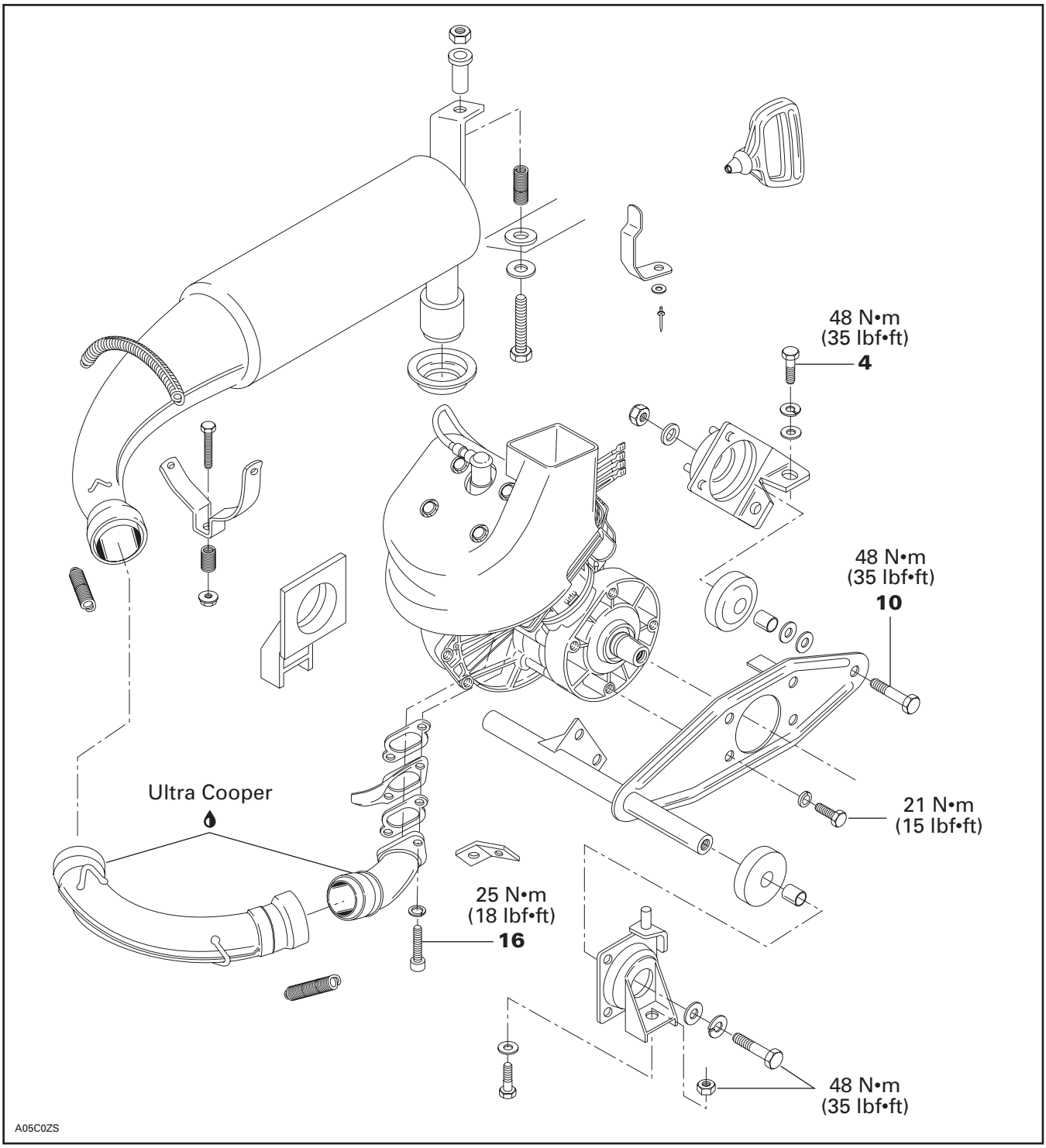
TABLE OF CONTENTS

277 ENGINE TYPE

ENGINE REMOVAL AND INSTALLATION



PARTS

REMOVAL FROM VEHICLE

Remove or disconnect the following then lift engine from vehicle:

- belt 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 engine support screws **nos. 4** and **10** to 48 N•m (35 lbf•ft).

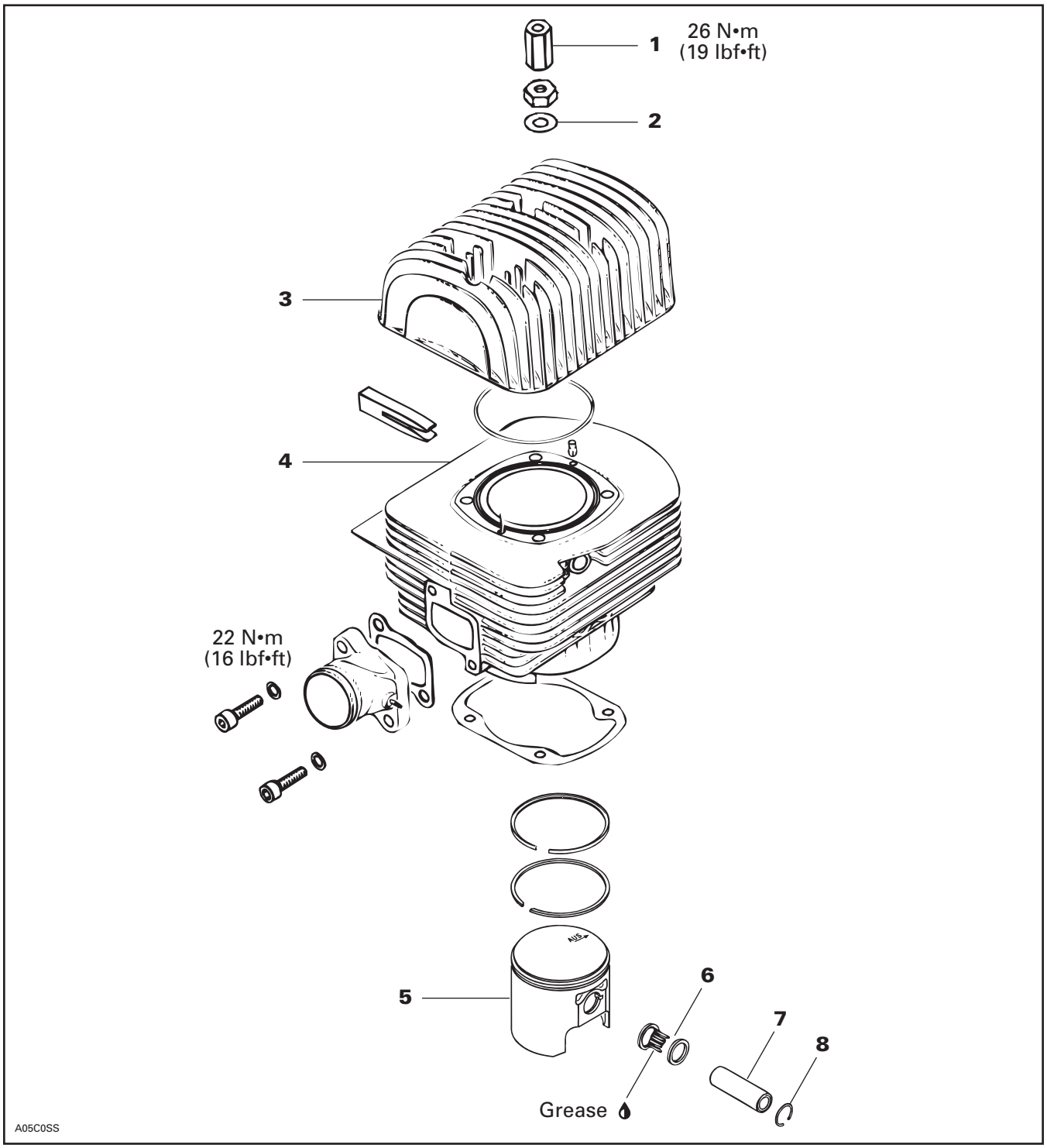
Torque the engine mount screws to 21 N•m (15 lbf•ft).

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.
- Should a light exhaust leak is experienced at muffler ball joint, Ultra Cooper (P/N 413 710 300) can be used.

TOP END



TROUBLESHOOTING

Before completely disassemble engine, check airtightness. Refer to LEAK TEST AND ENGINE DIMENSION MEASUREMENT 04-04.

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.

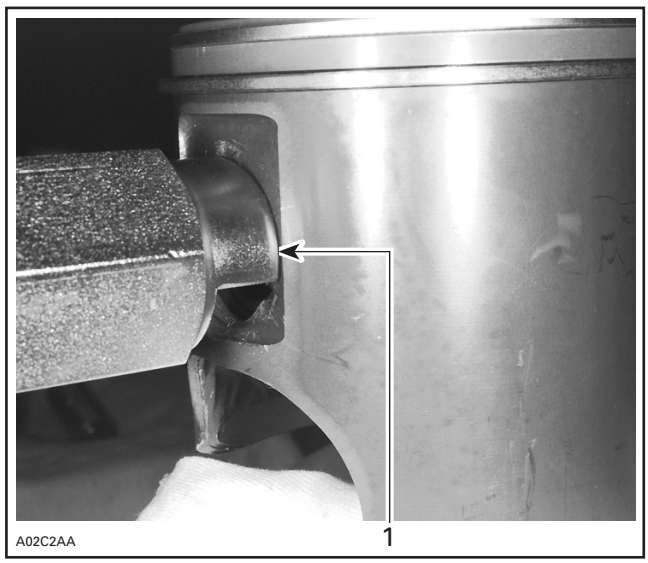
Use piston pin puller (P/N 529 035 503) along with 18 mm sleeve kit (P/N 529 035 541) and locating sleeve (P/N 529 023 800).

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

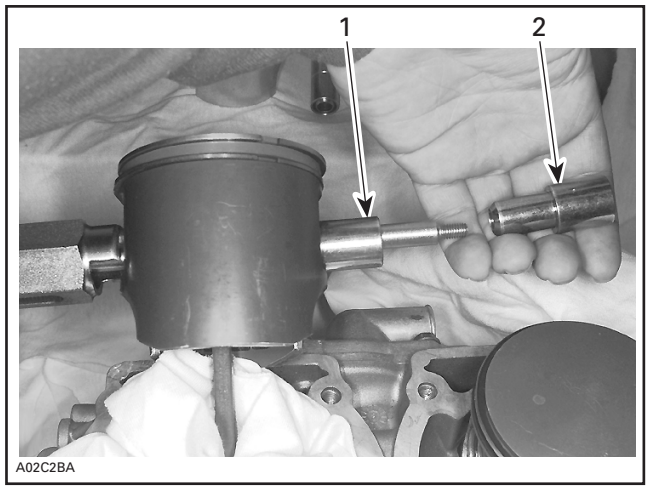
Insert piston pin puller (P/N 529 035 503) making sure it sits squarely against piston.



TYPICAL

1. Properly seated all around

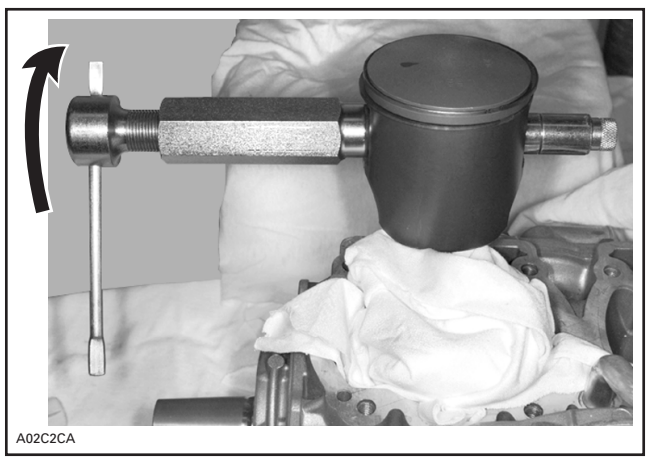
Install sleeve then shouldered sleeve over puller rod.



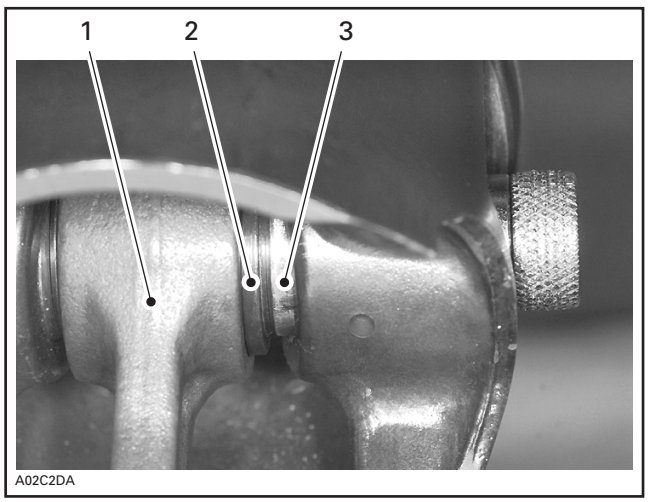
TYPICAL — INSTALLATION OF SLEEVE KIT

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.



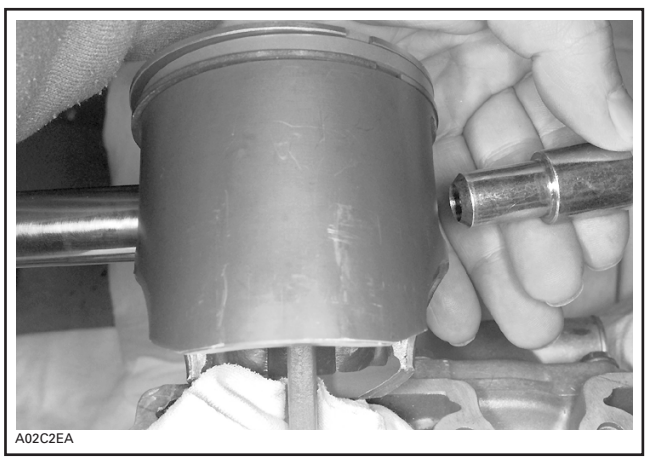
TYPICAL — PISTON PIN EXTRACTION



TYPICAL

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

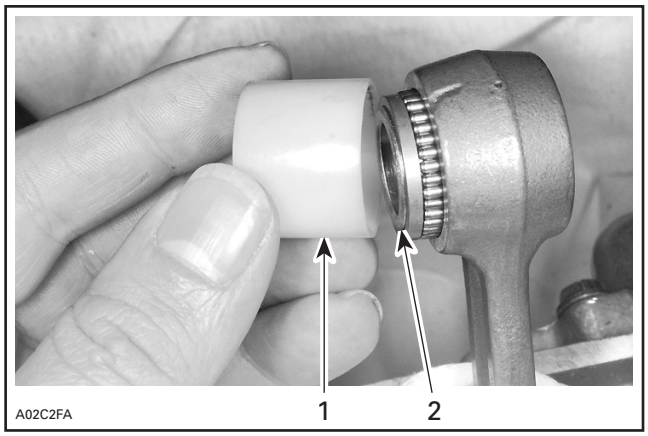
Remove puller. Pull out shouldered sleeve carefully.



TYPICAL

Remove piston from connecting rod.

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.

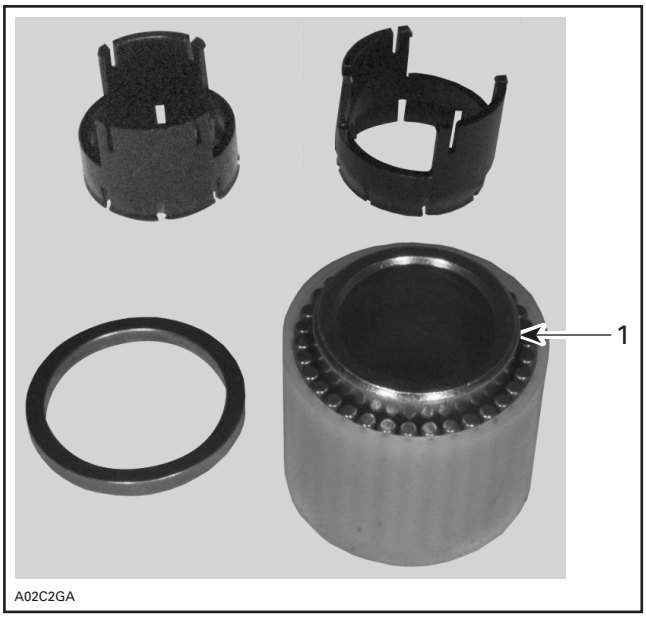
INSPECTION

Refer to LEAK TEST AND ENGINE DIMENSIONS MEASUREMENT 04-04.

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

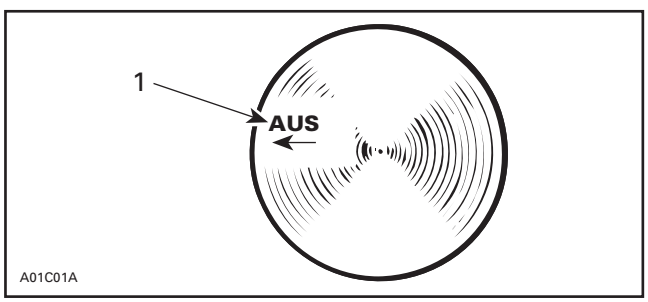
1. *Sleeve*

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.

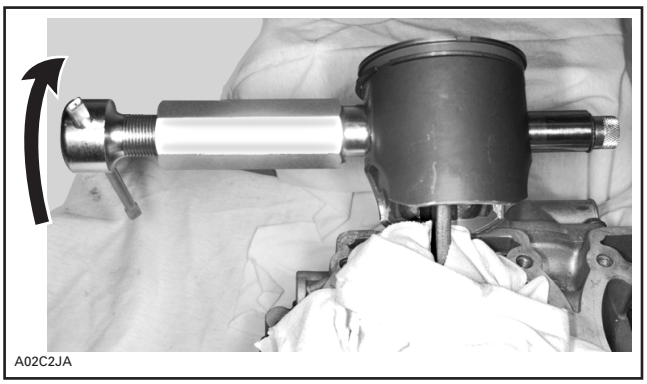


1. *Exhaust*

Install shouldered sleeve.

TYPICAL — SHOULDERED SLEEVE INSTALLATION

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

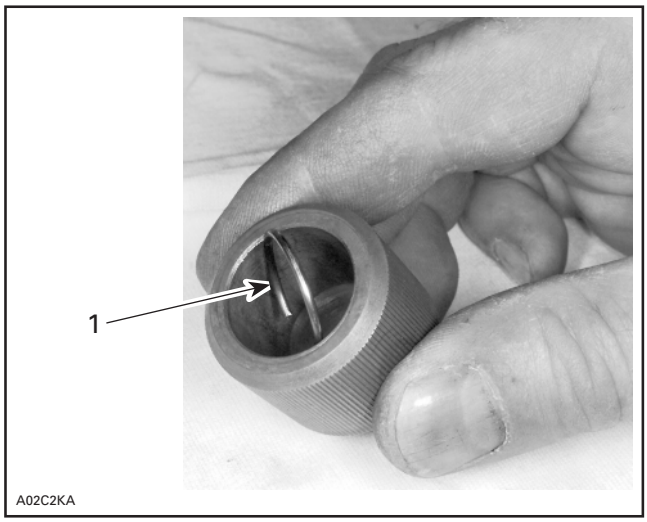


TYPICAL

Remove piston pin puller and sleeve kit.

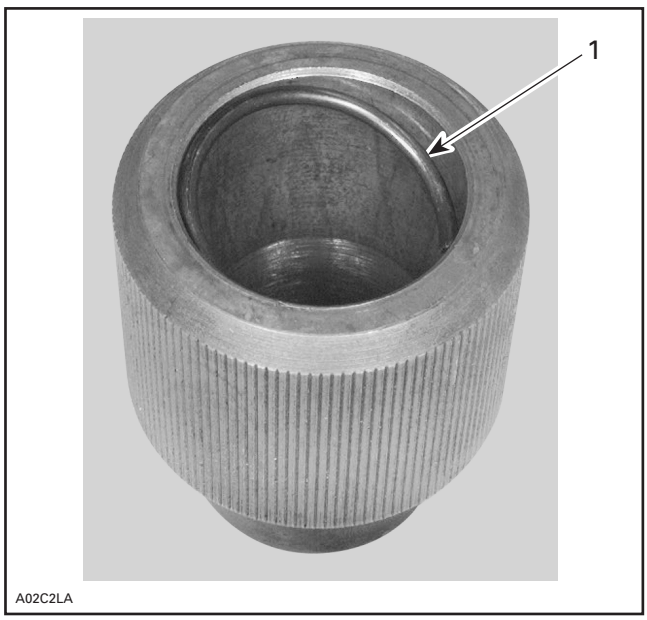
To minimize the effect of acceleration forces on circlip, install each circlip so the circlip break is at 6 o'clock as illustrated. Use piston circlip installer (P/N 529 035 561).

Insert circlip in tool at an angle.



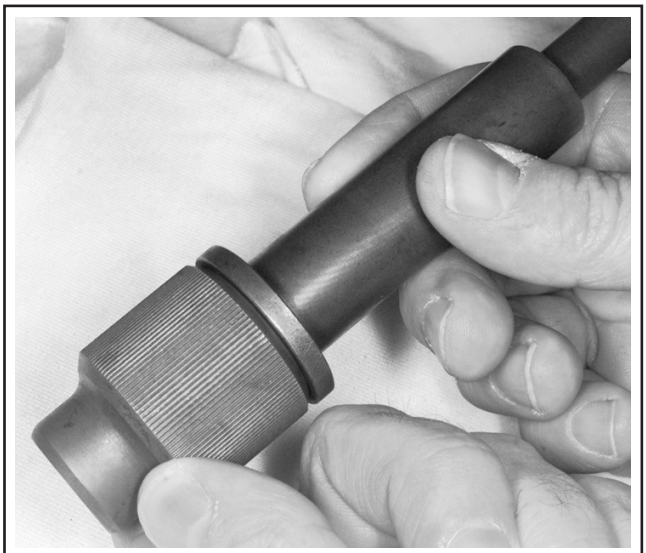
1. Circlip

Square it up using a finger.

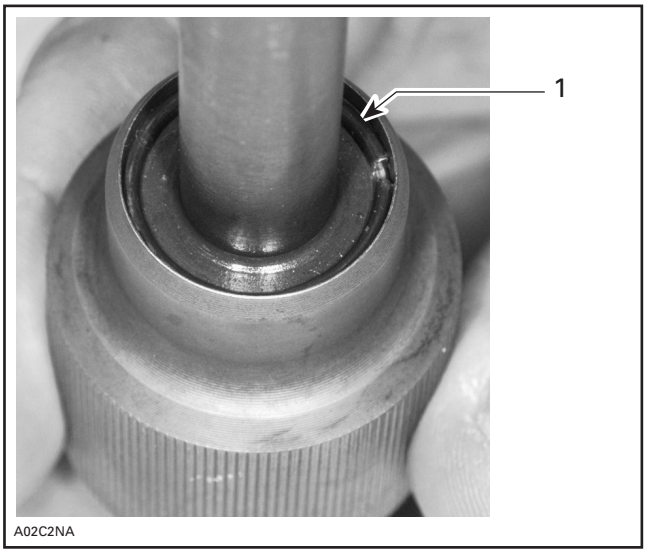


1. Circlip

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


A02C2MA

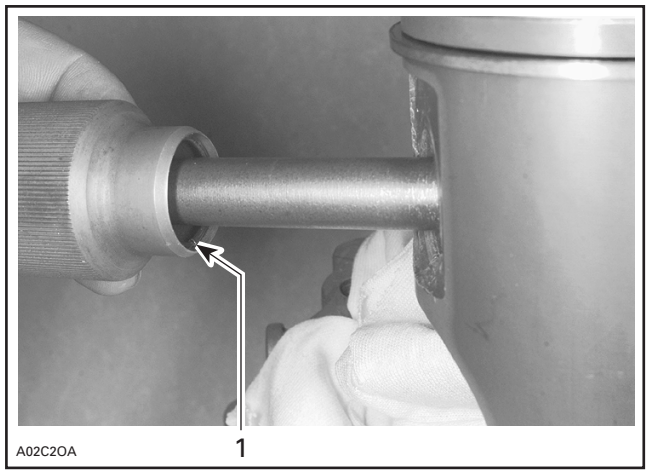
Using square end of tool, push circlip in until it rests in groove.



A02C2NA

1. Circlip in groove

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



A02C2OA

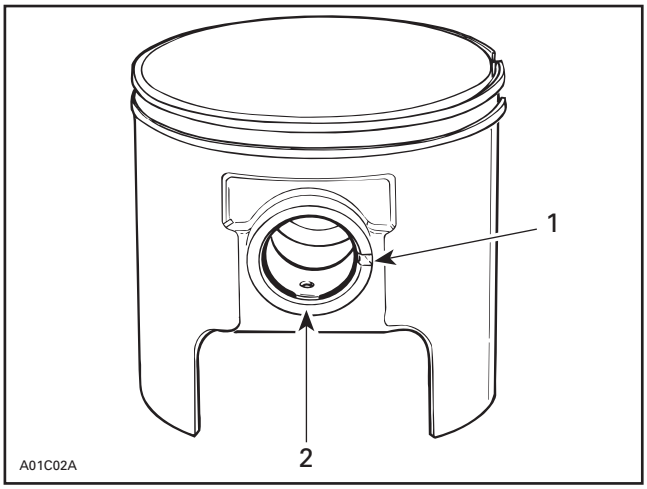
TYPICAL

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.


A02C2PA

TYPICAL



1. Piston notch
2. Circlip break

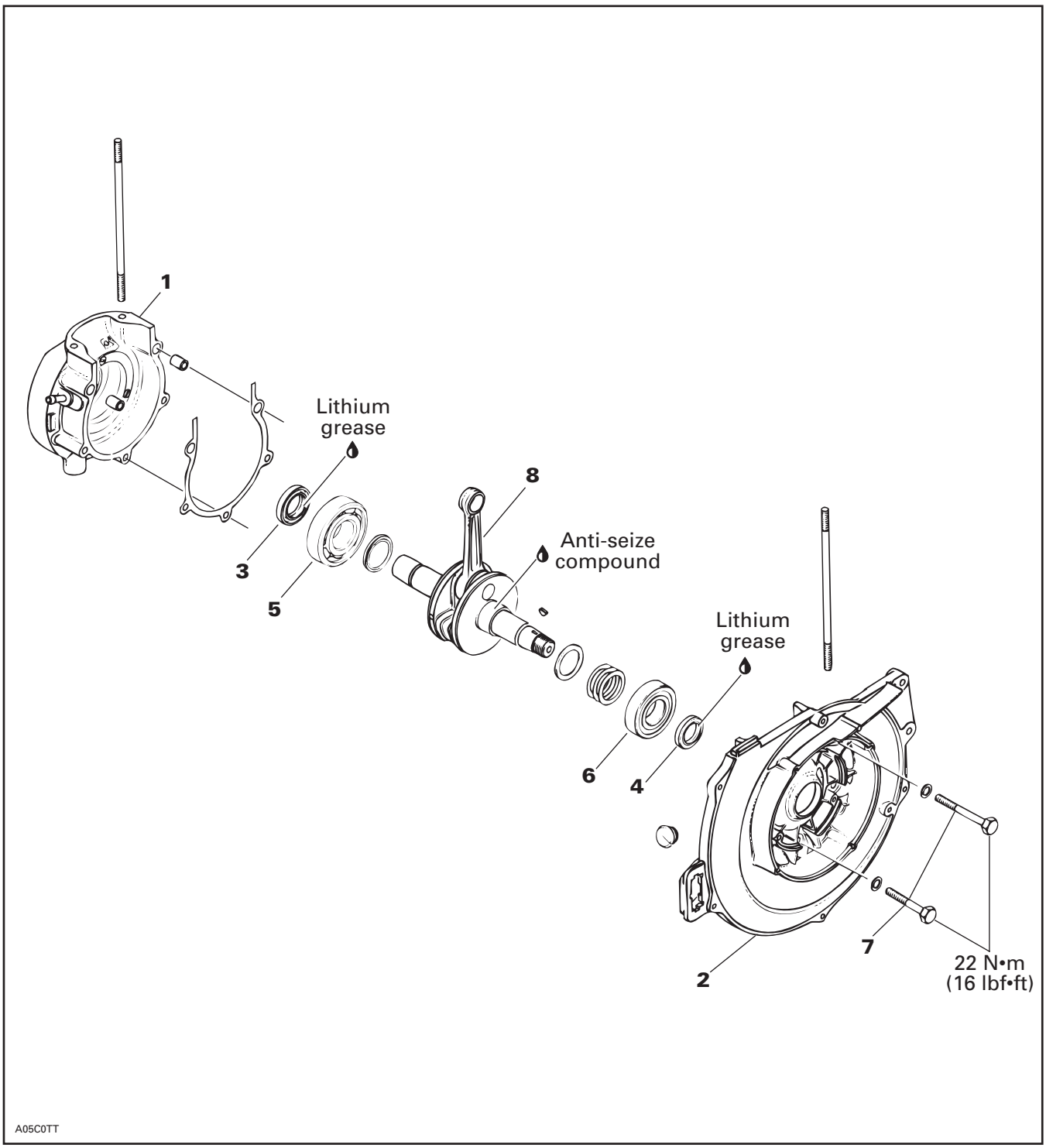
▼ CAUTION

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).

BOTTOM END


1
Lithium grease
3
5
8
Anti-seize compound
Lithium grease
6
4
7
2
22 N•m (16 lbf•ft)
A05C0TT

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

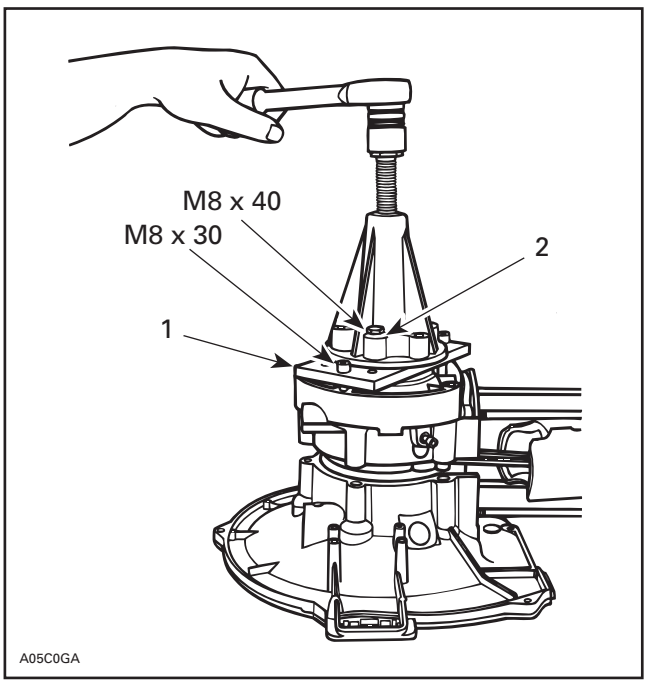
General

To remove drive pulley, refer to DRIVE PULLEY 05-03.

To remove magneto, refer to MAGNETO 04-05.

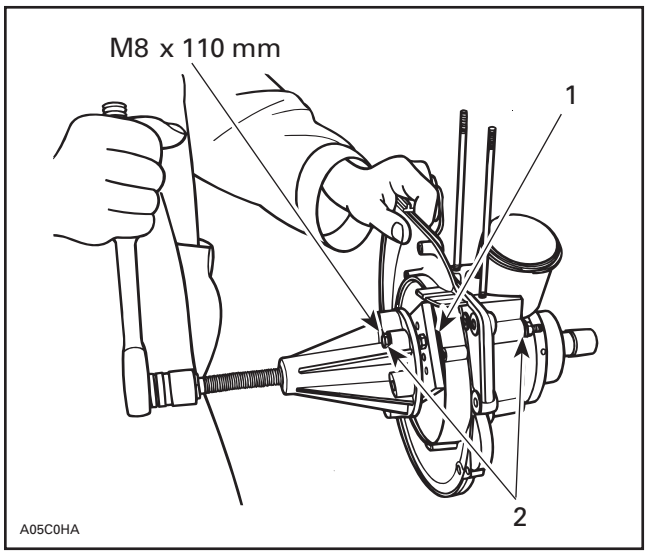
2,6, Crankcase Half

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 washer under screw heads and extract PTO side crankcase half no. 1.



1. Plate
2. Flat washer

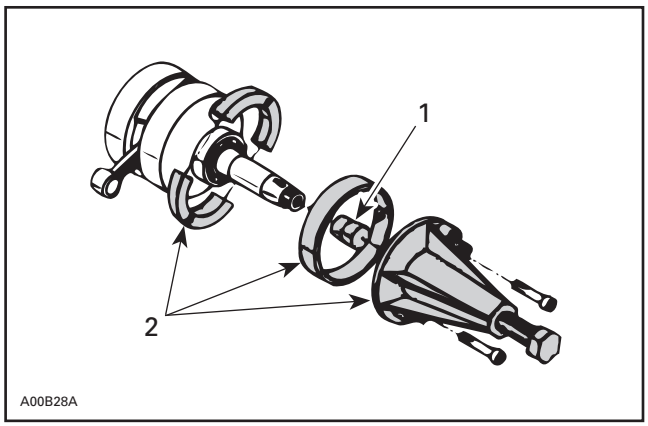
Heat to 110-120°C (230-248°F) all around bearing seat on MAG side. Install puller with plate, long bolts M8 x 110 mm and flat washers. Extract MAG side crankcase half no. 2.



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 ENGINE DIMENSIONS MEASUREMENT 04-04.

