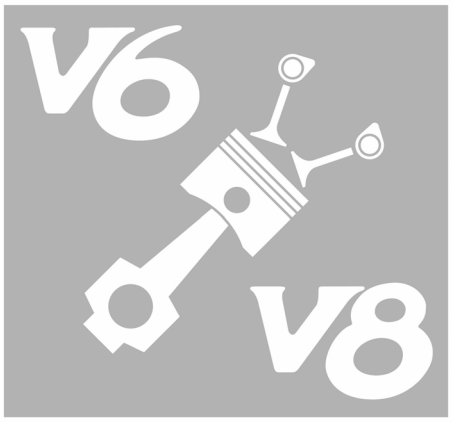
JAGUAR

TRAINING PROGRAM

JAGUAR V6/V8 ENGINE REPAIR



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COURSE OBJECTIVES

- Describe the practical similarities and differences between Jaguar V6 and V8 engines
- Disassemble and reassemble V6 and V8 engine using Jaguar special tools and factory recommended procedures
- Inspect, measure and identify out of specification components
- Select needed service part sizes (bearing shells, pistons, shims)
- Set camshaft timing and adjust valve clearances
- Describe the function and advantages of variable valve timing

PROGRAM CONTENT

1. INTRODUCTION
2. GENERAL INFORMATION
3. ENGINE SERVICE GENERAL INFORMATION
4. JAGUAR V8 ENGINES
5. JAGUAR V6 ENGINES
6. WORKSHEETS - AJ26/27/28
7. WORKSHEETS - AJ33/34
8. WORKSHEETS - AJ60
9. WORKSHEETS - AJ61/62

DISCLAIMER

The illustrations, technical information, data and descriptive text in this publication, to the best of our knowledge, were correct at the time of going to print. The right to change specifications, equipment, procedures and maintenance instructions at any time without notice is reserved as part of our policy of continuous development and improvement.

No liability can be accepted for any inaccuracies or omissions in this publication, although every possible care has been taken to make it as complete and accurate as possible.

Jaguar Cars North America Service Training Department

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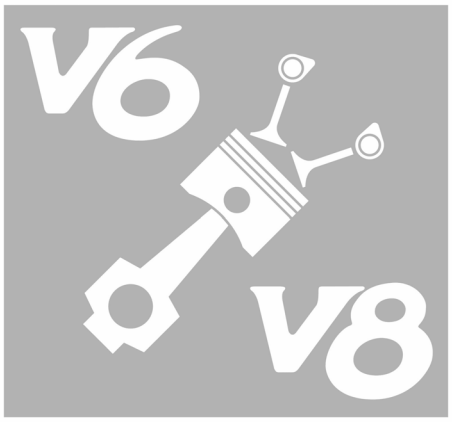

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COURSE CONTENT

Jaguar Service Training Course 168 covers the base engine components for the AJV8 and AJV6 engine families, and each of their variants:

- **AJV8**
  - AJ26 / AJ27 / AJ28
  - AJ33 / AJ34
- **AJV6**
  - AJ60
  - AJ61 / AJ62

The course will cover the basic engine hardware for both engine families, and detail the evolutionary changes to subsystems, where applicable.

The course will first review the common base engine integrity and specification measurements, and discuss the meaning of these measurements.

System Applicability

System applicability and variants are included in each section of this Student Guide.

Table 1 Jaguar V6/V8 Engine Evolution (1997–Onwards)

Vehicle	Model Year	Engine Configuration and Displacement	Comments
XJ and XK8	1997 - 98 N/A 1998 - 99 S/C	AJ26 4.0L V8 N/A and S/C	AJ26 Electronic throttle with mechanical guard
XK8 XJ8	1999 - 02 1999 - 03	AJ27 4.0L V8 N/A	AJ27 Electronic throttle with mechanical limp home mode, New continuous VVT, air assist, new CKP, O2, KS, MAF on N/A, new coils, top fed injectors
XJR XKR	2000 - 03 2000 - 02	AJ27 4.0L V8 S/C	S/C adopts AJ27 strategies
S-TYPE	2000 - 02	AJ28 4.0L V8 N/A AJ60 3.0L V6	New returnless fuel system, V6 with cylinder head temp sensor, AJ28 V8 new sensors, full authority throttle (no cable)
S-TYPE	2003 –	AJ33 4.2L V8 N/A AJ33 4.2L V8 S/C AJ62 3.0L V6	Increased V8 displacement, new VVT design, no air assist No CHT on V6, new VVT design
X-TYPE	2002 –	AJ61 2.5L V6 AJ61 3.0L V6	no CHT
XJ	2004 –	AJ33 4.2L V8 N/A AJ33 4.2L V8 S/C	C/O S-TYPE 2003MY
XK	2003 –	AJ34 4.2L V8 N/A AJ34 4.2L V8 S/C	modified AJ33 to package in XK

