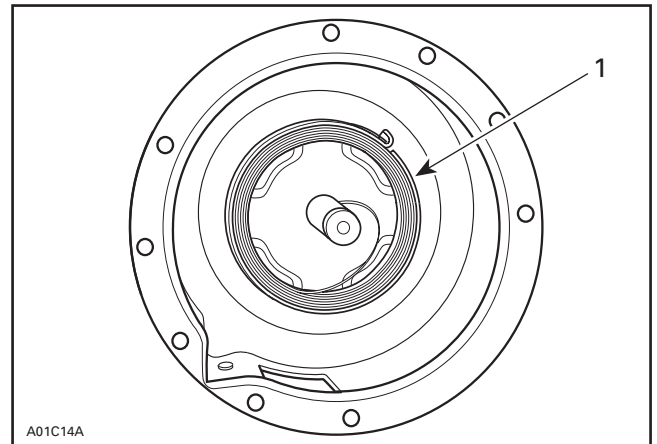
**⚠ WARNING**  
 Since the spring is tightly wound inside the guide it may fly out when rewind is handled. Always handle with care.



1. Outer end into guide notch

**CAUTION:** It is of the utmost importance that the rewind starter spring be lubricated periodically using specific lubricant. Otherwise, rewind starter component life will be shortened and/or rewind starter will not operate properly under very cold temperatures.

Lubricate spring assembly with Molykote PG 54 (P/N 420 899 763).

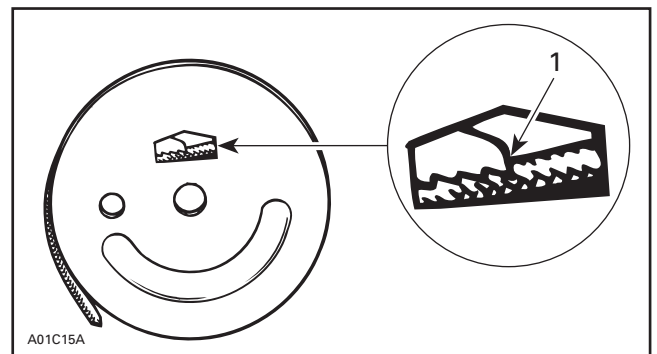


TYPICAL

1. Grease inside spring guide

**CAUTION:** The use of standard multi-purpose grease could result in rewind starter malfunction.

To install rope no. 6, insert rope into sheave no. 5 orifice and lock it with the key no. 7 as illustrated.



1. Push to lock

Lubricate housing post with silicone compound grease. Install sheave.



## Section 04 ENGINE

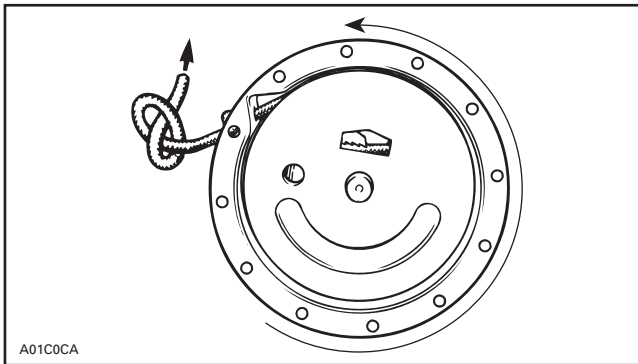
### Subsection 10 (REWIND STARTER)

To adjust rope tension:

Wind rope on sheave and place rope sheave into starter housing making sure that the sheave hub notch engages in the rewind spring hook.

Rotate the sheave counterclockwise until rope end is accessible through rope exit hole. This will give 1/2 turn of preload.

Pull the rope out of the starter housing and temporarily make a knot to hold it.



TYPICAL

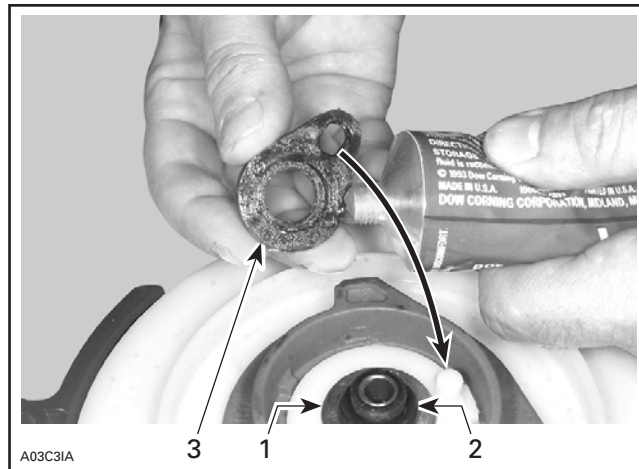
Lubricate pawl no. 8 with Molykote PG 54 (P/N 420 899 763) then install over rope sheave.



Lubricate pawl lock no. 9 with Molykote PG 54 (P/N 420 899 763). Install over pawl.



Install step collar no. 10 with its sleeve first. Lubricate a new O-ring no. 11 and locking element no. 9 with Molykote PG 54 (P/N 420 899 763). Install over pawl lock.



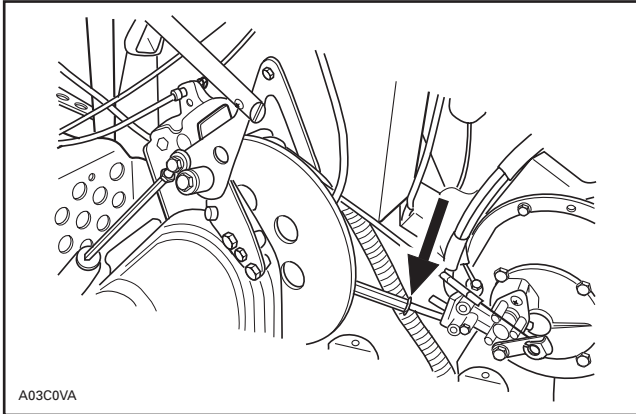
1. Step collar
2. O-ring
3. Locking element

Position a new push nut no. 13.

## INSTALLATION

Reinstall oil pump on rewind starter assembly.

