



# SEADOO®



## ENGINE Shop Manual

Watercraft and  
Sport Boats

2005 **ROTAX®**  
**1503 4-TEC™**  
**Engines**

2 1 9 1 0 0 2 1 4

[www.SeaDooManuals.net](http://www.SeaDooManuals.net)

# ***2005 Engine Shop Manual***

**ROTAX® 1503 4-TEC  
ENGINES**

**SEA-DOO®**



Legal deposit:

National Library of Quebec  
National Library of Canada 2005

All rights reserved. No parts of this manual may be reproduced in any form without the prior written permission of Bombardier Recreational Products Inc. (BRP).

©Bombardier Recreational Products Inc. (BRP) 2005

Technical Publications  
Bombardier Recreational Products Inc. (BRP)  
Valcourt (Quebec) Canada

Printed in Canada

®™Registered trademarks of Bombardier Recreational Products Inc. (BRP) or its affiliates.

\* Trademark of Bombardier Inc. used under license.

SEA-DOO®  
BOMBARDIER LUBE®  
Sea-Doo Synthetic Grease  
Sea-Doo® Learning Key™  
DESS™  
Rotax®  
TOPS™

This document contains the trademarks of the following companies:

Loctite® is a trademark of Loctite Corporation

Snap-on® is a trademark of Snap-on Tools Corporation

Molykote® is a trademark of Dow Corning Corporation

AMP® is a trademark of Tyco Electronics Corporation

---

# TABLE OF CONTENTS

---

<b>SAFETY NOTICE .....</b>	<b>III</b>
<b>INTRODUCTION .....</b>	<b>IV</b>
GENERAL INFORMATION.....	IV
ENGINE EMISSIONS INFORMATION .....	IV
ENGINE IDENTIFICATION NUMBER (E.I.N.) .....	IV
TIGHTENING TORQUES .....	IV
ARRANGEMENT OF THIS MANUAL, ILLUSTRATIONS AND PROCEDURES .....	V
<b>01 ENGINES (1503 4-TEC) .....</b>	<b></b>
<b>01 – LEAK TEST .....</b>	<b>1</b>
PROCEDURES .....	1
PREPARATION .....	1
PROCEDURE .....	2
DIAGNOSIS.....	3
POSSIBLE ENGINE LEAKAGE AREA.....	3
ASSEMBLY .....	4
<b>02 – INTAKE MANIFOLD AND SUPERCHARGER .....</b>	<b>5</b>
INSPECTION (PARTS ASSEMBLED).....	10
REMOVAL .....	12
DISASSEMBLY .....	17
INSPECTION (PARTS DISASSEMBLED) .....	20
ASSEMBLY .....	21
INSTALLATION .....	26
<b>03 – PTO HOUSING AND MAGNETO .....</b>	<b>29</b>
GENERAL.....	31
PROCEDURES .....	31
PTO HOUSING .....	31
PTO SEAL.....	34
COUPLING.....	35
STATOR .....	35
ROTOR AND TRIGGER WHEEL .....	36
RING GEAR.....	37
STARTER DRIVE ASS'Y.....	38
OIL SPRAY NOZZLE .....	39
<b>04 – LUBRICATION SYSTEM.....</b>	<b>41</b>
GENERAL.....	45
PROCEDURES .....	45
ENGINE OIL PRESSURE.....	45
PTO OIL STRAINER.....	46
SUCTION PUMP OIL STRAINER.....	47
ENGINE OIL PRESSURE REGULATOR.....	49
OIL PRESSURE PUMP.....	51
OIL SUCTION PUMP.....	54
OIL SEPARATOR COVER.....	57
TOPS VALVE .....	58
OIL COOLER .....	58
<b>05 – COOLING SYSTEM .....</b>	<b>61</b>
GENERAL.....	63
PROCEDURES .....	63
COOLANT PUMP .....	63
COOLANT PUMP IMPELLER .....	64

---

# TABLE OF CONTENTS

---

THERMOSTAT .....	65
ROTARY SEAL .....	65
<b>06 – CYLINDER HEAD .....</b>	<b>69</b>
GENERAL .....	71
PROCEDURES .....	71
SPARK PLUG .....	71
EXHAUST MANIFOLD .....	71
VALVE COVER .....	72
ROCKER ARM .....	73
CAMSHAFT TIMING GEAR .....	76
TIMING CHAIN .....	77
CYLINDER HEAD .....	78
CAMSHAFT .....	79
VALVE SPRING .....	80
VALVE .....	82
<b>07 – CYLINDER BLOCK .....</b>	<b>89</b>
GENERAL .....	92
PROCEDURES .....	92
TIMING CHAIN .....	92
CHAIN TENSIONER .....	92
PISTON/CONNECTING ROD .....	93
PISTON RINGS .....	98
CRANKSHAFT .....	99
BALANCER SHAFT .....	104
CYLINDER BLOCK .....	107
<b>08 – TECHNICAL SPECIFICATIONS .....</b>	<b>113</b>

# SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair the Rotax® 1503 4-TEC engines. This edition was primarily published to be used by technicians who are already familiar with all service procedures relating to BRP products. Mechanical technicians should attend training courses given by BRP Training Dept.

Please note that the instructions will apply only if proper hand tools and special service tools are used. This *ENGINE SHOP MANUAL* uses technical terms which may be slightly different from the ones used in the *PARTS CATALOG*.

It is understood that this manual may be translated into another language. In the event of any discrepancy, the English version shall prevail.

The content depicts parts and/or procedures applicable to the particular product at time of writing. Service and Warranty Bulletins may be published to update the content of this manual. Make sure to read and understand these.

In addition, the sole purpose of the illustrations throughout the manual, is to assist identification of the general configuration of the parts. They are not to be interpreted as technical drawings or exact replicas of the parts.

The use of BRP parts is most strongly recommended when considering replacement of any component. Dealer and/or distributor assistance should be sought in case of doubt.

The engine identified in this document should not be utilized on product(s) other than those for which it was designed.

## **WARNING**

Unless otherwise specified, engine should be turned OFF and cold for all maintenance and repair procedures.

This manual emphasizes particular information denoted by the wording and symbols:

## **WARNING**

Identifies an instruction which, if not followed, could cause serious personal injury including possibility of death.

**CAUTION:** Denotes an instruction which, if not followed, could severely damage engine components.

**NOTE:** Indicates supplementary information needed to fully complete an instruction.

Although the mere reading of such information does not eliminate the hazard, your understanding of the information will promote its correct use. Always use common shop safety practice.

BRP disclaims liability for all damages and/or injuries resulting from the improper use of the contents. We strongly recommend that any services be carried out and/or verified by a highly skilled professional mechanic. It is understood that certain modifications may render use of the engine illegal under existing federal, provincial and state regulations.



INTRODUCTION

GENERAL INFORMATION

This *ENGINE SHOP MANUAL* covers the Rotax 1503 4-TEC engine. It should be used in conjunction with the appropriate *VEHICLE SHOP MANUAL*.

The information and component/system descriptions contained in this manual are correct at time of writing. BRP however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured.

BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

This *SHOP MANUAL* uses technical terms which may be different from the ones of the *PARTS CATALOGS*.

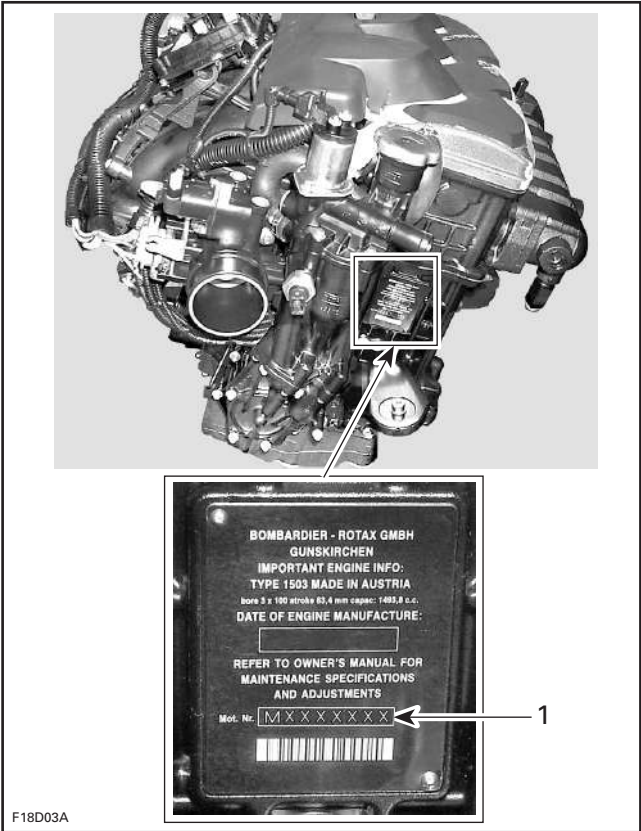
When ordering parts always refer to the specific model *PARTS CATALOGS*.

ENGINE EMISSIONS INFORMATION

Refer to the appropriate *VEHICLE SHOP MANUAL*.

ENGINE IDENTIFICATION NUMBER (E.I.N.)


The Engine Identification Number is located on front end of the engine.



1. Engine Identification Number (E.I.N.)

TIGHTENING TORQUES

Tighten fasteners to torque mentioned in exploded views and/or text.

 **WARNING**

Torque wrench tightening specifications must strictly be adhered to. Locking devices (ex.: locking tabs, elastic stop nuts, self-locking fasteners, etc.) must be installed or replaced with new ones, where specified. If the efficiency of a locking device is impaired, it must be renewed.

### ARRANGEMENT OF THIS MANUAL, ILLUSTRATIONS AND PROCEDURES

The manual is divided into many major sections as you can see in the main table of contents at the beginning of the manual.

Several sections are divided in various subsections. There is a table of contents at the beginning of many sections.

The illustrations show the typical construction of the different assemblies and, in all cases, may not reproduce the full detail or exact shape of the parts shown, however, they represent parts which have the same or a similar function.

**CAUTION:** These watercraft are designed with parts dimensioned mostly in the metric system. However some components may be from the imperial system. When replacing fasteners, make sure to use only those recommended by BRP.

As many of the procedures in this manual are inter-related, we suggest, that before undertaking any task, you read and thoroughly understand the entire section or subsection in which the procedure is contained.

A number of procedures throughout the book require the use of special tools. Before undertaking any procedure, be sure that you have on hand all the tools required, or approved equivalents.



TYPICAL PAGE

Subsection title indicates beginning of the subsection.

Italic sub-title above exploded view indicate pertaining models.

Drop represents a liquid product to be applied to a surface. In this case Loctite 243 to screw threads.

Exploded view assists you in identifying parts and related positions.

Bold face number indicates special procedure concerning this part.

Illustration number for publishing process.

Section 03 ENGINE

Subsection 04 (MAGNETO SYSTEM)

**MAGNETO SYSTEM**

*717 Engine*

12 11 5 N•m (44 lbf•in) 13 9 N•m (80 lbf•in)

Loctite 243

6 8 Loctite 243 6 N•m (53 lbf•in)

4 7 Loctite 243 9 6 N•m (53 lbf•in)

5 Loctite 243 3 Loctite 243 1 14

Loctite 648 10 15 145 N•m (107 lbf•ft)

Anti-seize lubricant 2 9 N•m (80 lbf•in)

F01D4WS

30

Page heading indicates section and subsection detailed.

Dotted box contains parts of a particular model or an exploded view.

Tightening torque nearby fastener. In this case, nut must be torqued to 145 N•m (107 lbf•ft).

Page number

**CAUTION:** Pay attention to torque specifications. Some of these are in lbf•in instead of lbf•ft. Use appropriate torque wrench.

F01A0CT

## TYPICAL PAGE

Sub-title with part name(s) from exploded view.

**Section 06 FUEL SYSTEM**  
Subsection 03 (CARBURETORS)

**CARBURETOR REMOVAL**

To remove carburetors from engine, proceed as follows:

- Remove air vent tube support.
- Unlock retaining slides holding air intake silencer base.
- Remove air intake silencer base from watercraft.
- Remove screws holding flame arrester base support to cylinder head cover.
- Unscrew base retaining screws then remove base from carburetors and move to front of watercraft.
- Turn the valve to OFF position.

**NOTE:** For fuel line removal, use pliers (P/N 295 000 054).

- Disconnect pulse line from fuel pump.
- Disconnect fuel supply line from fuel pump.
- Disconnect fuel return line.
- Disconnect oil injection pump cable, throttle cable and choke cable.

**XP Model Only**

- Remove screws no. 6 and lock washers no. 7 retaining carburetors.

**All Others Models**

- Remove 4 bolts no. 8 and lock washers no. 12 from rotary valve cover then move carburetors and rotary valve cover on top of engine.

**NOTE:** When removing rotary valve cover, pay attention that the rotary valve stay in place, otherwise it must be timed.

- Remove carburetors from intake manifold.
- Disconnect fuel bypass line between carburetors (twin carburetors).
- Remove carburetor(s) from rotary valve cover.

**DISASSEMBLY AND INSPECTION**

Inspect parts for corrosion damage (shaft, butterfly, spring, etc., check valve housing, etc.).

**Diaphragm**

**PUMP DIAPHRAGM LEAK TEST**

Using a suitable pump gauge tester, perform the following test proceeding as follows:

- Install pump gauge tester (P/N 295 000 083) on pulse nipple.
- Pump tester until it reaches 28 kPa (4 PSI).

**Illustration**

**TYPICAL**

Step 1: Install pump gauge tester to pulse nipple.  
Step 2: Pump tester until it reaches the desired pressure.

1: Fuel outlet nipple  
2: Fuel inlet nipple  
A: 28 kPa (4 PSI)

Diaphragm must stand pressure for 10 seconds. If pressure drops, replace diaphragm.

31

Title indicates main procedure to be carried-out.

Service tool to be used to perform a certain procedure.

Title in italic indicates a particular procedure concerning a model.

Sub-sub-title in this case indicates that particular procedure for XP is finished, so from this point, all others models are concerned.

Bold numbers in the text refer to the parts shown in the exploded view at the beginning of the subsection.

Numbers are used for description of components.

Sub-sub-title in capital indicates a particular testing, adjustment or repair procedure.

Illustration always follows text it is pertained to.

"TYPICAL" mention indicates a general view which does not represent full detail.

Numbered step are used to give a sequence to be performed.

Letters are used for any measures.

# LEAK TEST

## SERVICE TOOLS

Description	Part Number	Page
Drive shaft adapter .....	529 035 892 .....	2
Drive shaft adapter .....	529 035 985 .....	2

## SERVICE PRODUCTS

Description	Part Number	Page
Molykote 111.....	413 707 000 .....	4

## PROCEDURES

### PREPARATION

The procedure has to be done when engine operating temperature of approx. 70°C (158°F) is reached.

#### **⚠ WARNING**

Prevent burning yourself due to handling on the hot engine.

Remove:

- any parts to have access to engine
- safety lanyard

#### **⚠ WARNING**

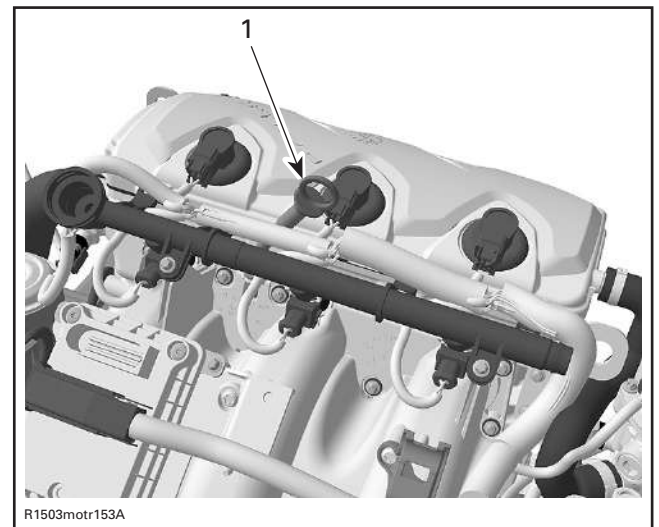
Safety lanyard must be removed to prevent engine to be cranked while fuel rail is removed to prevent fuel to be sprayed out. Fuel is flammable.

- jet pump (refer to JET PUMP in the appropriate *VEHICLE SHOP MANUAL*)
- coolant tank cap

#### **⚠ WARNING**

To prevent burning yourself only remove the coolant tank cap by wearing the appropriate safety equipment.

- oil dipstick

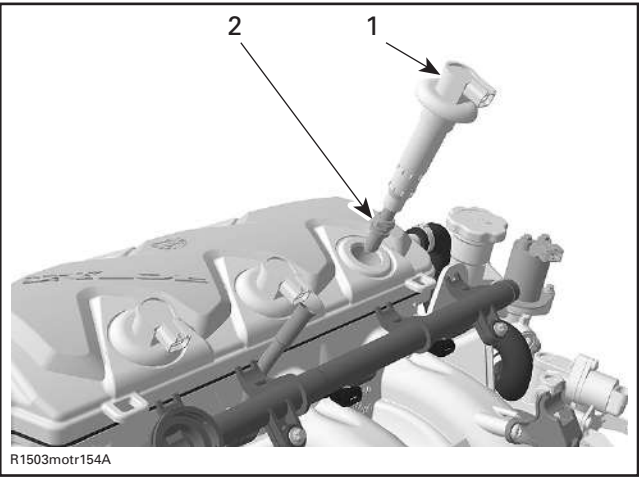


1. Oil dipstick

- Unplug ignition coil and pull it out
- spark plug.

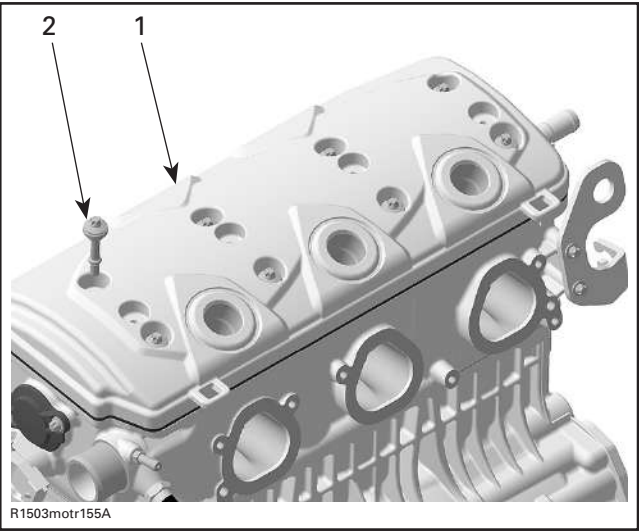
**NOTE:** Ignition coil may be used as an extractor.

Section 01 ENGINES (1503 4-TEC)  
Subsection 01 (LEAK TEST)



- 1. Ignition coil
- 2. Spark plug

- Remove valve cover cowl.
- Unscrew and remove valve cover.



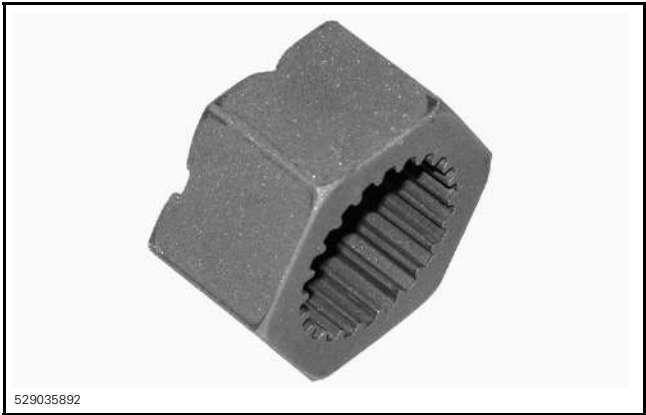
- 1. Valve cover
- 2. Valve cover screw

PROCEDURE

The following procedure has to be performed for each cylinder separately.

With an appropriate wrench lever, engine is rotated using the drive shaft adapter. Refer to the following table.

ENGINE	TOOL
1503 4-TEC Naturally Aspirated 1503 4-TEC Supercharged	Drive shaft adapter (P/N 529 035 892)
1503 4-TEC Supercharged Intercooled	Drive shaft adapter (P/N 529 035 985)

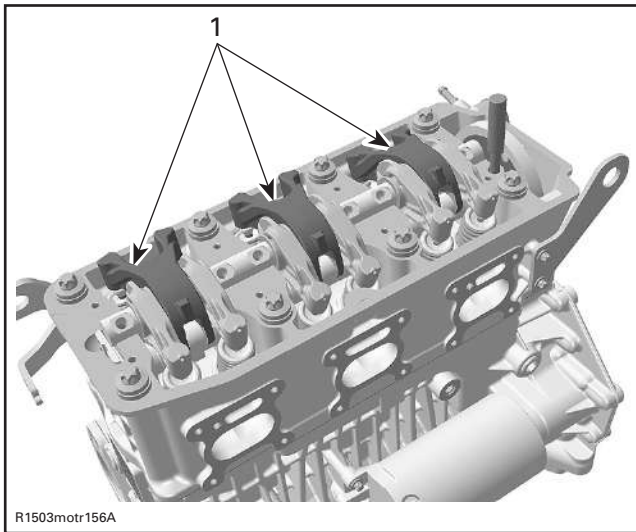


DRIVE SHAFT ADAPTER

Rotate engine counterclockwise until the cylinder no. 1 is at Top Dead Center (TDC) compression stroke.

**NOTE:** Cylinder numbers are molded on valve cover.

As the engine is turned over, observe the movement of intake rocker arm of the cylinder to be checked. After it completes the cycle and the intake valve closes, observe the piston. When it reaches its uppermost position that is TDC compression stroke.



1. Intake rocker arms

Protect the hull area then position the wrench lever so that it rest against hull to prevent further crankshaft rotation.

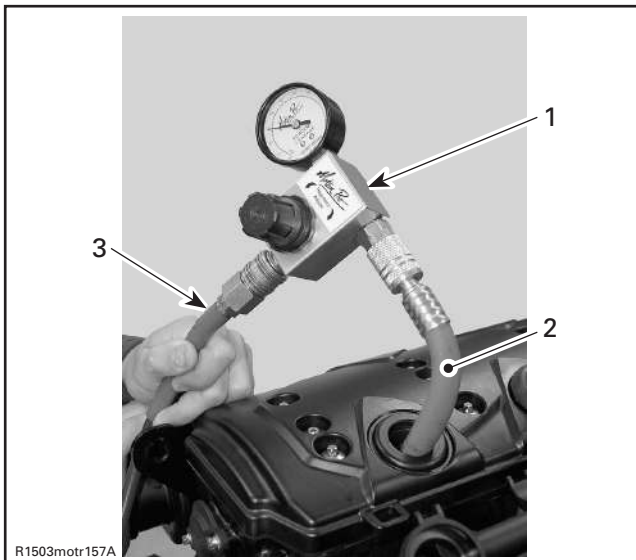
Install gauge adapter into previously cleaned spark plug hole.

Connect to adequate air supply.

**NOTE:** Each tester will have specific instruction on the gauge operation and required pressure.

Set needle of measuring gauge to zero.

Supply combustion chamber with air.



1. Measuring gauge  
2. Adequate adapter for spark plug hole  
3. Air supply

Note the amount of leaking or percentage (depending on tester).

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition.
16% to 25%	Good condition
26% to 40%	Fair condition; engine will run and performance might be down in some cases.
41% and higher	Poor condition, diagnose and repair engine.

Proceed the same way with remaining cylinders.

## DIAGNOSIS

Pressurize area to be tested, spray soap/water solution at the indicated location and look and/or listen for air bubbles.

- air escaping on intake port means leaking intake valve(s)
- air escaping on exhaust port means leaking exhaust valve(s)
- air bubbles out of coolant tank means leaking cylinder head gasket
- air escaping into crankcase area means excessively worn and/or broken piston rings.

## POSSIBLE ENGINE LEAKAGE AREA

Spray soap/water solution at the indicated location and look and/or listen for air bubbles.

Paying attention to the following checkpoints:

- clamp(s) tightened
- coolant hoses
- air/oil escaping from crankcase means damaged gasket(s) and/or loosened screws (refer to ENGINE BLOCK)
- air/water escaping from cylinder/head means damaged gasket(s) and/or loosened screws (refer to CYLINDER HEAD)
- oily contamination on weep hole (speed sensor area) means a damaged oil seal on coolant pump shaft

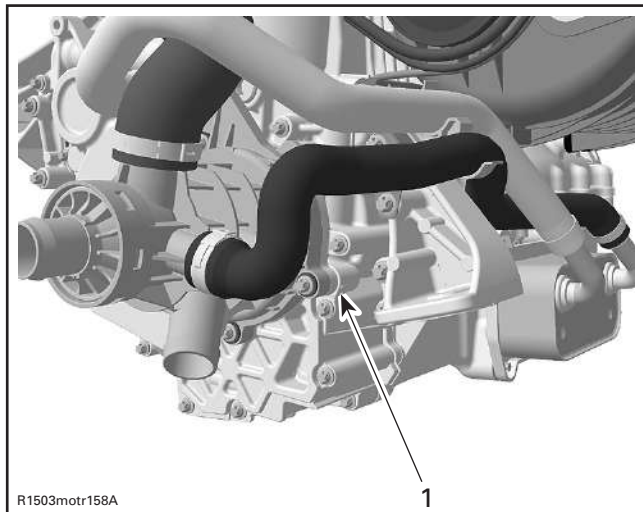
---

## Section 01 ENGINES (1503 4-TEC)

### Subsection 01 (LEAK TEST)

---

- coolant escaping from weep hole means a damaged rotary seal on coolant pump shaft (refer to COOLING SYSTEM)



1. Weep hole

- coolant escaping from coolant pump housing means damaged gasket(s) and/or loosened screws (refer to COOLING SYSTEM).

**NOTE:** For all the checkpoints mentioned above see the appropriate engine section to diagnose and repair the engine.

## ASSEMBLY

**NOTE:** For assembly, use the torque values and Loctite products from the exploded views (refer to proper engine section).

For assembly, reverse the preparation procedure.

**NOTE:** Prior to inserting the ignition coil in its location, apply some Molykote 111 (P/N 413 707 000) around the seal area that touches the spark plug hole. After installation, ensure the seal seats properly with the engine top surface.



# INTAKE MANIFOLD AND SUPERCHARGER

## SERVICE TOOLS

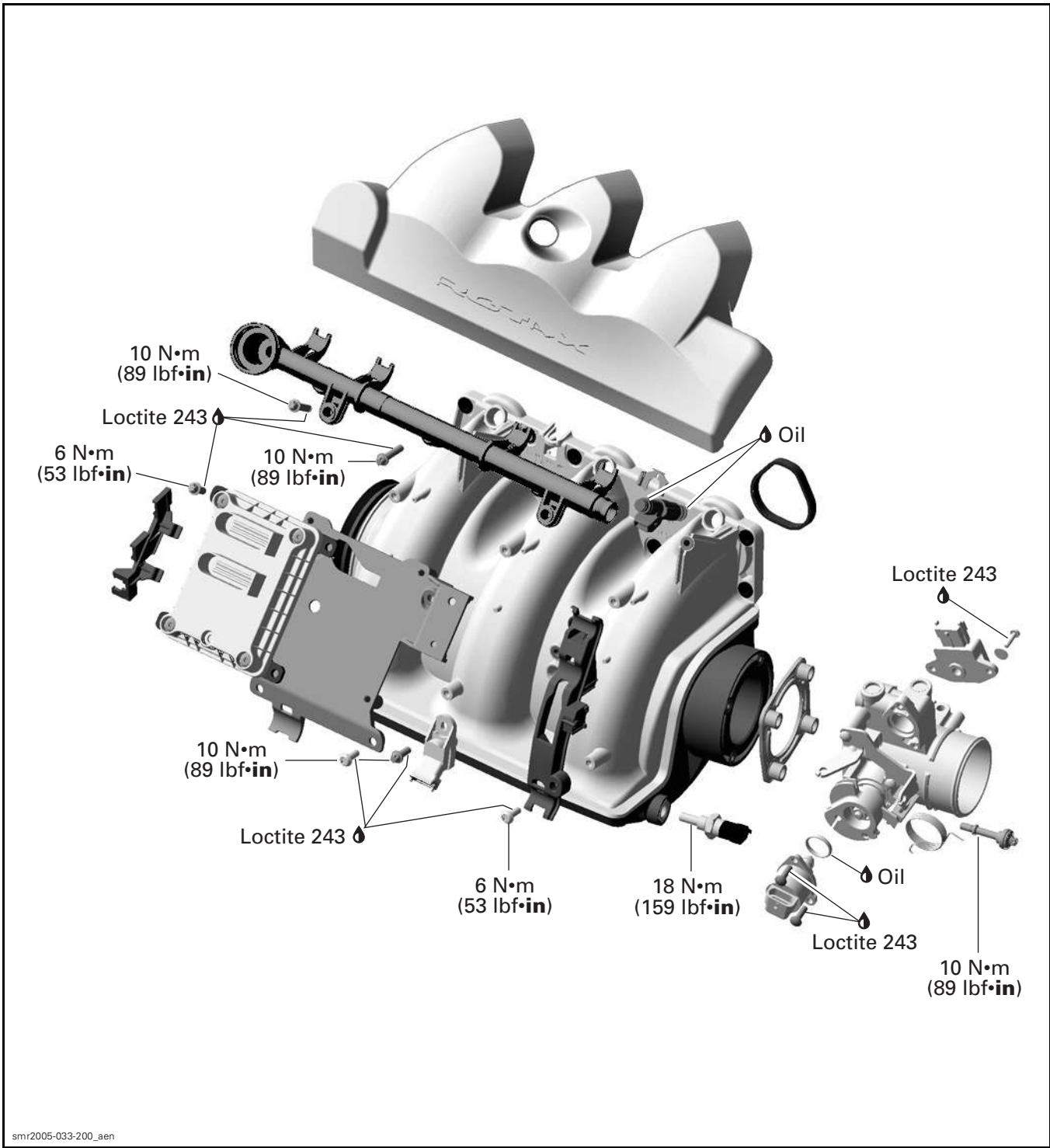
Description	Part Number	Page
4-pin socket .....	529 035 948 .....	20, 23
camshaft locking tool.....	529 035 839 .....	11
leak test pump.....	529 021 800 .....	10
retaining key .....	529 035 949 .....	18–19, 25
support plate.....	529 035 947 .....	22–23
support/pusher .....	529 035 950 .....	23
support/pusher .....	529 035 950 .....	22
Torx adapter .....	529 035 938 .....	17, 27

## SERVICE PRODUCTS

Description	Part Number	Page
Kluber Isoflex grease .....	293 550 021 .....	24
Loctite 243.....	293 800 060 .....	23–27
Loctite 5910.....	293 800 081 .....	25
Super Lube grease .....	293 550 030 .....	27

**Section 01 ENGINES (1503 4-TEC)**  
Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

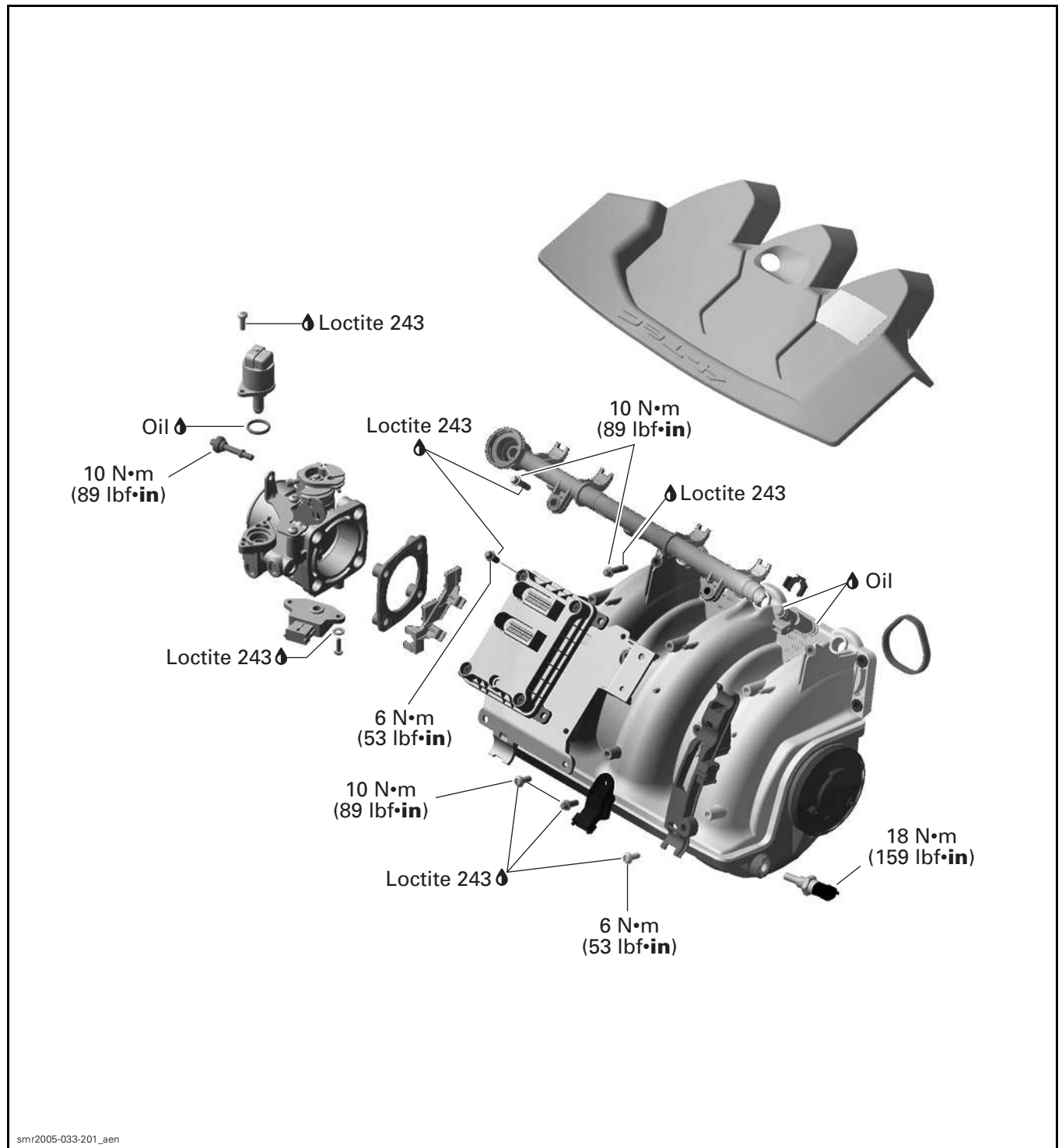
*Naturally Aspirated Engine — Intake Manifold and Throttle Body*



TYPICAL

**Section 01 ENGINES (1503 4-TEC)**  
Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

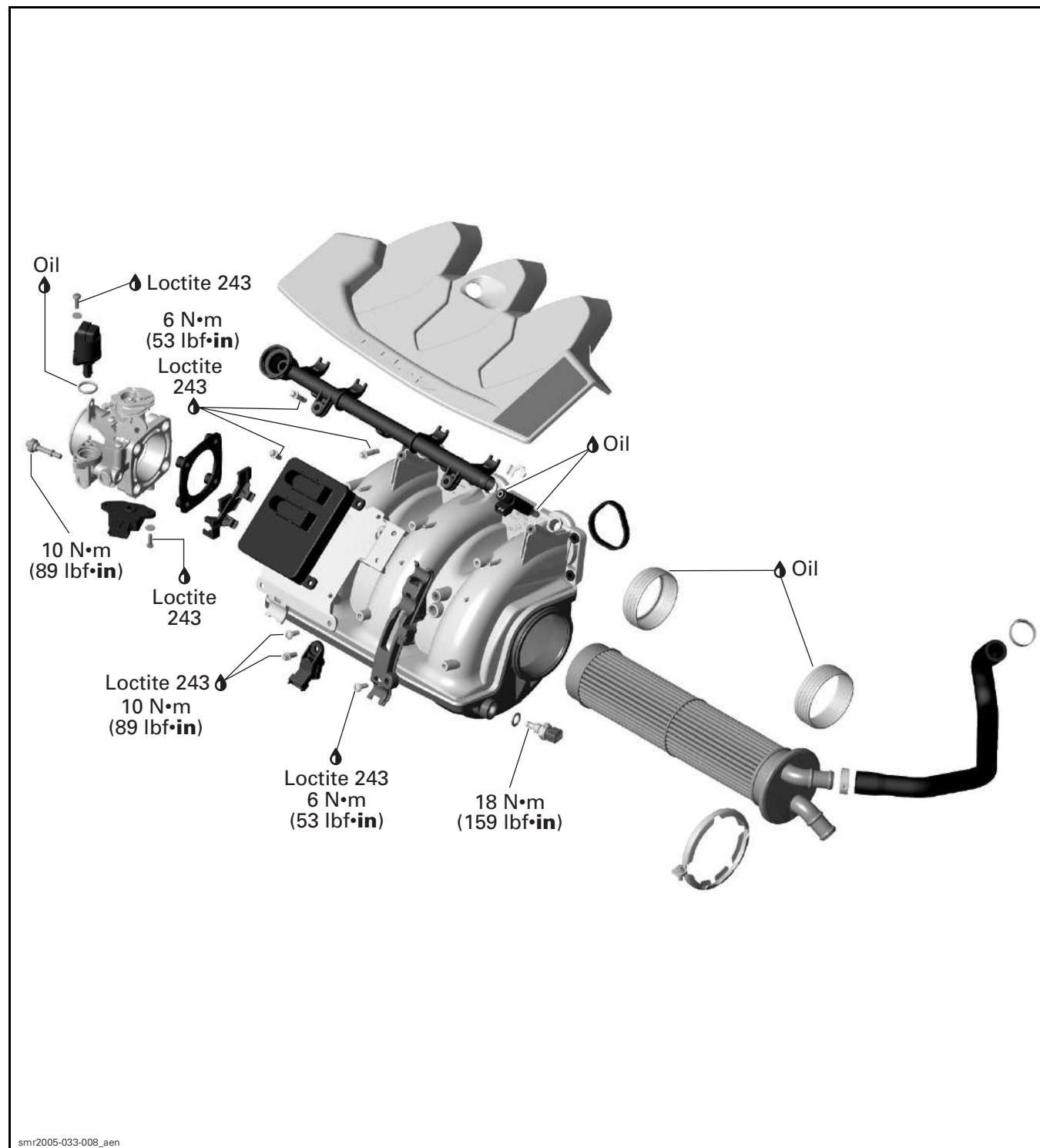
***Supercharged Engine — Intake Manifold and Throttle Body***



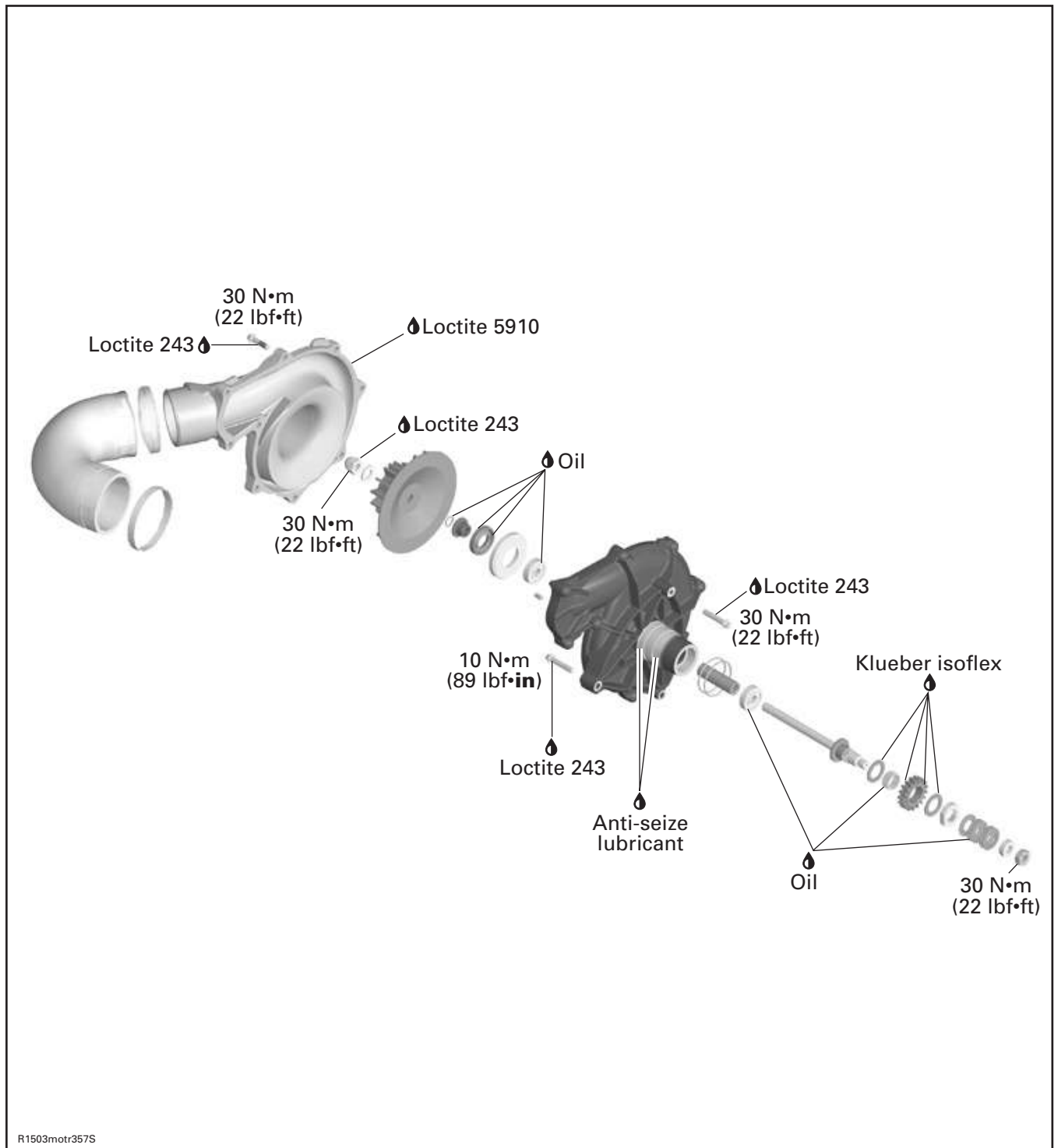
## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

#### *Supercharged Intercooled Engine — Intake Manifold and Throttle Body*



***Supercharged Engines — Supercharger***




**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)**

**INSPECTION (PARTS ASSEMBLED)**

**Intercooler Leak Test**  
***Supercharged Intercooled Engine***

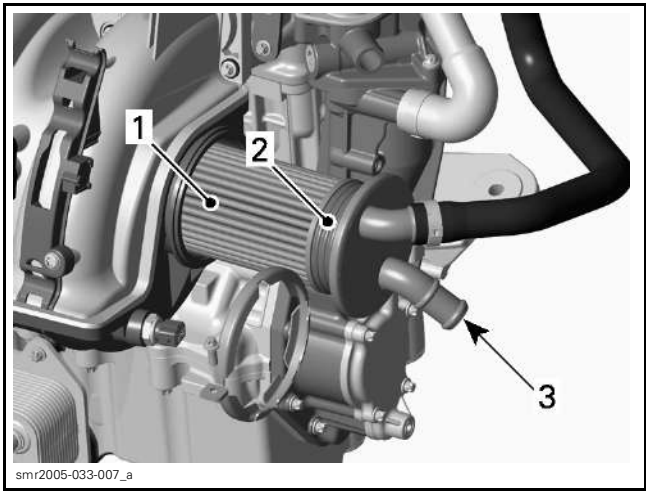
Perform intercooler leak test when engine loses performance, when there is white exhaust smoke or when temperature in exhaust system is too high.

 **WARNING**

Let engine cool down prior to perform leak test. Direct contact with hot engine may result in skin burn.

**NOTE:** The inspection can be done while intercooler remains installed in intake manifold.

- Remove:
- outlet hose from exhaust manifold
  - inlet hose from intercooler.



- 1. Intercooler
- 2. Outlet hose
- 3. Inlet nipple

Plug intercooler inlet nipple.  
Install an adapter on the outlet hose to connect the leak test pump (P/N 529 021 800).



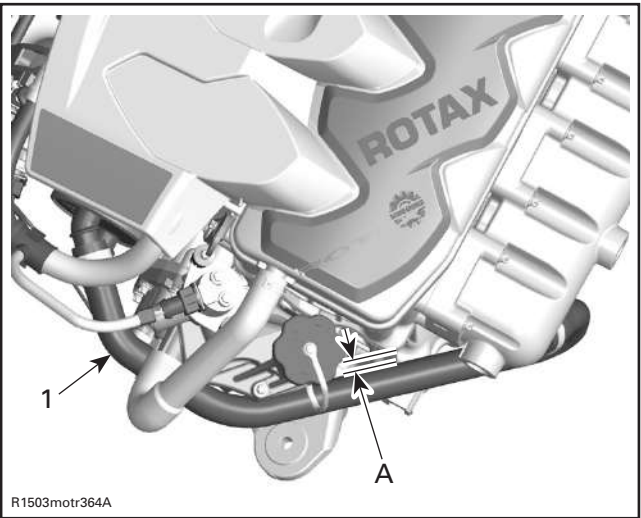
Pressurize the intercooler as follows:

PRESSURE TEST
69 kPa (10 PSI) for 10 minutes min

If there is a pressure drop, first spray hoses and adapters with a soapy solution to ensure they are not leaking.

Otherwise, remove intercooler from manifold to spray soapy water on it. If air bubbles are present, replace the intercooler. Refer to procedures farther in this section.

Properly reinstall removed parts.  
The distance between engine block and intercooler outlet hose must be 3 - 7 mm (0.12 - 0.27 in) otherwise the hose would scuff on the engine block.



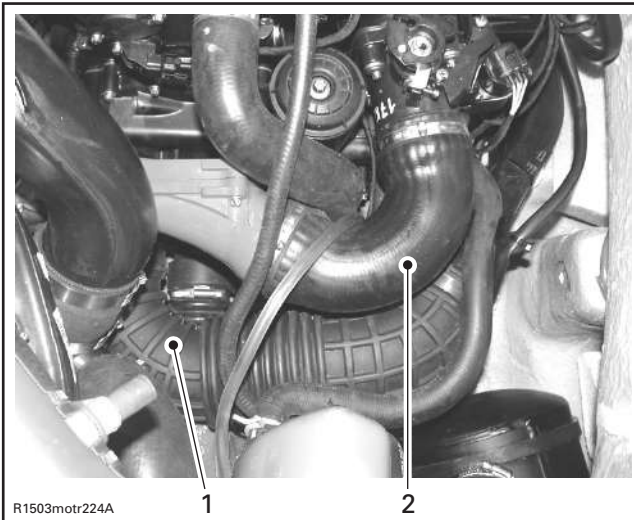
- 1. Outlet hose distance
- A. 3 - 7 mm (0.12 - 0.27 in)



## Supercharger Clutch Slipping Moment *Supercharged Engines*

**NOTE:** Remove required parts to access supercharger. Refer to appropriate *VEHICLE SHOP MANUAL*.

Remove air intake hose from supercharger.

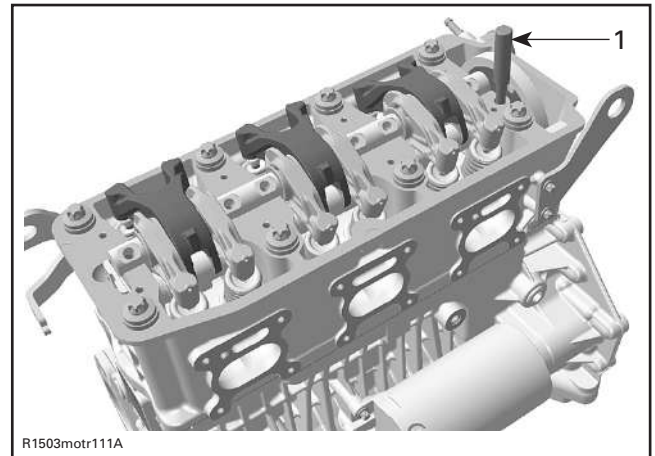


1. Supercharger ass'y
2. Air intake hose

Remove valve cover and install camshaft locking tool (P/N 529 035 839) to prevent camshaft rotation while checking slipping moment of supercharger. Refer to CYLINDER HEAD.

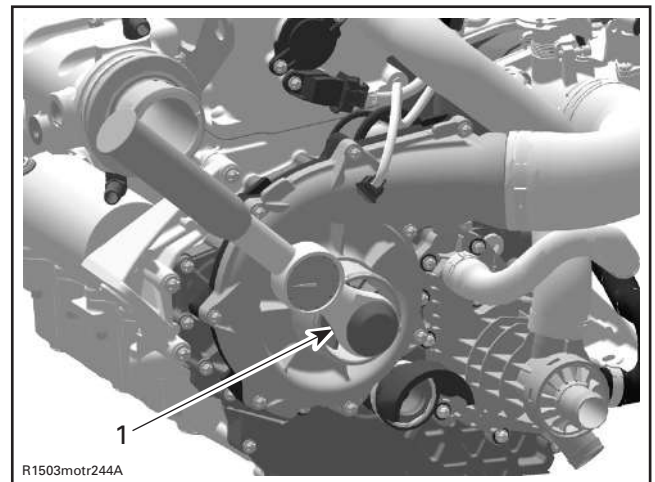


**NOTE:** Rotate supercharger nut to align camshaft holes and to allow insertion of the locking tool.



1. Camshaft locking tool

Check slipping moment counterclockwise by using a torque wrench with actual torque viewer. A mirror is useful to see the viewer.



1. Torque wrench

**NOTE:** Before checking the supercharger slipping moment it is recommended to turn the clutch a full revolution. This way the parts can mate together and you will get a more accurate reading.

Supercharger should start to turn at a torque within the specified values.

SLIPPING MOMENT	NEW SUPERCHARGER	BREAK-IN SUPERCHARGER
Torque value applied	7 - 12 N•m (62 - 106 lbf•in)	5 - 10 N•m (44 - 88 lbf•in)

**NOTE:** After supercharger ran for a few hours, the parts break-in and this brings a reduced slipping moment.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

If the torque is not within specifications, repair supercharger clutch. Verify supercharger clutch components as per INSPECTION (PARTS DISASSEMBLED) further in this section.

## REMOVAL

### Intake Manifold

**NOTE:** Remove required parts to access intake manifold. Refer to appropriate *VEHICLE SHOP MANUAL*.

Remove oil dipstick.

Pull fuel rail cover out.

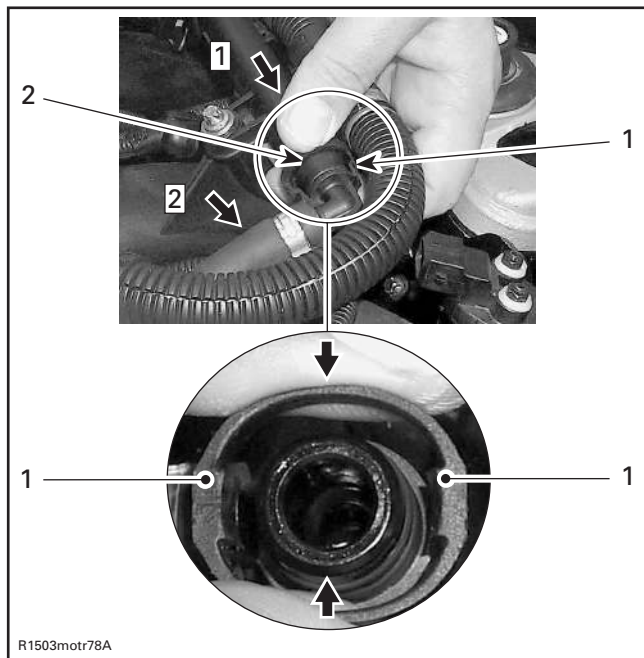
Release the fuel pressure in the system, refer to ENGINE MANAGEMENT section of the appropriate *VEHICLE SHOP MANUAL*.

Disconnect battery cables from battery.

### WARNING

Always disconnect battery cables exactly in the specified order, **BLACK** negative cable first then the **RED** positive battery cable last.

Disconnect fuel hose connector at fuel rail.



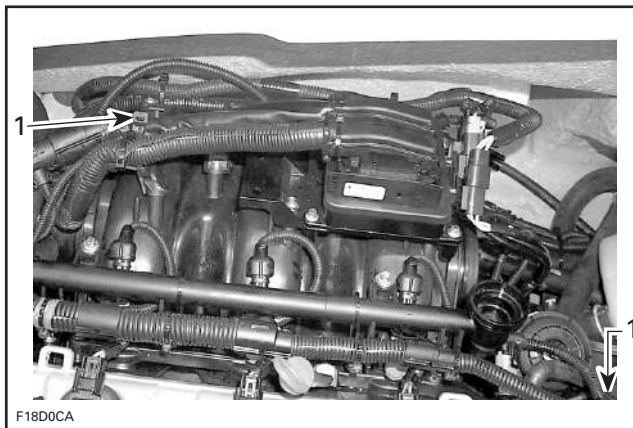
Step 1: Squeeze

Step 2: Pull out

1. Supporting tabs

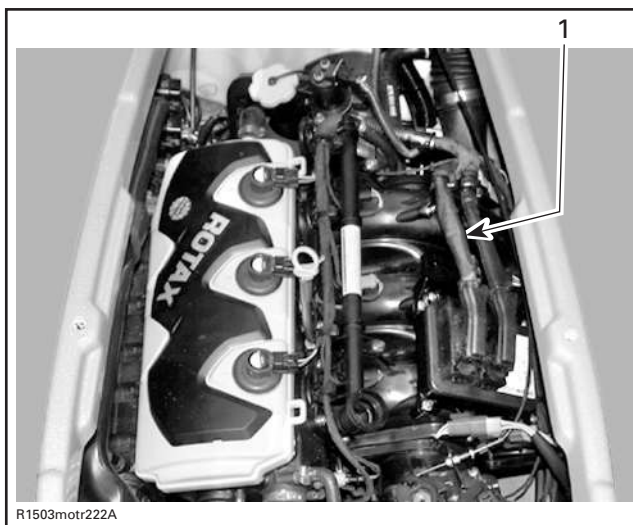
2. Squeeze in middle of supporting tabs, hold and pull out

Cut locking ties where shown.



### NATURALLY ASPIRATED ENGINE

1. Cut locking ties to release harness



### SUPERCHARGED ENGINE

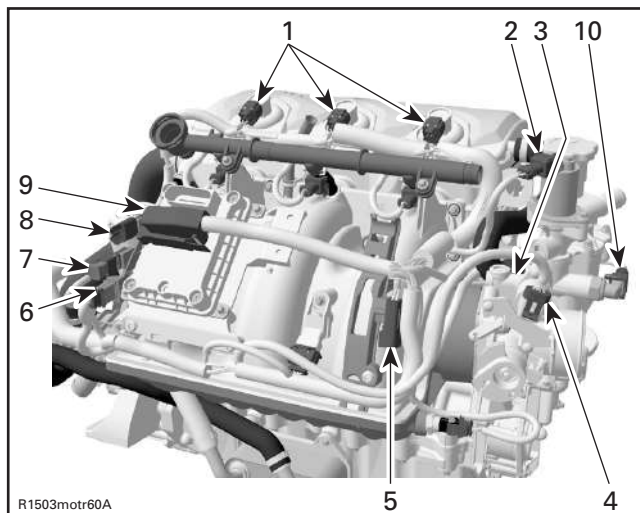
1. Cut locking ties to release harness

## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

Unplug electrical connectors.