ASSEMBLY

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

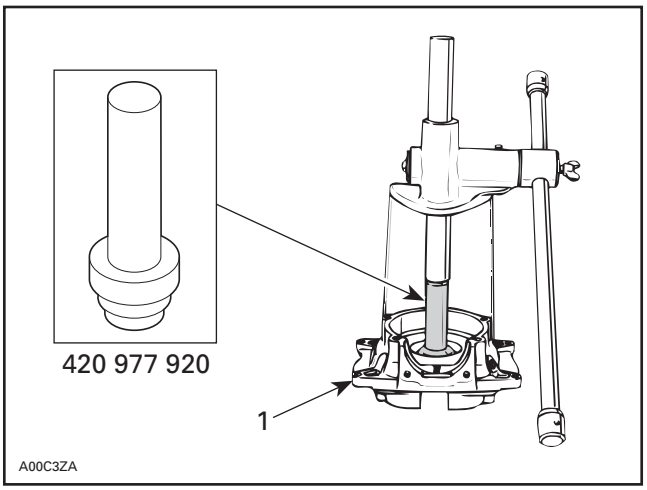
Smear anti-seize lubricant (P/N 413 701 000) on part of crankshaft where bearing fits.

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.

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 04-04.

To install new seal **nos. 3** and **4** into crankcase use oil seal pusher (P/N 420 977 920).



1. Crankcase half

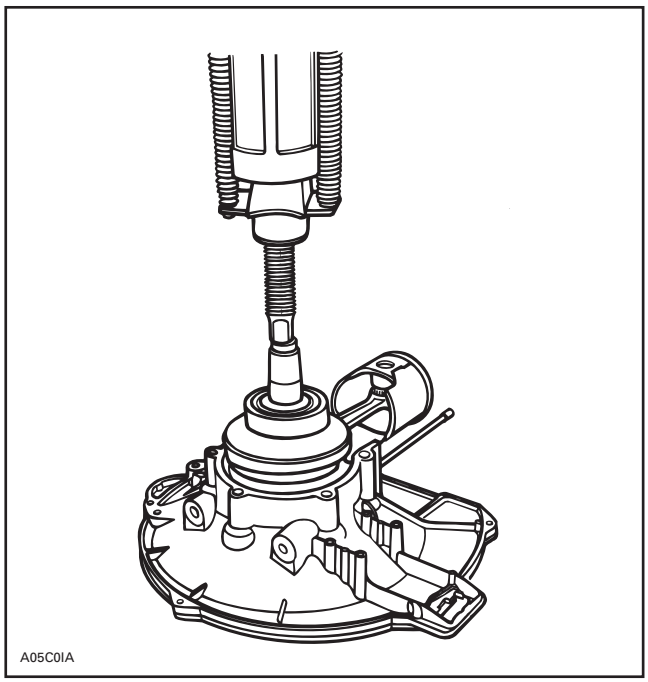
Prior to crankcase adjoining, install a protector sleeve on each crankshaft extension to prevent oil seal damage. Apply a light coat of lithium grease on seal lip. Spray some new injection oil on all moving parts of the crankshaft.

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**.

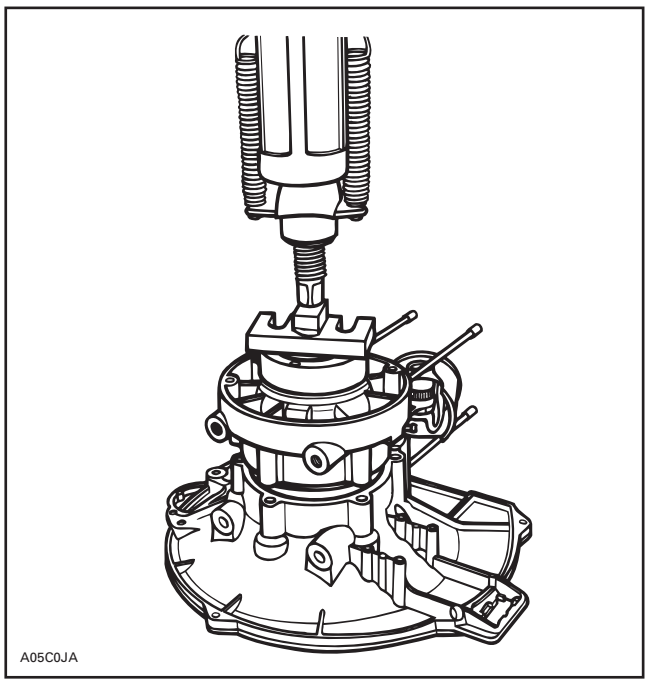
▼ CAUTION

To ensure appropriate crankshaft bearing lubrication, seal outer surface must be pressed on seal crankcase shoulder.

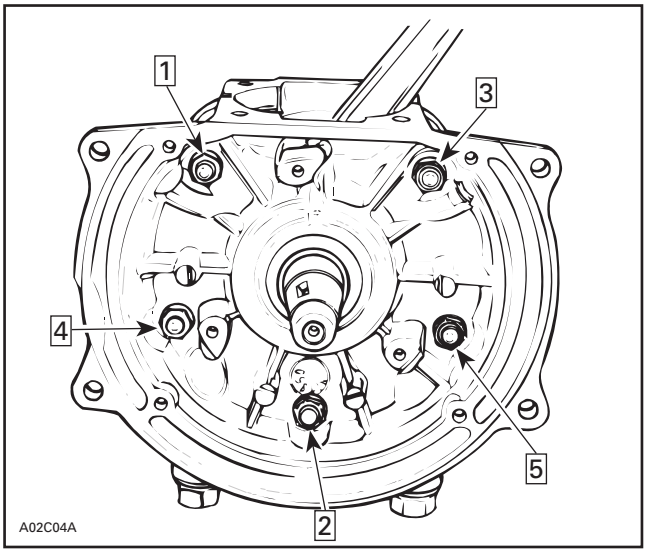
Using a press, install crankshaft into MAG side crankcase half.



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



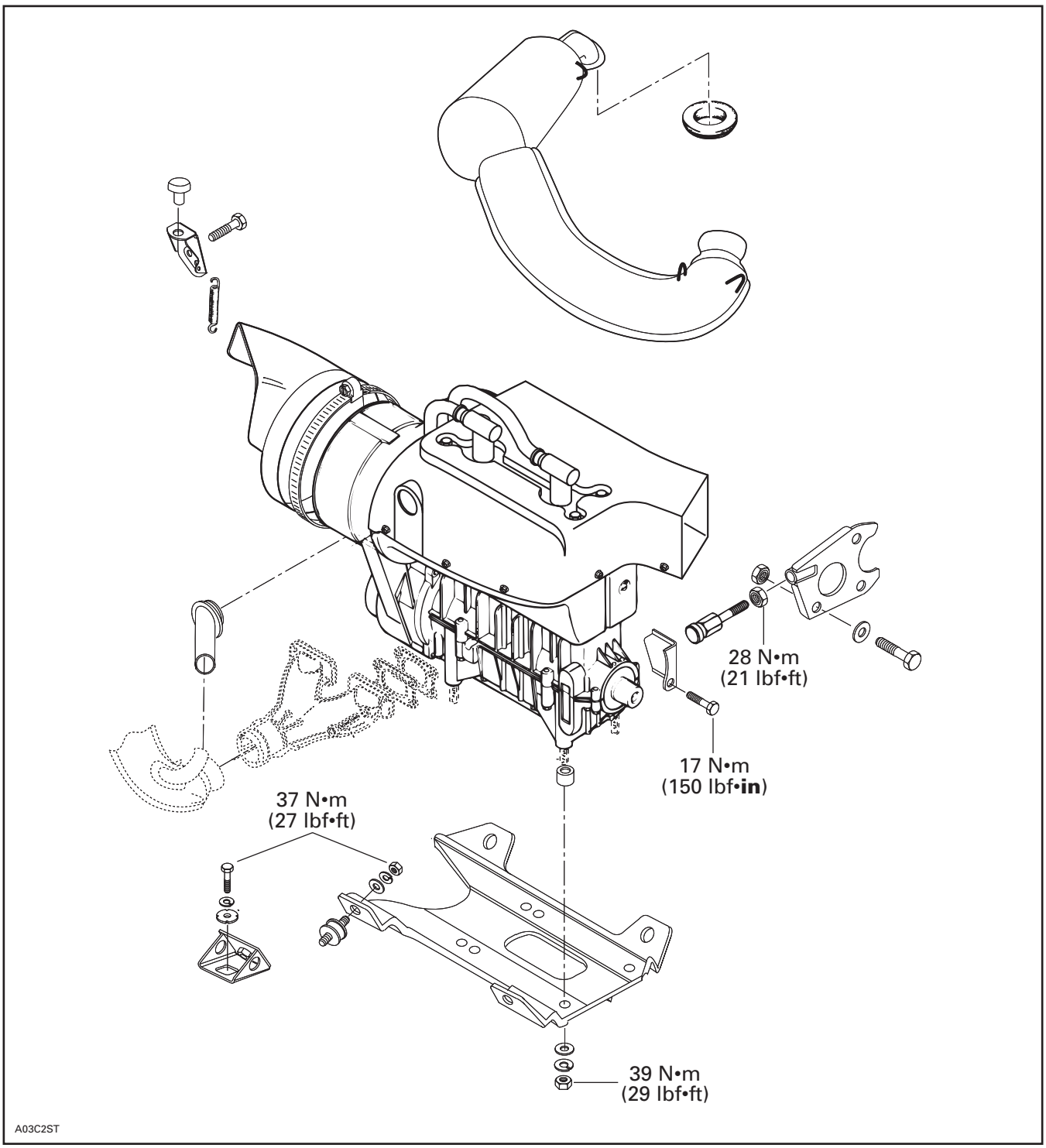
Torque the screws **no. 7** to 22 N•m (16 lbf•ft) following illustrated sequence.



377, 443 AND 503 ENGINE TYPES

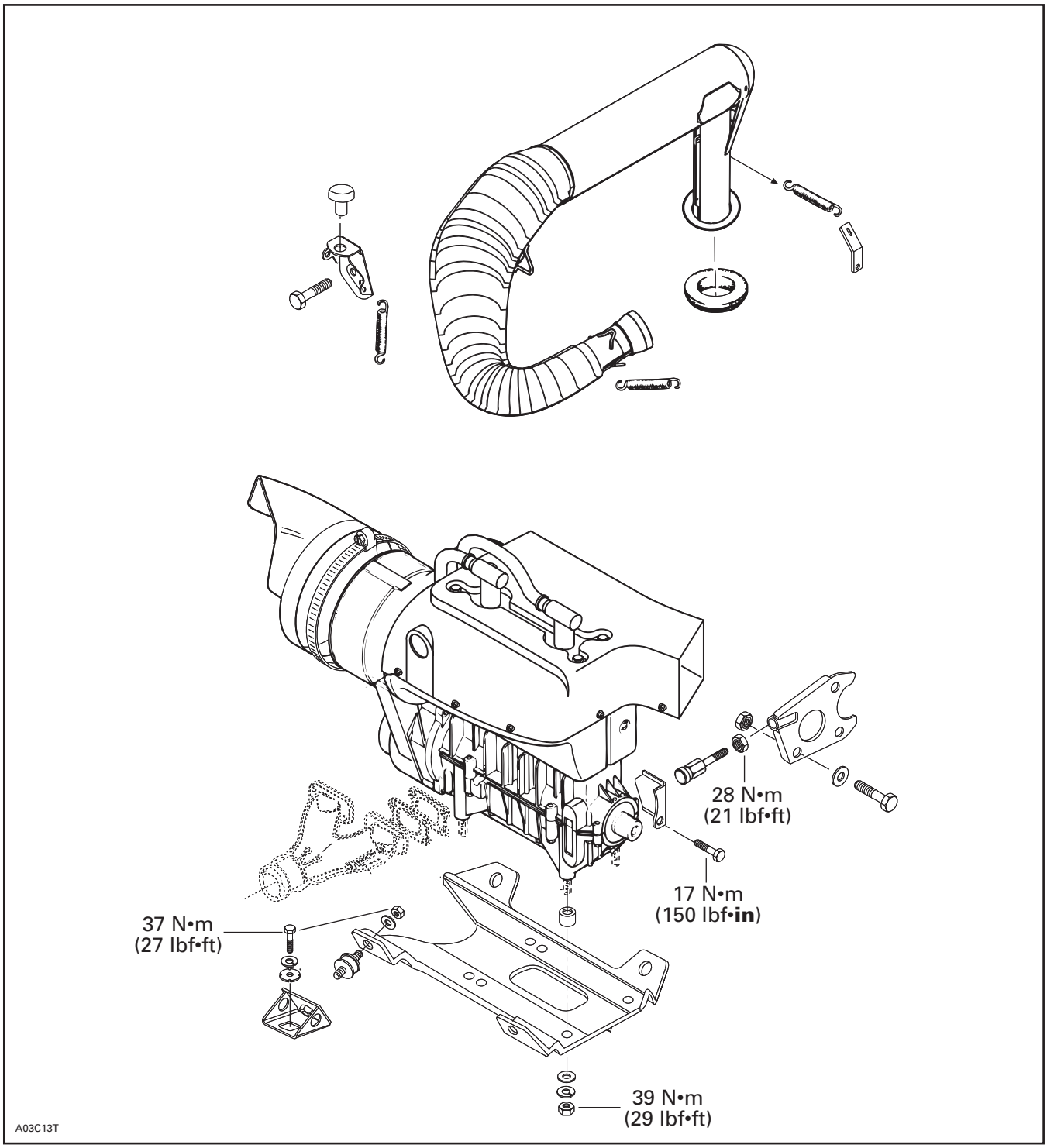
ENGINE REMOVAL AND INSTALLATION

377 and 443 Engine Types



PARTS

503 Engine Type



ENGINE REMOVAL AND INSTALLATION

Disconnect or remove the following:

◆ WARNING

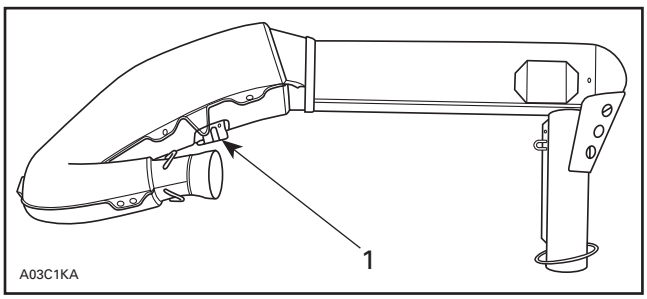
Before disconnecting any electrical wire in starter system always first disconnect the BLACK negative battery cable (on electric starting models).

- negative cable from battery (on electric starting models)
- belt guard
- drive belt
- drive pulley using appropriate puller, refer to 05-03 DRIVE PULLEY
- air silencer and carburetors
- impulse line from engine crankcase
- 4-connector housing
- exhaust pipe and exhaust cooling hose on so equipped models
- oil pump inlet line and plug it
- oil pump cable

TUNED PIPE IDENTIFICATION

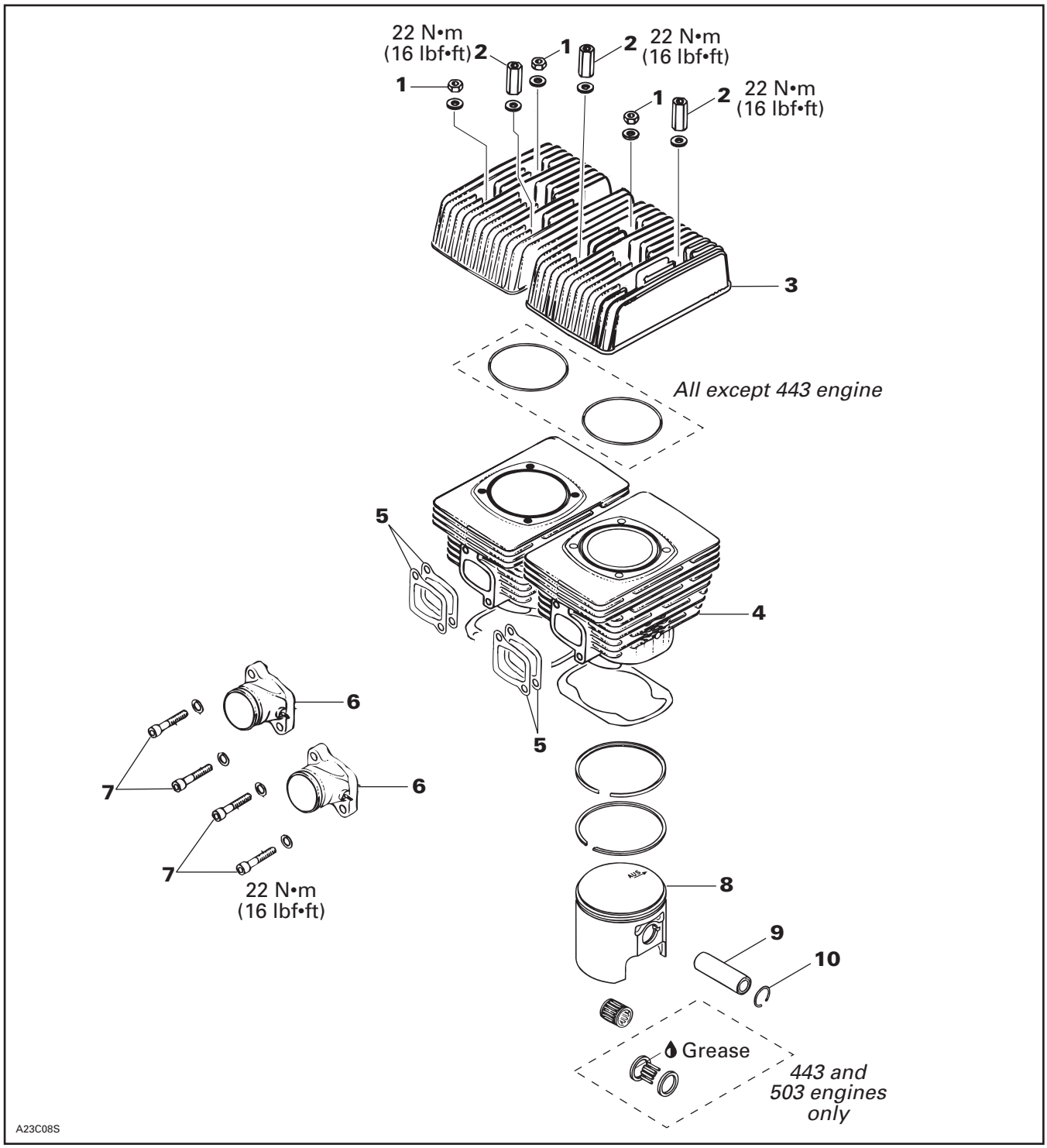
This part is identified on welded support.

Second number sequence of P/N is stamped on part.



1. Identification: 0467 for 514 046 700

TOP END



PARTS

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

377 Engine

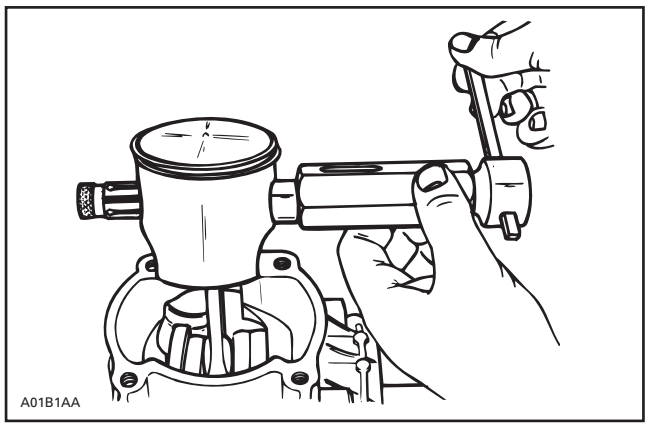
To remove piston pin **no. 9**, use piston pin puller (P/N 529 035 503).

Fully screw puller handle.

Insert puller end into piston pin.

Screw (LH threads) extracting nut.

Hold puller firmly and rotate puller handle counterclockwise to pull piston pin.



TYPICAL

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

443 and 503 Engines

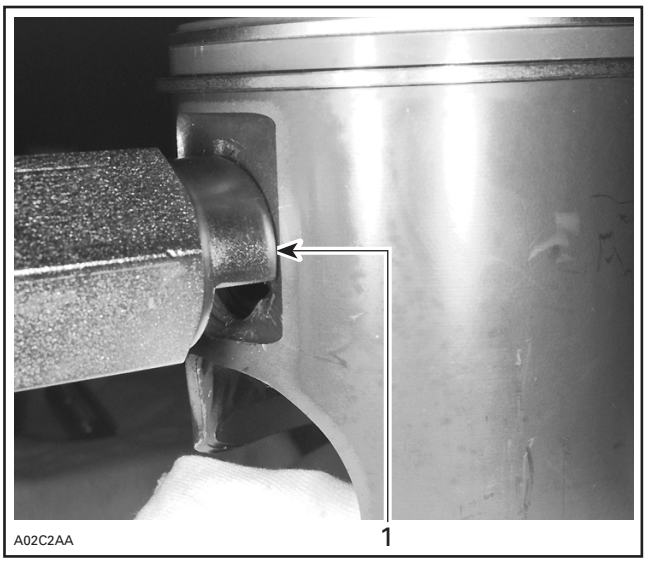
On these engines, piston pin needle bearing is mounted without a cage.

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.

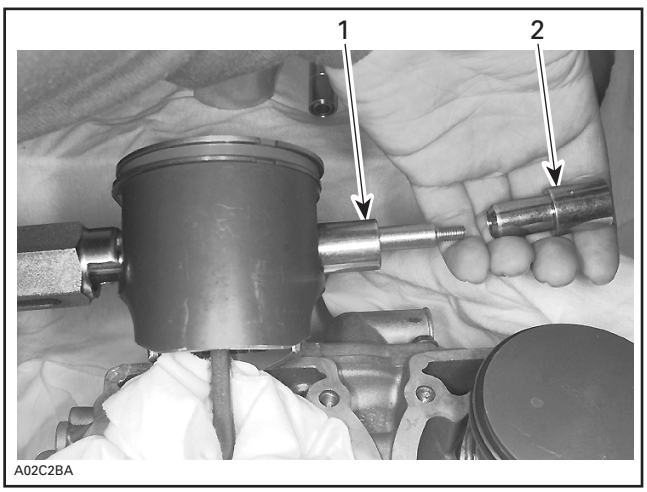
Place a clean cloth or rubber pad (P/N 529 023 400) over crankcase to prevent circlips **no. 10** from falling into crankcase. Then with a pointed tool inserted in piston notch, remove both circlips from piston **no. 8**.

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



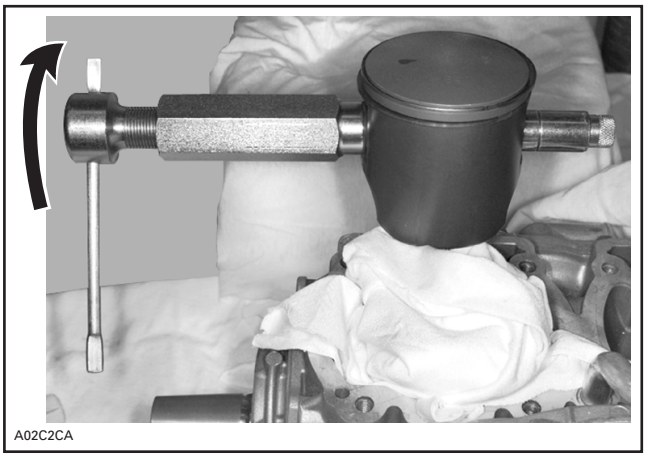
TYPICAL
1. Properly seated all around

Install sleeve then shouldered sleeve over puller rod.

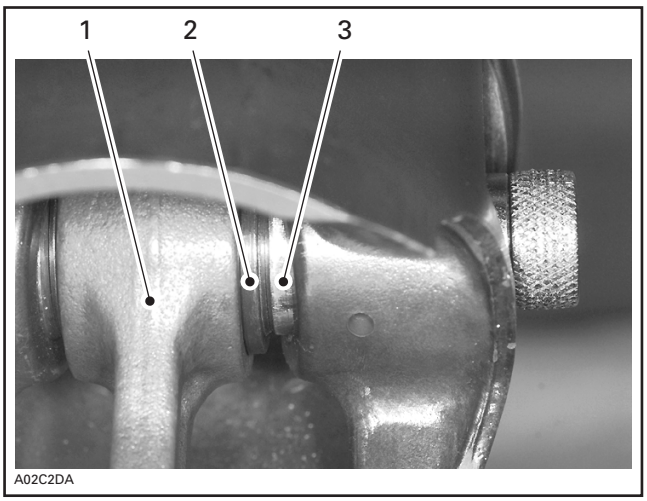


TYPICAL — INSTALLATION OF SLEEVE KIT
1. Sleeve
2. Shouldered sleeve

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

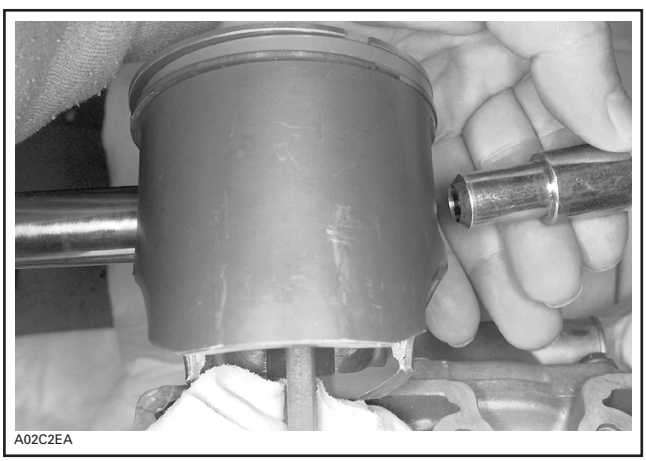


TYPICAL — PISTON PIN EXTRACTION



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

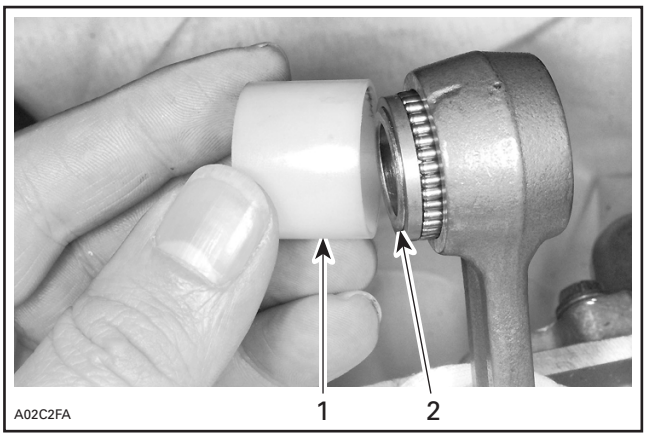
Remove puller. Pull out shouldered sleeve carefully.



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

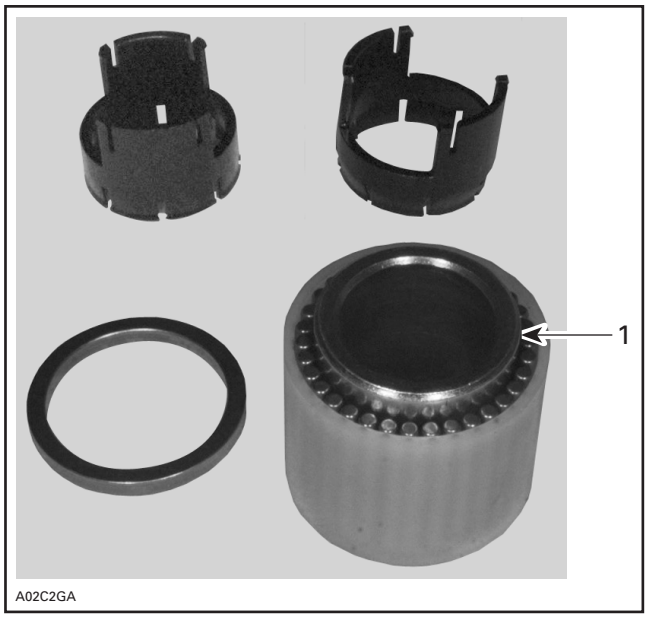
Refer to ENGINE DIMENSIONS MEASUREMENT 04-04.

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

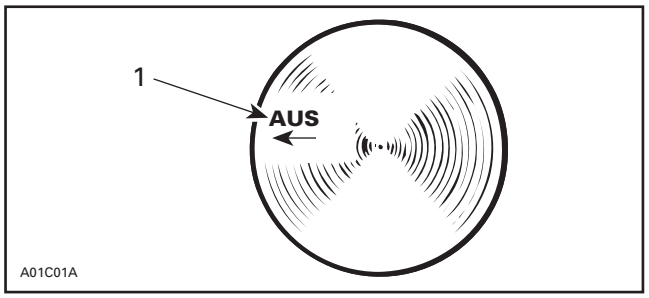
1. *Sleeve*

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

Insert cageless bearing into connecting rod.

TYPICAL — CAGELESS BEARING AND SLEEVE INSTALLED

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

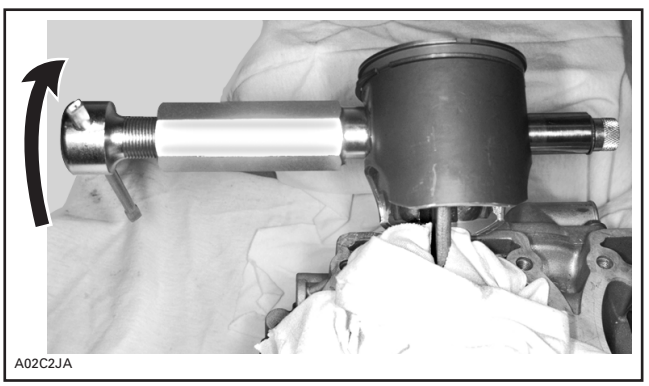


1. Exhaust

Install shouldered sleeve.

TYPICAL — SHOULDERED SLEEVE INSTALLATION

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

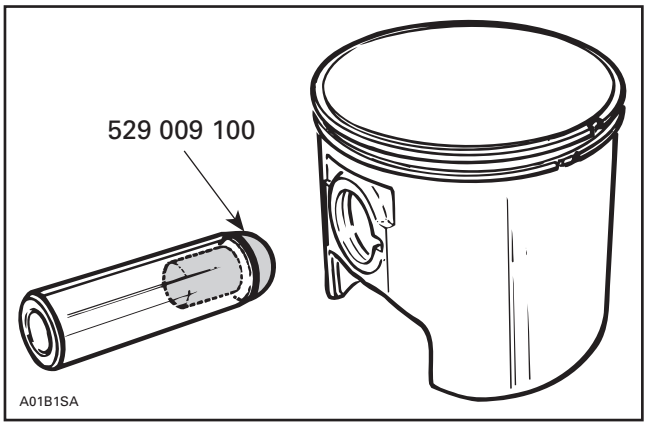


TYPICAL

– Remove piston pin puller and sleeve kit.

377 Engine

To center the piston pin with the connecting rod bearing, use centering tool (P/N 529 009 100).



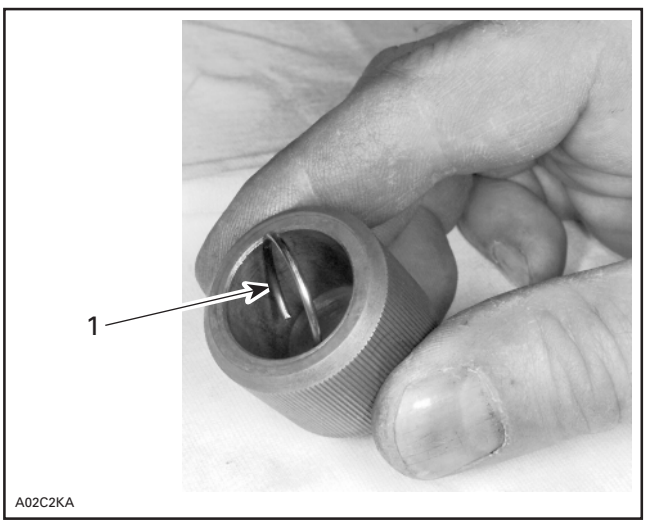
NOTE: The circlip on the opposite side can be installed before pin installation, the tool will easily go out.

Use piston pin puller (P/N 529 035 503) to install a piston pin that cannot be installed as described above.

All Models

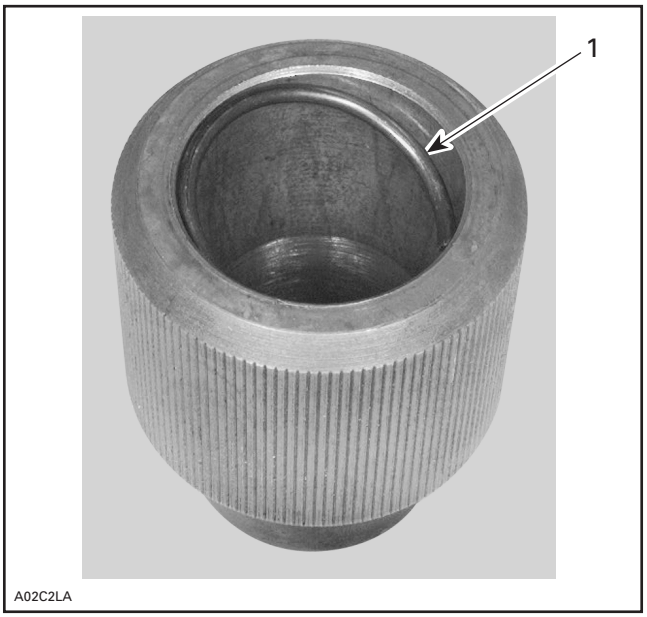
To minimize the effect of acceleration forces on circlip, install each circlip so the circlip break is at 6 o'clock as illustrated. Use piston circlip installer (P/N 529 035 561).

Insert circlip in tool at an angle.



1. Circlip

Square it up using a finger.