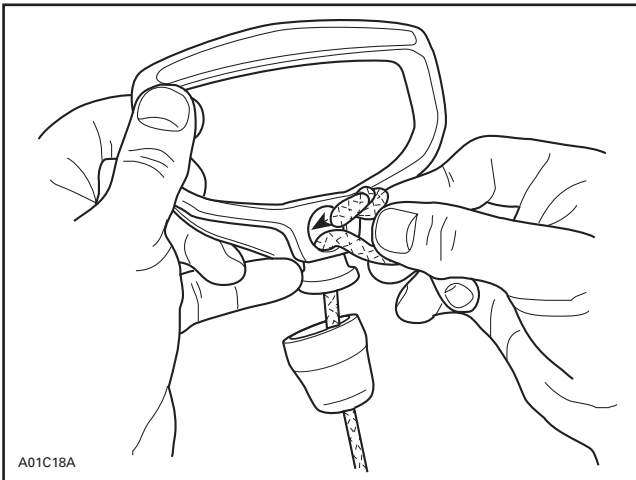
Thread starter rope **no. 6** through rope guide when applicable.



*TYPICAL*

Reinstall rewind starter assembly on engine.

Prior to installing starter grip **no. 15** on new rope, it is first necessary to fuse the rope end with a lit match. Pass rope through starter grip and tie a knot in the rope end. Fuse the knot with a lit match then insert rope end down and pull the starter grip over the knot.

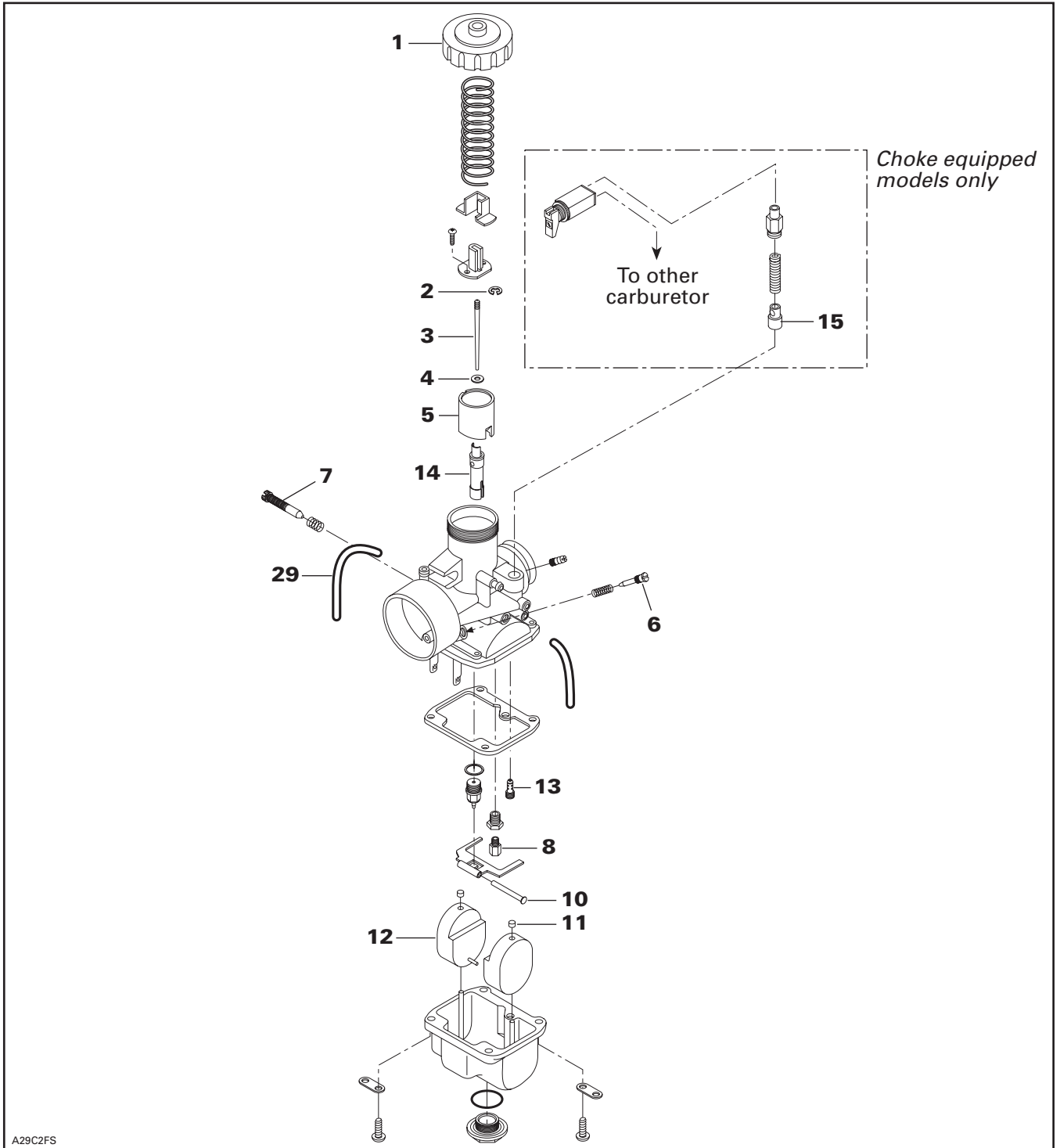


*TYPICAL*

# CARBURETOR AND FUEL PUMP

## CARBURETOR

All Models



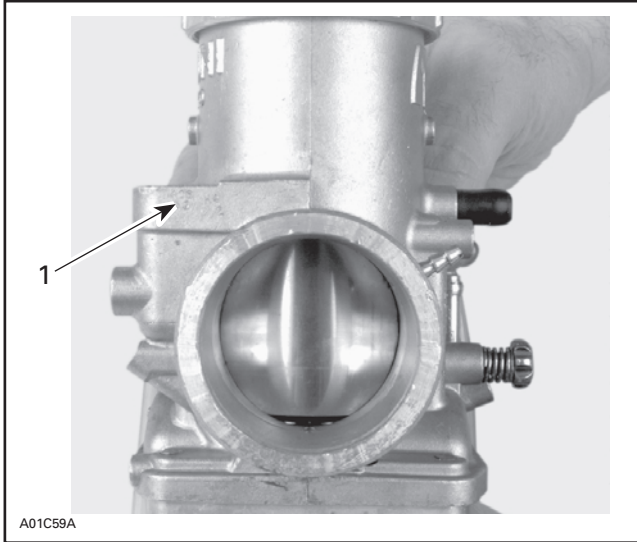
TYPICAL

## Section 04 ENGINE

### Subsection 11 (CARBURETOR AND FUEL PUMP)

## IDENTIFICATION

All carburetors are identified on their body.