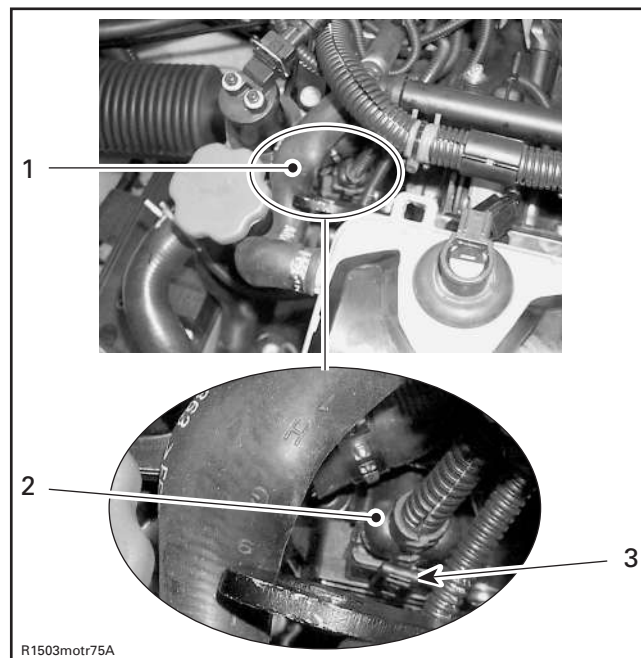
#### **Naturally Aspirated Engine**



#### **NATURALLY ASPIRATED ENGINE**

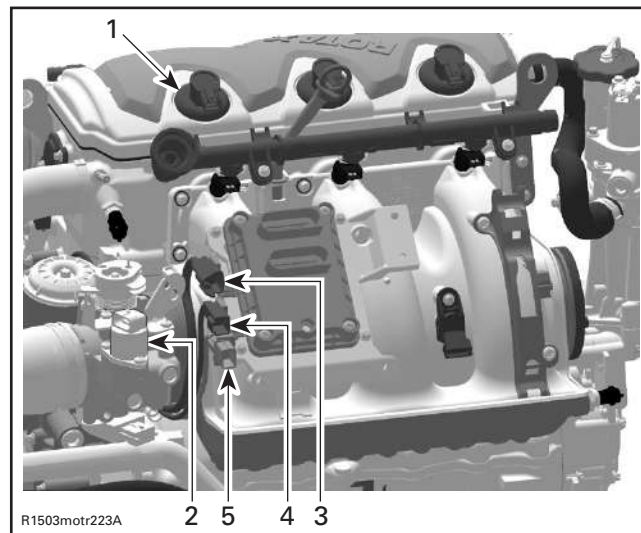
1. Ignition coils
2. TOPS
3. TPS (hidden behind throttle body)
4. Idle bypass valve
5. Engine connector
6. KS
7. CPS
8. Magneto
9. "B" Kostal connector
10. OSPS

**NOTE:** The TPS connector is hidden behind the TOPS hose. Disconnect hose from TOPS valve then move away to access the TPS connector. Slightly pry locking tab of connector to unlock.



1. TOPS hose disconnected and moved away
2. TPS connector
3. Slightly pry tab to unlock

#### **Supercharged Engines**



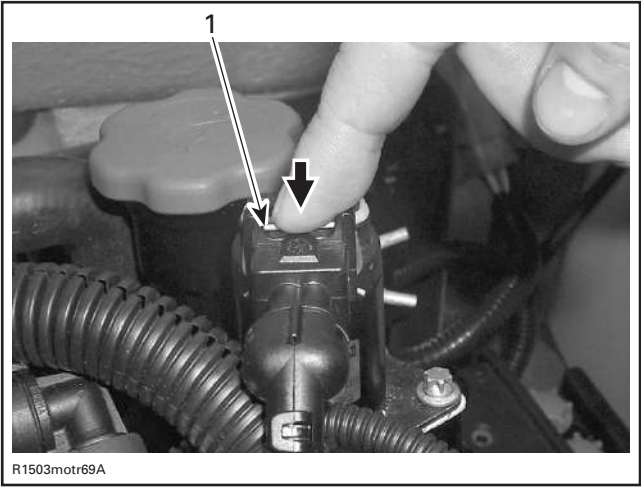
#### **SUPERCHARGED ENGINES**

1. Ignition coils
2. Idle bypass valve
3. KS
4. CPS
5. Magneto

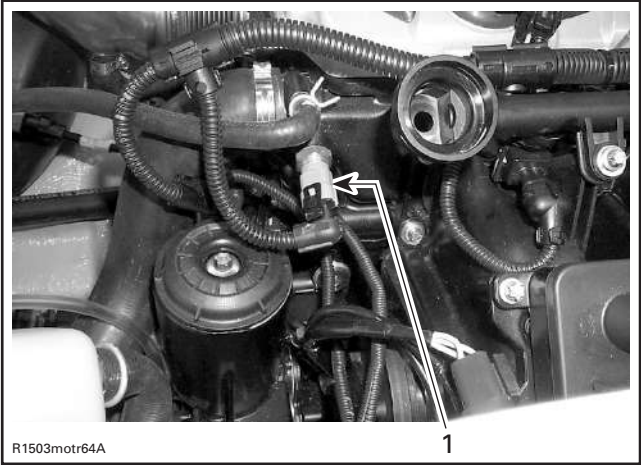


**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)**

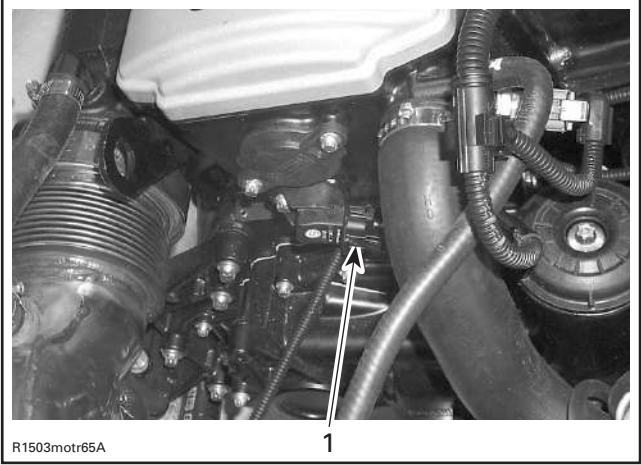
**All Engines**



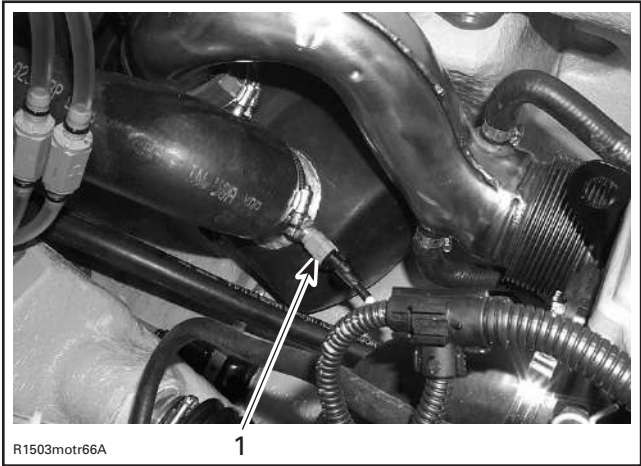
**TOPS VALVE**  
1. Push here and hold while pulling connector out



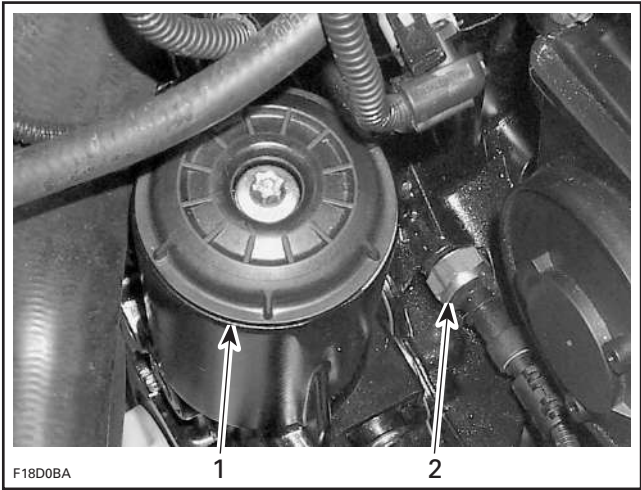
**TYPICAL**  
1. CTS connector



**TYPICAL**  
1. CAPS connector

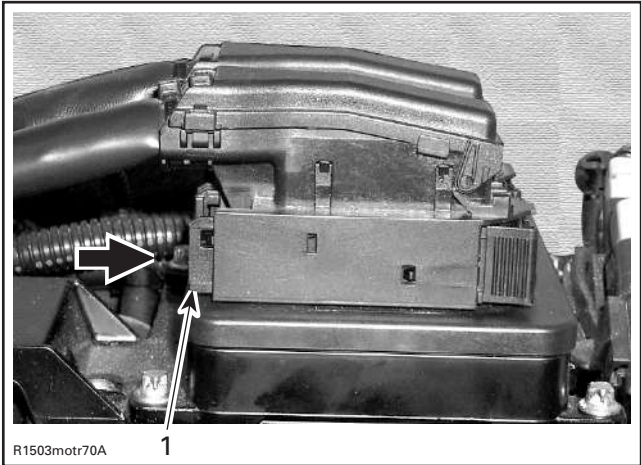


**TYPICAL**  
1. EGTS connector



1. Oil filter housing  
2. OPS

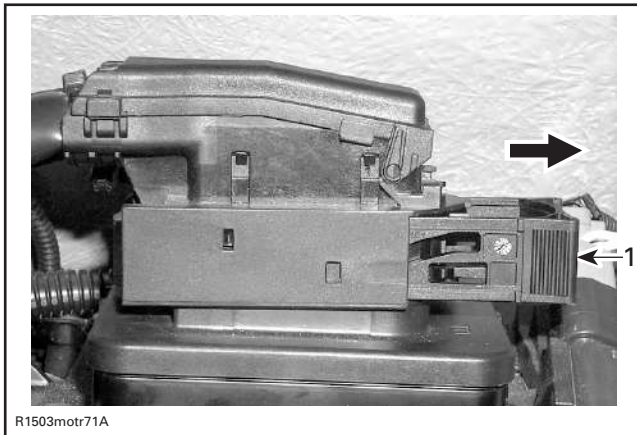
Unplug the "B" connector from the ECM.



1. Push this end to unlock

## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



1. Pull here to release

Pull the connectors for the knock sensor (KS), crankshaft position sensor (CPS) and magneto out of the ECM support. For more details, refer to ELECTRICAL CONNECTORS section of the appropriate *VEHICLE SHOP MANUAL*.

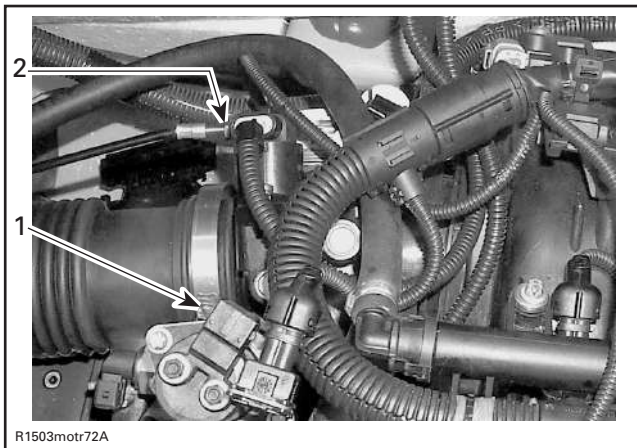
Disconnect knock sensor (KS) and crankshaft position sensor (CPS) connectors.

Cut locking ties as necessary and pull wiring harness away from intake manifold.

#### **Naturally Aspirated Engine**

Loosen air intake silencer collar.

Unlock throttle cable housing from throttle body. Cable is to be detached later on.

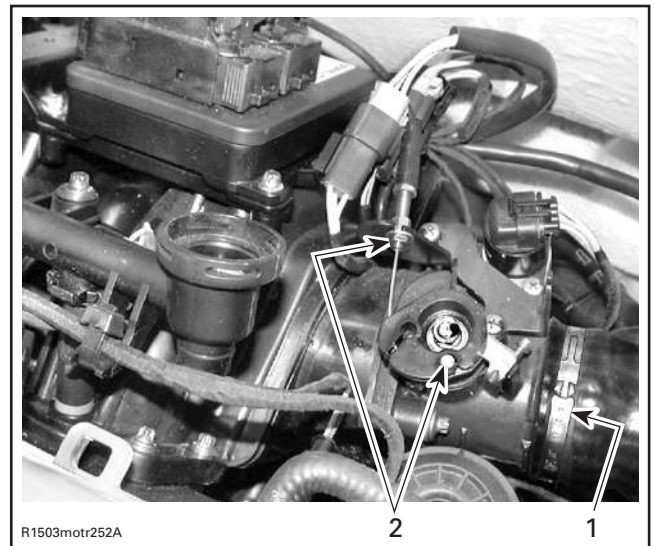


1. Air intake silencer collar
2. Unlock throttle cable housing

#### **Supercharged Engines**

Remove inlet hose from throttle body.

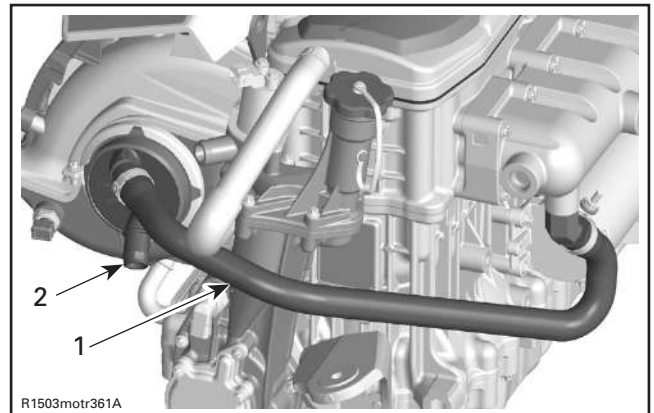
Disconnect throttle cable from throttle body.



1. Detach hose
2. Disconnect cable

#### **Supercharged Intercooled Engine**

Remove the hoses connected to the intercooler.



1. Hose from intercooler to exhaust manifold (outlet nipple)
2. Hose from jet pump

#### **All Engines**

Remove manifold retaining screws and push the oil dipstick tube out of the manifold slot.

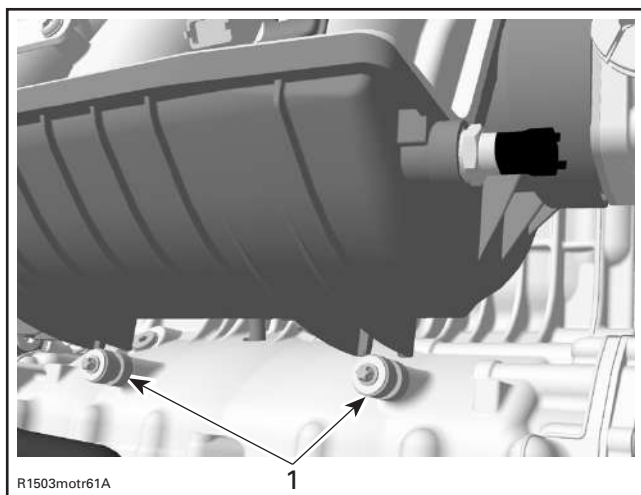


## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



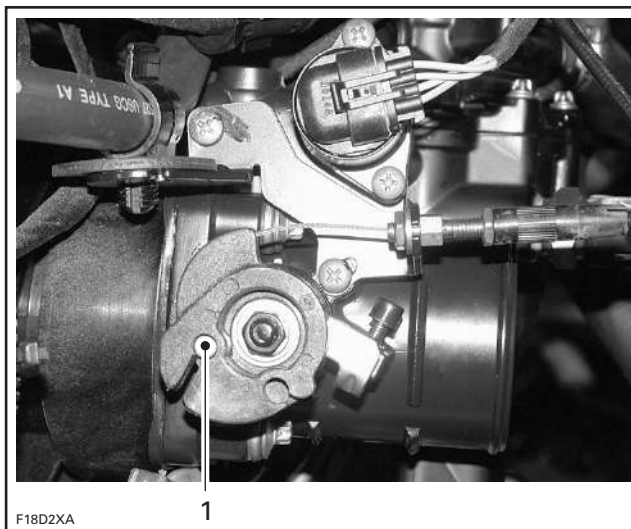
Lift intake manifold up to pull it out of the mounting brackets just enough to reach throttle cable end.



1. Mounting brackets

#### **Naturally Aspirated Engine**

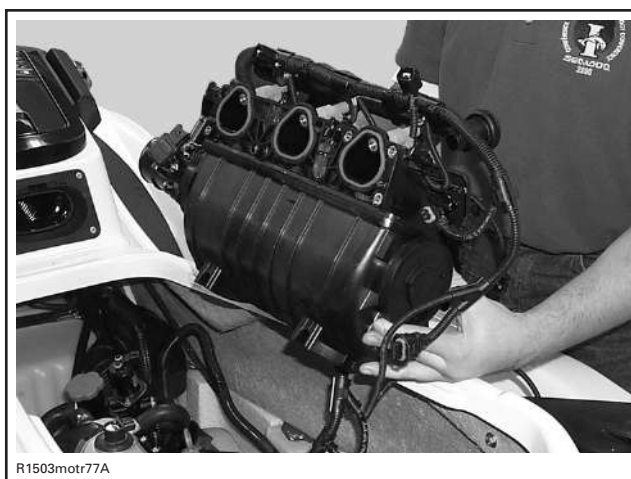
Detach throttle cable end from throttle body.



1. Detach cable end from throttle body

#### **All Engines**

Pull intake manifold out.



TYPICAL

**NOTE:** The flame arrester and the intercooler (if so equipped) in the intake manifold are maintenance free.

#### **Supercharger**

##### **Supercharged Engines**

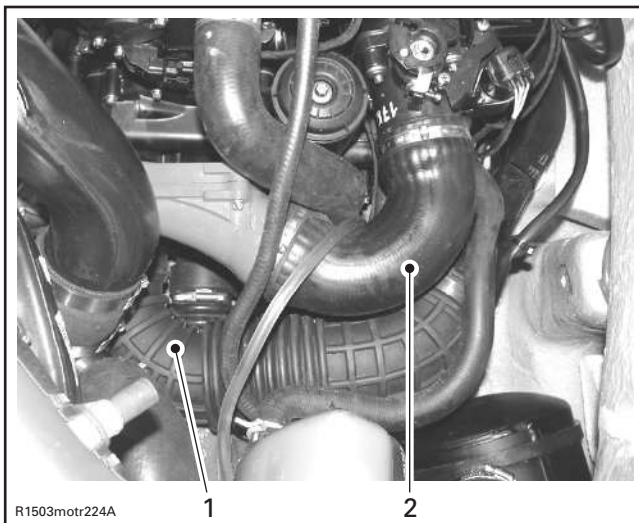
**NOTE:** Remove required parts to access supercharger. Refer to appropriate *VEHICLE SHOP MANUAL*.

Remove hoses from supercharger ports.



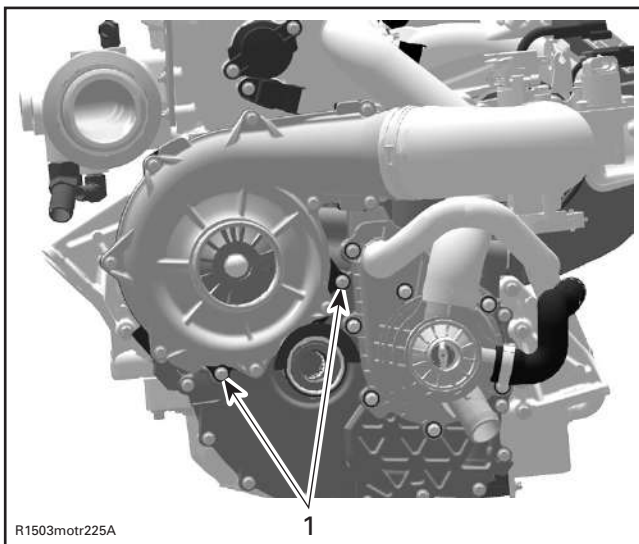
## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



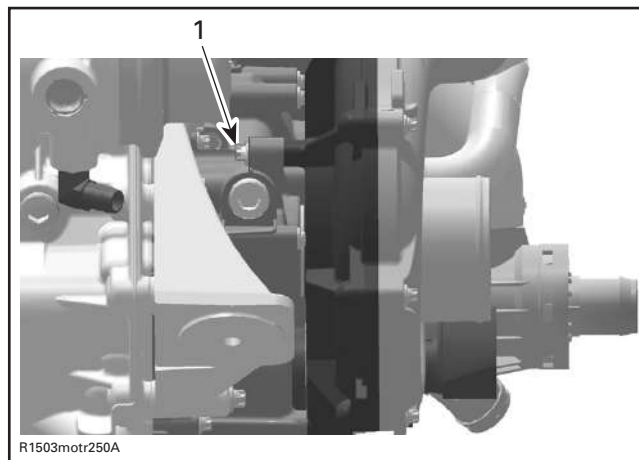
1. Inlet hose
2. Outlet hose

Remove retaining screws and pull out the super-charger ass'y.



1. Retaining screws

To remove the upper screw (not shown on the picture above), use the Torx adapter (P/N 529 035 938).

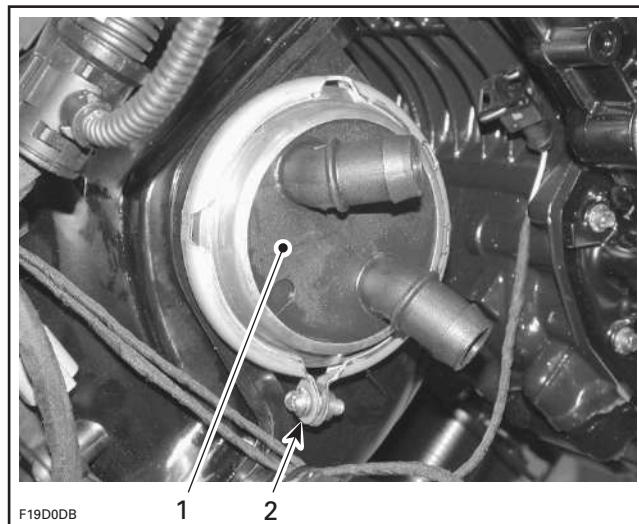


1. Upper retaining screws

## DISASSEMBLY

### Intake Manifold and Intercooler **Supercharged Intercooled Engines**

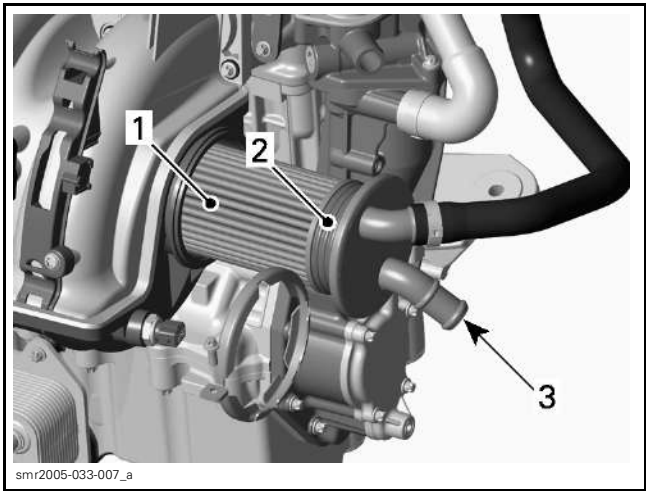
Remove collar from intercooler.



1. Intercooler
2. Collar

Carefully pull intercooler out of intake manifold.

**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)**

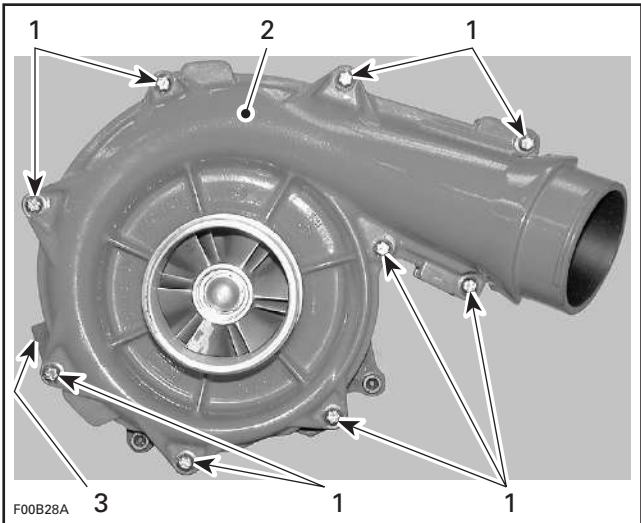


- 1. Intercooler
- 2. Profile Ring
- 3. Collar

**Supercharger**  
**Supercharged Engines**

**CAUTION:** Be scrupulous when working on supercharger parts. Supercharger rotation reaches 40 000 RPM. Any modification, improper repair/assembly or damage on the parts, may result in damage of the supercharger. Strictly follow the described procedures.

Take apart supercharger housing.



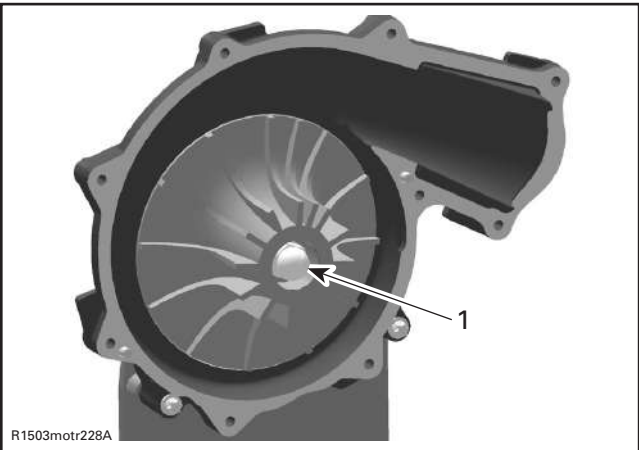
- 1. Retaining screws
- 2. Housing half (intake side)
- 3. Housing half (engine side)



PLASTIC HAMMER

**NOTE:** The cap nut on the supercharger shaft has LH threads.

Loosen cap nut (turn clockwise) on supercharger shaft turbine side while holding shaft with a retaining key (P/N 529 035 949).

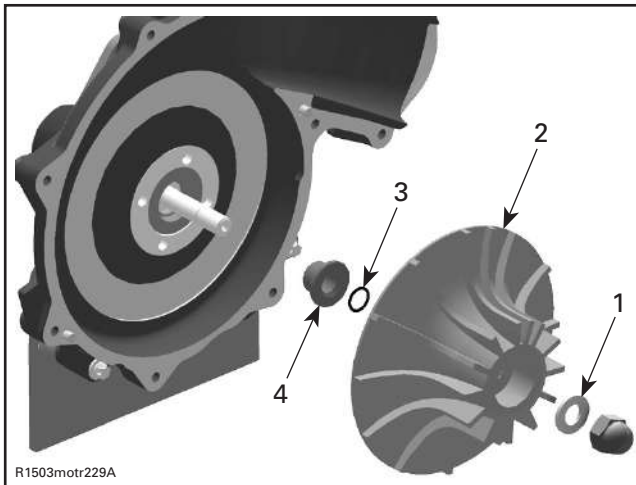


1. Cap nut

Remove washer, turbine, O-ring and step collar from supercharger shaft.

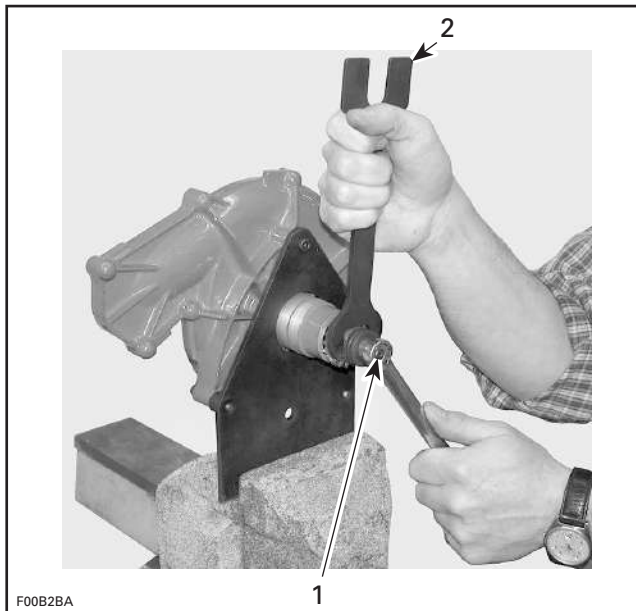
## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



1. Washer
2. Turbine
3. O-ring
4. Step collar

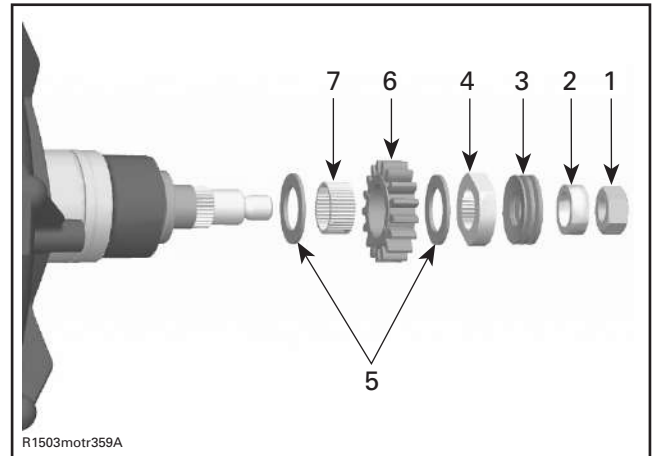
Loosen nut on supercharger shaft engine side while holding shaft with a retaining key (P/N 529 035 949).



1. Nut
2. Retaining key

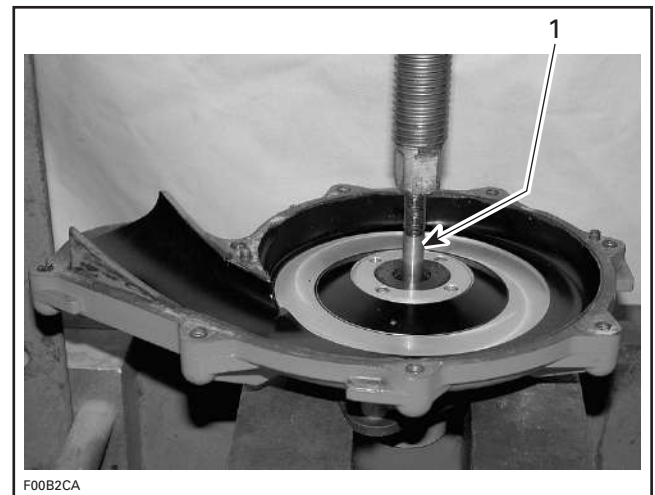
**NOTE:** There are 40 loose needle bearings under the gear. Do not reuse.

Remove L-ring, spring washers, lock washer, drive gear and needle pins by turning the supercharger ass'y upside down.



1. Nut
2. L-ring
3. Spring washers
4. Lock washer
5. Ceramic washers
6. Drive gear
7. Needle bearings

Carefully push out supercharger shaft towards engine side by using a press.

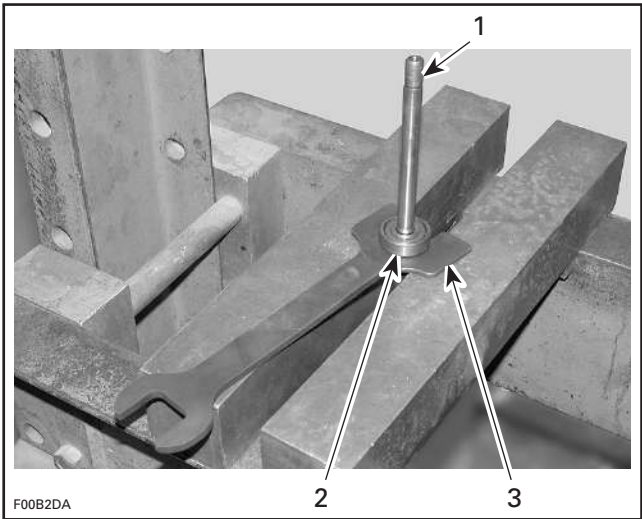


1. Supercharger shaft

**CAUTION:** Every time when removing the supercharger shaft, both ball bearings have to be replaced.

Remove ball bearing from supercharger shaft by using a press and retaining key (P/N 529 035 949).

**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)**

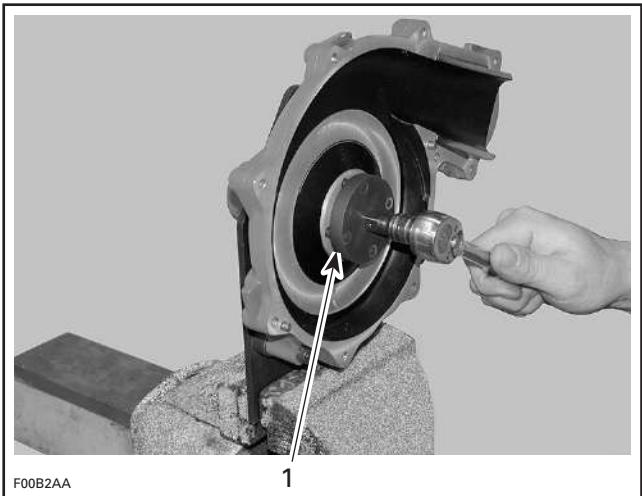


- 1. Supercharger shaft
- 2. Ball bearing
- 3. Retaining key

Screw out retaining disc with seal from housing half (engine side) by using the 4-pin socket (P/N 529 035 948).

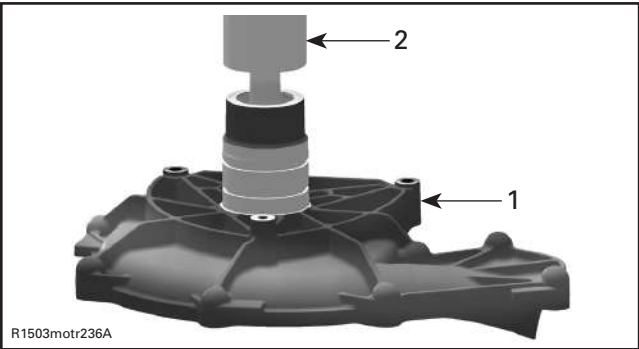


**NOTE:** It may be necessary to heat the housing with a heat gun to release the retaining disc.



- 1. 4-pin socket

Remove ball bearing from supercharger housing half (engine side) by using a press and a suitable bearing pusher.



- 1. Supercharger housing half (engine side)
- 2. Bearing pusher

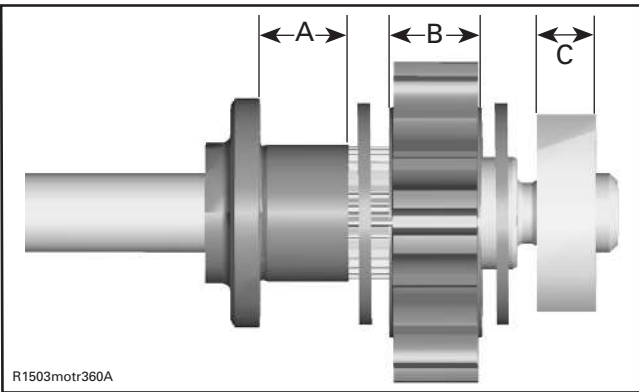
**INSPECTION (PARTS DISASSEMBLED)**

**Supercharged Clutch Components and Gear**

Replace worn parts by new ones. A clutch repair kit is available. If all parts are within specifications, replace the 40 needle bearings and spring washer package on supercharger shaft.

**NOTE:** Ceramic washers are not affected by wear.

Check the wear limit on drive gear, lock washer and driven plate on supercharger shaft. Check drive gear for cracks.



- A. Driven plate thickness
- B. Drive gear thickness
- C. Lock washer thickness



## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

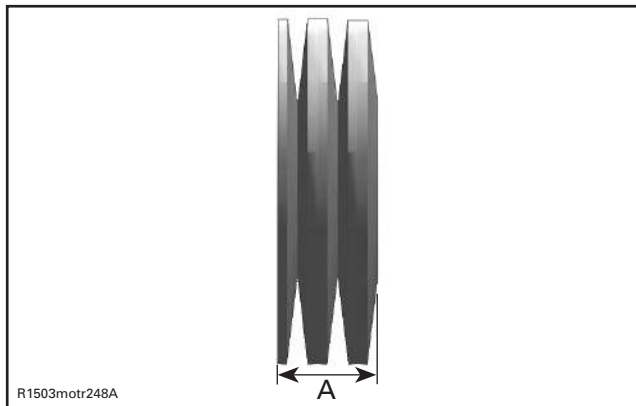
DRIVEN PLATE JOURNAL DEPTH	
NEW MINIMUM	9.960 mm (.3921 in)
NEW MAXIMUM	10.000 mm (.3937 in)
SERVICE LIMIT	10.3000 mm (.4055 in)

DRIVE GEAR THICKNESS	
NEW MINIMUM	11.000 mm (.4331 in)
NEW MAXIMUM	11.050 mm (.4350 in)
SERVICE LIMIT	10.500 mm (.4134 in)

LOCK WASHER THICKNESS	
NEW MINIMUM	6.900 mm (.2717 in)
NEW MAXIMUM	7.100 mm (.2795 in)
SERVICE LIMIT	6.600 mm (.2598 in)

#### Spring Washer

Put spring washer package together as it is assembled on the supercharger shaft. Measure the height of the unloaded spring washer package.



A. Spring washer package height

SPRING WASHER PACKAGE HEIGHT	
NEW	10.500 mm (.4134 in)
SERVICE LIMIT	9.700 mm (.3819 in)

## ASSEMBLY

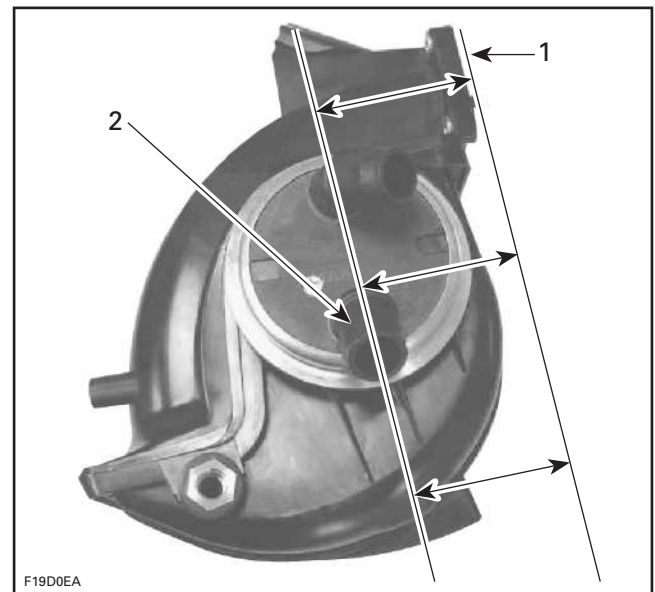
Assembly is essentially the reverse of removal procedures. However pay particular attention to the following.

### Intake Manifold and Intercooler *Supercharged Intercooled Engine*

Ensure O-rings are properly installed on intercooler and apply 4-stroke oil on them to ease installation.

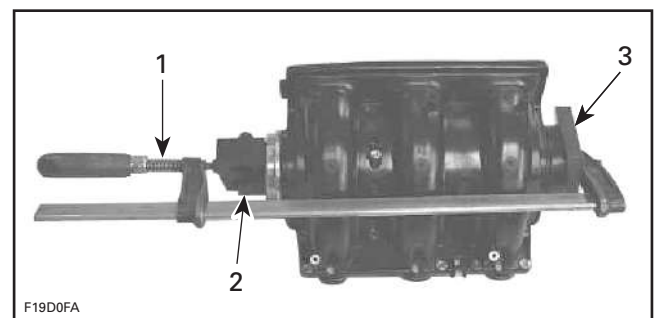
While properly aligning the inner end of intercooler in intake manifold, gently push intercooler until it bottoms.

Rotate intercooler to position nipples as shown.



1. Intake manifold flange
2. Nipple parallel with manifold flange

**NOTE:** If intercooler is hard to push in, a clamp can be used to press intercooler in.



1. Clamp
2. Plastic block between nipples
3. Plastic block

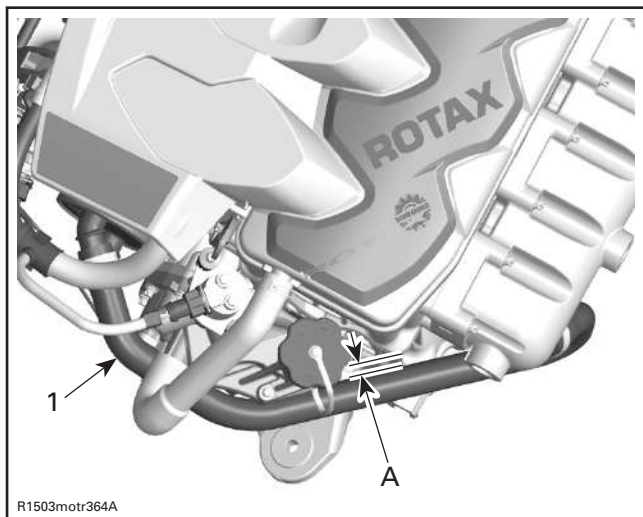
Reinstall collar.

The distance between engine block and intercooler outlet hose must be 3 - 7 mm (0.12 - 0.27 in) otherwise the hose would scuff on the engine block.



## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



1. Outlet hose distance  
A. 3 - 7 mm (0.12 - 0.27 in)

## Supercharger

### Supercharged Engines

**CAUTION:** Every time when supercharger shaft has been removed, both ball bearings have to be replaced.

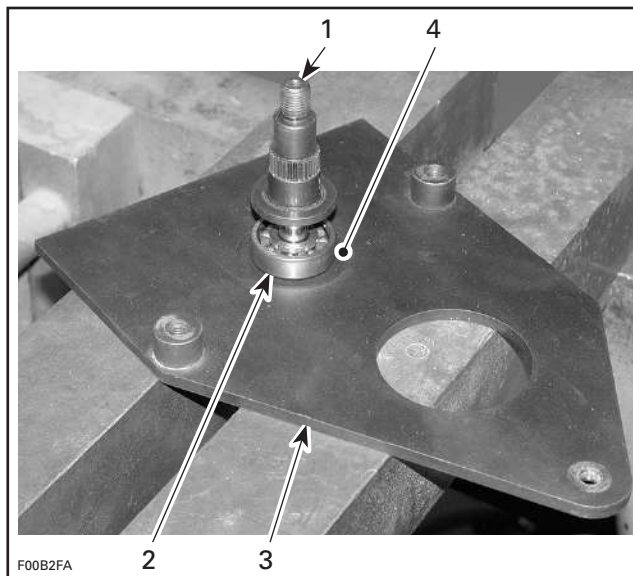
**CAUTION:** Both ball bearings have to be installed with cages facing supercharger impeller side.

Apply enough engine oil on ball bearing. Install ball bearing on supercharger shaft by using support plate (P/N 529 035 947) to hold bearing.



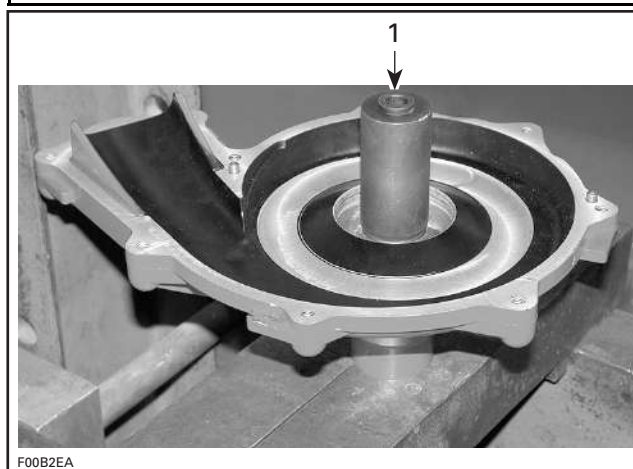
**CAUTION:** Ensure to position ball bearing against protrusion of support plate for the installation. This way, the installation pressure will be applied to the inner race and will not be transmitted to the bearing balls which would otherwise shorten the bearing life.

**CAUTION:** To install ball bearings and supercharger shaft always use a press, never use any beating force like a hammer.



1. Supercharger shaft  
2. Ball bearing  
3. Bearing support plate  
4. Protrusion of support plate on this side (underneath inner race)

Apply enough engine oil on ball bearing. Press in the ball bearing in supercharger housing half (engine side), by using ball bearing support/pusher (P/N 529 035 950).



1. Bearing support/pusher

## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

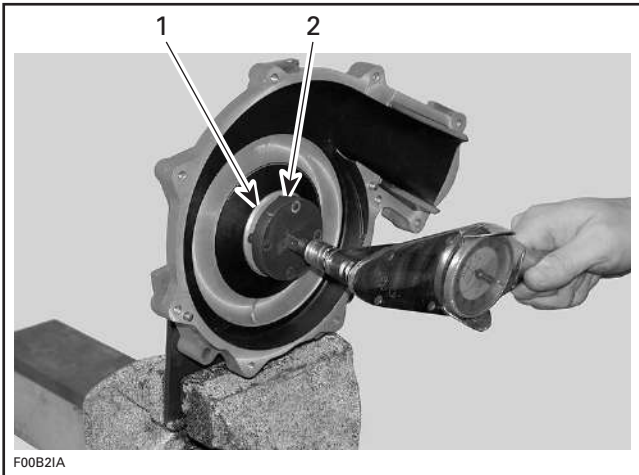
Mount supercharger housing half (engine side) on support plate (P/N 529 035 947).



Apply Loctite 243 (P/N 293 800 060) on retaining disc and install it in supercharger housing half by using the 4-pin socket (P/N 529 035 948). Torque to 30 N•m (22 lbf•ft).

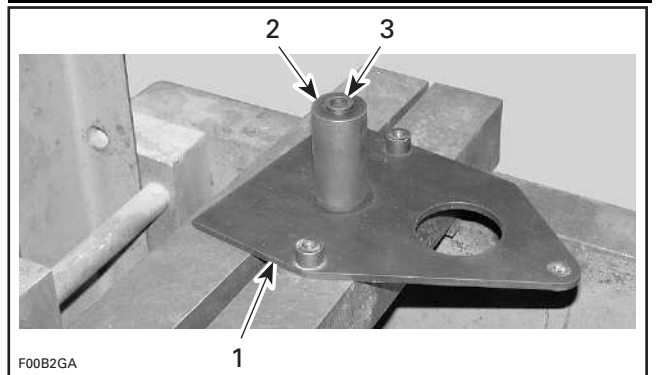


**NOTE:** If a new disc is installed, do not use any Loctite, threadlocker is already applied.



1. Retaining disc
2. 4-pin socket

To press supercharger shaft in housing half (engine side), properly support bearing, using support plate (P/N 529 035 947) and bearing support/pusher (P/N 529 035 950) under supercharger housing half.



1. Support plate
2. Bearing support/pusher
3. Protrusion here

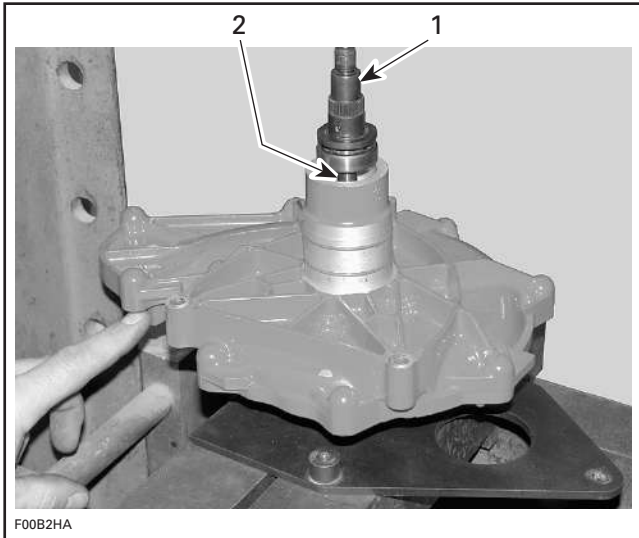
**CAUTION:** Before pressing in the supercharger shaft, be sure to properly support the inner race of ball bearing in supercharger housing half with the recommended tool. This way, the installation pressure will be applied to the inner race and will not be transmitted to the bearing balls which would otherwise shorten the bearing life.

Apply heat outside of the housing with a heat gun to expand its diameter prior to inserting the shaft. Ensure there is no O-ring on the housing half prior to heating.

Apply engine oil on supercharger shaft. Press shaft with distance sleeve together in supercharger housing half.

## Section 01 ENGINES (1503 4-TEC)

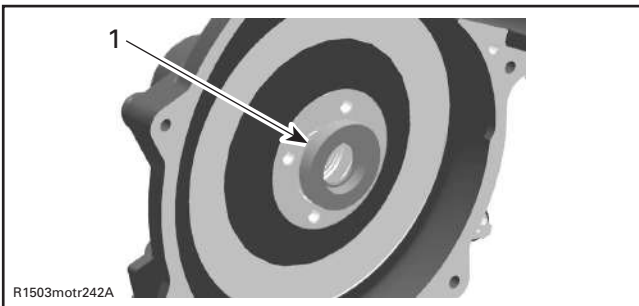
### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



1. Supercharger shaft
2. Distance sleeve

Apply engine oil on seal and push into retaining disc by hand.

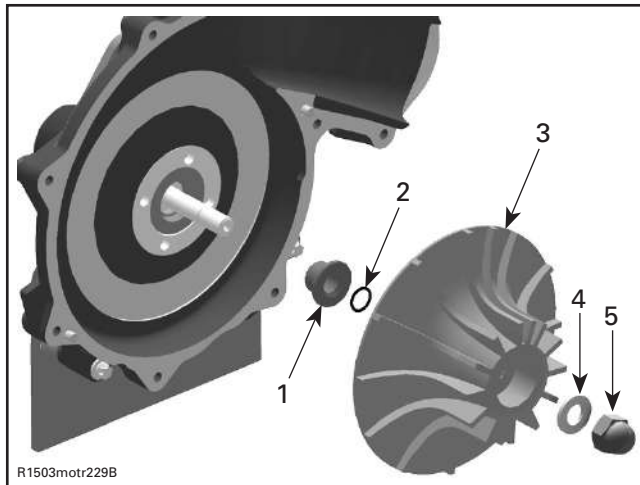
**NOTE:** Always use a new oil seal when assembling the supercharger.



1. Oil seal

Install step collar, O-ring, supercharger impeller and washer on supercharger shaft. Apply Loctite 243 (P/N 293 800 060) on cap nut and temporary finger tight cap nut.

**NOTE:** The cap nut on the supercharger shaft has a left-handed thread. The Loctite has to be applied in a small dose into the nut.



1. Step collar
2. O-ring
3. Supercharger impeller
4. Washer
5. Cap nut

Complete installation of supercharger shaft, engine side as follows:

**CAUTION:** It is of the utmost importance that all parts be absolutely clean. The compressor shaft spins at up to 45 000 RPM and any debris could cause a failure.

Install the first ceramic washer.

**NOTE:** The ceramic washers differ in their inner diameter. Install first the ceramic washer with the bigger inner diameter. The ceramic washer with the smaller inner diameter will be installed on the lock washer side.

**CAUTION:** Manipulate ceramic washers with care, those parts are fragile.

**IMPORTANT:** Apply Kluber Isoflex grease (P/N 293 550 021) to the inner diameter of the gear thrust surface on the shaft, ceramic washers, needle bearings shaft surface and lock washer.

**CAUTION:** No other grease can be used, otherwise damage to bearings will occur.

Install the 40 needle bearings on the compressor shaft.

**NOTE:** The 40 needle bearings comes in a wax strip with an adhesive backing.

Remove the adhesive backing.

Install the drive gear over the needle bearings.

Install the other ceramic washer (ceramic washer with smaller inner diameter).

## Section 01 ENGINES (1503 4-TEC)

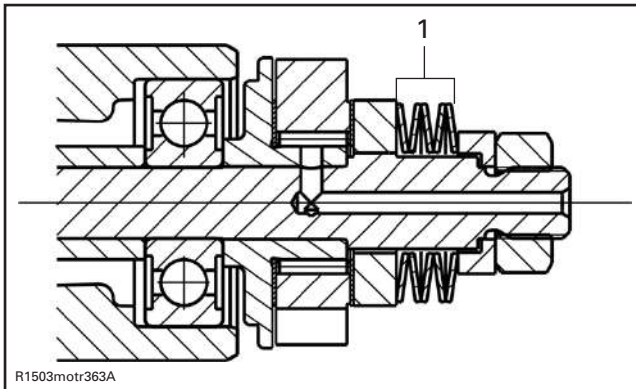
### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

Install the lock washer.

Apply engine oil to the spring washers.

Position the spring washers as per illustration.

**CAUTION:** When installing the spring washers, take care of the exact installation direction of the washers.

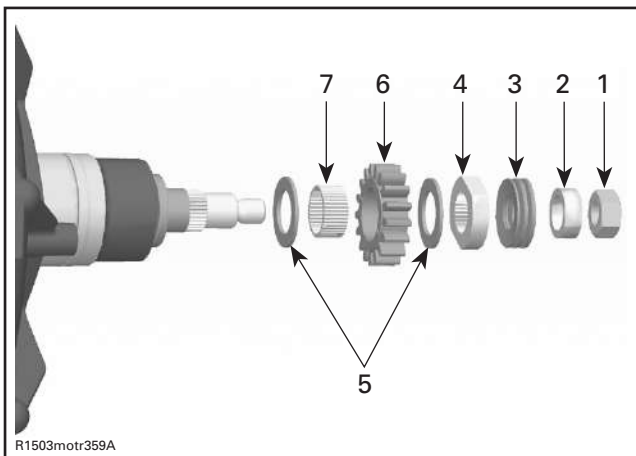


1. Spring washers

Install the L-ring on the compressor shaft.

Apply Loctite 243 (P/N 293 800 060) on the hexagonal nut threads. Torque to 30 N•m (22 lbf•ft).