Table 2 Jaguar Model Year and Model Code Information

Model year	Model (Engineering Designation)
1998-2003	XJ Sedan Range (X308)
2004–Onwards	XJ Sedan Range (X350)
1997-2002	XK Range (X100)
2003–2004	XK Range (X103)
2005–Onwards	XK Range (X105)
2000–2002	S-TYPE (X200)
2003–2004	S-TYPE (X202)
2005–Onwards	S-TYPE (X204)
2002–2003	X-TYPE (X400)
2004–Onwards	X-TYPE (X404)

ACRONYMS AND ABBREVIATIONS

NOTE:

A large majority of these abbreviations conform to the standards of SAE J1930

- AACV — Air Assist Control Valve
- AAI — Air Assisted Injection
- ABS — Anti-lock Braking System
- A/C – Air Conditioning
- A/C CM Air Conditioning Control Module
- ACC — Adaptive Cruise Control
- APP sensor – Accelerator Pedal Position Sensor
- ASL — Automatic Speed Limiter
- B+ – Battery Voltage
- CAN – Controller Area Network
- CCV — Canister Close Valve
- CKP sensor – Crankshaft Position Sensor
- CHT sensor — Cylinder Head Temperature sensor
- CM — Control Module
- CMP sensor (A) 1 – Camshaft Position Sensor - RH Bank
- CMP sensor (B) 2 – Camshaft Position Sensor - LH Bank
- C/O — Carry Over
- CO — Carbon Monoxide
- CPU – Central Processing Unit
- D2B — Digital Data Bus
- DC — Direct Current
- DIN — Deutsche Industrie Normen
- DLC – Data Link Connector
- DPFE — Differential Pressure Feedback EGR
- DTC – Diagnostic Trouble Code
- DSC — Dynamic Stability Control
- ECATS — Enhanced Computer Active Technology Suspension
- ECM – Engine Control Module
- ECT sensor – Engine Coolant Temperature Sensor
- ECU — Electronic Control Unit
- EPROM — Erasable Programmable Read Only Memory
- EEPROM — Electrically Erasable Programmable Read Only Memory
- EFT sensor – Engine Fuel Temperature Sensor
- EGR – Exhaust Gas Recirculation
- EMS — Engine Management System
- EOT sensor – Engine Oil Temperature Sensor
- EVAP Canister Close Valve – Evaporative Emission Canister Close Valve
- FPDB — Front Power Distribution Box
- FEM – Front Electronic Control Module
- FTP — Federal Test Procedure
- FTP sensor – Fuel Tank Pressure Sensor
- FSC — Fail Safe Cooling strategy
- GEM – Generic Electronic Module
- HC — Hydrocarbons
- HO2 sensor 1/1 –Heated Oxygen Sensor - RH Bank/Upstream
- HO2 sensor 1/2 –Heated Oxygen Sensor - RH Bank/Downstream
- HO2 sensor 2/1 –Heated Oxygen Sensor - LH Bank/Upstream
- HO2 sensor 2/2 –Heated Oxygen Sensor - LH Bank/Downstream
- IAT sensor – Intake Air Temperature Sensor
- IC — Instrument Cluster
- IG – Ignition
- IMT Valve – Intake Manifold Tuning Valve (1 = top, 2 = bottom)
- IP sensor – Injection Pressure Sensor
- ISO — International Standards Organization
- JTIS — Jaguar Technical Information System
- KAM — Keep Alive Memory
- KS 1 – Knock Sensor RH bank