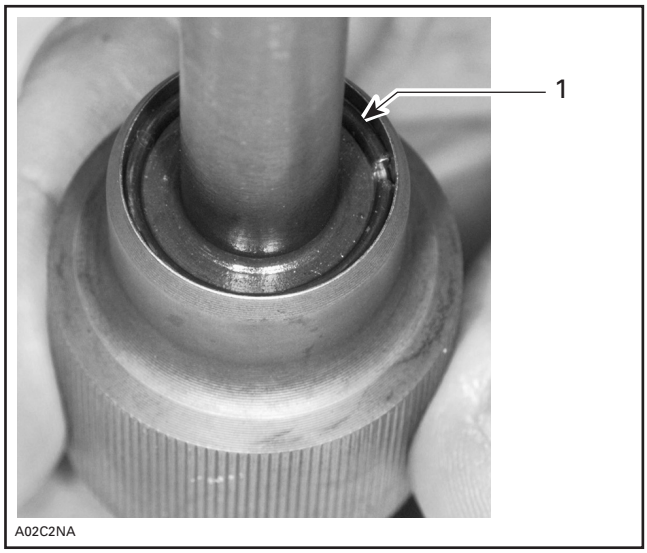


1. Circlip

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

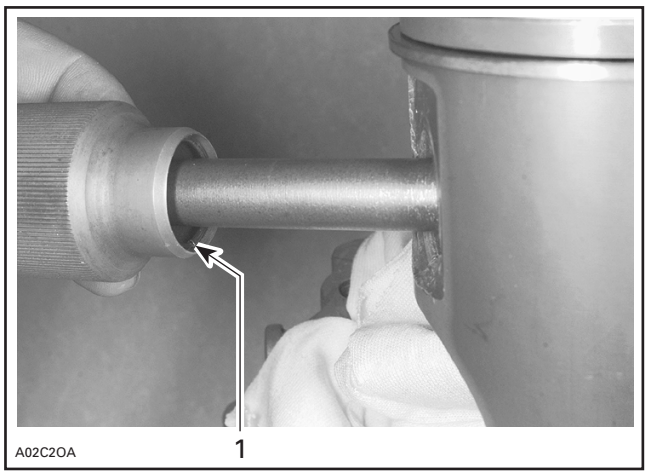
1. Circlip

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.



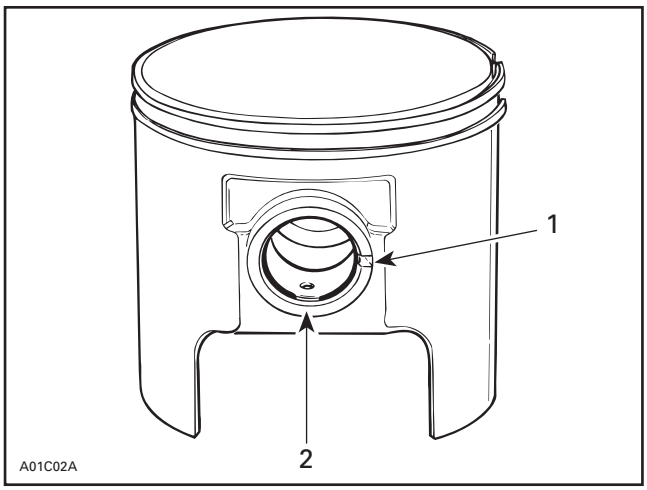
TYPICAL

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.


A02C2PA

TYPICAL



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.

Install proper ring compressor on piston assembly.

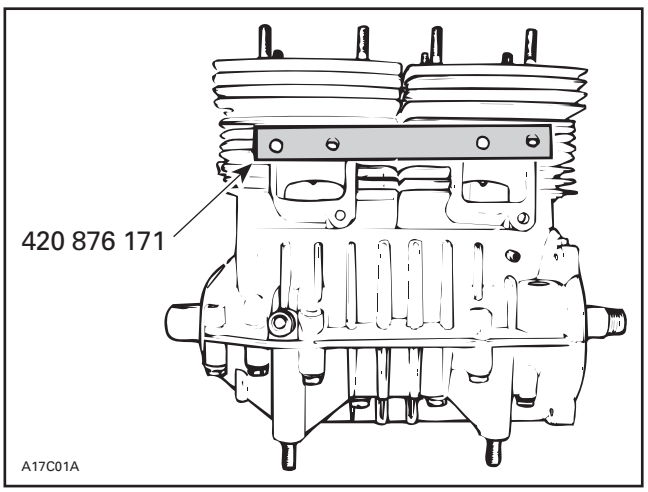
ENGINE TYPE	RING COMPRESSOR P/N
377 and 443	420 876 090
503	420 876 970

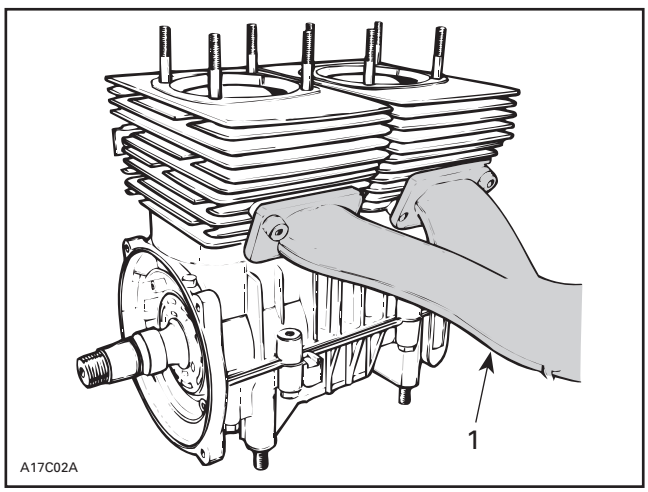
NOTE: The ring compressor will not fit on over size pistons.

Check flatness of intake sockets **no. 6**. Refer to ENGINE DIMENSION MEASUREMENT 04-04 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.

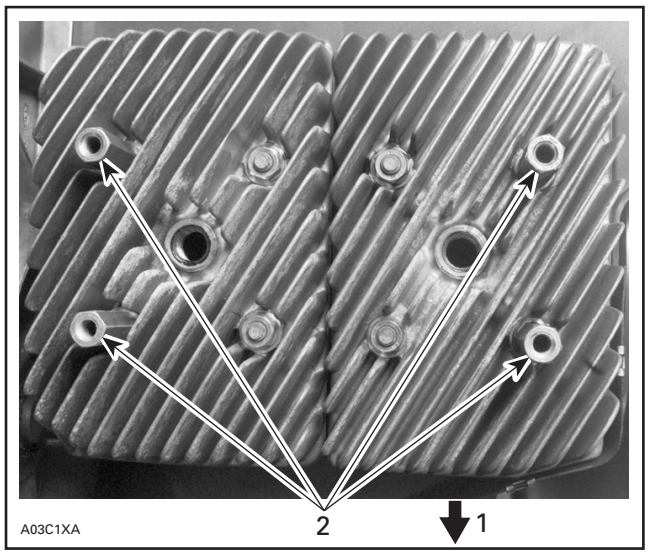
ENGINE TYPE	ALIGNING TOOL P/N
377, 443 and 503	420 876 171





1. *Or use exhaust manifold to align cylinders*

Position distance nuts **no. 2** as illustrated.



1. Exhaust
2. Distance nuts

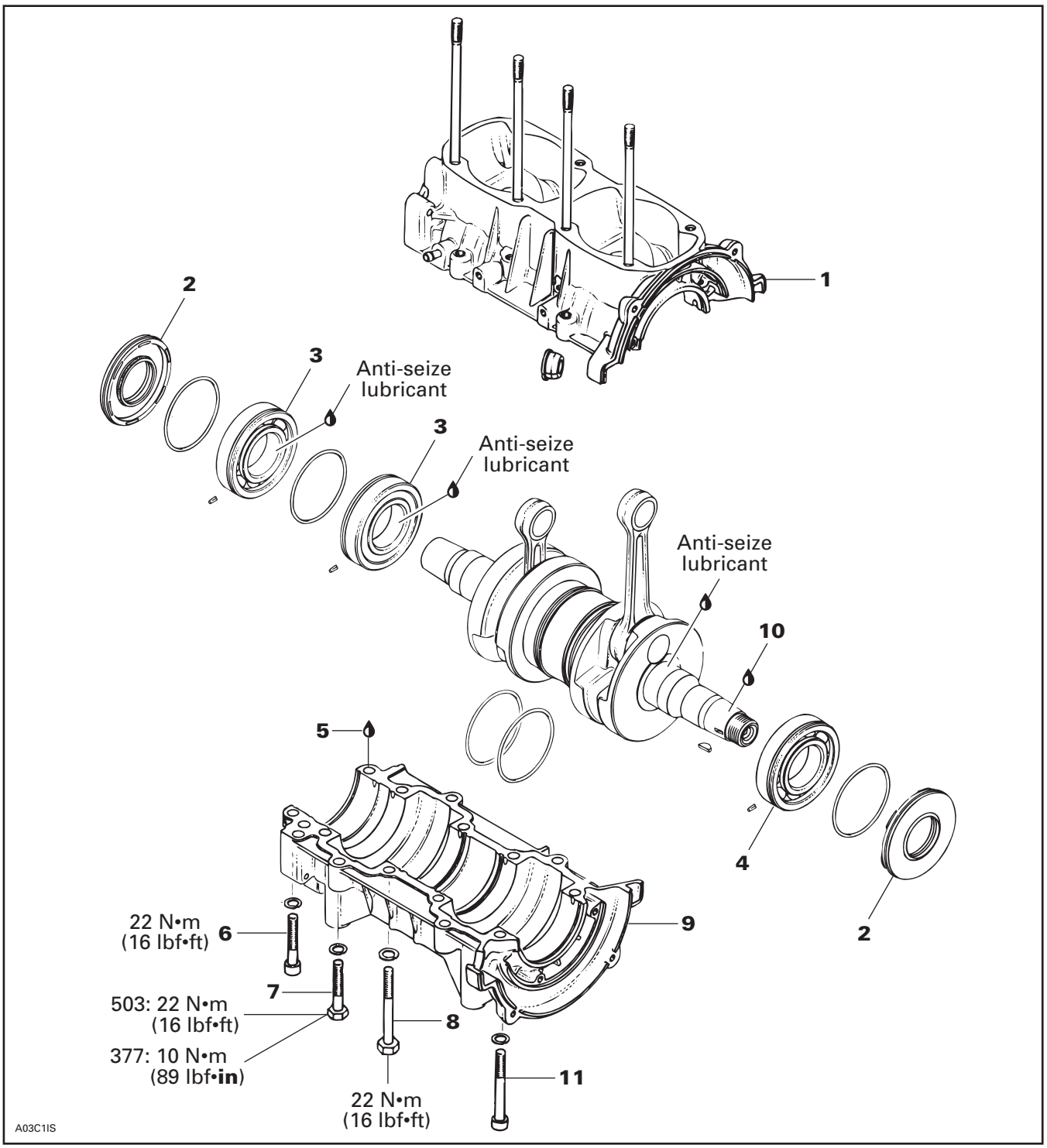
Cross torque cylinder head nuts **nos. 1** and **2** to 22 N•m (16 lbf•ft); torque each cylinder head individually.

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



PARTS

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, magneto 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 242 from crankshaft taper.

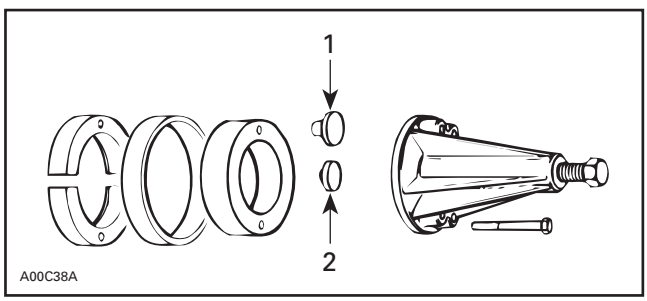
Remove old sealant from crankcase mating surfaces with Bombardier gasket remover (P/N 413 708 500).

▼ 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

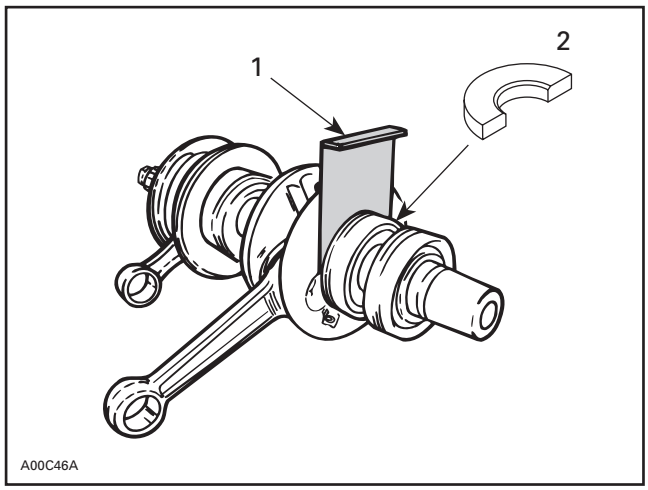
Refer to ENGINE DIMENSIONS MEASUREMENT 04-04.

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 377 and 443 and (P/N 420 876 824) for 503 for proper positioning.



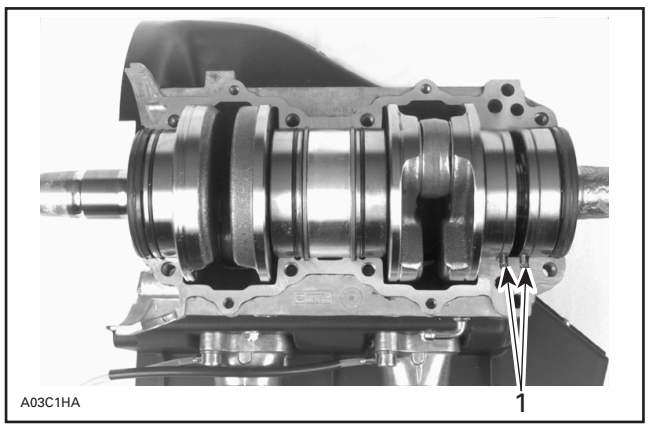
1. Feeler gauge
2. Distance gauge

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. 10** as illustrated.

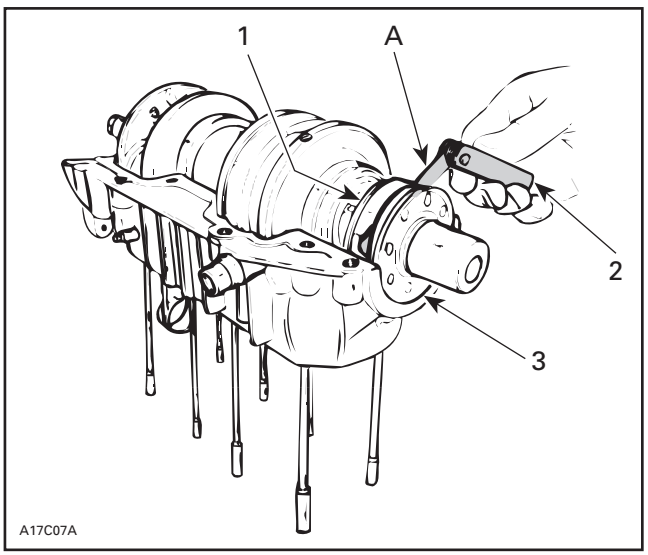


TYPICAL
1. Drive pins

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.

Prior to joining of crankcase halves, spray some new injection oil (or equivalent) on all moving parts of the crankshaft. Spray Primer N (P/N 413 708 100) on one of mating surfaces. Let it dry for 10 to 20 minutes.

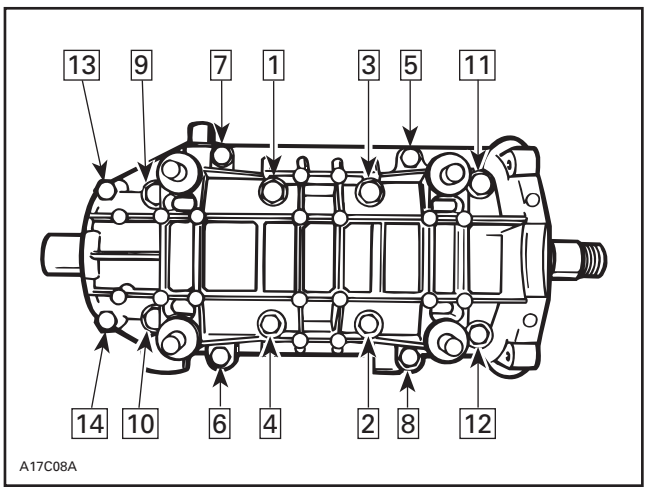
Apply paste gasket (P/N 413 702 700) **no. 5** on the other mating surface.

NOTE: Primer N allows Loctite 515 to fully cure on aluminum surfaces. It increases filling capacity and reduce curing time.

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.

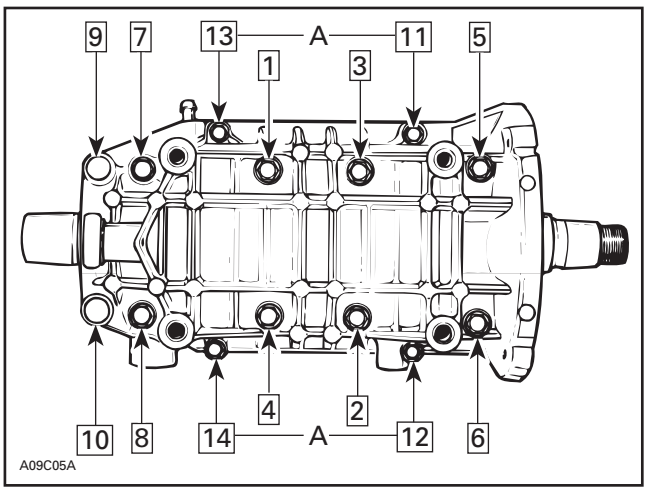
503 Engine Type

Torque screws **nos. 6, 7, 8** and **11** to 10 N•m (89 lbf•**in**) then to 22 N•m (16 lbf•ft) following illustrated sequence.



377 and 443 Engines

Torque screws to proper torque in the following sequence.



*A. 10 N•m (89 lbf•**in**)*
All the other screws are torqued to 21 N•m (15 lbf•ft)

All Engines

To install magneto, refer to CDI MAGNETO 04-05.

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 crankcase rotary valve gear reservoir/components.

On twin-cylinder engines, each cylinder cannot be verified individually due to leakage from one cylinder to the other through rotary valve (except on engines with separate intake manifolds). Besides, on FC engines, leak will occur through labyrinth sleeve in center of crankshaft.

PREPARATION

1. Remove tuned pipe/muffler and exhaust manifold.
2. Install plug(s) over exhaust flange(s). Tighten with previously removed screws.
3. On engines with RAVE system, remove RAVE valves and install plugs over flanges. Tighten with previously removed screws.
4. Remove carburetor(s).
5. Insert plug(s) in intake rubber boot(s). Tighten with clamps already there.
6. Using a hose pincher(s) (P/N 529 009 900), block impulse hose(s).

NOTE: Do not block large hoses of rotary valve gear lubrication system.

7. Install air pump on any valve of 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.

8. Rotate crankshaft so that piston goes to BDC (Bottom Dead Center) on side where the pump is installed. This will open exhaust port.
9. Activate pump and pressurize engine to 34 kPa (5 PSI). Do not exceed this pressure.
10. Engine must stand this pressure during 3 minutes. If pressure drops before 3 minutes, check tester kit by spraying a soapy solution on pump piston, 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.

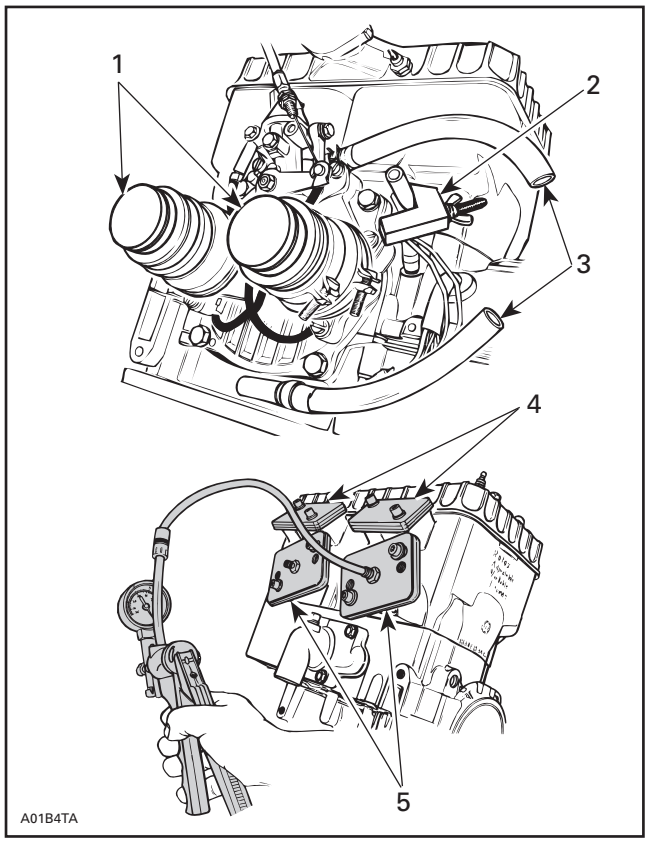
Using flow chart and following text, pressurize area to be tested and spray soapy solution at the indicated location.

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.

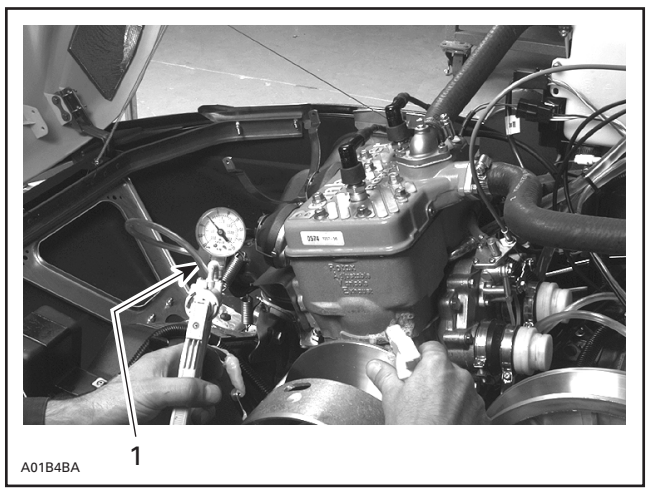
Engine



TYPICAL

1. *Blocked intake flanges*
2. *Blocked impulse fitting*
3. *Open ends (if applicable)*
4. *Blocked RAVE valve flanges (if applicable)*
5. *Blocked exhaust flanges*

When exhaust manifold is installed, use rubber plug. (In this case it is not necessary to move piston to BDC).

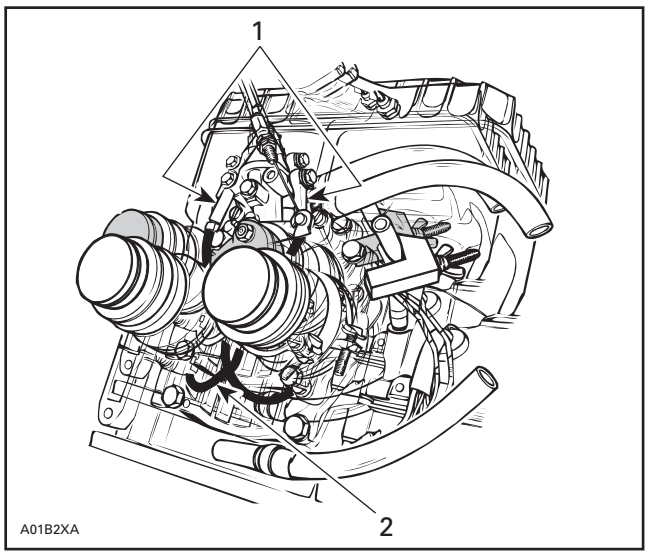


TYPICAL

1. *Rubber plug*

Check the following:

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



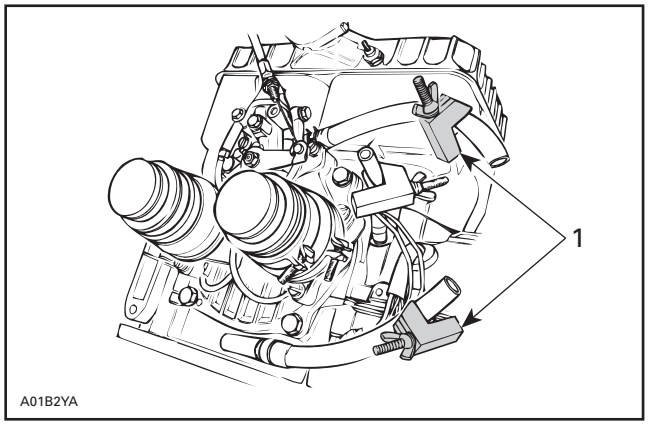
1. *Banjo fittings*
2. *Small injection oil lines*

Check for air bubbles or oil column going toward pump. It indicates defective check valve in banjo fitting (or lines).

3. Remove cooling system cap.

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

4. Block both hoses of rotary valve gear lubrication system with hose pinchers.



1. Block both hoses

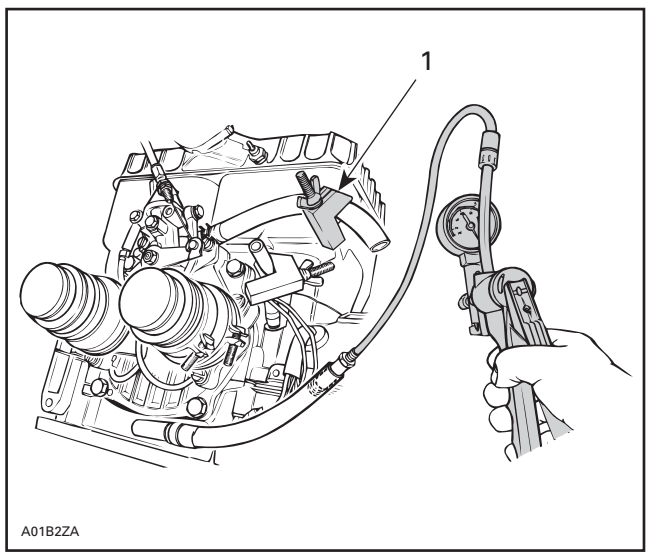
If leakage stops, ignore remaining items and check crankcase rotary valve gear reservoir as per **Crankcase Rotary Valve Gear Reservoir** of this section.

5. Remove drive pulley then check crankshaft outer seal.
6. Remove rewind starter and magneto system then check crankshaft outer seal.
7. Check crankcase rotary valve gear reservoir.

Crankcase Rotary Valve Gear Reservoir

Block one hose of rotary valve gear lubrication system with a hose pincher and install an adapter in remaining hose.

Install air pump on adapter and pressurize as before.

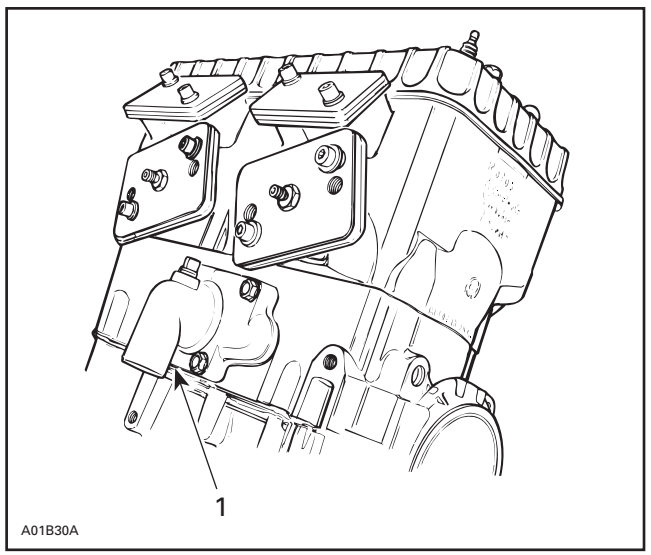


1. Blocked hose

1. Remove a spark plug or any plug of leak tester kit on PTO side.

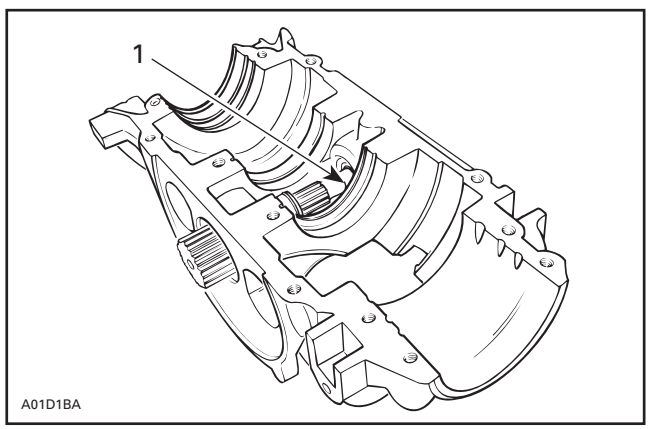
   If pressure drops, it indicates defective crankshaft inner seal on PTO side.
2. Remove a spark plug or any plug of leak tester kit on MAG side.

   If pressure drops, it indicates defective crankshaft inner seal on MAG side.
3. Check drain hole below coolant pump housing with soapy water.



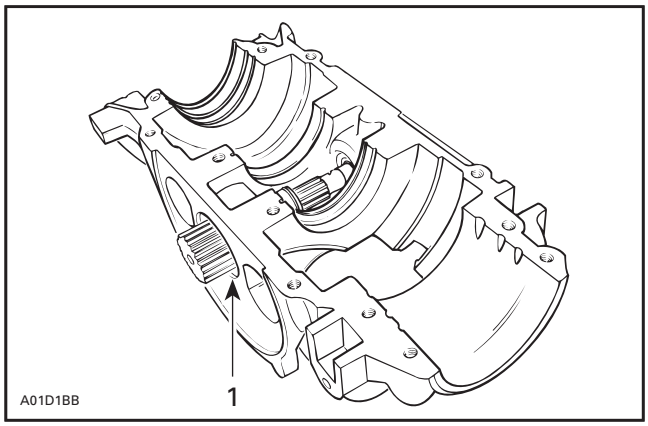
1. Drain hole

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



1. Oil seal

4. Remove rotary valve cover and check for leak of rotary valve seal with soapy water.



1. Seal

5. 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 leading to leakage.

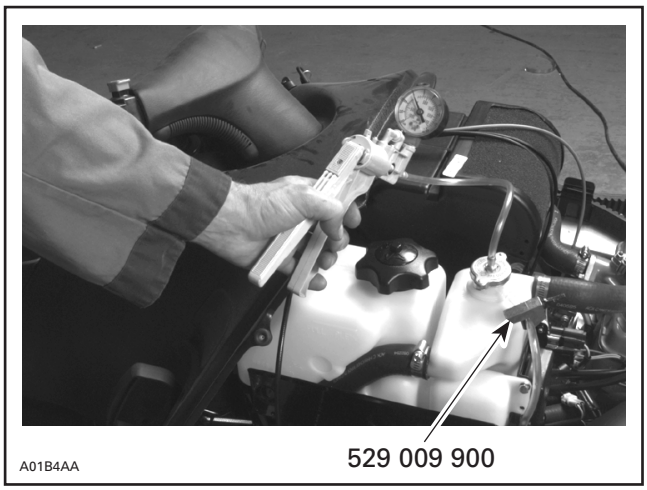
FINALIZING REASSEMBLY

After reassembling engine, always recheck for leakage.

COOLING SYSTEM LEAK TEST

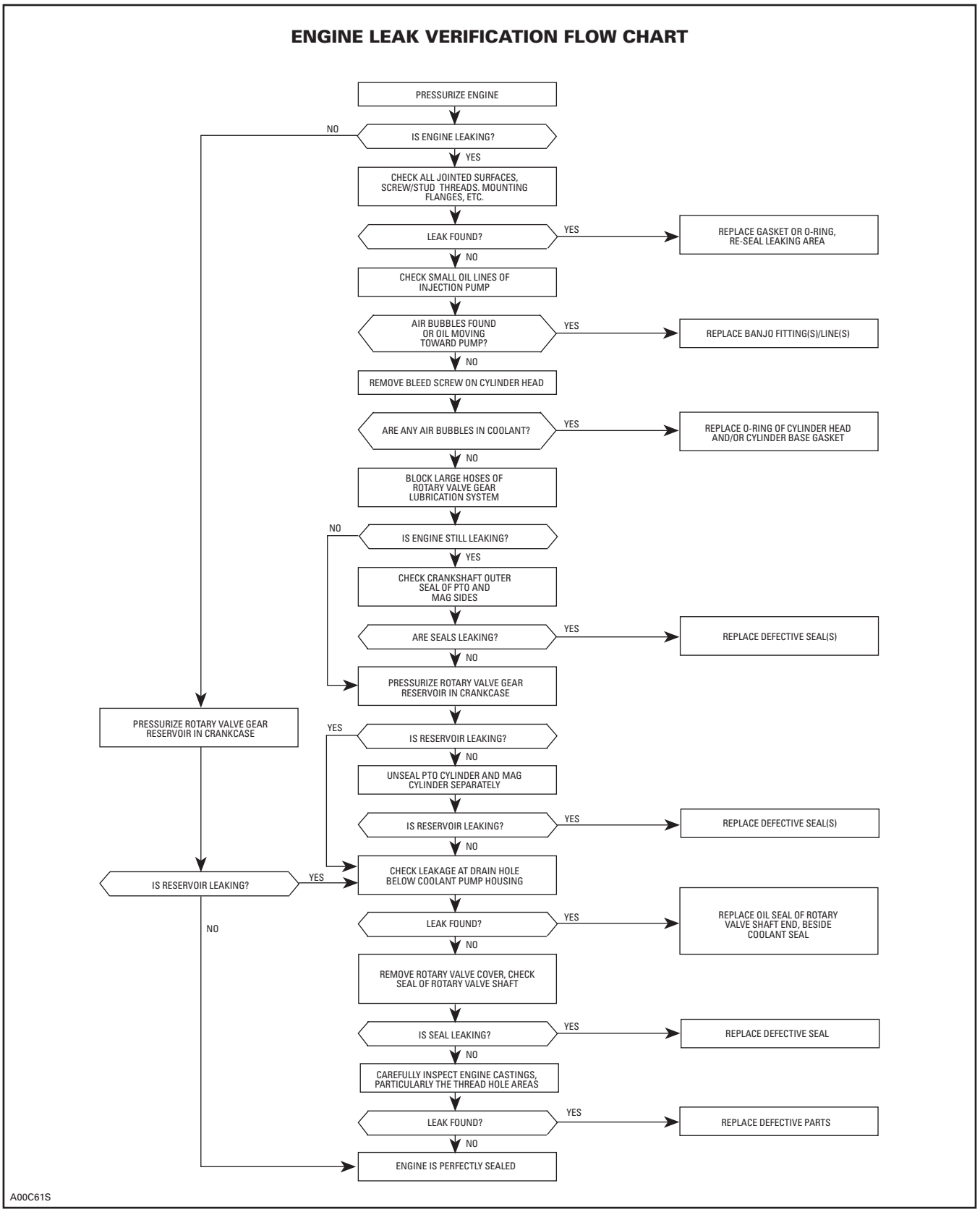
Install special plug (radiator cap) (P/N 529 021 400) and hose pincher (P/N 529 009 900) on overflow hose. Pressurize all system through coolant reservoir to 15 PSI.