**NOTE:** The L-ring will pre-load the spring washers.



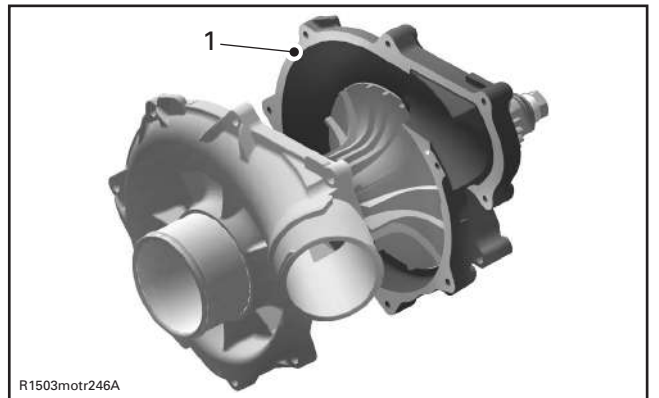
1. Nut
2. L-ring
3. Spring washers
4. Lock washer
5. Ceramic washers
6. Drive gear
7. Needle bearings

Hold the lock washer of the supercharger shaft (engine side) using the retaining key (P/N 529 035 949).



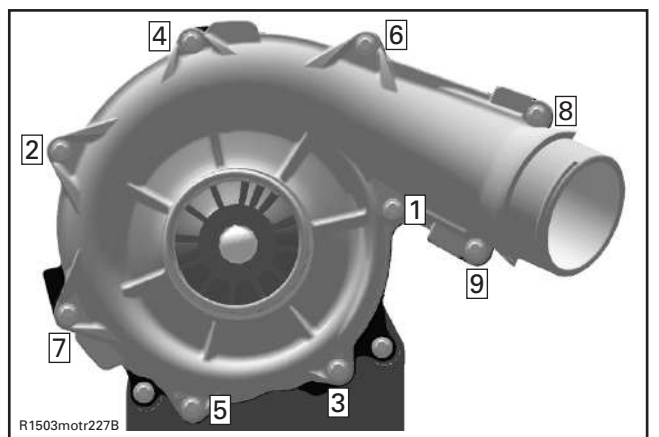
Tighten the impeller cap nut to 30 N•m (22 lbf•ft).

Apply Loctite 5910 (P/N 293 800 081) on supercharger housing sealing surface. For correct procedure refer to ENGINE BLOCK Installation in ENGINE section.



1. Apply Loctite 5910 on sealing surface

Assemble supercharger housing halves. Apply Loctite 243 (P/N 293 800 060) on retaining screws and torque to 10 N•m (89 lbf•in) according to the following sequence.



**SUPERCHARGER TIGHTENING SEQUENCE**



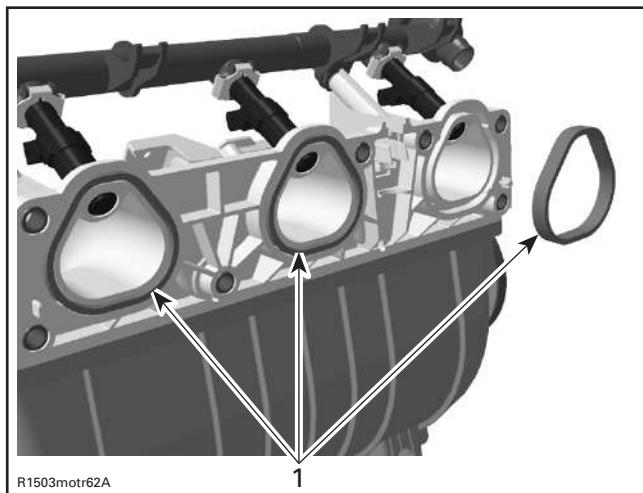
## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)

## INSTALLATION

### Intake Manifold

Ensure that all gaskets are properly installed and in a good condition.

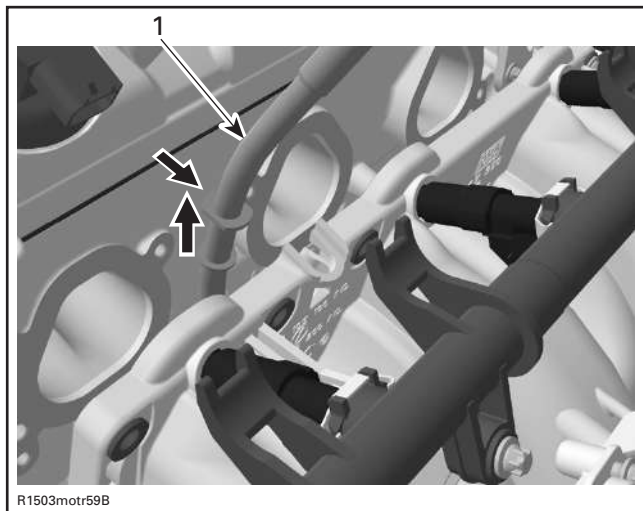


#### INTAKE MANIFOLD

##### 1. Gaskets

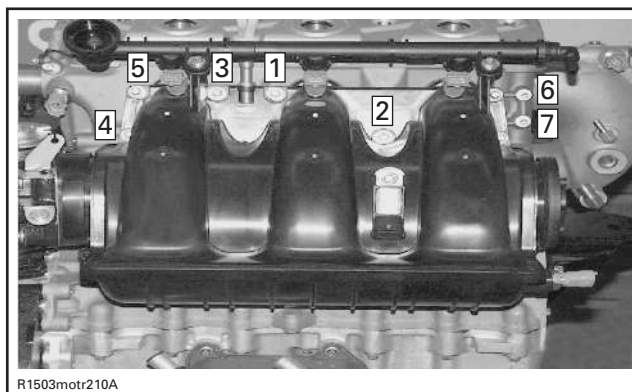
First, position intake manifold on front mounting bracket then push manifold toward engine to then proceed with rear mounting bracket.

When installing the intake manifold, lift up the oil dipstick tube a little bit to fit in the slot of the manifold.



##### 1. Oil dipstick tube

Apply Loctite 243 (P/N 293 800 060) on the intake manifold screws. Torque them to 10 N•m (89 lbf•in) following the tightening sequence shown.

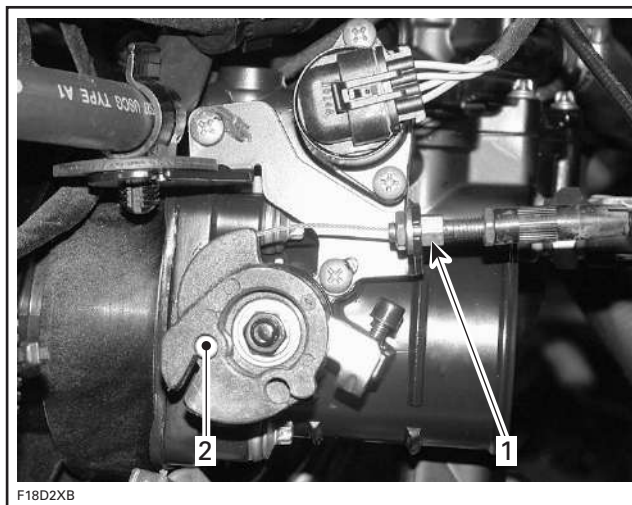


Ensure to properly route and resecure wiring harness with locking ties.

### WARNING

Always check O-ring for damage such as deformation at reinstallation. Replace the O-ring if it is damaged.

When installing throttle cable, ensure cable is in the proper position of bracket and that cable barrel is in the proper position of throttle cam.



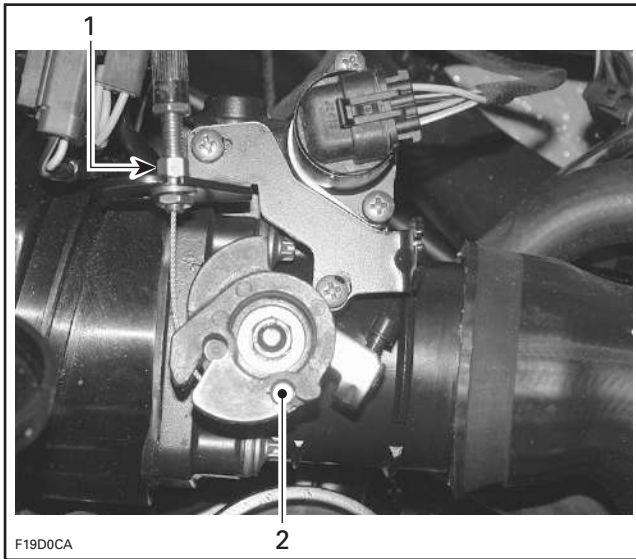
#### 4-TEC NA ENGINES

1. Cable position in bracket
2. Cable barrel position in cam



## Section 01 ENGINES (1503 4-TEC)

### Subsection 02 (INTAKE MANIFOLD AND SUPERCHARGER)



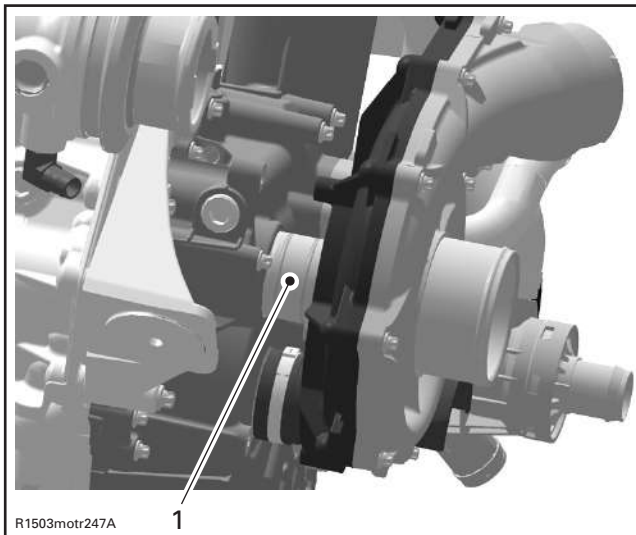
#### 4-TEC SUPERCHARGED ENGINES

1. Cable position in bracket
2. Cable barrel position in cam

### Supercharger

#### Supercharged Engines

Sealing surface between supercharger and PTO housing has to be greased with Super Lube grease (P/N 293 550 030).



1. Super Lube grease

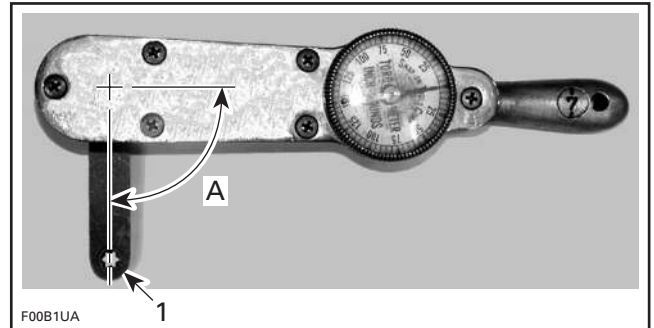
Install supercharger ass'y on PTO housing. Apply Loctite 243 (P/N 293 800 060) on the retaining screws.

Torque screws to 10 N•m (89 lbf•in).

To tighten and torque the upper screw, use the Torx adapter (P/N 529 035 938).



Ensure to install the tool perpendicularly (90°) to torque wrench to apply the proper torque to the screw.



1. Tool perpendicular (90°) to torque wrench
- A. 90°

**CAUTION:** Not installing the tool as shown will change the torque applied to the screw. Proper torque and tightening sequence are important.

After complete installation of the supercharger, the slipping moment has to be rechecked. Refer to SUPERCHARGER CLUTCH SLIPPING MOMENT above in this section.

### Finalizing the Installation

Readjust throttle cable and reset the TPS using the VCK. Refer to ENGINE MANAGEMENT section of the appropriate *VEHICLE SHOP MANUAL*.

# PTO HOUSING AND MAGNETO

## SERVICE TOOLS

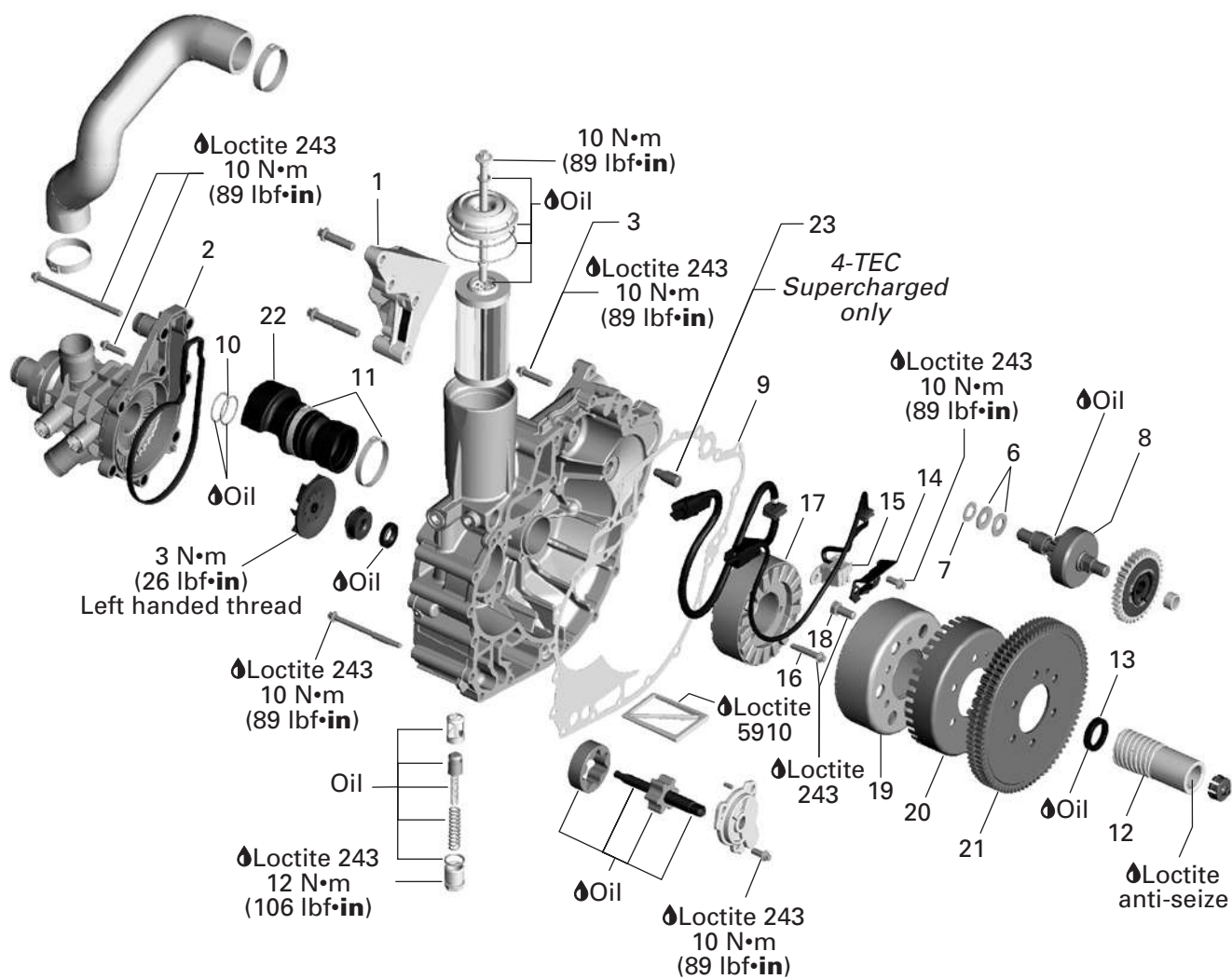
Description	Part Number	Page
fitting .....	293 710 037 .....	31
impeller remover/installer .....	529 035 820 .....	35
locking tool .....	529 035 821 .....	35–37
syphon pump.....	529 035 880 .....	31

## SERVICE PRODUCTS

Description	Part Number	Page
Isoflex Topas NB52 grease .....	293 550 021 .....	38
Loctite 243.....	293 800 060 .....	31, 34, 36–38
Loctite 648.....	413 711 400 .....	39
Loctite anti-seize.....	293 800 070 .....	35
pulley flange cleaner.....	413 711 809 .....	31–32, 34

## Section 01 ENGINES (1503 4-TEC)

### Subsection 03 (PTO HOUSING AND MAGNETO)



R1503motr366S

## GENERAL

Always perform the electric tests before removing or installing any components.

Clean threads before using Loctite when installing the screws.

## PROCEDURES

### PTO HOUSING

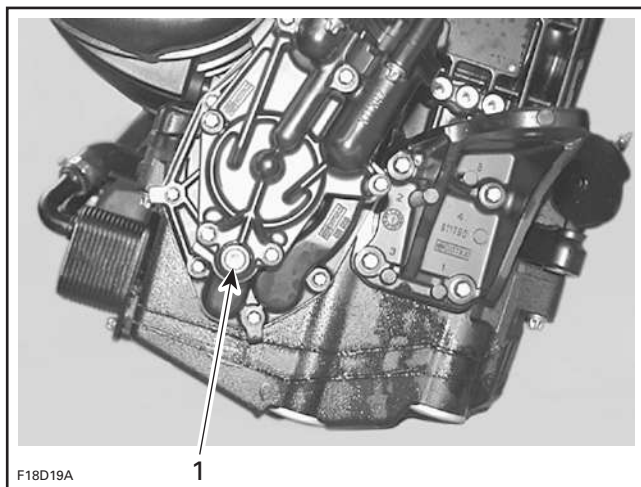
#### Removal

Drain engine oil. Refer to LUBRICATION in the appropriate *VEHICLE SHOP MANUAL*.

Drain oil from PTO housing using one of the following procedures:

#### Procedure for Removing Oil in PTO Housing Through the Scavenge Oil Pump Cover

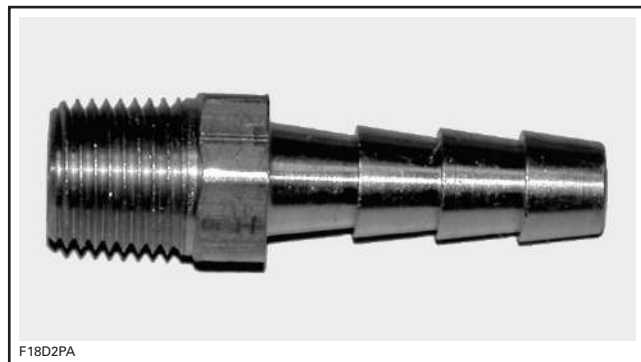
- Remove the scavenge oil pump cover drain plug.



#### TYPICAL

1. Scavenge oil pump cover drain plug

- Install tool fitting (P/N 293 710 037).



#### TYPICAL

- Connect the syphon pump (P/N 529 035 880) to the fitting.



- The front of the engine must be tilted down approximately 15 degrees to facilitate the removal of the oil. Raise the rear of the watercraft accordingly. Siphon the oil from the fitting.
- When done, remove the syphon pump and the fitting. Apply Loctite 243 (P/N 293 800 060) and reinstall the drain plug.

**NOTE:** If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains.

#### Procedure for Removing Oil in the PTO Housing through the Timing Chain Area

As an alternate method, the oil located in the PTO housing can be syphoned through the timing chain area.

- Remove the valve cover. Refer to CYLINDER HEAD section.
- Using the syphon pump (P/N 529 035 880), insert the tube in the lower area of the timing chain. Syphon the oil.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 03 (PTO HOUSING AND MAGNETO)

#### PTO HOUSING REMOVAL

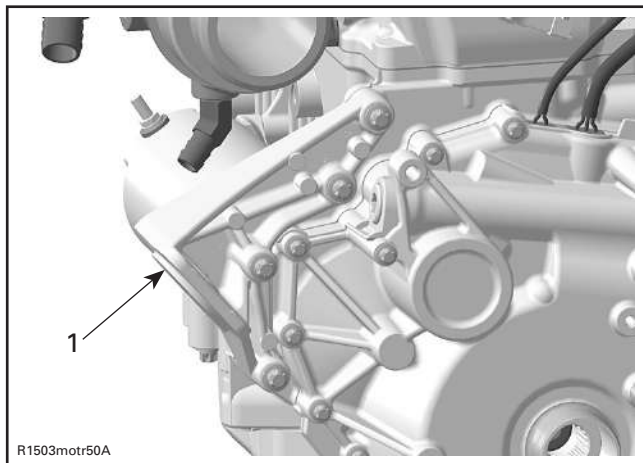
Place rags under PTO housing to prevent spillage. Up to 250 mL (8 oz) of oil could flow out when removing PTO housing. If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains.

Disconnect CPS and magneto from wiring harness.

#### WARNING

Always disconnect battery or starter cables exactly in the specified order, **BLACK** negative cable first. Disconnect electrical connections prior to disconnecting fuel lines.

Slightly lift rear part of engine and safely block in this position. Remove rear LH side engine support **no. 1**.

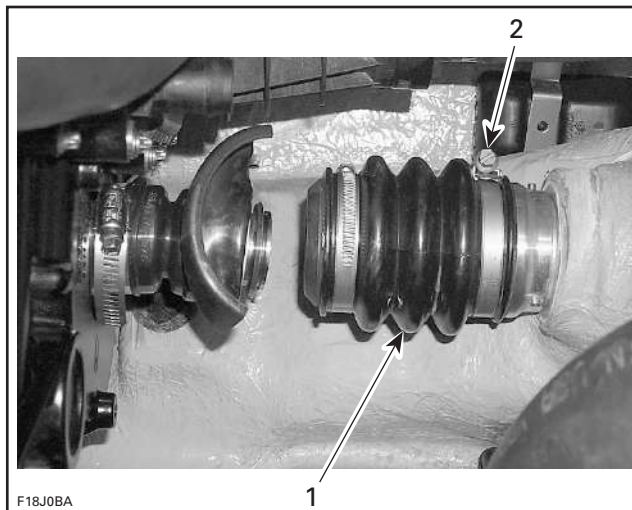


#### TYPICAL

1. Engine support

Remove:

- thru-hull fitting boot



1. Thru-hull fitting boot
2. Remove this collar

- coolant pump housing **no. 2** (refer to COOLING SYSTEM)
- screws **no. 3** and **no. 4**

**NOTE:** Carefully separate the PTO housing from the engine using two flat screwdrivers prying equally at the same time. Proceed slowly so that starter gear disc springs **no. 6** and washer **no. 7** do not fall down.

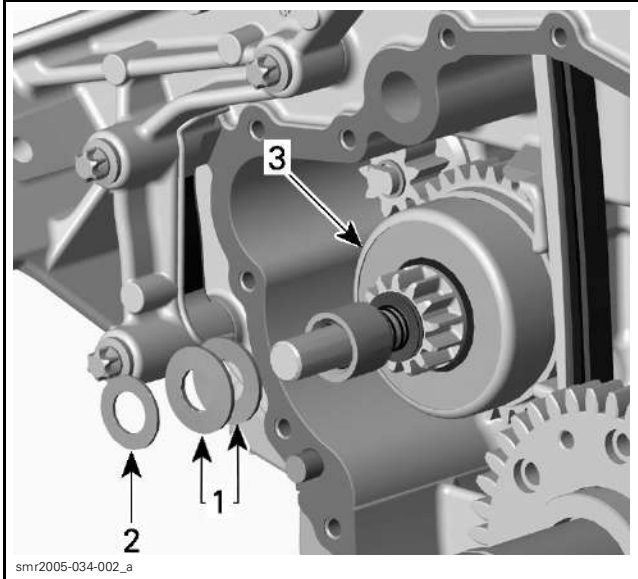
- PTO housing **no. 5**

**CAUTION:** Ensure to use prying lugs to separate PTO housing to prevent damaging contact surface.



## Section 01 ENGINES (1503 4-TEC)

### Subsection 03 (PTO HOUSING AND MAGNETO)



1. Disc springs
2. Washer
3. Starter drive gear

– gasket no. 9.

### Inspection

Check PTO housing for cracks or other damages. Replace if necessary.

### Installation

**NOTE:** Clean all metal component in a non-ferrous metal cleaner.

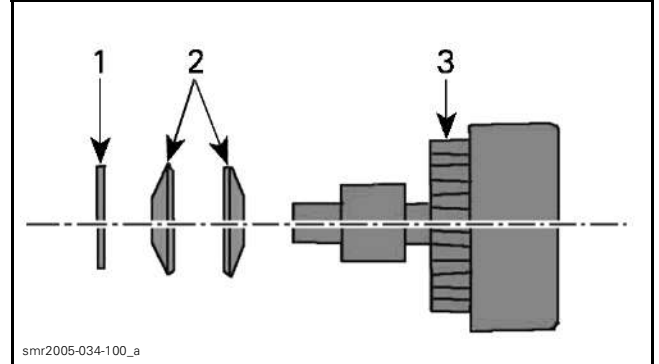
#### **WARNING**

Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

For installation, reverse the removal procedure. However, pay attention to the following.

**NOTE:** Turn the oil/coolant pump shaft in the right position to fit into the balance shaft.

Position the disc springs no. 6 and washer no. 7 as per the following illustration.



#### **TYPICAL**

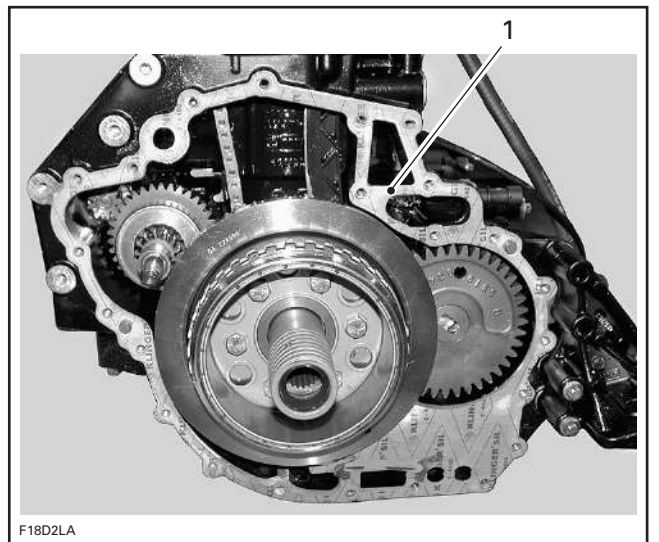
1. Washer
2. Disc spring
3. Starter drive ass'y

**NOTE:** When installing a new starter drive ass'y, oil the shaft and threads of the gear with engine oil.

**CAUTION:** Ensure the starter drive gear shaft is well engaged in its bore.

Gently install PTO housing.

**CAUTION:** While installing housing, pay particular attention that gasket does not get pinched or slide out of its contact surface in the area shown in the following illustration. Never force to install cover. If there is a strong resistance, remove housing and check oil/coolant pump alignment and starter gear alignment.

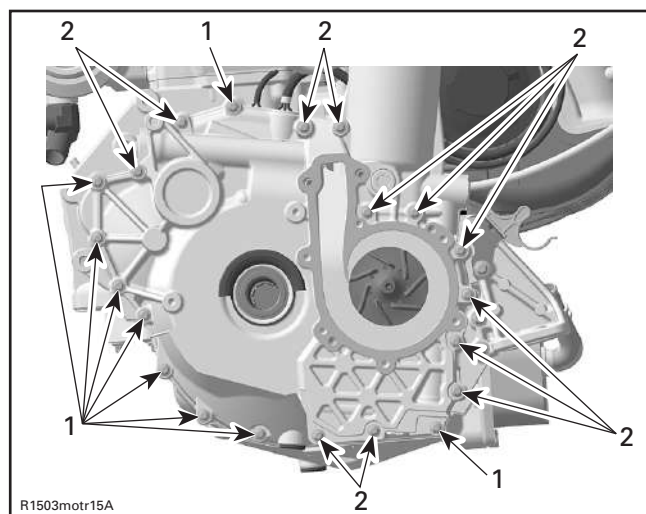


1. Pay attention that gasket remains properly positioned on this surface

Refer to the following illustration for proper installation of screws.

## Section 01 ENGINES (1503 4-TEC)

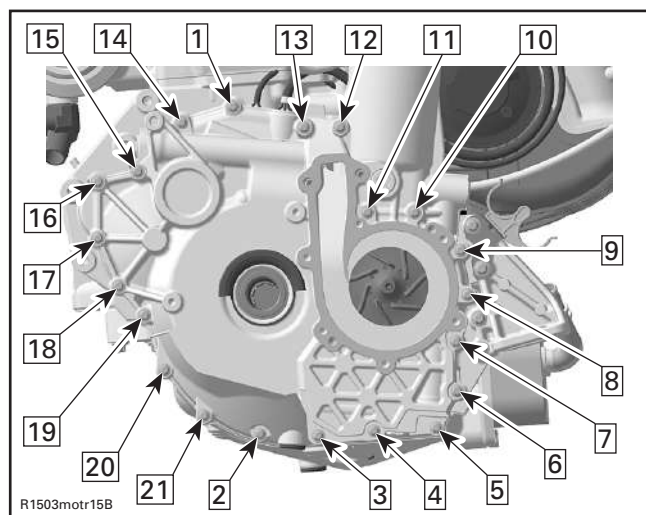
### Subsection 03 (PTO HOUSING AND MAGNETO)



#### TYPICAL

1. Screws M6 x 35
2. Screws M6 x 85

Tightening sequence for screws on PTO housing is as per following illustration.



Reinstall LH engine support. Apply Loctite 243 (P/N 293 800 060) on screw threads then torque to 24 N•m (17 lbf•ft).

Remove block under engine.

Refill engine with oil and cooling system with coolant. Refer to LUBRICATION and COOLING SYSTEM sections of the appropriate *VEHICLE SHOP MANUAL*.

## PTO SEAL

### Inspection

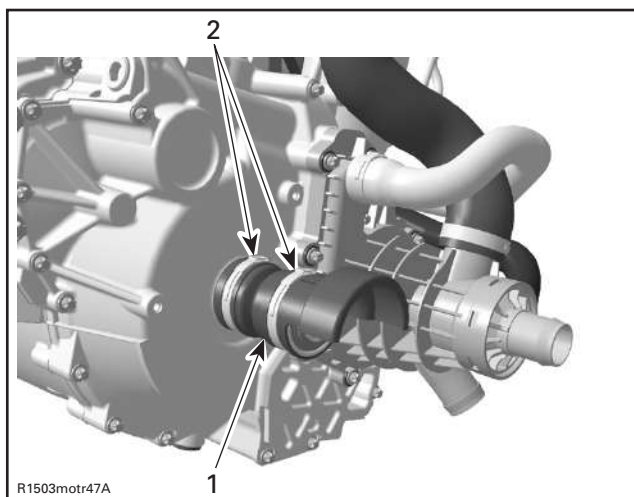
Check the PTO seal **no. 22** and O-rings **no. 10** on the PTO housing. If brittle, hard or damaged, or if you see a sign of oil leakage, replace it.

### Removal

Place rags under PTO housing to prevent spillage. If spillage occurs, clean immediately with the pulley flange cleaner (P/N 413 711 809) to prevent oil stains.

Remove:

- Oetiker clamp **no. 11** located close to the PTO housing
- PTO seal **no. 22**.



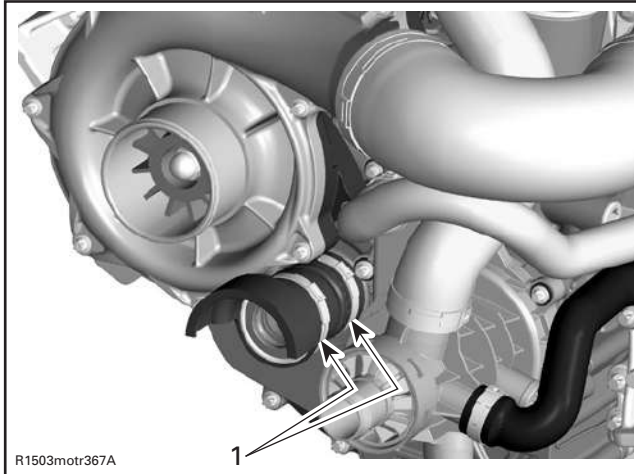
#### TYPICAL

1. Oetiker clamps
2. PTO seal

## Installation

Reinstall removed parts in the reverse order.

**CAUTION:** When installing PTO seal on super-charged engines, make sure to position the Oetiker clamps as shown in the picture.



1. Oetiker clamps

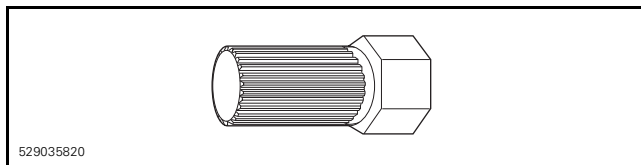
## COUPLING

### Removal

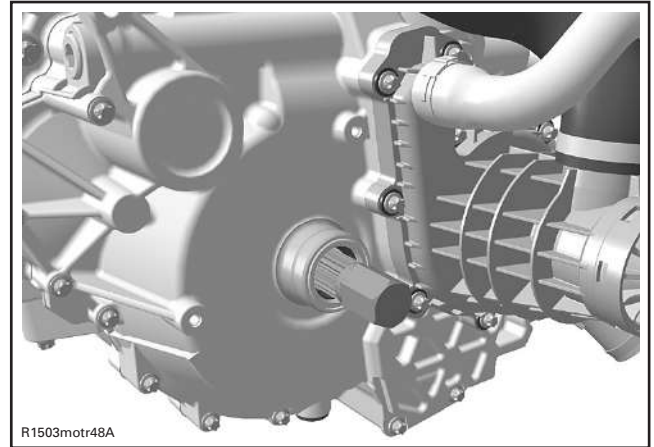
Lock crankshaft with locking tool (P/N 529 035 821). Refer to CYLINDER BLOCK section.

Remove:

- PTO seal as described above
- coupling **no. 12** using impeller remover/installer (P/N 529 035 820).



**CAUTION:** Apply some oil on the tool to protect the seal located in the PTO coupling.

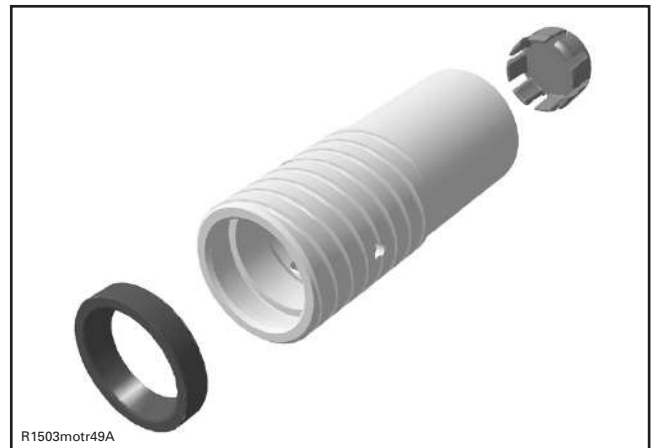


TYPICAL

### Inspection

Check if seal **no. 13** is brittle, cracked or hard. Check coupling for worn splines.

If damaged, replace faulty part.



### Installation

For installation, reverse the removal procedure. However, pay attention to the following.

Torque PTO coupling to 250 N•m (184 lbf•ft). Apply Loctite anti-seize (P/N 293 800 070) on threads.

## STATOR

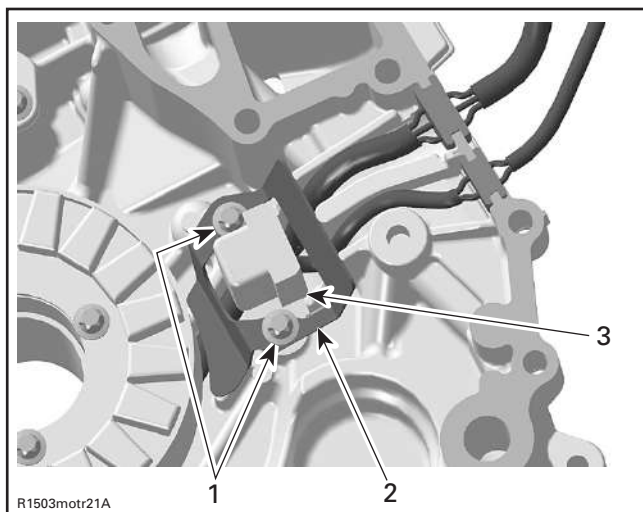
### Removal

Remove:

- PTO housing (refer to PTO HOUSING REMOVAL elsewhere in this section)
- holding plate **no. 14** with CPS **no. 15**

## Section 01 ENGINES (1503 4-TEC)

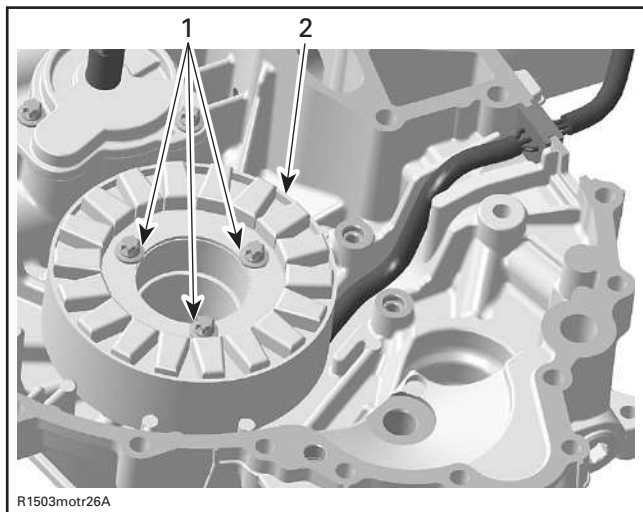
### Subsection 03 (PTO HOUSING AND MAGNETO)



#### TYPICAL

1. CPS screws
2. Holding plate
3. CPS

- screws no. 16
- stator no. 17.



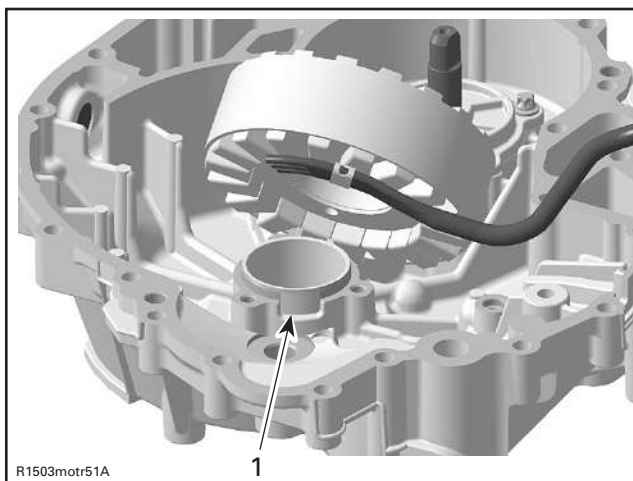
#### TYPICAL

1. Stator screws
2. Stator

## Installation

For installation, reverse the removal procedure. However, pay attention to the following.

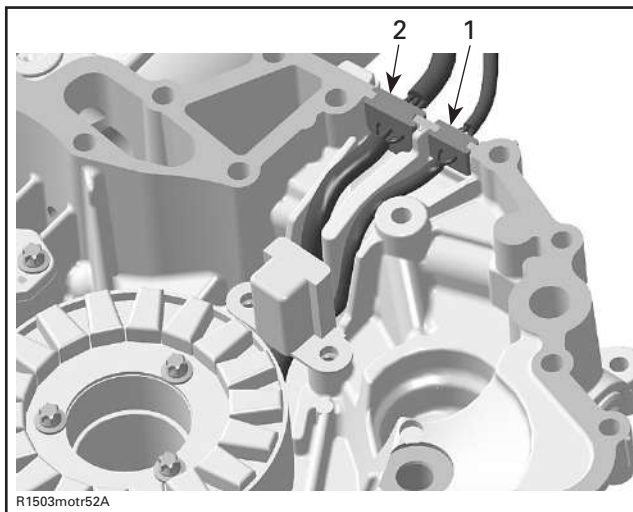
**NOTE:** There is only one position for the stator (notch in the magneto housing cover).



#### TYPICAL

1. Notch for stator

Place the rubber grommets on both cables in the proper notches at the PTO housing.



#### TYPICAL

1. Grommet on CPS cable
2. Grommet on stator cable

Apply Loctite 243 (P/N 293 800 060) on threads. Torque stator and CPS screws to 10 N•m (88 lbf•in).

## ROTOR AND TRIGGER WHEEL

### Removal

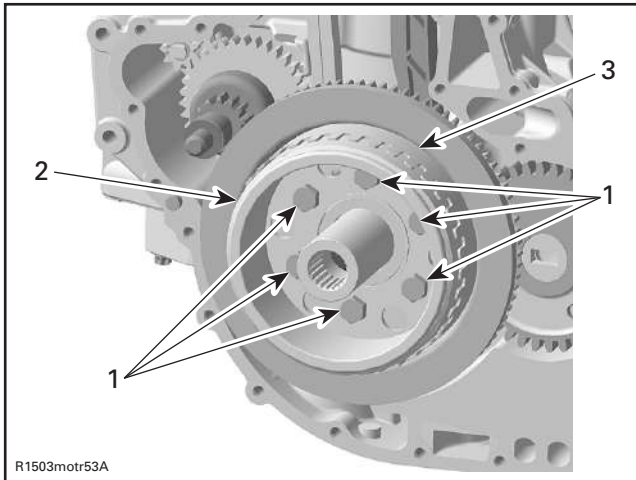
Lock crankshaft with locking tool (P/N 529 035 821). Refer to CYLINDER BLOCK section.

Remove:

- PTO housing
- hexagonal screws no. 18 retaining rotor.



Withdraw rotor **no. 19** with trigger wheel **no. 20**.



**TYPICAL**

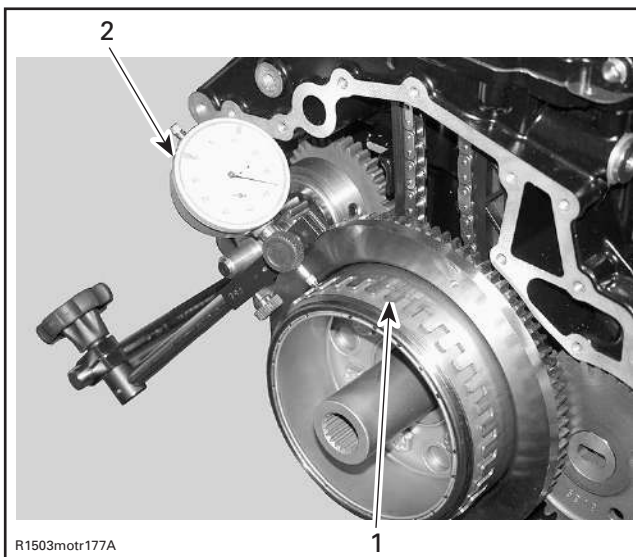
- 1. Hexagonal screws
- 2. Rotor
- 3. Trigger wheel

**Inspection**

Check rotor, bent teeth and trigger wheel condition. If damaged, replace faulty part.

To check the trigger wheel for bent teeth, proceed as follows.

Install a dial indicator on crankcase casting. Position the gauge on a tooth and set it to zero (0). Rotate flywheel and check needle movement. The maximum allowed difference between teeth is 0.15 mm (.006 in). Otherwise, straighten the tooth or replace the trigger wheel.



- 1. Trigger wheel
- 2. Dial indicator

Properly reinstall cover.

**Installation**

For installation, reverse the removal procedure. However, pay attention to the following.

Trigger wheel position has to be located with the location pin on the crankshaft gear.

Apply Loctite 243 (P/N 293 800 060) on threads. Torque rotor screws to 24 N•m (17 lbf•ft).

**RING GEAR**

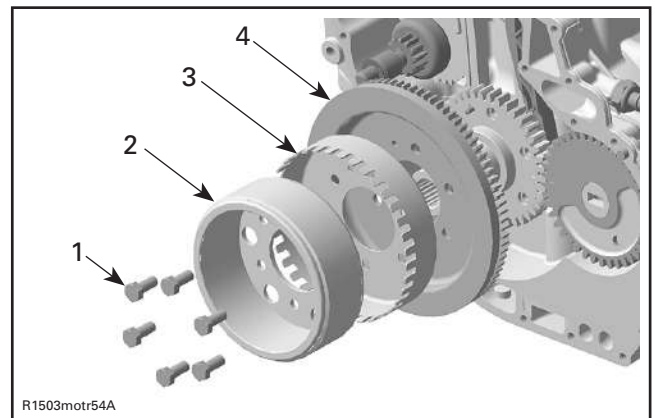
**Removal**

Lock crankshaft with locking tool (P/N 529 035 821). Refer to CYLINDER BLOCK section.

Remove:

- PTO housing cover
- hexagonal screws **no. 18**.

Withdraw rotor **no. 19**, trigger wheel **no. 20** and starter ring **no. 21**.



**TYPICAL**

- 1. Hexagonal screws
- 2. Rotor
- 3. Encoder wheel
- 4. Ring gear

**Inspection**

Check ring gear condition, especially teeth condition. If damaged, replace faulty part.

**Installation**

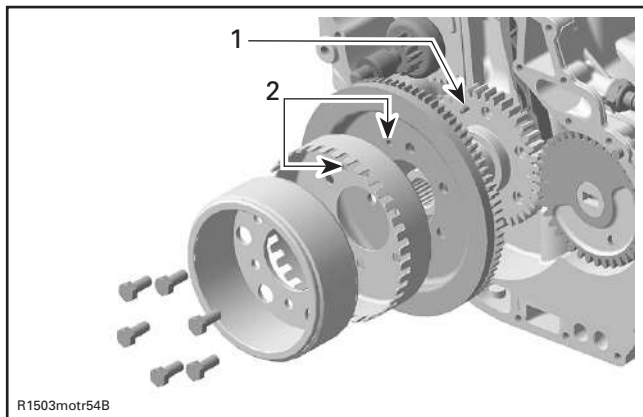
For installation, reverse the removal procedure. However, pay attention to the following.

Ring gear and trigger wheel position has to be located with the location pin on the crankshaft gear.



## Section 01 ENGINES (1503 4-TEC)

### Subsection 03 (PTO HOUSING AND MAGNETO)



#### TYPICAL

1. Location pin
2. Location pin holes

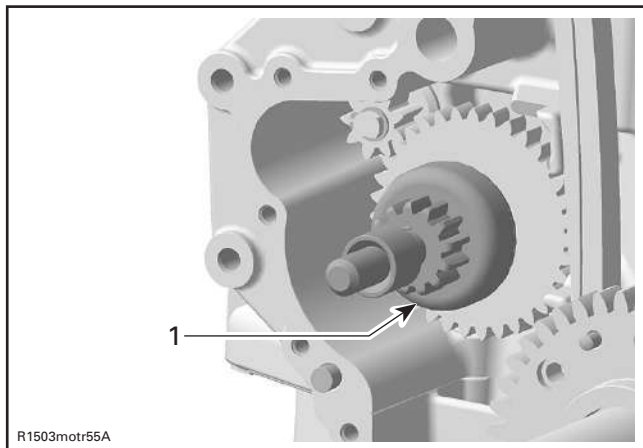
Apply Loctite 243 (P/N 293 800 060) on threads.  
Torque rotor screws to 24 N•m (17 lbf•ft).

## STARTER DRIVE ASS'Y

### Removal

Remove:

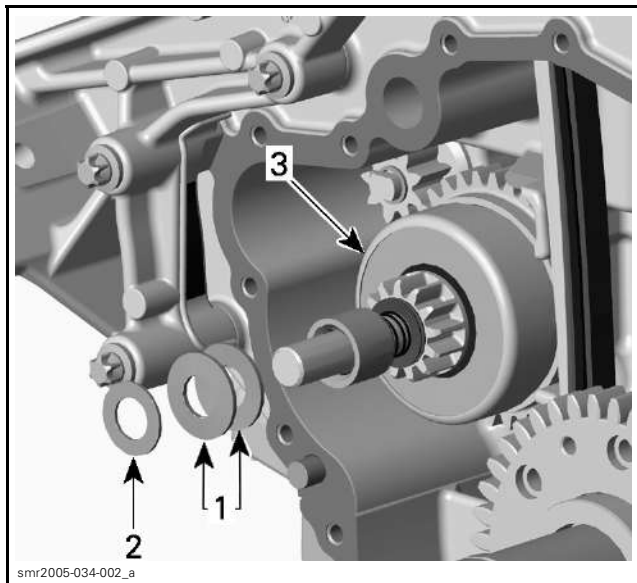
- PTO housing and ring gear as described above
- starter drive ass'y no. 8.



#### TYPICAL

1. Starter drive ass'y

**CAUTION:** Be careful not to lose the distance washer, disc springs no. 6 and washer no. 7 located on the starter drive shaft.



#### TYPICAL

1. Disc springs
2. Washer
3. Starter drive gear

### Inspection

Check condition of the teeth, shaft, etc. and if the sprag clutch operates well. If damaged, replace faulty part.

### Installation

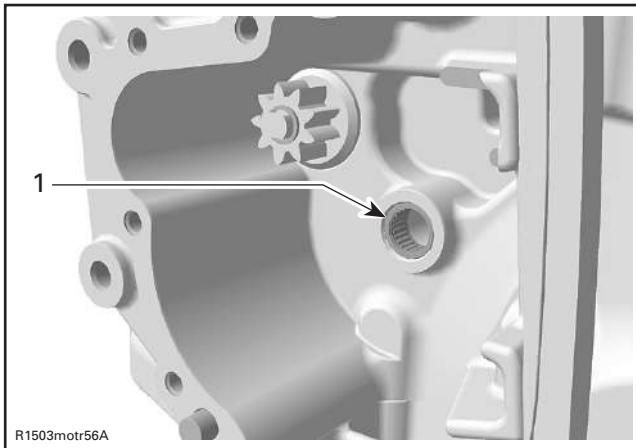
For installation, reverse the removal procedure. However, pay attention to the following.

**NOTE:** When installing a new starter drive ass'y, oil the shaft and threads of the gear with engine oil.

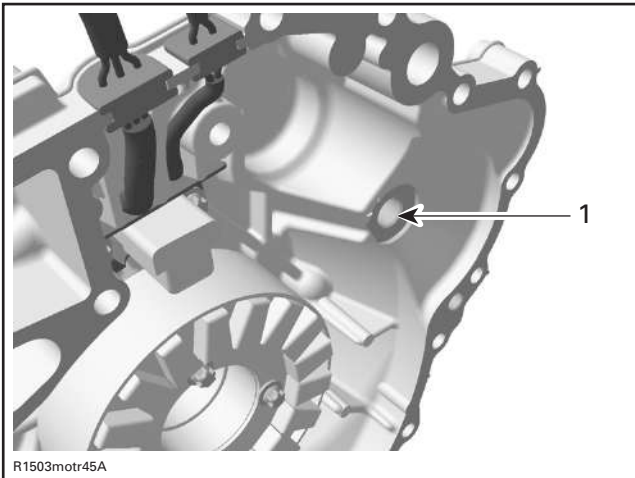
Apply some Isoflex Topas NB52 grease (P/N 293 550 021) on the starter drive bearing located in the cylinder block and on the starter drive support in the PTO housing cover.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 03 (PTO HOUSING AND MAGNETO)



**TYPICAL**  
1. Starter drive bearing



**TYPICAL**  
1. Starter drive support

**CAUTION:** Be sure not to forget the distance washer, disc springs and washer on the starter drive shaft when assembling.

## OIL SPRAY NOZZLE

### **Supercharged Engines Only**

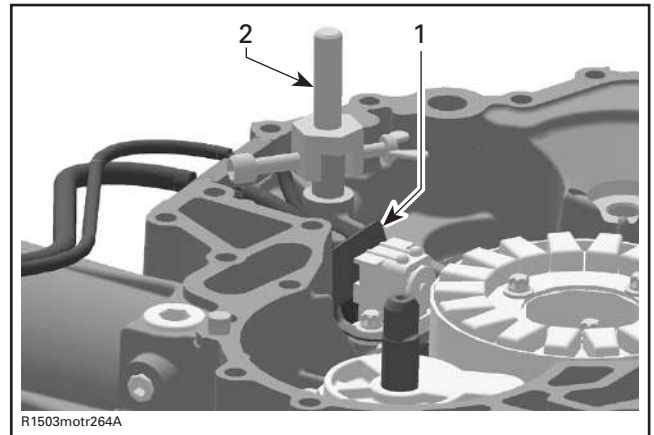
#### Removal

Remove the PTO housing as described above:

- Turn oil spray nozzle no. 23 by using a grip plier to crack the Loctite.

**CAUTION:** Do not try to pull out the oil spray nozzle with a plier. This may damage the force fit in the PTO housing.

- Fix supercharger spray nozzle remover tight on oil spray nozzle.



1. Oil spray nozzle  
2. Spray nozzle remover

- Remove oil spray nozzle carefully by using a slide hammer puller.

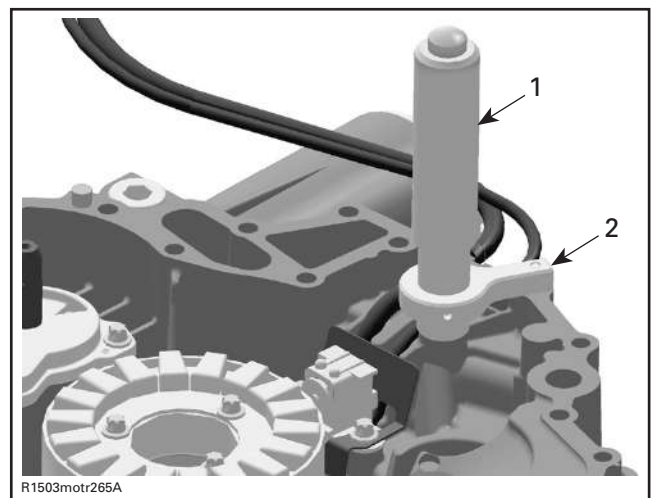
#### Installation

For installation, reverse the removal procedure. However, pay attention to the following.

Apply Loctite 648 (P/N 413 711 400) on oil spray nozzle fitting surface.

**CAUTION:** The oil spray nozzle must be in exact position to supply enough oil to the supercharger. Any other installation will lead to a supercharger damage.

Only use supercharger spray nozzle installer to push in the nozzle no. 23. Use retaining screw hole to ensure the exact position.



