

# ENGINE MEASUREMENT

## SERVICE TOOLS

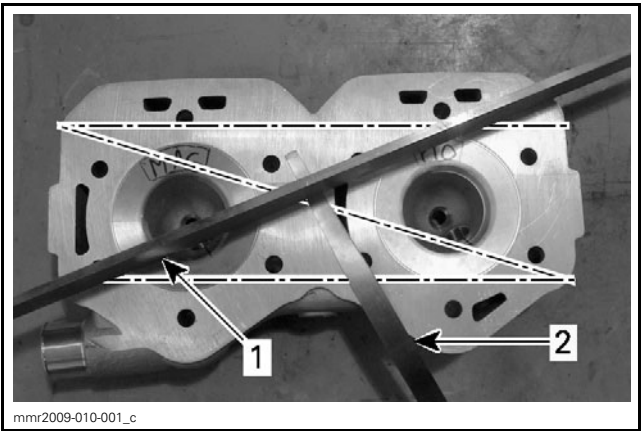
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## PROCEDURES

**NOTE:** This subsection explains the procedures to correctly measure engine components. For the engine technical specifications, refer to *INSPECTION* in the appropriate *ENGINE* subsection.

### CYLINDER HEAD WARPAGE

1. Check gasket mating surface of the cylinder head with a straight edge and a feeler gauge. Make sure part is within the given specification.
2. If cylinder head is out of specification, replace it.

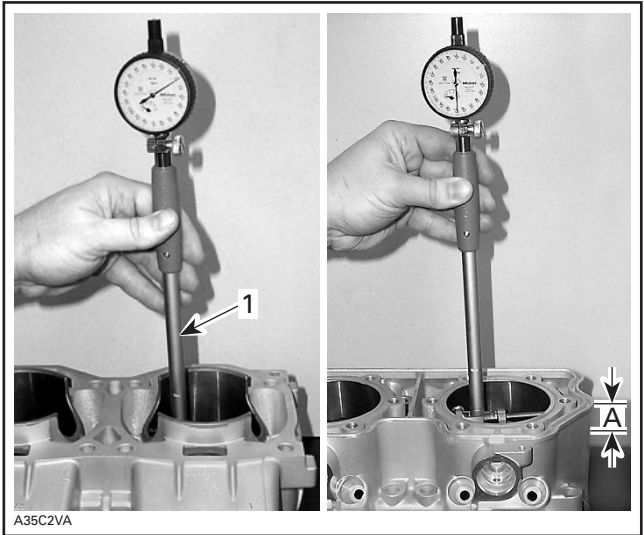


1. Straight edge
2. Feeler gauge

### CYLINDER TAPER

1. Measure cylinder diameter in the following locations:
  - Above exhaust port
  - Below intake port.
2. Compare cylinder diameters.
3. If the difference exceeds the specified dimension, the cylinder should be rebored and honed or should be replaced. Nikasil cylinder can be honed using diamond hone but can not be rebored.

