KIT TOOLS MANUAL
For
Engine Assembly

YEC
RACING PARTS

Preface

This manual provides motorcycle teams with clear information on a line of tools that simplify basic tuning. We believe that these tools make engine tuning accessible to beginners and bring efficiency to professional tuners.

Through this manual, we present a method to:

- Set up camshaft
- Measure squish height
- Install pistons
- Fit valves into the cylinder head

Contents

1 Camshaft Setting

2 Measurement of squish height

3 Piston installation

4 Valve fitting

1 Camshaft Setting

Basically, you need to adjust a camshaft's timing in the following cases Basically, you must control and or adjust a camshaft's timing in the following cases:

- When you replace a standard camshaft by a YEC kit camshaft
- When you are tuning an engine in stock condition
- When you change a cylinder head gasket or cylinder base gasket thickness
- When you grind the cylinder head or cylinder body
- When you fit Superbike pistons

1.1 Basic tools

MGC-A3589-80 ADJUSTMENT TOOL for valve timing basic kit

Item	Qty
Gauge to measure valve position	2
Lever to lift up the valve	1
Timing wheel	1
TDC (Top Dead Centre) detecting tool	1

Beside this basic kit, you need to prepare an "Attachment Tool" for your engine (model) as shown below.

Attachment tool

Tool number	Tool name	Model
2CO-2816-70	ATTACHMENT TOOL	2006 - 2009 YZF-R6
2CO-2816-70	ATTACHMENT TOOL	2009 YZF-R1

Note : The "Attachment tool" set is delivered without dial gauges.

1.2 Other tools

In order to work effectively and precisely, you need to use the appropriate tools (such as spanner). To drive the timing wheel, we recommend that you use a long ratchet wrench with a 22mm socket. A **long wrench** will help you to smoothly and precisely drive the engine crankshaft. With this method, you will be ensured to reach perfect piston TDC.

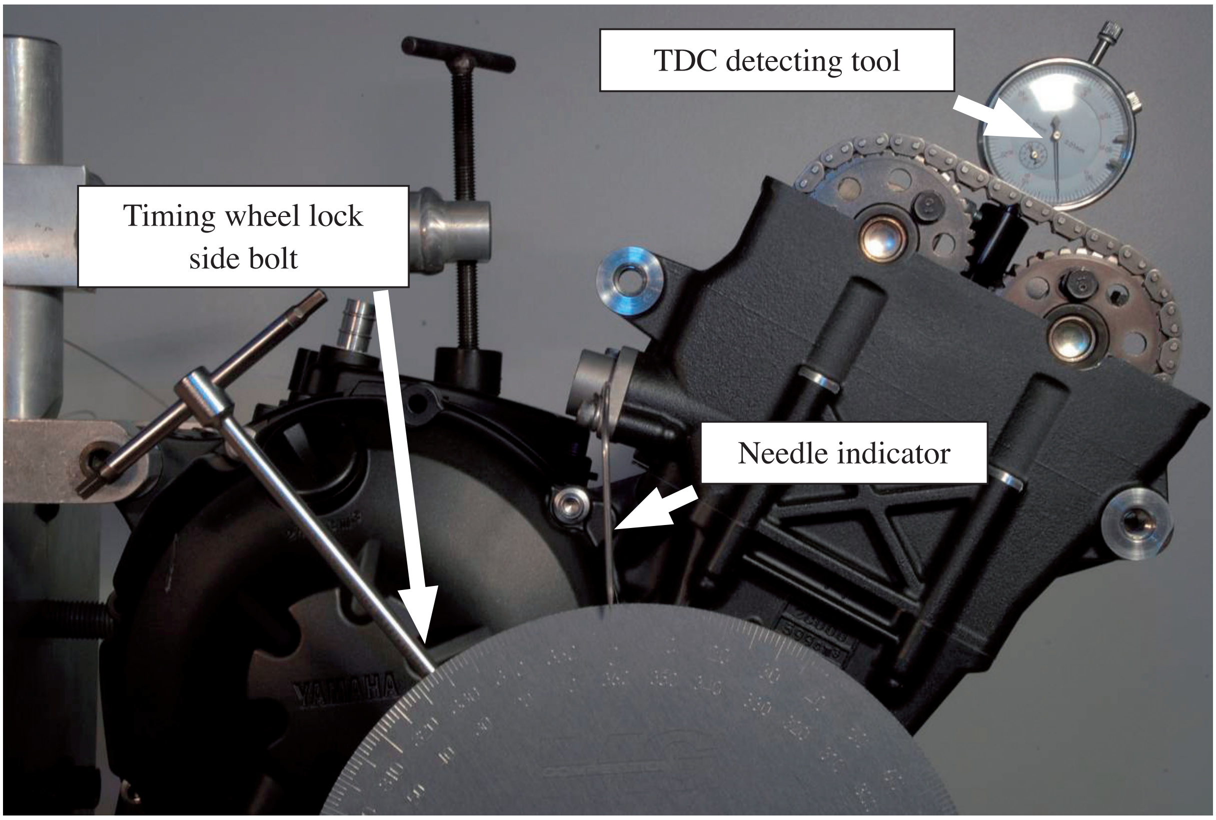
1.3 Setting

1.3.1 Detecting the TDC (Top Dead Centre)

The first stage of camshaft setting consists of locating the crankshaft position. Crankshaft position is displayed by a timing wheel. To fit the timing wheel to the engine, unscrew the bolt situated on the right side of the engine crankshaft. Then, with a 22mm socket on a ratchet, drive the engine crankshaft.

Then, fit a needle to indicate the crankshaft position.