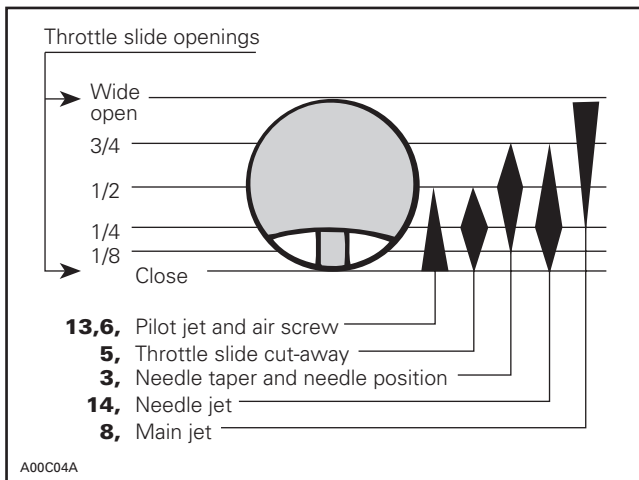


1. Identification: 34-482

## CARBURETOR CIRCUIT OPERATION VERSUS THROTTLE OPENING

The following illustration shows the part of the carburetor which begins and stops to function at different throttle slide openings.

Note that the wider part of symbol corresponds to the opening mostly affected. For instance, throttle slide cut-away begins to function at closed position but it is most effective at 1/4 opening and decreases up to 1/2 opening.



VIEW FROM AIR INTAKE OPENING

**NOTE:** For proper calibration refer to TECHNICAL DATA and to SPARK PLUG.

**NOTE:** For high altitude regions, a Service Bulletin will give information about calibration according to altitude and temperature.

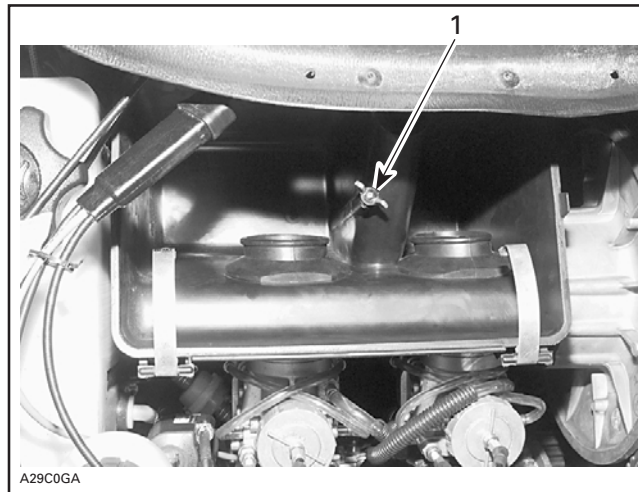
## REMOVAL

### *Tundra R and Skandic LT/WT/SWT*

Remove air silencer.

### *Skandic WT LC*

Remove air silencer cover. Unscrew through bolt then, remove air silencer.



1. Through bolt

### **All Models**

Disconnect fuel inlet line.

Disconnect primer line from carburetor on some models.

Disconnect choke cable on some models.

Unscrew carburetor cover no. 1 then pull out throttle slide no. 5 from carburetor.

### **WARNING**

Exercise care when handling throttle slide. Scratches incurred may cause throttle slide to stick open in operation.

Disconnect throttle cable from throttle slide.

Untighten rubber flange clamps then remove carburetor from engine.

## CLEANING AND INSPECTION

The entire carburetor should be cleaned with a general solvent and dried with compressed air before disassembly.

**CAUTION:** Heavy duty carburetor cleaner may be harmful to the float material and to the rubber parts, O-rings, etc. Therefore, it is recommended to remove those parts prior to cleaning.

Carburetor body and jets should be cleaned in a carburetor cleaner following manufacturer's instructions. Do not hesitate to replace any jets having gum or varnish on their surfaces.

**⚠ WARNING**

Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

Check inlet needle tip condition. If worn, the inlet needle and seat must be replaced as a matched set.

**NOTE:** Install needle valve for snowmobile carburetor only. It is designed to operate with a fuel pump system.

Check throttle slide **no. 5** for wear. Replace as necessary.

Check that idle speed screw **no. 7** is straight. Replace as necessary.

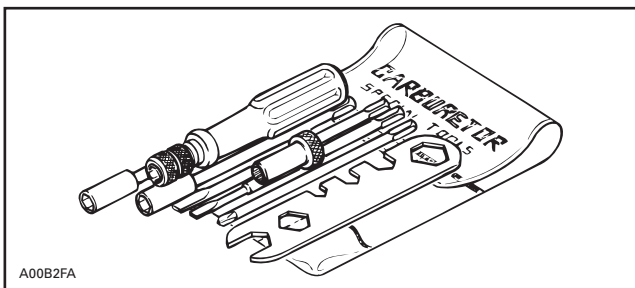
Check for fuel soaked into float **no. 12**; replace as necessary.

Check float **no. 12** for cracks or other damages affecting free movement; replace as necessary.

Inspect throttle cable and housing for any damages. Replace as necessary.

## DISASSEMBLY AND ASSEMBLY

**NOTE:** To ease the carburetor disassembly and assembly procedures it is recommended to use carburetor tool kit (P/N 404 112 000).

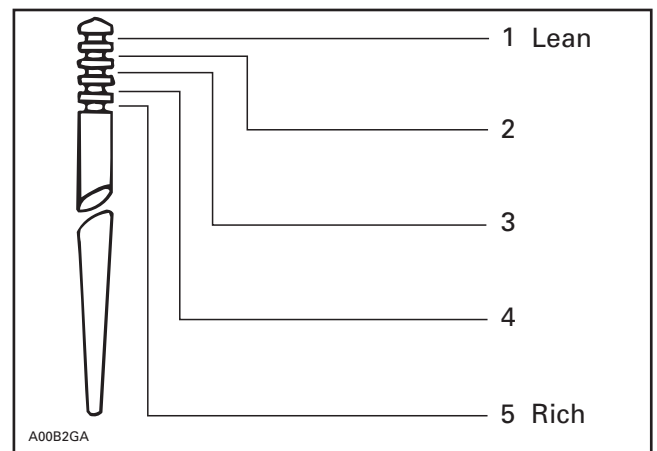
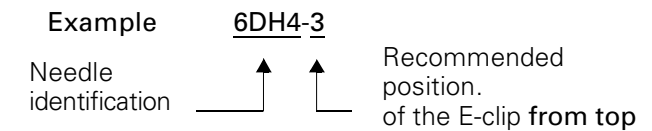


## 2,3, E-Clip and Needle

Remove screws from needle retaining plate to withdraw the needle.