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

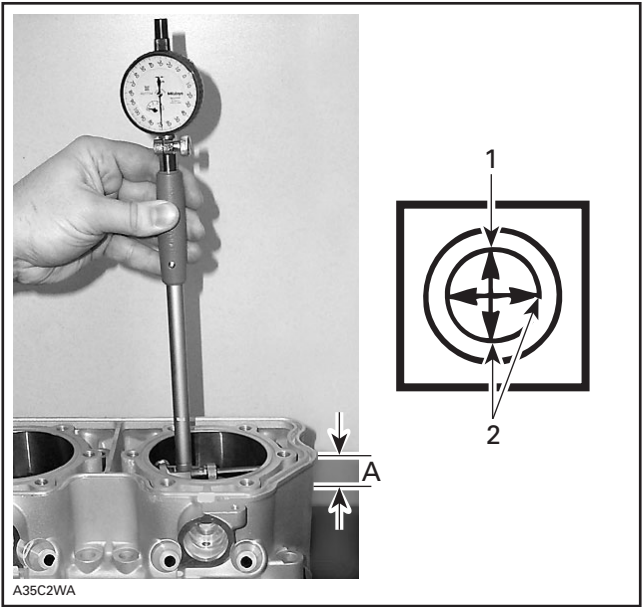


1. Below the intake port
- A. Above exhaust port

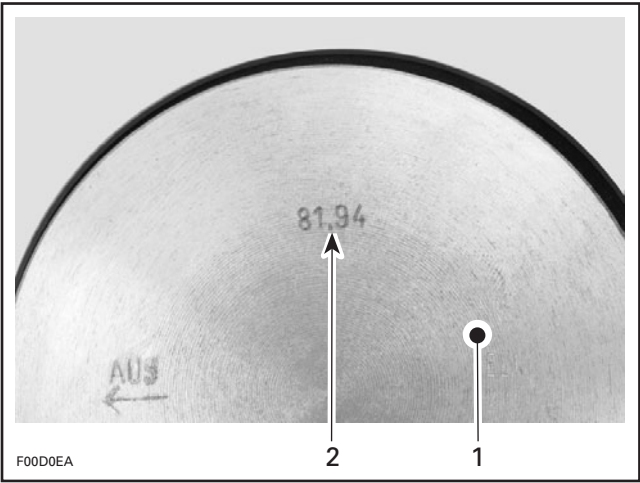
### CYLINDER OUT OF ROUND

1. Measuring above exhaust port with a cylinder gauge, check if the cylinder out of round is more than the specified dimension.
2. If larger, cylinder should be rebored and honed or should be replaced. Nikasil cylinder can be honed using diamond hone but cannot be rebored.

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



- 1. Piston pin position
- 2. Measures to be compared
- A. Above exhaust port

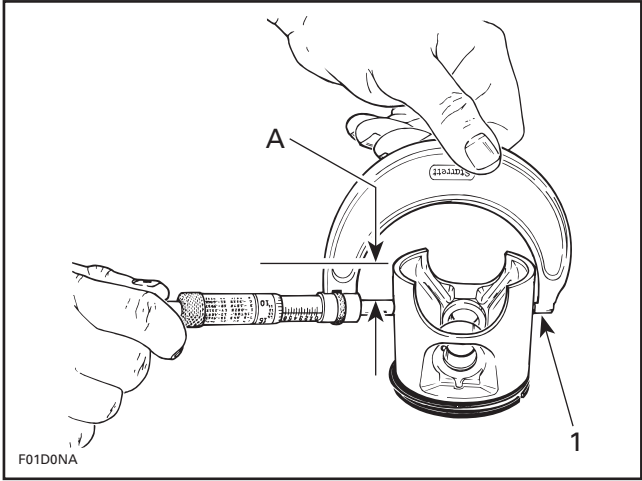


- TYPICAL**
- 1. Piston dome
  - 2. Piston diameter marking

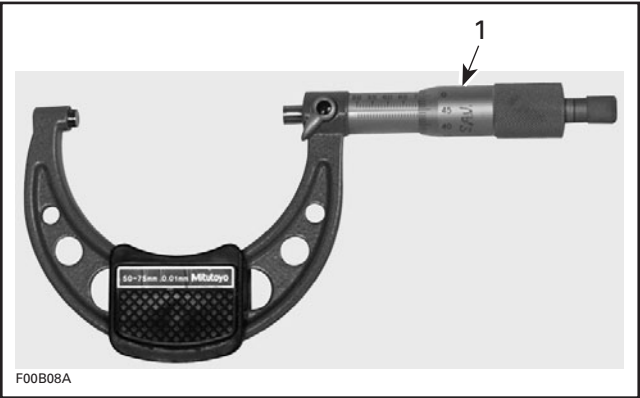
- 2. If piston is out of tolerance, install a new piston.
- 3. If piston is within tolerance, adjust and lock a micrometer to the piston diameter.