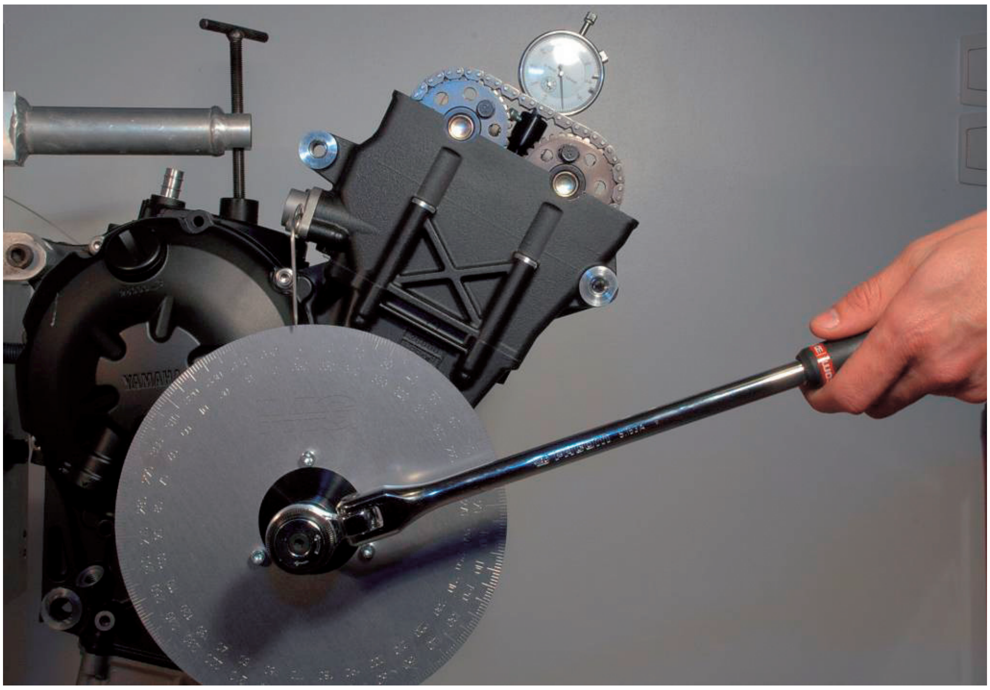
Finally, screw the TDC detecting tool into the spark plug hole.



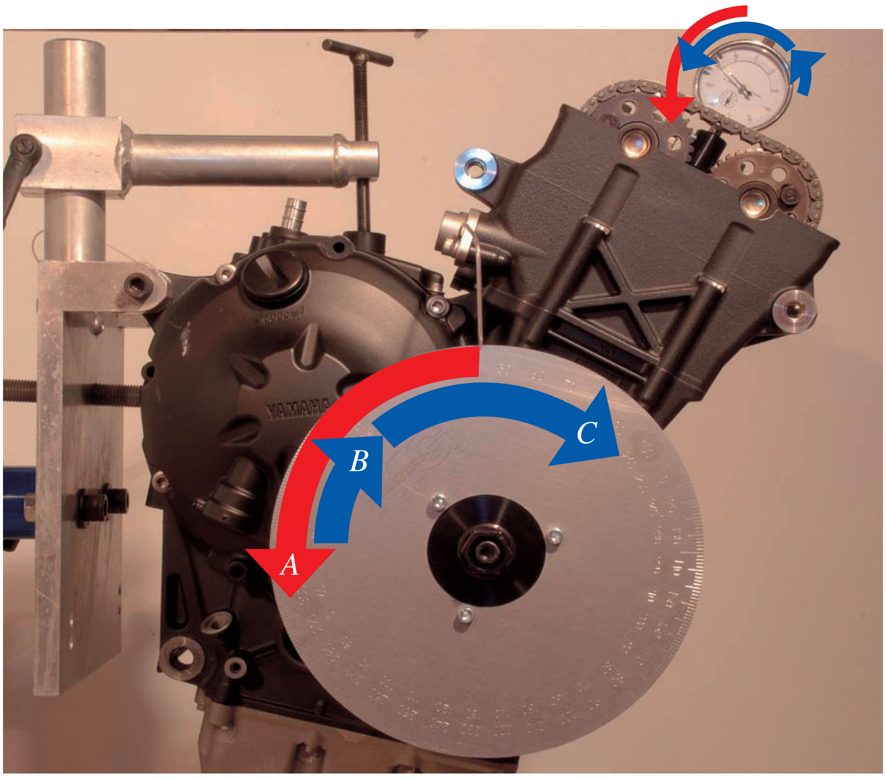
Once the tools are installed on the engine, you can start to detect the TDC.

Quickly reach the TDC (TDC dial gauge detecting piston position. When the dial gauge indicates top position, turn the scaling in order to set 0 mm on the gauge)

Unscrew the lock side bolt of the timing wheel and put the "0°" angle in front of the needle



Once you roughly set up the timing wheel position, you must control and re-adjust precisely the "0°" of the timing wheel. Then, turn the crankshaft in order to move down the piston 2 mm on each side of the TDC (before and after Top Dead Center). Meanwhile, each time, be aware that the **crankshaft should be driven clockwise (the usual crankshaft direction)** to clear out all back clearance from a counter-clockwise rotation. This remark is particularly important during camshaft setting. In this case, we suggest driving backwards (counter-clockwise) so that the piston goes down a minimum of 3mm **(Direction A pictured)**. Then, you may run the crankshaft clockwise to clear out the back clearance **(Direction B and C pictured)**.



The table below describes the steps you must follow to adjust the final position of the timing wheel.