- KS 2 – Knock Sensor LH bank
- KTM — Key Transponder Module
- LED — Light Emitting Diode
- LEV — Low Emissions Vehicle
- LTFT — Long Term Fuel Trim
- MAF sensor – Mass Air Flow Sensor
- MIL — Malfunction Indicator Lamp
- N/A – Normally Aspirated
- NAS – North American Specification
- NTC – Negative Temperature Coefficient
- NOx — Oxides of Nitrogen
- OBD – On-Board Diagnostics
- O/C — Open Circuit
- ORVR — On-board Refuelling Vapor Recovery
- PATS — Passive Anti-Theft System
- PAD — Passenger Airbag Deactivation light
- PCB — Printed Circuit Board
- PJB — Passenger Junction Box
- PTEC — PowerTrain Electronic Control
- PPS – Pedal Position Sensor
- PCM – Powertrain Control Module
- PWM — Pulse Width Modulation
- RAM — Random Access Memory
- RCM — Restraints Control Module
- RCCM — Remote Climate Control Module
- RCCP — Rear Climate Control Panel
- REM – Rear Electronic Module
- ROM — Read Only Memory
- RHS — Right Hand Side
- RPDB — Rear Power Distribution Box
- ROW – Rest of the World Specification
- SAE — Society of Automotive Engineers
- S/C – Super Charged
- SCP – Standard Corporate Protocol Network
- STFT — Short Term Fuel Trim
- SWAS — Steering Wheel Angle Sensor
- TACM — Throttle Actuator Control Module
- TCM — Transmission Control Module
- TFT sensor – Transmission Fluid Temperature Sensor
- TLEV — Transitional Low Emission Vehicle
- TM – Throttle Motor
- TOT — Transmission Oil Temperature
- TP– Throttle Position
- ULEV — Ultra Low Emissions Vehicle
- VIS – Variable Intake System
- VSV — Vacuum Solenoid Valves
- VVT 1 – Variable Valve Timing solenoid valve - RH Bank
- VVT 2 – Variable Valve Timing solenoid valve - LH Bank
- WOT — Wide Open Throttle

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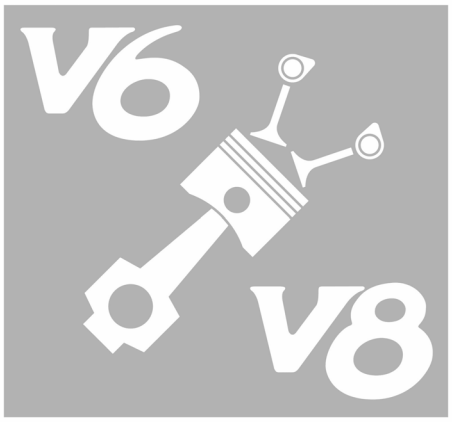

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ENGINE SERVICE

Best Practices — Servicing Aluminum Engines

Never use metal scrapers to remove residue. Metallic scrapers are capable of causing serious damage to aluminum and plastic surfaces in the form of scratches and depressions. The surface damage results in leaks. A plastic or wooden scraper is essential for carrying out these kinds of operations.

IMPORTANT: Never attempt to clean gasket surfaces using grinders, rotating steel brushes or tools with cutting edges. Prevent gasket residue from entering the engine by covering all engine orifices where possible. Be especially careful when installing components such as cylinder heads, intake manifolds, timing covers and oil pans as these are all critical areas with high potential for leakage.

ALWAYS replace used gaskets, regardless of condition or type of material. Observe the instruction in GTR. Gasket sealer is not required on all gaskets, and could be a detriment if used when not required. Some gaskets are pre-shaped meaning that the application of sealant could lead to excess height or local distortion in the gasket, with leaks as the ultimate results.

Long Term Wear Items

Over the life of an engine, some parts may wear beyond their operational specifications. Typical components which may require evaluation for replacement are:

- Engine Block — Cylinder bore size and roundness
- Cylinder Head — Sealing surface flatness and condition
- Bearings — Connecting rod and crank bearing clearance and condition
- Valve Shims — Clearance

The following measurement and inspection techniques can be used to ensure stock and replacement parts meet the specifications required for proper performance.