1. Spray nozzle installer  
2. Screw hole for positioning

# LUBRICATION SYSTEM

## SERVICE TOOLS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
hose adaptor.....	529 035 652 .....	45
oil pressure gauge .....	529 035 709 .....	45
oil seal guide.....	529 035 822 .....	54
rotary seal pusher.....	529 035 823 .....	53–54

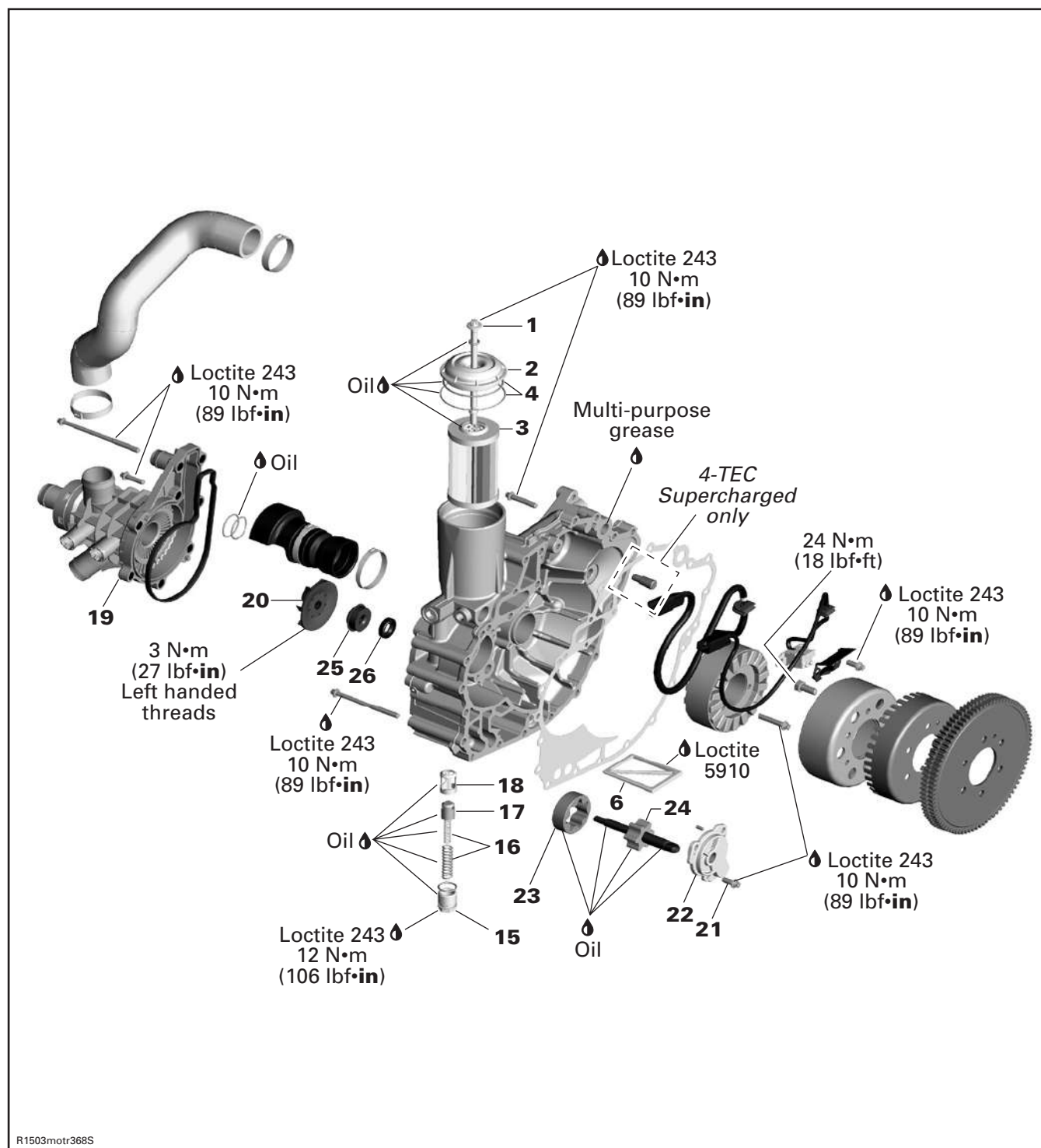
## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Loctite 243.....	293 800 060 .....	49, 51, 54, 57–59
pulley flange cleaner.....	413 711 809 .....	47, 55

## Section 01 ENGINES (1503 4-TEC)

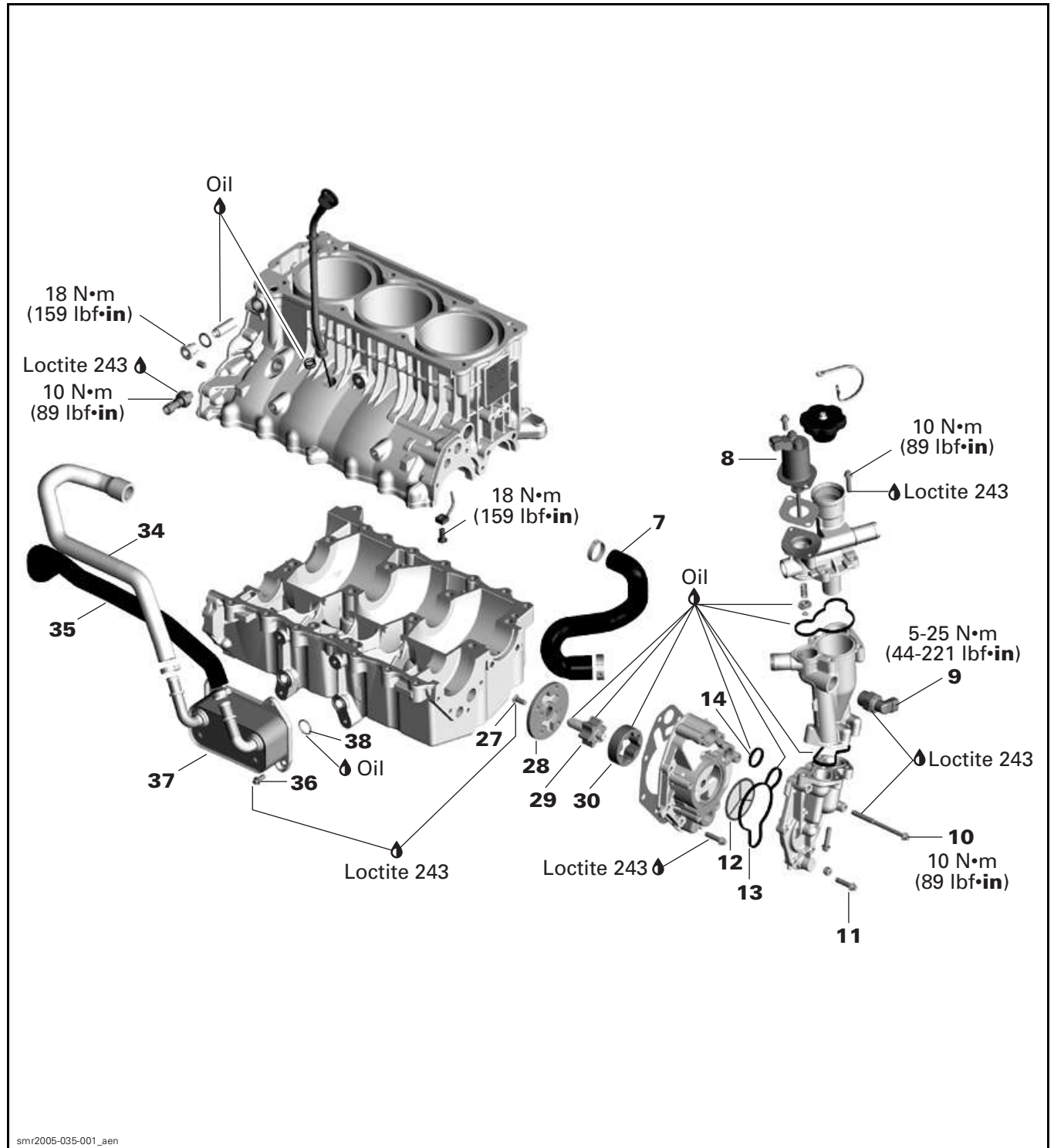
### Subsection 04 (LUBRICATION SYSTEM)

#### All Engines



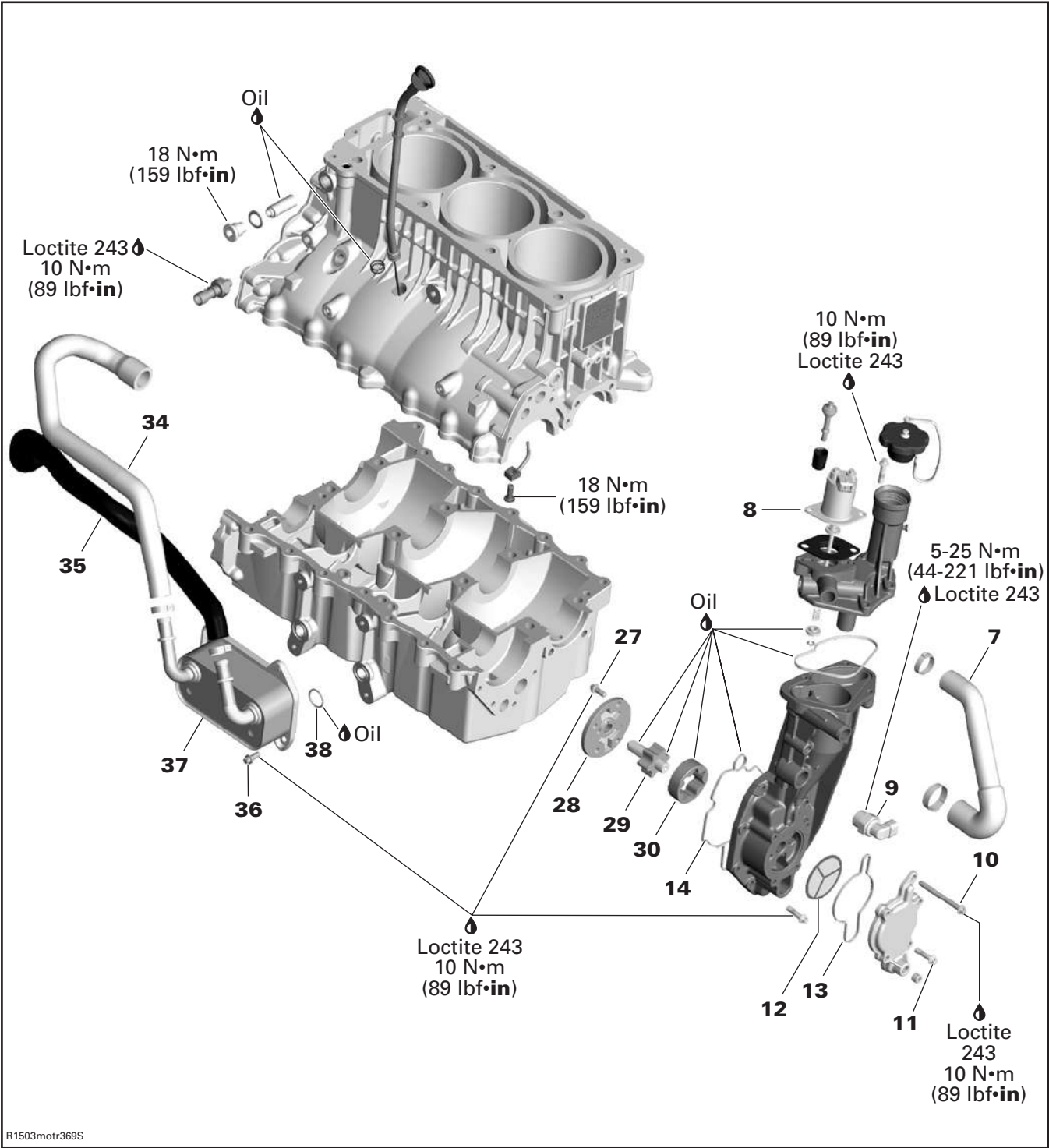
R1503motr368S

***Naturally Aspirated and Supercharged Engines***





Supercharged Intercooled Engine



R1503motr369S

## GENERAL

For oil change procedure, refer to LUBRICATION in the appropriate *VEHICLE SHOP MANUAL*.

## PROCEDURES

### ENGINE OIL PRESSURE

**NOTE:** Depending the oil pressure switch, the threshold value to send a signal of low oil pressure may vary from a minimum of 180 kPa (26 PSI) to a maximum of 220 kPa (32 PSI).

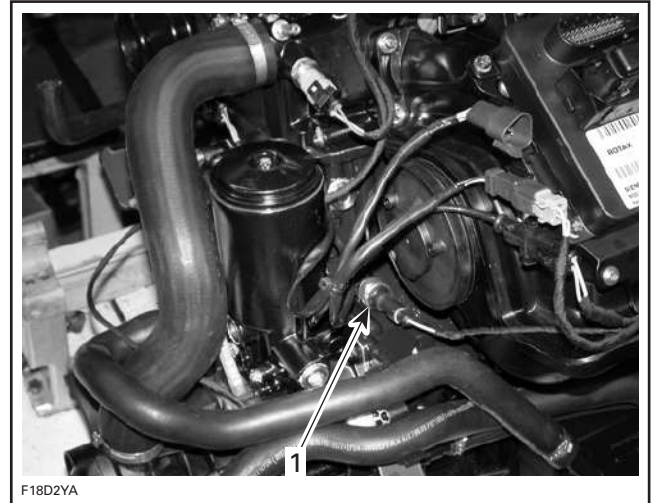
**NOTE:** The engine pressure test should be done with a warm engine and the recommended oil.

Use oil pressure gauge (P/N 529 035 709) and hose adaptor (P/N 529 035 652) and install where shown. A 1/8 NPT pipe extension may ease the installation.



#### Test at the Oil Pressure Switch Location

Remove oil pressure switch and install gauge.



#### INSTALLATION AT PRESSURE SWITCH LOCATION

1. Remove oil pressure switch and install gauge here

To prevent the EMS to go in limp home mode (at 2500 RPM) or to generate a fault code, start engine, THEN ground OPS connector to engine.

Read oil pressure at different RPM as per following table.

OIL PRESSURE MEASURED AT PRESSURE SWITCH LOCATION	
1503 4-TEC NATURALLY ASPIRATED ENGINE	
ENGINE RPM	PRESSURE kPa (PSI)
Idle (cold)	296 - 400 (43 - 58)
Idle (at 80°C (176°F))	Min. 160 (23)
4000 - 7500	296 - 400 (43 - 58)
ALL 1503 4-TEC SUPERCHARGED ENGINES	
Idle (cold)	448 - 648 (65 - 94) for a very short time
Idle (at 80°C (176°F))	Min. 228 (33)
4000 - 7500	400 - 496 (58 - 72)

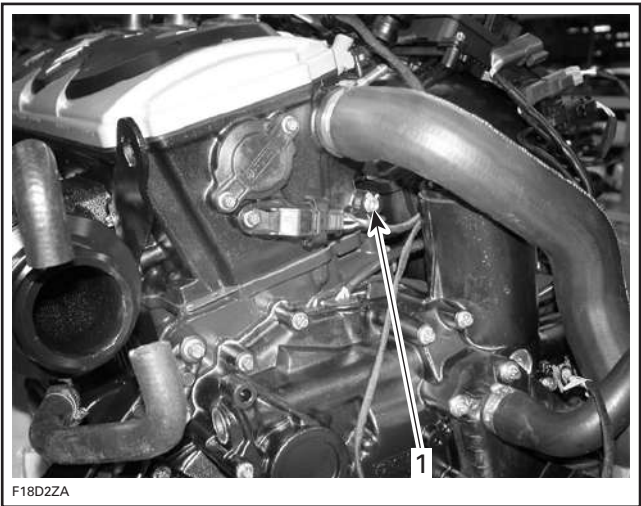
Reinstall oil pressure switch.

#### Test at the Cylinder Head Location

The oil pressure may be measured from cylinder head if desired.

Remove plug located on cylinder head and install gauge.

Section 01 ENGINES (1503 4-TEC)  
Subsection 04 (LUBRICATION SYSTEM)



INSTALLATION AT CYLINDER HEAD  
1. Remove this plug and install gauge here

Start engine and read pressure at different RPM as per following table.

OIL PRESSURE MEASURED AT CYLINDER HEAD LOCATION	
1503 4-TEC NATURALLY ASPIRATED ENGINE	
ENGINE RPM	PRESSURE kPa (PSI)
Idle (cold)	296 - 400 (43 - 58) for a very short time
Idle (at 80°C (176°F))	Min. 138 (20)
4000 - 7500	172 - 241 (25 -35)
ALL 1503 4-TEC SUPERCHARGED ENGINES	
Idle (cold)	400 - 497 (58 - 72) for a very short time
Idle (at 80°C (176°F))	Min. 138 (20)
4000 - 7500	172 - 241 (25 - 35)

Reinstall plug.

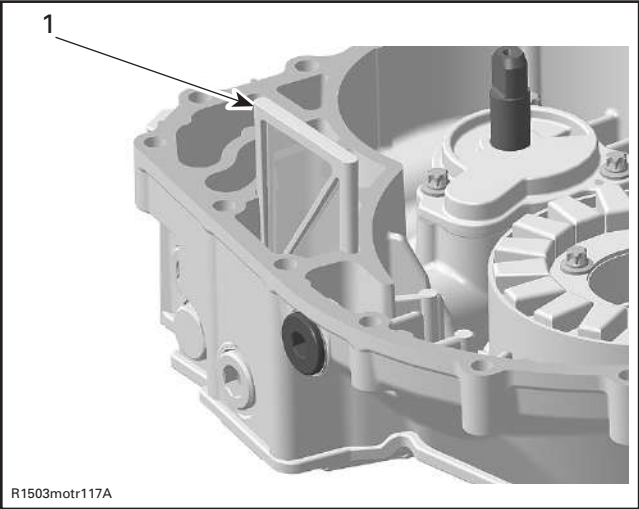
PTO OIL STRAINER

**NOTE:** The oil strainer does not need to be cleaned at every oil change. Clean it during other inspections, especially when the engine is disassembled.

Removal

Remove:

- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- PTO cover no. 5 (refer to PTO COVER/MAGNETO section)
- oil strainer no. 6.



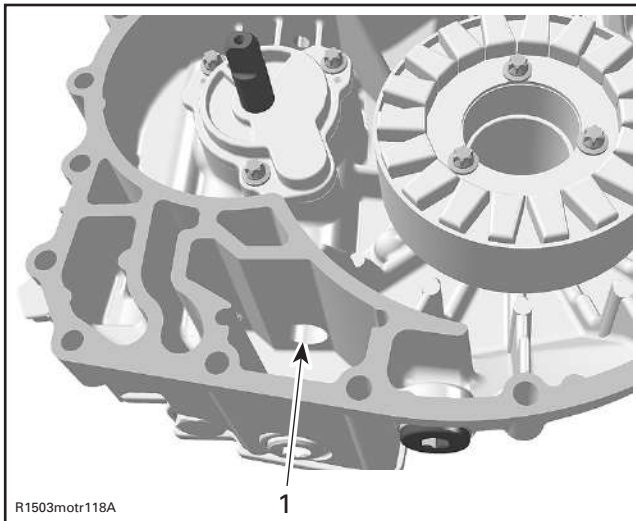
1. Oil strainer

Cleaning and Inspection

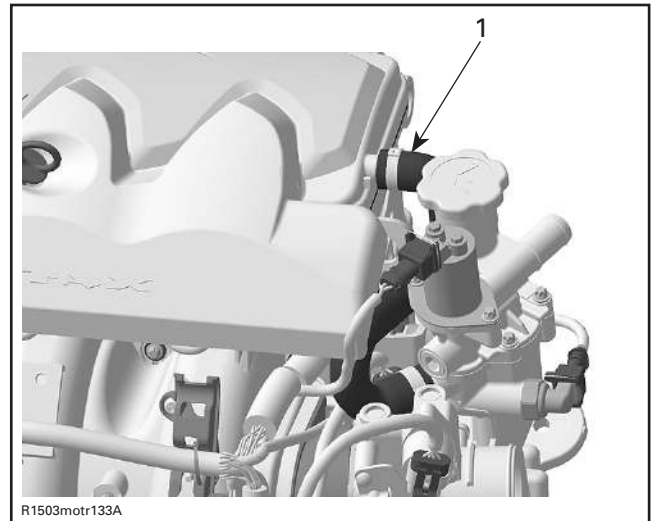
Clean oil strainer with a part cleaner then use an air gun to dry it.

**WARNING**  
Always wear eye protector. Chemicals can cause a rash break out in and an injury to your eyes.

Check and clean the oil outlet area for dirt and other contaminations.



1. Oil inlet to the oil pump



**TYPICAL — NATURALLY ASPIRATED AND SUPERCHARGED ENGINES**  
1. Ventilation hose

## Installation

For installation, reverse the removal procedure.

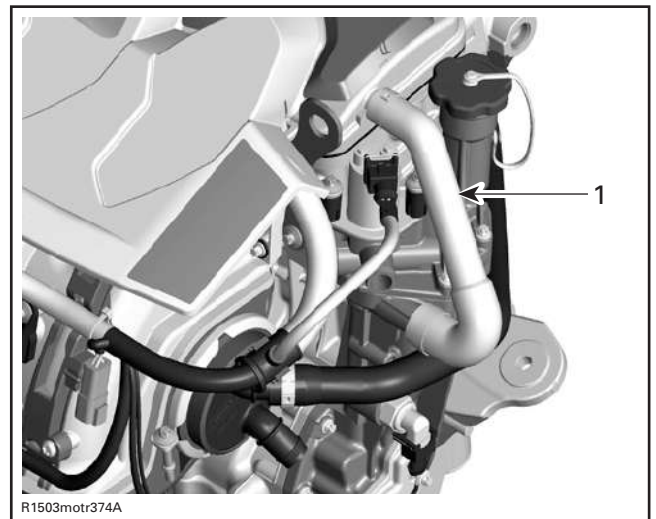
Refill engine at the proper level with the recommended oil. Refer to LUBRICATION SYSTEM in the appropriate *VEHICLE SHOP MANUAL* for the procedure.

## SUCTION PUMP OIL STRAINER

**NOTE:** The oil strainer does not need to be cleaned at every oil change. Clean it during other inspections, especially when the engine is disassembled.

## Removal

- Remove ventilation hose **no. 7**.



**TYPICAL — SUPERCHARGED INTERCOOLED ENGINE**  
1. Ventilation hose

- Disconnect wiring harness from TOPS valve **no. 8** and oil separator pressure switch (OSPS) **no. 9**.
- Detach intake hose from throttle body (naturally aspirated engine only).
- Remove other required parts from vehicle to access the oil suction pump cover.
- Remove retaining screws **no. 10** and **no. 11**.
- Place rags under cover to prevent spillage. If spillage occurs, clean with the pulley flange cleaner (P/N 413 711 809) .



**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 04 (LUBRICATION SYSTEM)**

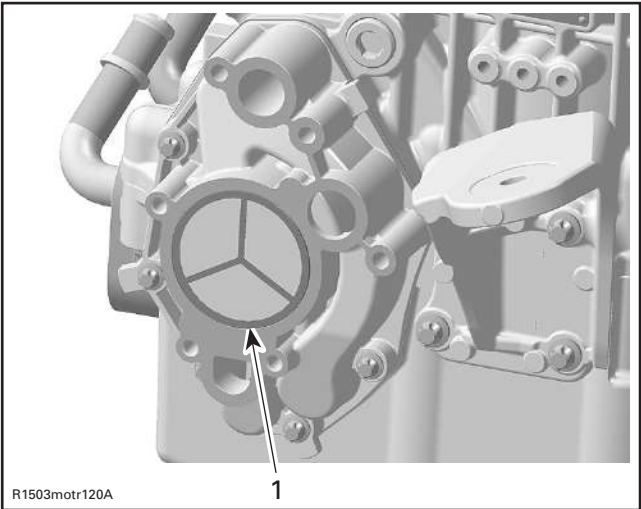
**⚠ WARNING**

Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

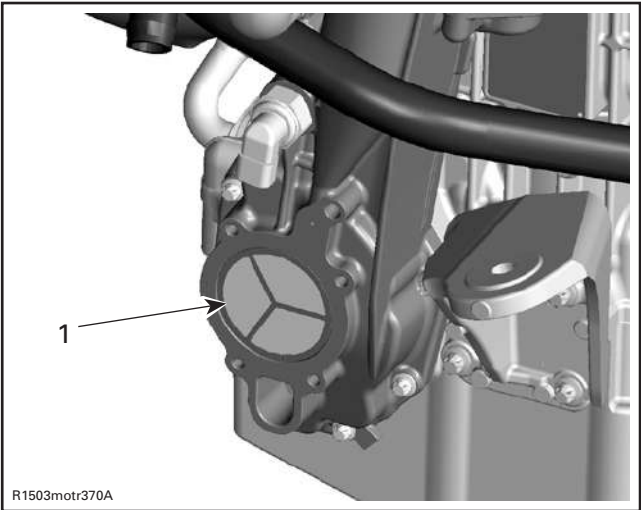
- Remove oil suction pump cover with oil separator housing and its cover.

**NOTE:** On the supercharged intercooled engine, the oil suction pump cover and oil separator is a one-piece design.

- Remove oil strainer no. 12.



**TYPICAL — NATURALLY ASPIRATED AND SUPERCHARGED ENGINES**  
1. Oil strainer



**TYPICAL — SUPERCHARGED INTERCOOLED ENGINE**  
1. Oil strainer

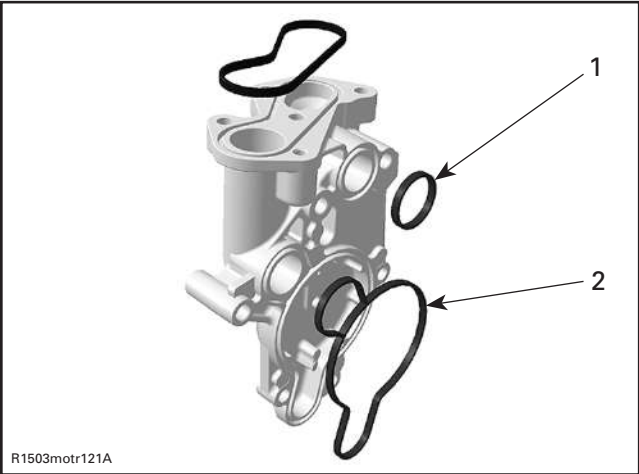
**Cleaning and Inspection**

Clean oil strainer with a part cleaner then use an air gun to dry it.

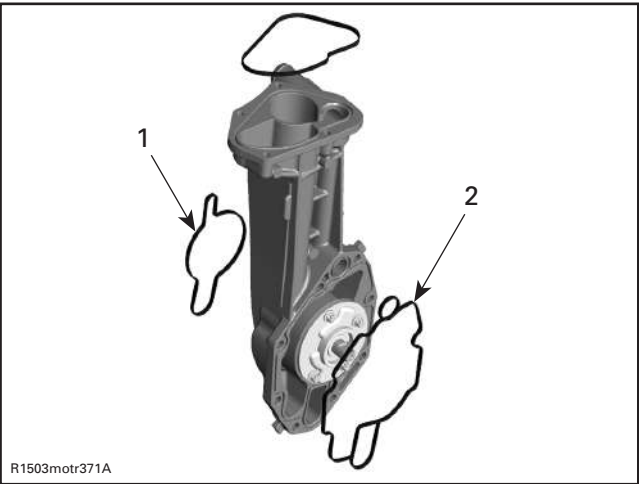
**⚠ WARNING**

Always wear eye protector. Chemicals can cause a rash break out in and an injury to your eyes.

Inspect rubber rings no. 13 and no. 14.



**TYPICAL — NATURALLY ASPIRATED AND SUPERCHARGED ENGINES**  
1. O-ring  
2. Rubber ring gasket

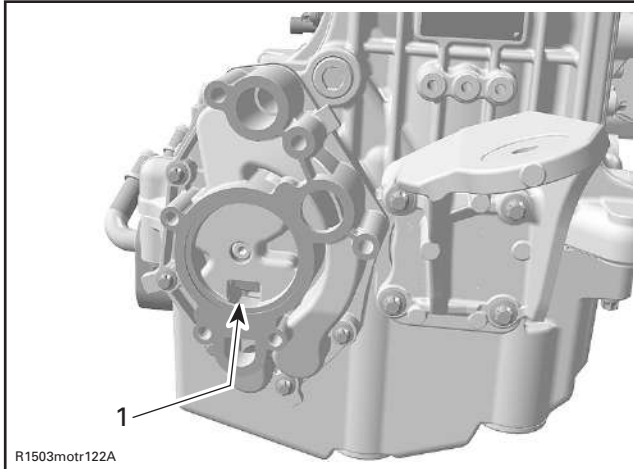


**TYPICAL — SUPERCHARGED INTERCOOLED ENGINE**  
1. Gasket  
2. Rubber ring gasket

If rubber rings are brittle, cracked or hard, replace them.



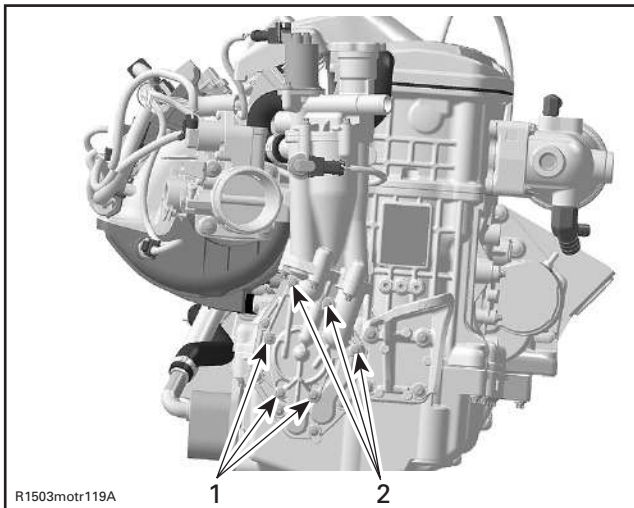
Clean both contact surfaces of oil strainer cover.  
 Check and clean the oil inlet and outlet area for dirt and other contaminations.



**TYPICAL**  
 1. Oil inlet to the oil pump

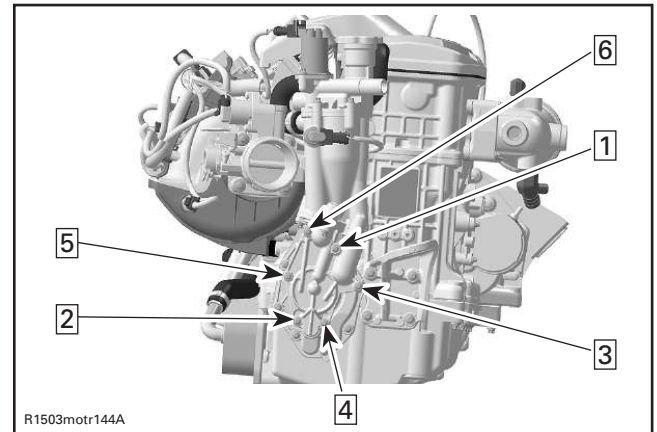
## Installation

For installation, reverse the removal procedure.  
 Position screws according to their length as shown.



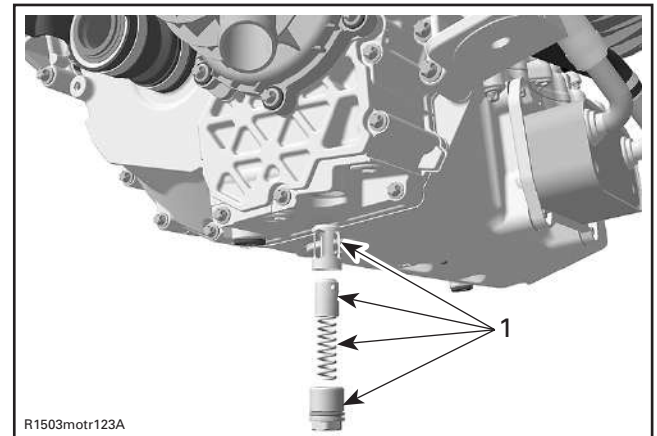
**TYPICAL**  
 1. Screws M6 x 25  
 2. Screws M6 x 85

Torque suction pump cover screws to 10 N•m (89 lbf•in) as per sequence illustrated below. Apply Loctite 243 (P/N 293 800 060) on threads.



## ENGINE OIL PRESSURE REGULATOR

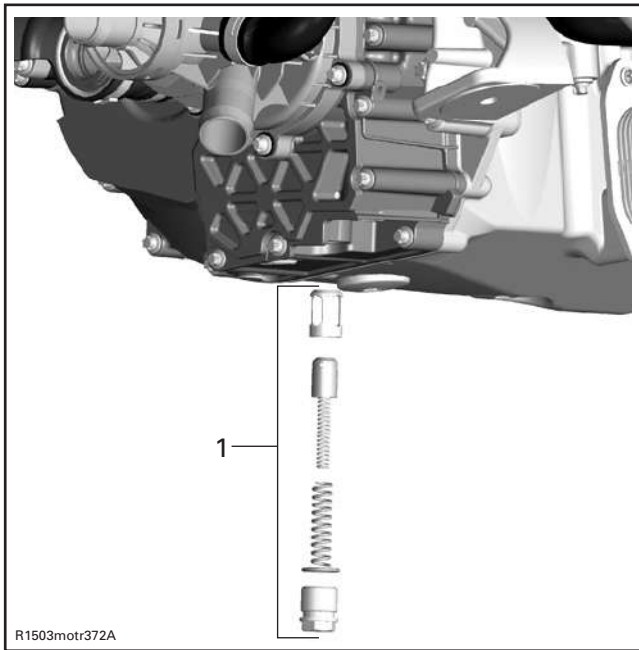
The oil pressure regulator is located on the bottom of the PTO housing.



**TYPICAL — NATURALLY ASPIRATED ENGINE**  
 1. Oil pressure regulator

## Section 01 ENGINES (1503 4-TEC)

### Subsection 04 (LUBRICATION SYSTEM)



**TYPICAL — SUPERCHARGED ENGINES**

1. Oil pressure regulator

**NOTE:** The oil pressure regulator system opens when the oil pressure exceeds 400 kPa (58 PSI).

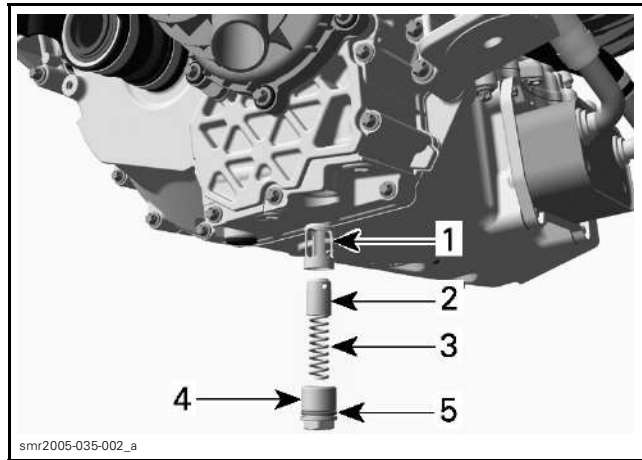
### Removal

Remove:

- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- oil pressure regulator plug **no. 15**, compression spring **no. 16**, valve piston **no. 17** and valve piston guide **no. 18**.

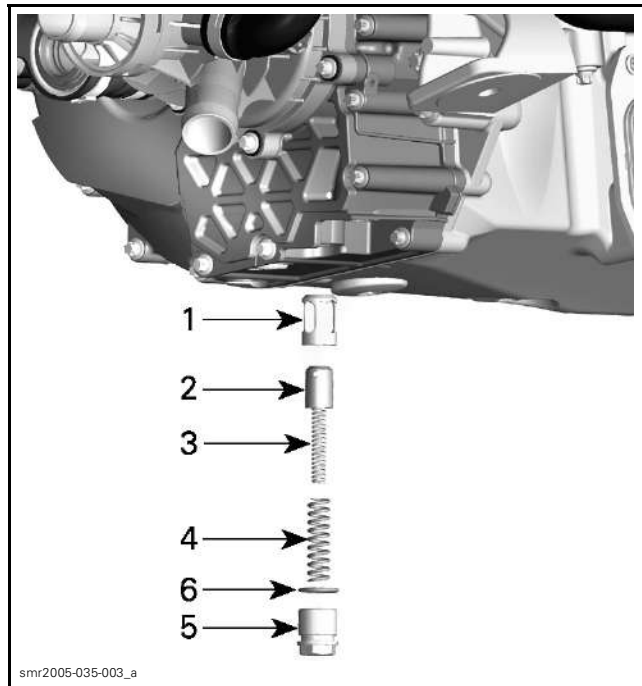
### **WARNING**

Oil pressure regulator plug on oil pump housing is spring loaded.



**TYPICAL — NATURALLY ASPIRATED ENGINE**

1. Valve piston guide
2. Valve piston
3. Compression spring
4. Oil pressure regulator plug
5. O-Ring



**TYPICAL — SUPERCHARGED ENGINES**

1. Valve piston guide
2. Valve piston
3. Compression spring
4. Compression spring
5. Oil pressure regulator plug
6. O-Ring

### Inspection

Inspect valve piston and valve piston guide for scoring or other damages.

Check compression spring for free length.

COMPRESSION SPRING FREE LENGTH	
NEW NOMINAL	60 mm (2.362 in)
SERVICE LIMIT	50.3 mm (1.980 in)

Replace parts if important wear or damage are present.

Clean bore and threads in the PTO housing from metal shavings and other contaminations.

### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Be careful that the O-ring on plug screw is in place.

Torque plug screw to 12 N•m (106 lbf•in) maximum. Apply Loctite 243 (P/N 293 800 060) on threads.

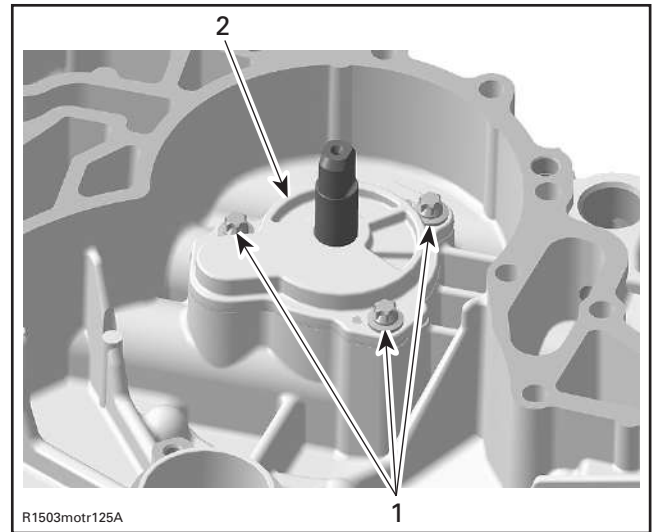
## OIL PRESSURE PUMP

The oil pressure pump is located in the PTO housing and is driven by the balance shaft.

### Removal

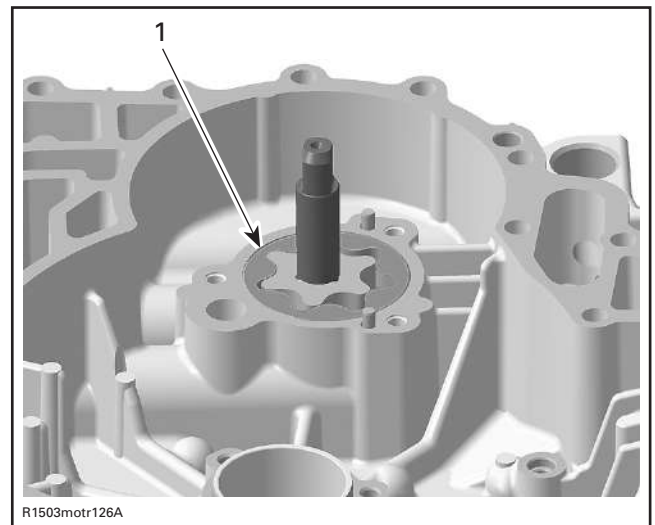
Remove:

- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- PTO housing (refer to PTO HOUSING AND MAGNETO section)
- coolant pump housing **no. 19** and impeller **no. 20** (refer to COOLING SYSTEM section)
- screws **no. 21**
- oil pump cover **no. 22**



- 1. Screws
- 2. Oil pump cover

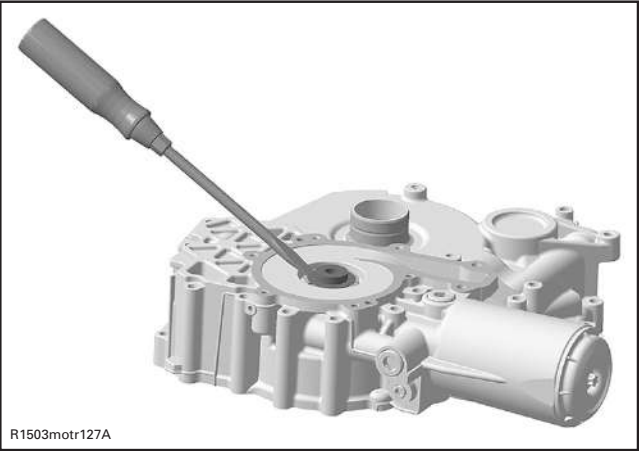
- outer oil pump rotor **no. 23**



- 1. Outer oil pump rotor

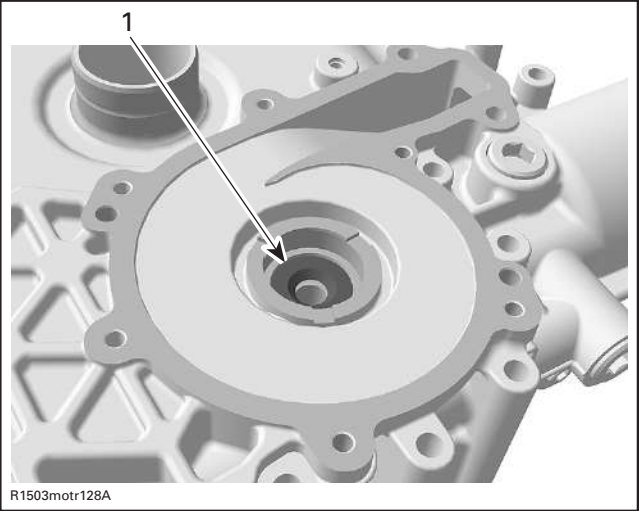
- extract the coolant/oil pump shaft **no. 24** from outside PTO housing with a pusher
- remove rotary seal **no. 25** with a screwdriver

Section 01 ENGINES (1503 4-TEC)  
Subsection 04 (LUBRICATION SYSTEM)



TYPICAL

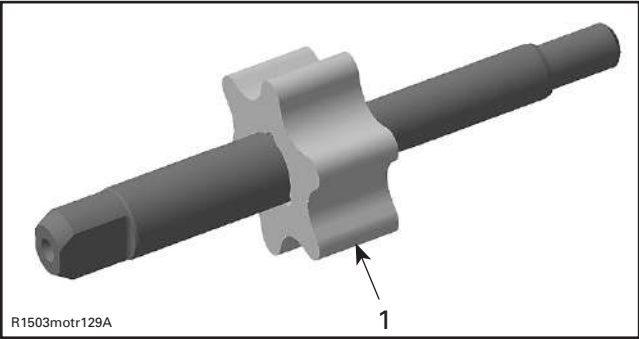
**CAUTION:** Be careful not to damage the surface of the rotary seal bore in PTO housing cover.  
– oil seal no. 26.



1. Oil seal

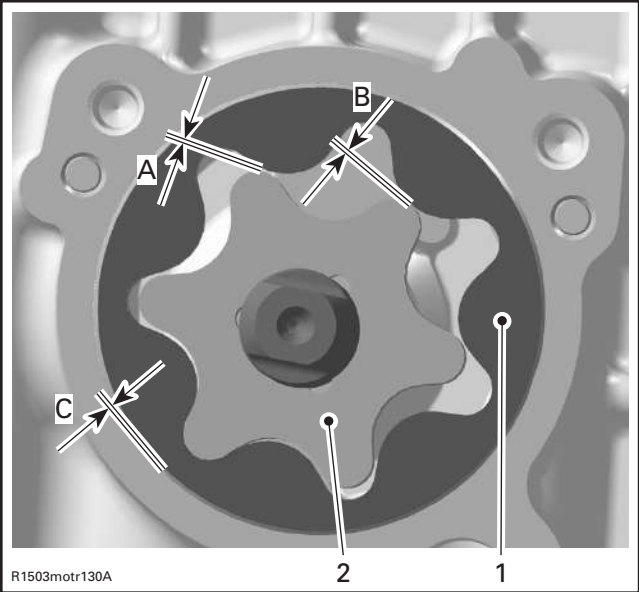
Inspection

Inspect oil pump shaft assembly, housing and cover for marks or other damages.  
Check inner rotor for corrosion pin-holes or other damages. If so, replace oil pump shaft assembly. Ensure to also check oil pump housing and cover and replace if damaged.



1. Pittings on the teeth

Using a feeler gauge, measure the clearance between inner and outer rotors.



1. Outer rotor  
2. Inner rotor

OUTER AND INNER ROTOR CLEARANCE	
SERVICE LIMIT	
A	0.25 mm (.009 in)
B	
C	

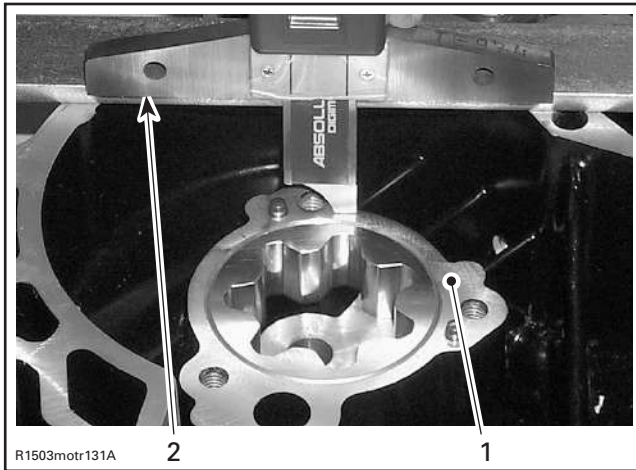
If clearance between inner and outer rotors exceeds the tolerance, replace coolant/oil pump shaft assembly. Ensure to also check oil pump housing and cover and replace if damaged.  
If clearance between outer rotor and its bore in oil pump exceeds the tolerance, replace the complete oil pump and the PTO housing.



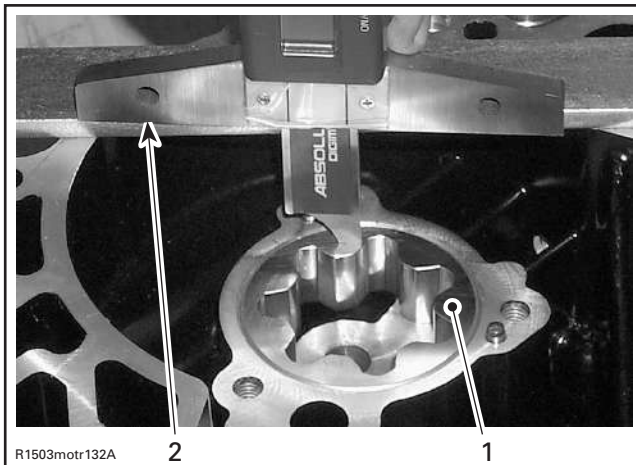
## Section 01 ENGINES (1503 4-TEC)

### Subsection 04 (LUBRICATION SYSTEM)

Using a vernier depth gauge, measure side wear as shown.



1. PTO housing surface
2. Vernier depth gage



1. Oil pump outer rotor surface
2. Vernier depth gage

Difference between pump housing and outer rotor should not exceed 0.1 mm (.004 in). If so, replace the complete oil pump assembly.

**NOTE:** When the axial clearance of the oil pump shaft assembly increases, the oil pressure decreases.

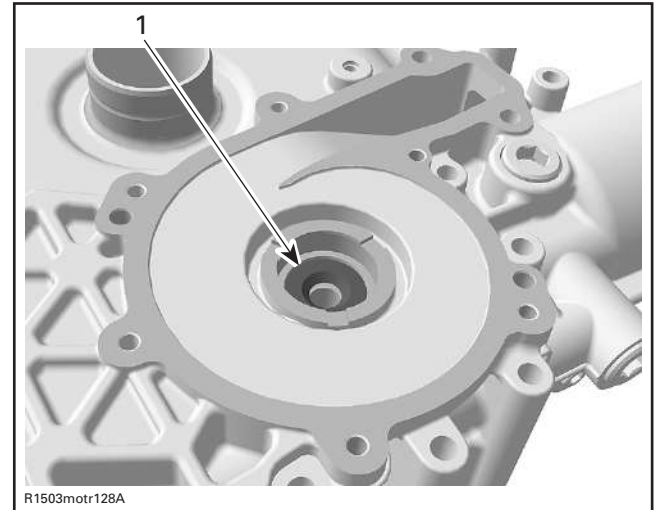
Check the inside of oil pump housing and its cover for scoring or other damages and replace if damaged.

### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

**NOTE:** Never use oil in the press fit area of the rotary seal.

Push coolant/oil pump shaft seal in place by using thumb.



1. Oil seal

Install the new rotary seal by using the rotary seal pusher (P/N 529 035 823).

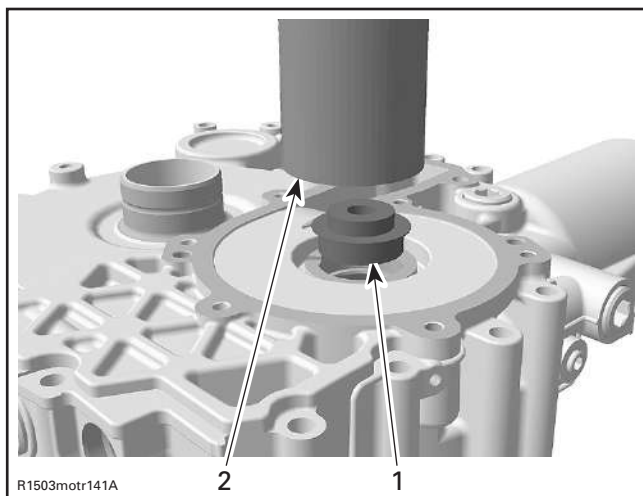


**CAUTION:** Never use a hammer for the rotary seal or coolant/oil pump shaft installation. Only use a press to avoid damaging the ceramic component.



## Section 01 ENGINES (1503 4-TEC)

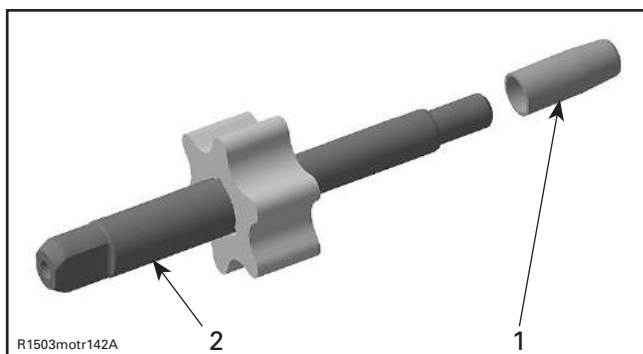
### Subsection 04 (LUBRICATION SYSTEM)



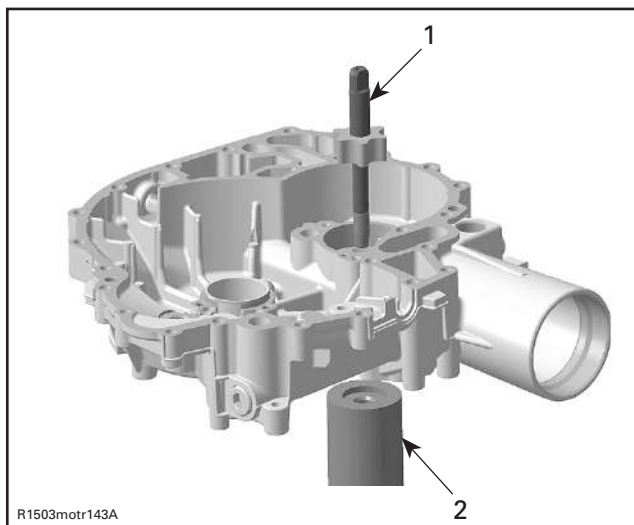
#### TYPICAL

1. Rotary seal
2. Rotary seal pusher

Install the coolant/oil pump shaft using the rotary seal pusher (P/N 529 035 823) on the opposite side to support the rotary seal. Use the oil seal guide (P/N 529 035 822) with a press.



1. Oil seal guide
2. Coolant/oil pump shaft



1. Coolant/oil pump shaft with oil seal guide
2. Rotary seal pusher

Tighten oil pump cover screws and torque to 10 N•m (89 lbf•in). Apply Loctite 243 (P/N 293 800 060) on threads.

### Final Test

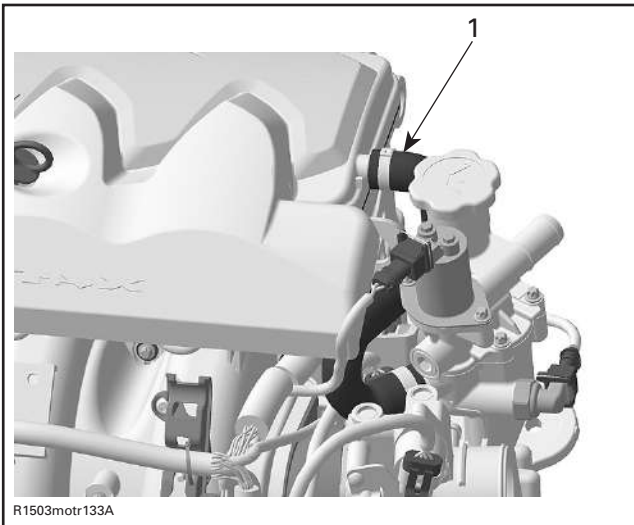
After engine is completely reassembled, start engine and make sure oil pressure is within specifications.

### OIL SUCTION PUMP

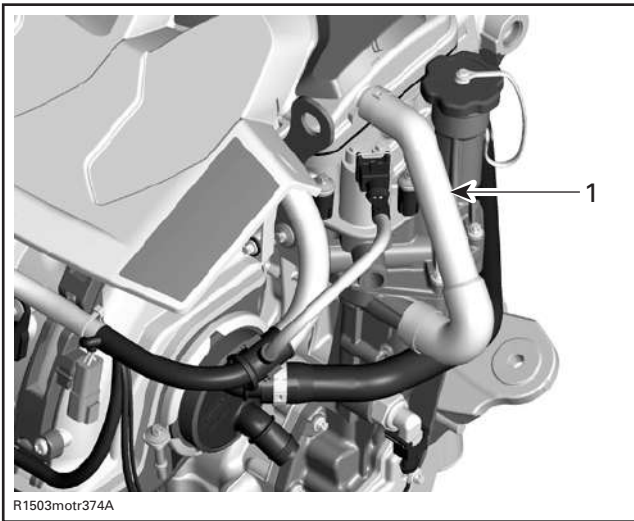
The oil suction pump is located on the front side of the engine at the bottom of the oil separator.

### Removal

- Remove ventilation hose no. 7.