			Piston position		
			2mm BTDC ***B position***	**TDC**	**2mm ATDC** ***C position***
Angle in Degree on the timing wheel	Stage 1	Set timing wheel position roughly		**" 0° "**	
	Stage 2	Measurement at 2mm before and after Top Dead Center	22°		24°
	Stage 3	1st adjustement of the timing wheel	22.5°		23.5°
	Stage 4	2nd adjustment of the timing wheel	23°	**0°**	23°

The angles indicated above are an example. You may measure different values

Symmetrical degree on each side of the *timing wheel* => the timing wheel correctly indicates TDC

You must go through these steps as there is backlash (about 2 to 3 degrees in timing wheel angle). You must repeat the stages in order to get the same angle on the timing wheel when the piston is 2mm symmetrically before and after the Top Dead Center.

On the sample, in stage 4, the timing wheel is in the correct position. This is the starting point for the measurement of the camshaft event angle.

1.3.2 Setting the exhaust camshaft

As the exhaust camshaft is the first one driven by the chain, we recommend starting the camshaft setting on the exhaust side. To measure cam position, fit the "Adjustment Tool" on the left side of the cylinder head.

Be aware, that gauge should measure a complete valve stroke (Drive 360° the camshaft to control the gauge stroke). You may adjust the gauge altitude with the clamp screw. Once you have been through this point, you may start camshaft position measurement.

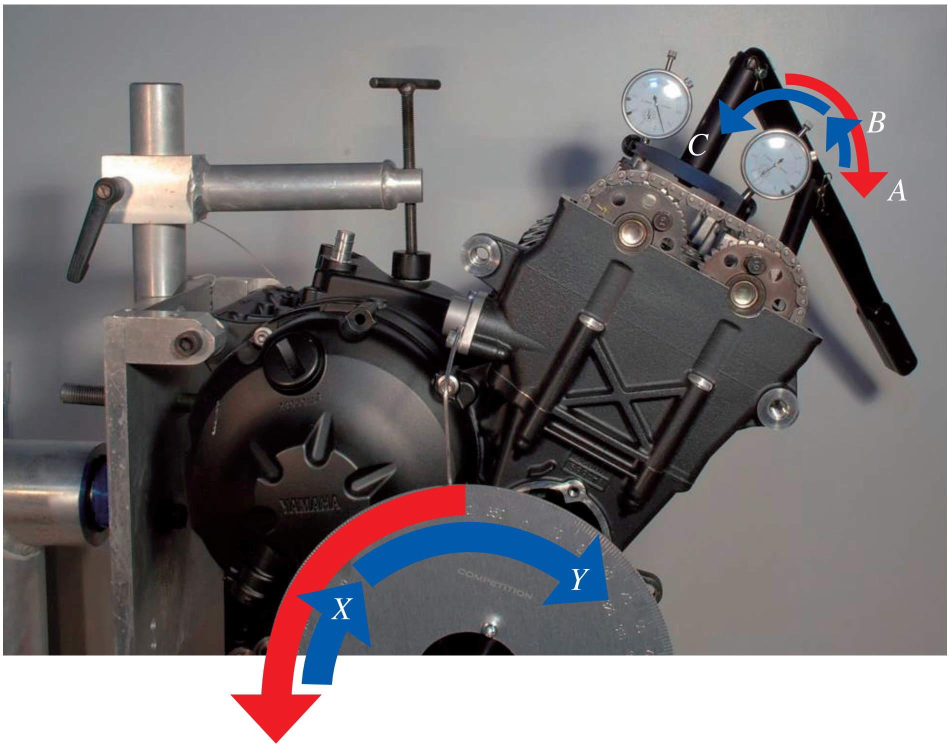
- Measurement of event angle

By definition, event angle means the crankshaft position at maximum valve lift.

First of all, you have to quickly reach the valve maximum lift. Then, adjust the valve gauge scaling to the "0 mm" position. In a similar way as the method used to reach the piston TDC, you are going to measure the crankshaft angle on each side of the maximum valve lift. Moreover, to clear out backlash between the chain and cam sprocket, **it is imperative to drive the crankshaft clockwise.**

Near the maximum valve lift point, read the crankshaft position on the timing wheel. With these two values, you are calculating the exhaust camshaft event angle.

To get the timing wheel angle, follow the procedure below.