Check all hoses and cylinder/base for coolant leaks. Spray a soap/water solution and look for presence of air bubbles.



TYPICAL

ENGINE LEAK VERIFICATION FLOW CHART



ENGINE DIMENSION MEASUREMENT

This section covers all engine types.

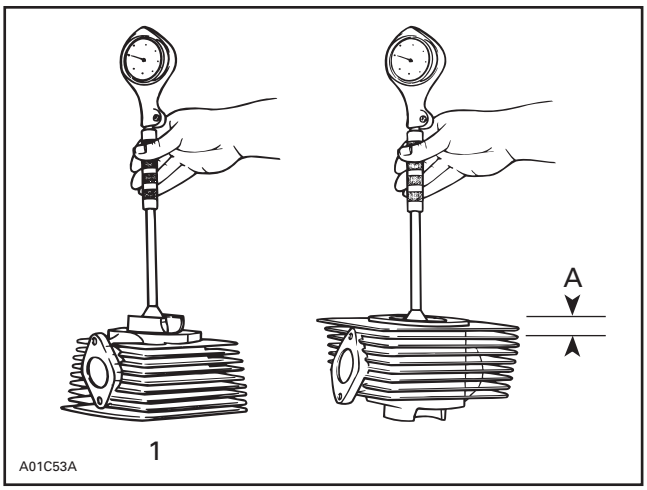
CYLINDER TAPER

ENGINE TYPE	MAXIMUM
All	0.08 mm (.003 in)

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

On rotary valve engines, measure just below auxiliary transfer port, facing exhaust port. 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.



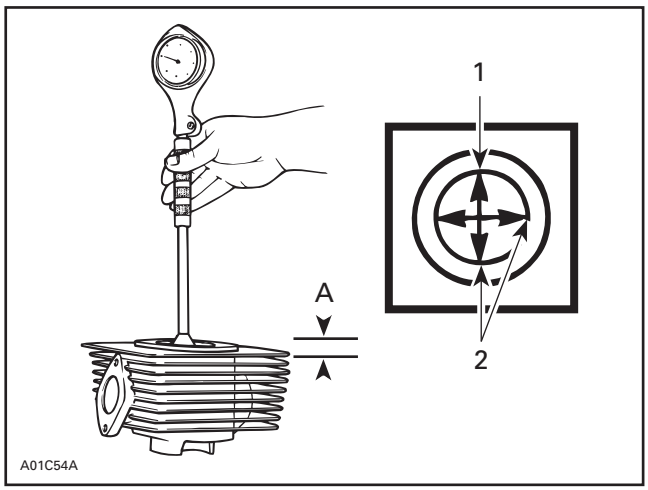
1. Below the intake port
A. 16 mm (5/8 in) from top

CYLINDER OUT OF ROUND

ENGINE TYPE	MAXIMUM
All	0.05 mm (.002 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.

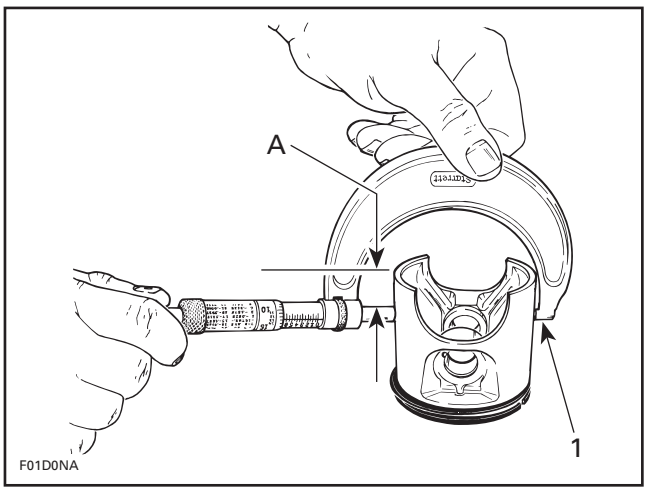
NOTE: Be sure to restore the chamfer around all cylinder sleeve port openings.



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

USED PISTON MEASUREMENT

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



1. Measuring perpendicularly (90°) to piston pin axis
A. See table below

ENGINE TYPE	DIMENSION A mm (in)
277 and 503	18 (.71)
337 and 443	20.8 (.82)

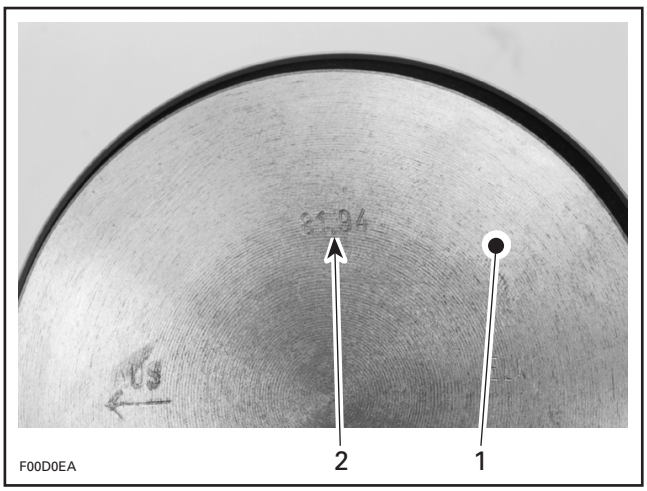
The measured dimension should be the same as the one scribed on piston dome. If not, install a new piston.

CYLINDER/PISTON CLEARANCE

Used and New Pistons

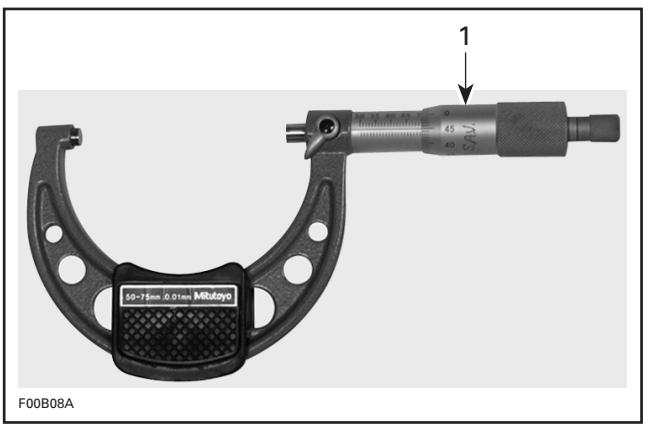
NOTE: Make sure used piston is not worn. See USED PISTON MEASUREMENT above.

Take the measurement on the piston dome.



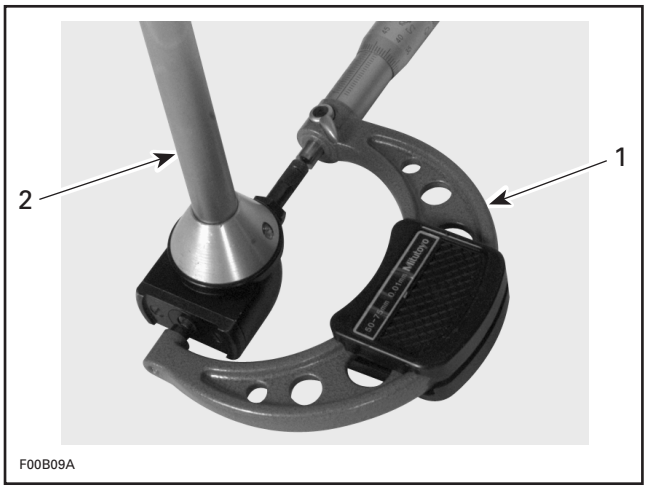
1. Piston dome
2. Piston measurement

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

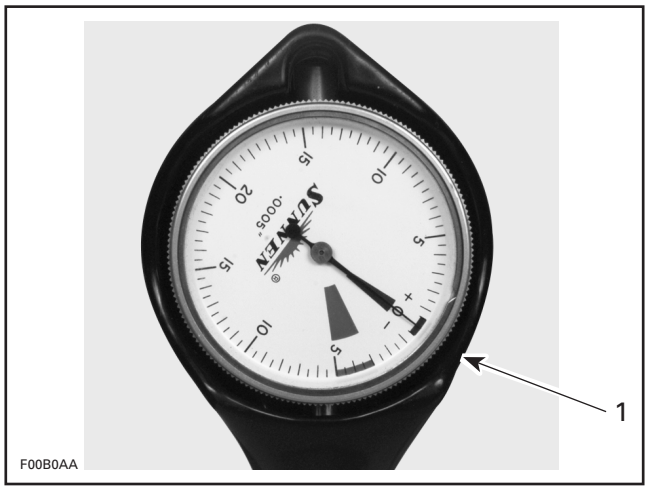


1. Micrometer set to the piston dimension

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

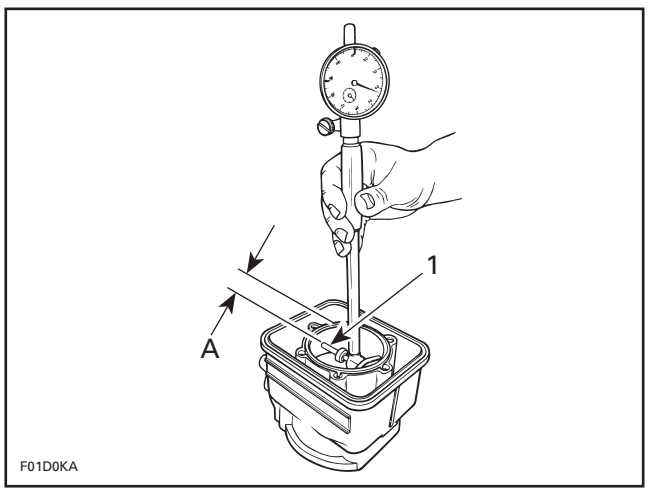


1. Use the micrometer to set the cylinder bore gauge
2. Dial bore gauge



1. Indicator set to 0

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



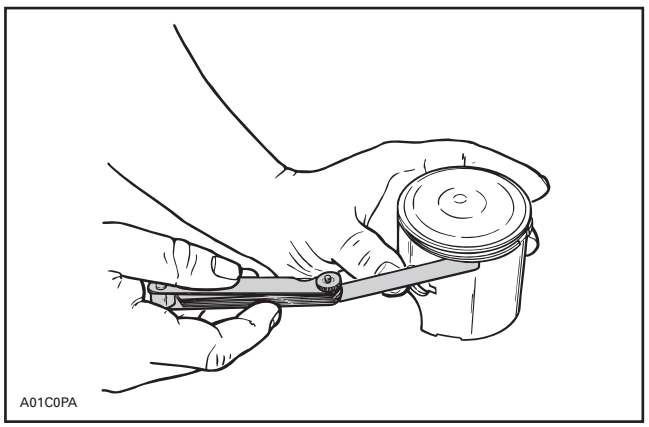
1. Measuring perpendicularly (90°) to piston pin axis
A. 16 mm (5/8 in)

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 10.

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 ring and groove. Replace piston if clearance exceeds specified tolerance. Refer to TECHNICAL DATA 10.

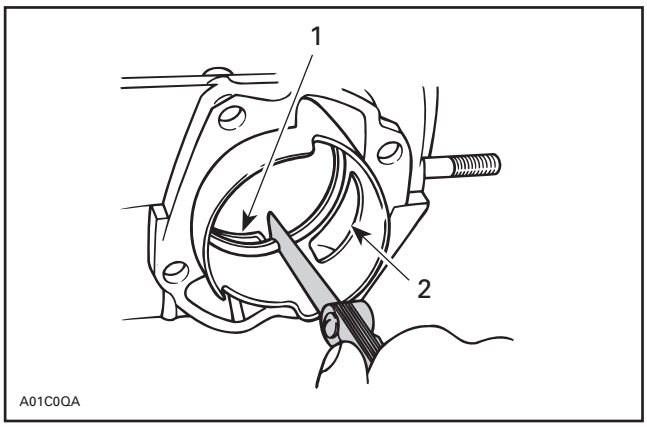


RING END GAP

Position ring half way between transfer ports and intake port. On rotary valve engines, position ring just below transfer ports.

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 10.



1. Transfer port
2. Intake port

CRANKSHAFT DEFLECTION

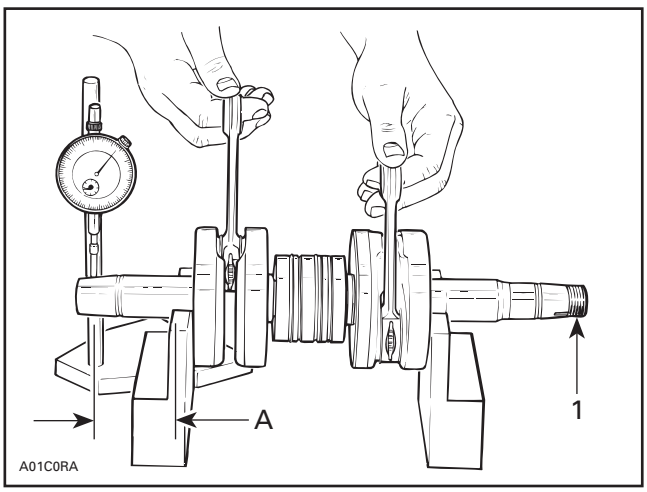
Crankshaft deflection is measured with a dial indicator.

Measuring (in engine)

First, check deflection with crankshaft in engine. If deflection exceeds the specified tolerance, recheck 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. See table below

Crankshaft Deflection on PTO Side

ENGINE TYPE	DISTANCE A mm (in)	MAXIMUM ON PTO SIDE mm (in)
377, 443	75.5 (2.972)	0.06 (.002)
503	82.5 (3.248)	

Crankshaft Deflection on MAG Side

ENGINE TYPE	MAXIMUM ON MAG SIDE mm (in)
All	0.03 (.001)

Crankshaft Deflection in Center of Crankshaft

ENGINE TYPE	MAXIMUM IN CENTER OF CRANKSHAFT
All	0.08 mm (.0031 in)

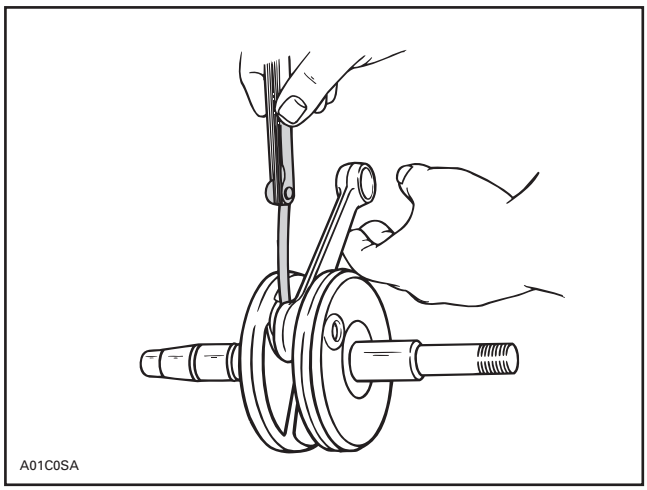
NOTE: Crankshaft deflection can not be correctly measured between centers of a lathe.

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, 377 443 and 503	0.20 - 0.53 mm (.008 - .021 in)	1.00 mm (.039 in)

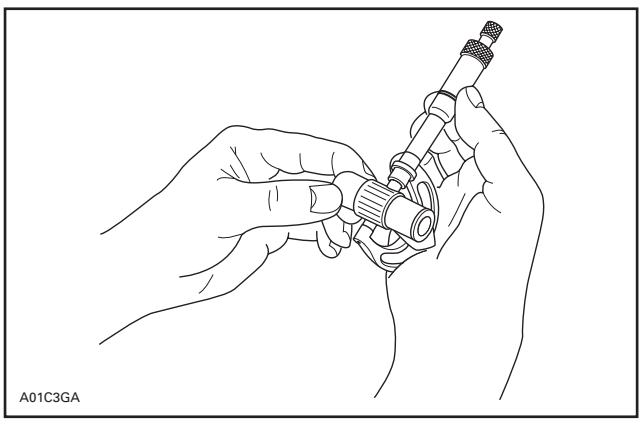
Using a feeler gauge, measure distance between thrust washer and crankshaft counterweight. If the distance exceeds specified tolerance, repair or replace the crankshaft.

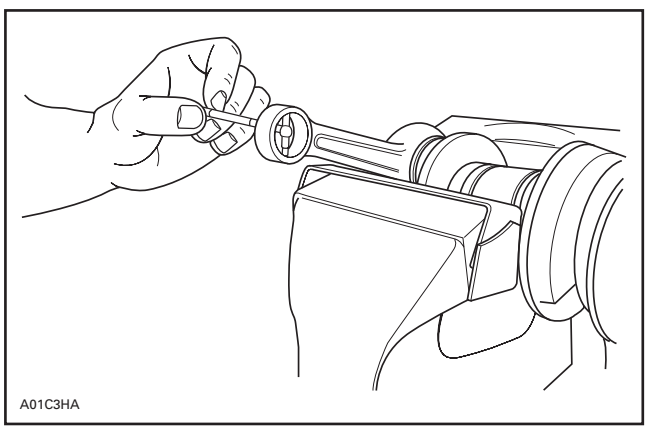


TYPICAL

CONNECTING ROD/PISTON PIN CLEARANCE

Measure piston pin with its needle bearing. Compare to inside diameter of connecting rod.





ENGINE TYPE	NEW PARTS MIN. - MAX.	WEAR LIMIT
All	0.03 - 0.012 mm (.0001 - .0005 in)	0.015 mm (.0006 in)

CONNECTING ROD/CRANKPIN CLEARANCE

ENGINE TYPE	NEW PARTS MIN. - MAX.	WEAR LIMIT
All	0.020 - 0.033 mm (.0008 - .0013 in)	0.05 mm (.0020 in)

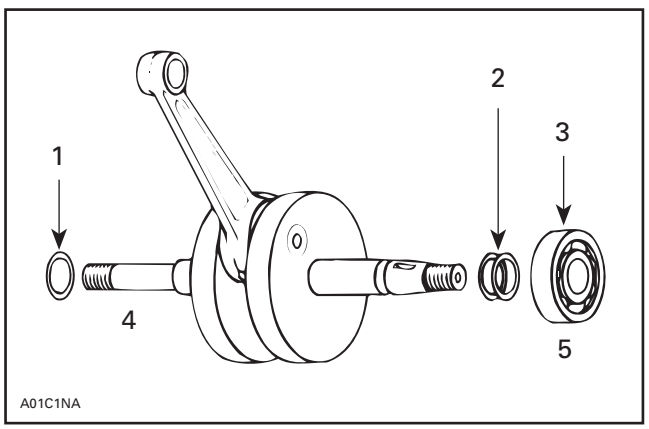
CRANKSHAFT END-PLAY

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)
1.00 mm (.040 in)

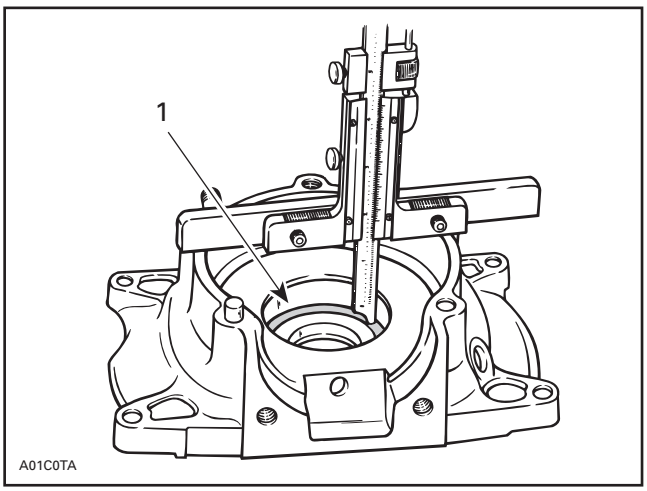
– micrometer

– caliper

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

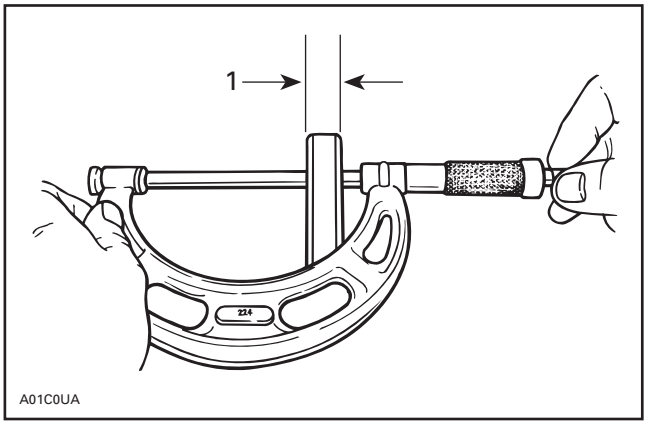
a. Measure crankcase halves as illustrated (M_1 and M_2).

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



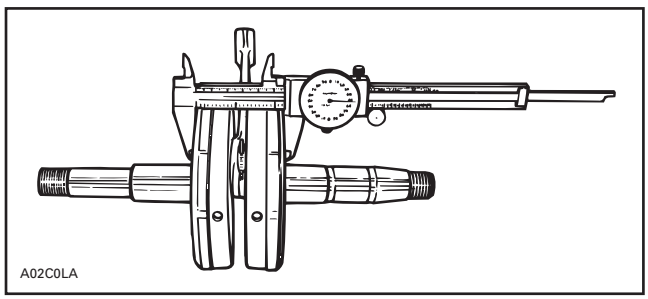
MEASURING M_1 AND M_2
1. Bearing seat

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.

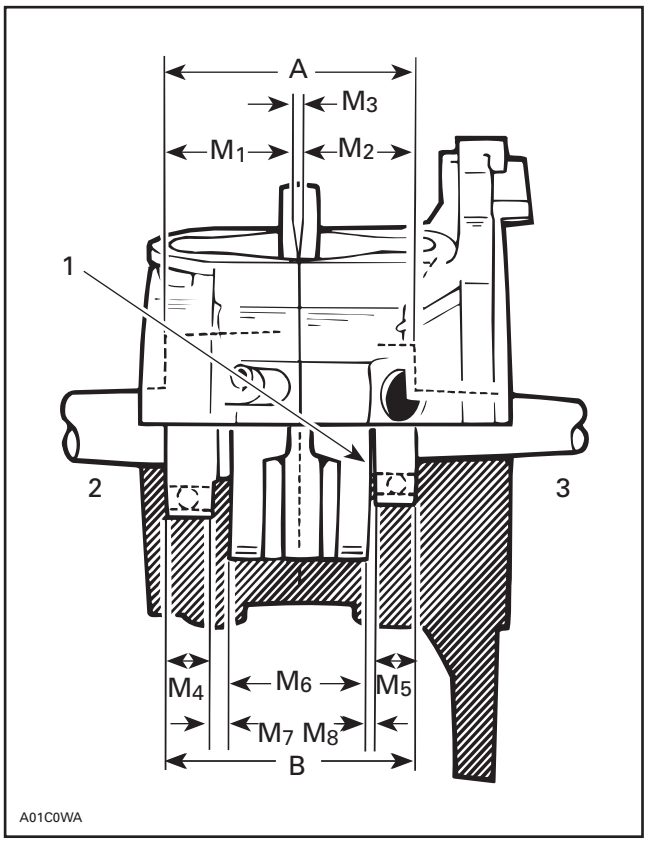
To Summarize

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 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, rotary valve 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.

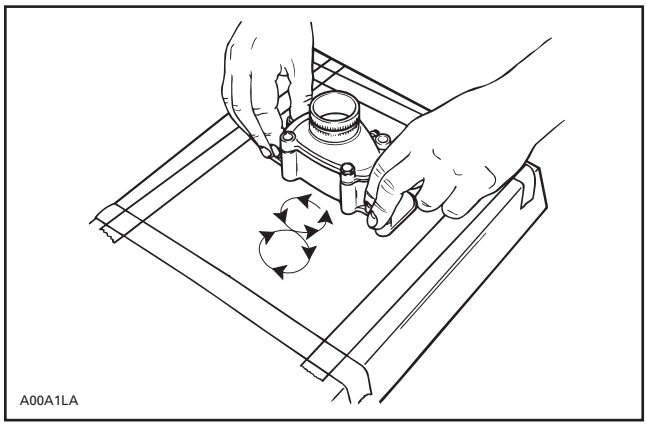
If any play is felt, part must be rectified.

RECTIFYING SURFACES

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

Rub manifold 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 295 000 007) on crankshaft end.

Remove both spark plugs.

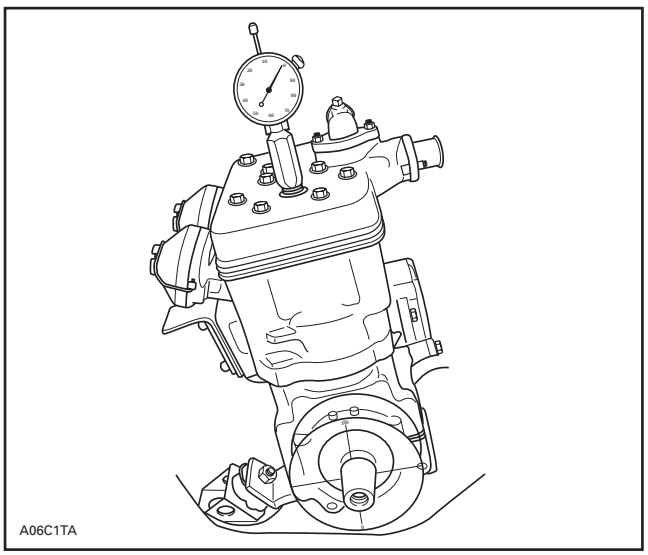
Install a TDC gauge (P/N 414 104 700) in spark plug hole on MAG side.

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.

Bring PTO piston to top dead center.



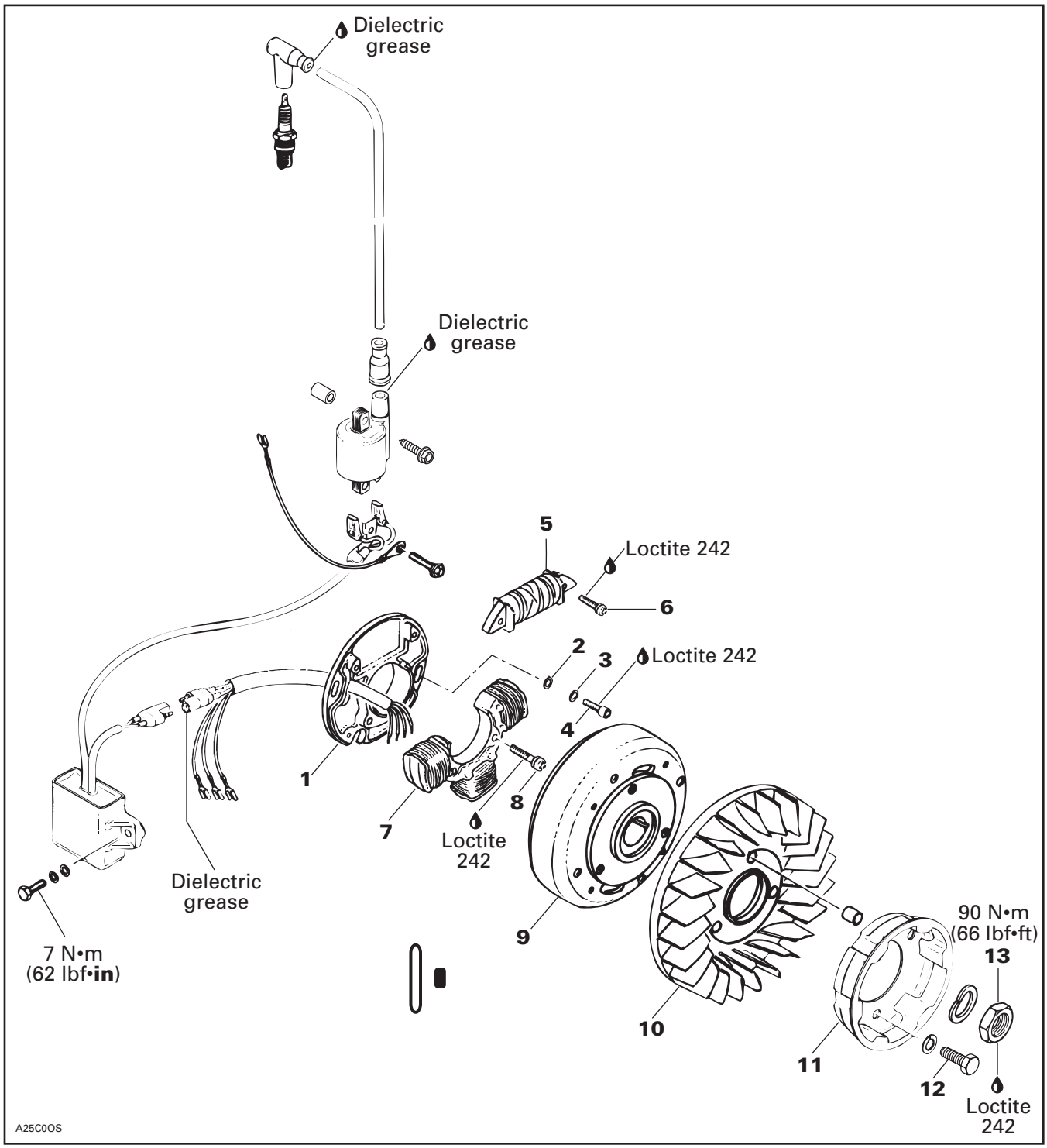
Interval between cylinders must be exactly 180°.

Any other reading indicates a misaligned (twisted) crankshaft.

CDI SYSTEM

NIPPONDENSO IGNITION SYSTEM WITH SINGLE GENERATING COIL

Tundra



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

CLEANING

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

▼ CAUTION

Clean armature and magneto using only a clean cloth.

DISASSEMBLY

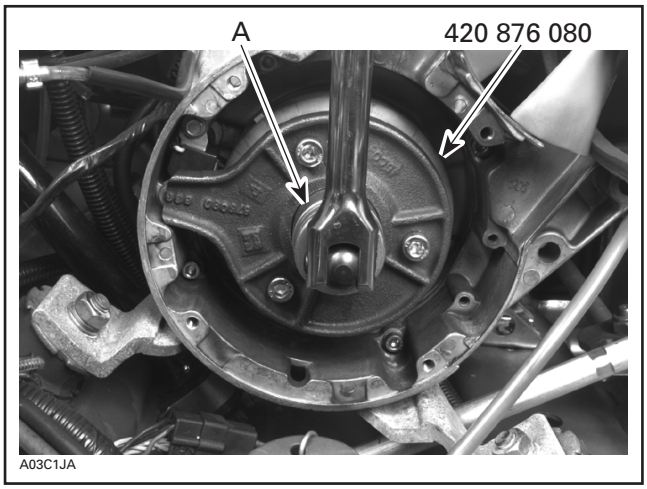
To gain access to magneto assembly, remove the following parts as needed on different engines:

– tuned pipe and muffler
– oil injection pump mounting plate from rewind starter
– rewind starter
– starting pulley no. 11 and fan no. 10

To remove magneto flywheel retaining nut no. 13, install puller ring (P/N 420 876 080) and M8 x 20 screws.

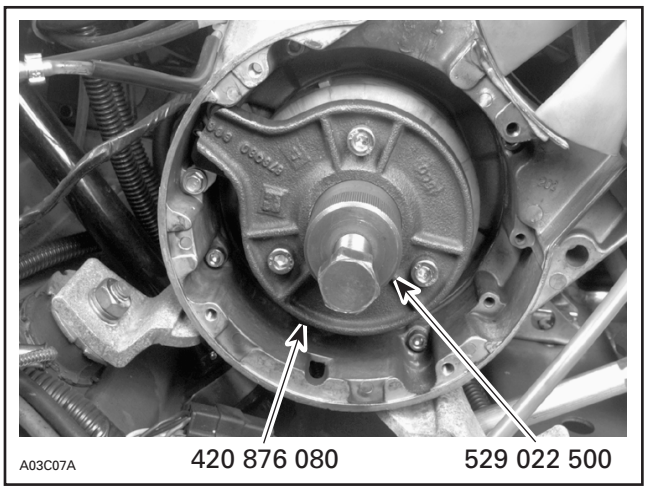
– Remove magneto flywheel nut, using a 30 mm socket machined to 40 mm (1.580 in) outside diameter by 16 mm (5/8 in) long.

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

To remove magneto flywheel no. 9, install the magneto puller (P/N 529 022 500).



TYPICAL

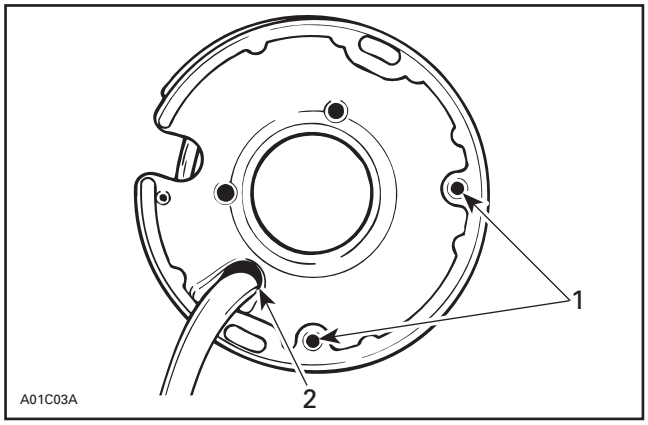
– Tighten puller bolt and at same time, tap on bolt head using a hammer to release magneto flywheel from its taper.

NOTE: Before disassembling armature plate, indexing marks should be scribed to facilitate reassembly.