**TYPICAL — NATURALLY ASPIRATED AND SUPERCHARGED ENGINES**  
 1. Ventilation hose



**SUPERCHARGED INTERCOOLED ENGINES**  
 1. Ventilation hose

- Disconnect wiring harness from OSPS no. 9 and TOPS valve no. 8.
- Detach intake hose from throttle body (naturally aspirated engine only).
- Remove other required parts from vehicle to access the oil suction pump housing.
- Remove retaining screws no. 10 and no. 11.
- Place rags under cover to prevent spillage. If spillage occurs, clean with the pulley flange cleaner (P/N 413 711 809).

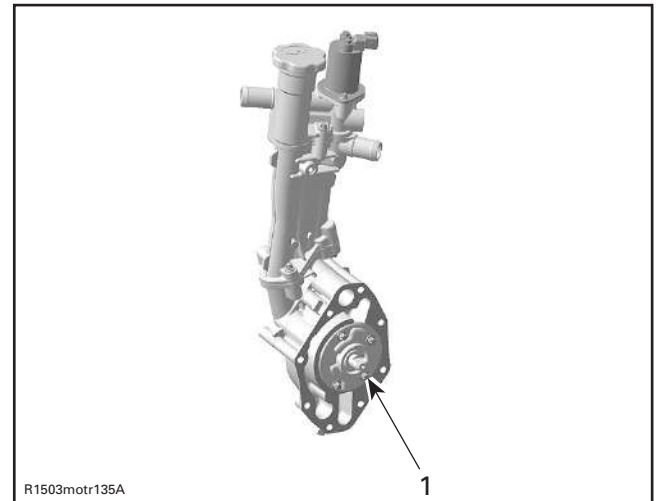
**⚠ WARNING**

Wear safety glasses and work in a well ventilated area when working with strong chemical products. Also wear suitable non-absorbent gloves to protect your hands.

- Remove the oil suction pump cover with oil separator housing and its cover.

**NOTE:** On the supercharged intercooled engine, the oil suction pump cover and oil separator is a one-piece design.

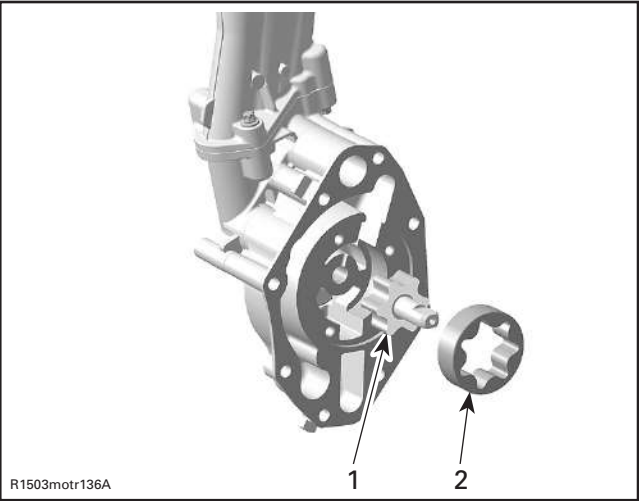
- Remove oil pump screws no. 27 and cover no. 28.



**TYPICAL**  
 1. Oil pump cover

- Remove oil pump shaft ass'y no. 29.
- Remove outer rotor no. 30.

Section 01 ENGINES (1503 4-TEC)  
Subsection 04 (LUBRICATION SYSTEM)

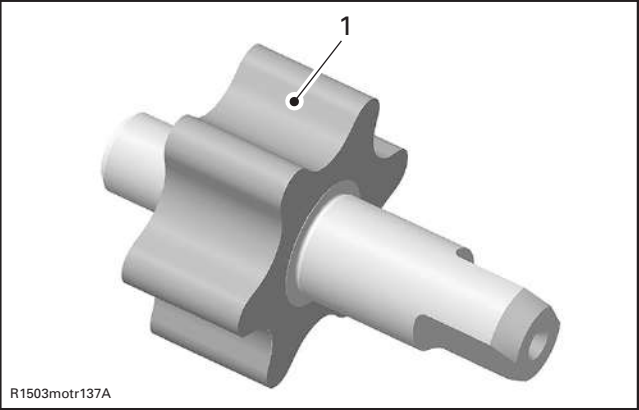


**TYPICAL**  
1. Oil pump shaft ass'y  
2. Outer rotor

Inspection

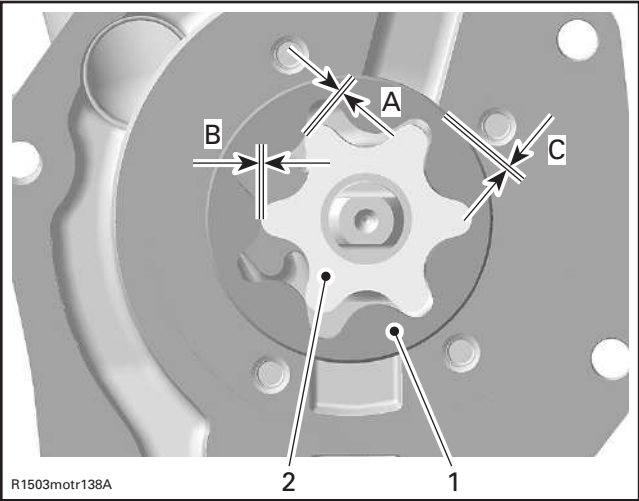
Inspect oil pump shaft assembly, housing and cover for marks or other damages.

Check inner rotor for corrosion, pin-holes or other damages. If so, replace oil pump shaft assembly. Ensure to also check oil pump housing and cover and replace if damaged.



1. Pittings on the teeth

Using a feeler gauge, measure the clearance between inner and outer rotors.



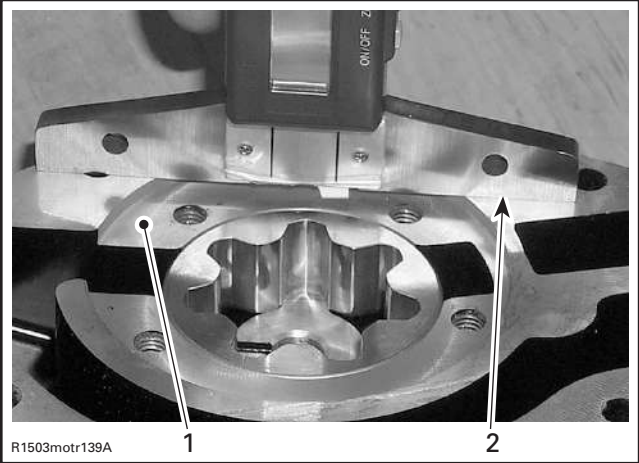
1. Outer rotor  
2. Inner rotor

OUTER AND INNER ROTOR CLEARANCE		
SERVICE LIMIT		
A	0.25 mm (.009 in)	
B		
C		

If clearance between inner and outer rotors exceeds the tolerance, replace oil pump shaft assembly. Ensure to also check oil pump housing and cover and replace if damaged.

If clearance between outer rotor and its bore in oil pump exceeds the tolerance, replace the complete oil pump and the PTO housing.

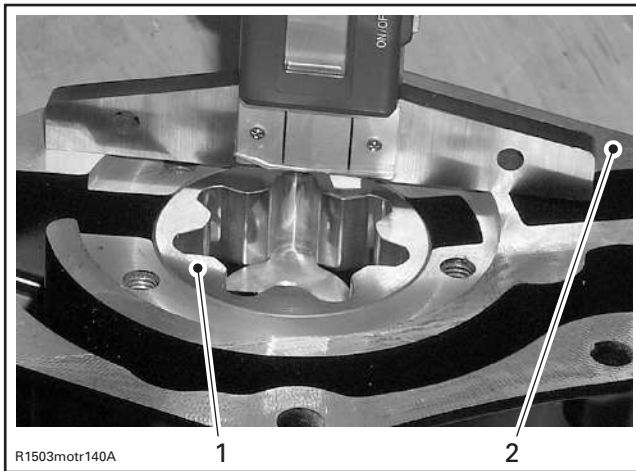
Using a vernier depth gage, measure side wear as shown.



1. Oil pump housing surface  
2. Vernier depth gage

## Section 01 ENGINES (1503 4-TEC)

### Subsection 04 (LUBRICATION SYSTEM)



1. Oil pump outer rotor surface
2. Vernier depth gage

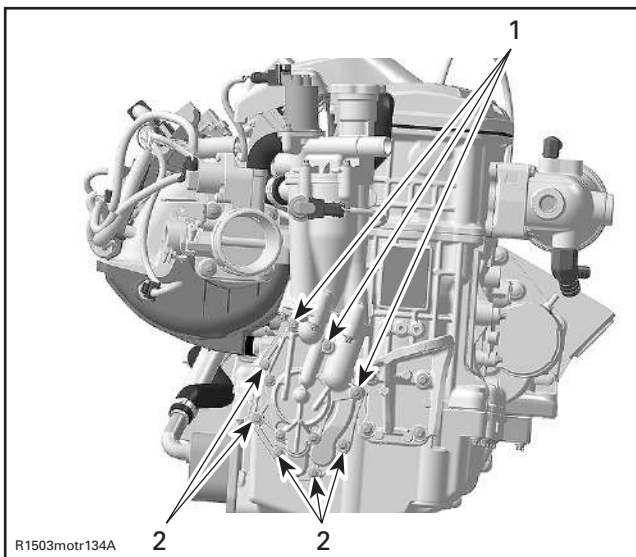
Difference between pump housing and outer rotor should not exceed 0.1 mm (.004 in). If so, replace the complete oil pump assembly.

**NOTE:** When the axial clearance of the oil pump shaft assembly increases, the oil pressure decreases.

Check the inside of oil pump housing and its cover for scoring or other damages and replace if damaged.

#### Installation

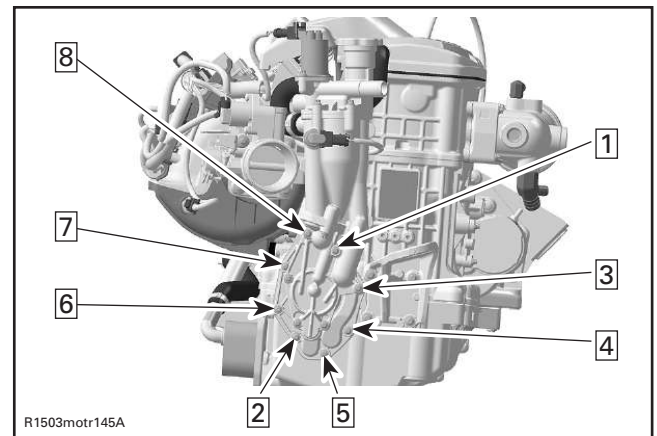
For installation, reverse the removal procedure. Pay attention to the following details.



1. Screws M6 x 85
2. Screws M6 x 25

Torque oil pump cover screws to 10 N•m (89 lbf•in)

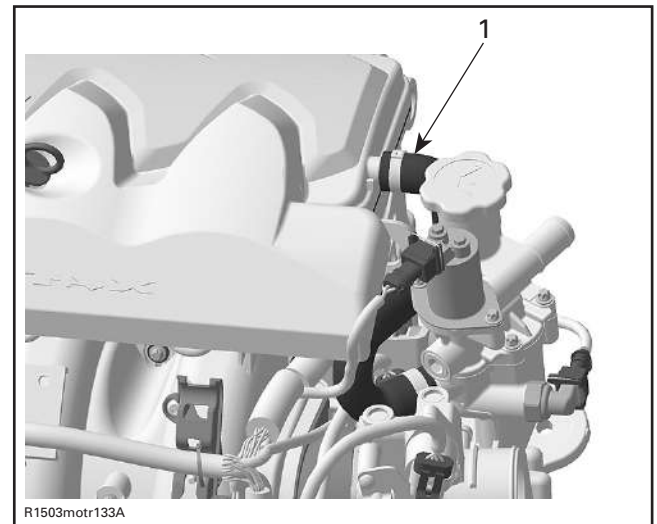
Tighten suction pump housing screws as per following sequence and torque to 10 N•m (89 lbf•in). Apply Loctite 243 (P/N 293 800 060) on threads.



## OIL SEPARATOR COVER

### Removal

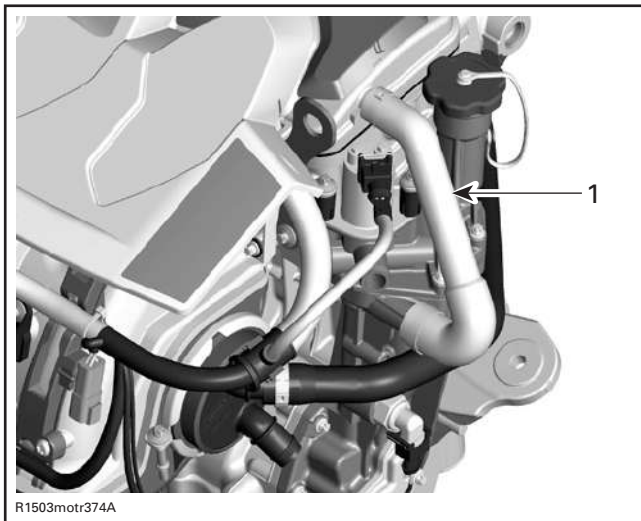
- Remove from valve cover the ventilation hose no. 7.



**TYPICAL — NATURALLY ASPIRATED ENGINE**  
1. Ventilation hose

## Section 01 ENGINES (1503 4-TEC)

### Subsection 04 (LUBRICATION SYSTEM)



**TYPICAL — SUPERCHARGED ENGINES**

1. Ventilation hose

- Disconnect wiring harness from TOPS valve **no. 8**.
- Remove retaining screws holding oil separator cover.
- Remove oil separator cover.

### Inspection

If O-rings and rubber rings are brittle, cracked or hard, replace them.

Clean all contact surfaces of oil separator cover.

### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Apply grease on O-rings and rubber rings.

Torque screws to 10 N•m (89 lbf•in). Apply Loc-tite 243 (P/N 293 800 060) on threads.

## TOPS VALVE

### Removal

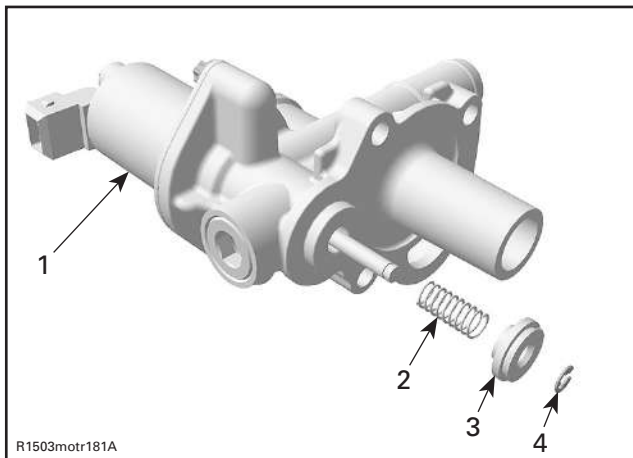
Remove the oil separator cover as described above.

Unscrew and remove the TOPS valve.

Remove the valve disc and the spring on the bottom of the TOPS valve after removing the retaining washer.

### WARNING

The spring on the TOPS valve is tensioned and can shoot away the valve disc. Hold the valve disc with fingers while removing the washer.



1. Solenoid valve
2. Spring
3. Valve disc
4. Retaining washer

### Installation

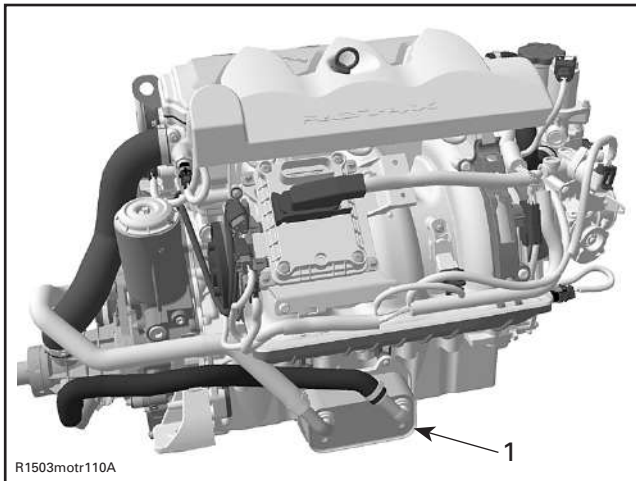
Install the new valve with new gasket. Apply Loc-tite 243 (blue) on threads and torque to 10 N•m (89 lbf•in).

Reinstall remaining removed parts.

## OIL COOLER

The oil cooler is located below the air intake manifold.



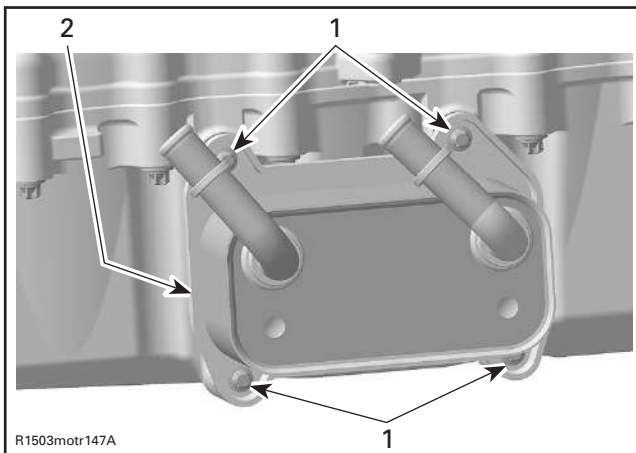


**TYPICAL**  
1. Oil cooler

## Removal

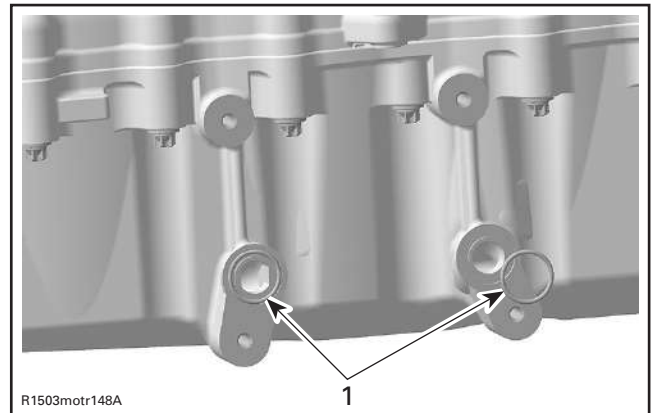
Remove:

- cooling hoses **no. 34** and **no. 35**
- retaining screws **no. 36**
- oil cooler **no. 37**



1. Screws  
2. Oil cooler

- O-rings **no. 38**.



1. O-rings

## Inspection

If O-rings are brittle, cracked or hard, replace them.

Clean both contact surfaces of oil cooler.

Check and clean the oil inlet and outlet area for dirt and other contaminations.

## Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Apply grease on O-rings.

Torque oil pump cover screws to 10 N•m (89 lbf•in). Apply Loctite 243 (P/N 293 800 060) on threads.

# COOLING SYSTEM

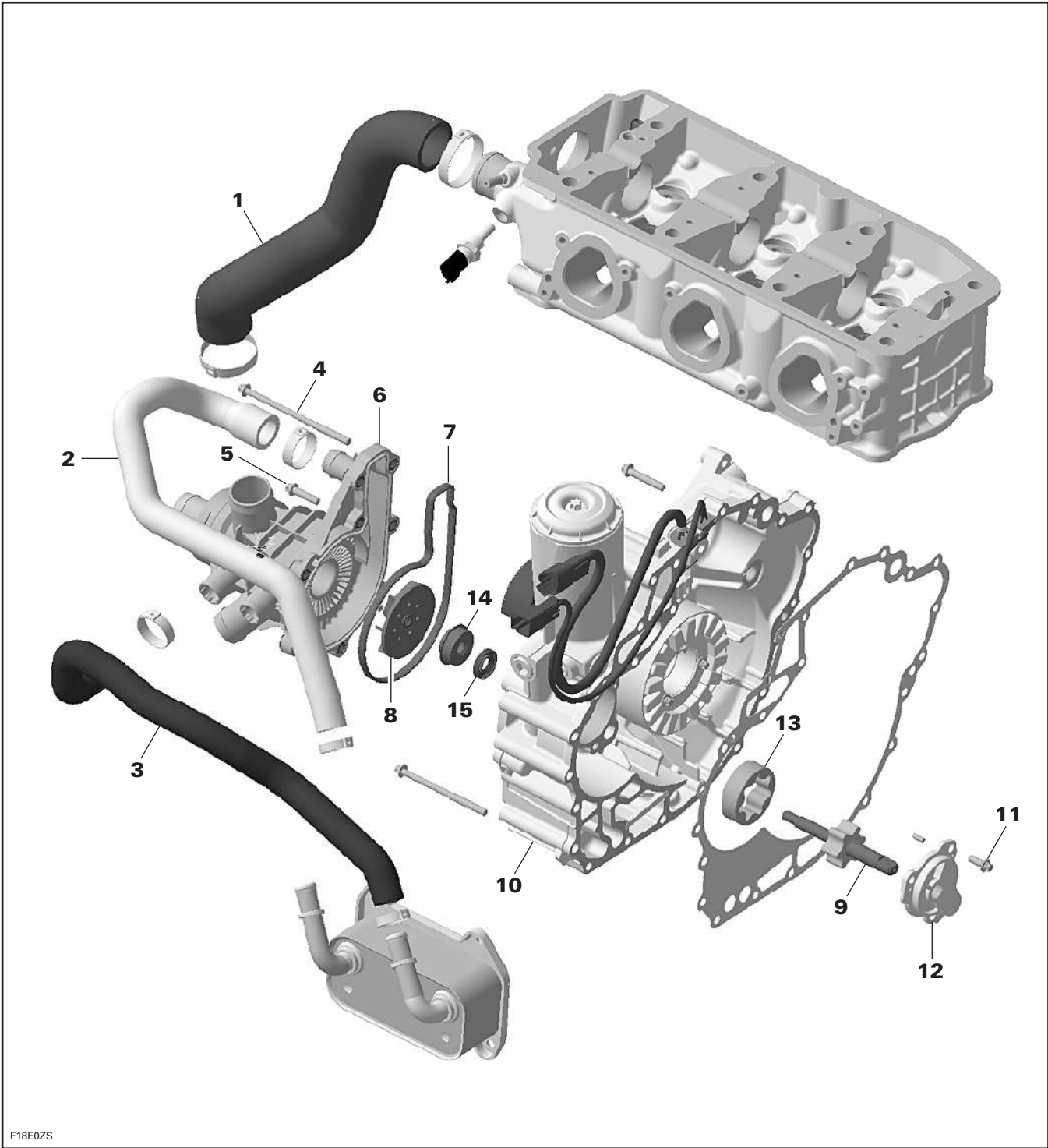
## SERVICE TOOLS

Description	Part Number	Page
oil seal protector.....	529 035 822 .....	67
rotary seal installer.....	529 035 823 .....	67

## SERVICE PRODUCTS

Description	Part Number	Page
Loctite 243.....	290 897 651 .....	64

**Section 01 ENGINES (1503 4-TEC)**  
Subsection 05 (COOLING SYSTEM)

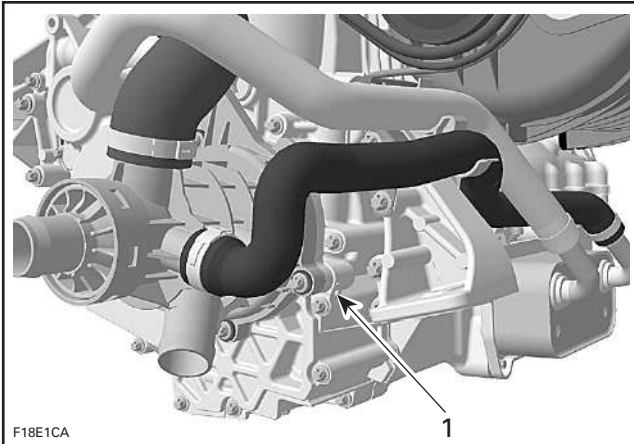


## GENERAL

For additional information pertaining to the vehicle cooling system, refer to the appropriate *VEHICLE SHOP MANUAL*.

Check general condition of hoses and clamp tightness.

Check the leak indicator hole if there is oil or coolant.

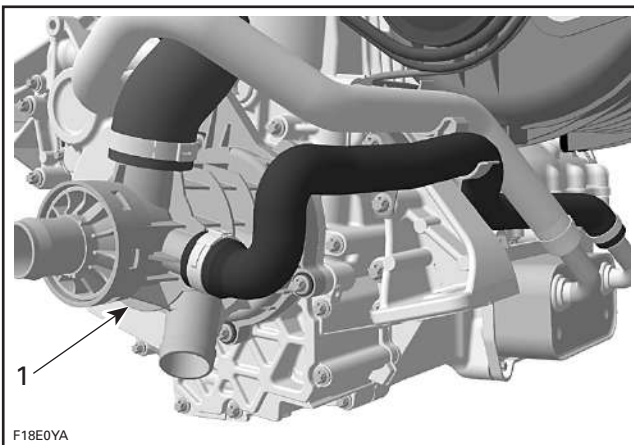


1. Weep hole

**NOTE:** Flowing coolant indicates a damaged rotary seal. Oil out of the leak indicator hole indicates a non working oil seal.

## PROCEDURES

### COOLANT PUMP

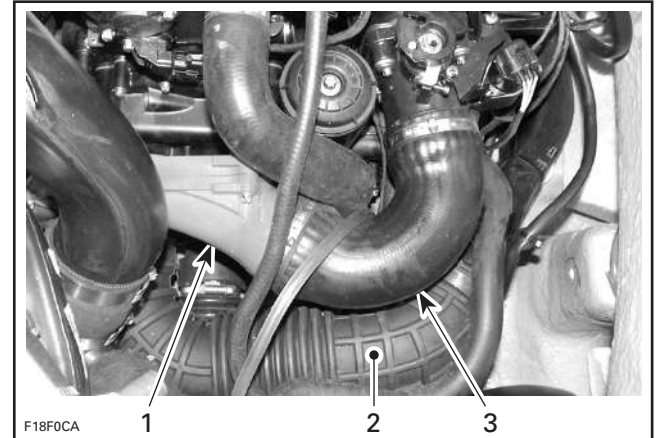


1. Coolant pump

## Removal

### **Supercharged Engines**

Remove supercharger inlet and outlet hoses to make room.



1. Supercharger
2. Inlet hose
3. Outlet hose

### **All Engines**

Drain cooling system and engine oil, refer to appropriate *VEHICLE SHOP MANUAL*.

Remove from housing:

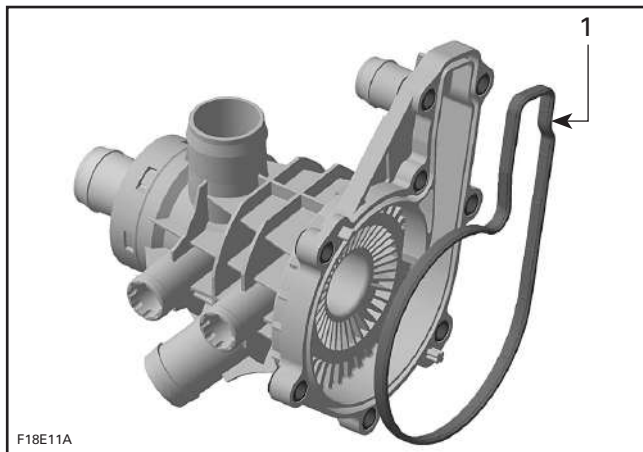
- ride plate inlet and outlet hoses
- cylinder head outlet hose **no. 1**
- oil cooler inlet hose **no. 2**
- oil cooler outlet hose **no. 3**
- screws **no. 4** and **no. 5** retaining coolant pump housing **no. 6**
- coolant pump housing **no. 6**.

## Inspection

Check if gasket **no. 7** is brittle, hard or damaged and replace as necessary.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 05 (COOLING SYSTEM)

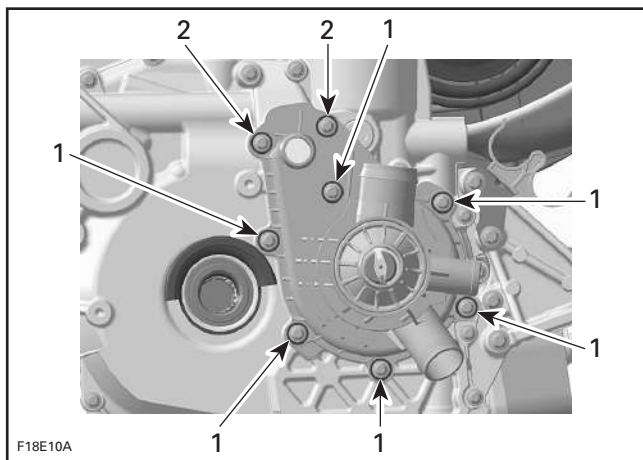


1. Weep hole pump housing gasket

Check if thermostat is in good condition. Refer to THERMOSTAT elsewhere in this section.

#### Installation

The installation is the opposite of the removal procedure. Install screws as per the following illustration.

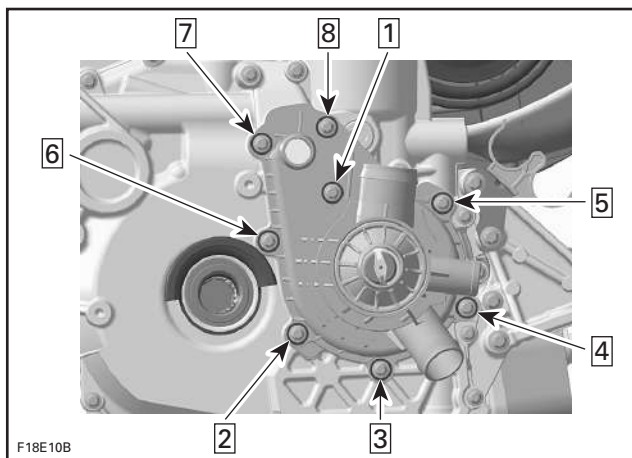


- 1. Screws M6 x 25
- 2. Screws M6 x 105

**CAUTION:** To prevent leaking, take care that the gaskets are exactly in groove when you reinstall the coolant pump housing.

Apply Loctite 243 (P/N 290 897 651) on screw threads and torque to 10 N•m (89 lbf•in).

Tightening sequence for screws on coolant pump housing is as per following illustration.



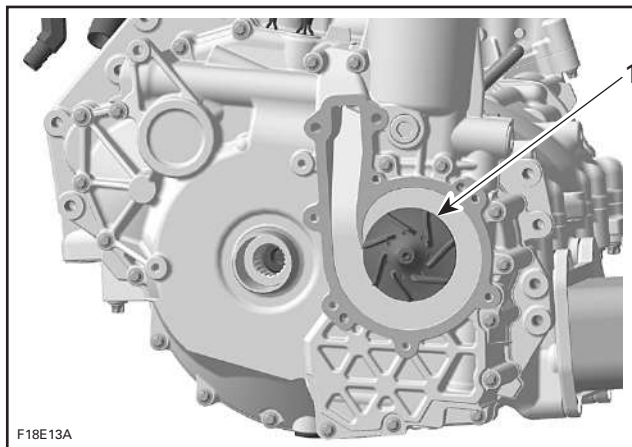
F18E10B

## COOLANT PUMP IMPELLER

#### Removal

Remove:

- coolant pump no. 6 as described in this section
- unscrew the impeller no. 8 clockwise.



F18E13A

1. Impeller

**CAUTION:** Coolant/oil pump shaft no. 9 and impeller no. 8 have left-hand threads. Remove by turning clockwise and install by turning counterclockwise.

#### Inspection

Check impeller for cracks or other damage. Replace impeller if damaged.

#### Installation

The installation is the opposite of the removal procedure. Pay attention to the following details.



**CAUTION:** Be careful not to damage impeller wings during installation.

Torque impeller to 3 N•m (26 lbf•in).

## THERMOSTAT

The thermostat is a single action type.

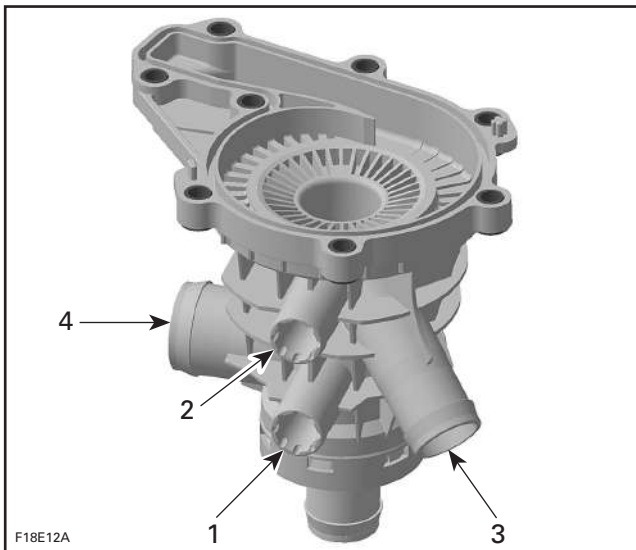
### Removal

Remove the coolant pump from the PTO cover. Refer to COOLANT PUMP above in this section.

**NOTE:** The thermostat is located inside the coolant pump housing.

### Leak Test

Plug the connections of the oil cooler return hose, coolant tank hose, ride plate return hose and cylinder head return hose with a rag.



1. Oil cooler return connection
2. Coolant tank hose connection
3. Ride plate return hose connection
4. Cylinder head return hose connection

Fill the coolant pump housing with water.

If a bigger quantity of coolant leaks out at the ride plate outlet connection, replace the coolant pump. Refer to COOLANT PUMP in this section.

If there is no leak, check the operation of the thermostat.

### Dynamic Test

To check the operation of the thermostat, put it in water and heat water. Look inside the cylinder head return hose connection to see the movement of the thermostat. Thermostat should open when water temperature reaches 87°C (188°F).

If there is no operation, replace the coolant pump.

### Installation

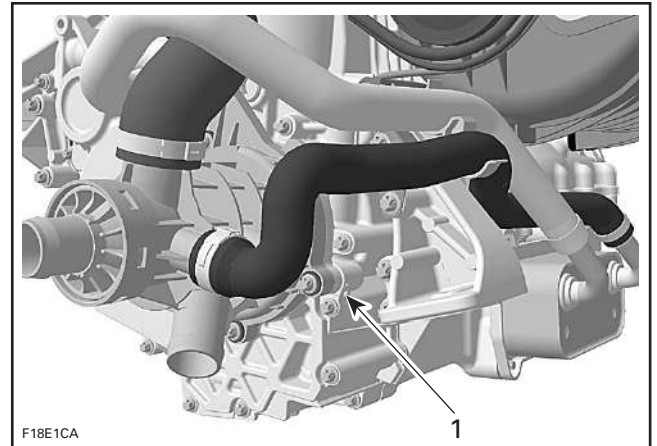
For installation, reverse the removal procedure, paying attention to the following details.

Refer to COOLANT PUMP in this section.

## ROTARY SEAL

### Inspection

Check weep hole for oil or coolant leak.



1. Weep hole

Coolant leaking out of the hole indicates a defective rotary seal. Leaking oil indicates a faulty oil seal.

However, if seal is disassembled both parts have to be replaced together.

### Removal

Remove:

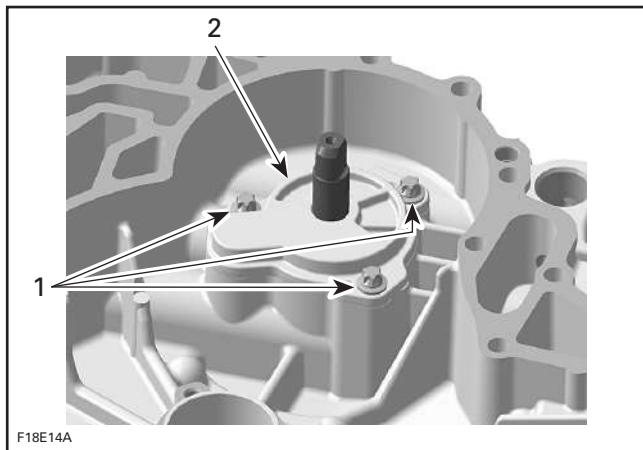
- coolant pump **no. 6**

**CAUTION:** Always unscrew the impeller clockwise otherwise you can damage the components.

- unscrew the impeller **no. 8** clockwise
- remove PTO cover **no. 10** (refer to PTO HOUSING/MAGNETO section)
- remove screws **no. 11** retaining oil pump cover

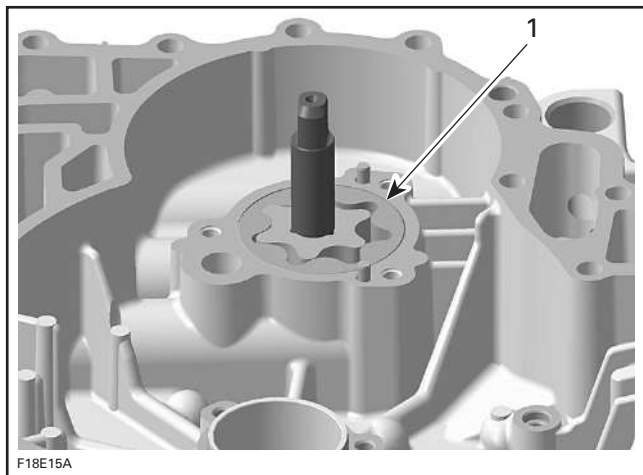
## Section 01 ENGINES (1503 4-TEC)

### Subsection 05 (COOLING SYSTEM)



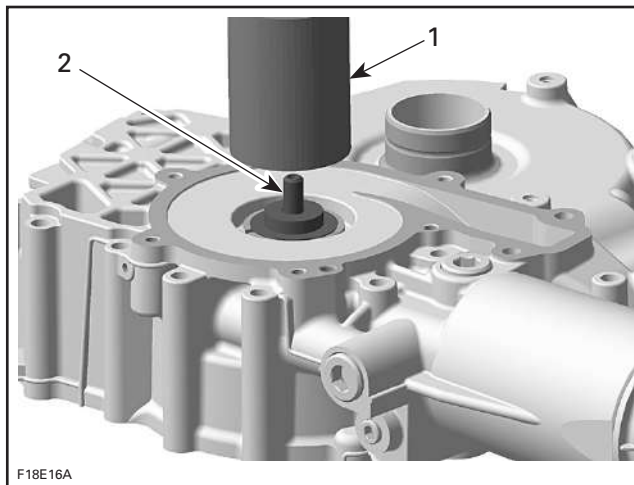
1. Retaining screws
2. Oil pump cover

- remove oil pump cover **no. 12**
- remove outer oil pump rotor **no. 13**



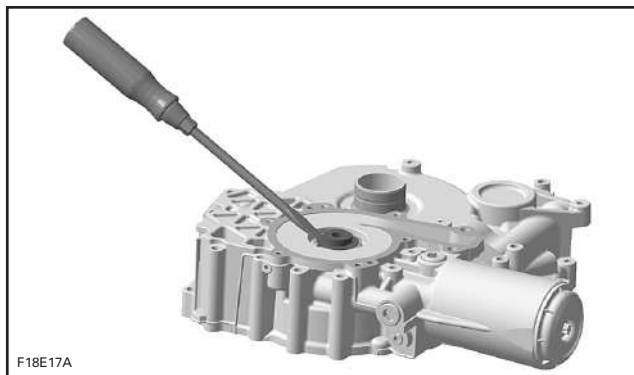
1. Outer oil pump rotor

- extract the coolant/oil pump shaft **no. 9** from outside PTO housing cover with a pusher



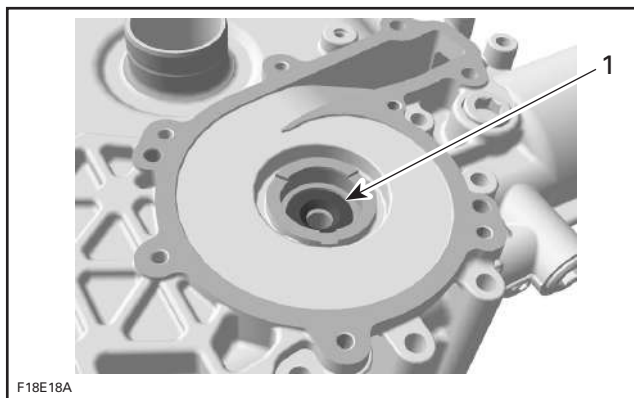
1. Pusher
2. Coolant/oil pump shaft

- remove rotary seal **no. 14** with a screwdriver



**CAUTION:** Be careful not to damage the surface of the rotary seal bore in magneto housing cover.

- always replace also the oil seal **no. 15** behind the rotary seal.



1. Oil seal

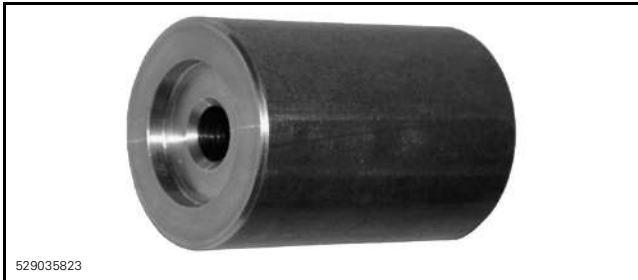
## Installation

The installation is the opposite of the removal procedure. Pay attention to the following details.

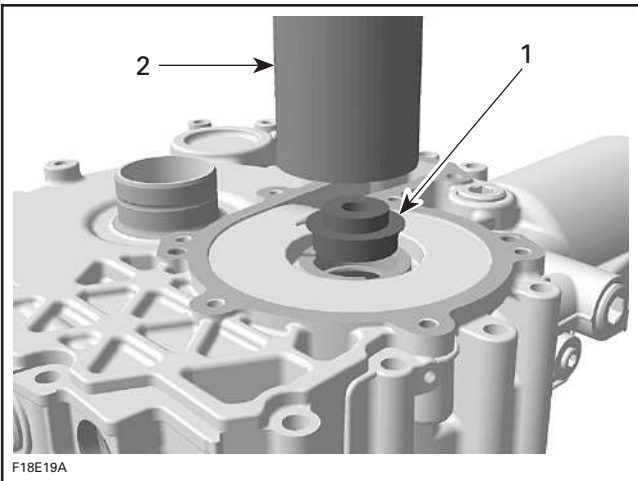
**NOTE:** Never use oil in the press fit area of the oil seal and rotary seal.

Push coolant pump shaft oil seal in place by using thumb.

Install the new rotary seal using the rotary seal installer (P/N 529 035 823).

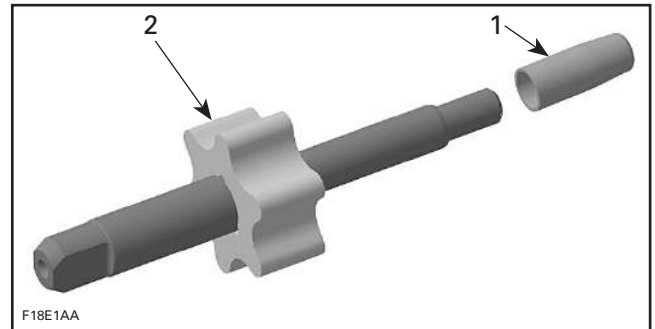


**CAUTION:** Never use a hammer for the rotary seal or water/oil pump shaft installation. Only use a press to avoid damaging the ceramic component.

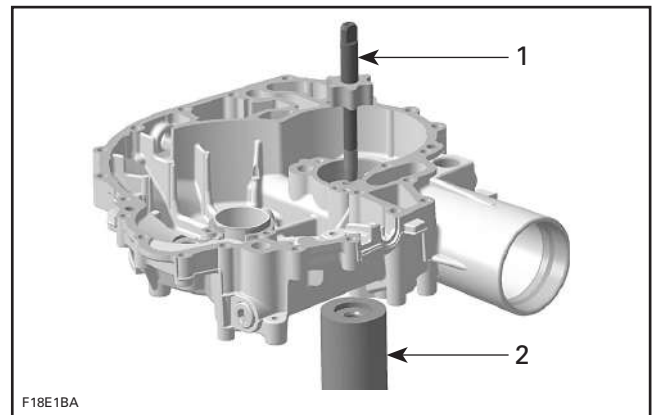


1. Rotary seal
2. Rotary seal installer

Install the coolant/oil pump shaft using the rotary seal installer (P/N 529 035 823) on the opposite side to the rotary seal and the oil seal protector (P/N 529 035 822) with a press.



1. Oil seal protector
2. Coolant/oil pump shaft



1. Coolant/oil pump shaft with oil seal protector
2. Rotary seal installer

# CYLINDER HEAD

## SERVICE TOOLS

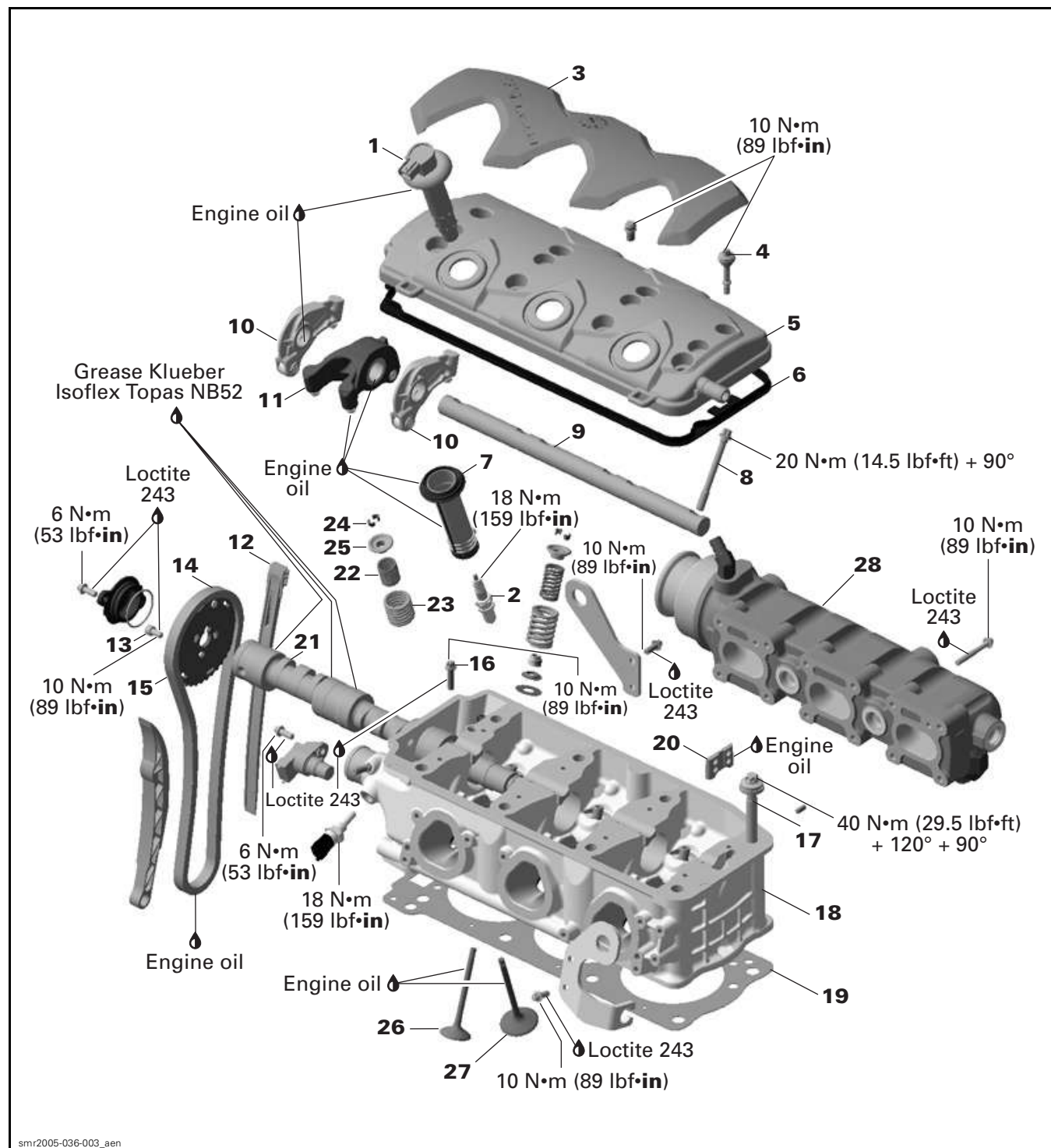
<b>Description</b>	<b>Part Number</b>	<b>Page</b>
camshaft locking tool.....	529 035 839 .....	75, 77
crankshaft locking tool.....	529 035 821 .....	73, 76, 78
valve spring compressor clamp .....	529 035 724 .....	80
valve spring compressor cup.....	529 035 725 .....	80

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
Klueber Isoflex grease .....	293 550 021 .....	80
Loctite 243 (blue).....	293 800 060 .....	72
Molykote G-N paste.....	413 703 700 .....	84

## Section 01 ENGINES (1503 4-TEC)

### Subsection 06 (CYLINDER HEAD)





## GENERAL

**NOTE:** When diagnosing an engine problem, always perform a cylinder leak test. This will help pin-point a problem. Refer to the instructions included with your leak tester and LEAK TEST for procedures.

Always place the vehicle on level surface.

Always disconnect the negative wire from the battery before working on the engine.

Even if the removal of many parts is not necessary to reach another part, it is recommended to remove these parts in order to check them.

For installation, use the torque values and Loctite products as mentioned. Clean threads before using Loctite product when installing screws.

When disassembling parts that are duplicated in the engine, (e.g.: valves, bushings), it is strongly recommended to note their position (cylinder 1, 2 or 3) and to keep them as a "group". If you find a defective component, it would be much easier to find the cause of the failure within the group of parts (e.g.: you found a worn valve guide. A bent spring could be the cause and it would be easy to know which one among the springs is the cause to replace it if you grouped them at disassembly). Besides, since used parts have matched together during the engine operation, they will keep their matched fit when you reassemble them together within their "group".

## PROCEDURES

### SPARK PLUG

#### Removal

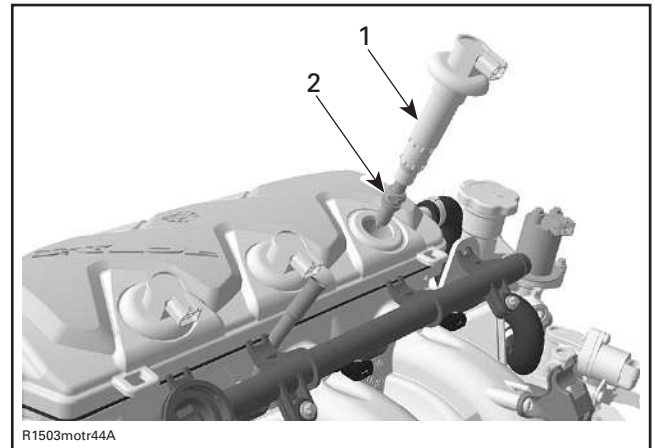
Remove fuel rail cover from engine.

Unplug the ignition coil connector on the spark plug you need to remove.

Remove the ignition coil **no. 1**.

Clean spark plug and ignition coil area before disassembly.

Unscrew spark plug **no. 2** then use the ignition coil to take spark plug out of spark plug hole.



1. Ignition coil  
2. Spark plug

#### Inspection

Check spark plug and each ignition coil condition (refer to appropriate *VEHICLE SHOP MANUAL*).

#### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Check spark plug gap.

Place spark plug into ignition coil, screw spark plug then remove the ignition coil. Torque spark plug. Reinstall the ignition coil.

**NOTE:** Prior to inserting the ignition coil in its location, apply some BOMBARDIER LUBE lubricant around the seal area that touches the spark plug hole. After installation, ensure the seal seats properly with the engine top surface.

### EXHAUST MANIFOLD

#### Removal

Refer to the appropriate *VEHICLE SHOP MANUAL* to disconnect hoses and other required components.

Unscrew the exhaust manifold **no. 28** beginning with the bottom screws. This will help holding the manifold while you remove the screws.

Remove exhaust manifold.

#### Inspection

Inspect exhaust manifold condition paying attention for cracks or other damage. Check contact surfaces and hose. Replace any defective part.

**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 06 (CYLINDER HEAD)**

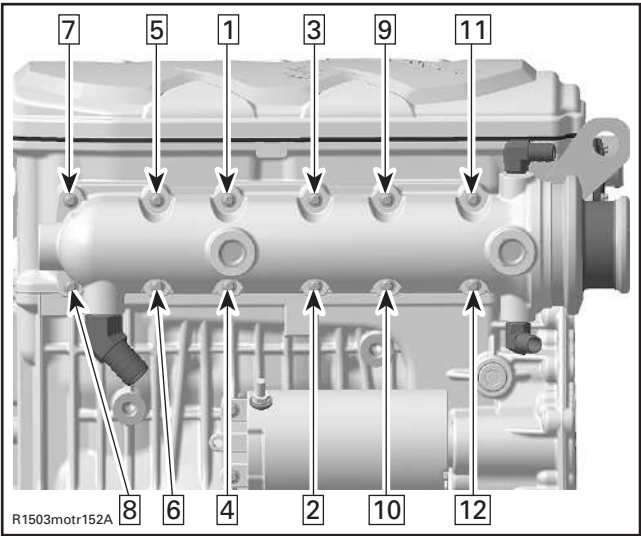
Inspect plane surfaces for warpage. Small deformation can be corrected by grinding surface with a fine sand paper. Install sand paper on a surface plate and rub part against oiled sand paper.

**Installation**

**NOTE:** There is no gasket between cylinder block and exhaust manifold.

Apply Loctite 243 (blue) (P/N 293 800 060) on threads of screws.

Torque screws to 10 N•m (89 lbf•in) as per following illustrated sequence.

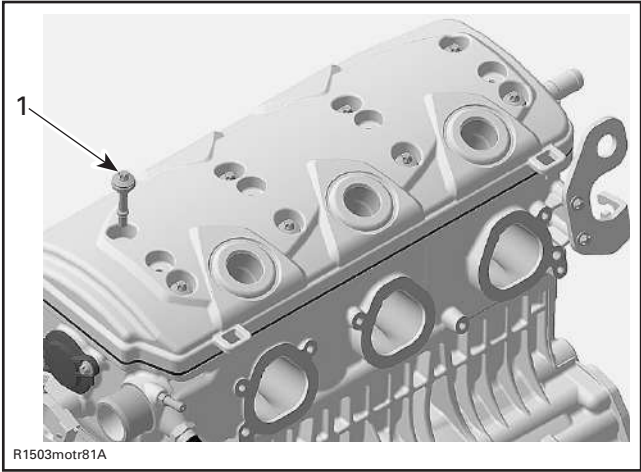


**VALVE COVER**

**Removal**

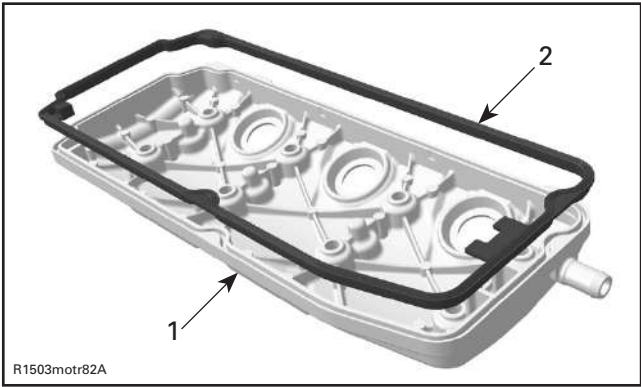
Remove:

- valve cover shield **no. 3**
- valve cover screws **no. 4**



1. Valve cover screws

- valve cover **no. 5** and profile sealing ring **no. 6**.