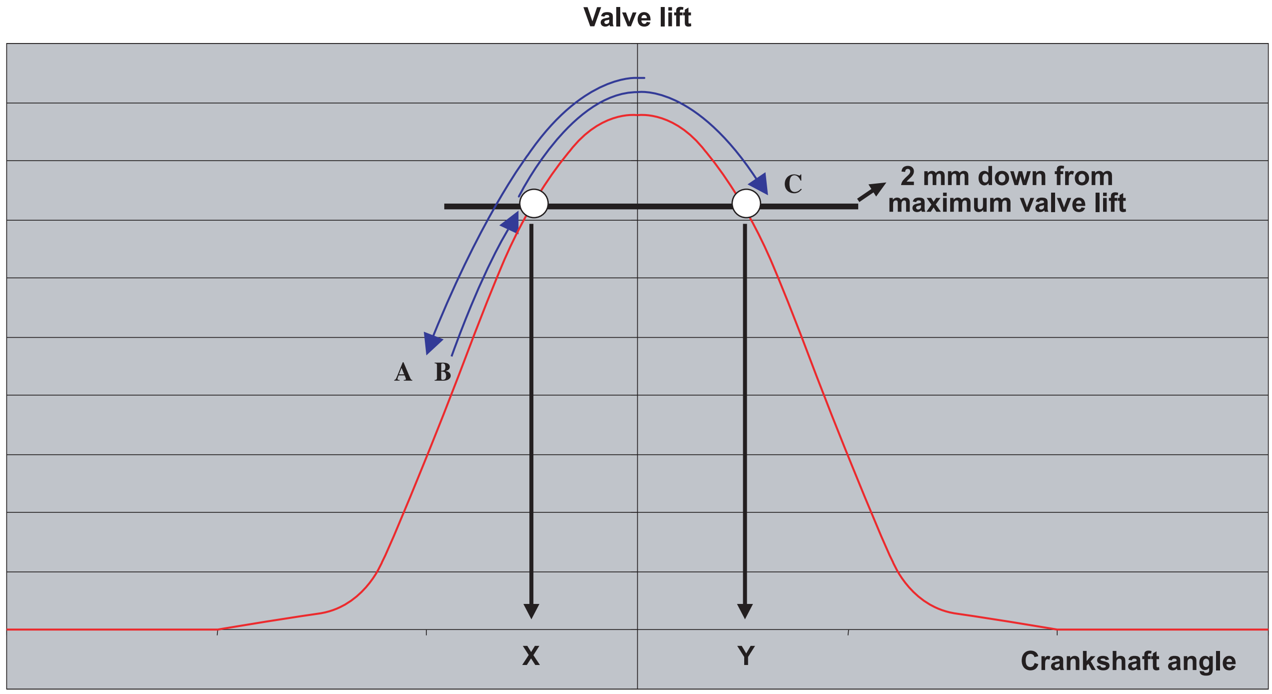


1. turn the crankshaft counter-clockwise with a minimum of **3mm down on the valve (A)**
2. turn the crankshaft clockwise in order to clear out the backlash from the chain and camshaft sprocket and reach the position of the valve **2 mm down before maximum lift** (the value on the timing wheel is **"X"** from outside angle scale on the timing wheel) **(B)**
3. then drive the crankshaft clockwise again to reach **2mm down after maximum lift** and note the crankshaft angle (value on the timing wheel is **"Y"** from the outside angle scale on the timing wheel) **(C)**
4. Then calculate the camshaft event angle:

Calculating formula: **Exhaust event angle**

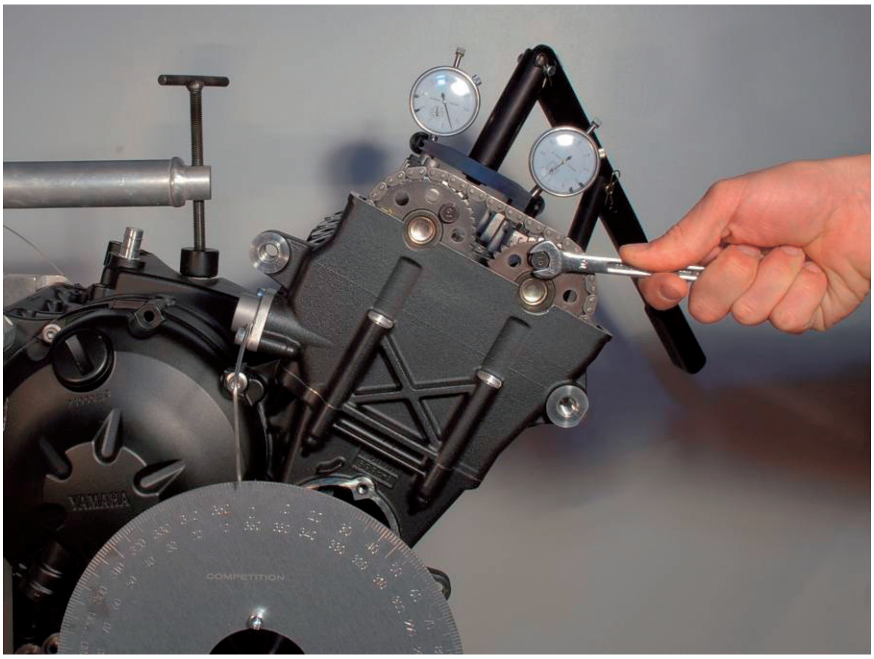
Exhaust event angle = (X+Y) / 2 (From outside timing wheel angle scale)

The graph below describes the valve lift curve.



Once you have measured the position of the camshaft, you may need to change it. In any case, you have to follow the **recommended data from the Kit Manual.**

To change the position of the camshaft, unscrew the sprocket bolts and drive the crankshaft to make the sprocket turning a tiny angle around the camshaft. Then, tighten the bolts and measure the position of the camshaft.



You must repeat this operation until you reach the recommended camshaft position.

Repetitive operation table

			Valve position		
			2mm down Before maximum lift	Maximum lift	2mm down After maximum lift
Angle in Degree on the timing wheel	Stage 1	Measurement of the original camshaft position		**115°**	
	Stage 2	Second measurement after modifying camshaft position		**108°**	
	Stage 3	Third measurement after modifying camshaft position	169°	**111°**	53°
	Stage 4	Fourth measurement after modifying camshaft position	168°	**110°**	52°

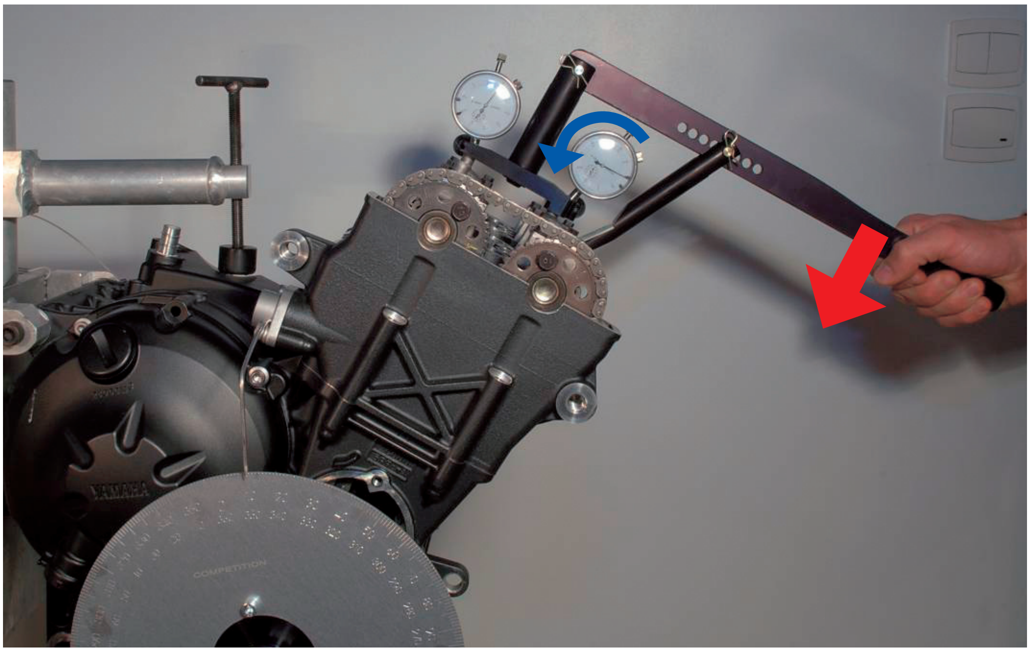
The angles indicated above are an example. You may measure different values