CYLINDER/PISTON CLEARANCE

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

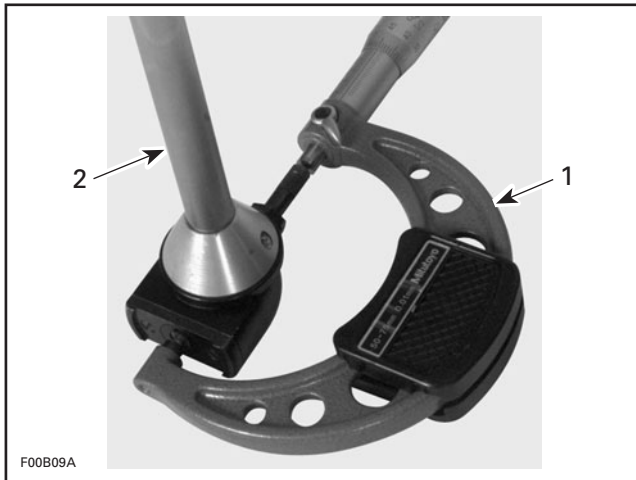


- TYPICAL**
- 1. Measuring diameter perpendicularly (90°) to piston pin axis
  - A. 15 mm (.591 in)

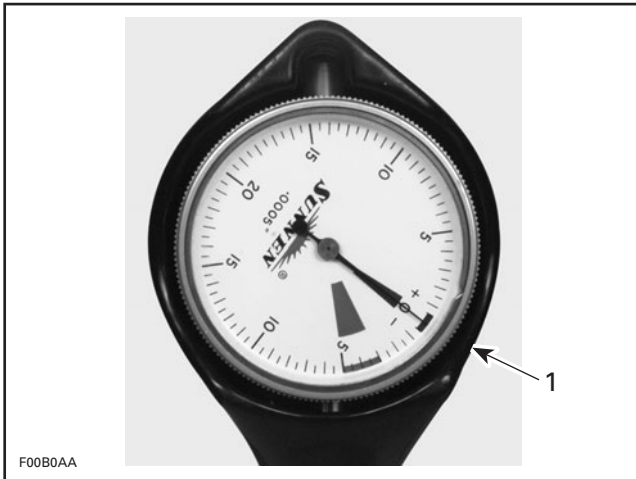


- 1. Micrometer set to the piston diameter
- 4. With the micrometer set to the piston diameter, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0.

PISTON DIAMETER	
SERVICE LIMIT	Measured diameter must not be less than 0.15 mm (.006 in) of the diameter stamped on piston dome



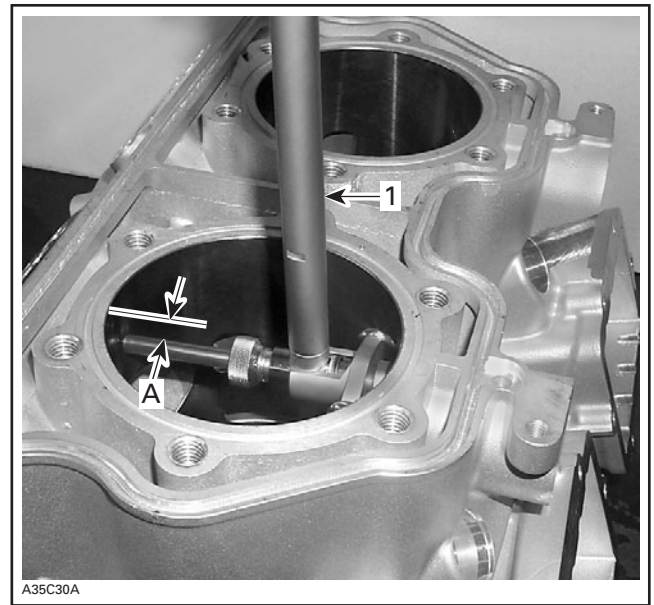
1. Use the micrometer to set the cylinder bore gauge
2. Dial bore gauge



1. Indicator set to 0 (zero)

**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.

5. Position the dial bore gauge above the exhaust port.
6. **IMPORTANT:** Always remove cylinder-block from crankcase before measuring.