1. Valve cover  
2. Profile sealing ring

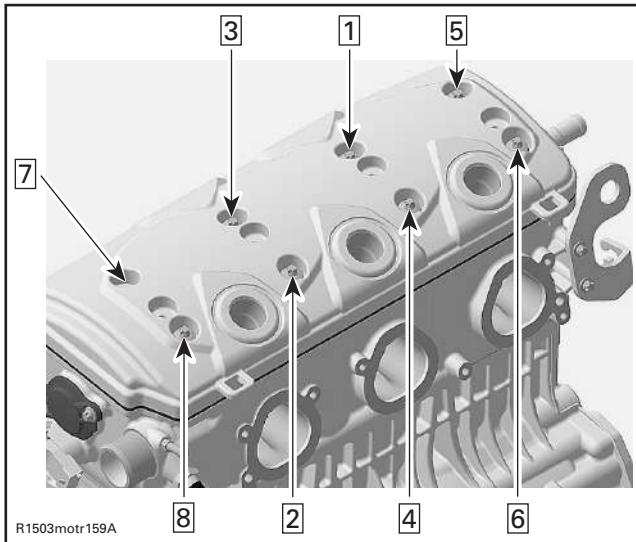
**Inspection**

Check if the profile sealing ring on the valve cover and the rubber bushing on the valve cover screws are brittle, cracked or hard. If so, replace the profile sealing ring or the valve cover screw accordingly.

**Installation**

For installation, reverse the removal procedure.

**NOTE:** Install the valve cover screws according to following sequence.



Torque screws to 10 N•m (89 lbf•in).

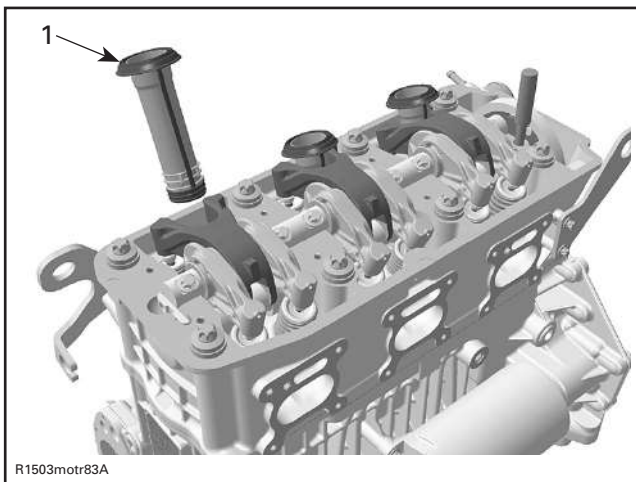
## ROCKER ARM

### Removal

Lock crankshaft with crankshaft locking tool (P/N 529 035 821), refer to CYLINDER BLOCK section.

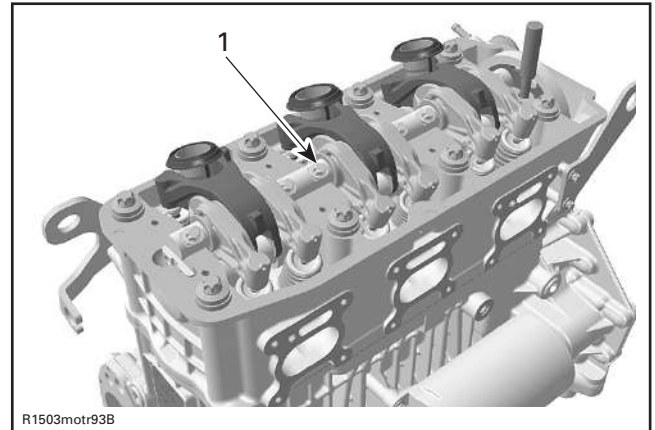
Remove:

- spark plug
- valve cover
- spark plug tube no. 7



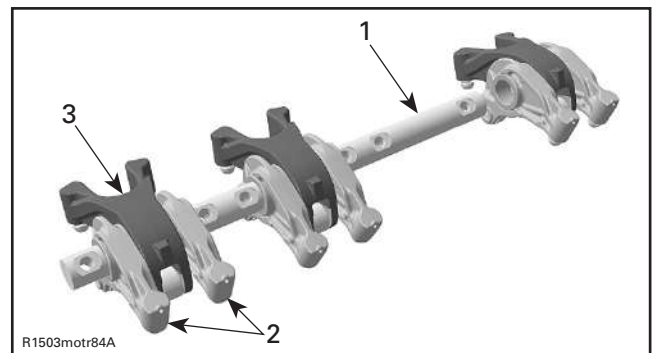
1. Spark plug tube

- rocker arm shaft screws no. 8. Discard screws.

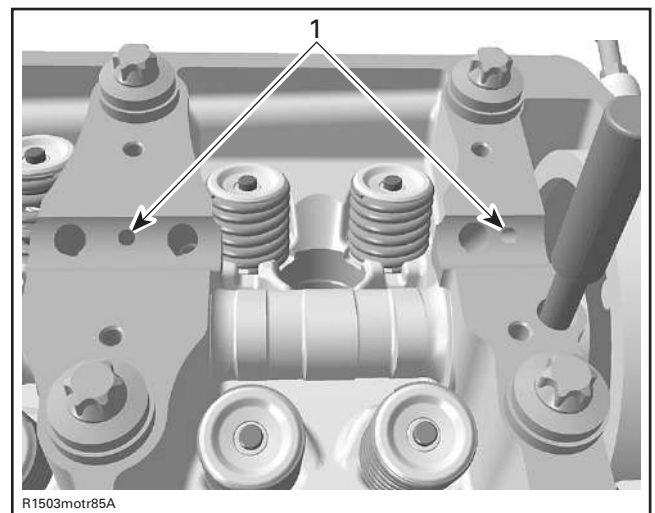


1. Rocker arm shaft screws

- rocker arm shaft no. 9 with rocker arm assembly (exhaust side no. 10 and intake side no. 11).



1. Rocker arm shaft  
2. Rocker arms (exhaust side)  
3. Rocker arm (intake side)



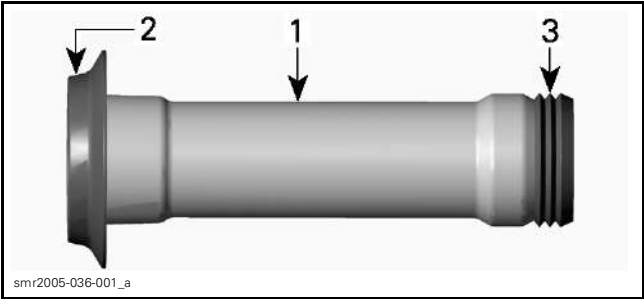
1. Oil supply from the camshaft to the rocker arm shaft, then to the rocker arms and finally to the valve adjustment

Section 01 ENGINES (1503 4-TEC)  
Subsection 06 (CYLINDER HEAD)

Inspection

Spark Plug Tube

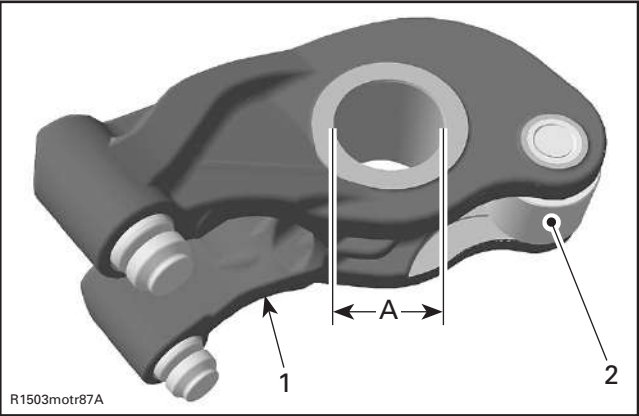
Check seals on spark plug tube. If seals are brittle, cracked or hard, replace spark plug tube.



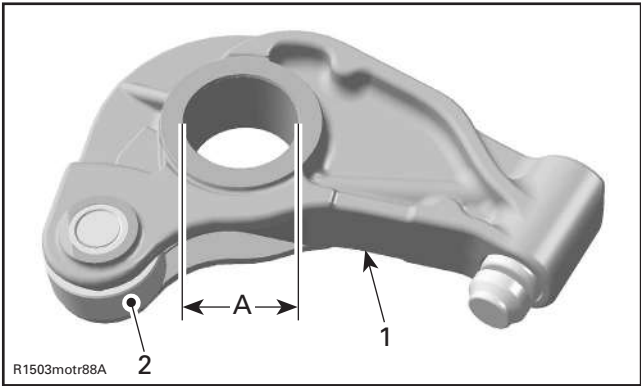
- 1. Spark plug tube
- 2. Seal to the valve cover
- 3. Seal to the cylinder head

Rocker Arm

Inspect each rocker arm for cracks and scored friction surfaces. If so, replace rocker arm assembly. Check the rocker arm rollers for free movement, wear and excessive radial play. Replace rocker arm assembly as necessary.



- 1. Rocker arm (intake side)
- 2. Roller
- A. Bore for rocker arm shaft

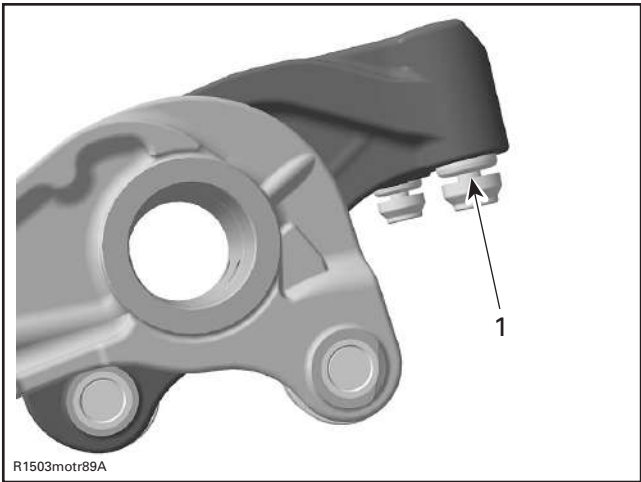


- 1. Rocker arm (exhaust side)
- 2. Roller
- A. Bore for rocker arm shaft

Measure rocker arm bore diameter. If diameter is out of specification, change the rocker arm assembly.

ROCKER ARM BORE DIAMETER	
NEW MINIMUM	20.007 mm (.7877 in)
NEW MAXIMUM	20.020 mm (.7881 in)
SERVICE LIMIT	20.035 mm (.7887 in)

Press the hydraulic lifter with your thumb. If the hydraulic lifter groove disappears inside rocker arm casting, replace rocker arm assembly. Lifter must turn freely in rocker arm bore. Otherwise, replace.



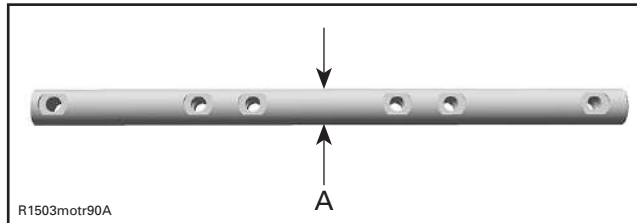
- 1. Hydraulic lifter groove

Rocker Arm Shaft

Check for scored friction surfaces, if so, replace parts.

Measure rocker arm shaft diameter.

ROCKER ARM SHAFT DIAMETER	
NEW MINIMUM	19.980 mm (.7866 in)
NEW MAXIMUM	19.993 mm (.7871 in)
SERVICE LIMIT	19.965 mm (.7860 in)



A. Measure rocker arm shaft diameter here

Any area worn excessively will require parts replacement.

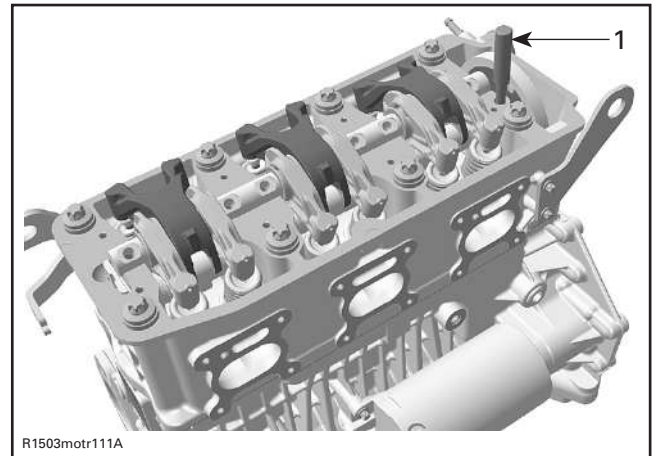
### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Apply engine oil on rocker arm shaft.

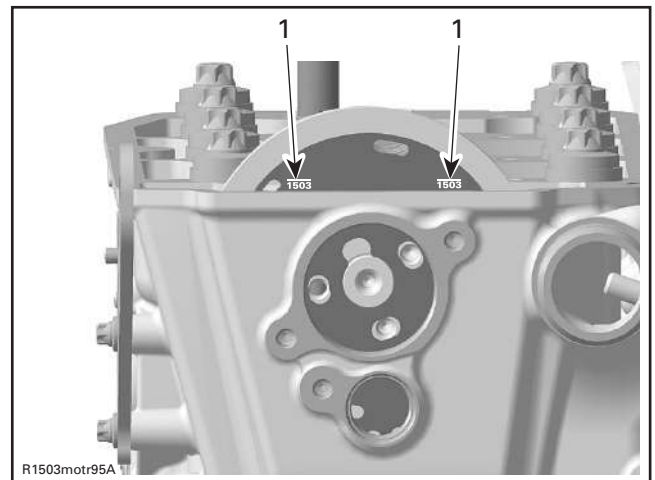
**IMPORTANT:** The rocker arm shaft can only be installed in one specific position. Therefore crankshaft as well as camshaft has to be positioned with their locking pins when the piston of cylinder **no. 3** is on ignition TDC. Refer to CYLINDER BLOCK section for crankshaft and the following for the camshaft locking.

Use camshaft locking tool (P/N 529 035 839). Rotate camshaft so that tool can be pushed in camshaft hole and lock camshaft in place.



1. Camshaft locking tool

Then, the camshaft sprocket lines should be lined up as shown in the following illustration.



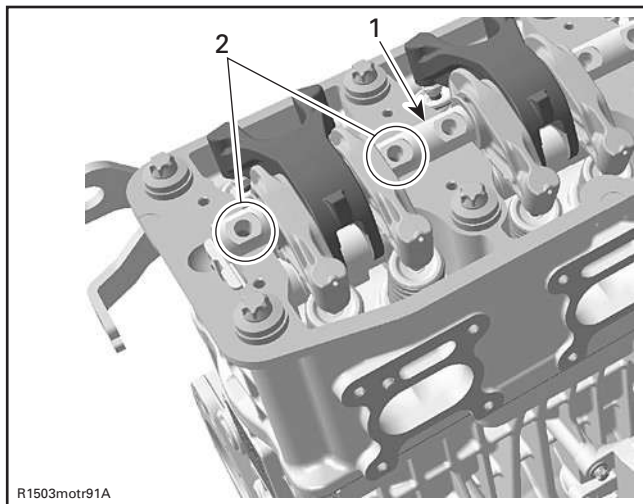
1. Position lines

Position the rocker arm shaft with the notches on top.



## Section 01 ENGINES (1503 4-TEC)

### Subsection 06 (CYLINDER HEAD)

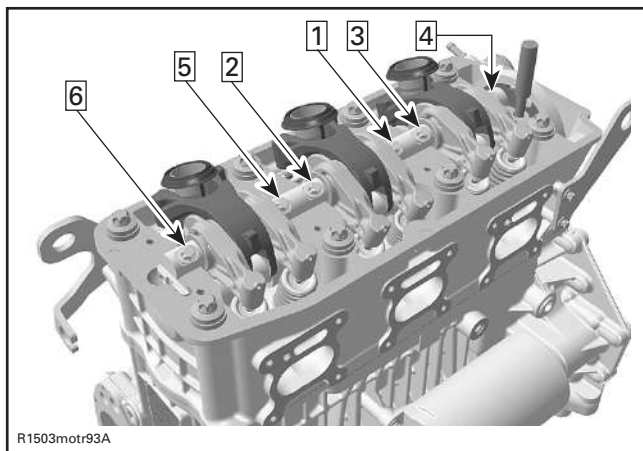


1. Rocker arm shaft
2. Rocker arm shaft notches

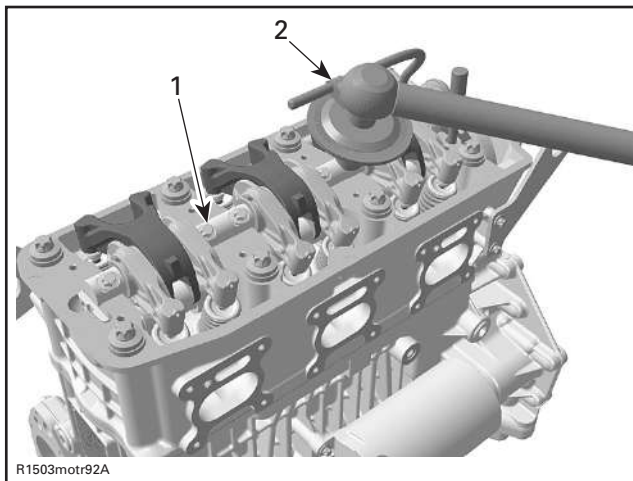
Install NEW rocker arm shaft screws no. 8.  
Torque as per following procedure:

**CAUTION:** This assembly uses stretch screws. As the screws have been stretched from the previous installation, it is very important to use new screws at assembly. Failure to replace screws and to strictly follow the torque procedure may cause screws to loosen and lead to engine damage.

- Torque screws at first to 10 N•m (89 lbf•in) according to following sequence.



- Torque screws to 20 N•m (177 lbf•in).
- Finish tightening screws turning an additional 90° rotation with a torque angle gauge.



1. Rocker arm shaft screw
2. Torque angle gauge

## CAMSHAFT TIMING GEAR

**NOTE:** Although it is not necessary to position crankshaft to TDC for disassembly, it is a good practice to do it, as a troubleshooting step, to know before disassembly if valve timing was appropriate.

### Removal

Lock crankshaft with crankshaft locking tool (P/N 529 035 821), refer to CYLINDER BLOCK section.

Remove:

- valve cover (refer to CYLINDER BLOCK section)
- chain guide no. 12
- Allen screws no. 13
- camshaft timing gear no. 14.

**NOTE:** Secure timing chain no. 15 with a retaining wire.

### Inspection

Check camshaft timing gear for wear or deterioration.

If gear is worn or damaged, replace it as a set (camshaft timing gear and timing chain).

For crankshaft timing gear, refer to CYLINDER BLOCK section.

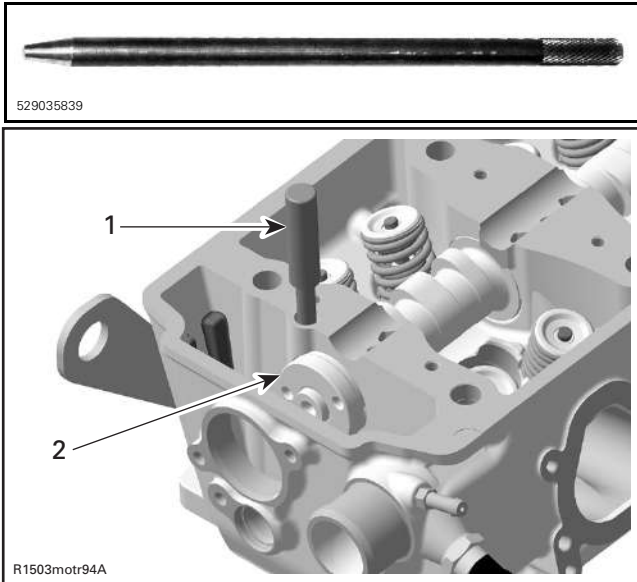
### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

## Section 01 ENGINES (1503 4-TEC)

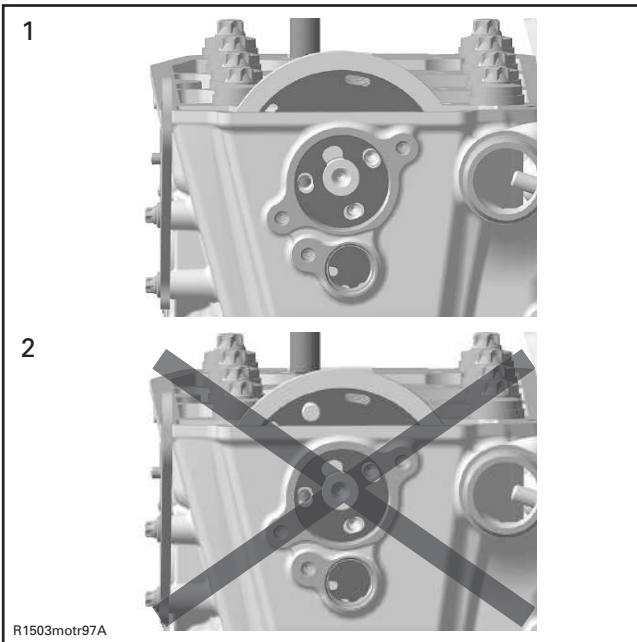
### Subsection 06 (CYLINDER HEAD)

Using the camshaft locking tool (P/N 529 035 839), lock camshaft on TDC position.



1. Camshaft locking tool
2. Camshaft on TDC position

Install the camshaft timing gear with the writing visible, i.e. to be able to see the position lines when looking from outside of engine.



1. Good (with 1503 aligned)
2. Never

Install timing chain. Refer to CYLINDER BLOCK section.

Ensure chain guides are in place.

Loosely install screws.

Install chain tensioner.

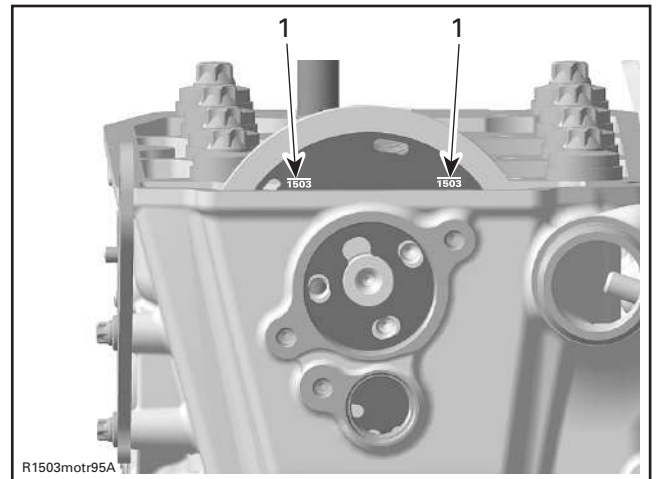
**NOTE:** There can be 2 different positions to install the timing gear on the camshaft. Basically both positions are working well, since the camshaft and crankshaft are locked in their proper position. Due to some tolerances, there could be one position which fits better than the other one. To check this, perform the following test.

Check if screws are still loose. If screws are squeezed by the timing gear, remove the chain tensioner again and rotate timing gear by one tooth clockwise. Then install the chain tensioner again.

Tighten screws and torque to 10 N•m (89 lbf•in).

Remove locking tools.

**CAUTION:** Crankshaft and camshaft must be locked on TDC position to place camshaft timing gear and timing chain in the proper position. To double check, take a look at the timing gear lines. They must be parallel to the cylinder head surface.



1. Position lines

**CAUTION:** Ensure to remove locking tools when finished.

## TIMING CHAIN

Refer to CYLINDER BLOCK section.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 06 (CYLINDER HEAD)

## CYLINDER HEAD

### Removal

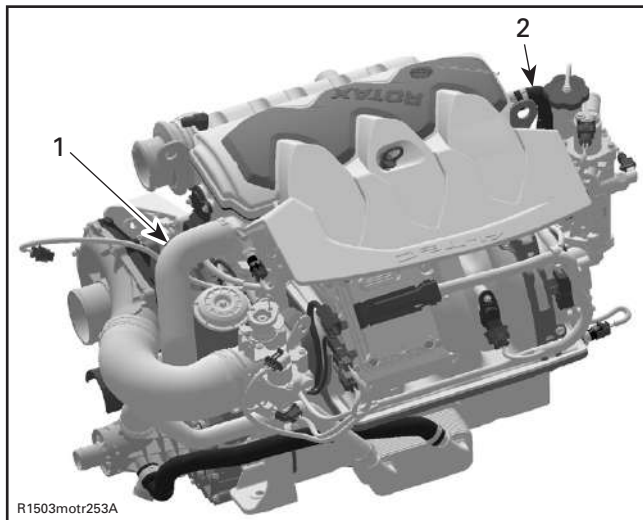
Lock crankshaft with crankshaft locking tool (P/N 529 035 821), refer to CYLINDER BLOCK section.

Drain coolant (refer to appropriate *VEHICLE SHOP MANUAL*).

Disconnect coolant temperature and camshaft position sensors (CTS and CAPS).

Remove:

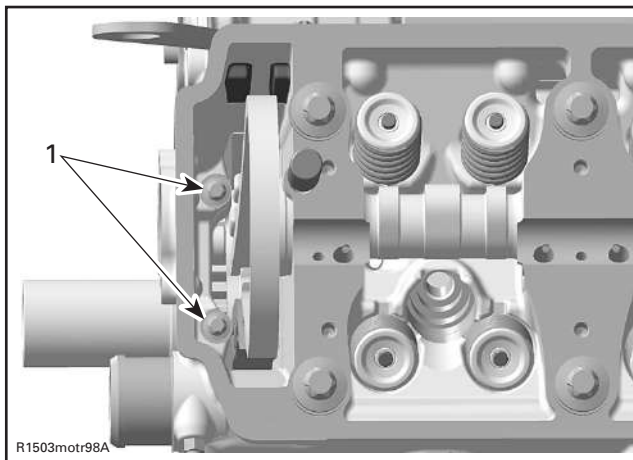
- exhaust manifold (refer to EXHAUST MANIFOLD elsewhere in this section)
- engine hoses



#### TYPICAL

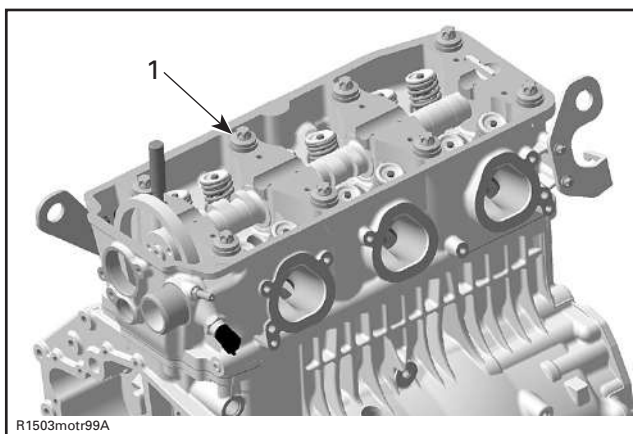
1. Coolant hose
2. TOPS ventilation hose

- chain tensioner (refer to CYLINDER BLOCK section)
- valve cover shield (see VALVE COVER REMOVAL above)
- camshaft timing gear
- cylinder head screws M6 no. 16



1. Cylinder head screws M6

- cylinder head screws M11 no. 17 retaining cylinder head to cylinder block.



1. Cylinder head screws M11

Pull up cylinder head no. 18.

Remove gasket no. 19.

### Cleaning

Remove carbon deposits from combustion chamber, exhaust port and piston top.

### Inspection

Check for cracks between valve seats, if so, replace cylinder head.

Check mating surface between cylinder and cylinder head for contamination. If so, clean both surfaces.

#### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Ensure dowel pins are in place.

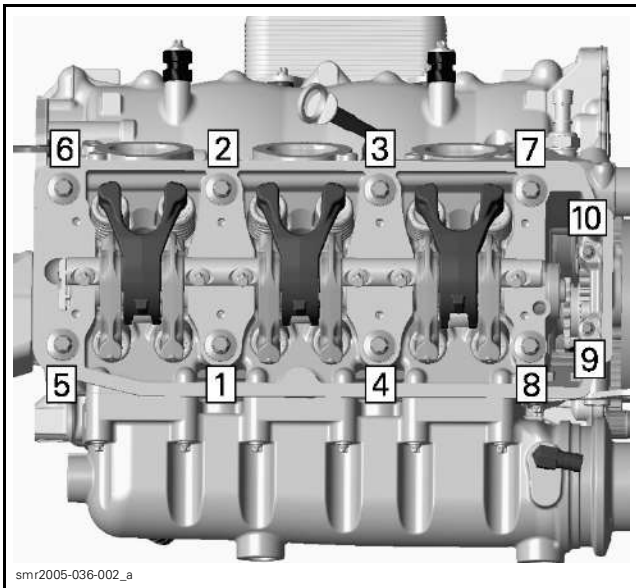
Install new cylinder head gasket.

**CAUTION:** Each installation of the cylinder head requires a new cylinder head gasket. Using a gasket twice will cause engine damage, even if the engine had not run.

Install cylinder screws M11 no. 17. Torque screws as per following procedure.

**CAUTION:** This assembly uses stretch screws. As the screws have been stretched from the previous installation, it is very important to measure each screw at assembly. If screw is out of specification, replace by a new. Failure to replace screws and to strictly follow the torque procedure may cause screws to loosen and lead to engine damage.

CYLINDER SCREW M11	
SERVICE LIMIT	148.5 mm (5.846 in)

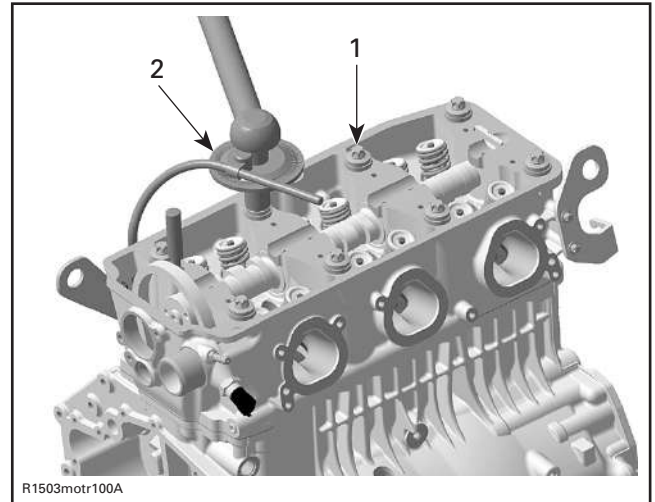


**NOTE:** Torque screws no. 16 after the tightening of the cylinder head screws is finished.

Torque screws according to following sequence.

First torque to 40 N•m (30 lbf•in).

Then tighten screws turning an additional 120° rotation with a torque angle gauge and finish tightening with a 90° rotation. Torque screws no. 16 to 10 N•m (89 lbf•in).



1. Cylinder screws M11
2. Angle torque wrench

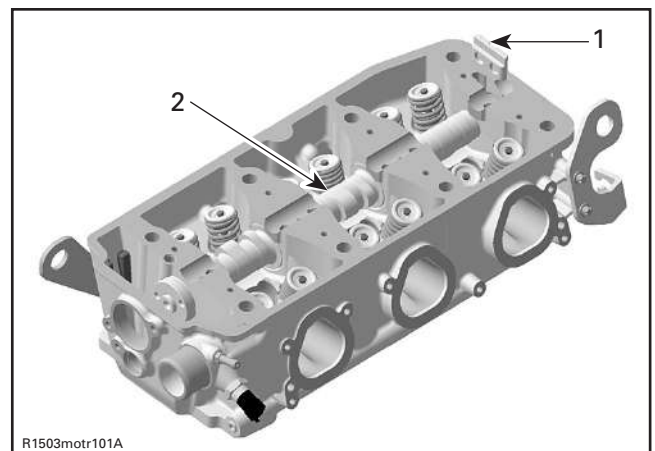
Remove crankshaft locking tool then install plug with sealing ring.

#### CAMSHAFT

##### Removal

Remove:

- valve cover
- rocker arms
- chain tensioner (refer to CYLINDER BLOCK section)
- camshaft timing gear
- camshaft lock no. 20
- camshaft no. 21.



1. Camshaft lock
2. Camshaft



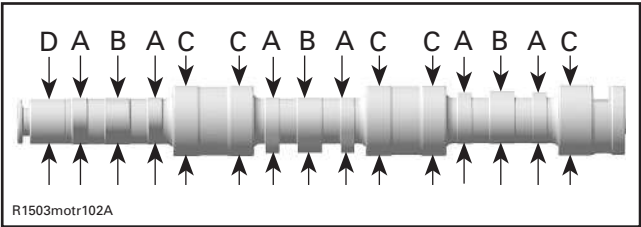
Section 01 ENGINES (1503 4-TEC)  
Subsection 06 (CYLINDER HEAD)

Inspection

Check each lobe and bearing journal of camshaft for scoring, scuffing, cracks or other signs of wear.

Measure camshaft bearing journal diameter and lobe height using a micrometer.

Measure clearance between both ends of camshaft and cylinder head.



- A. Camshaft lobe (exhaust valves)
- B. Camshaft lobe (intake valves)
- C. Camshaft bearing journal
- D. Camshaft bearing journal — engine front

CAMSHAFT LOBE — EXHAUST VALVE	
NEW MINIMUM	31.699 mm (1.248 in)
NEW MAXIMUM	31.809 mm (1.252 in)
SERVICE LIMIT	31.670 mm (1.247 in)
CAMSHAFT LOBE — INTAKE VALVE	
NEW MINIMUM	31.480 mm (1.239 in)
NEW MAXIMUM	31.590 mm (1.244 in)
SERVICE LIMIT	31.450 mm (1.238 in)
CAMSHAFT BEARING JOURNAL	
NEW MINIMUM	39.892 mm (1.5705 in)
NEW MAXIMUM	39.905 mm (1.5711 in)
SERVICE LIMIT	39.860 mm (1.5693 in)
CAMSHAFT BEARING JOURNAL — ENGINE FRONT	
NEW MINIMUM	24.939 mm (.9818 in)
NEW MAXIMUM	24.960 mm (.9826 in)
SERVICE LIMIT	24.910 mm (.9807 in)
CAMSHAFT BORE MEASURED IN DIAMETER	
NEW MINIMUM	40.000 mm (1.5748 in)
NEW MAXIMUM	40.016 mm (1.5754 in)
SERVICE LIMIT	40.050 mm (1.5767 in)

CAMSHAFT BORE — ENGINE FRONT MEASURED IN DIAMETER	
NEW MINIMUM	25.000 mm (.9842 in)
NEW MAXIMUM	25.013 mm (.9848 in)
SERVICE LIMIT	25.050 mm (.9862 in)

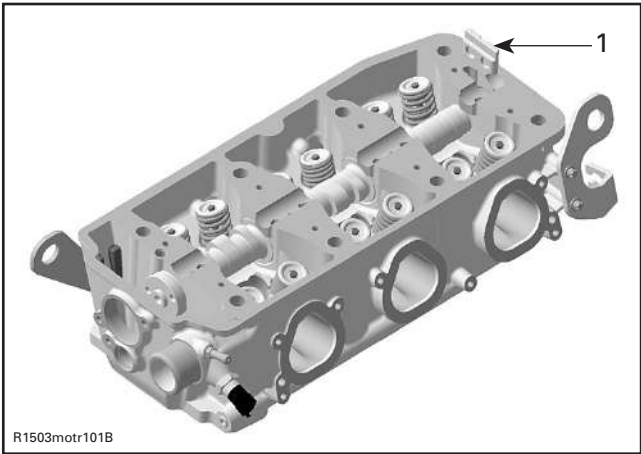
Replace parts that are not within specifications.

Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Grease the camshaft bearing journals well by using the Klueber Isoflex grease (P/N 293 550 021) or a similar product.

Install camshaft then place the camshaft lock no. 20 in the slot.



1. Camshaft lock position

For other parts, refer to proper installation procedure.

VALVE SPRING

Removal

Remove:

- rocker arms
- cylinder head.

Compress valve springs no. 22 and no. 23. Use valve spring compressor clamp (P/N 529 035 724) and valve spring compressor cup (P/N 529 035 725).



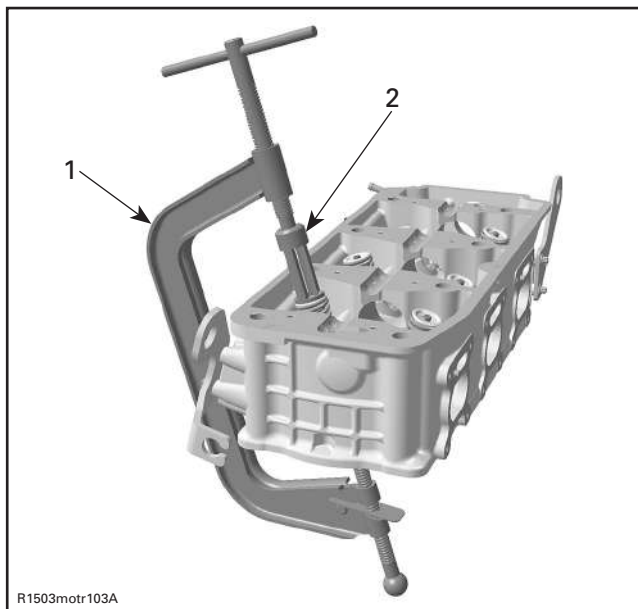
## Section 01 ENGINES (1503 4-TEC)

### Subsection 06 (CYLINDER HEAD)

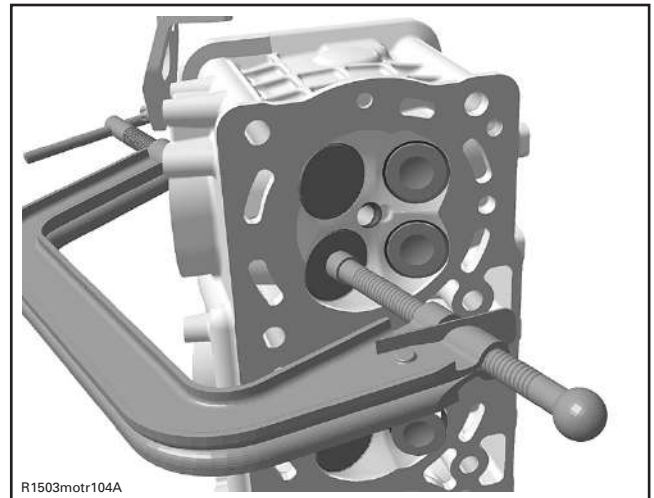


#### **WARNING**

Always wear safety glasses when disassembling valve springs. Be careful when unlocking valves. Components could fly away because of the strong spring preload.



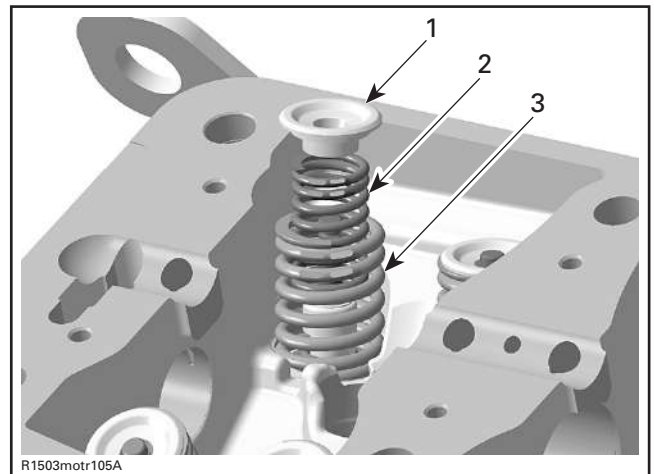
1. Valve spring compressor clamp
2. Valve spring compressor cup



LOCATE VALVE SPRING COMPRESSOR CLAMP IN CENTER OF THE VALVE

Remove valve cotters no. 24.

Withdraw valve spring compressor, valve spring retainer no. 25 and valve springs.



1. Valve spring retainer
2. Inner valve spring
3. Outer valve spring

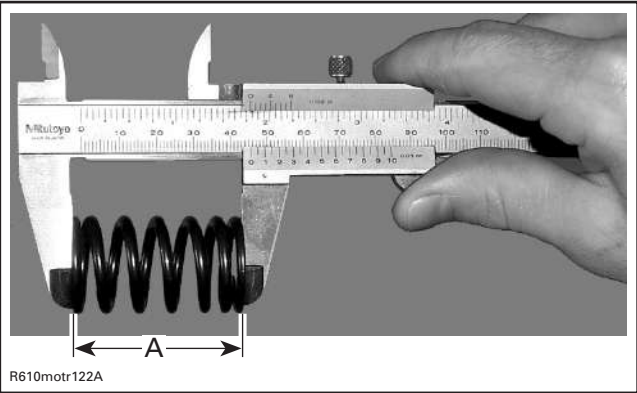
#### Inspection

Check valve springs for rust, corrosion or other visible damages. If so, replace faulty valve springs.

Check valve springs for free length and straightness.

Replace valve springs if not within specifications.

Section 01 ENGINES (1503 4-TEC)  
Subsection 06 (CYLINDER HEAD)



A. Valve spring length

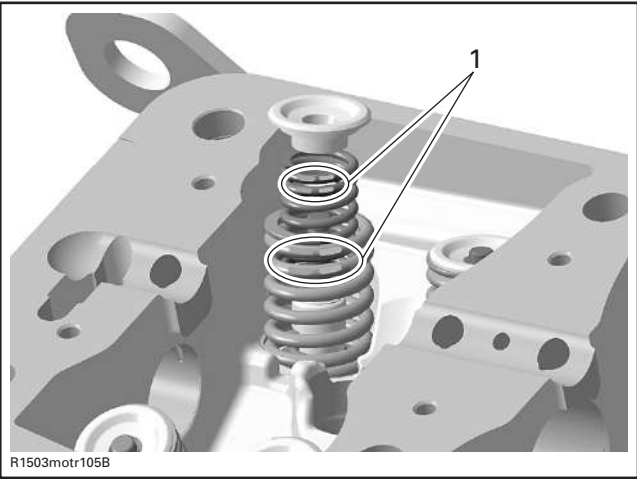
OUTER VALVE SPRING FREE LENGTH	
NEW NOMINAL	45.45 mm (1.789 in)
SERVICE LIMIT	43 mm (1.693 in)
INNER VALVE SPRING FREE LENGTH	
NEW NOMINAL	41.02 mm (1.615 in)
SERVICE LIMIT	38.8 mm (1.499 in)

Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Colored area of the valve spring must be placed on top.

**NOTE:** Valve cotters must be properly engaged in valve stem grooves.



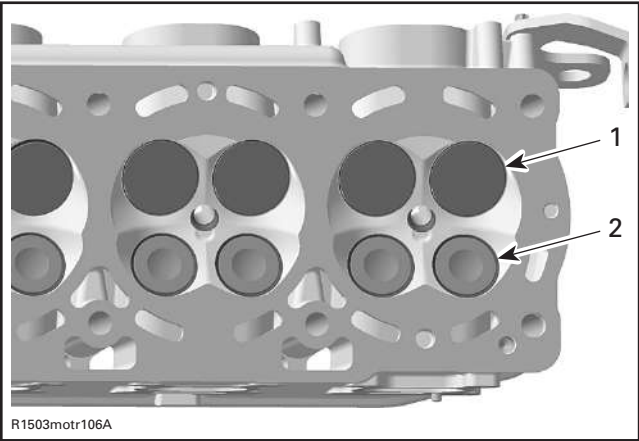
1. Position of the valve spring

VALVE

Removal

Remove valve spring.

Push valve stem then pull valves no. 26 and no. 27 out of valve guides.



1. Intake valve 38 mm  
2. Exhaust valve 31 mm

Remove valve stem seal no. 28 with special pliers such as Snap-on YA 8230.



### Inspection

#### Valve Stem Seal

Inspection of valve stem seals is not needed because new seals should always be installed whenever cylinder head is removed.

#### Valve

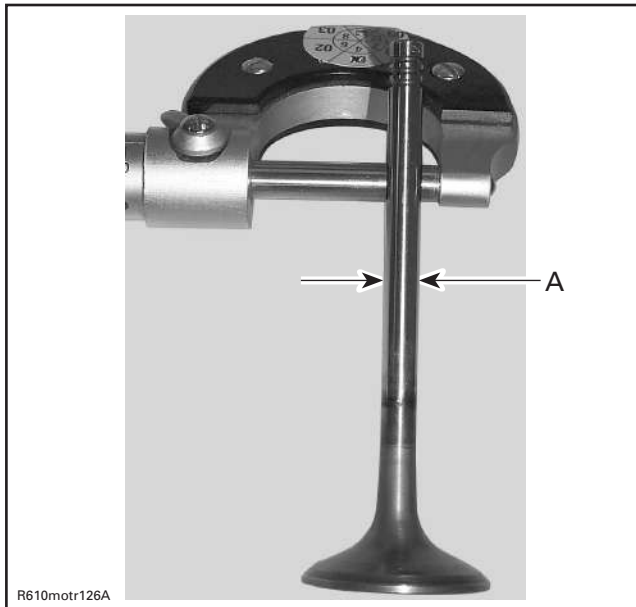
Inspect valve surface, check for abnormal stem wear and bending. If so, replace by a new one.

#### Valve Stem and Valve Guide Clearance

Measure valve stem and valve guide in three places, using a micrometer and a small bore gauge.

**NOTE:** Clean valve guide to remove carbon deposits before measuring.

Change valve if valve stem is out of specification or has other damages such as wear or friction surface.



A. Valve stem diameter

VALVE STEM DIAMETER	
NEW MINIMUM	
Exhaust	5.946 mm (.2341 in)
Intake	5.961 mm (.2347 in)
NEW MAXIMUM	
Exhaust	5.960 mm (.2346 in)
Intake	5.975 mm (.2352 in)
SERVICE LIMIT	
Exhaust	5.93 mm (.233 in)
Intake	

Replace valve guide if it is out of specification or has other damages such as wear or friction surface. Refer to valve guide replacement below.

VALVE GUIDE DIAMETER	
NEW MINIMUM	
Exhaust	5.994 mm (.2359 in)
Intake	
NEW MAXIMUM	
Exhaust	6.018 mm (.2369 in)
Intake	
SERVICE LIMIT	
Exhaust	6.060 mm (.2386 in)
Intake	

#### Valve Guide Replacement

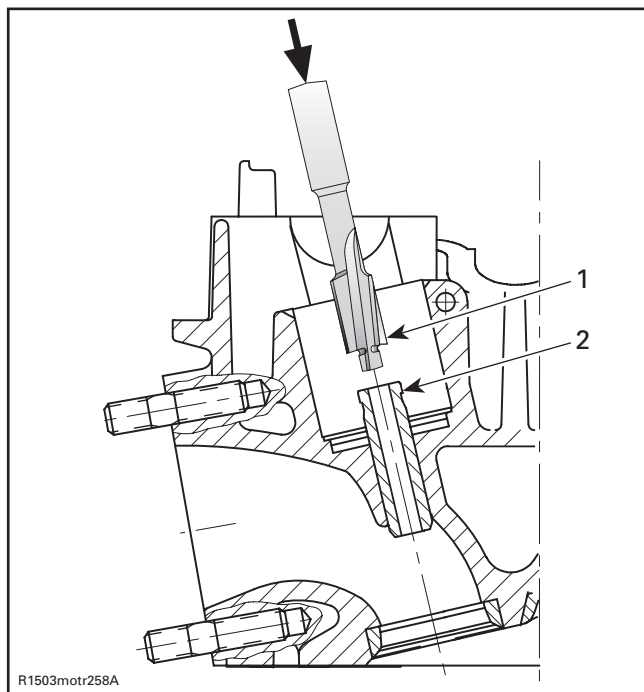
**CAUTION:** Do not heat cylinder head for this procedure.

**CAUTION:** The sharp edge near the top of the valve guide must be machined away. Otherwise it will foul the valve guide hole in the cylinder head and destroy the cylinder head, as the valve guide is removed.

Use a special reamer as far as the top of the notch.

## Section 01 ENGINES (1503 4-TEC)

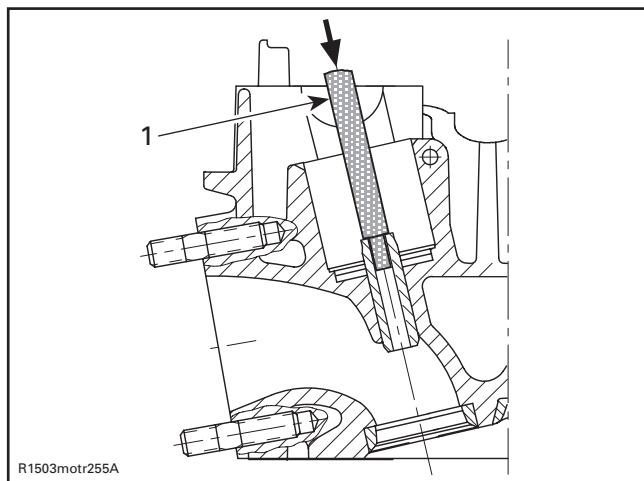
### Subsection 06 (CYLINDER HEAD)



#### TYPICAL

1. Special reamer
2. Notch

Chase valve guide out of the cylinder head towards combustion chamber by using a suitable punch.



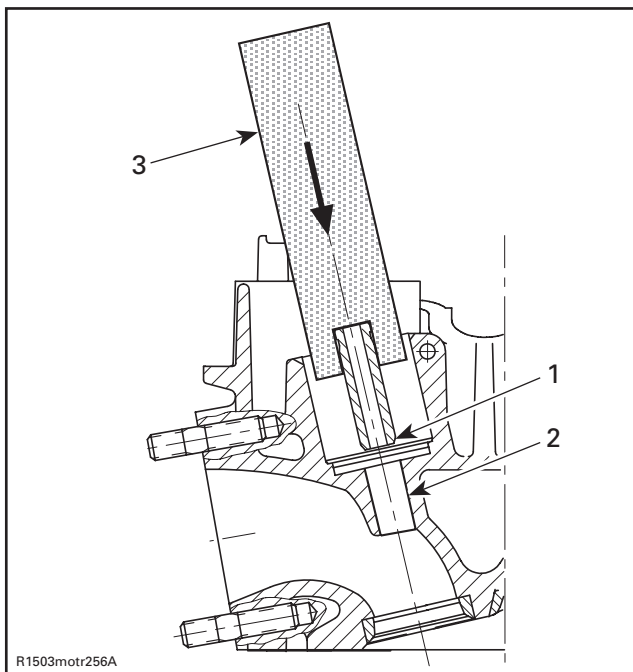
#### TYPICAL

1. Punch

Check valve guide bore for abraded material. The inlet and exhaust valve guides have the same length and are interchangeable.

**NOTE:** If valve guide has caused scoring during extraction, replace the cylinder head.

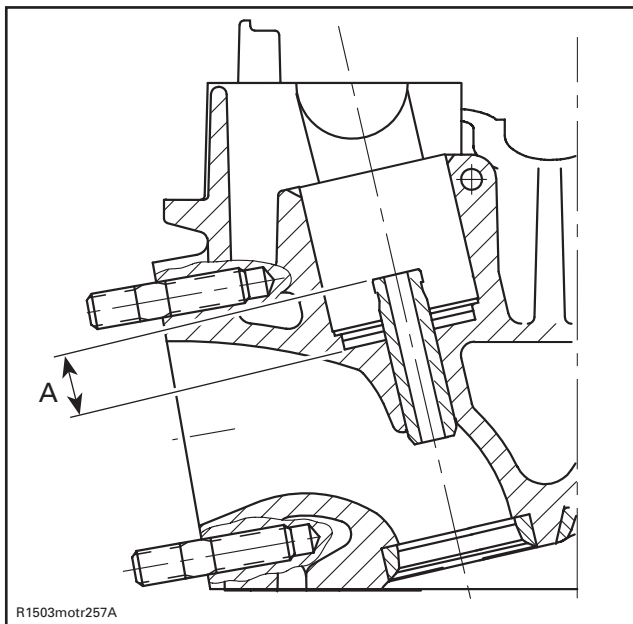
Grease the bore in cylinder head and the leading end of valve guide with Molykote G-N paste (P/N 413 703 700).



#### TYPICAL

1. Valve guide leading end
2. Cylinder head bore
3. Jig

With a suitable jig press the valve guide into the cold cylinder head as shown.



#### TYPICAL

- A. Protrusion

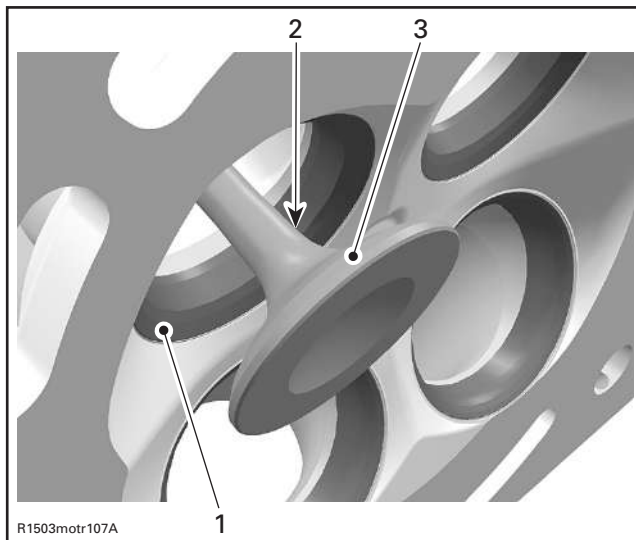
VALVE GUIDE PROTRUSION	
MINIMUM	12.4 mm (.4882 in)
MAXIMUM	12.8 mm (.5039 in)

**NOTE:** For lubrication of the reamer use only cutting oil. Turn the reamer only forward, in cutting direction, never backward. Clean the reamer at short intervals from swarf, moving the reamer only while turning in cutting direction.

Ream the new valve guide with a reamer 6 mm diameter.

Clean cylinder head carefully. Check that the valve seat is concentric with the new guide axis (check contact surface with engineer's blue).

### Valve Face and Seat



1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

Check valve face and seat for burning or pittings and replace valve or cylinder head if there are signs of damage.