Measure repeatedly to acquire the recommended position

• Measurement of valve to piston clearance

Once the camshaft has reached the event angle target, you must control the clearance from the valve to piston. On the exhaust side, the minimum distance from valve to piston is situated at 10 degrees before TDC.

To measure this clearance, the Kit Adjustment tool includes a lever. This lever, as you may see in the following picture, is pushing the tappet valve. The distance from valve to piston is displayed on the gauge.



Stage of the valve to piston measurement:

1. Place the crankshaft 10° BTDC
2. Turn the gage scaling so that the needle displays "0mm"
3. Apply force on the lever in order to lift the valve till the valve hits the piston
4. Read the position of the needle on the gauge

The minimum distance between valve and piston is mentioned in the kit manual. To avoid any engine failure, you can not go lower than the recommended values. Moreover, in case of a distance between valve and piston measured under the minimum value (due to the use of special parts), it is recommended to move out the camshaft in order to secure the valve to piston distance.

Give preference to the valve to piston distance (valve clearance) over the event angle.
Once the exhaust camshaft event angle has reached kit manual recommended value and valve to piston clearance over the minimum secure distance, you can start to set up the intake camshaft.

1.3.3 Setting intake camshaft

The method used to set up the intake camshaft is similar to setting the exhaust.

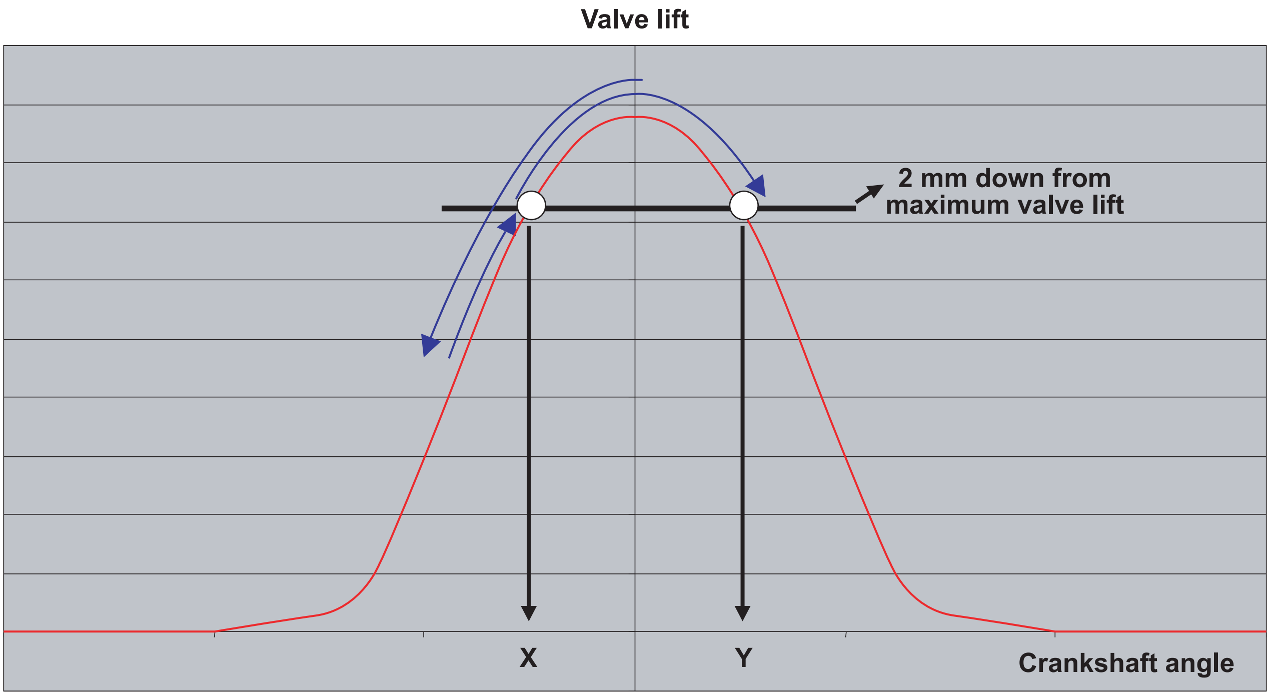
• Measurement of event angle

1. Reach maximum lift of intake valve by driving the crankshaft
2. Adjust the intake gauge scaling to the "0 mm" position
3. Lower the intake valve about 3mm by turning the crankshaft counter-clockwise
4. Lift the valve up to reach 2mm before maximum lift by turning the crankshaft clockwise (position of the timing wheel = X from inside angle on the timing wheel)
5. Symmetrically after maximum lift, lower the intake valve to 2mm by turning the crankshaft clockwise (position of the timing wheel =Y from inside angle on the timing wheel)
6. Calculate the camshaft event angle by using the following formula:

Calculating formula: **Intake event angle**

Intake event angle = (X+Y)/2 (From inside timing wheel angle scale)

The graph below describes the movement of the intake valve through crankshaft position



In case of re-adjustment of the camshaft event angle, you may proceed in a similar way as the method described in the paragraph concerning the exhaust camshaft.