1. Measuring perpendicularly (90°) to piston pin axis
- A. Above exhaust port

7. Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder wall clearance.
8. If clearance exceeds specified tolerance, replace cylinder and piston.

## RING/PISTON GROOVE CLEARANCE

1. Using a feeler gauge check clearance between rectangular ring and groove.
2. Replace piston if clearance exceeds specified tolerance.

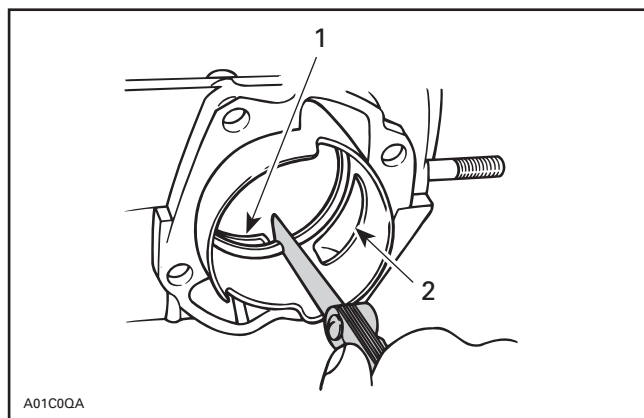


### RING END GAP

1. Position ring halfway between transfer ports and intake port.

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

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



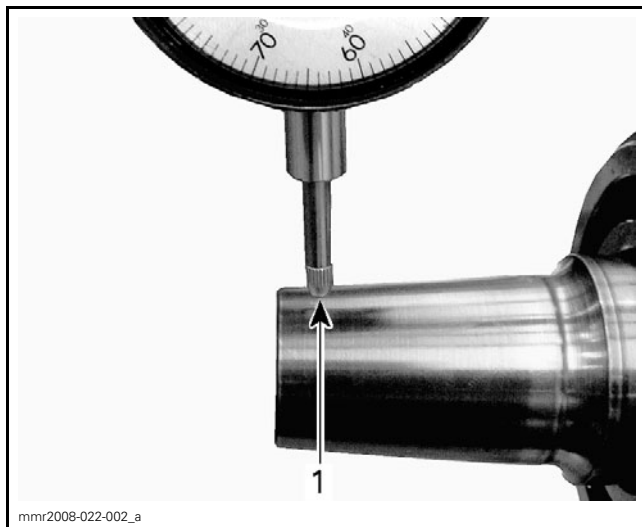
**TYPICAL**

1. Transfer port
2. Intake port

### CRANKSHAFT DEFLECTION

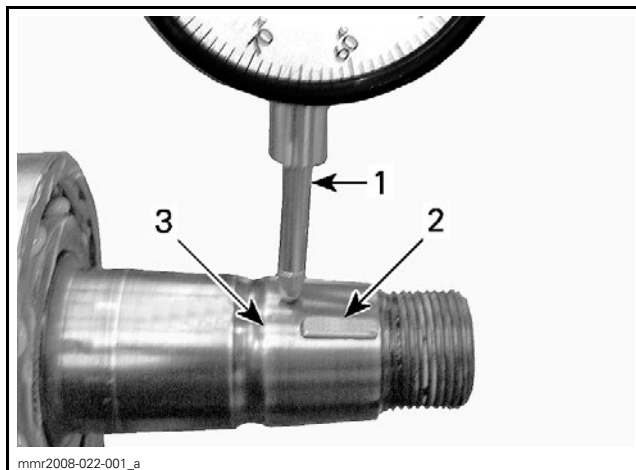
#### Measuring in Crankcase

1. Using a dial indicator, check deflection with crankshaft in crankcase.



**TYPICAL — PTO SIDE**

1. Measure deflection 3 mm (1/8 in) from crankshaft end