Wear Measurements — Cylinder Bore Out-of-Round

Measure the cylinder bore with an internal micrometer.

- Carry out the measurements in different directions and at different heights to determine if there is any out-of-roundness or tapering.
- If the measurement is out of the specified range then the block must be replaced.

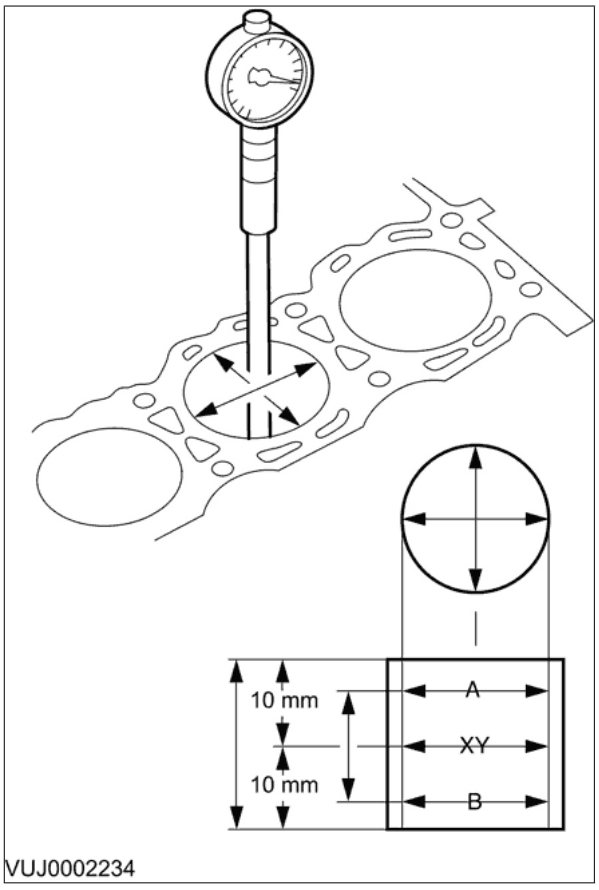

Fig. 1

Cylinder Head Distortion

- Measure the cylinder block/cylinder head distortion.
- Using the special tool, measure the mating face distortion.
- If the value is not to specification, replace the cylinder head.

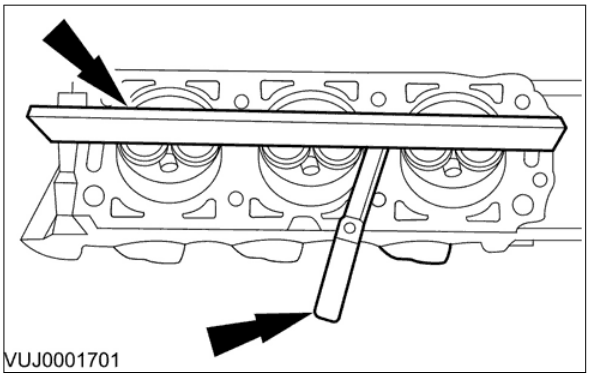

Fig. 2

Piston Inspection

Carry out a visual inspection.

- Clean the piston skirt, pin bush, ring grooves and crown and check for wear or cracks.
- If there are signs of wear on the piston skirt, check whether the connecting rod is twisted or bent.

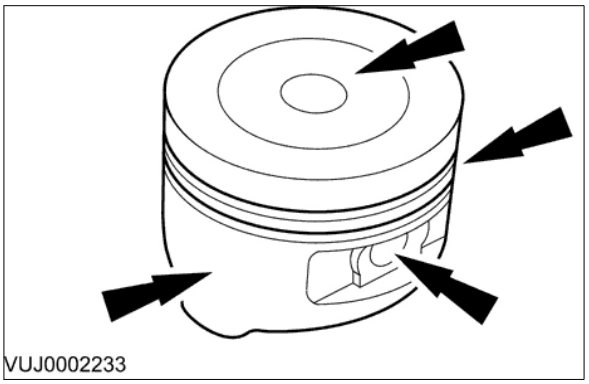

Fig. 3

Crankshaft End Play

Using the Dial Indicator Gauge with bolt on brackets, or a magnetic base on a large steel bolt head, measure the end play.