• Measurement of the valve to piston clearance

The final intake camshaft setting requires controlling the distance from valve to piston. This distance takes priority over the event angle.

The minimum distance from valve to piston is mentioned in the Kit manual. This value may change depending on the model year and model type.

The method of measurement is similar to the method of measuring the exhaust. Meanwhile, the minimum distance from the intake valve to pistons occurs at 10 degrees After TDC.

Stage of the valve to piston measurement:

1. Place the crankshaft 10° ATDC
2. Turn the gauge scale so that the needle displays "0mm"
3. Apply force on the lever in order to lift the intake valve till the valve hits the piston
4. Read the position of the needle on the gauge

1.3.4 Specified value for camshaft setting

The specified value for camshaft setting is mentioned in the Kit manual. Since the value may change depending on the model year and model type, be sure to refer your engine model to the matching kit manual.

1.3.5 Resume of camshaft setting stages

> Fitting the timing wheel so that 0° of the scale indicate piston Top Dead Center

1. Roughly reach TDC and set 0mm on the TDC dial gage
2. Adjust the angle of the timing wheel so that it becomes symmetric when the piston is 2mm down before and after TDC
3. Re-adjust the timing wheel position if necessary

> Setting the exhaust camshaft

1. Reach maximum exhaust valve lift and set 0 mm on the dial gauge
2. Measure crankshaft angle position when the valve is symmetrically 2mm down from maximum lift
3. Calculate the camshaft event angle
4. Adjust the camshaft event angle if necessary
5. Measure valve to piston clearance
6. Re-adjust the camshaft event angle if necessary

> Setting intake camshaft

1. Reach maximum intake valve lift and set 0 mm on the dial gauge
2. Measure the crankshaft angle position when the valve is symmetrically 2mm down from maximum lift
3. Calculate the camshaft event angle
4. Adjust the camshaft event angle if necessary
5. Measure valve to piston clearance
6. Re-adjust the camshaft event angle if necessary

2 Measurement of squish height

The squish height is the distance between the piston and cylinder head. Through this paragraph, you will find the stages to adjust squish height.

The squish height must be controlled and adjusted in the following cases:

- When you change cylinder head gasket or cylinder base gasket thickness
- When you grind cylinder body height
- When you perform engine maintenance

2.1 Basic tools

To measure squish height, use MGC-A3108-07-05 SQUISH TOOL in addition to MGC-A3589-80 ADJUSTMENT TOOL.

- Dial gauge bridge

2.2 Other tools

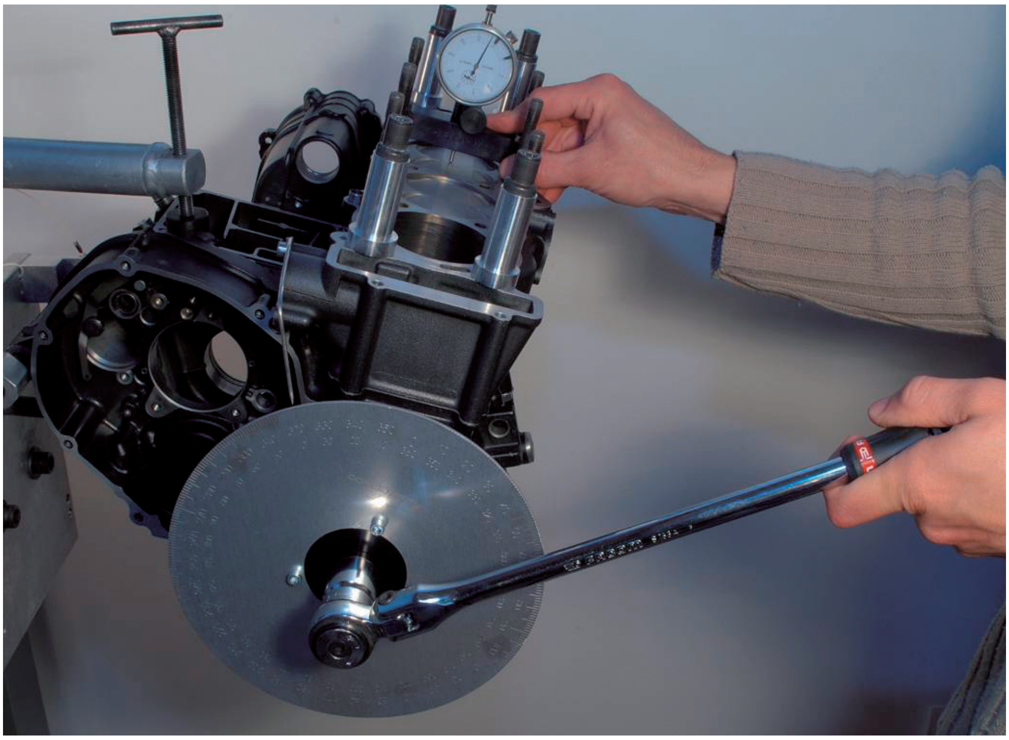
No specific spanner is required for this measurement.

2.3 Measuring method

2.3.1 Detecting the TDC (Top Dead Centre)

To achieve this process, it is not necessary to precisely adjust the timing wheel. The dial gauge bridge is placed on the piston centre. Then, by rotation of the crankshaft, the dial gage needle indicates the TDC when it reaches the highest position.

When the piston reaches the TDC position, we usually horizontally rebalance the piston in order to provide an accurate piston depth measurement.