Ensure to seat valves properly. Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

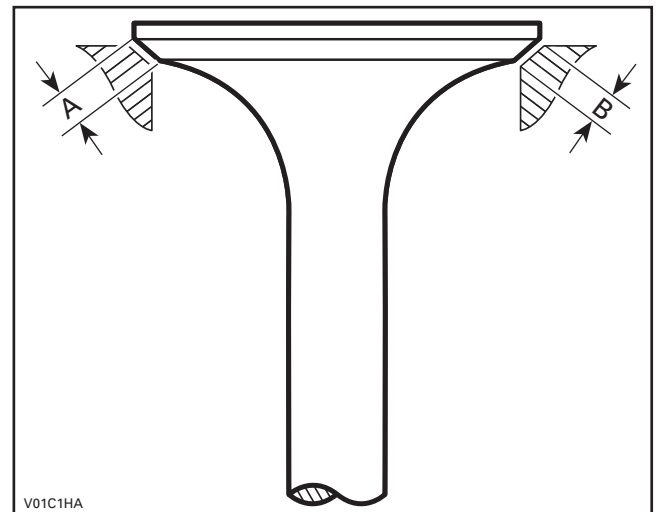
Measure valve face contact width.

**NOTE:** The location of contact area should be in center of valve seat.

Measure valve seat width, using a caliper.

VALVE SEAT CONTACT WIDTH	
NEW	
Exhaust	1.25 to 1.55 mm (.049 to .061 in)
Intake	1.10 to 1.30 mm (.043 to .051 in)
SERVICE LIMIT	
Exhaust	2 mm (.078 in)
Intake	1.8 mm (.07 in)

If valve seat contact width is too wide or has dark spots, replace the cylinder head.



- A. Valve face contact width
- B. Valve seat contact width

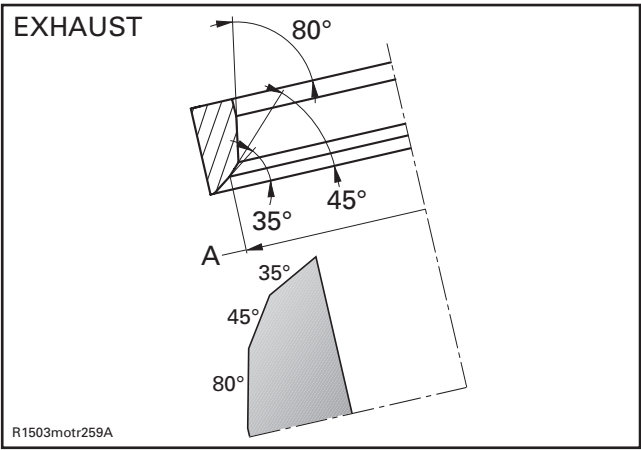
### Valve Seat Grinding

**NOTE:** The valve seats may be reground with a valve seat grinder which centers on the valve guide.

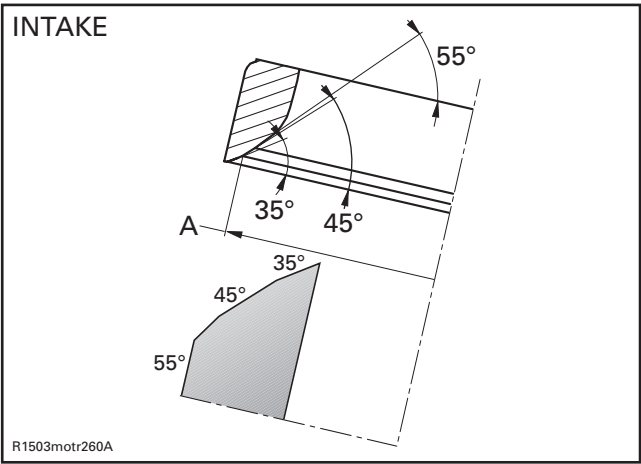
- Grind the valve seat at 45°. Remove no more material than absolutely necessary to clean the seat up.
- Using a 35° stone, narrow the valve seat until the appropriate outer diameter is obtained.



**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 06 (CYLINDER HEAD)**



A. Valve seat outer diameter EXHAUST



A. Valve seat outer diameter INTAKE

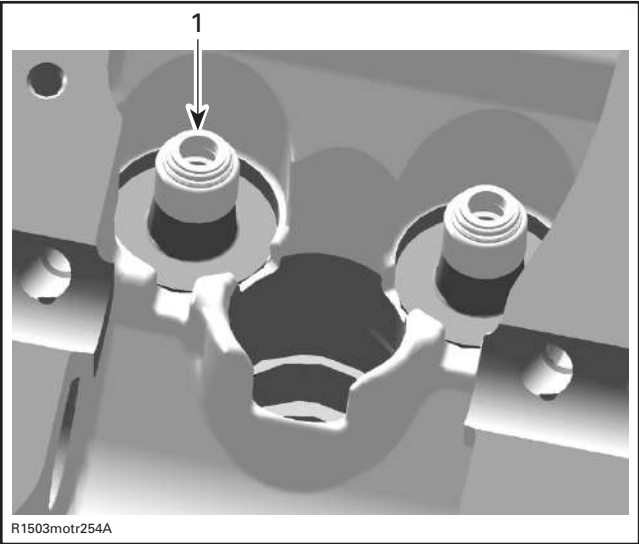
VALVE SEAT OUTER DIAMETER	
Intake	37.35 mm (1.4705 in)
Exhaust	30.3 mm (1.1929 in)

- Using a 55° stone for the intake and an 80° stone for the exhaust valve, reduce the valve seat contact width to the appropriate value mentioned above.
- Finally, coat the valve head sealing seating surface with a fine paste of valve grinding compound using a manual valve grinding mandrel. Lightly grind the valves until a smooth, even, uniform sealing surface of the appropriate inside and outside diameter is obtained on both the valve and the seat. Use only a hand held valve grinding mandrel with a suction cup, rotating the valve back and forth through about 45°, and then advancing the valve 45° before repeating this operation.

**Installation**

For installation, reverse the removal procedure. Pay attention to the following details.

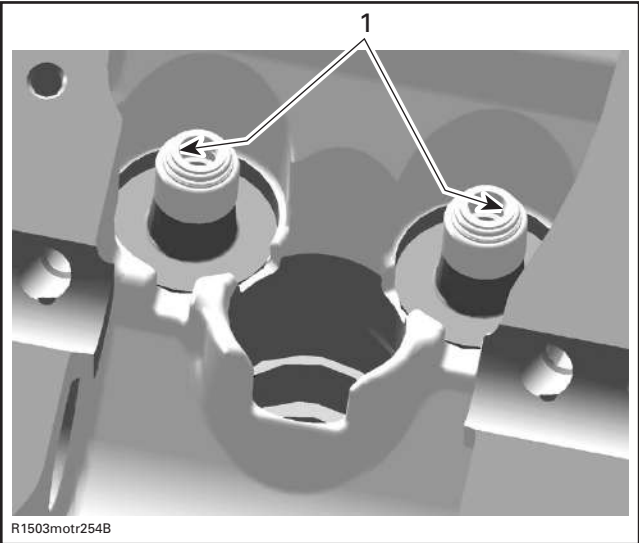
Install valve stem seal no. 28.



1. Valve stem seal

Apply engine oil on valve stem and install it.

**CAUTION:** Be careful when valve stem is passed through sealing lips of valve stem seal.



1. Sealing lips of valve stem seal

To ease installation of cotters, apply oil or grease on them so that they remain in place while releasing the spring.

After spring is installed, ensure it is properly locked by tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

**CAUTION:** An improperly locked valve spring will cause engine damage.

# CYLINDER BLOCK

## SERVICE TOOLS

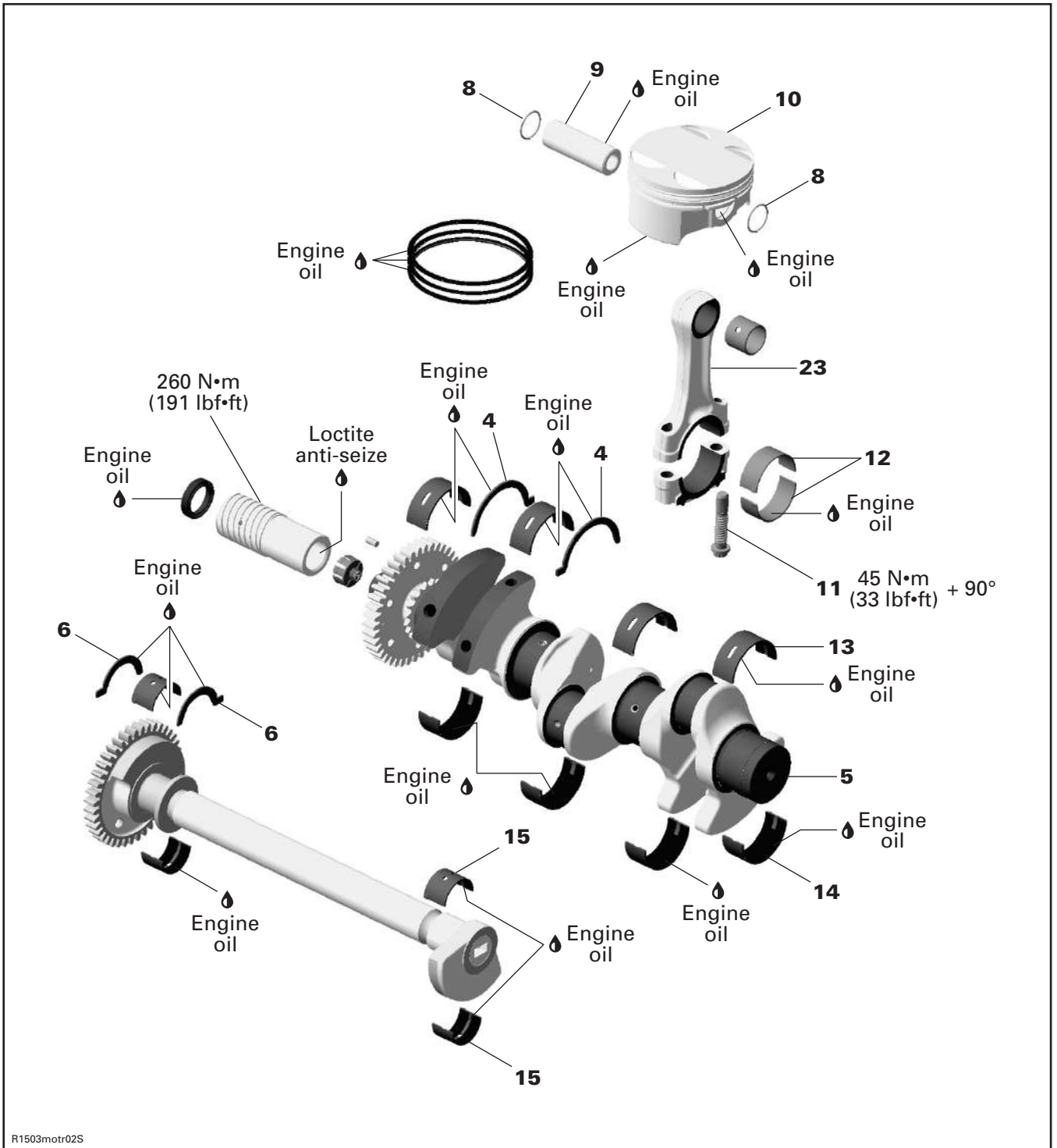
<b>Description</b>	<b>Part Number</b>	<b>Page</b>
crankshaft locking tool.....	529 035 821 .....	100, 104, 107, 112
handle .....	420 877 650 .....	110
piston circlip installer .....	529 035 765 .....	97
pusher.....	420 876 502 .....	110

## SERVICE PRODUCTS

<b>Description</b>	<b>Part Number</b>	<b>Page</b>
chisel gasket remover .....	413 708 500 .....	111
Loctite 243 (blue).....	293 800 060 .....	111
Loctite 5910.....	293 800 081 .....	111

### Subsection 07 (CYLINDER BLOCK)







## Section 01 ENGINES (1503 4-TEC)

### Subsection 07 (CYLINDER BLOCK)

## GENERAL

When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position (cylinder 1, 2 or 3) and to keep them as a "group". If you find a defective component, it would be much easier to find the cause of the failure within the group of parts. Besides, since used parts have matched together during the engine operation, they will keep their matched fit when you reassemble them together within their "group".

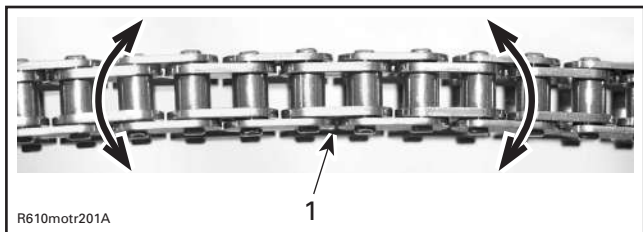
## PROCEDURES

### TIMING CHAIN

#### Inspection

Check timing chain on camshaft gear for excessive radial play.

Check chain condition for wear and rollers condition.



1. Timing chain

If chain is excessively worn or damaged, replace it as a set (camshaft timing gear and timing chain).

#### Removal

Remove:

- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- engine from vehicle (refer to the appropriate *VEHICLE SHOP MANUAL*)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING/MAGNETO section)
- crankshaft (refer to CRANKSHAFT elsewhere in this section)
- timing chain.

#### Installation

The installation is essentially the reverse of the removal procedure but, pay attention to the following details.

Ensure to perform proper valve timing. Lock crankshaft and camshaft at TDC (refer to CYLINDER HEAD section for the camshaft locking procedure).

Install chain then, install chain tensioner.

**CAUTION:** Improper valve timing will damage engine components.

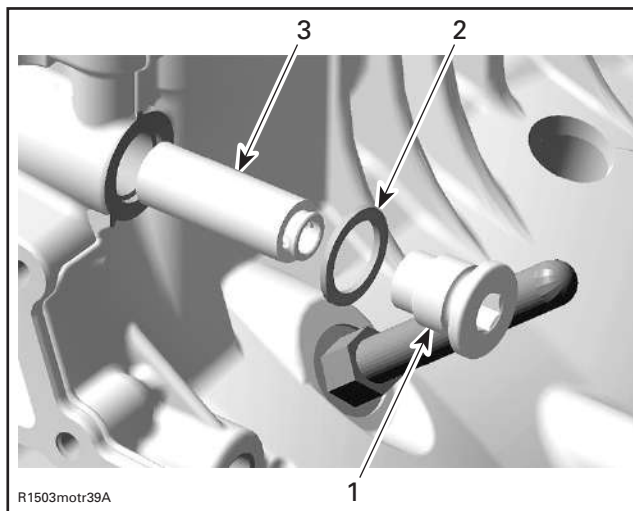
### CHAIN TENSIONER

#### Removal

**NOTE:** Removal of the intake manifold allows easier access to the chain tensioner, but is not necessary. Refer to INTAKE MANIFOLD AND SUPERCHARGER section.

Remove:

- chain tensioner plug screw **no. 18** with gasket ring **no. 19**
- chain tensioner **no. 20**.



- 1. Plug screw
- 2. Gasket ring
- 3. Chain tensioner

#### Inspection

Check chain tensioner for excessive wear or cracks. Also check free movement of the chain tensioner piston.

#### Installation

The installation is essentially the reverse of the removal procedure but, pay attention to the following details.

Torque chain tensioner plug screw to 18 N•m (160 lbf•in).

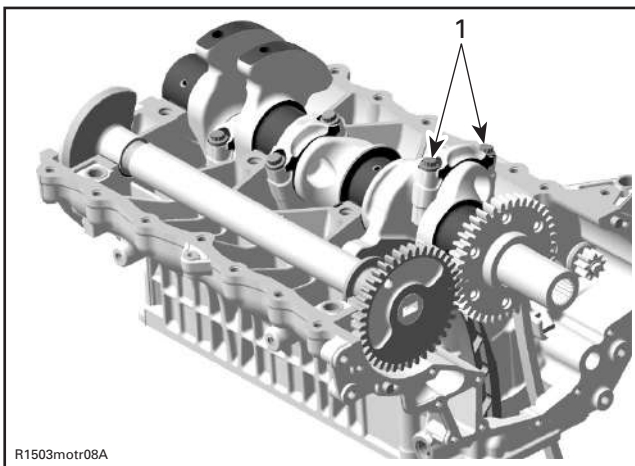
#### PISTON/CONNECTING ROD

##### Removal

Disassemble cylinder block as per procedure in this section. Refer to CYLINDER BLOCK.

**NOTE:** It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to INSPECTION below.

Remove connecting rod cap screws.

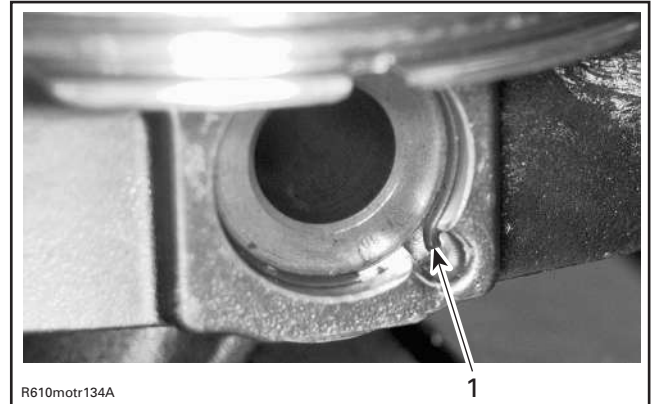


1. Connecting rod screws

**NOTE:** Before removing the connecting rod caps, mark them to remember the right position when reassembling.

Pull piston with connecting rod out of the cylinders.

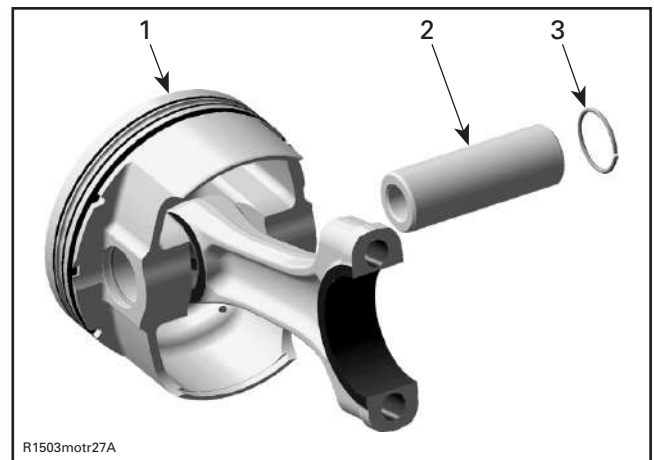
Remove one piston circlip **no. 8** and discard it.



1. Piston circlip

**NOTE:** The removal of both piston circlips is not necessary to remove piston pin.

Push piston pin **no. 9** out of piston.



1. Piston  
2. Piston pin  
3. Circlip

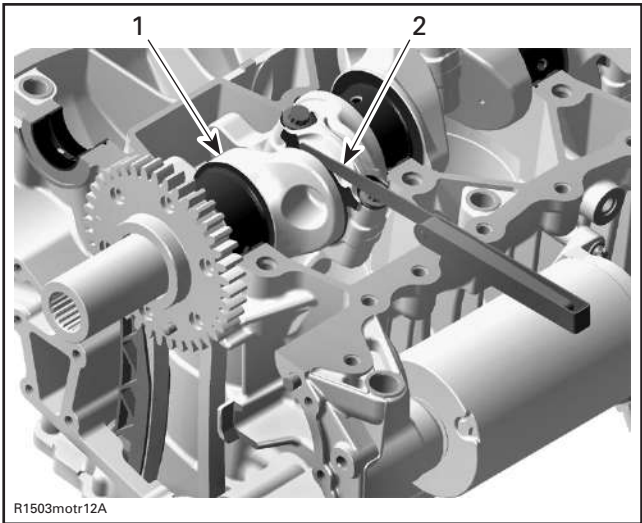
Detach piston **no. 10** from connecting rod.

#### Inspection

##### Connecting Rod Big End Axial Play

Using a feeler gauge, measure distance between butting face of connecting rod and crankshaft counterweight. If the distance exceeds specified tolerance, replace the worn part.

Section 01 ENGINES (1503 4-TEC)  
Subsection 07 (CYLINDER BLOCK)

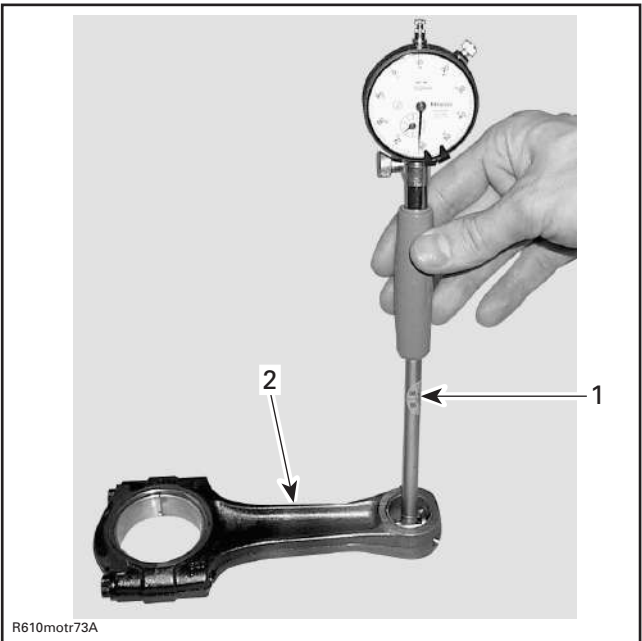


1. Crankshaft  
2. Feeler gauge

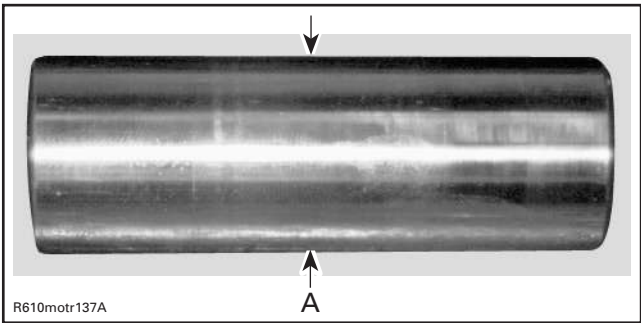
CONNECTING ROD BIG END AXIAL PLAY mm (in)	
NEW MINIMUM	0.150 (.06)
NEW MAXIMUM	0.302 (.01)
SERVICE LIMIT	0.5 (.02)

Connecting Rod/Piston Pin Clearance

Measure piston pin. Compare to inside diameter of connecting rod no. 5.



1. Bore gauge  
2. Connecting rod



A. Piston pin diameter in the area of the bushing

CONNECTING ROD SMALL END DIAMETER mm (in)	
NEW MINIMUM	23.01 (.9059)
NEW MAXIMUM	23.02 (.9063)
SERVICE LIMIT	23.07 (.908)

PISTON PIN DIAMETER mm (in)	
NEW MINIMUM	22.996 (.9053)
NEW MAXIMUM	23.000 (.9055)
SERVICE LIMIT	22.990 (.904)

PISTON PIN BORE CLEARANCE mm (in)	
SERVICE LIMIT	0.080 (.0035)

If the connecting rod small end diameter is out of specification, replace connecting rod.

Connecting Rod Big End Radial Play

Measure inside diameter of connecting rod big end. Compare to crankshaft pin.

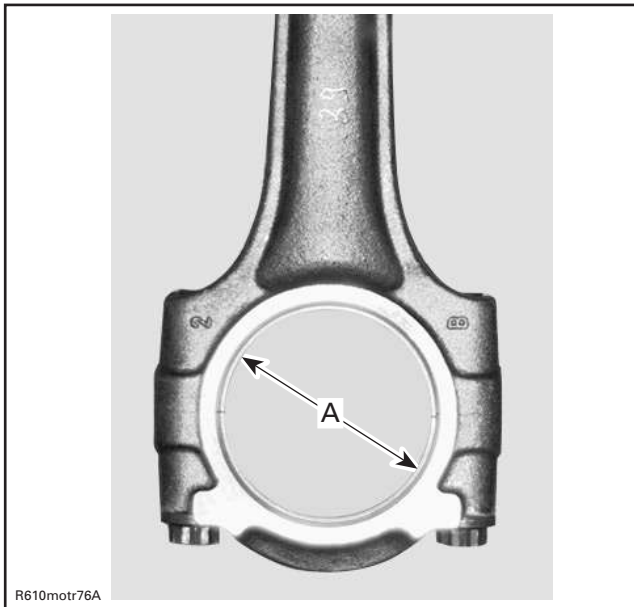
To measure the connecting rod big end diameter, use the OLD screws no. 11.

Install the OLD bearings no. 12 as they were mounted initially.

Do the torque procedure as described below.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 07 (CYLINDER BLOCK)



A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER mm (in)	
SERVICE LIMIT	45.080 (1.774)

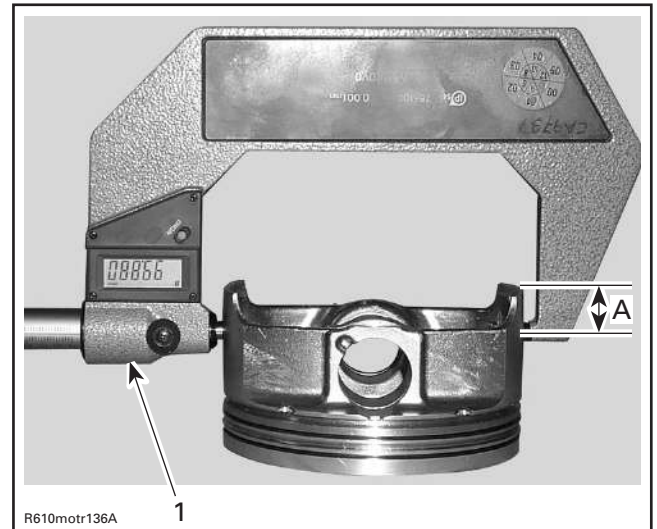
CONNECTING ROD BIG END CLEARANCE mm (in)	
SERVICE LIMIT	0.09 (.0035)

Use NEW bearings **no. 12**, when connecting rod big end diameter is out of specification.

#### Piston

Inspect piston for scoring, cracking or other damages. Replace piston and piston rings if necessary.

Using a micrometer, measure piston at 18 mm (.709 in) perpendicularly (90°) to piston pin axis.



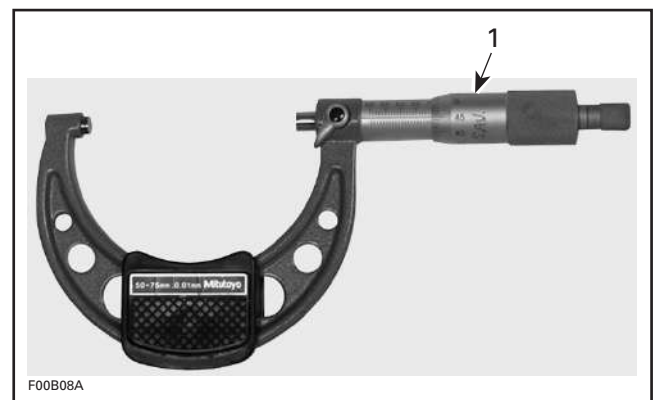
1. Measuring perpendicularly (90°) to piston pin axis  
A. 18 mm (.709 in)

The measured dimension should be as described in the subsequent table. If not, replace piston.

PISTON MEASUREMENT mm (in)	
NEW NOMINAL	99.951 to 99.969 (3.935 to 3.936)
SERVICE LIMIT	99.80 (3.929)

#### Piston/Cylinder Wall Clearance

Adjust and lock a micrometer to the piston dimension.



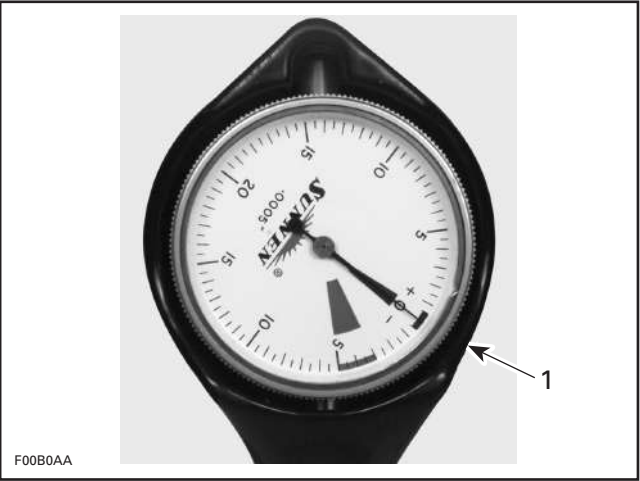
1. Micrometer set to the piston dimension

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

Section 01 ENGINES (1503 4-TEC)  
Subsection 07 (CYLINDER BLOCK)



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



- TYPICAL**  
1. Indicator set to 0 (zero)

Position the dial bore gauge 62 mm (2.44 in) above cylinder base, measuring perpendicularly (90°) to piston pin axis.  
Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance.

PISTON/CYLINDER CLEARANCE mm (in)	
NEW NOMINAL	0.024 to 0.056 (.0009 to.0022)
SERVICE LIMIT	0.090 (.004)

**NOTE:** Make sure used piston is not worn.

If clearance exceeds specified tolerance, rehone cylinder sleeve and replace piston ass'y by an oversize one.  
**NOTE:** It is not necessary to have all pistons replaced with an oversize if they are not all out of specification. Mixed standard size and oversize piston are allowed.

**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.

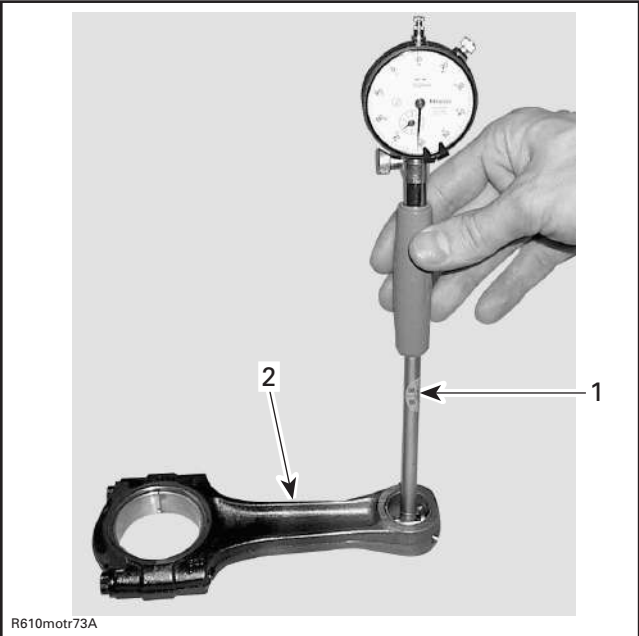
**Piston Pin**

Using synthetic abrasive woven, clean piston pin from deposits.  
Inspect piston pin for scoring, cracking or other damages.

Measure piston pin. See the following illustration for the proper measurement positions.

**Piston Pin/Connecting Rod Bearing Clearance**  
Measure inside diameter of connecting rod.

CONNECTING ROD SMALL END DIAMETER mm (in)	
NEW MINIMUM	23.01 (.9059)
NEW MAXIMUM	23.02 (.9063)
SERVICE LIMIT	23.07 (.908)



1. Bore gauge  
2. Connecting rod



#### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Apply engine oil on the piston pin.

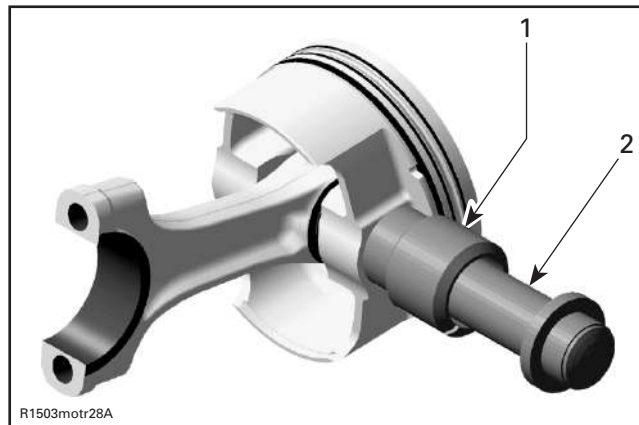
Insert piston pin into piston and connecting rod.

Use the piston circlip installer (P/N 529 035 765) to assemble the piston circlip.



**CAUTION:** Secure piston pin with new piston circlips.

**NOTE:** Take care that the hook of the piston circlip is positioned properly.

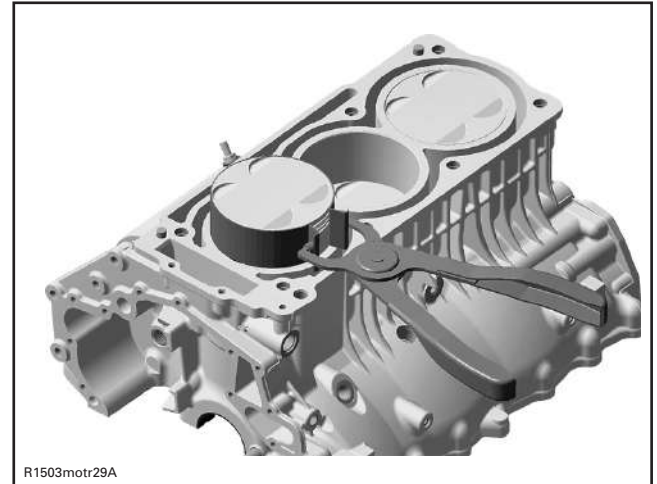


1. Sleeve with piston circlip inside
2. Assembly jig from piston clip installer

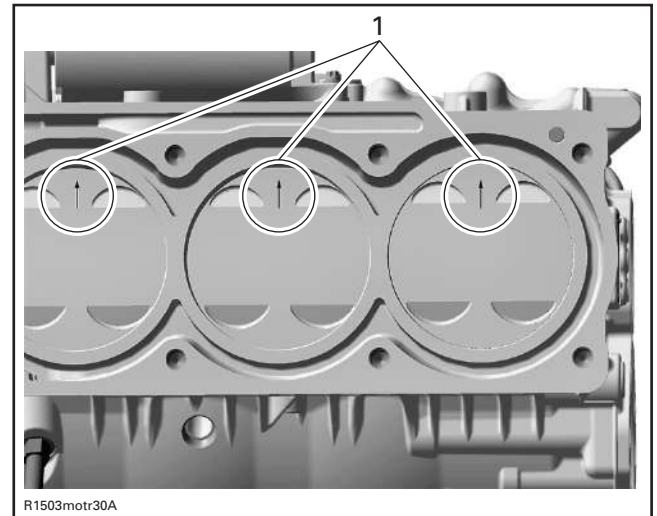


CORRECT POSITION OF THE PISTON CIRCLIP

Using piston ring compressor pliers, such as Snap-On RC-980, slide piston into cylinder.



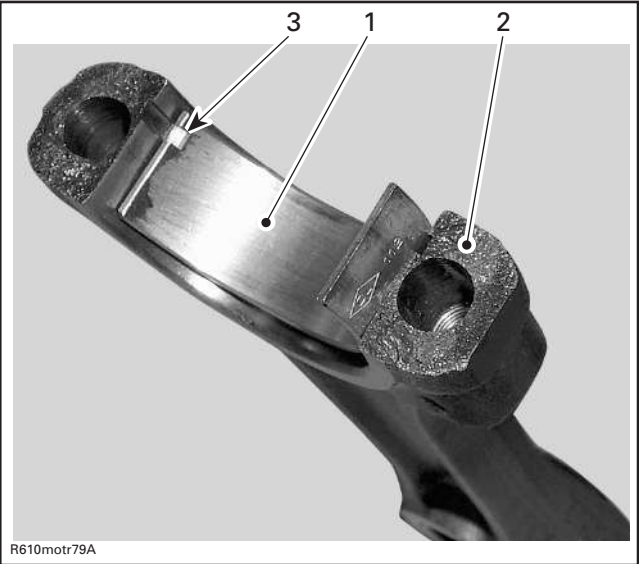
**CAUTION:** Install piston with punched arrow toward exhaust side.



1. Arrow toward exhaust side

Correctly install bearings and carefully clean split surface on both sides (cracked area).

Section 01 ENGINES (1503 4-TEC)  
Subsection 07 (CYLINDER BLOCK)

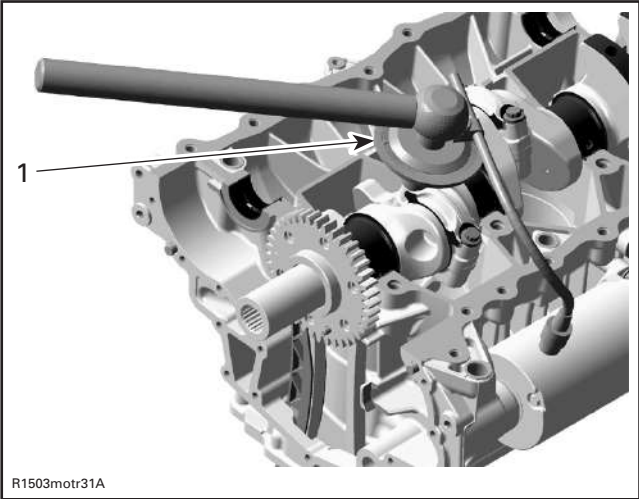


- 1. Half bearing of connecting rod big end
- 2. Split surface of the connecting rod
- 3. Protrusion of bearing in line with connecting rod groove

Torque NEW connecting rod screws no. 11 as per following procedure:

- Install screws and torque to 45 N•m (33 lbf•ft). Do not apply any thread locker product.
- Finish tightening the screws with an additional 90° turn using an angle torque wrench.

**CAUTION:** Failure to strictly follow this procedure may cause screw to loosen and lead to engine damage. Knowing that the screws have been stretched from the previous installation, it is very important to use new screws at assembly.



- 1. Angle torque wrench

PISTON RINGS

Removal

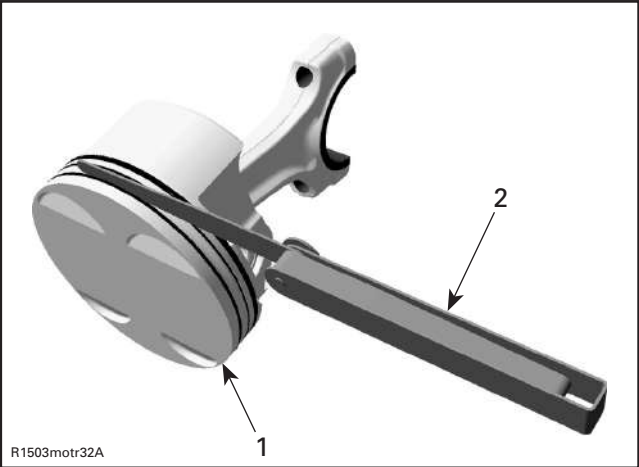
Remove piston ass'y as described above.  
Remove rings.

Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance. If the clearance is too large, the piston and the piston rings should be replaced.

RING/PISTON GROOVE CLEARANCE mm (in)	
NEW MINIMUM	
RECTANGULAR	0.025 (.001)
TAPER-FACE	0.015 (.0006)
OIL SCRAPER RING	0.020 (.0008)
NEW MAXIMUM	
RECTANGULAR	0.070 (.0028)
TAPER-FACE	0.060 (.0024)
OIL SCRAPER RING	0.055 (.0021)
SERVICE LIMIT	
ALL	0.15 (.006)



- 1. Piston
- 2. Filler gauge

### Ring End Gap

RING END GAP mm (in)	
NEW MINIMUM	
RECTANGULAR	0.35 (.014)
TAPER-FACE	
OIL SCRAPER RING	
NEW MAXIMUM	
RECTANGULAR	0.50 (.020)
TAPER-FACE	
OIL SCRAPER RING	
SERVICE LIMIT	
ALL	1 (.04)

Measure position for ring end gap in the area of 8 to 16 mm (.315 to .630 in) from top of cylinder.

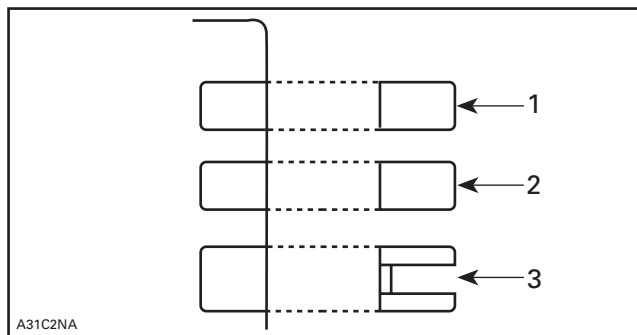
**NOTE:** In order to correctly position the ring in the cylinder, use piston as a pusher.

Using a feeler gauge, check ring end gap. Replace ring if gap exceeds above described specified tolerance.

### Installation

For installation, reverse the removal procedure. Pay attention to the following details.

Install the oil scraper ring first, then the taper-face ring with the word "TO" facing up, then the rectangular ring with the word "T" facing up.



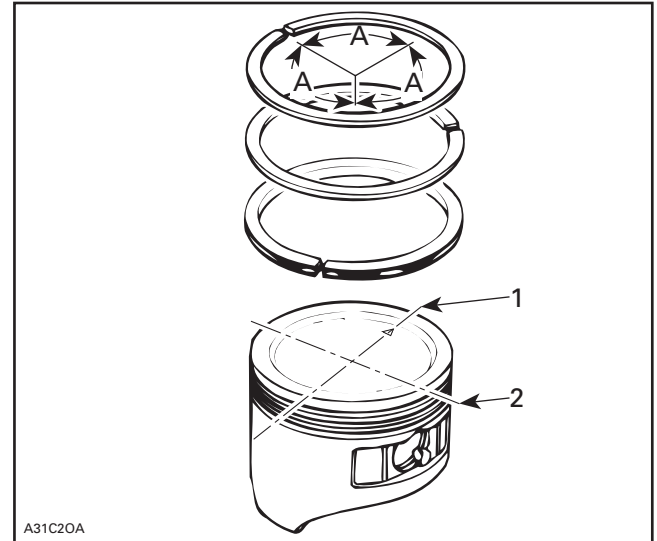
1. Rectangular ring
2. Taper-face ring
3. Oil scraper ring

**CAUTION:** Ensure that top and second rings are not interchanged

**NOTE:** Use a ring expander to prevent breakage during installation. The oil ring must be installed by hand.

Check that rings rotate smoothly after installation.

Space the piston ring end gaps 120° apart and do not align the gaps with the piston pin bore or the thrust side axis.



1. DO NOT align ring gap with piston thrust side axis
2. DO NOT align ring gap with piston pin bore axis
- A. 120°

## CRANKSHAFT

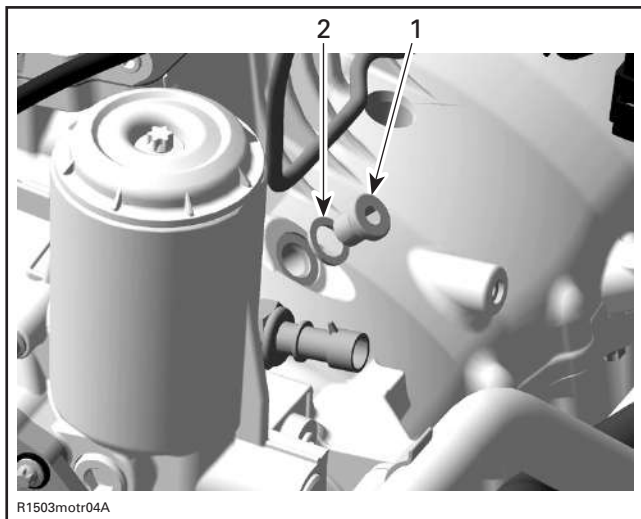
### Crankshaft Locking

Remove:

- intake manifold (refer to INTAKE MANIFOLD AND SUPERCHARGER section)
- fuel rail cover
- spark plugs
- plug screw.

## Section 01 ENGINES (1503 4-TEC)

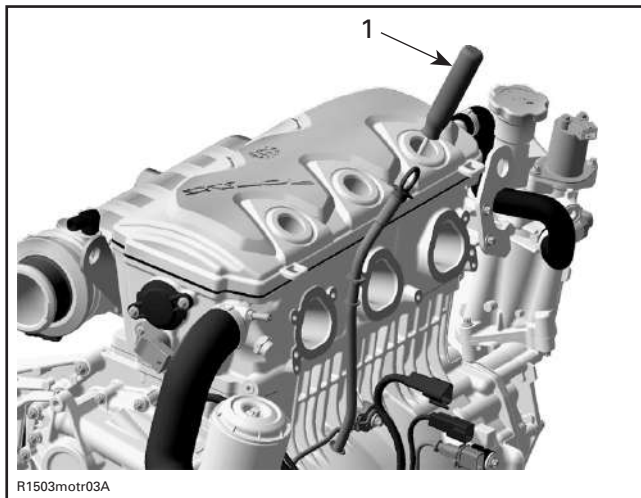
### Subsection 07 (CYLINDER BLOCK)



#### TYPICAL

1. Plug screw
2. Gasket ring

Put a screwdriver or similar tool into the spark plug hole of cylinder **no. 3** and feel when the piston reaches TDC.



#### TYPICAL

1. Screwdriver

In this position, the crankshaft can be locked by using crankshaft locking tool (P/N 529 035 821).

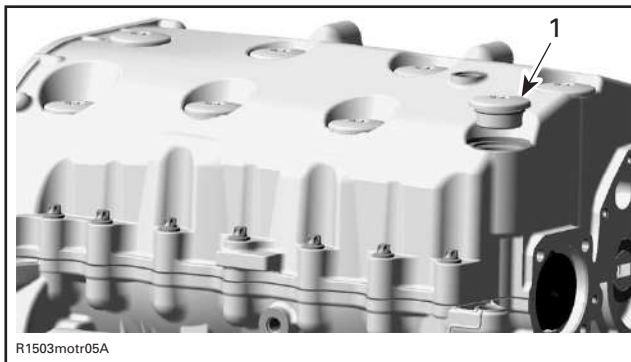


When finished, reinstall all removed parts.

## Removal

Remove:

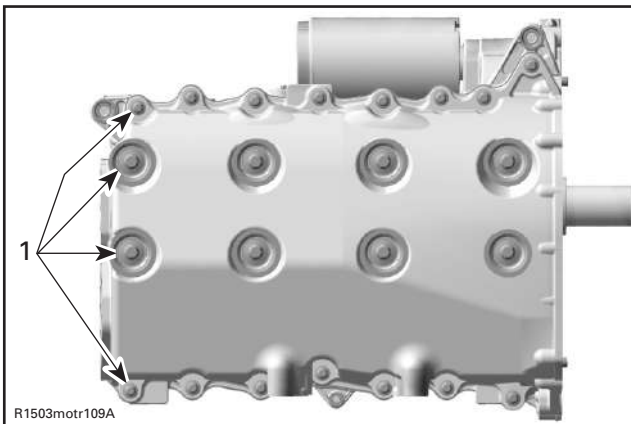
- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- engine from vehicle (refer to the appropriate *VEHICLE SHOP MANUAL*)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING/MAGNETO section)
- starter gear (refer to PTO HOUSING/MAGNETO section)
- starter drive ass'y
- oil suction pump with oil separator ass'y (refer to LUBRICATION section)
- engine mounting brackets
- oil tank plug screws **no. 1** with O-ring **no. 2**



#### ENGINE UPSIDE DOWN

1. Oil tank plug screw with O-ring

- cylinder block screws **no. 3** and **no. 7**



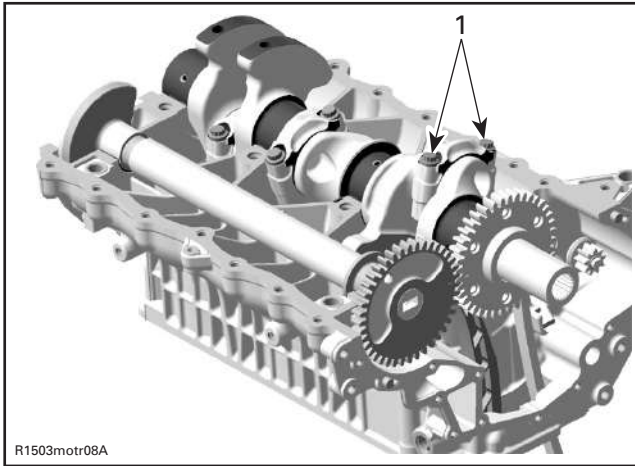
#### BOTTOM VIEW OF ENGINE

1. Screws

- cylinder block lower half

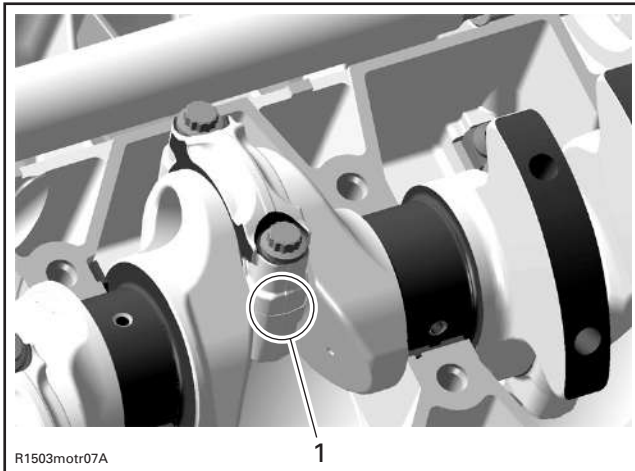


– connecting rod screws



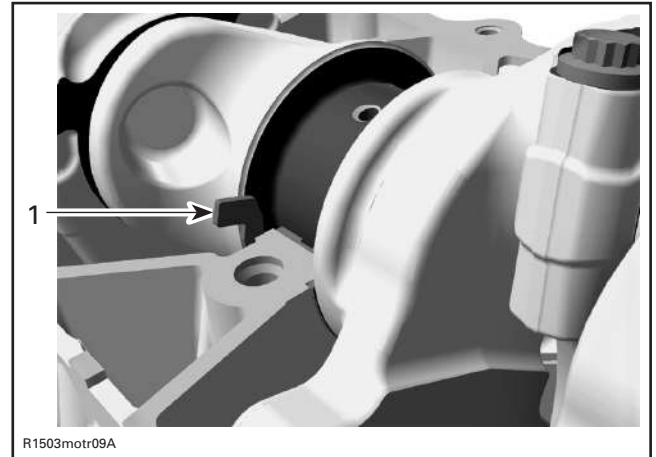
1. Connecting rod screws

**NOTE:** Before removing the connecting rod caps, mark them to remember the right position when reassembling. It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to PISTON/CONNECTING ROD in this section for the procedure.



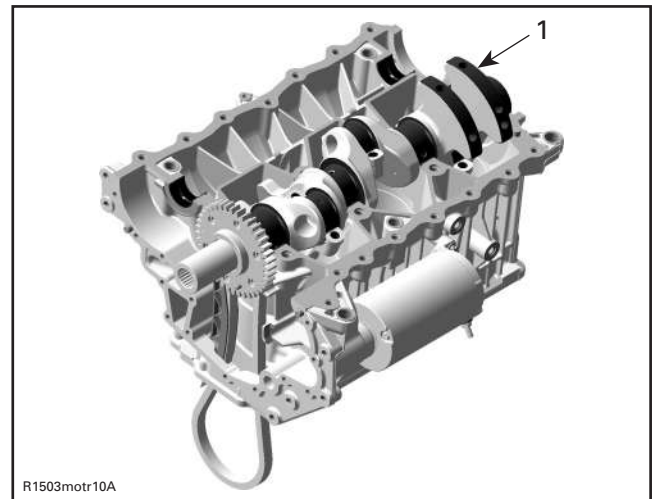
1. Mark on connecting rod

– thrust washers no. 4



1. Thrust washer

– crankshaft no. 5.



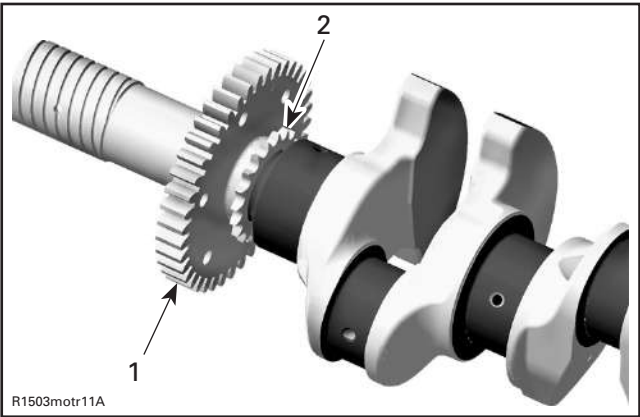
1. Crankshaft

### Inspection

Replace crankshaft if the gears are worn or otherwise damaged.



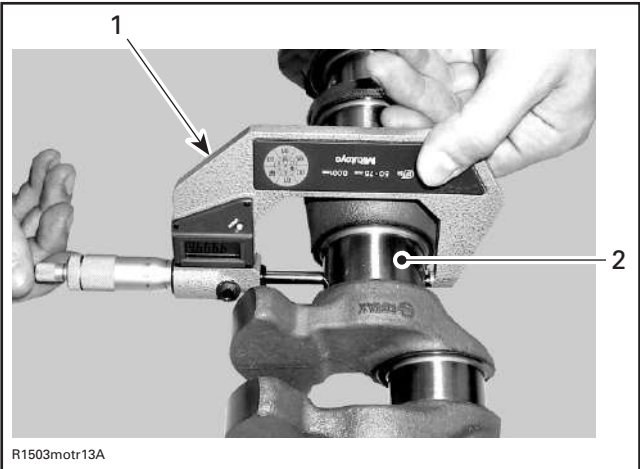
Section 01 ENGINES (1503 4-TEC)  
Subsection 07 (CYLINDER BLOCK)



1. Balancer gear  
2. Crankshaft timing gear

Crankshaft Radial Play

Measure all crankshaft journals. Compare to inside diameter of crankshaft bearings (elsewhere in this section).



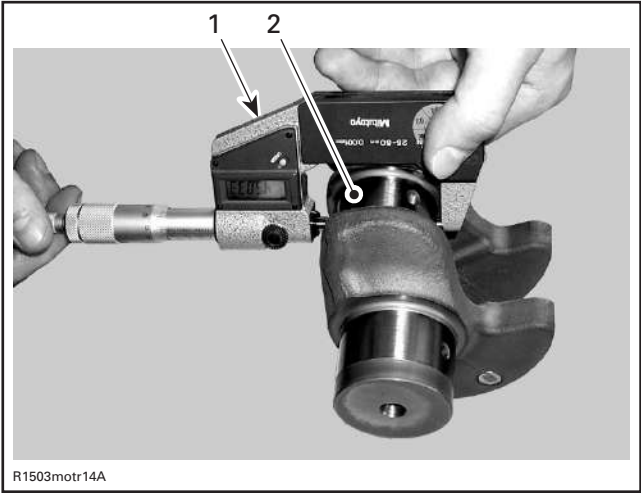
1. Micrometer  
2. Crankshaft area for bearing

CRANKSHAFT JOURNAL DIAMETER mm (in)	
NEW MINIMUM	49.991 (1.9681)
NEW MAXIMUM	50.01 (1.9689)
SERVICE LIMIT	49.95 (1.9665)

CRANKSHAFT JOURNAL RADIAL CLEARANCE mm (in)	
SERVICE LIMIT	0.07 (.0028)

Crankshaft Pin

Measure all crankshaft pin diameters. Compare to inside diameter of connecting rod bearings (elsewhere in this section).