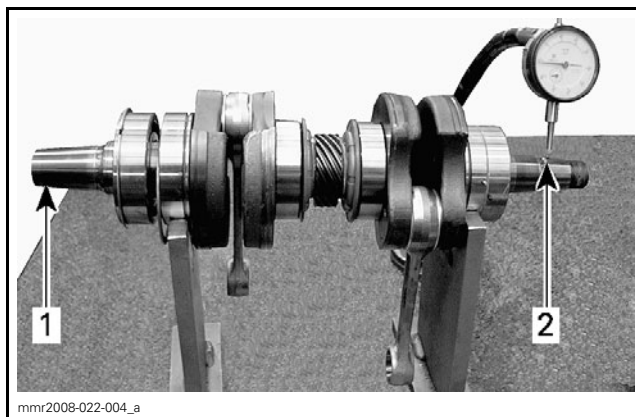
**TYPICAL — MAG SIDE**

1. Measure deflection at mid point between key and groove
2. Key
3. Groove

2. If deflection exceeds the specified tolerance, recheck deflection using V-shaped blocks to determine the defective part(s). See *MEASURING ON BENCH*.

#### Measuring on Bench

1. Once engine is disassembled, check crankshaft deflection on V-shaped blocks.

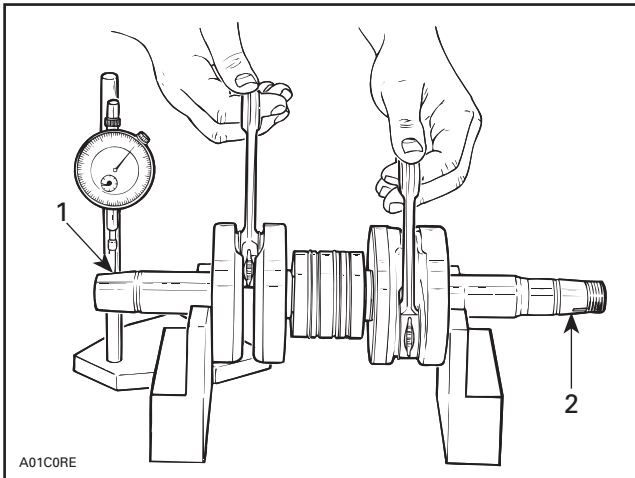


**TYPICAL — V-SHAPED BLOCKS POSITION WITH BEARINGS**

1. Measure deflection 3 mm (1/8 in) from crankshaft end
2. Measure deflection at mid point between key and groove

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

2. If deflection exceeds the specified tolerance, it can be worn bearings or a bent crankshaft.
3. Remove crankshaft bearings and check deflection again on V-shaped blocks to determine the defective part(s).



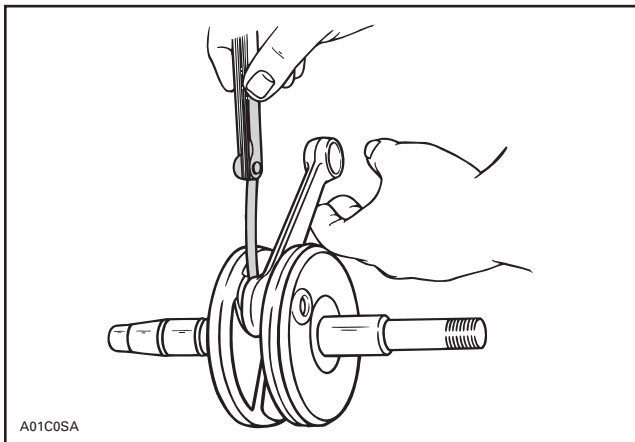
#### TYPICAL — V-SHAPED BLOCKS POSITION WITHOUT BEARINGS