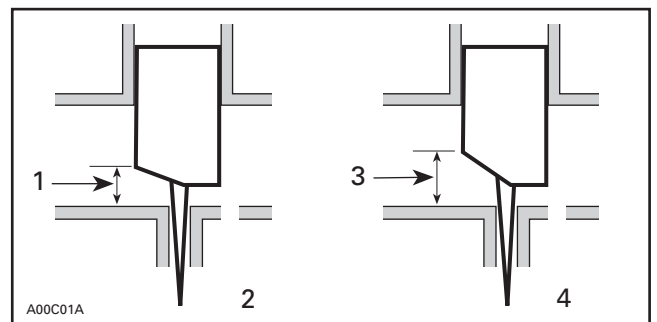
The position of the needle in the throttle slide is adjustable by means of an E-clip inserted into 1 of 5 grooves located on the upper part of the needle. Position 1 (at top) is the leanest, 5 (at bottom) the richest.

**NOTE:** The last digit of the needle identification number gives the recommended position of the E-clip from the top of the needle.



**CLIP POSITIONS**

The size of the throttle slide cut-away affects the fuel mixture between 1/8 to 1/2 throttle opening.



1. Low cut-away low
2. Rich mixture
3. High cut-away high
4. Lean mixture

## Section 04 ENGINE

### Subsection 11 (CARBURETOR AND FUEL PUMP)

#### 8, Main Jet

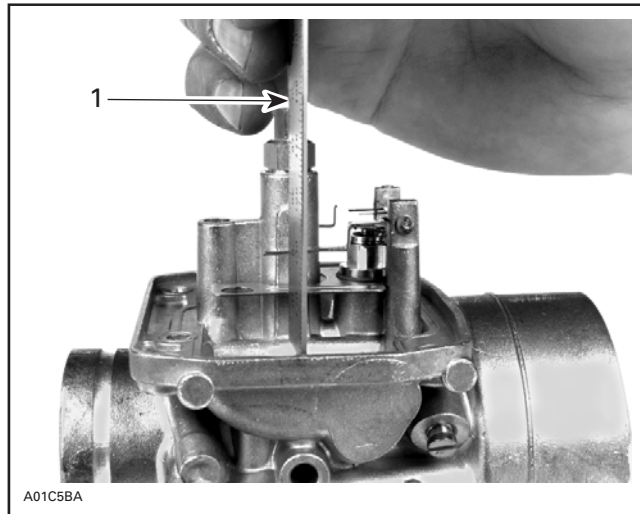
The main jet installed in the carburetor has been selected for a temperature of - 20°C (0°F) at sea level. Different jetting can be installed to suit temperature and/or altitude changes.

#### CARBURETOR FLOAT LEVEL ADJUSTMENT

##### 9,10, Float Arm and Float Arm Pin

Correct fuel level in float chamber is vital toward maximum engine efficiency. To check for correct float level proceed as follows:

- Make sure that float arm is symmetrical — not distorted.
- Remove float bowl and gasket from carburetor.
- With carburetor chamber upside-down on a level surface, measure height H between bowl seat and top edge of float arm. Keep ruler perfectly vertical and in line with main jet hole.

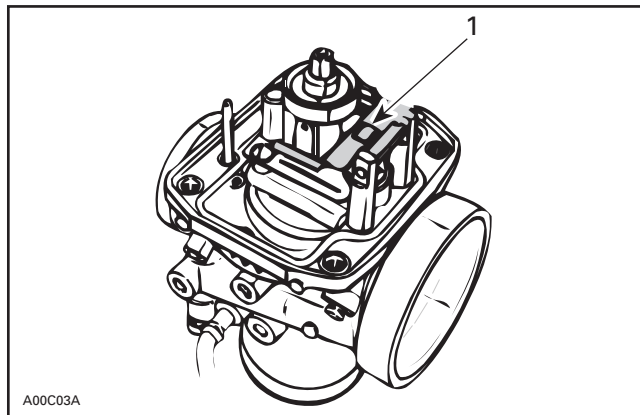


1. Ruler vertical and in line with main jet

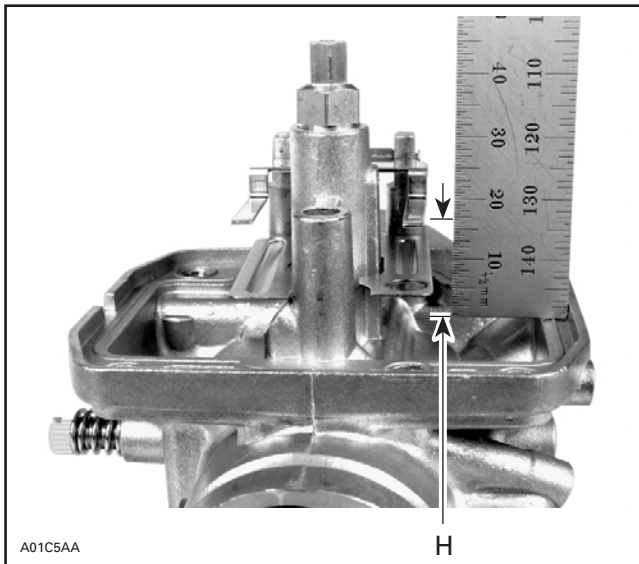
MODELS	FLOAT HEIGHT H ± 1 mm (± .040 in)
Tundra R Skandic LT/WT/SWT	23.9 (.941)
Skandic WT LC	18.1 (.713)

#### To Adjust Height H

- Bend the contact tab of float arm until the specified height is reached.