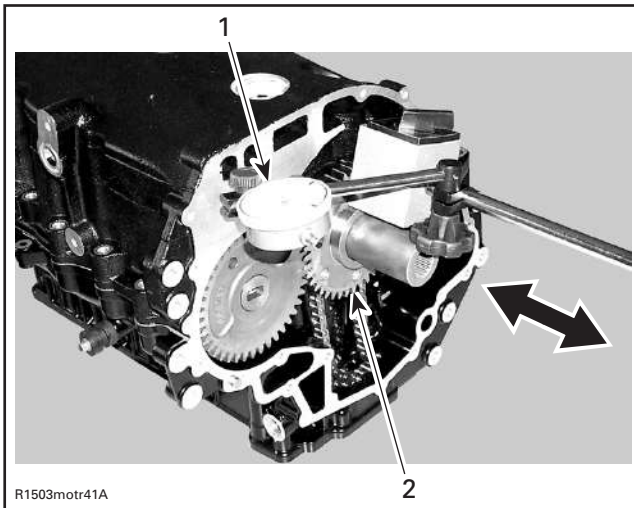
1. Micrometer  
2. Crankshaft pin area for bearing

CRANKSHAFT PIN DIAMETER mm (in)	
NEW MINIMUM	45.032 (1.7729)
NEW MAXIMUM	45.048 (1.7735)
SERVICE LIMIT	45.029 (1.7728)

CRANKSHAFT PIN RADIAL CLEARANCE mm (in)	
SERVICE LIMIT	0.09 (.0035)

Crankshaft Axial Clearance

When assembling the cylinder-block, measure the crankshaft axial clearance:



1. Dial gauge
2. Crankshaft

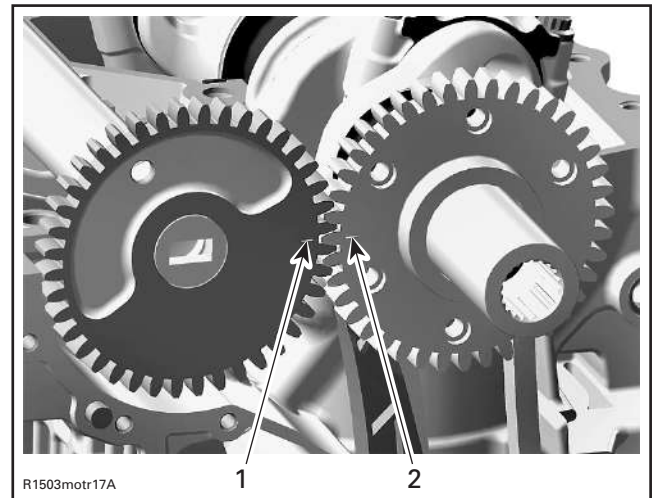
CRANKSHAFT AXIAL CLEARANCE mm (in)	
NEW MINIMUM	0.08 (.003)
NEW MAXIMUM	0.22 (.009)
SERVICE LIMIT	0.35 (.014)

#### Installation

For installation, reverse the removal procedure. Pay attention to following details.

**NOTE:** Before installing the crankshaft, make sure that the timing chain is on the crankshaft and the chain guide has been installed first. Those parts cannot be installed when the crankshaft is in place.

**CAUTION:** Crankshaft and balancer shaft marks have to be aligned.



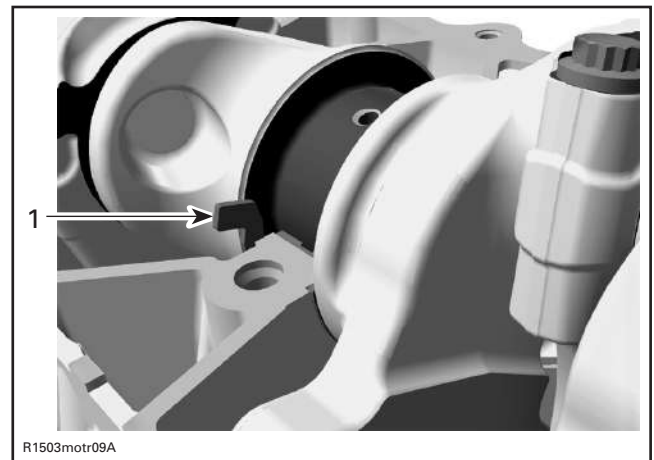
1. Mark on balancer shaft
2. Mark on crankshaft

For correct installation of the connecting rods, refer to PISTON/CONNECTING ROD in this section.

**CAUTION:** It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.

**CAUTION:** Never forget thrust washers no. 4 on center of crankshaft to control axial adjustment.

Insert thrust washers as soon as crankshaft is in place as per following illustration.



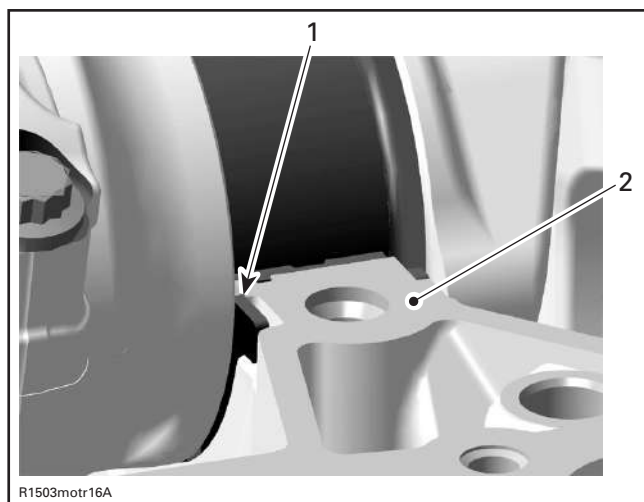
#### THRUST WASHER INSERT DIRECTION

1. Thrust washer

**CAUTION:** Thrust washers have to be flush with the cylinder block sealing surface.

## Section 01 ENGINES (1503 4-TEC)

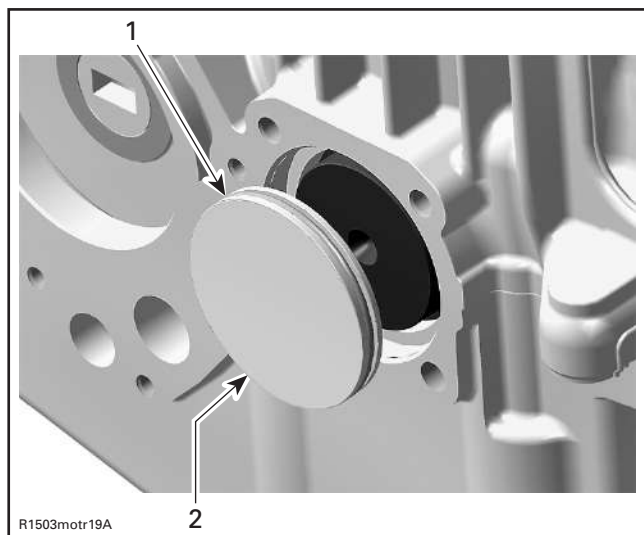
### Subsection 07 (CYLINDER BLOCK)



1. Thrust washer
2. Sealing surface

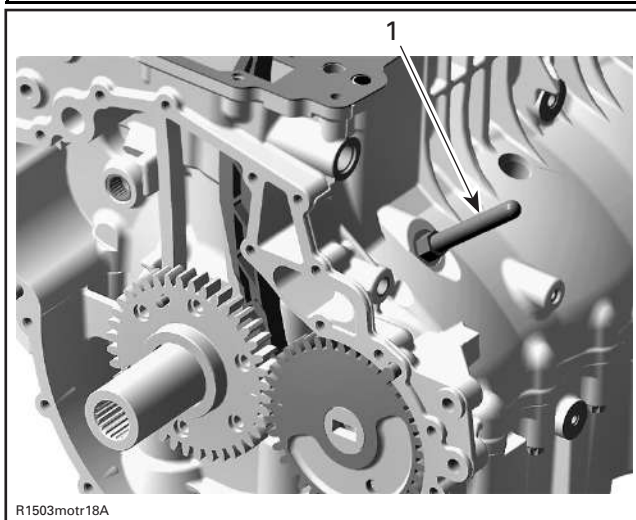
Install cylinder block lower half. Refer to CYLINDER BLOCK in this section.

Install the crankshaft cover before mounting the engine bracket. Apply oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.



1. O-ring
2. Crankshaft cover

**CAUTION:** Install crankshaft locking tool (P/N 529 035 821) right away to position crankshaft at TDC before installing the camshaft and rockers (refer to CYLINDER HEAD).



1. Crankshaft locking tool

## BALANCER SHAFT

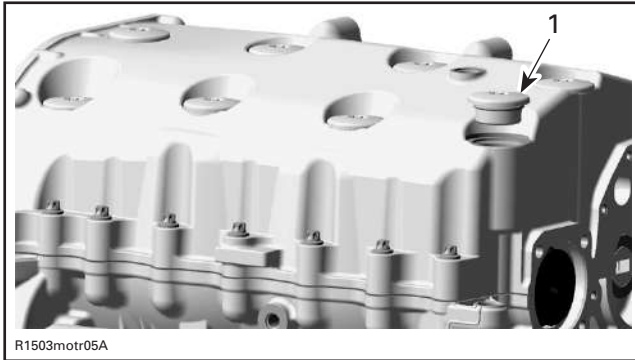
### Removal

Remove:

- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- engine from vehicle (refer to the appropriate *VEHICLE SHOP MANUAL*)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING/MAGNETO section)
- starter gear (refer to PTO HOUSING/MAGNETO section)
- starter drive ass'y
- oil suction pump with oil separator ass'y (refer to LUBRICATION section)
- engine mounting brackets
- oil reservoir plug screws **no. 1** with O-ring **no. 2**

## Section 01 ENGINES (1503 4-TEC)

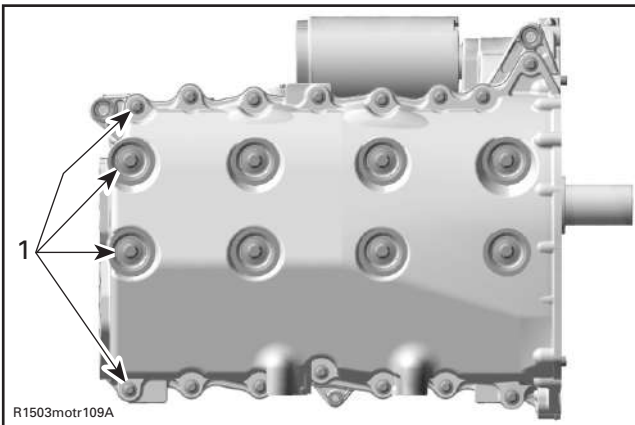
### Subsection 07 (CYLINDER BLOCK)



#### ENGINE UPSIDE DOWN

1. Oil reservoir plug screw with O-ring

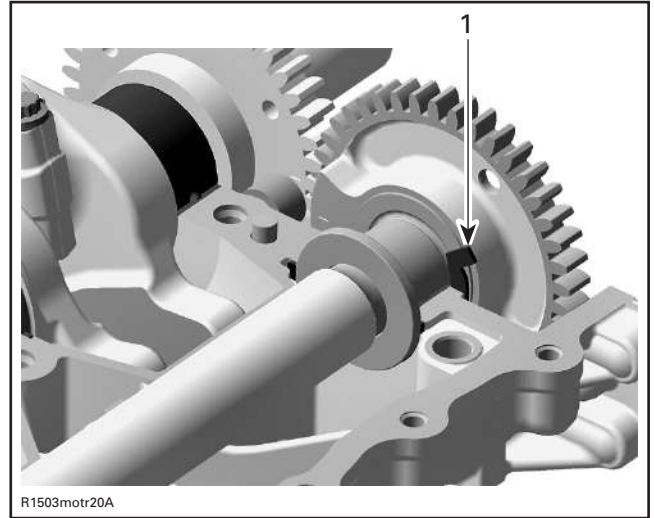
– cylinder block screws no. 3



1. Screws

– cylinder block lower half

– thrust washers no. 6



1. Thrust washer

– balancer shaft.

#### Inspection

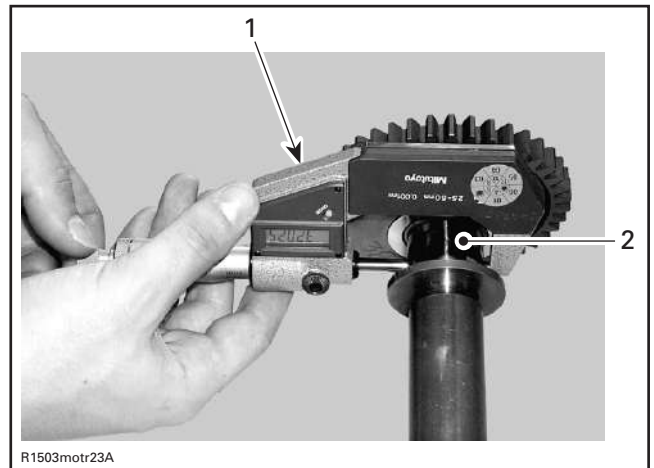
Check balancer shaft and replace if damaged.

If the gear on the balancer shaft is damaged, replace balancer shaft.

Check gear on the crankshaft at the same time and replace crankshaft if necessary (refer to CRANK-SHAFT above).

#### Balancer Shaft Bearing Seat Play

Measure all balancer shaft bearing seats. Compare to inside diameter of balancer shaft bearings (elsewhere in this section).



1. Micrometer

2. Balancer shaft area for bearing



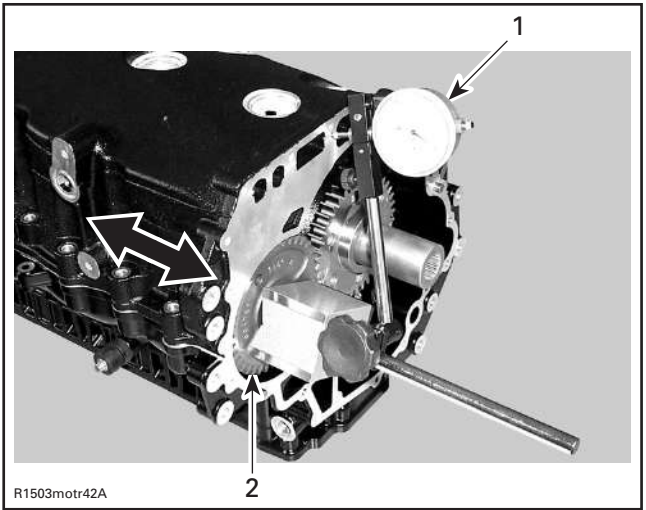
Section 01 ENGINES (1503 4-TEC)  
Subsection 07 (CYLINDER BLOCK)

BALANCER SHAFT SEAT DIAMETER mm (in)	
NEW MINIMUM	31.984 (1.2592)
NEW MAXIMUM	32.000 (1.2598)
SERVICE LIMIT	31.960 (1.2583)

BALANCER SHAFT SEAT RADIAL CLEARANCE mm (in)	
SERVICE LIMIT	0.07 (.0028)

Balancer Shaft Axial Clearance

When assembling the cylinder-block, measure the balance shaft axial play:



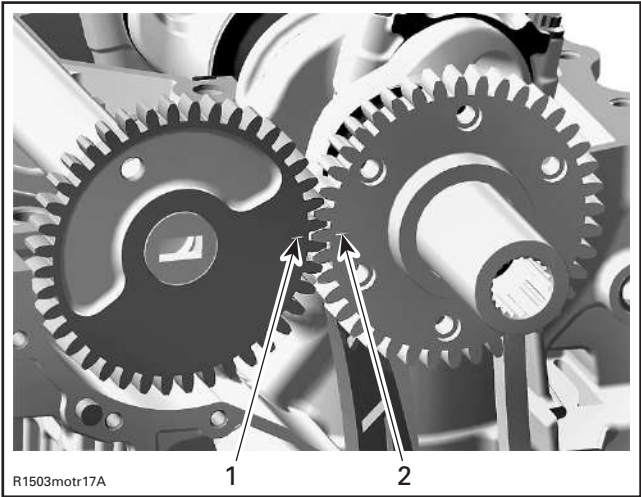
- 1. Dial gauge
- 2. Balancer shaft

BALANCER SHAFT AXIAL CLEARANCE mm (in)	
NEW MINIMUM	0.02 (.001)
NEW MAXIMUM	0.25 (.010)
SERVICE LIMIT	0.35 (.014)

Installation

For installation, reverse the removal procedure. Pay attention to following detail.

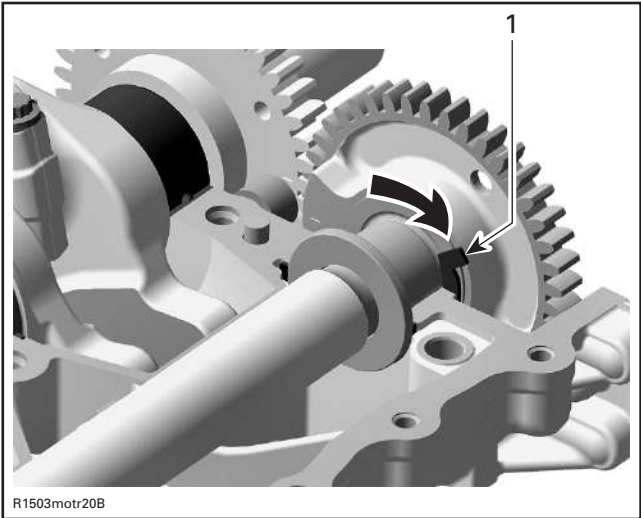
**CAUTION:** Balancer shaft and crankshaft marks have to be aligned.



- 1. Mark on balancer shaft
- 2. Mark on crankshaft

**CAUTION:** Never forget thrust washers no. 6 on PTO side to control axial adjustment on balancer.

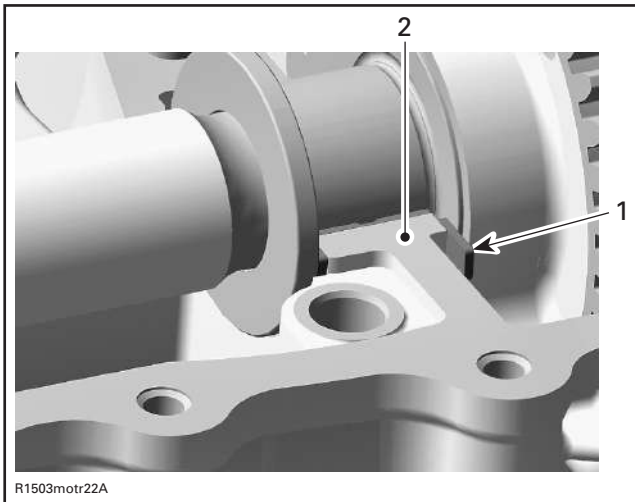
Insert thrust washers as soon as balancer shaft is in place as per following illustration.



- THRUST WASHER INSERT DIRECTION
- 1. Thrust washer

**CAUTION:** Thrust washers have to be flush with the cylinder block sealing surface.

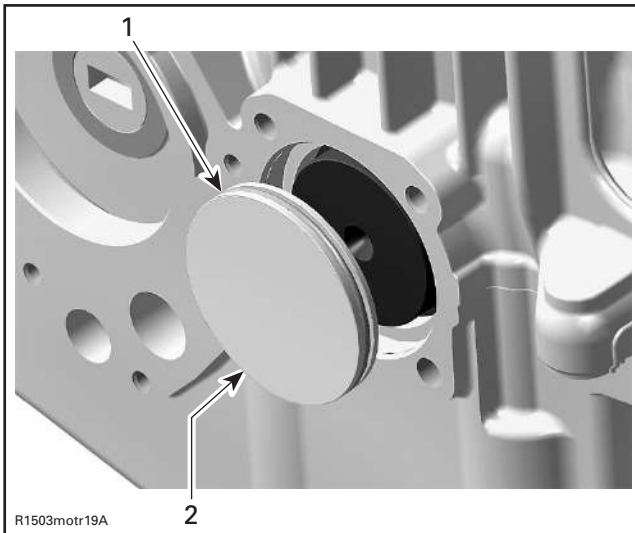




1. Thrust washer
2. Sealing surface

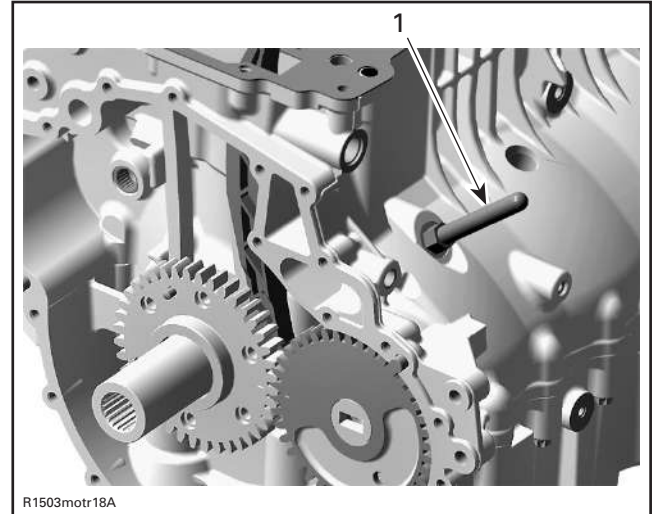
Install cylinder block lower half. Refer to CYLINDER BLOCK in this section.

Install the crankshaft cover before mounting the engine bracket. Apply oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.



1. O-ring
2. Crankshaft cover

**CAUTION:** Install crankshaft locking tool (P/N 529 035 821) right away to position crankshaft at TDC before installing the camshaft and rockers (refer to CYLINDER HEAD).



1. Crankshaft locking tool

## CYLINDER BLOCK

### Disassembly

Remove:

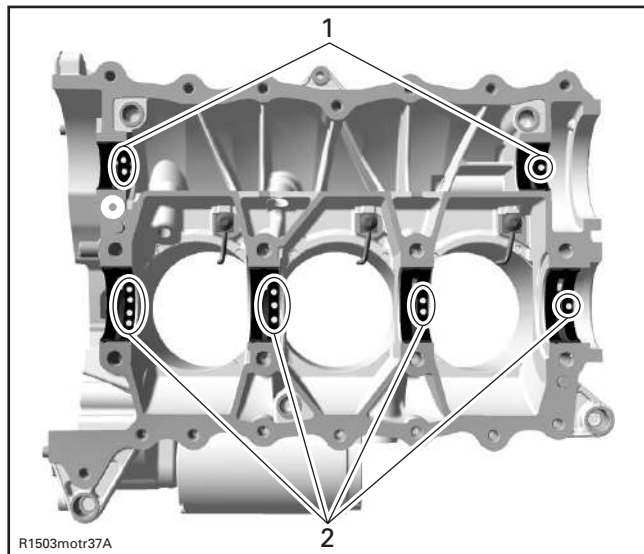
- engine oil (refer to OIL CHANGE in the appropriate *VEHICLE SHOP MANUAL*)
- engine from vehicle (refer to the appropriate *VEHICLE SHOP MANUAL*)
- cylinder head (refer to CYLINDER HEAD section)
- PTO housing (refer to PTO HOUSING/MAGNETO section)
- starter gear (refer to PTO HOUSING/MAGNETO section)
- starter drive ass'y
- oil suction pump with oil separator cover (refer to LUBRICATION section)
- balancer shaft (refer to BALANCER SHAFT elsewhere in this section)
- crankshaft (refer to CRANKSHAFT elsewhere in this section)
- piston with connecting rod (refer to PISTON/CONNECTING ROD elsewhere in this section).

## Section 01 ENGINES (1503 4-TEC)

### Subsection 07 (CYLINDER BLOCK)

#### Bearings

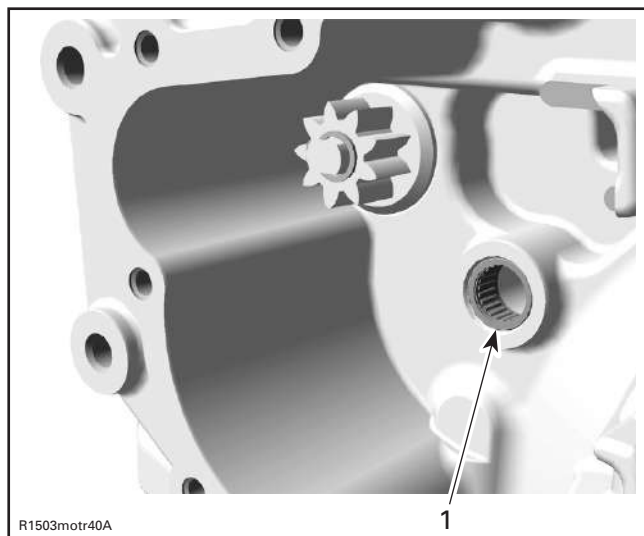
When bearings need to be removed from the cylinder block, mark them to identify the correct position at installation. See the following illustration for an example:



1. Mark on balancer shaft bearings
2. Mark on crankshaft bearings

#### Starter Drive Bearing

Check bearing no. 21 of starter drive assembly no. 22 in cylinder block and replace it if damaged.

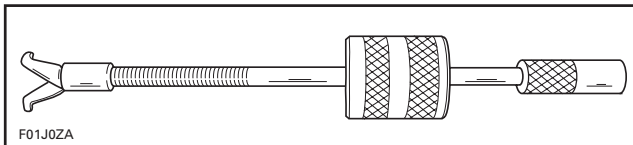


#### TYPICAL

1. Bearing of starter drive assembly

Starter drive bearing can be easily removed from crankcase lower half using the following suggested tool or equivalent:

- Snap-on hammer puller including:
- handle CJ93-1
- hammer CJ125-6
- claws CJ93-4.



Close puller claws so that they can be inserted in end bearing. Holding claws, turn puller shaft clockwise so that claws open and become firmly tight against bearing.

Slide puller hammer outwards and tap puller end. Retighten claws as necessary to always maintain them tight against bearing. Continue this way until bearing completely comes out.

#### Inspection

##### Cylinder

Check cylinder for cracks, scoring and wear ridges on the top and bottom of the cylinder. If so, replace cylinder.

##### Cylinder Taper

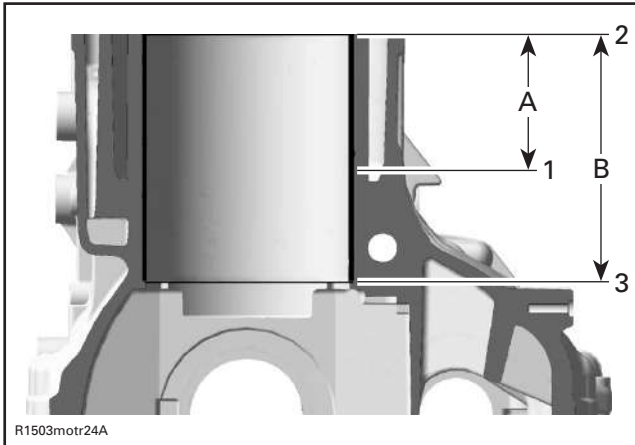
Measure cylinder bore and if it is out of specifications, rehone cylinder sleeve and replace piston ass'y with first oversize.

**NOTE:** It is not necessary to have all cylinders rehone if they are not all out of specification. Mixed standard size and oversize cylinders are allowed.

Measure cylinder bore at 3 recommended positions. See the following illustration.

## Section 01 ENGINES (1503 4-TEC)

### Subsection 07 (CYLINDER BLOCK)



1. First measuring diameter
2. Second measuring diameter
3. Third measuring diameter
- A. 60 mm (2.362 in)
- B. 110 mm (4.331 in)

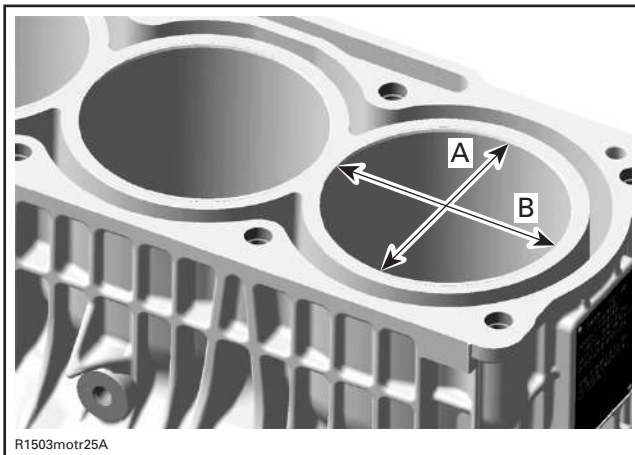
CYLINDER TAPER IN DIAMETER mm (in)	
NEW MAXIMUM	0.038 (.001)
SERVICE LIMIT	0.090 (.004)

Distance between measurements should not exceed the service limit mentioned above.

#### Cylinder Out of Round

Measure cylinder diameter in piston axis direction from top of cylinder. Take an other measurement 90° from first one and compare.

**NOTE:** Take the same measuring points as described in CYLINDER TAPER above.



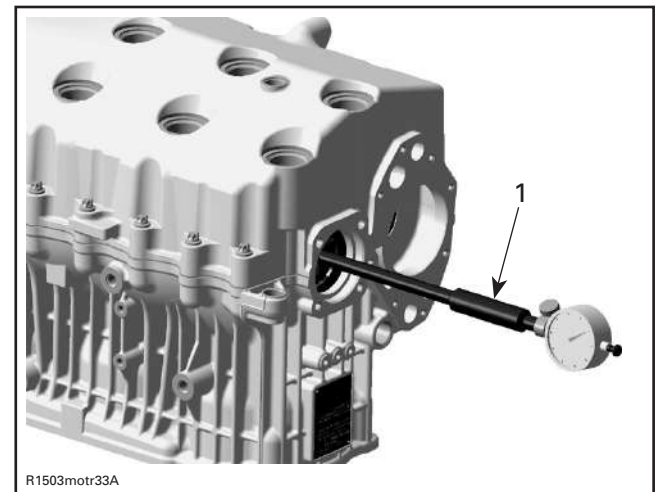
- A. Perpendicular to crankshaft axis
- B. Parallel to crankshaft axis

CYLINDER OUT OF ROUND mm (in)	
NEW MAXIMUM	0.008 (.0003)
SERVICE LIMIT	0.015 (.0006)

#### Bearings

To measure the wear of the crankshaft bearings no. 13 and no. 14 and balancer shaft bearings no. 15, both cylinder block halves with OLD bearings have to be screwed together as per tightening procedure described below.

Measure the inside diameter of the bearings with a bore gauge.

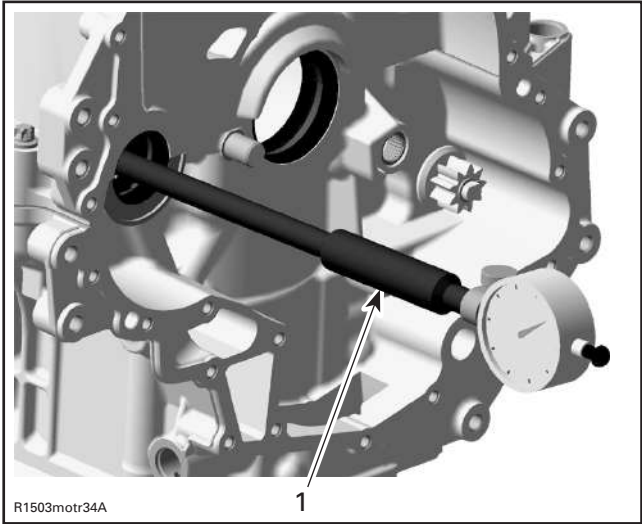


ENGINE UPSIDE DOWN

1. Bore gauge

CRANKSHAFT BEARING INSIDE DIAMETER mm (in)	
SERVICE LIMIT	50.1 (1.9724)

Section 01 ENGINES (1503 4-TEC)  
Subsection 07 (CYLINDER BLOCK)



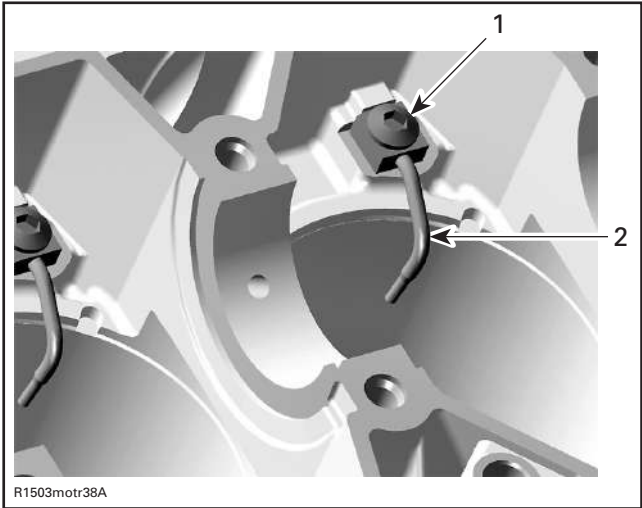
ENGINE UPSIDE DOWN  
1. Bore gauge

BALANCER SHAFT BEARING INSIDE DIAMETER mm (in)	
SERVICE LIMIT	32.11 mm (1.2642 in)

Replace bearings if they are out of specifications.

Oil Spray Nozzles

Remove oil spray nozzle **no. 16** and banjo screw **no. 17** from cylinder block.



1. Banjo screw  
2. Oil spray nozzle

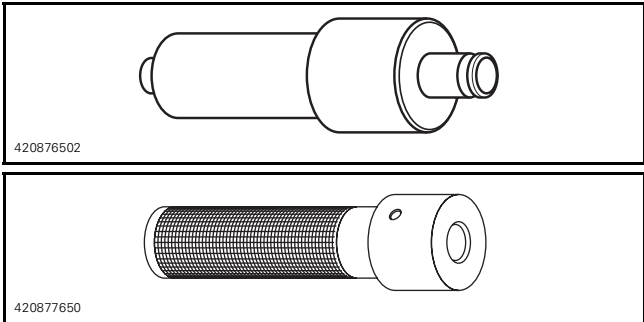
Check if ball inside moves freely in the banjo screw. Clean Nozzle and banjo screw from dirt and debris.

Assembly

For assembly, reverse the disassembly procedure. Pay attention to the following details.

Torque oil spray nozzle to 18 N•m (160 lbf•in).

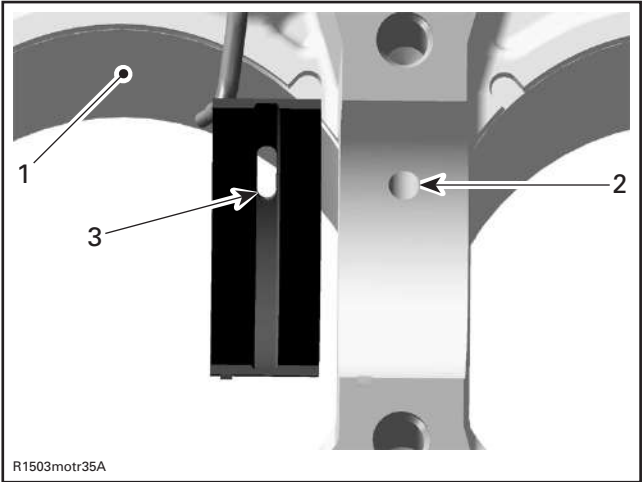
To install starter drive bearing **no. 21** of starter drive assembly, use pusher (P/N 420 876 502) and handle (P/N 420 877 650).



Use NEW bearings when diameters are out of specification.

If OLD bearings can be used again, make sure they are at the same position as they were before.

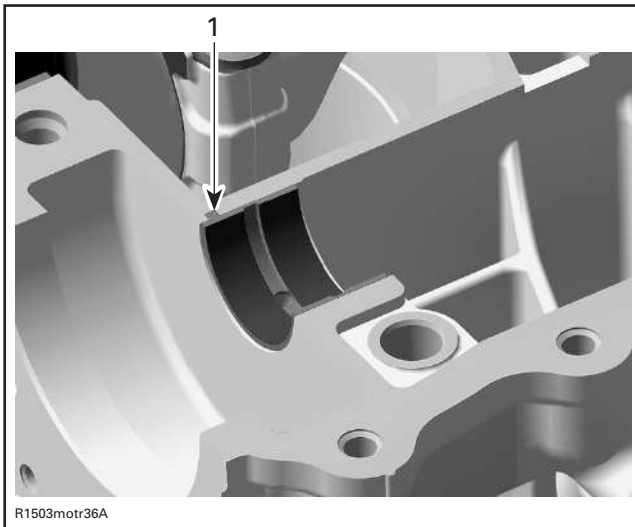
Correctly install bearings. Top crankshaft bearing halves have a bore which has to be placed in the upper cylinder block.



1. Cylinder block upper half  
2. Oil bore in cylinder block  
3. Oil bore in bearing

Bearings have to be flush with the cylinder block split surface and their protrusions have to fit in the notched areas in the cylinder block seat.





1. Bearing protrusion in cylinder block notch

Apply engine oil on all bearings, in the bottom area of the cylinder bore and also on the band of the piston ring compressor tool.

For proper installation of pistons, refer to PISTON/CONNECTING ROD in this section.

**NOTE:** Before installing the crankshaft, make sure that the timing chain is on the crankshaft and the chain guide has been installed first. Those parts cannot be installed after as the crankshaft is in place.

Clean oil passages and make sure they are not clogged.

Clean all metal components in a solvent.

cylinder block mating surfaces are best cleaned using a combination of the chisel gasket remover (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

**CAUTION:** Do not wipe with rags. Use a new clean hand towel only.

**IMPORTANT:** When beginning the application of the crankcase sealant, the assembly and the first torquing should be done within 10 minutes. It is suggested to have all you need on hand to save time.

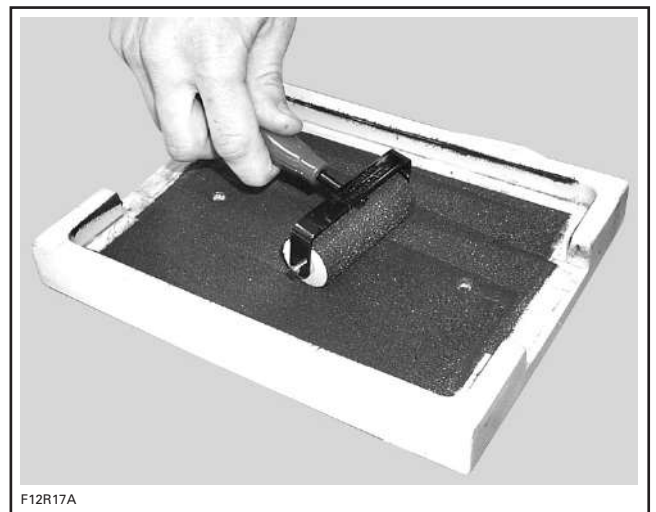
**NOTE:** It is recommended to apply this specific sealant as described here to get an uniform application without lumps. If you do not use the roller method, you may use your finger to uniformly distribute this sealant.

Use the silicone-based Loctite 5910 (P/N 293 800 081) on mating surfaces.

**CAUTION:** Do not use other products to seal crankcase. Do not use an activator with the Loctite 5910. Using other products or non silicone-based sealant over a previously sealed crankcase with Loctite 5910 will lead to poor adhesion and possibly a leaking crankcase.

**NOTE:** Refer to the product label for the sealant curing time. Respect the manufacturer's recommendations prior to start engine.

Use a plexiglass plate and apply some sealant on it. Use a soft rubber roller (50 - 75 mm (2 - 3 in)) (available in arts products suppliers for printmaking) and roll the sealant to get a thin uniform coat on the plate (spread as necessary). When ready, apply the sealant on crankcase mating surfaces.



Do not apply in excess as it will spread out inside crankcase.

Tighten cylinder block screws as per following procedure:

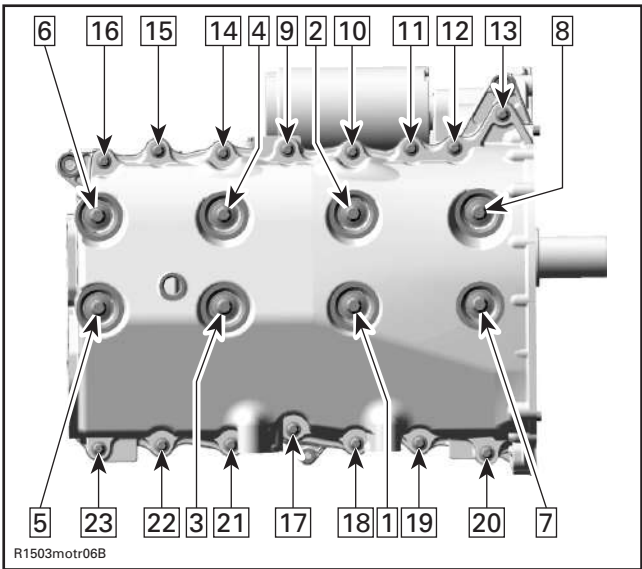
Apply Loctite 243 (blue) (P/N 293 800 060) on screw threads.

Torque cylinder block screws **no. 3** to 40 N•m (29 lbf•ft) following sequence 1 to 8 and then to 55 N•m (41 lbf•ft) (repeat sequence).

Torque cylinder block screws **no. 7** to 22 N•m (17 lbf•ft) following sequence 9 to 23.

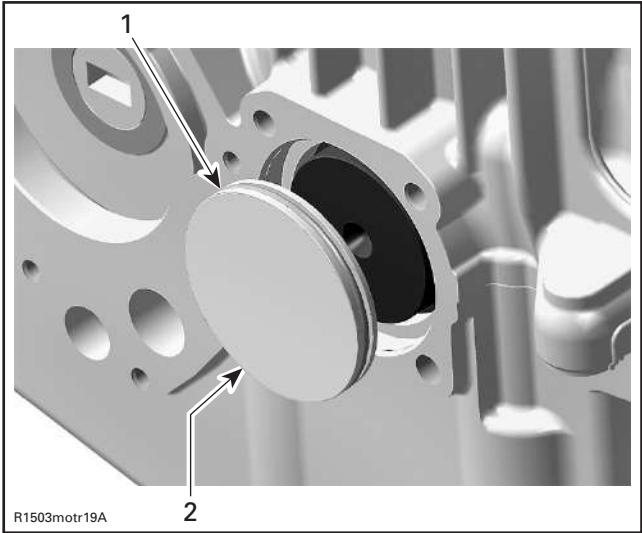


**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 07 (CYLINDER BLOCK)**



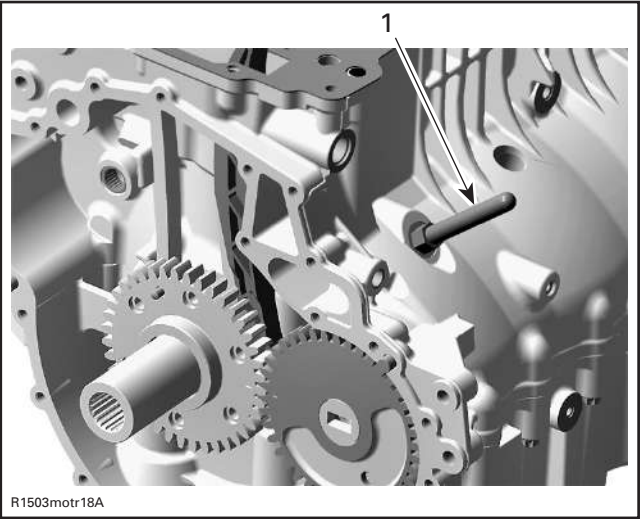
**NOTE:** Before continuing the assembly process, the axial clearance of balancer shaft and crankshaft has to be checked. Refer to CRANKSHAFT and BALANCER SHAFT in this section for the procedure.

Install the crankshaft cover before mounting the engine bracket. Apply oil on O-ring and press cover in. Crankshaft cover has to be flush with cylinder block surface.



- 1. O-ring
- 2. Crankshaft cover

**CAUTION:** Install crankshaft locking tool (P/N 529 035 821) right away to position crankshaft at TDC before installing the camshaft and rockers (refer to CYLINDER HEAD).



1. Crankshaft locking tool

Install cylinder head, PTO housing and the other parts in accordance with the proper assembly procedures.

# TECHNICAL SPECIFICATIONS

ENGINE			NATURALLY ASPIRATED	SUPERCHARGED
Engine type			ROTAX 1503 4-TEC, 4-stroke, Single Over Head Camshaft (SOHC), liquid cooled	
Number of cylinders			3	
Number of valves			12 valves with hydraulic lifters (no adjustment)	
Bore	Standard		100 mm (3.9 in)	
Stroke			63.4 mm (2.49 in)	
Displacement			1493.8 mm³ (58.81 in³)	
Compression ratio			10.6:1	SC engine: 8.1:1 SC IC engine: 8.4:1
Induction type			Naturally-aspirated	SC engine: gear-driven supercharger SC IC engine: gear-driven supercharger with air/water intercooler
Maximum HP RPM			7300 ± 50 RPM	SC engine: 7300 ± 50 RPM SC IC engine: 8000 ± 50 RPM
Lubrication	Type	Dry sump (2 oil pumps). Replaceable paper type oil filter. Water-cooled oil cooler		
	Oil type	10W40 4-stroke oil (API service classification SL, SJ or SH)		XP-S 10W40 or an approved equivalent
Intake valve opening			10° BTDC	
Intake valve closing			45° ABDC	
Exhaust valve opening			50° BBDC	
Exhaust valve closing			5° ATDC	0° ATDC
Valve stem diameter	Intake	Minimum (new)	5.961 mm (.2347 in)	
		Maximum (new)	5.975 mm (.2352 in)	
		Wear limit	5.930 mm (.2330 in)	
	Exhaust	Minimum (new)	5.946 mm (.2341 in)	
		Maximum (new)	5.960 mm (.2346 in)	
		Wear limit	5.930 mm (.2330 in)	
Valve guide diameter		Minimum (new)	5.99 mm (.2358 in)	
		Maximum (new)	6.01 mm (.2366 in)	
		Wear limit	6.060 mm (.2386 in)	
Valve spring free length	Inner	Nominal (new)	41.02 mm (1.615 in)	
		Wear limit	38.8 mm (1.499 in)	
	Outer	Nominal (new)	45.45 mm (1.789 in)	
		Wear limit	43 mm (1.693 in)	
Valve seat contact width	Intake	Nominal (new)	1.1 to 1.3 mm (.043 to .051 in)	
		Wear limit	1.6 mm (.063 in)	
	Exhaust	Nominal (new)	1.25 to 1.55 mm (.049 to .061 in)	
		Wear limit	1.8 mm (.071 in)	

## Section 01 ENGINES (1503 4-TEC)

### Subsection 08 (TECHNICAL SPECIFICATIONS)

ENGINE			NATURALLY ASPIRATED	SUPERCHARGED
Rocker arm bore diameter		Minimum (new)	20.00 mm (.7874 in)	
		Maximum (new)	20.02 mm (.7882 in)	
		Wear limit	20.03 mm (.7886 in)	
Rocker arm shaft diameter		Minimum (new)	19.98 mm (.7866 in)	
		Maximum (new)	19.99 mm (.7870 in)	
		Wear limit	19.96 mm (.7858 in)	
Cylinder head screw		Service limit	148.5 mm (5.846 in)	
Piston ring type and quantity		1 <sup>st</sup>	Upper compression ring, rectangular	
		2 <sup>nd</sup>	Lower compression ring, tapered face	
		3 <sup>rd</sup>	Oil scraper ring	
Ring end gap	Rectangular	Minimum (new)	0.3 mm (.012 in)	
	Taper-face		0.3 mm (.012 in)	
	Oil scraper ring		0.3 mm (.012 in)	
	Rectangular	Maximum (new)	0.5 mm (.020 in)	
	Taper-face		0.5 mm (.020 in)	
	Oil scraper ring		0.5 mm (.020 in)	
	All	Wear limit	1.0 mm (.04 in)	
Ring/piston groove clearance	Rectangular	Minimum (new)	0.02 mm (.0008 in)	
	Taper-face		0.015 mm (.0006 in)	
	Oil scraper ring		0.02 mm (.0008 in)	
	Rectangular	Maximum (new)	0.07 mm (.0028 in)	
	Taper-face		0.06 mm (.0024 in)	
	Oil scraper ring		0.055 mm (.0021 in)	
	All	Wear limit	0.15 mm (.006 in)	
Piston/cylinder wall clearance		Minimum (new)	0.024 - 0.056 mm (.001 - .0022 in)	0.04 mm (.001 in)
		Wear limit	0.1 mm (.0039 in)	
Cylinder taper (maximum)			0.03 mm (.0011 in)	
Cylinder out of round (maximum)			0.015 mm (.0006 in)	
Camshaft bearing journal	Front	Minimum (new)	24.93 mm (.9815 in)	
		Maximum (new)	24.96 mm (.9827 in)	
		Wear limit	24.93 mm (.9815 in)	
	PTO and center	Minimum (new)	39.89 mm (1.5705 in)	
		Maximum (new)	39.9 mm (1.5709 in)	
		Wear limit	39.88 mm (1.5701 in)	
Camshaft bore	Front	Minimum (new)	25.00 mm (.9842 in)	
		Maximum (new)	25.01 mm (.9846 in)	
		Wear limit	25.02 mm (.9850 in)	
	PTO and center	Minimum (new)	40.00 mm (1.5748 in)	
		Maximum (new)	40.01 mm (1.5752 in)	
		Wear limit	40.02 mm (1.5756 in)	

**Section 01 ENGINES (1503 4-TEC)**  
**Subsection 08 (TECHNICAL SPECIFICATIONS)**

ENGINE			NATURALLY ASPIRATED	SUPERCHARGED
Cam lobe	Intake	Minimum (new)	31.48 mm (1.2394 in)	31.69 mm (1.2476 in)
		Maximum (new)	31.59 mm (1.2437 in)	31.8 mm (1.2520 in)
		Wear limit	31.43 mm (1.2374 in)	31.65 mm (1.2461 in)
	Exhaust	Minimum (new)	31.69 mm (1.2476 in)	31.48 mm (1.2394 in)
		Maximum (new)	31.8 mm (1.2520 in)	31.59 mm (1.2437 in)
		Wear limit	31.65 mm (1.2461 in)	31.43 mm (1.2374 in)
Crankshaft axial clearance		Minimum (new)	0.08 mm (.0031 in)	
		Maximum (new)	0.22 mm (.0087 in)	
		Wear limit	0.35 mm (.014 in)	
Crankshaft journal diameter		Minimum (new)	49.991 mm (1.9681 in)	
		Maximum (new)	50.000 mm (1.9685 in)	
		Wear limit	49.950 mm (1.9665 in)	
Crankshaft radial clearance		Wear limit	0.007 mm (.0028 in)	
Connecting rod big end diameter		Service limit	45.080 mm (1.7740 in)	
Connecting rod big end clearance		Service limit	0.065 mm (.0026 in)	
Connecting rod big end axial play		Minimum (new)	0.135 mm (.0053 in)	
		Maximum (new)	0.287 mm (.0113 in)	
		Wear limit	0.500 mm (.0197 in)	
Crankshaft deflection		Maximum	0.050 mm (.002 in)	
Connecting rod small end diameter		Minimum (new)	23.010 mm (.9059 in)	
		Maximum (new)	23.020 mm (.9063 in)	
		Wear limit	23.070 mm (.9080 in)	
Piston pin diameter		Minimum (new)	22.99 mm (.9051 in)	
		Maximum (new)	23.000 mm (.9055 in)	
		Wear limit	22.980 mm (.9047 in)	
Piston pin bore clearance		Wear limit	0.080 mm (.0035 in)	
Balance shaft journal diameter		Minimum (new)	31.98 mm (1.2591 in)	
		Maximum (new)	32.000 mm (1.2598 in)	
		Wear limit	31.950 mm (1.2579 in)	
Balance shaft radial clearance		Wear limit	0.07 mm (.0028 in)	
Balance shaft axial clearance		Minimum (new)	0.02 mm (.0008 in)	
		Maximum (new)	0.25 mm (.0098 in)	

## Section 01 ENGINES (1503 4-TEC)

### Subsection 08 (TECHNICAL SPECIFICATIONS)

ENGINE		NATURALLY ASPIRATED	SUPERCHARGED
Supercharger shaft driven plate journal depth	Minimum (new)	Not applicable	9.960 mm (.3921 in)
	Maximum (new)	Not applicable	10.0 mm (.3937 in)
	Wear limit	Not applicable	9.700 mm (.3819 in)
Supercharger drive gear thickness	Minimum (new)	Not applicable	11.0 mm (.4331 in)
	Maximum (new)	Not applicable	11.050 mm (.4350 in)
	Wear limit	Not applicable	10.500 mm (.4134 in)
Supercharger lock washer thickness	Minimum (new)	Not applicable	6.900 mm (.2717 in)
	Maximum (new)	Not applicable	7.100 mm (.2795 in)
	Wear limit	Not applicable	6.600 mm (.2598 in)

ELECTRICAL		NATURALLY ASPIRATED	SUPERCHARGED
Magneto generator output		360 W @ 6000 RPM	
Ignition system type		DI (Digital Induction)	
Ignition timing		Not adjustable	
Spark plug	Make and type	NGK DCPR8E	
	Gap	0.7 - 0.8 mm (.030 in)	
Engine RPM limiter setting		7650 RPM	SC engine: 7650 RPM SC IC engine: 8000 RPM

COOLING		NATURALLY ASPIRATED	SUPERCHARGED
Type		Liquid cooled	
Coolant		Ethylene-glycol 50%/50% antifreeze/water. Coolant containing corrosion inhibitors for internal combustion aluminum engines	
Thermostat		87°C (188°F)	

CAPACITIES		NATURALLY ASPIRATED	SUPERCHARGED
Engine oil		4.5 L (4.1 U.S. qt) total Oil change with filter: 3 L (2.7 U.S. qt)	
Cooling system (coolant)		See appropriate <i>VEHICLE SHOP MANUAL</i>	



[illegible]

NOTES



219 100 214

CA

ENGINE SHOP MANUAL, ROTAX 1503 4-TEC ENGINES / ENGLISH  
MANUEL DE RÉP. MOTEUR, ROTAX 1503 4-TEC / ANGLAIS

FAIT AU / MADE IN CANADA

U/M:P.C.

®™ AND BRP LOGO ARE TRADEMARKS OF BOMBARDIER RECREATIONAL PRODUCTS INC. OR ITS AFFILIATES.  
©2005 BOMBARDIER RECREATIONAL PRODUCTS INC. ALL RIGHTS RESERVED. PRINTED IN CANADA.

[www.SeaDooManuals.net](http://www.SeaDooManuals.net)