REPAIR

To replace generator coil no. 2:

– Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.

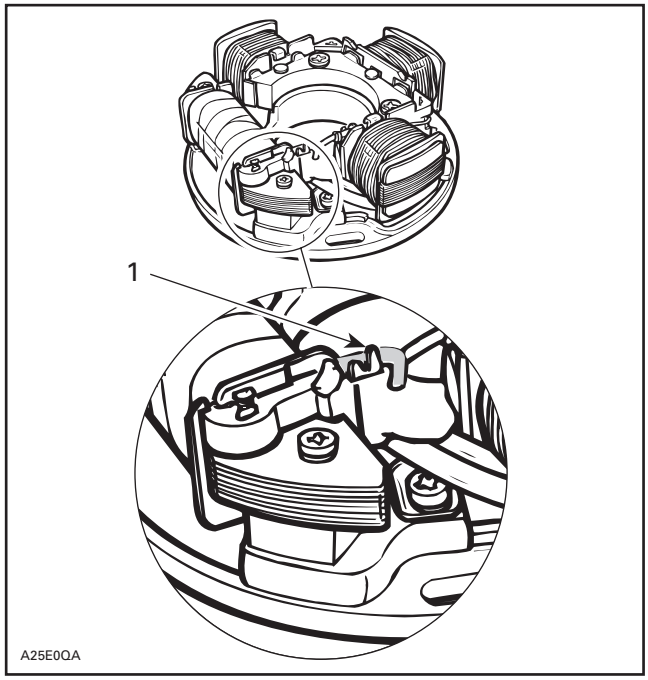


1. Heat
2. Protect harness from flame

▼ CAUTION

Protect harness from flame.

– Remove screws.
– Uncrimp and unsolder BLACK/RED wire from coil terminal.

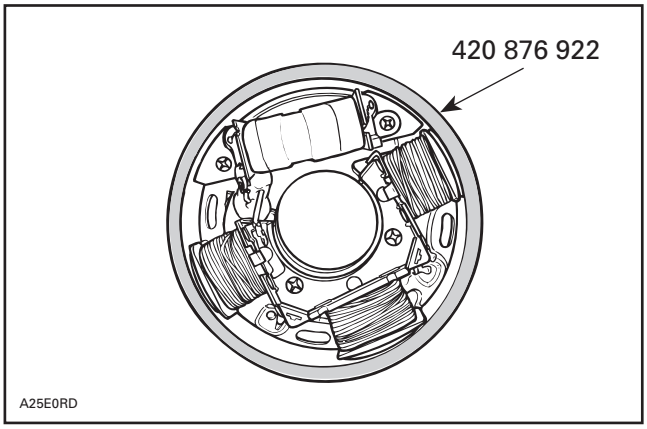


1. Uncrimp and unsolder wire here

– Strip end of old wire then crimp and solder on new coil.

Apply Loctite 242 (blue) to screws **nos. 6** and **8** then install the new coil on armature plate.

Use magneto coil centering tool (P/N 420 876 922) and install it so that it fits around armature plate before tightening screws.

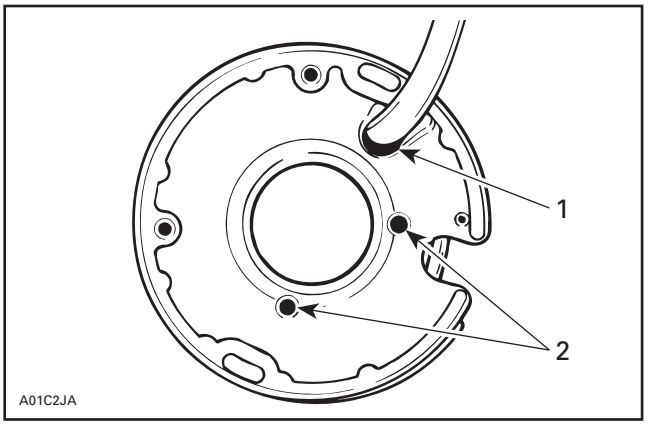


▼ CAUTION

Before reinstalling the magneto, remove the loose epoxy from harness.

To replace lighting generator coil **no. 7**:

– Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.

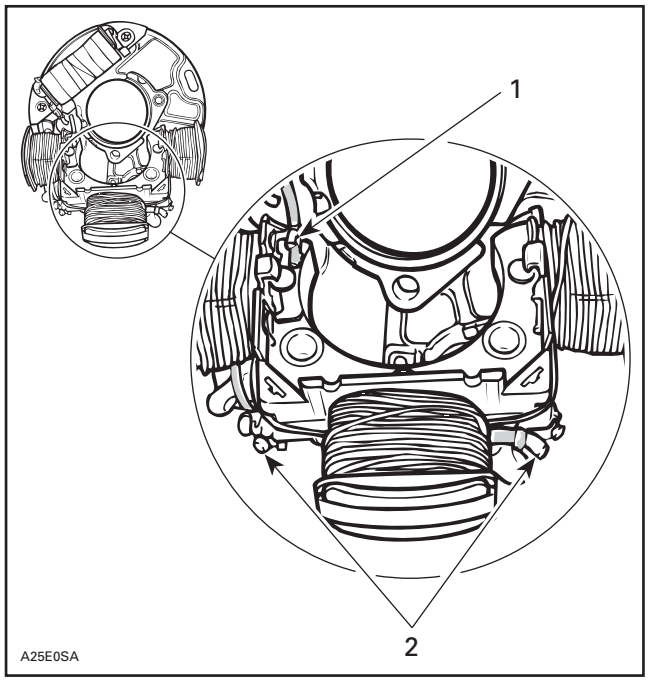


1. Protect harness from flame
2. Heat

▼ CAUTION

Protect harness from flame.

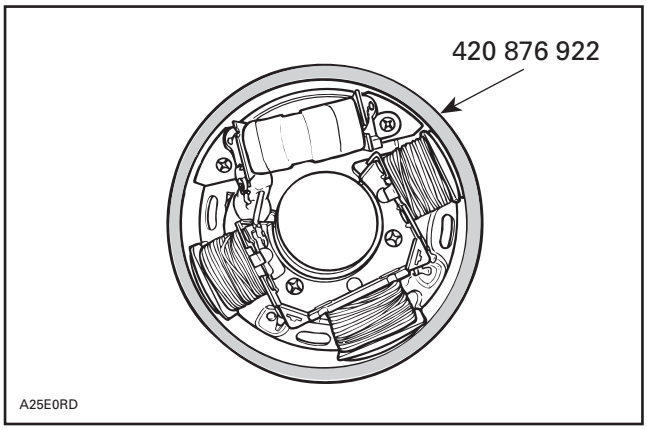
– Remove screws.
– Uncrimp and unsolder YELLOW and YELLOW/BLACK wires from coil terminals.
– Uncrimp and unsolder ground wire (BLACK) from coil core.



1. Uncrimp and unsolder ground wire (BLACK) here
2. Uncrimp and unsolder YELLOW and YELLOW/BLACK wires here

– Position new coil, crimp and solder all wires.
– Prior to assembly, apply Loctite 242 (blue).

Use magneto coil centering tool (P/N 420 876 922) and install it so that it fits around armature plate before tightening screws.



▼ CAUTION

Before reinstalling magneto, remove the loose epoxy from harness.

ASSEMBLY

Position the armature plate **no. 1** on the crankcase, aligning the marks on both parts.

Put a drop of Loctite 242 (blue) on screw threads and tighten.

Clean crankshaft extension (taper).

Apply Loctite 242 (blue) on taper.

Position Woodruff key, magneto flywheel **no. 9** and lock washer **no. 12** on crankshaft.

Clean nut threads and apply Loctite 242 (blue) before tightening nut **no. 13**.

Torque nut to 90 N•m (66 lbf•ft).

At reassembly coat all electric connections with silicone dielectric grease (P/N 413 701 700) to prevent corrosion or moisture penetration.

▼ CAUTION

Do not use silicone "sealant", this product will corrode contacts.

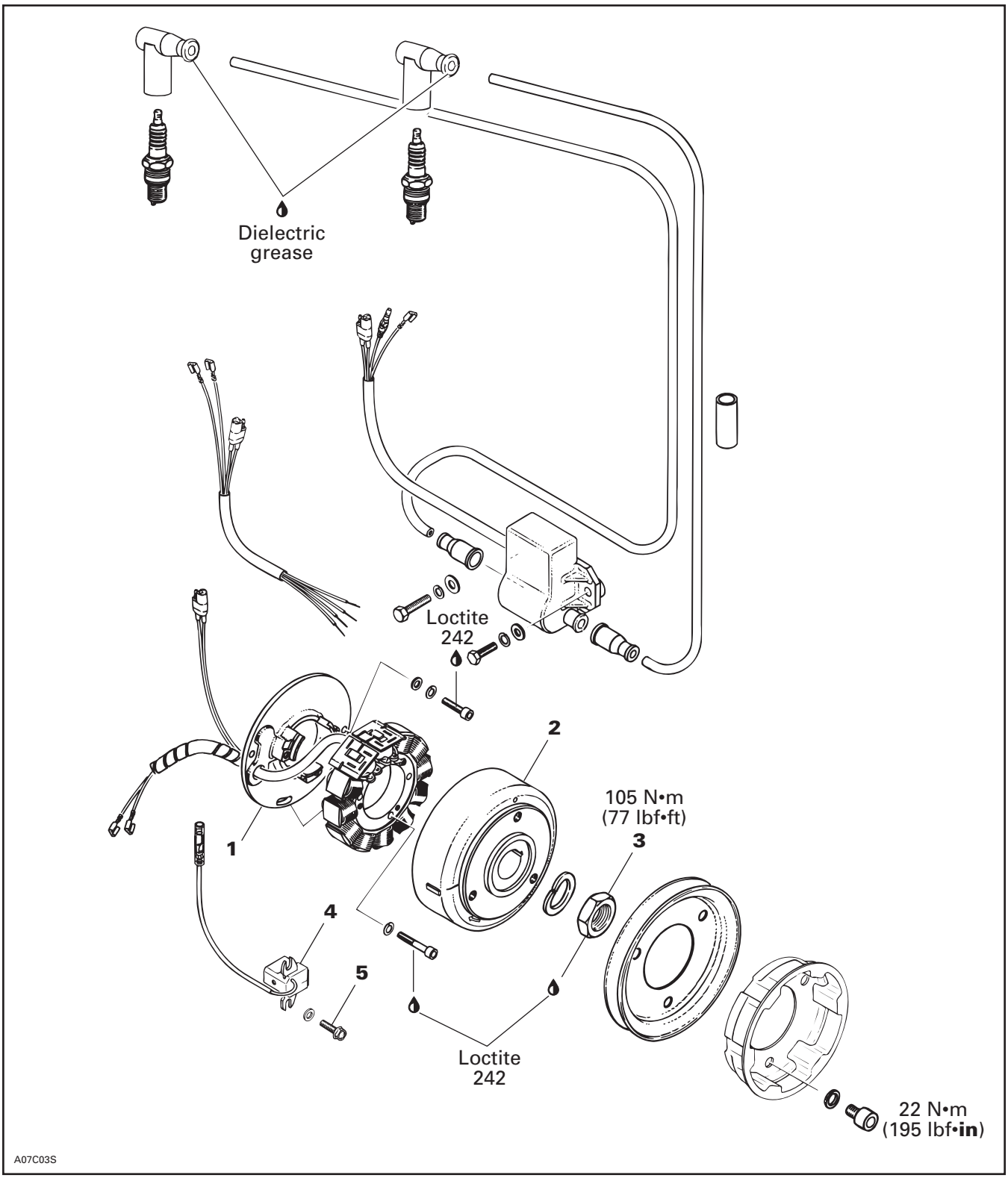
Reinstall fan and starting pulley. Make sure yellow fin of fan is aligned with timing hole when piston is at TDC.

Ignition Timing

Check ignition timing as described in IGNITION TIMING 06-03.

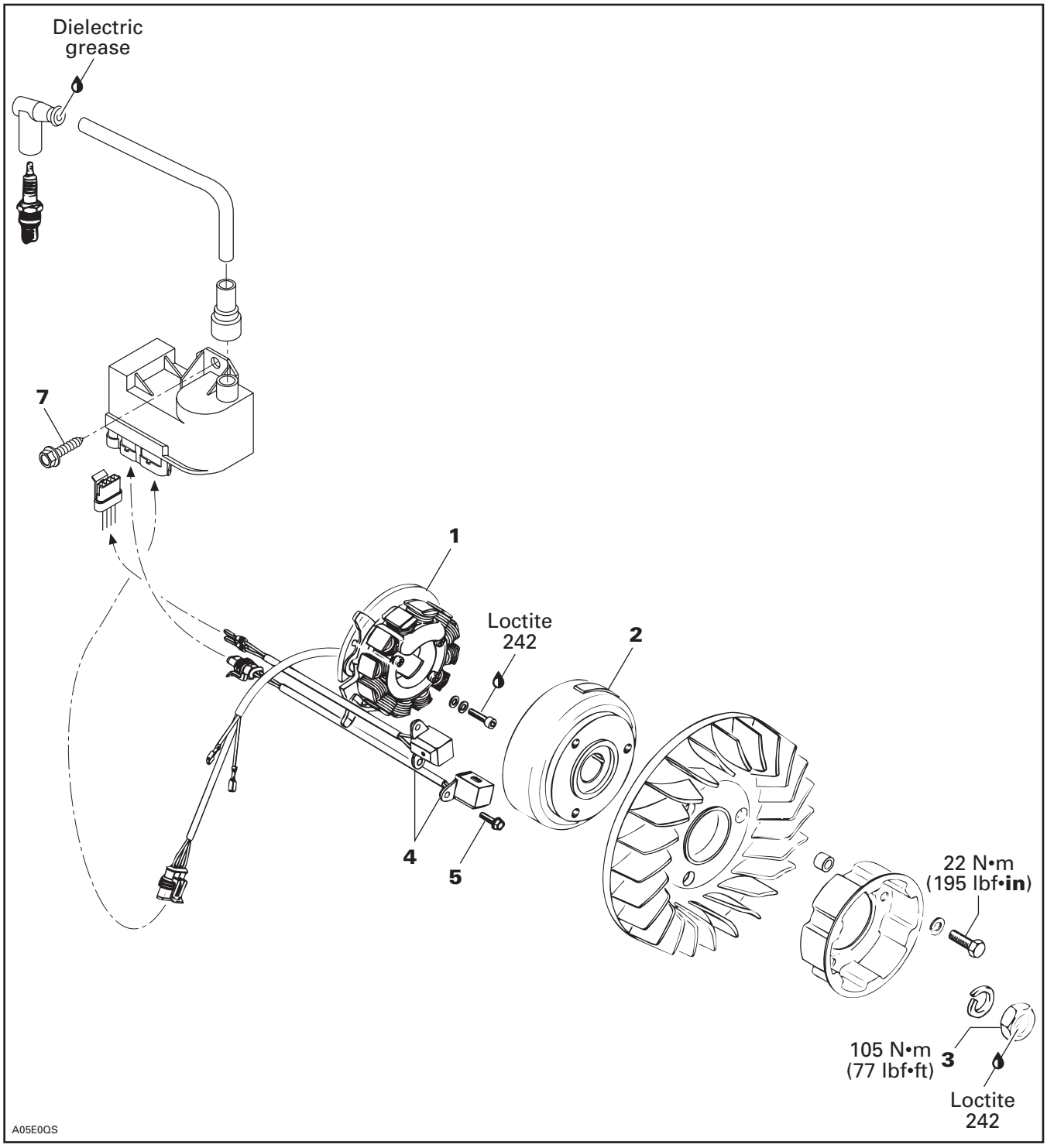
DUCATI IGNITION SYSTEM

Formula S/SL



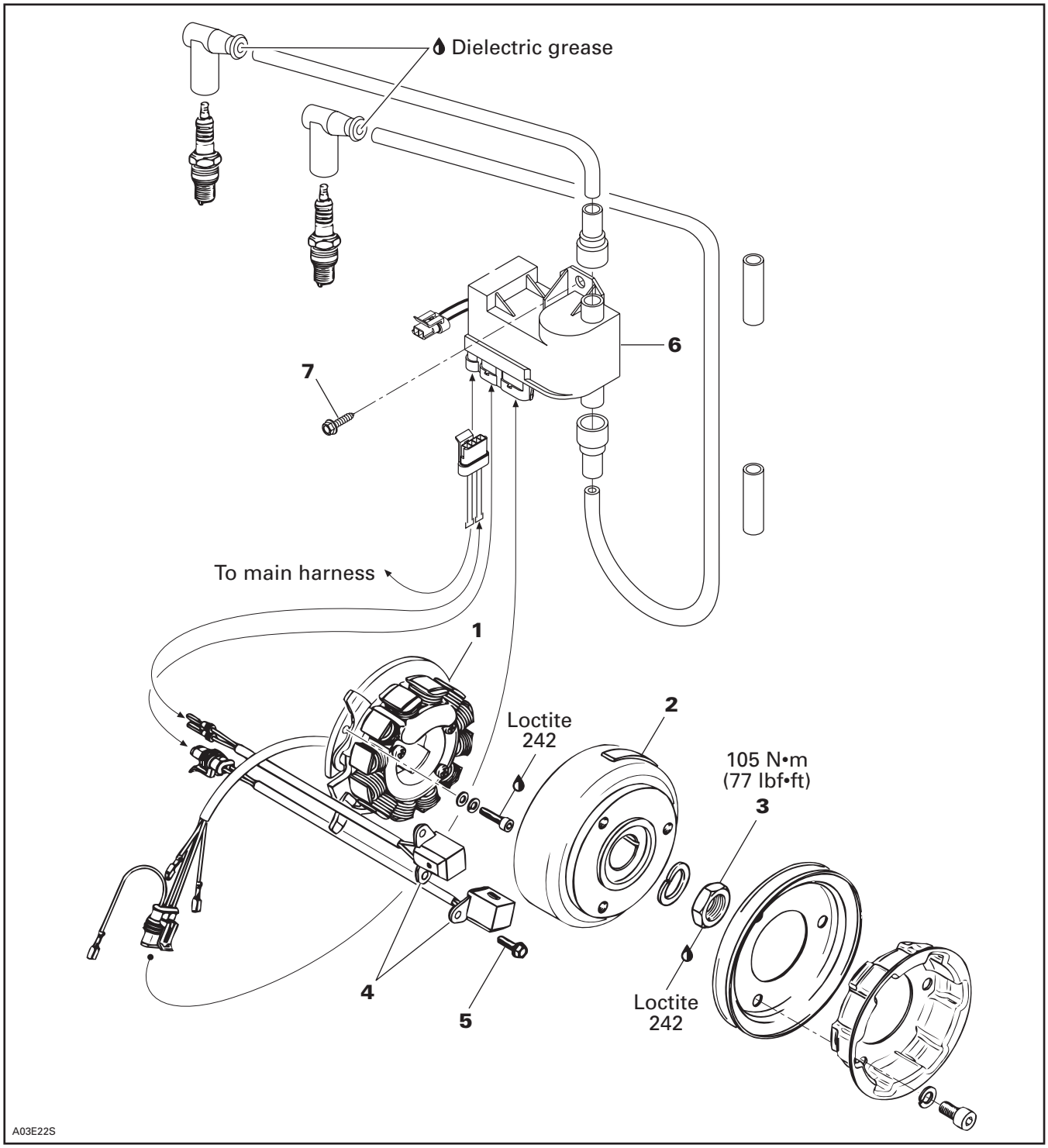
RER IGNITION SYSTEM

Tundra R



PARTS

Skandic 380/500, Touring E/LE/SLE and Formula DLX 380/500



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

CLEANING

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

▼ CAUTION

Clean armature and magneto using only a clean cloth.

DISASSEMBLY

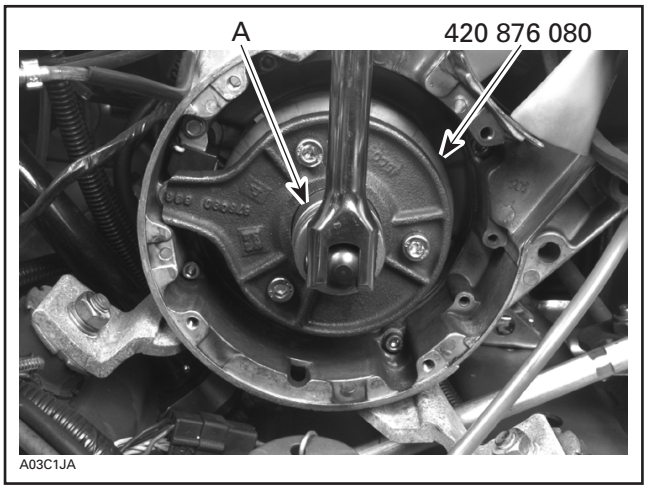
To gain access to magneto assembly, remove the following parts as needed on different engines:

– tuned pipe and muffler
– oil injection pump mounting plate from rewind starter
– rewind starter
– starting and V-belt pulleys

To remove magneto flywheel retaining nut **no. 3**, install puller ring (P/N 420 876 080) and M8 x 20 screws.

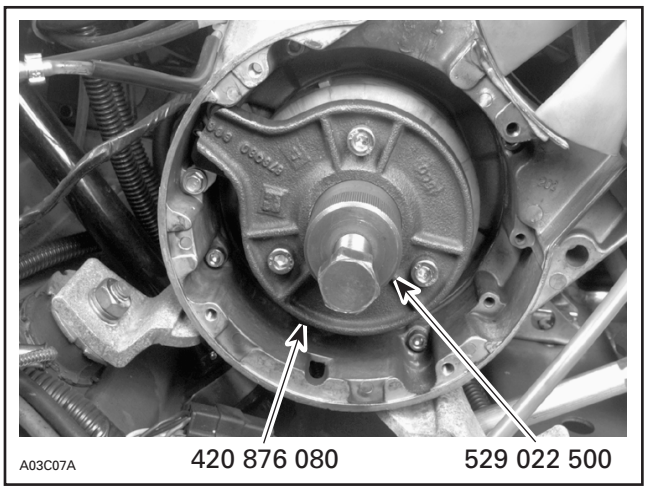
– Remove magneto flywheel nut, using a 30 mm socket machined to 40 mm (1.580 in) outside diameter by 16 mm (5/8 in) long.

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

To remove magneto flywheel **no. 2**, install the magneto puller (P/N 529 022 500).



TYPICAL

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

NOTE: Before disassembling armature plate, indexing marks should be scribed to facilitate reassembly.

To replace generator coil **no. 1**:

– Heat the armature plate to 93°C (200°F) around the screw holes to break the threadlocker bond.

To replace trigger coil **no. 4**:

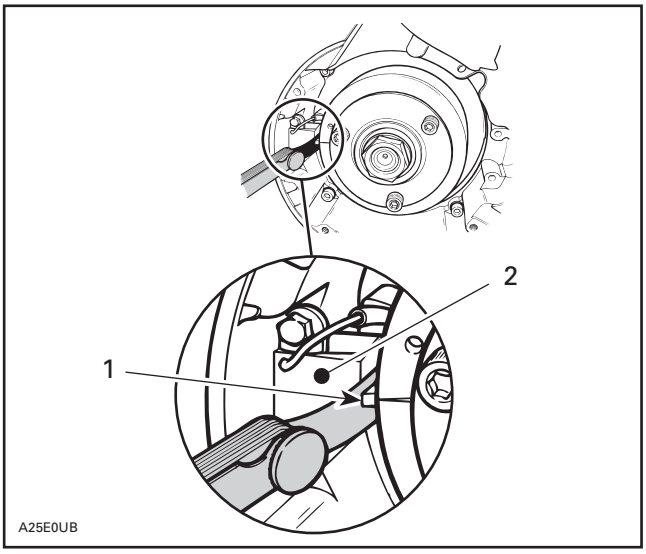
– Disconnect trigger coil wire (RED).
– Remove grommet from crankcase where trigger coil wire exits magneto housing.
– Remove retaining screws **no. 5**.
– Remove trigger coil and carefully pull wire.
– Install new trigger coil and other parts removed.

ADJUSTMENT

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 06-02.

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.
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

To replace armature:

– Disconnect the 2-wire connector (GREEN and WHITE wires).
– Disconnect YELLOW/BLACK and YELLOW wires.
– Remove grommet from crankcase where magneto harness exits magneto housing.
– Remove armature plate retaining screws.
– Remove armature plate with armature and carefully pull wires.
– Install new parts and other parts removed.

ASSEMBLY

Clean crankshaft extension (taper).

Apply Loctite 242 (blue) on taper.

Position Woodruff key, flywheel and lock washer on crankshaft.

Clean nut threads and apply Loctite 242 (blue) before tightening nut to 105 N•m (77 lbf•ft).

At reassembly coat all electric connections with silicone dielectric grease (P/N 413 701 700) to prevent corrosion or moisture penetration.

▼ CAUTION

Do not use silicone "sealant", this product will corrode contacts.

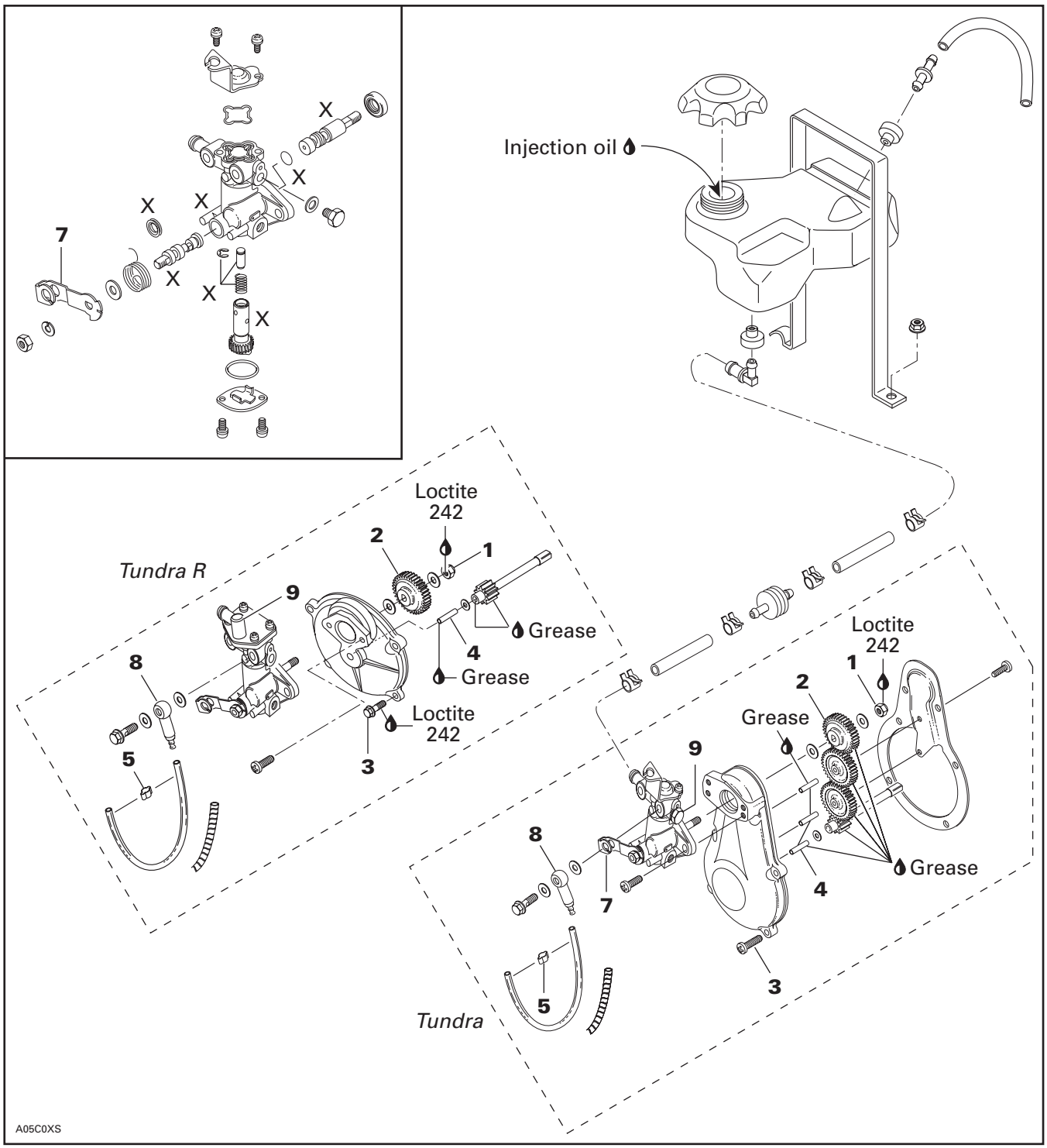
Ignition Timing

Check as described in IGNITION TIMING 06-02.

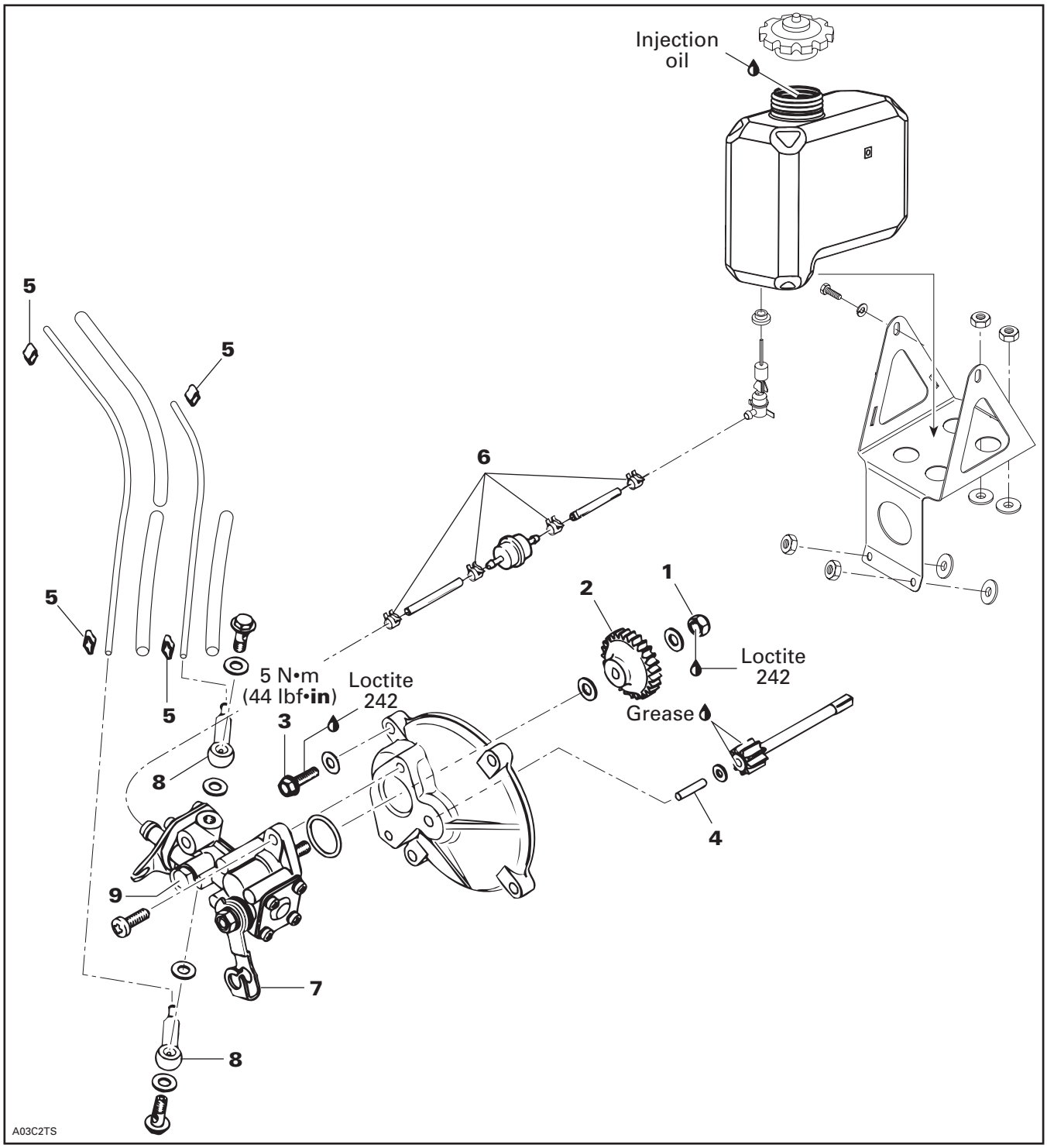
OIL INJECTION SYSTEM

OIL INJECTION PUMP

277 Engine



377, 443 and 503 Engines



PARTS

OIL SYSTEM LEAK TEST

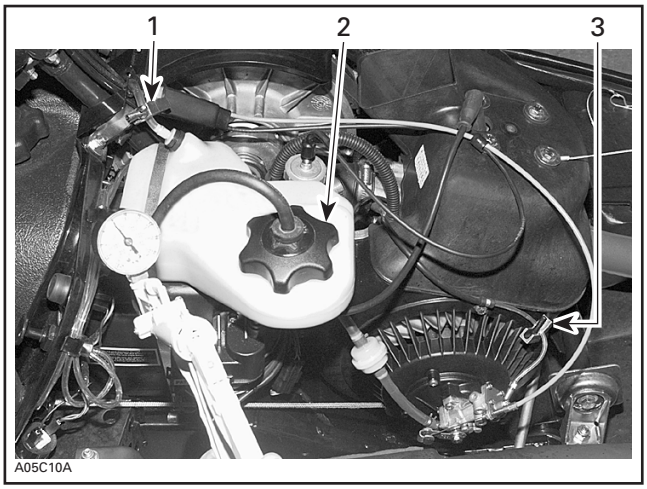
All Models

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).

Tundra Series

Install hose pinchers (P/N 295 000 076) on oil reservoir vent line and outlet hose.