1. Contact tab



TYPICAL

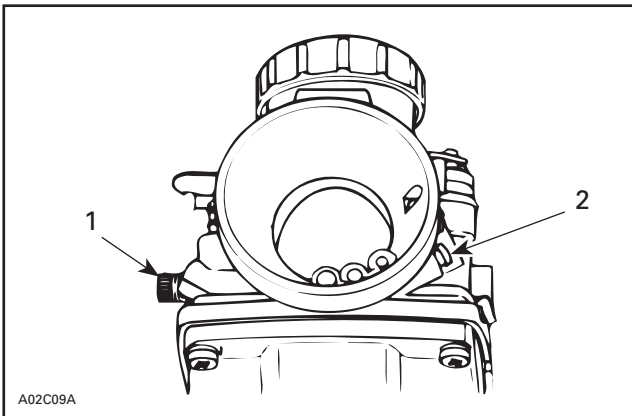
H: Float height



## CARBURETOR ADJUSTMENTS

Adjustments should be performed following this sequence:

- air screw adjustment
- throttle slide height (preliminary idle speed adjustment)
- throttle cable adjustment
- carburetor synchronization (dual carburetor models)
- final idle speed adjustment (engine running)
- oil pump and carburetor synchronization.



1. Idle speed screw
2. Air screw

### 6, Air Screw

Completely close the **air screw** (until a slight seating resistance is felt) then back off as specified.

Turning screw in clockwise enriches mixture and conversely, turning it out counterclockwise leans mixture.

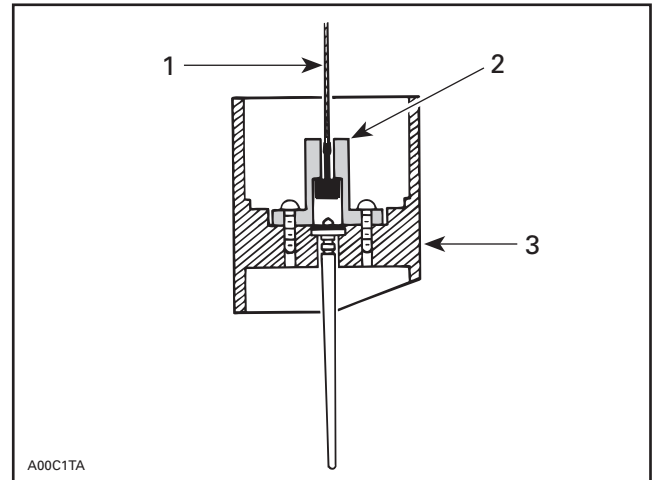
Refer to TECHNICAL DATA for the specifications.

### 7, Idle Speed Screw

#### Throttle Slide Opening (preliminary idle speed adjustment)

Hook throttle cable into the needle retainer plate.

**NOTE:** Do not obstruct hole in throttle slide when installing needle retaining plate. This is important to let air escape through and thus allow a quick response.

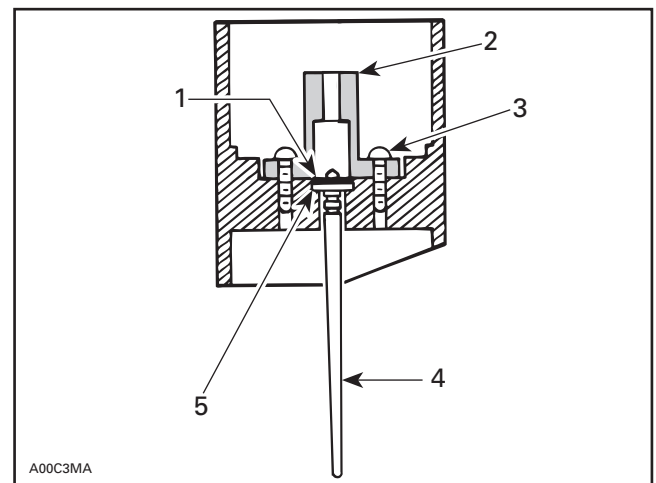


#### CENTER POST TYPE

1. Throttle cable
2. Needle retaining plate
3. Throttle slide

Make sure the nylon packing **no. 4** is installed on all applicable throttle slides.

**CAUTION:** Serious engine damage can occur if this notice is disregarded.



#### CENTER POST TYPE

1. E-clip
2. Needle retaining plate
3. Screw
4. Needle
5. Nylon packing

Adjust throttle slide height (see following table) by turning idle speed screw **no. 7**. Throttle slide height is measured on **outlet** side of carburetor (engine side).

**NOTE:** Make sure that throttle cable does not hold throttle slide. Loosen cable adjuster accordingly. Throttle cable adjustment will be done during adjustment of throttle-slide-to-cover free play.

## Section 04 ENGINE

### Subsection 11 (CARBURETOR AND FUEL PUMP)

Final idle speed adjustment (engine running at idle speed) should be within 1/2 turn of idle speed screw from preliminary adjustment.

MODELS	THROTTLE SLIDE HEIGHT ± 0.1 mm (± .004 in)
Tundra R Skandic WT/SWT/WT LC	1.5 (.059)
Skandic LT	1.3 (.051)

**CAUTION:** The rubber flange must be checked for cracks and/or damage. At assembly, the flange must be perfectly matched with the air intake manifold or severe engine damage will occur.

Install clamps in a way that their tightening bolts are staggered — not aligned.

### Throttle Cable Adjustment

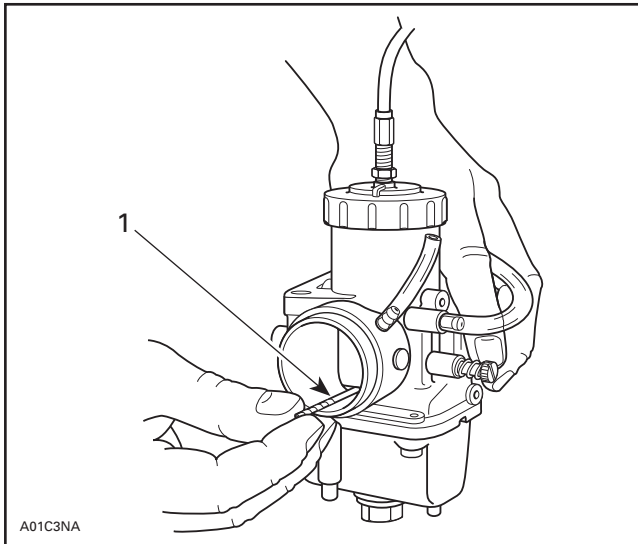
#### **⚠ WARNING**

Ensure the engine is turned OFF, prior to performing the throttle cable adjustment.