- Measure the end play by lifting the crankshaft using a lever.
- If the value is out of the specification, install new thrust bearing and half ring (washer) to take up the end float and repeat the measurement.

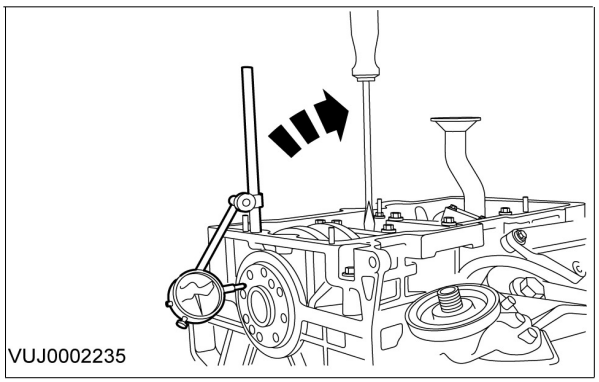

Fig. 4

Bearing Inspection

Inspect bearings for the following defects.

1. Cratering - fatigue failure
2. Spot polishing - incorrect seating.
3. Imbedded dirt - dirty engine oil.
4. Scratching - dirty engine oil.
5. Base exposed - poor lubrication.
6. Both edges worn - Crank journal damaged.
7. One edge worn - Crank journal tapered or bearing not seated.