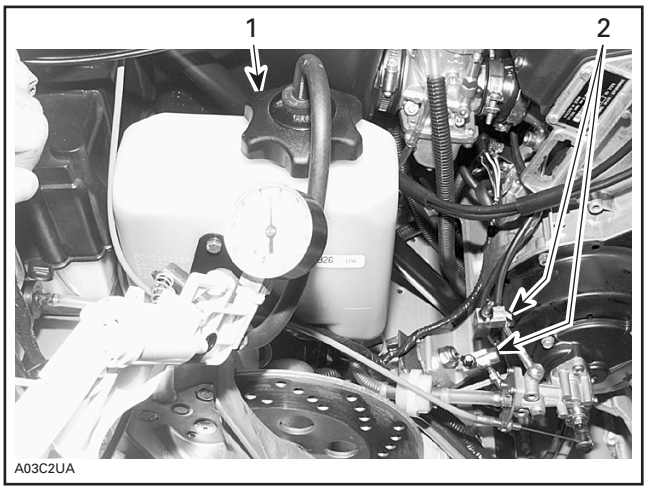


TUNDRA SERIES

1. *Hose pincher on vent line*
2. *Special cap on reservoir*
3. *Hose pincher on outlet hose*

S-Series

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



S-SERIES

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

All Models

Connect pump of leak testing kit to special cap.

Pressurize oil system to 34 kPa (5 PSI). That pressure must not drop during 3 minutes.

If pressure drops, locate leak(s) and repair/replace leaking component(s). To ease locating leak(s) spray soapy water on components, bubbles will indicate leak location(s).

OIL PUMP IDENTIFICATION

Different engines need different pumps. See identification on pump lever **no. 7**.

▼ CAUTION

Always mount proper pump on engine.

ENGINE TYPE	OIL PUMP IDENTIFICATION
277 (Tundra)	135 T
277 (Tundra R)	132 J*
377 (Formula S)	L4 or L5*
377 (Formula DLX 380, Touring E and Skandic 380)	L6*
503 (Formula SL)	E6*
503 (Skandic 500, Touring SLE and Formula DLX 500)	E7*

* These oil pumps do not supply any oil at idle. They are called zero oil delivery at idle.

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

CLEANING

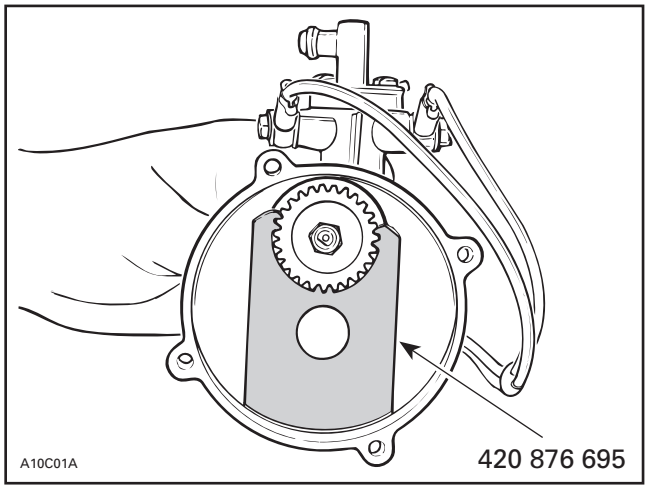
Clean all metal components in a non-ferrous metal cleaner.

DISASSEMBLY

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

To remove gear retaining nut **no. 1**, first extract the needle roller **no. 4** with pliers then lock gear **no. 2** in place using the following gear holder:

ENGINE TYPE	TOOL P/N
377/443/503	420 876 695



ASSEMBLY

At gear **no. 2** assembly, apply a light coat of synthetic grease (P/N 413 711 500) on gear teeth.

The needle roller **no. 4** must be engaged as deep as possible in the pump mounting flange.

Always check for spring clips **no. 5** and clamps **no. 6** tightness.

Torque screws **no. 3** to 5 N•m (44 lbf•**in**).

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

Secure barrel with plastic washer and circlip.

Verify cable and oil pump lever operation.

ADJUSTMENT

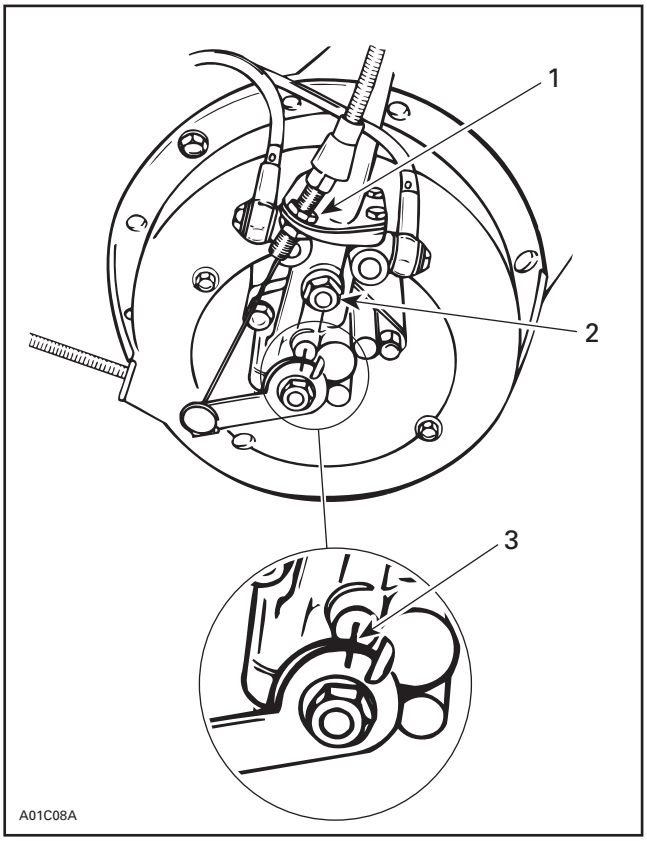
Prior to adjusting the pump, make sure all carburetor adjustments are completed.

Synchronizing Pump with Carburetor

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

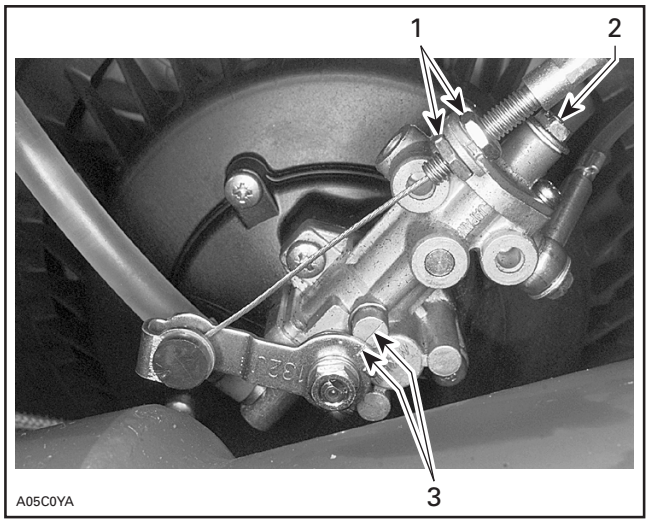
The marks on the pump casting and on the lever must align. Pump lever mark may be up to 2 mm (.080 in) at right of casting mark. So pump may be partially opened at idle. Loosen the adjuster nut and adjust accordingly.

Retighten the adjuster nut.



TYPICAL — S-SERIES AND TUNDRA

1. *Adjuster nuts*
2. *Bleeder screw*
3. *Marks must align*



TYPICAL — TUNDRA R

1. *Adjuster nuts*
2. *Bleeder screw*
3. *Marks must align*

▼ CAUTION

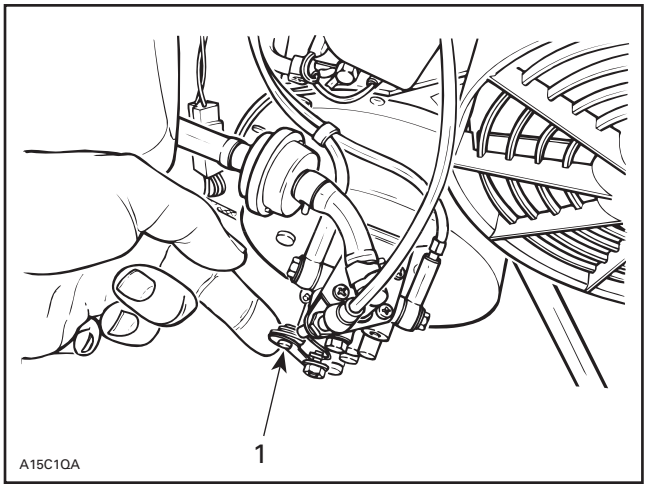
Proper oil injection pump adjustment is very important. Any delay in the opening of the pump can result in serious engine damage.

BLEEDING

All oil lines should be full of oil. If required, bleed the main oil line (between tank and pump) by loosening the bleeder screw no. 9 until all air has escaped from the line.

Make sure the tank is sufficiently filled.

Check the small oil lines (between pump and intake manifold). If required, fill the lines by running the engine at idle speed while holding the pump lever in fully open position.



TYPICAL — ENGINE AT IDLE

1. Fully open position

◆ WARNING

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

CHECKING OPERATION

Oil Pump

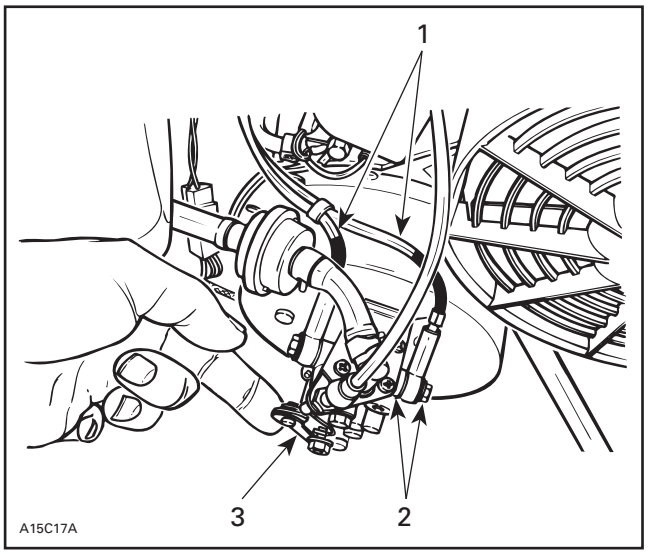
On Vehicle

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

Lift rear of vehicle and support with a mechanical stand. Unbolt banjo fittings from pump. Start engine and stop it as soon as it fires.

Check that oil level in small oil lines is passed banjo fittings end by about 25 mm (1 in) (this will be indicated by a clear section of small oil lines of about 25 mm (1 in)). Repeat the procedure until this condition is attained.

Reconnect banjo fittings with a washers on each side, start engine and run at idle while holding the pump lever in fully open position. Oil columns must advance into small oil lines.



TYPICAL — ENGINE AT IDLE

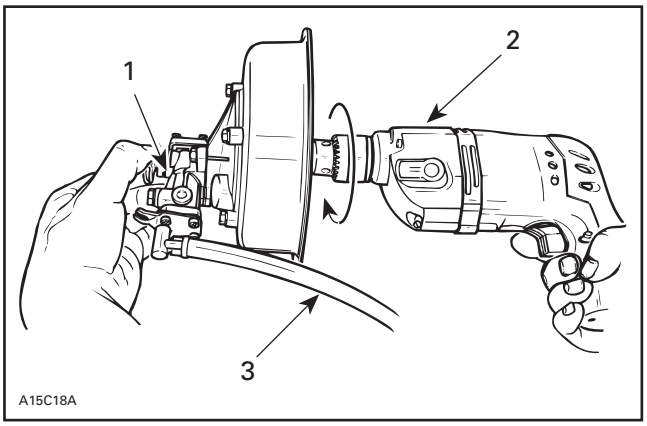
1. Oil columns advancing
2. Washer on each side
3. Fully open position

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 tubes. If oil drops, verify check valve operation in banjo fittings. Replace as necessary.

Test Bench

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



TYPICAL

1. *Fully open position*
2. *Counterclockwise rotating drill*
3. *Main line*

Banjo Fitting

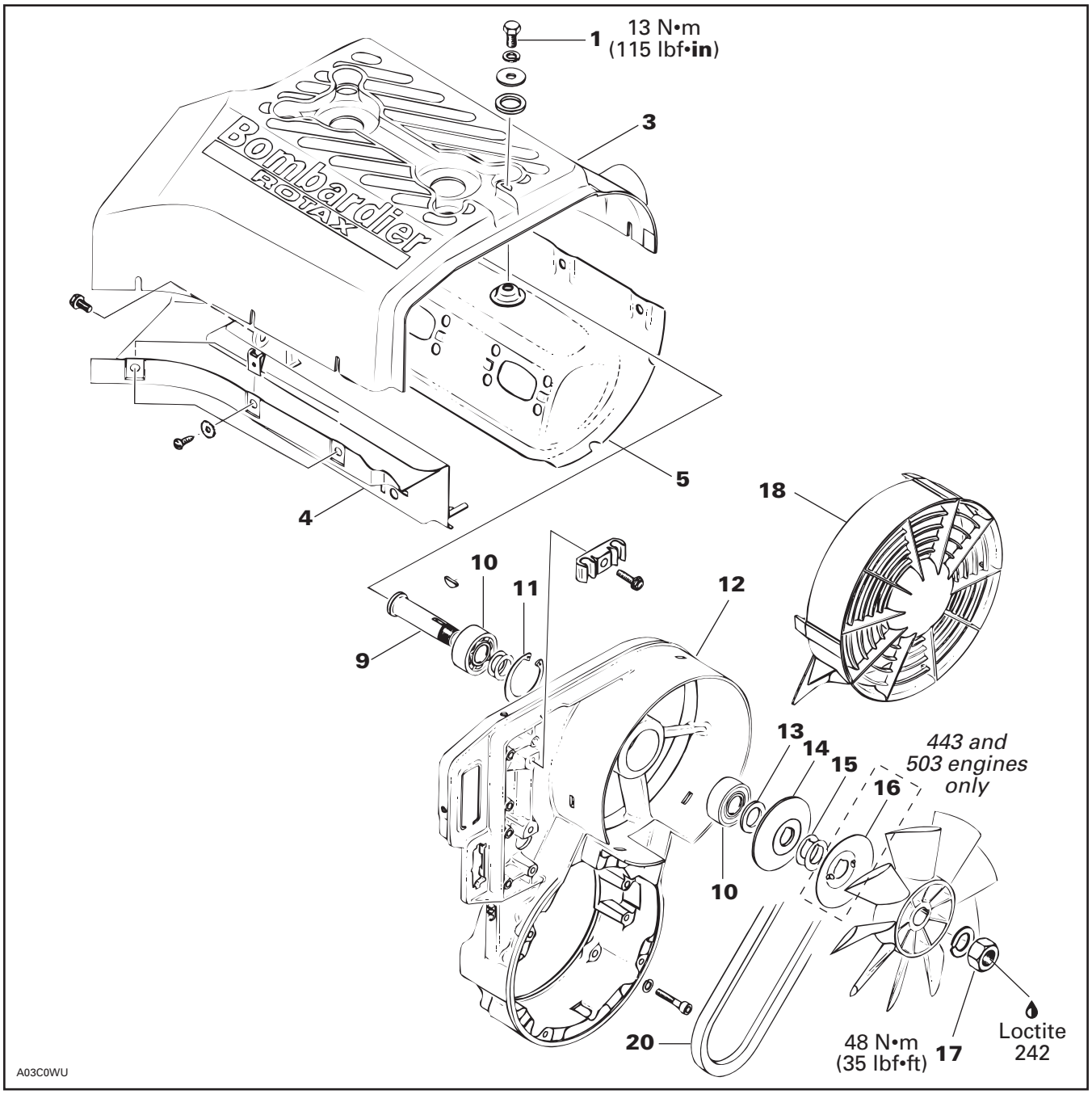
Inside the banjo fitting, there is a ball that acts as a check valve. To verify this check valve, proceed the same as for checking pump operation on vehicle. First unbolt banjo fitting from pump. After restarting the engine, check that a clear section in small oil line is present. Reconnect banjo fitting.

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

NOTE: For 277 engine radial fan cooling system, refer to CDI SYSTEM 04-05.

377, 443 and 503 Engines



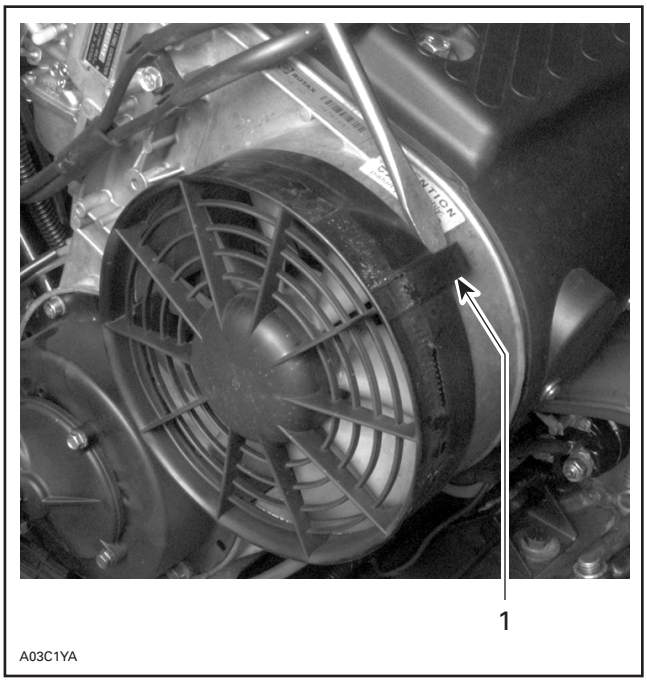
PARTS

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

REMOVAL

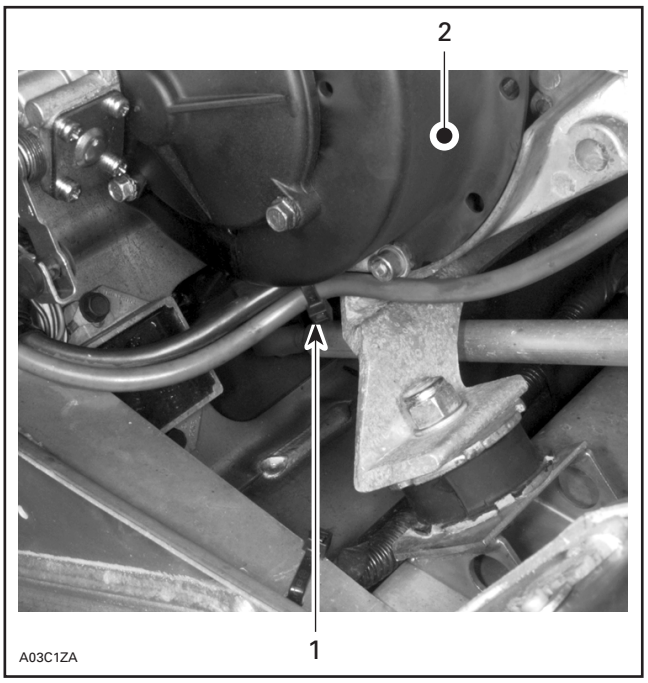
Remove muffler.

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

Cut locking tie located under rewind starter (electric start models only).

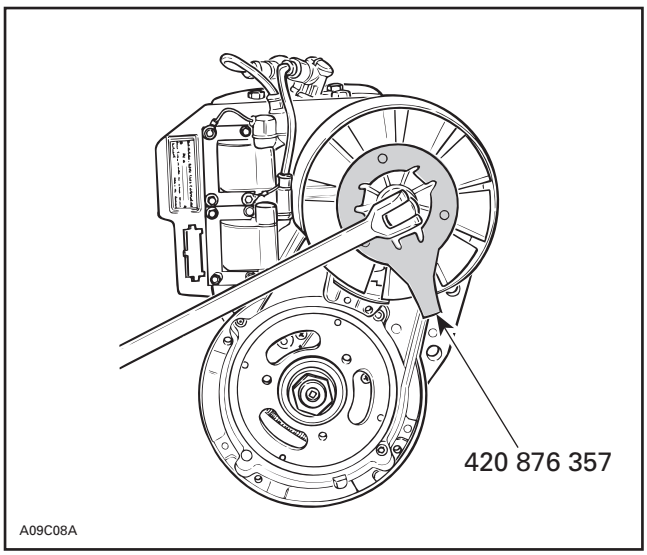


ELECTRIC START MODELS ONLY

1. Cut this locking tie
2. Rewind starter

Remove rewind starter and put it aside. On models so equipped remove connecting flange bolted to fan housing.

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



TYPICAL

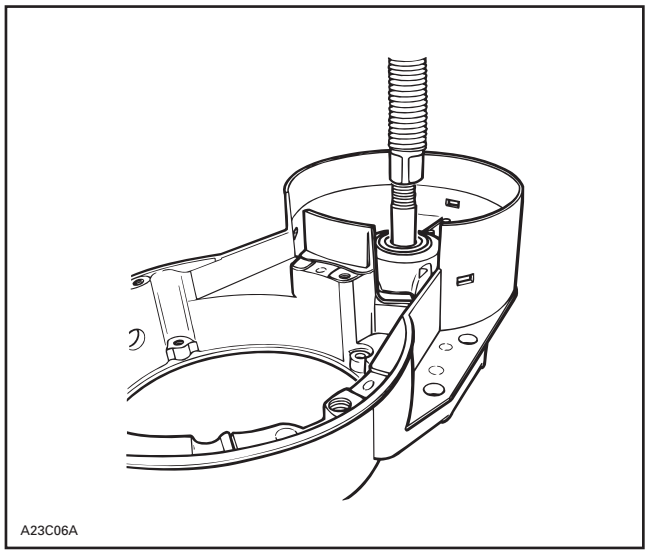
Unplug trigger coil(s) then remove fan housing ass'y.

CLEANING

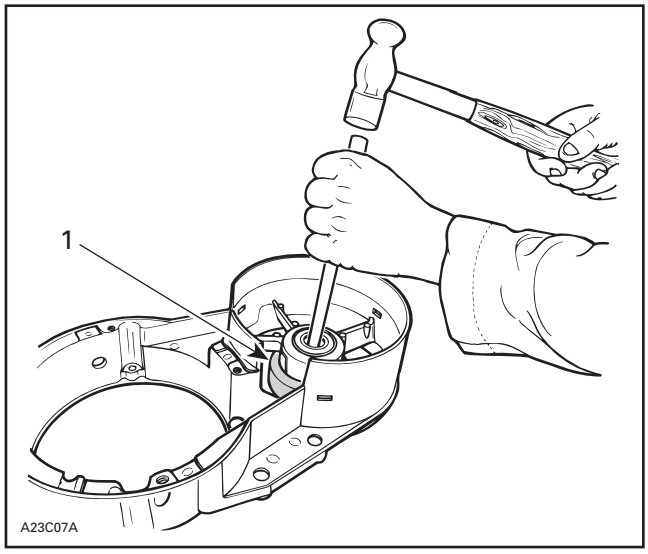
Clean all metal components in a non-ferrous metal cleaner.

DISASSEMBLY AND ASSEMBLY

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 242 (blue) on screw **no. 1** threads.

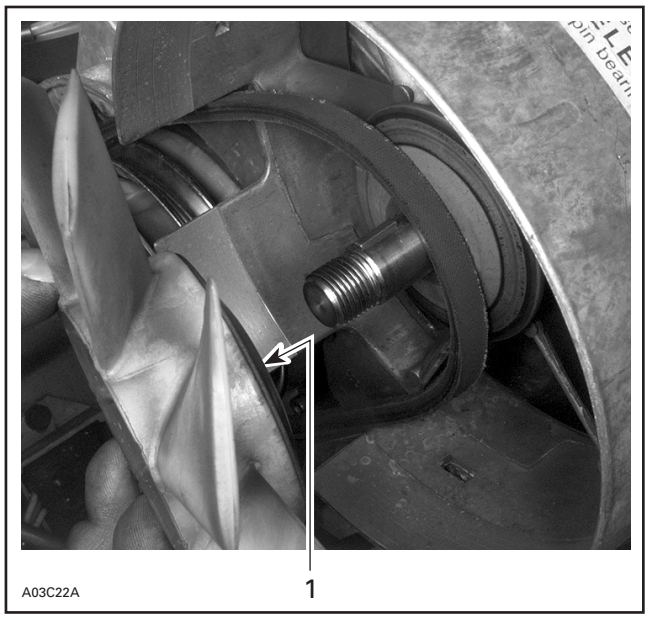
A gasket must be placed on both sides (inner and outer) of intake and exhaust holes of cylinder cowl **nos. 4** and **5**.

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.

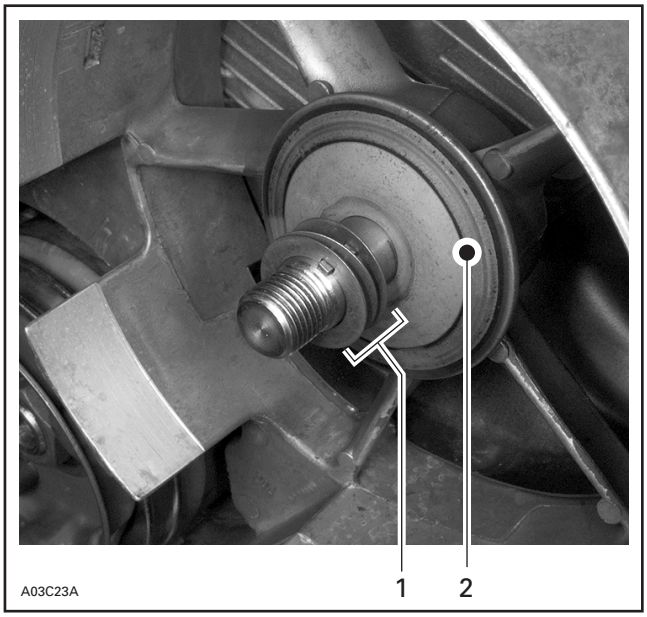
Remove fan with pulley half.



1. Remove fan with pulley half

Remove fan belt.

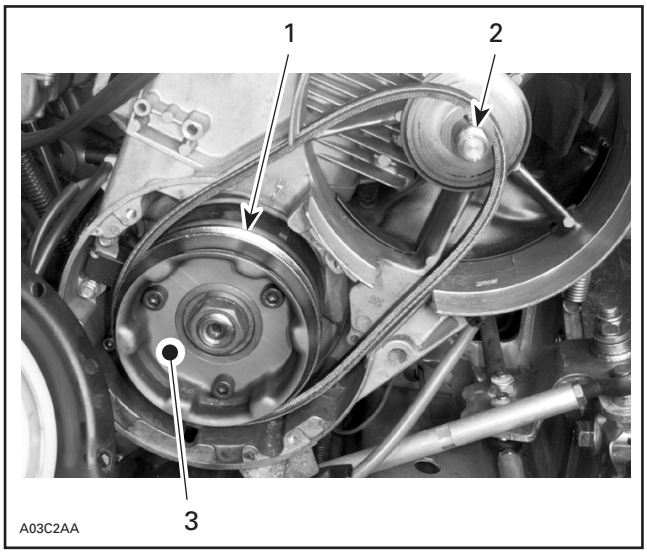
Leave shims and second half pulley in place. Refer to the following photo.



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

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

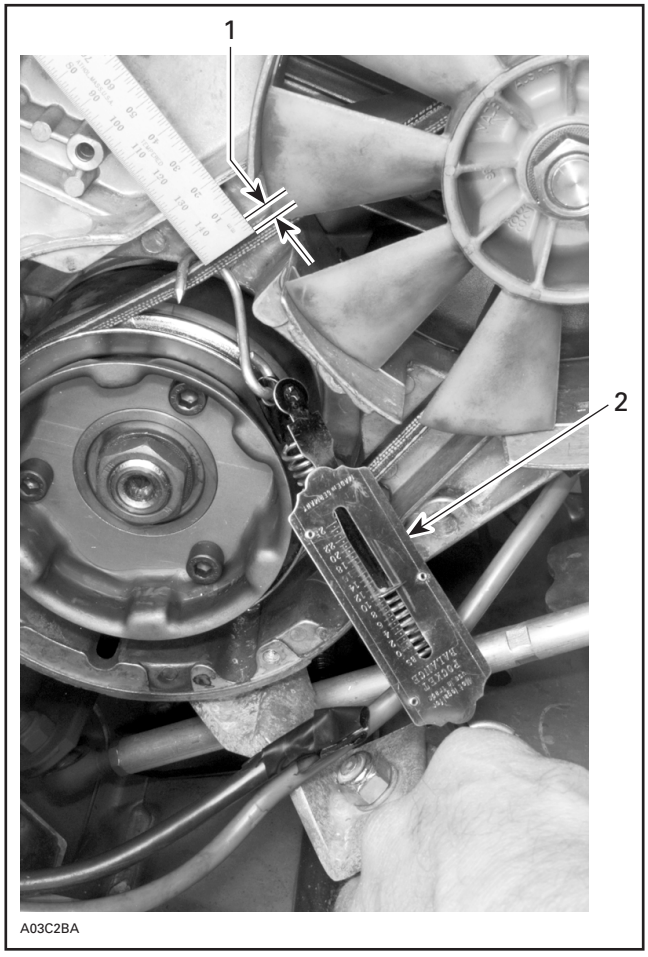
Reinstall fan assembly on fan shaft. Temporarily tighten fan nut.

▼ 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.



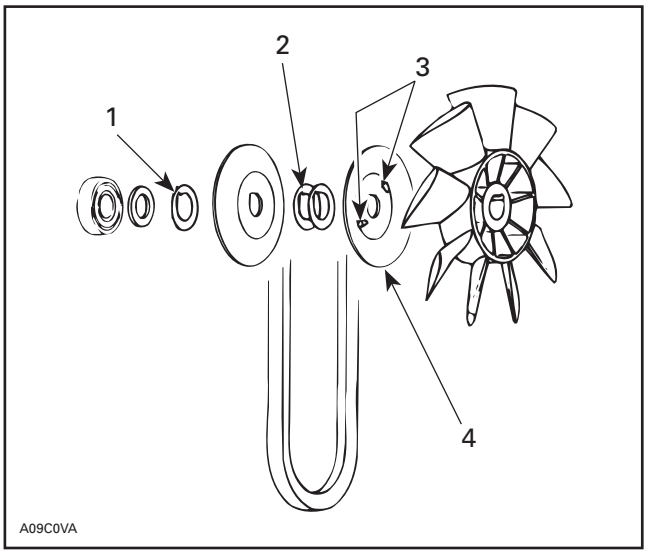
TYPICAL

1. Measure deflection here
2. Fish scale

Belt deflection must be according to the following specifications:

ENGINE TYPE	BELT DEFLECTION	FORCE APPLIED
377	8.5 mm (11/32 in)	5 kg (11 lb)
443 and 503	9.5 mm (3/8 in)	

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 half pulley **no. 14** (housing side).

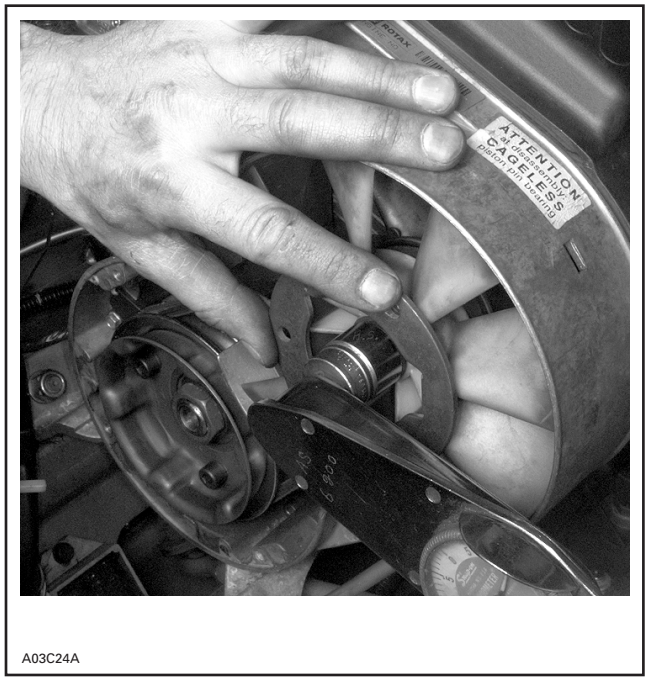


1. Unused shim(s) here
2. Adjust here
3. Positioning noses
4. Some engines only

Some engines have a separate metal pulley half instead of using back of fan as pulley half. On first mentioned engines, 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 fan holder tool (P/N 420 876 357), as shown in the following photo.

NOTE: Apply Loctite 242 (blue) on fan nut threads.



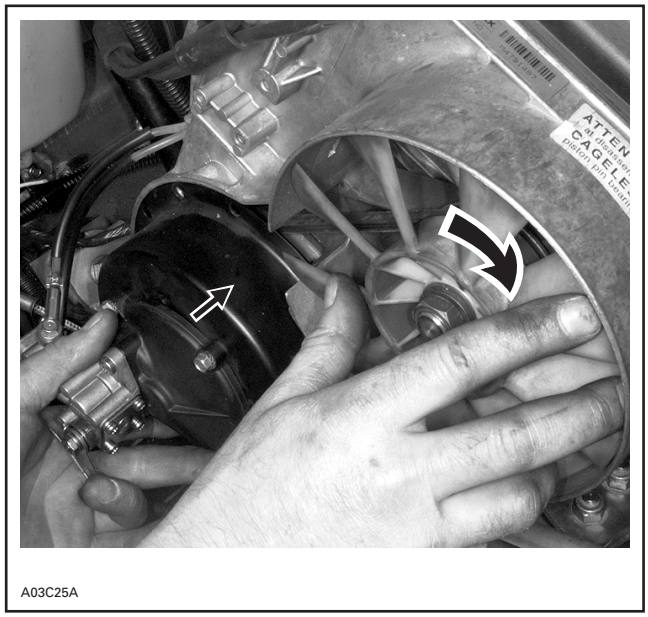
TORQUE FAN NUT USING FAN HOLDER TOOL

Finalizing Reassembly

Reinstall rewind starter.