For maximum performance, correct cable adjustment is critical.

At full opening, throttle slide must be flush or 1.0 mm (.040 in) lower than the top of carburetor outlet bore (engine side).

First loosen adjuster nut then turn throttle cable adjuster accordingly.



TYPICAL

1. Drill bit used as gauge for throttle slide height

## INSTALLATION

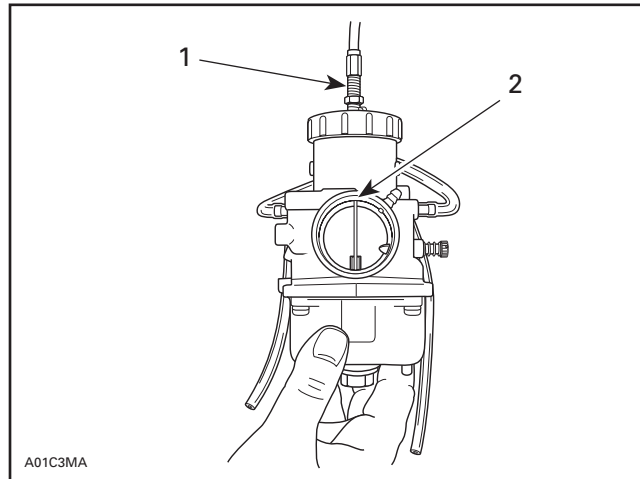
**CAUTION:** Never allow throttle slide(s) to snap shut.

Prior to installing carburetor, adjust air screw and preliminary idle speed as described above.

To install carburetor on engine, inverse removal procedure.

However, pay attention to the following:

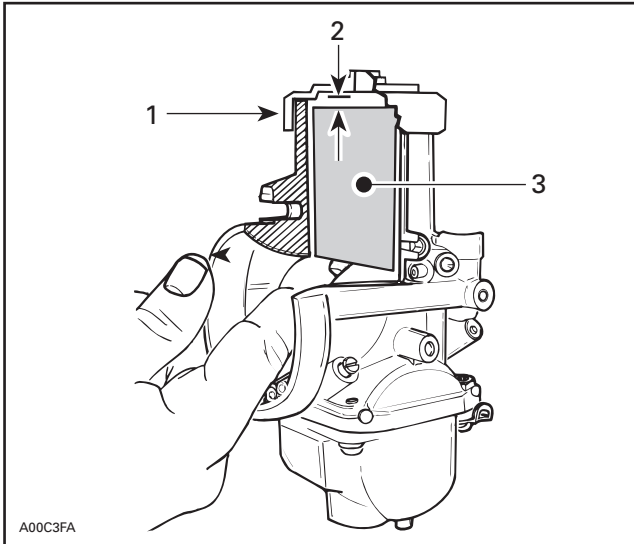
On applicable models, make sure to align tab of carburetor and air intake silencer (if applicable) with notch of adaptor(s). On applicable models, install adaptor with UP mark facing up.



FULL OPENING (THROTTLE LEVER AGAINST HANDLE GRIP)

1. Throttle cable adjuster
2. Throttle slide flush or 1.0 mm (.040 in) lower than carburetor outlet bore (engine side)

Check that with the throttle lever fully depressed, there is a free play between the carburetor cover and top of throttle slide.



FULL OPENING (THROTTLE LEVER AGAINST HANDLE GRIP)

1. Cover
2. Free play
3. Throttle slide

**CAUTION:** This gap is very important. If the throttle slide rests against the carburetor cover at full throttle opening, this will create too much strain and may damage the throttle cable or other components in throttle mechanism.

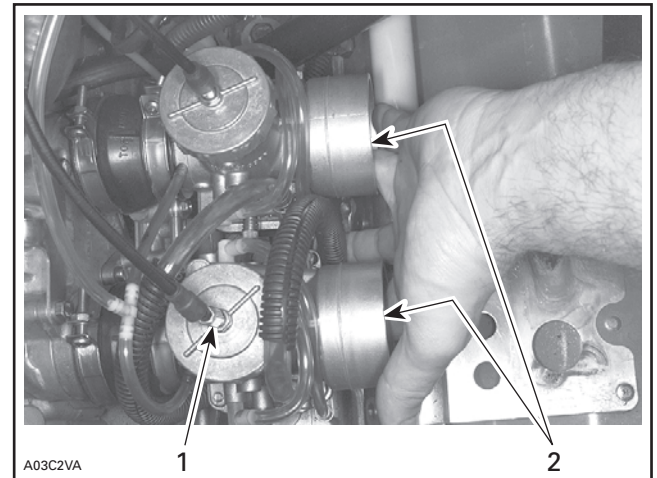
## Carburetor Synchronization

### **Dual Carburetor Models Only**

When depressing throttle lever, both carburetor slides must start to open at the same time.

Unlock cable adjustment lock nut on one carburetor.

Screw or unscrew cable adjuster until both carburetor slides start to open at same time. Cable play will be identical on both carburetors. Retighten jam nut.



TYPICAL

1. Screw or unscrew adjuster
2. Check that both slides start to open at the same time

Check throttle slide position at wide open throttle. Throttle slide must be flush or 1 mm (.040 in) lower than carburetor outlet bore. At that same position, check that throttle slide does not contact carburetor cover. Turn cable adjuster and recheck synchronization.

**CAUTION:** If the throttle slide rests against the carburetor cover at full throttle opening, this will create too much strain and may damage the throttle cable or other components in throttle mechanism.

**CAUTION:** On dual carburetor models, make sure both carburetors start to operate simultaneously. Do not interchange carburetors as the jetting may be different on each side. A red dot is printed on one carburetor and on the engine. Match the carburetor and the engine dots when applicable.

**CAUTION:** The oil injection pump adjustment must be checked each time carburetor is adjusted. Refer to OIL INJECTION SYSTEM.

## Section 04 ENGINE

### Subsection 11 (CARBURETOR AND FUEL PUMP)

## IDLE SPEED FINAL ADJUSTMENT

### 7, Idle Speed Screw

**CAUTION:** Before starting engine for the final idle adjustment, make sure that oil pump is adjusted. The oil injection pump adjustment must be checked each time carburetor is adjusted. Refer to OIL INJECTION SYSTEM.