1. Measure deflection 3 mm (1/8 in) from crankshaft end
2. Measure deflection at mid point between key and groove

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

### CONNECTING ROD BIG END AXIAL PLAY

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



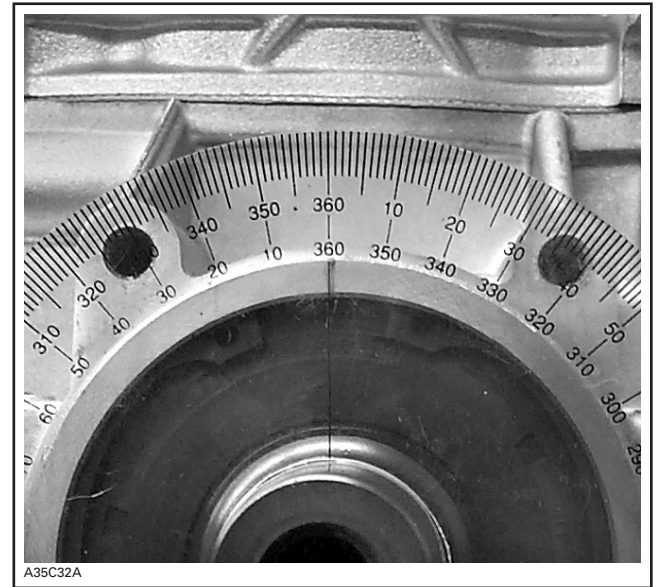
TYPICAL

### CRANKSHAFT ALIGNMENT

1. Remove injectors. Refer to *E-TEC DIRECT FUEL INJECTION* subsection.
2. Bring MAG piston at top dead center. Refer to *IGNITION SYSTEM* subsection.
3. Scribe a mark on crankcase (see illustration).

4. Install a degree wheel on crankshaft end so that 360° mark aligns with the mark on crankcase. Do not rotate crankshaft.

REQUIRED TOOL	
DEGREE WHEEL (P/N 529 035 607)	



5. Remove dial indicator and install it in spark plug hole on PTO side.
6. Bring PTO piston to top dead center. Degree wheel must rotate with crankshaft.
7. Interval between cylinders must be  $180^\circ \pm 0.5$ .
8. Any other reading indicates a misaligned (twisted) crankshaft.

### PISTON PROJECTION MEASUREMENT


**NOTE:** The piston projection measurement is used to determine the correct cylinder base gasket thickness when engine components are replaced.

#### Engine Preparation

**NOTE:** As a troubleshooting step, It is possible to measure piston projection without removing engine from vehicle.

1. Bring PTO piston to TDC.



Subsection XX (ENGINE MEASUREMENT)

REQUIRED TOOL	
TDC DIAL INDICATOR (P/N 295 000 143)	

- 2. Remove cylinder head from engine. Refer to *TOP END* subsection.
- 3. Remove O-rings from cylinder block.
- 4. Clean top surface of cylinder block.
- 5. Ensure piston dome is clean and free of any carbon deposits.
- 6. Ensure cylinder block screws are properly tightened.

Measurement

- 1. Place piston projection tool on a flat steel surface.

REQUIRED TOOL	
PISTON PROJECTION (P/N 529 036 215)	
TDC DIAL INDICATOR (P/N 295 000 143)	

- 2. Rotate dial indicator face to position the **0** in line with needle.



SETTING THE ZERO

- 3. Install tool on PTO cylinder.
- 4. Center tool with cylinder to ensure that dial indicator reads piston dome.



TOOL PROPERLY CENTERED

- 5. Ensure that PTO piston is set to TDC.
- 6. Read dial indicator then note measurement.



TYPICAL

**NOTE:** Convert dial indicator measurement to millimeter.

- 7. Check if piston projection is according to specification. Refer to *TOP END* subsection.

**NOTICE** Take care to use the proper specification according to the type of engine and the model of vehicle.

- 8. Repeat procedure for MAG cylinder.
- 9. If piston projection is out of specification, replace base gasket.

**NOTE:** A thicker base gasket will lower the piston projection measurement.