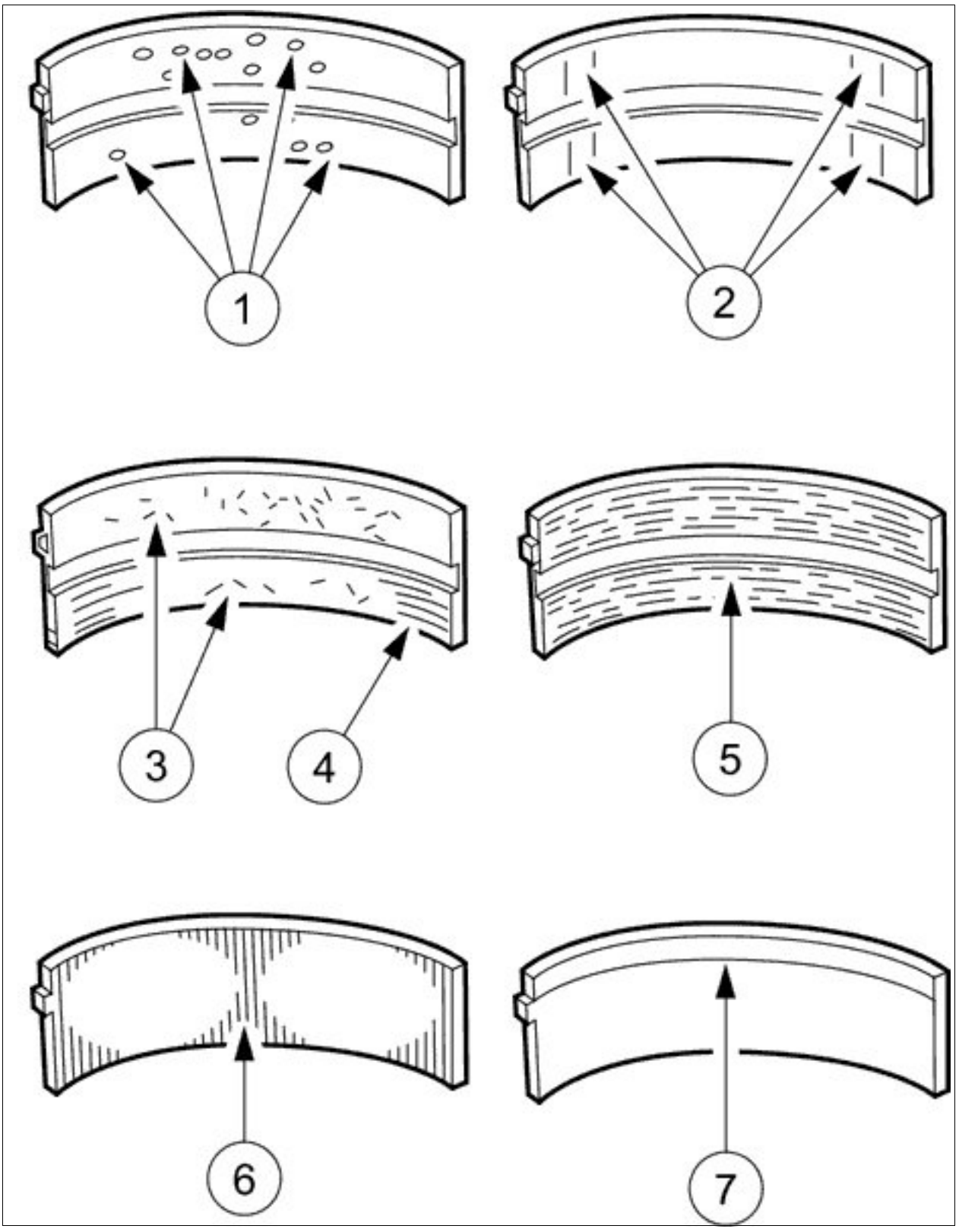

Fig. 5 Potential Bearing Defects

Connecting Rod and Crankshaft Main Bearing Journal Clearance

NOTE:

The bearing shells and journals must be free from engine oil and dirt. The measuring point should be near to the center.

- Insert the associated bearing shells, without lubrication, into the cylinder block.
- Insert the crankshaft, without lubrication, into the cylinder block.
- Position a strip of Plastigage, equal to the width of the bearing, on the bearing journal.

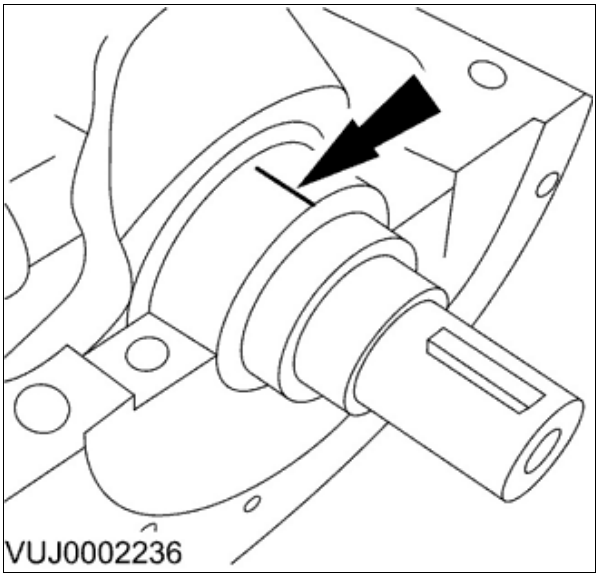

Fig. 6

NOTE:

Measure all the bearings at the same time.

- Carry out the measurement.
- Install the lower crankcase with bearing shells following the relevant tightening sequence.
- Remove the lower crankcase with bearing shells
- Compare the width of plastigage with the Plastigage scale.
- The value that is read off of the Plastigage scale is the actual bearing clearance
- If the measurement is out of the specified range, replace the bearing shells with the correct size to return the clearance to within specifications, and repeat the measurement.

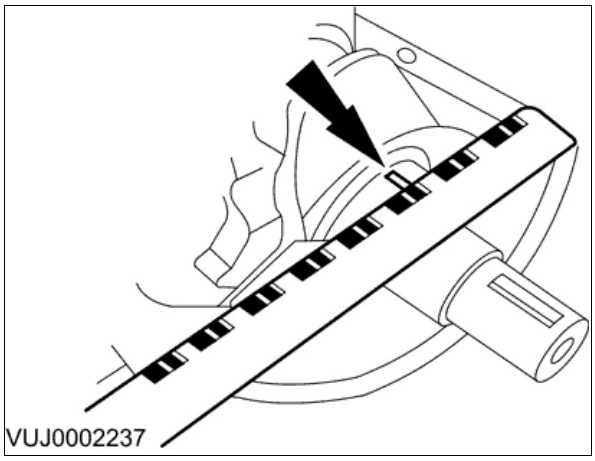

Fig. 7