Start engine and allow it to warm then adjust idle speed to specifications by turning **idle speed screw** clockwise to increase engine speed or counterclockwise to decrease it.

**NOTE:** On twin-carburetor models, turn adjustment screw the same amount to keep carburetors synchronized.

Refer to TECHNICAL DATA for the specifications.

**CAUTION:** Do not attempt to set the idle speed by using the air screw. Severe engine damage can occur.

## CHOKE

### *Skandic LT/WT/SWT/WT LC*

#### Choke Plunger Adjustment

Set choke lever to fully open position.



CHOKE LEVER — FULLY OPEN POSITION

### *Skandic LT/WT/SWT*

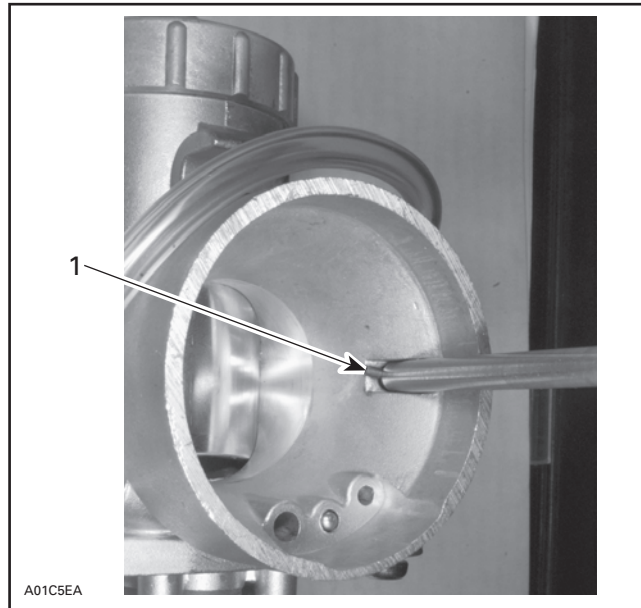
Use small diameter (for VM 30, VM 32 and VM 34 carburetors) of choke plunger tool (P/N 529 032 100).

### *Skandic WT LC*

Use big diameter (for VM 38) of choke plunger tool (P/N 529 032 100).

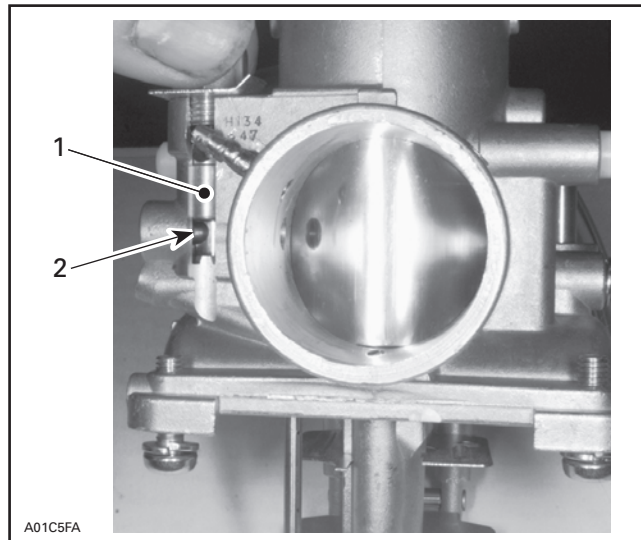
### *All Models*

Insert proper diameter of choke plunger tool into choke air inlet of each carburetor. Tool stopper may not lean against recess wall. Though it must be within 1 mm (.040 in) of recess wall.



AIR SILENCER SIDE SHOWN

1. Tool stopper within 1 mm (.040 in) of recess wall



CUT-AWAY (ENGINE SIDE SHOWN)

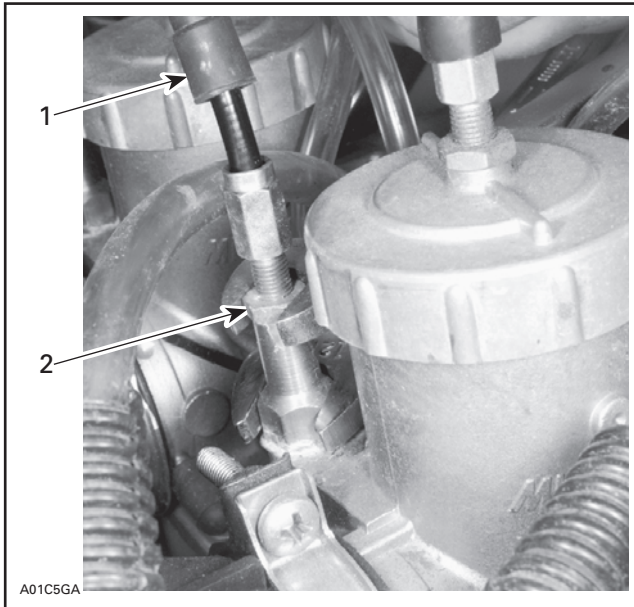
1. Choke plunger  
2. Tool properly seated under choke plunger



If tool tip does not seat under choke plunger no. 15, adjust as follows:

Make sure choke lever is at fully open position.

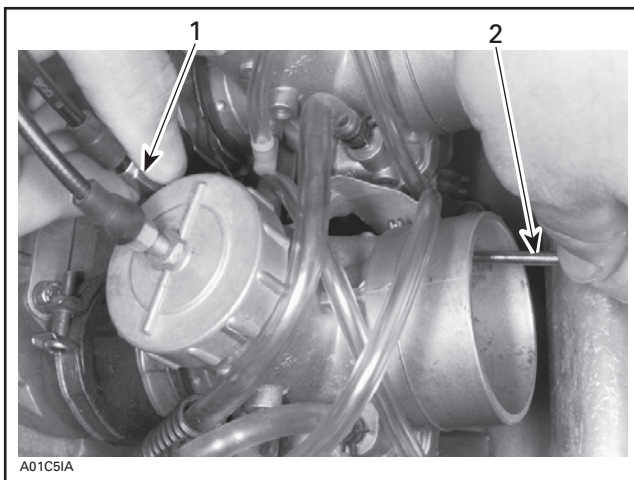
Lift up protector cap and loosen choke cable lock nut, as shown in the next photo.