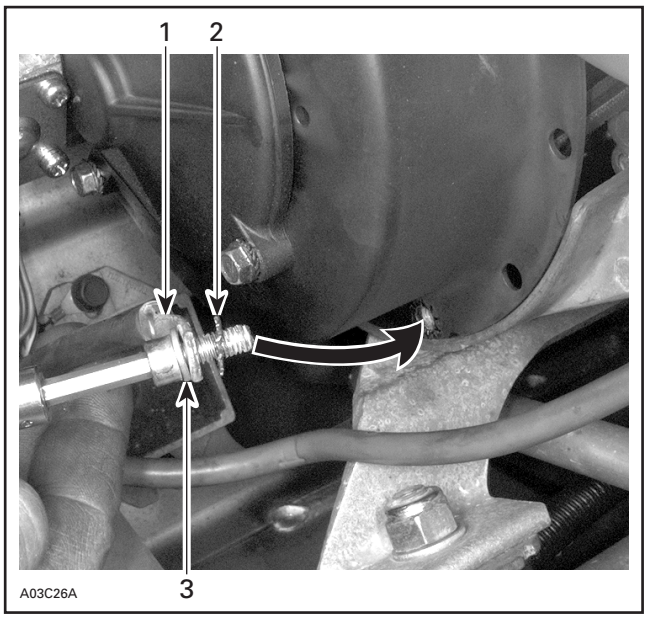
▼ CAUTION

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

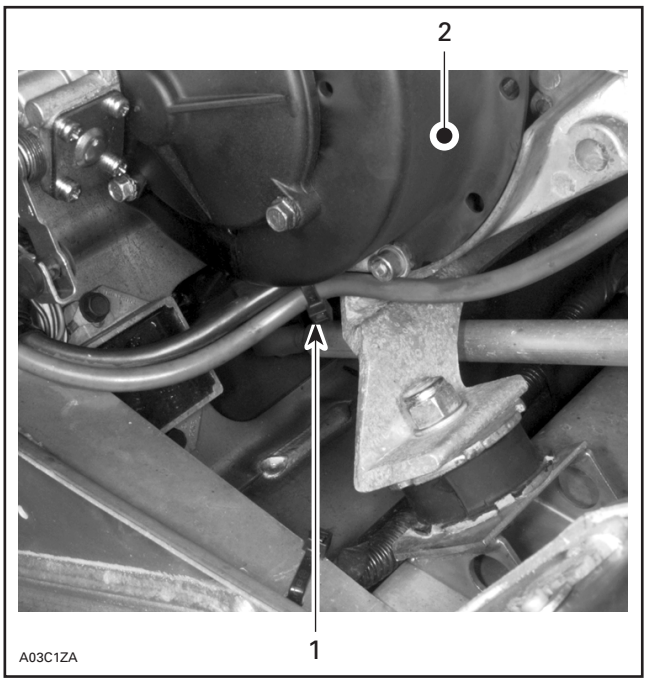
Secure rewind starter with original screws and ensure that ground cable (electric start models only) is properly installed, as shown in the following photo.



ELECTRIC START MODELS ONLY

1. *Ground cable*
2. *Tooth washer*
3. *Washer*

On electric start models, secure cables with a locking tie.



ELECTRIC START MODELS ONLY

1. *Secure cables with a locking tie*
2. *Rewind starter*

Reinstall fan protector no. 18 properly.

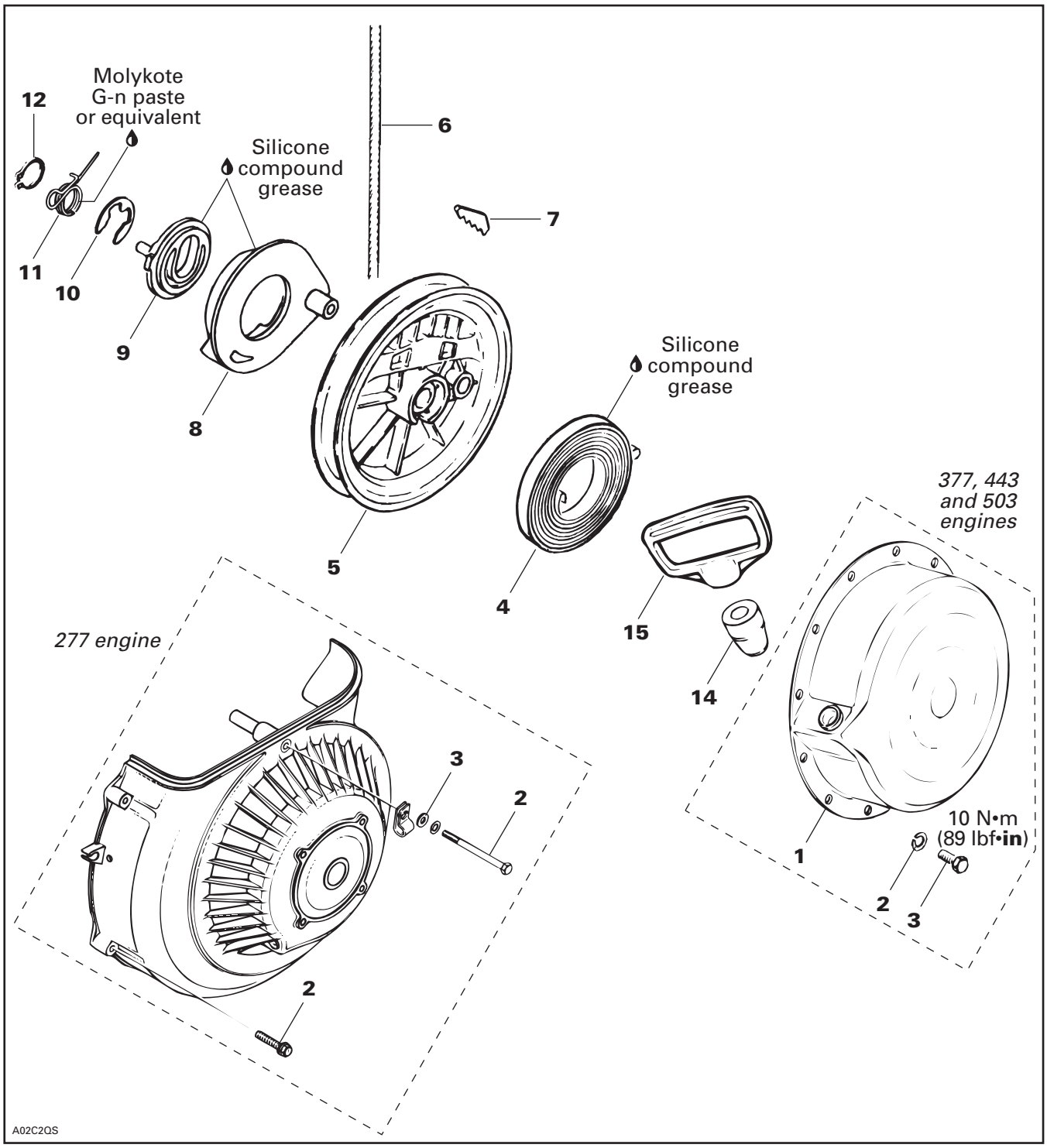
◆ WARNING

Always reinstall fan protector after servicing.

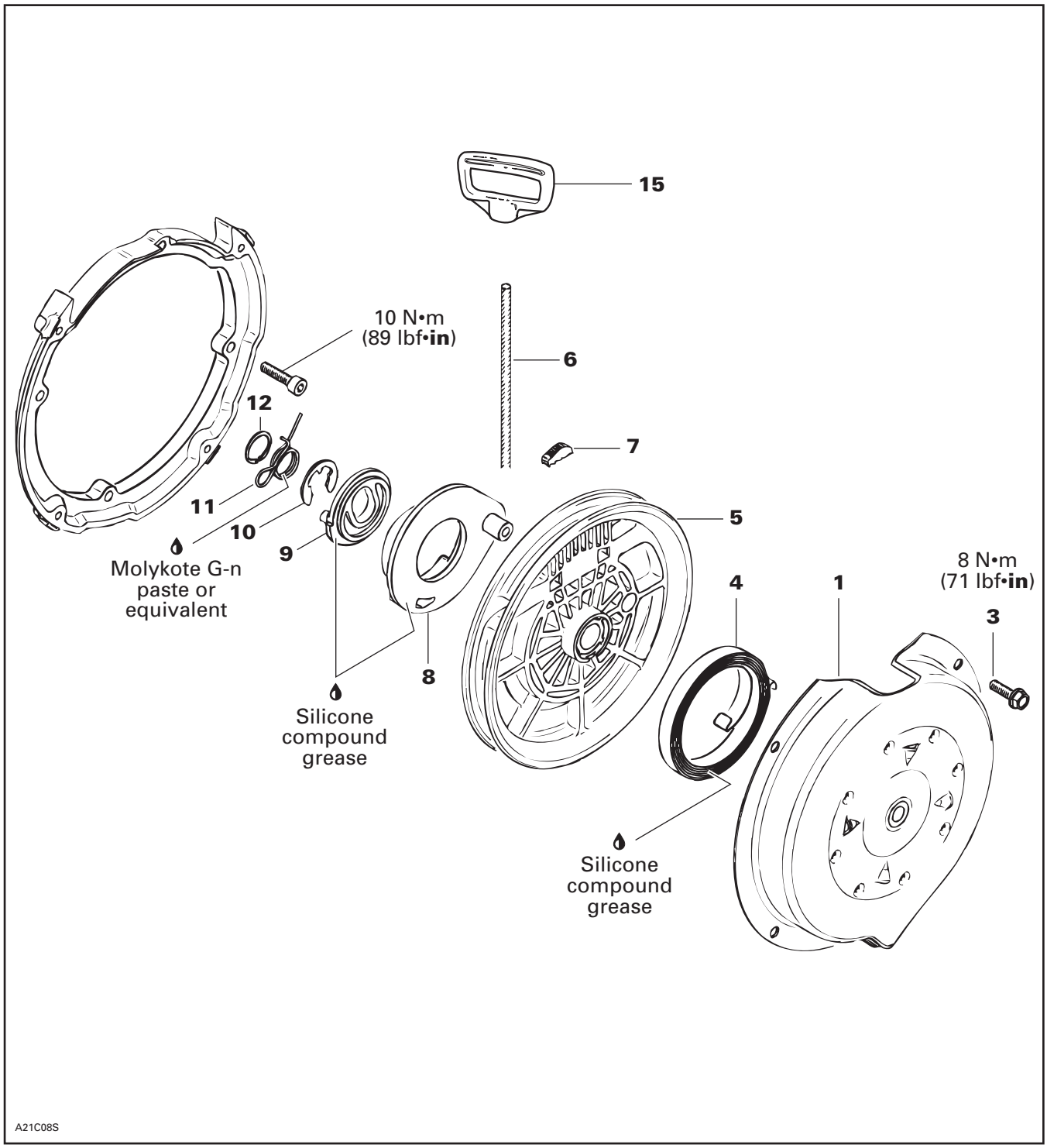
Reinstall muffler.

REWIND STARTER

277, 377, 443 and 503 on Touring SLE Engines



503 Engine on Skandic 500 and Formula SL



PARTS

REMOVAL

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

Tundra Series

Slightly lift cylinder cowl. Remove screws no. 3, lock washer, washer no. 2 and clip. Remove fan cowl that contains rewind starter.

S-Series

Remove screws no. 3 and washers no. 2 securing rewind starter no. 1 to engine then remove rewind starter.

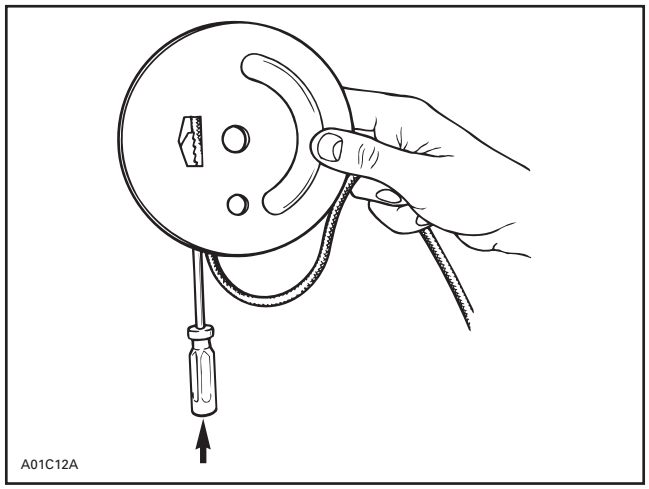
All Models

Remove pump from rewind starter cover.

DISASSEMBLY

To remove rope from rewind starter mechanism:

– First remove locking ring no. 12, locking spring no. 11, circlip no. 10, pawl lock no. 9 and pawl no. 8.
– Remove sheave no. 5 from starter housing no. 1.
– Disengage key no. 7 and pull out rope no. 6.



GENTLY TAP ON KEY

INSPECTION

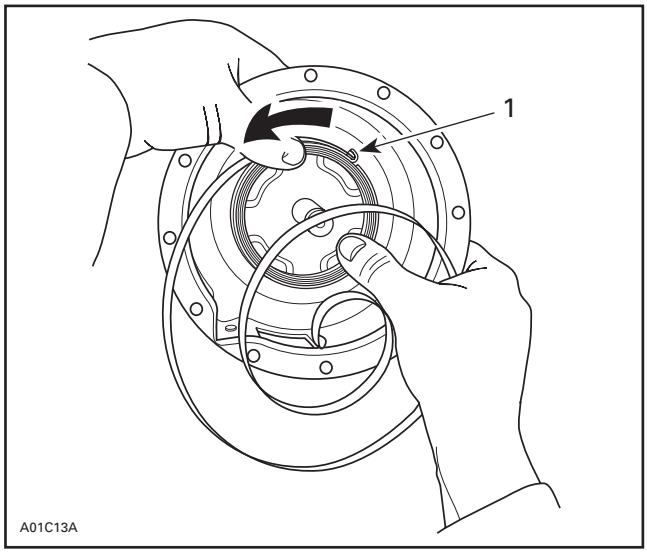
Check rope no. 6 for fraying. Replace if so.

ASSEMBLY

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

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

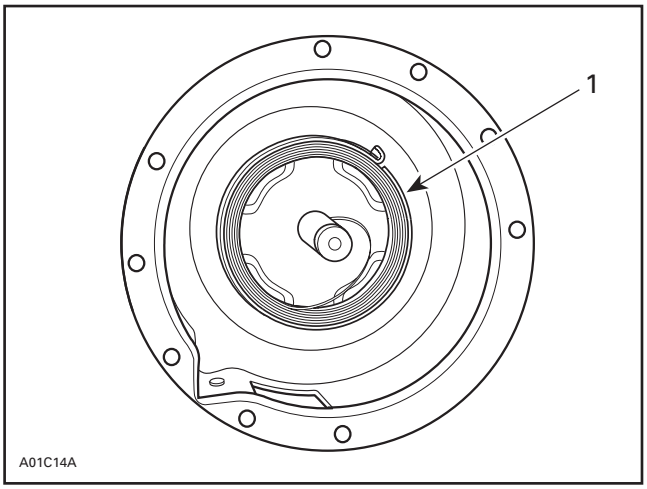
▼ CAUTION

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

Lubricate spring assembly with silicone compound grease (P/N 420 897 061) and position into starter housing as illustrated.

▼ CAUTION

This lubricant must NOT be used on rewind starter locking spring as it does not stay on under vibration.

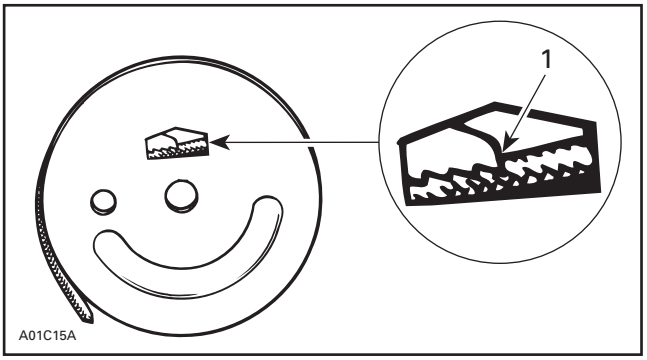


1. Grease inside spring guide

▼ CAUTION

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

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



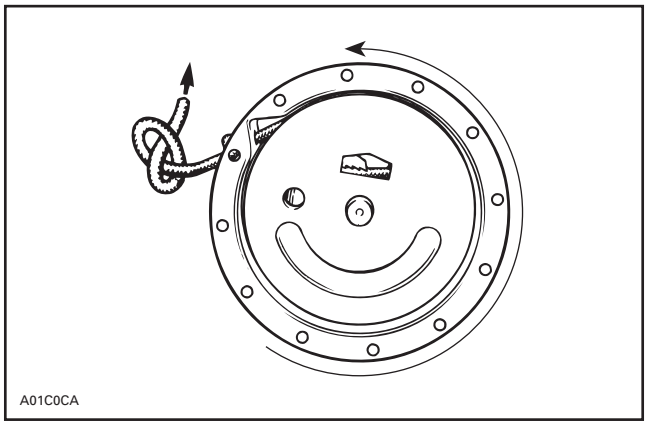
1. Push to lock

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.

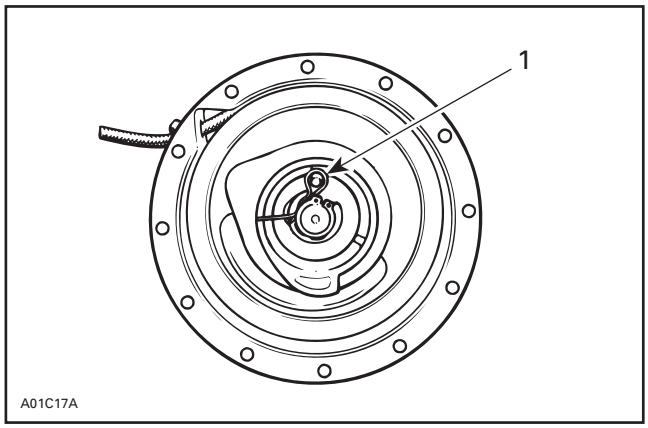
Rotate the sheave counterclockwise until rope end is accessible through starter housing orifice.

Pull the rope out of the starter housing and temporarily make a knot to hold it. One turn preload will give 7 turns of tension when fully extended.



Position pawl **no. 8**, pawl lock **no. 9** and circlip **no. 10**.

Install locking spring **no. 11** and lubricate with MOLYKOTE G-n paste from Dow Corning® or equivalent.



1. Spring coated with MOLYKOTE G-n paste

Install locking ring.

▼ CAUTION

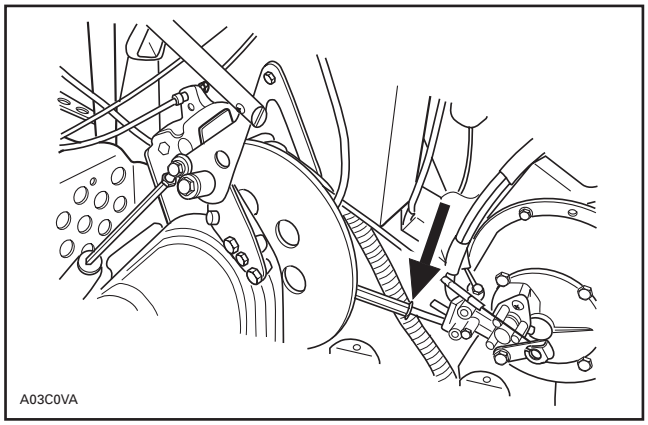
This lubricant must NOT be used on rewind springs as it does not stay on when dry.

INSTALLATION

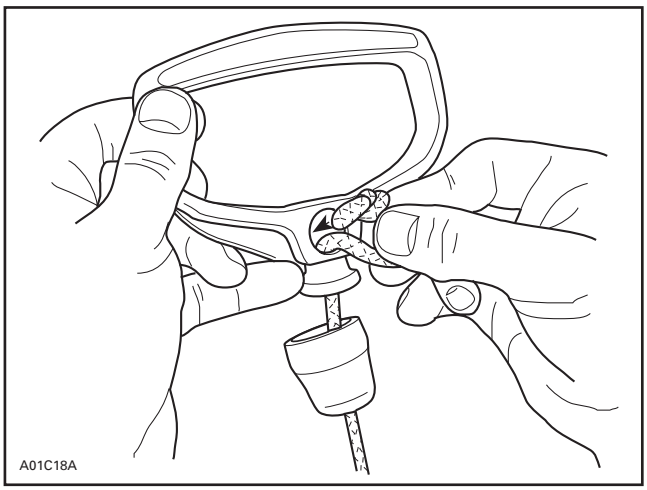
On fan cooled models with oil injection pump, re-install oil pump on rewind starter assembly.

Reinstall rewind starter assembly on engine.

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

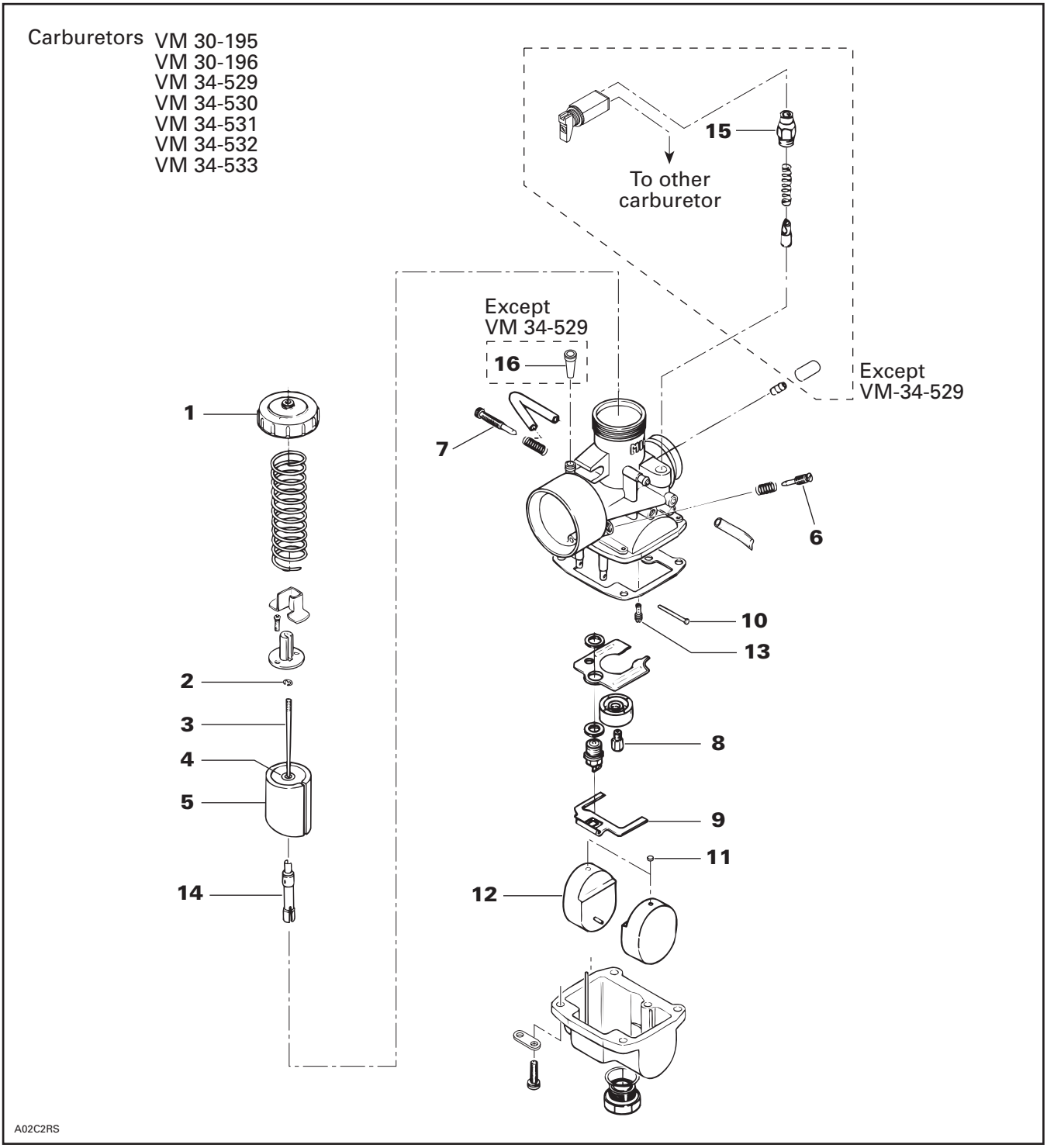


Prior to installing starter grip **no. 15** on new rope, it is first necessary to fuse the rope end with a lit match. pass rope through rubber buffer **no. 14** and starter grip and tie a knot in the rope end. Fuse the knot with a lit match then insert rope end down and pull the starter grip over the knot.



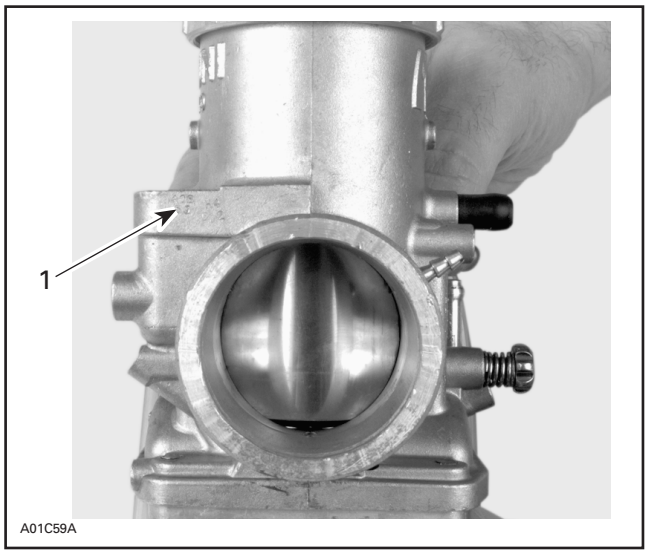
TYPICAL

CARBURETOR AND FUEL PUMP



IDENTIFICATION

All carburetors are identified on their body.

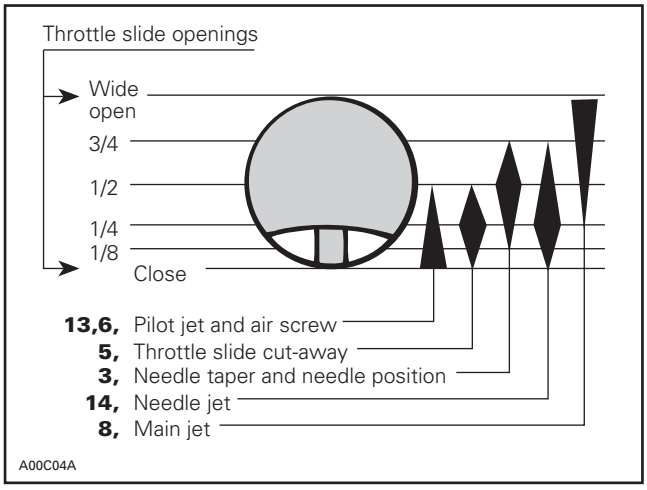


1. Identification: 34-482

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 cutaway 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 fine tuning refer to TECHNICAL DATA 10 and to SPARK PLUG 06-03.

NOTE: For high altitude regions, the *High Altitude Technical Data Booklet* (P/N 484 300 003 and 484 054 500 for binder) gives information about calibration according to altitude and temperature.

REMOVAL

Remove air silencer(s). For S-Series, see BATTERY 06-05.

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

Inspect throttle cable and housing for rubbing damages, kinks or rust. Check for free sliding action. Replace cable as required.

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.

◆ WARNING

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

16, Filter

Check for clogged filter. Clean or replace as required.

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 for wear. Replace as necessary.

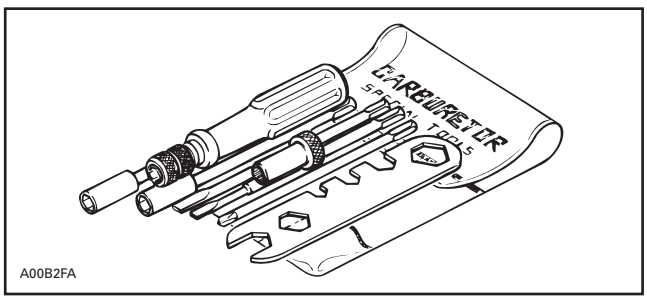
Check idle speed screw straightness. Replace as necessary.

Check for fuel soaked into float no. 12. Replace as necessary.

Check float for cracks or other damages affecting free movement. 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).

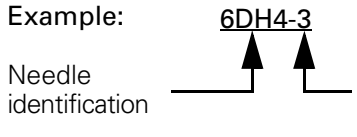


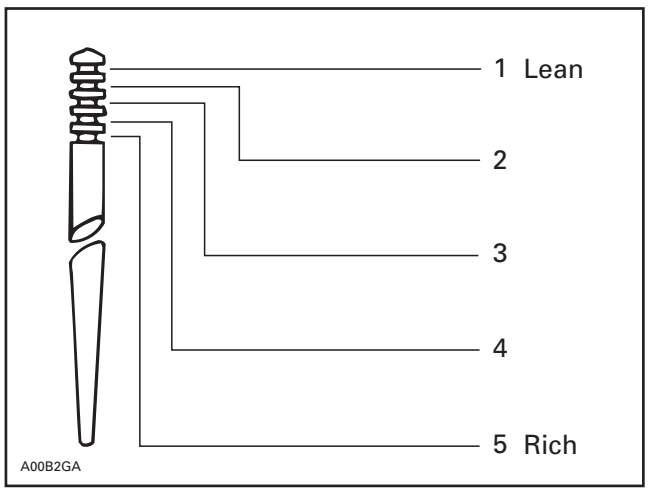
2,3, E-Clip and Needle

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.

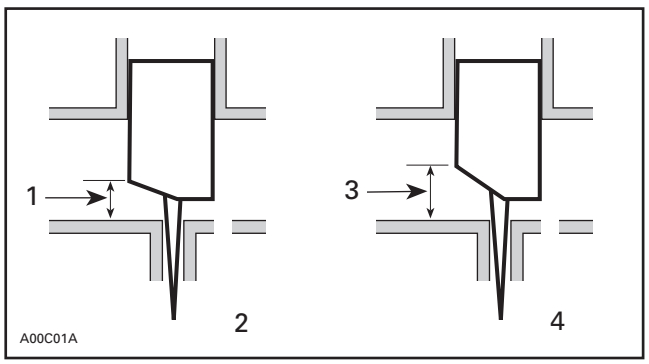
NOTE: The last digit of the needle identification number gives the recommended position of the E-clip **from the top** of the needle.





CLIP POSITIONS

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



1. *Low cut-away (high air speed)*
2. *Rich mixture*
3. *High cut-away (low air speed)*
4. *Lean mixture*

8, Main Jet

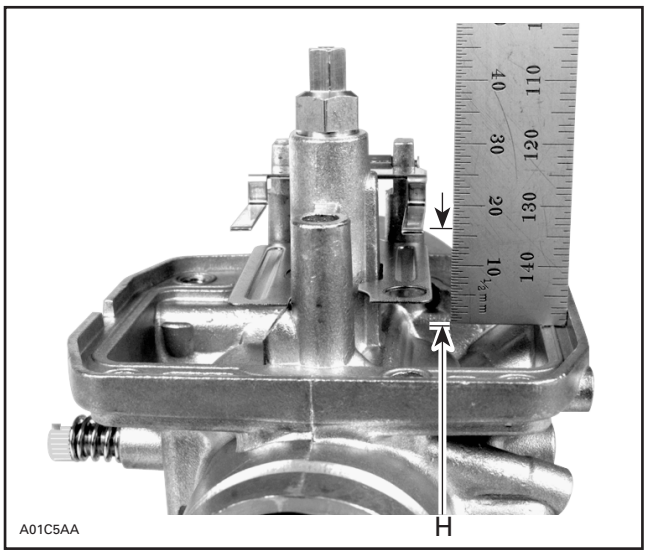
The main jet installed in the carburetor has been selected for a temperature of -20°C (0°F) at sea level. Different jetting can be installed to suit temperature and/or altitude changes. Always check spark plug tip and/or piston dome color to find out correct jetting.

CARBURETOR FLOAT LEVEL ADJUSTMENT

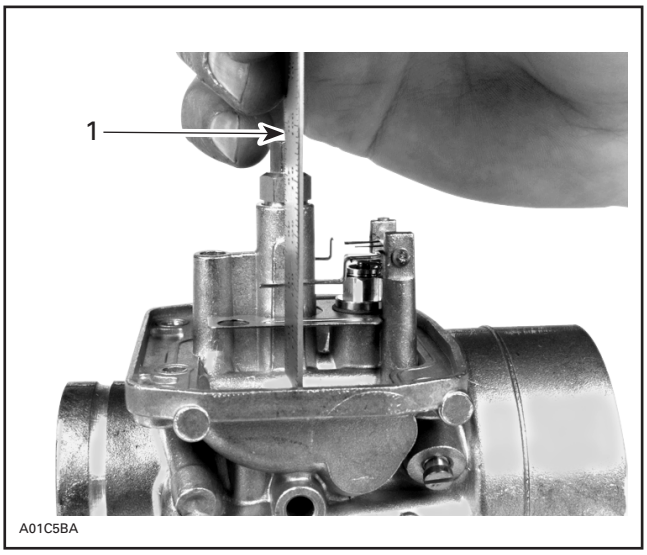
9,10, Float Arm and Float Arm Pin

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

– Remove float bowl and gasket from carburetor.
– Make sure that float arm is symmetrical — not distorted.
– 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.