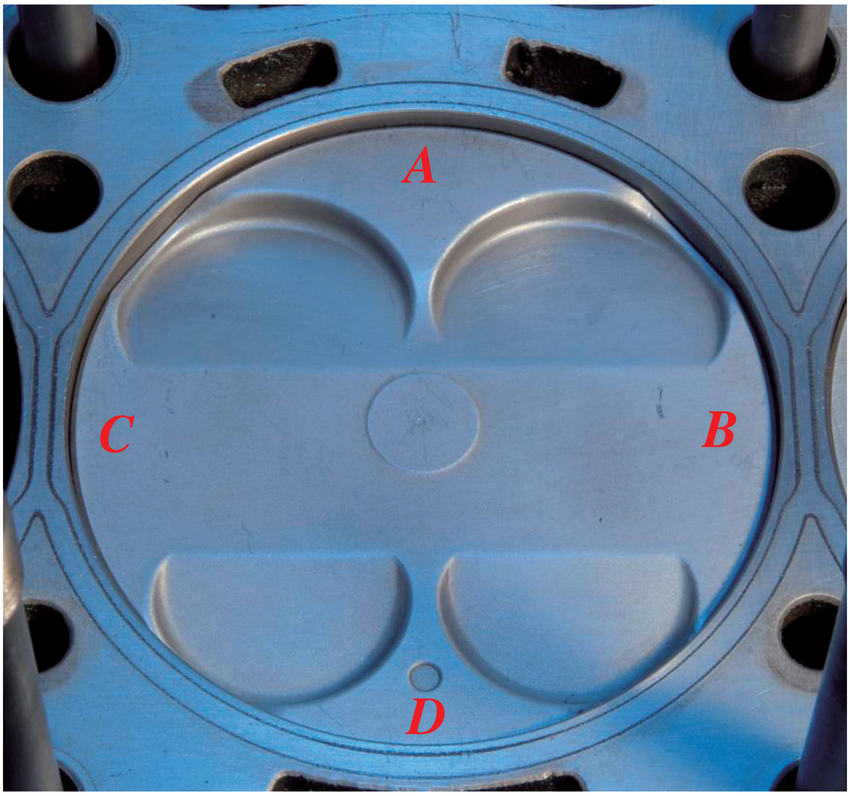


The dial gauge indicates TDC when the needle reaches maximum value.

2.3.2 Measurement of piston depth

Once the piston reaches the TDC, you may begin measuring piston depth.

To provide an accurate piston depth measurement, you usually measure 4 points (Points A, B, C, and D pictured). This measurement is applied to each piston.



Measure the 4 points of each piston as below and transfer the information to the table below. Before presenting the bridge on piston top, it is necessary to adjust the dial gauge scale to 0 mm on a table.

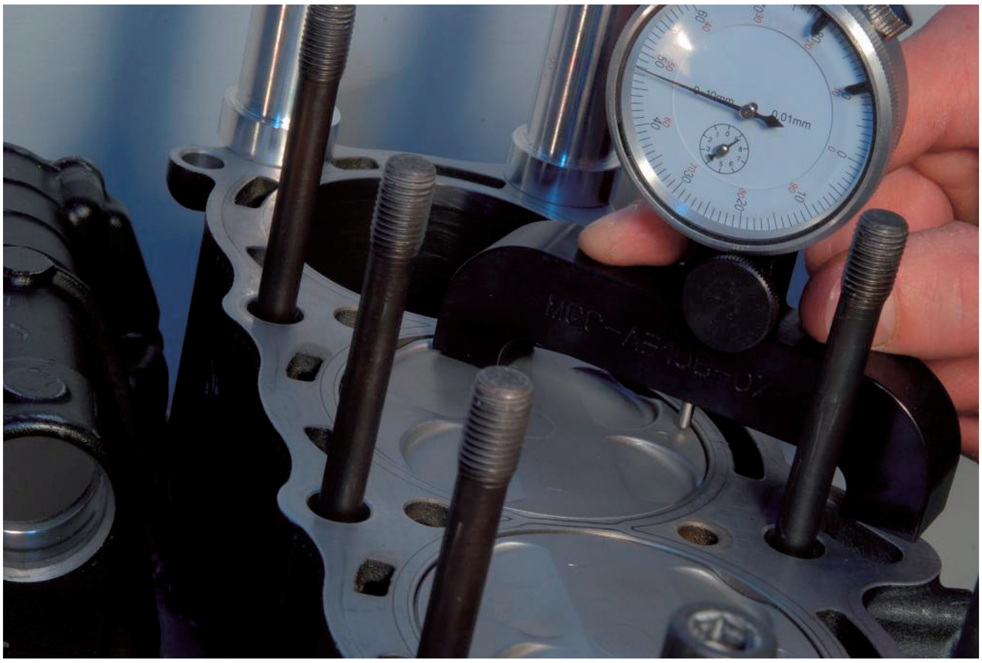


Chart: Piston

Piston Number	
A	B
C	D

Once all 4 pistons and 4 points are measured, calculate the piston depth average. The average of those 4 points defines the piston depth. This value is transferred to the table below.

The value that will be used for the calculation of squish is the minimum value of average. That means the highest piston position.

	Piston Number							
	1		**2**		**3**		**4**	
Piston depth								
Average of 4 measurement points								

Note: piston depth may be influenced by the cylinder base gasket thickness on R1 engines.

2.3.3 Calculation of squish height

Squish height is the distance from piston to cylinder head. You may define the squish height by the following formula:

Calculating formula: **Squish height**

Squish height = minimum piston depth + Cylinder Head gasket thickness

Usually, we are following recommended squish height (from Kit Manual) and calculate cylinder head gasket thickness

Calculating formula: **Cylinder Head gasket thickness**

Cylinder Head gasket thickness = Squish height - minimum piston depth

2.3.4 Specified value for squish height

The minimum squish heights are mentioned in the kit manual. It is imperative to follow that data to avoid any engine failure.