1. Lift up protector cap
2. Loosen lock nut

Turn choke cable adjustment nut by hand until tool properly seats under choke plunger.

**NOTE:** A light pressure should be needed to position tool under plunger.



1. Choke cable adjustment nut
2. Choke plunger tool

Tighten choke cable lock nut and reinstall protector cap.

Set choke lever to close and open positions and ensure that tool properly seats under plunger **only** when lever is set to fully open position.

Set choke lever to close position and, by pulling and pushing choke lever, make sure there is no tension on cable (free play).

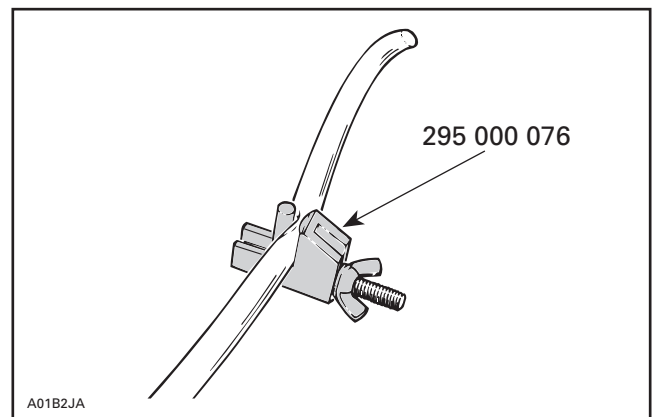


**CHOKE LEVER — CLOSED POSITION**

## FUEL PUMP

### REMOVAL

Install a hose pincer (P/N 295 000 076) on fuel supply line close to pump inlet.



Disconnect fuel outlet line(s).

Disconnect impulse line.

Remove screws securing fuel pump.

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## Section 04 ENGINE

### Subsection 11 (CARBURETOR AND FUEL PUMP)

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#### PUMP VERIFICATION

Check fuel pump valves operation as follows:

Connect a clean plastic tubing to the inlet nipple and alternately apply pressure and vacuum with pump of leak test kit. The inlet valve should release with pressure and hold under vacuum.

Repeat the same procedure at the outlet nipple. This time the outlet valve should hold with pressure and release under vacuum.

**NOTE:** On model fitted with 2 outlets, plug 1 outlet with finger while checking outlet valve.

To check impulse diaphragm and gasket on high-supply fuel pump equipped with twin outlets, proceed as follows:

Connect a clean plastic tubing to the impulse nipple and plug vent hole on top cover. Either apply pressure or vacuum. The diaphragm/gasket must not leak.

#### CLEANING AND INSPECTION

The entire pump should be cleaned with general purpose solvent before disassembly.

Fuel pump components should be cleaned in general purpose solvent and dried with compressed air.

#### WARNING

Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as each is flammable and explosive.

Inspect diaphragm. The pumping area should be free of holes, tears or imperfections. Replace as needed.

**High-supply pump with twin outlets:** Thoroughly clean filter on top cover. Replace pump if too dirty.

#### INSTALLATION

To install, inverse removal procedure.

#### WARNING

Pressure test to ensure there is no leak in fuel system.

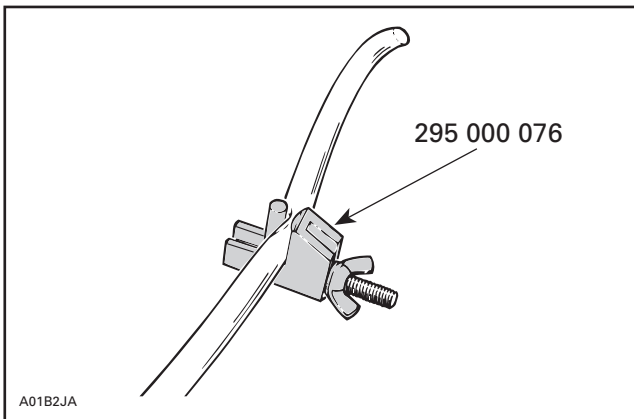


# FUEL TANK AND THROTTLE CABLE

## Fuel Tank Lines

### **⚠ WARNING**

When draining a fuel tank or whenever a fuel line is disconnected, obstruct line with a hose pincher (P/N 295 000 076) or equivalent device. Fuel is flammable and explosive under certain conditions. Ensure work area is well ventilated. Do not smoke or allow open flames or sparks in the vicinity.



## Impulse/Fuel Lines Spring Clips

### **All Models**

Always reposition spring clips after any repair to prevent possible leaks.

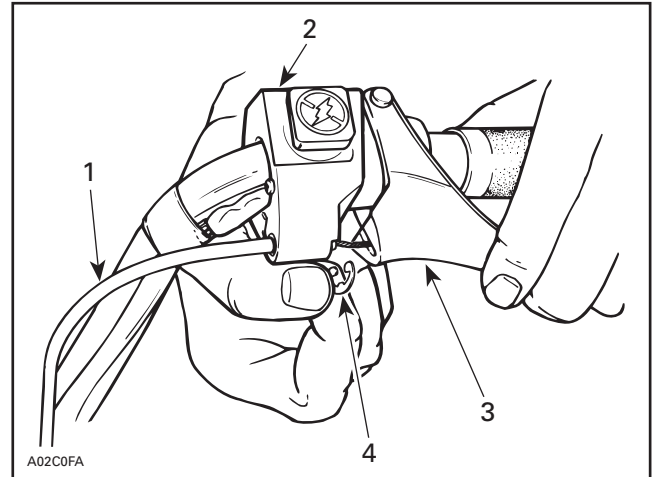
## Throttle Cable Circlip at Handlebar

### **All Models**

Put silicone grease (P/N 413 701 700) around cable barrel. Locate circlip as per illustration.

### **⚠ WARNING**

If this procedure is disregarded, throttle lever might be half-open at normally closed position and the engine will speed up when starting.



### **TYPICAL**

1. Throttle cable housing
2. Throttle lever housing
3. Throttle lever
4. Circlip

Adjust throttle cable as specified in CARBURETOR AND FUEL PUMP.

## Throttle Cable Routing

**CAUTION:** Check that throttle cable is routed away from sharp edges, hot or vibrating parts. When turning handlebar while engine is running, idle speed must not vary.