TYPICAL
H: Float height

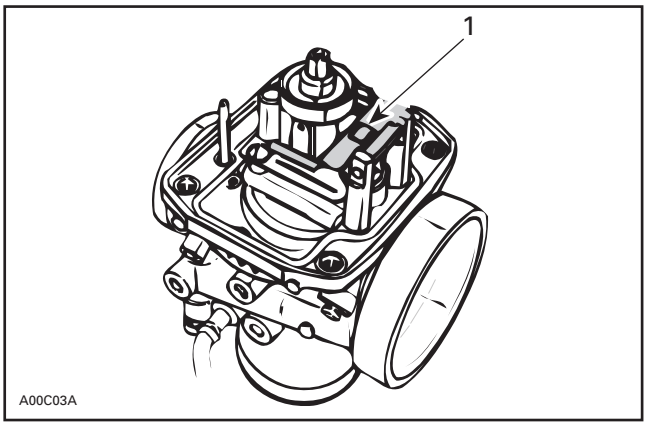


1. Ruler vertical and in line with main jet

CARBURETOR MODEL	FLOAT HEIGHT H	
	± 1 mm	(± .040 in)
VM 30 VM 34	23.9	(.941)

To Adjust Height H

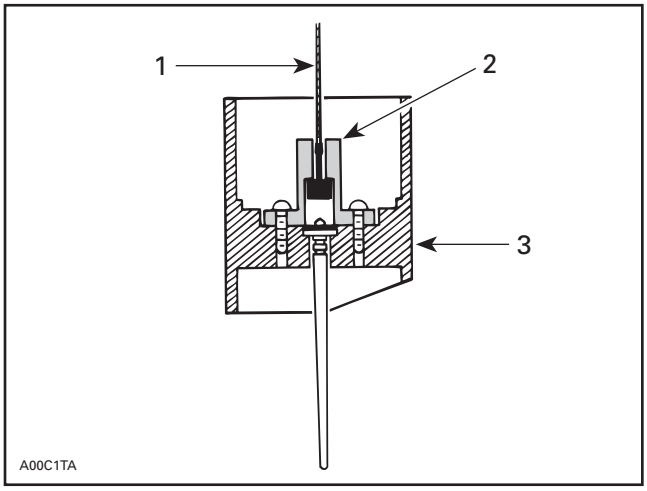
– Bend the contact tab of float arm until the specified height is reached.



1. Contact tab

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 allow air escaping through and thus allowing a quick response.



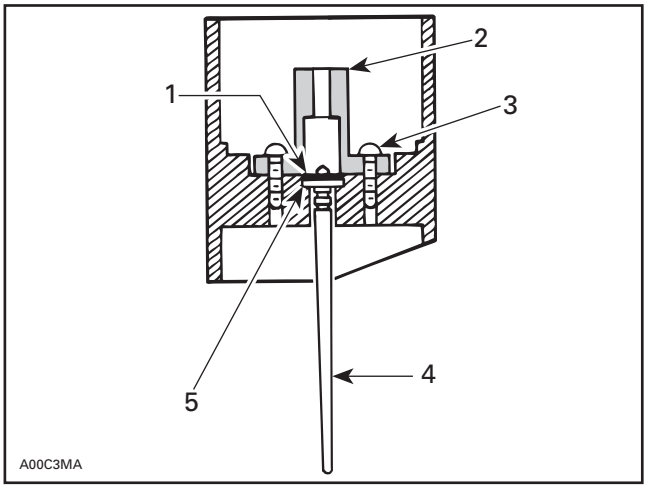
CENTER POST TYPE

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.



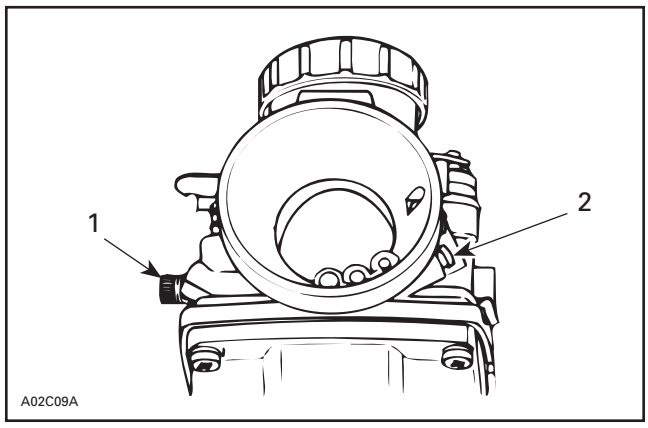
CENTER POST TYPE

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

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 with 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 enrichners mixture and conversely, turning it out counterclockwise leans mixture.

Refer to TECHNICAL DATA 10 for the specifications.

7, Idle Speed Screw

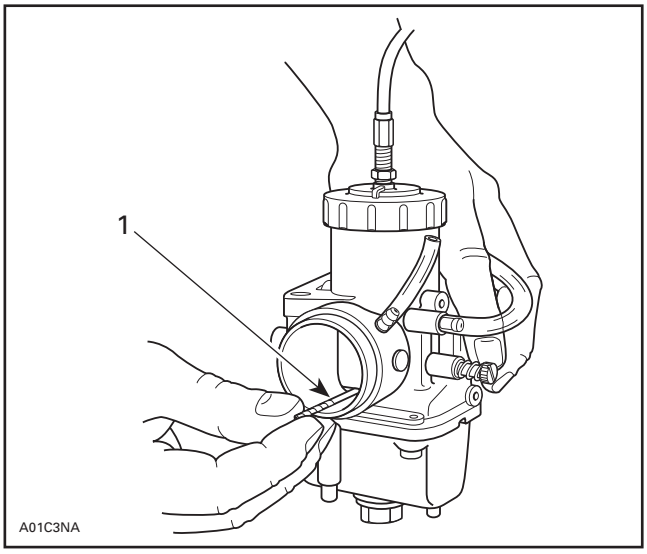
Throttle Slide Opening (preliminary idle speed adjustment)

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.

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 mm (in)
Tundra Skandic 380, Touring E, Formula S/DLX 380	1.3 (.051)
Tundra R Skandic 500, Formula SL/DLX 500, Touring LE/SLE	1.5 (.059)



TYPICAL
1. Drill bit used as gauge for throttle slide height

INSTALLATION

▼ CAUTION

Never allow throttle slide(s) to snap shut.

Prior to install 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.

▼ 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

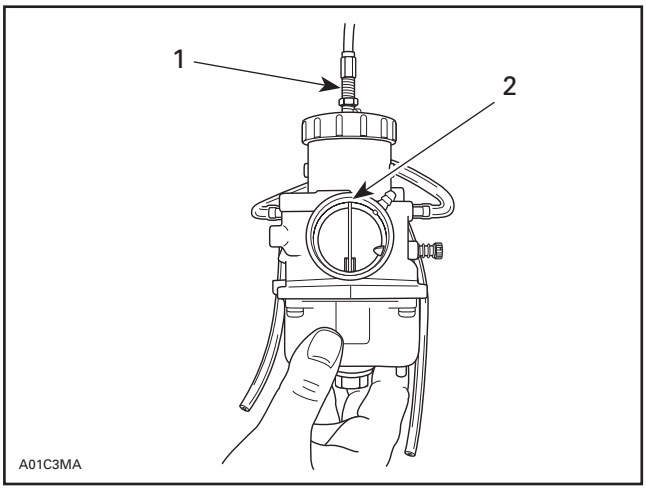
◆ WARNING

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

For maximum performance, correct cable adjustment is critical.

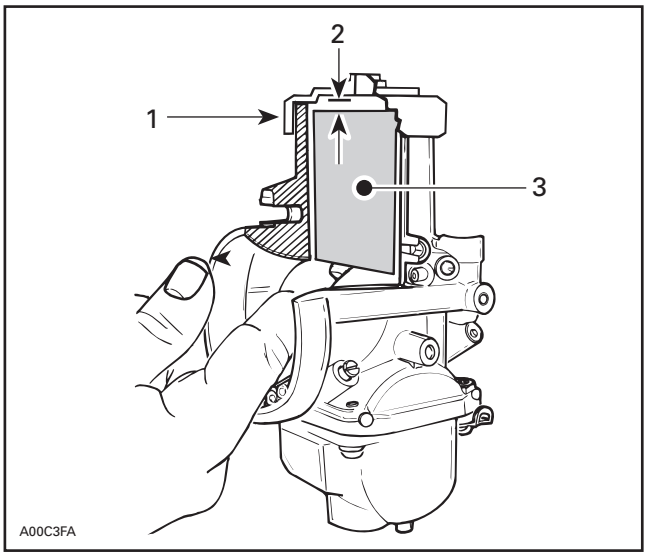
At full opening throttle slide must be flush or 1.0 mm (.040 in) lower than the top of carburetor **outlet** bore (engine side).

First loosen adjuster nut then turn throttle cable adjuster accordingly.



FULL OPENING (THROTTLE LEVER AGAINST HANDLE GRIP)
1. Throttle cable adjuster
2. Throttle slide flush or 1.0 mm (.040 in) lower than carburetor oulet 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*

◆ WARNING

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.

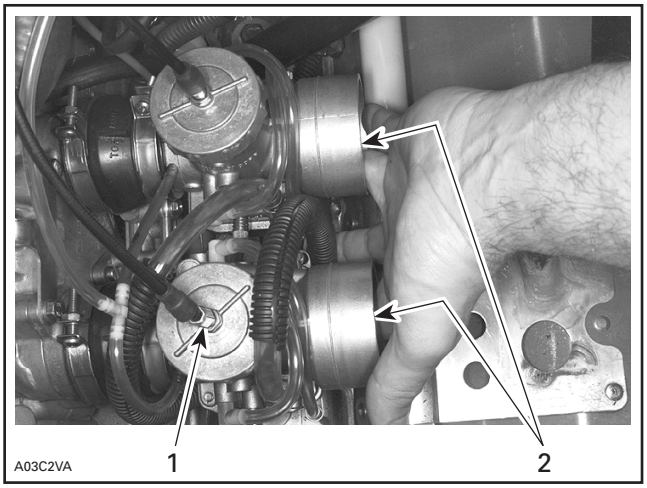
Carburetor Synchronization

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. Beside do not interchange carburetors, 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

On oil injection models, the oil injection pump adjustment must be checked each time carburetor is adjusted. Refer to OIL INJECTION SYSTEM 04-06.

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 04-06.

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 10 for the specifications.

▼ CAUTION

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

CHOKE

S-Series

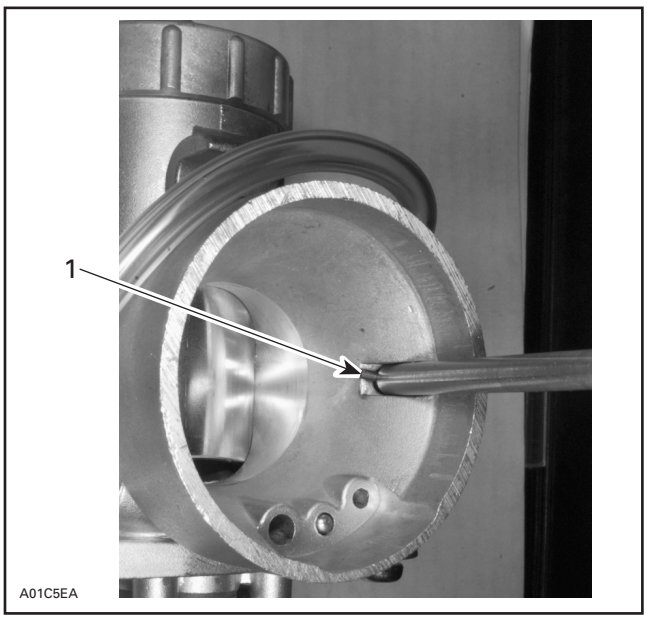
Choke Plunger Adjustment

Set choke lever to fully open position.

CHOKE LEVER — FULLY OPEN POSITION

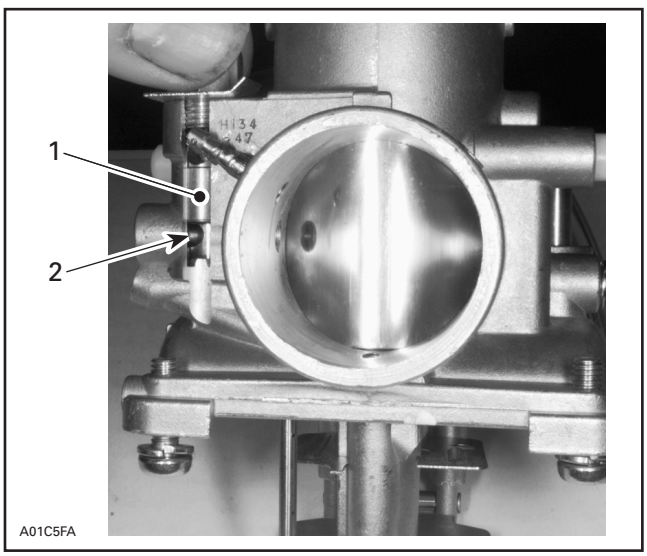
Use small diameter of tool for VM 34 carburetors.

Insert 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*



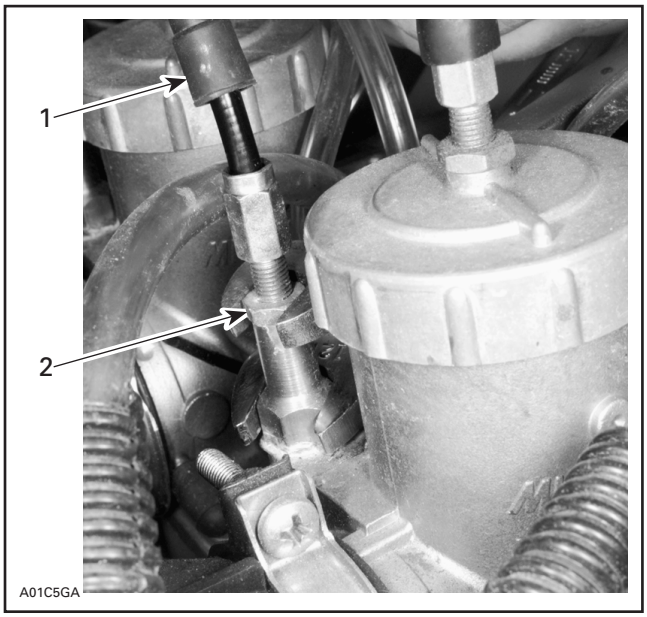
CUTAWAY (ENGINE SIDE SHOWN)

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.

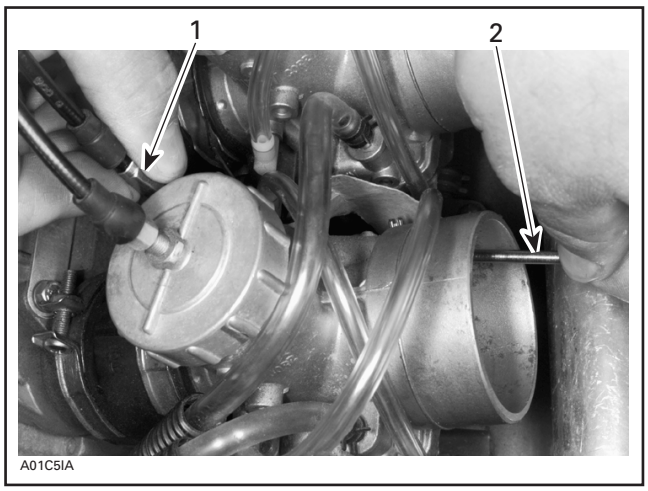
Lift up protector cap and loosen choke cable lock nut, as shown in the next photo.



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

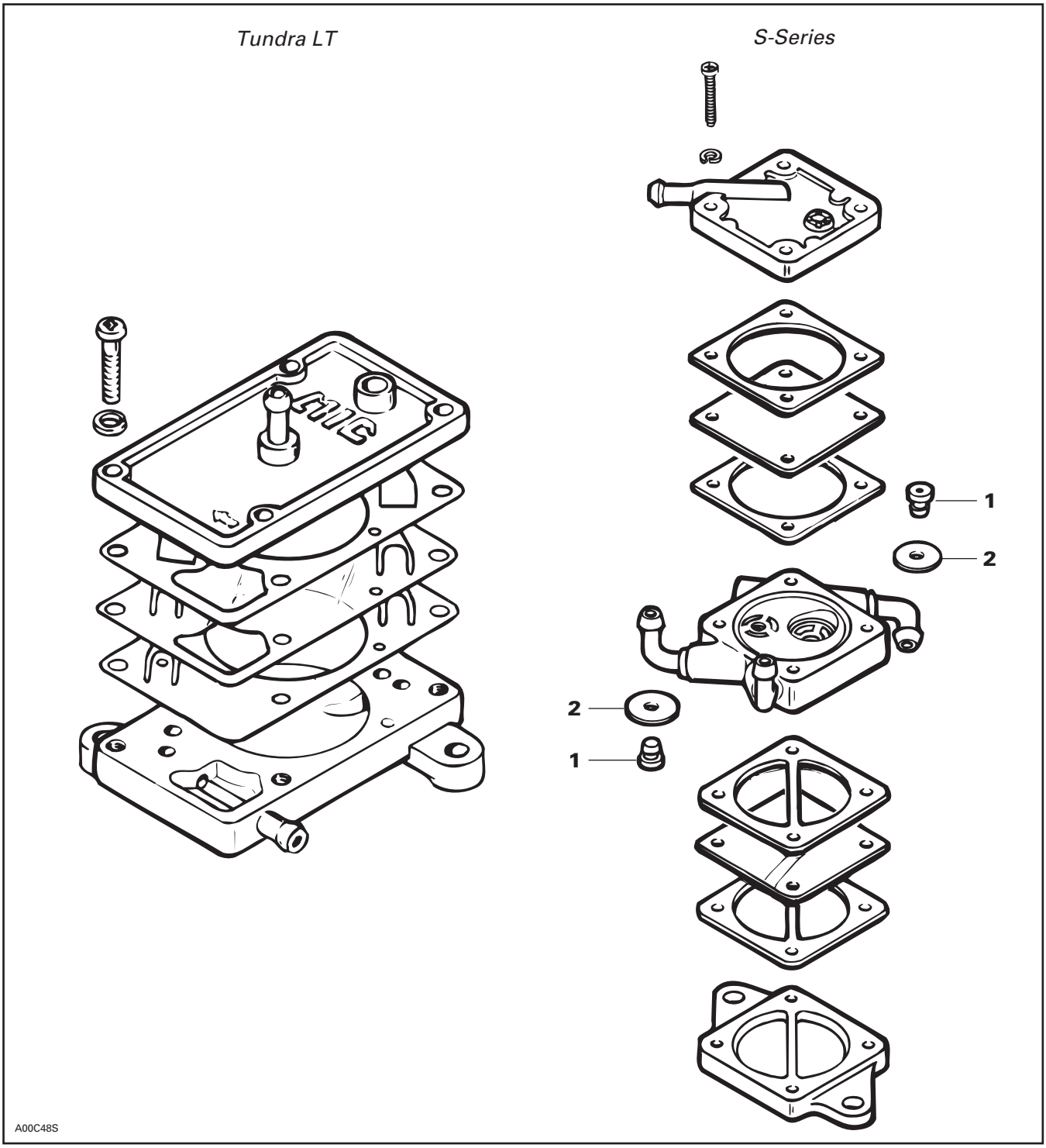
Tighten choke cable lock nut and reinstall protector cap.

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).

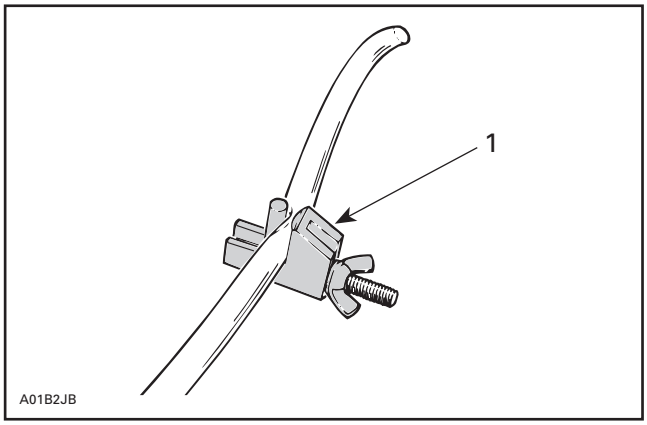
CHOKE LEVER — CLOSED POSITION

FUEL PUMP



REMOVAL

Install a hose pincher (P/N 529 009 900) on fuel supply line close to pump inlet.

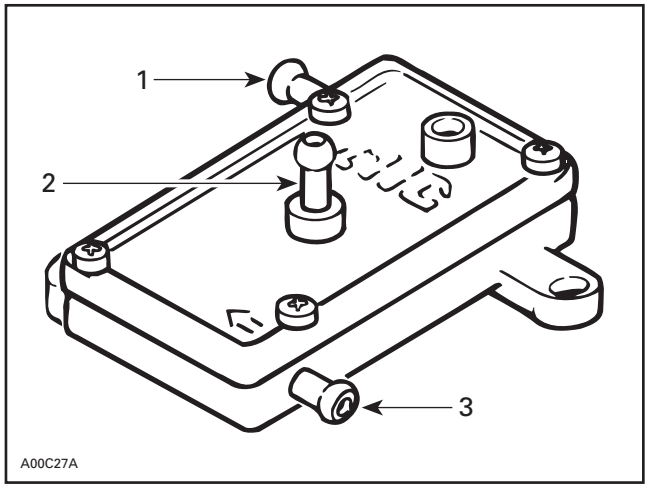


1. Hose pincher (P/N 529 009 900)

Disconnect fuel outlet line(s).

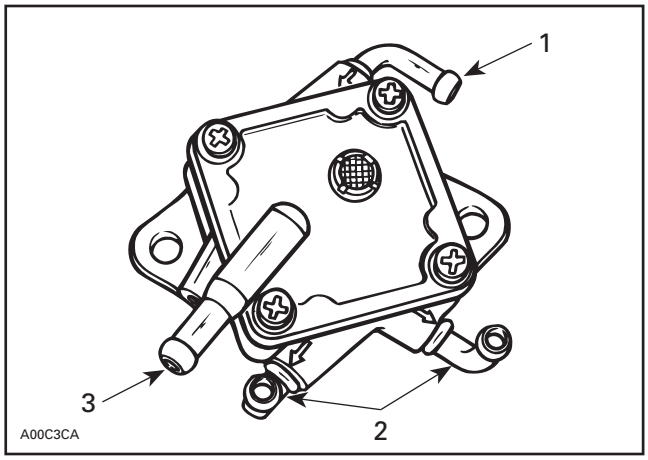
Disconnect impulse line.

Remove screws (or nuts if applicable) securing fuel pump.



LOW-SUPPLY FUEL PUMP WITH SINGLE OUTLET

1. Fuel outlet line
2. Impulse line
3. Fuel inlet line



HIGH-SUPPLY FUEL PUMP WITH TWIN OUTLETS

1. Inlet
2. Outlets
3. Impulse

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.

Check impulse diaphragm and gasket on high-supply fuel pump with twin outlets 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.

DISASSEMBLY

1,2, Grommet and Valve (high-supply pump with twin outlets only)

Do not disassemble valves unless replacement is necessary.

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.

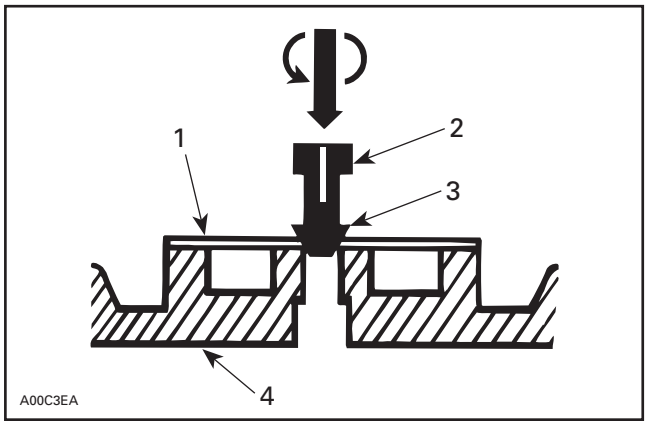
Inspect diaphragm. The pumping area should be free of holes, tears or imperfections. Replace as needed.

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

ASSEMBLY

To install a new valve, proceed as follows:

– Place new valve flat on its seat.
– Slightly oil taper tip of grommet.
– Push grommet with a rotational movement until it crosses its housing.



1. Valve
2. Grommet
3. Lubricate tip
4. Pump body

When assembling pump, ensure to properly position stages together. Refer to previous illustrations if necessary.

INSTALLATION

To install, inverse removal procedure.

◆ WARNING

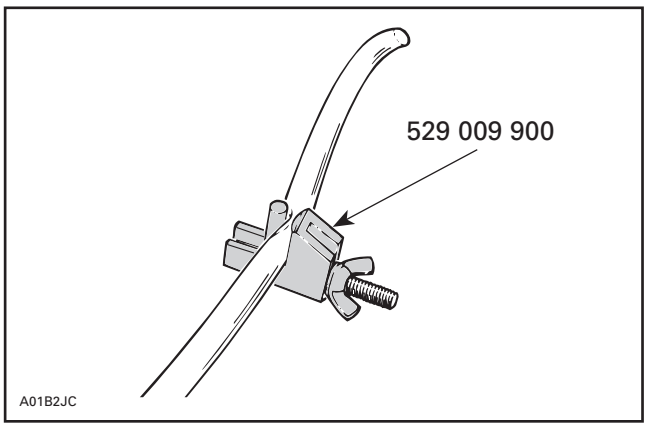
Pressure test to ensure there is no leak in fuel system.

FUEL TANK AND THROTTLE CABLE

Fuel Tank Lines

◆ WARNING

When draining a fuel tank or when-ever a fuel line is disconnected, obstruct line with a hose pincher (P/N 529 009 900) 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

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

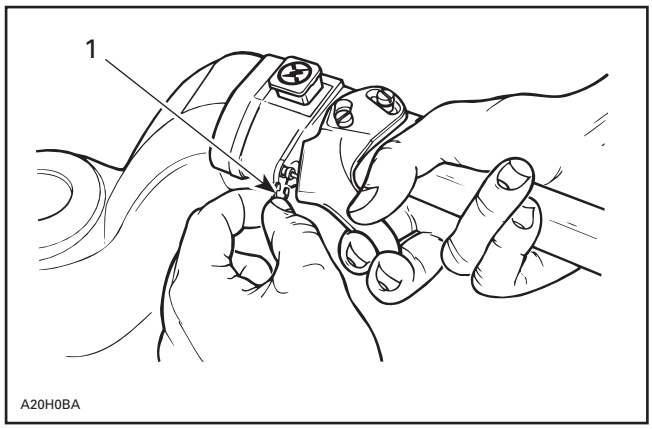
Throttle Cable Circlip at Handlebar

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

◆ WARNING

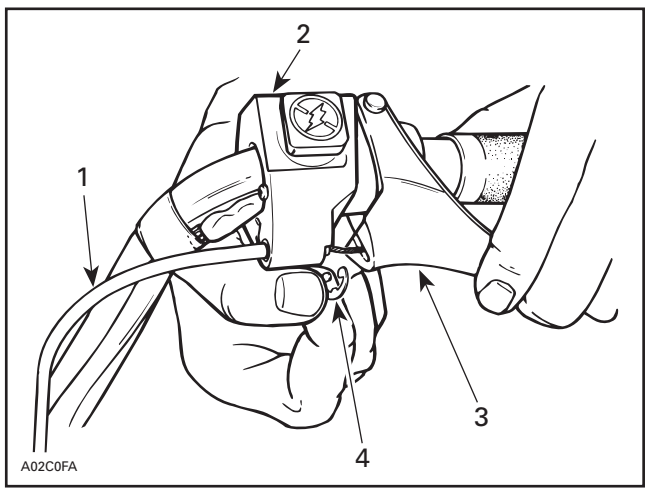
If this procedure is disregarded, throttle might be half-open at normally closed position and the engine will speed up when starting.

Models with Easy Action Throttle Lever



TYPICAL
1. Circlip

Other Models



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

FUEL SYSTEM LEAK TEST

All Models

The following test will indicate any leak from fuel tank to carburetor(s).

Fill up fuel tank.

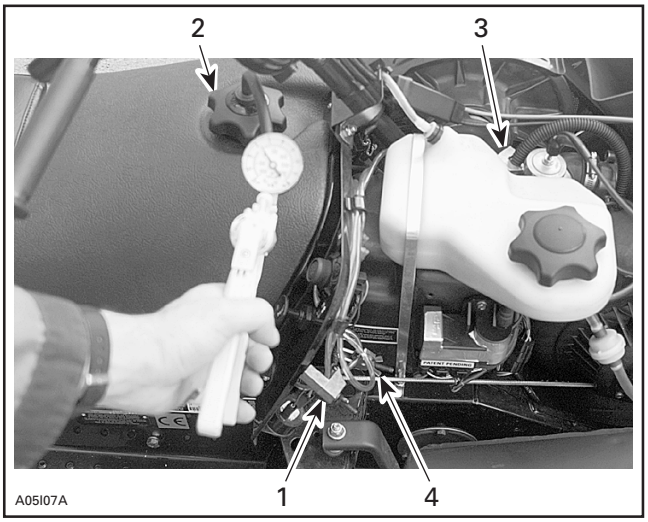
Install on fuel tank special cap of leak testing kit (P/N 529 033 100).

Install hose pinchers (P/N 295 000 076) on fuel tank vent line and fuel pump outlet hose at carburetor(s).

Tundra Series Only

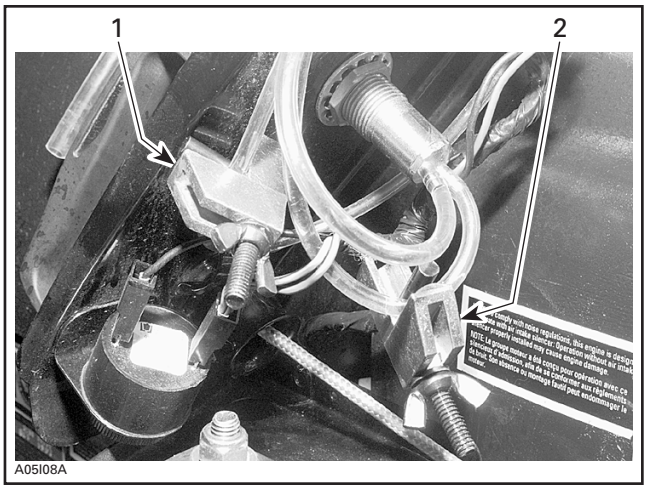
Install a hose pincher (P/N 295 000 076) on primer outlet hose.

NOTE: To verify leaks up to carburetor fitting, install hose pincher on primer outlet hose near carburetor.



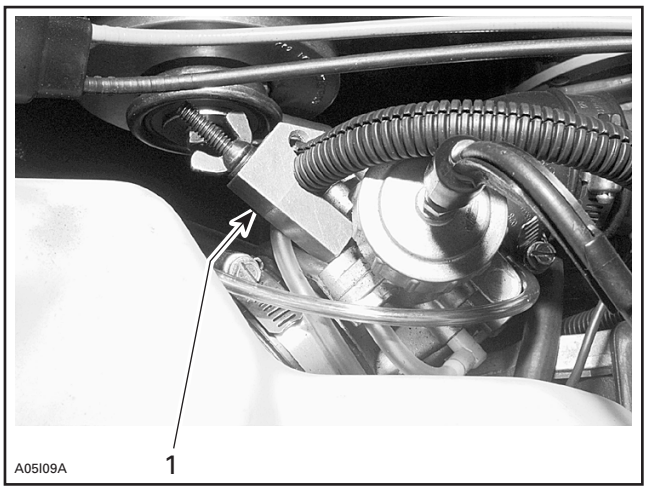
TUNDRA SERIES

1. *Hose pincher on fuel tank vent line*
2. *Special cap on tank*
3. *Hose pincher on fuel pump outlet hose*
4. *Hose pincher on primer outlet hose*



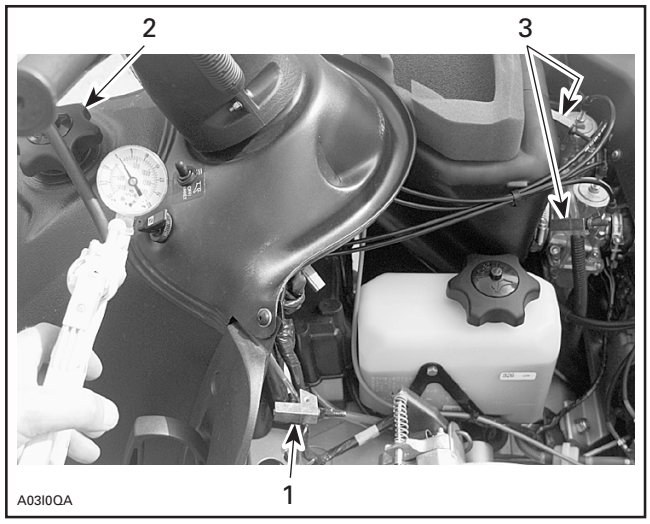
TUNDRA SERIES

1. *Hose pincher on fuel tank vent line*
2. *Hose pincher on primer outlet hose*



TUNDRA SERIES

1. *Hose pincher on fuel pump outlet hose*



S-SERIES

1. *Hose pincher on fuel tank vent line*
2. *Special cap on tank*
3. *Hose pinchers on fuel pump outlet hoses*

All Models

Using air pump from engine leak test kit (P/N 861 749 100) inject air into fuel tank.

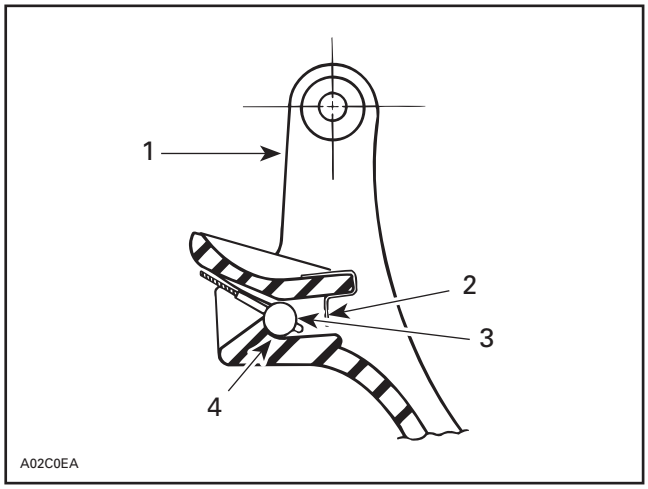
Pressurize fuel system to 21 kPa (3 PSI). That pressure must not drop during 3 minutes.

If pressure drops, locate leak(s) and repair/replace leaking component(s). To ease locating leak(s) spray soapy water on components, bubbles will indicate leak location(s).

Throttle Cable Retainer

Tundra Series

The retainer must be pushed on the throttle handle tab until it sits properly.



1. *Throttle handle*
2. *Retainer*
3. *Cable barrel*
4. *Silicone grease*

Adjust throttle cable as specified in CARBURETOR AND FUEL PUMP 04-09.

Throttle Cable Routing

▼ CAUTION

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