2.3.5 Summary of squish measurement stages

1. Reach piston TDC
2. Measurement of 4 points of 4 pistons
3. Calculation of piston depth average
4. Calculation of squish height according to cylinder head gasket thickness

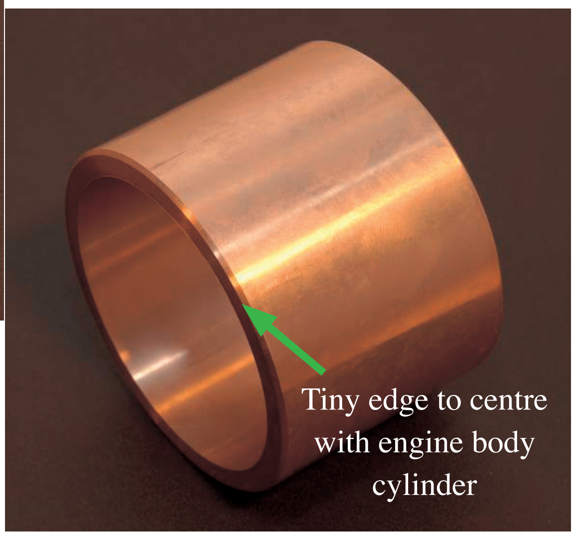
3 Piston installation

Following engine maintenance, or deep tuning, the tuner (mechanic) needs to install the pistons into the cylinder body. As this operation is sensitive, YEC developed a tool to install pistons efficiently and safely.

3.1 Basic tools

Tool number	Tool name	Model
MGC-A2708-07-02	PISTON and PISTON RING INSTALLATION TOOL	2006 - 2009 YZF-R6
MGC-A290908-00	PISTON and PISTON RING INSTALLATION TOOL	2009YZF-R1

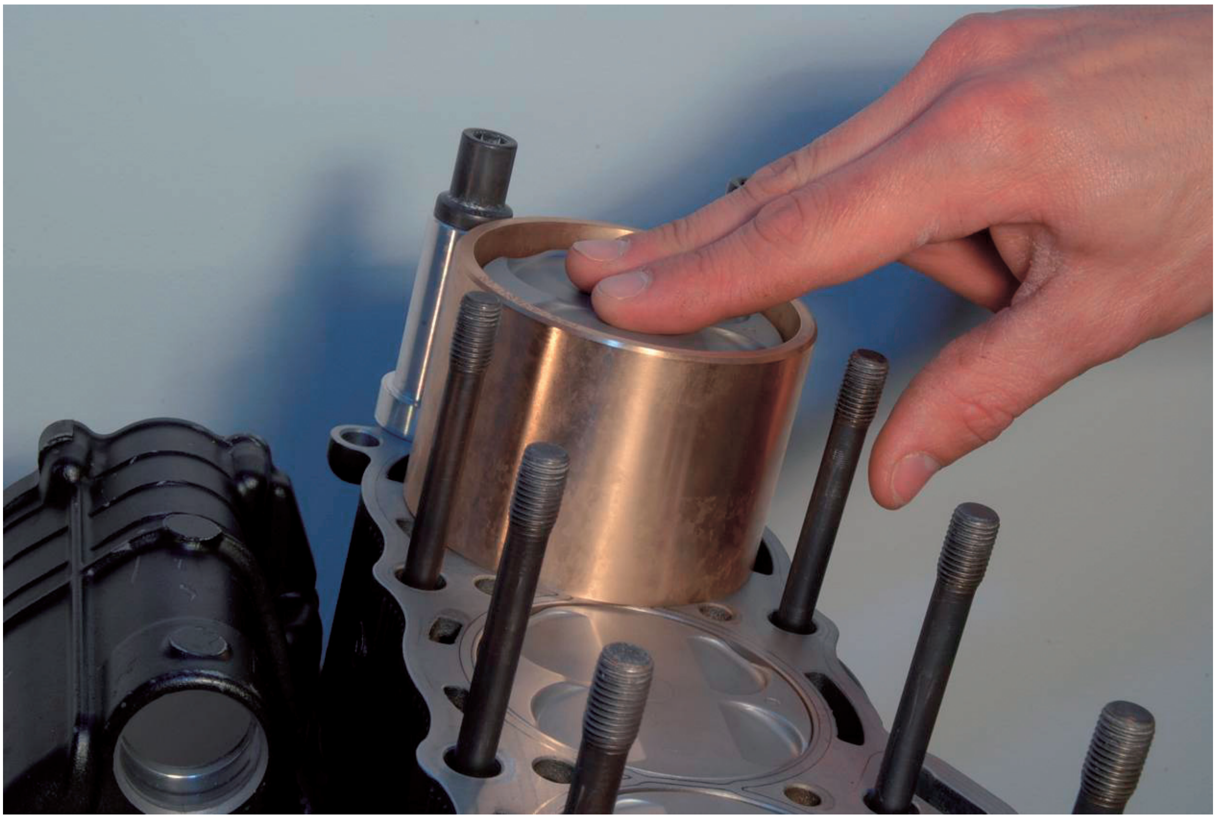
The basic tool is a brass cylinder. This cylinder is designed with an edge on the bottom side to center the piston cylinders to the engine cylinders.
On the upper side, from top to bottom, there is a light angle that makes it easier to put the piston rings in place.



3.2 Fitting pistons

First, fit the ring in the piston ring grooves by following the Service Manual of the base model.
Then with some lubricant, insert the couple piston / conrod in the brass cylinder. Push the piston until the piston skirt appears underneath the cylinder brass.
Position the cylinder brass upper cylinder body and center with piston skirt and brass cylinder edge.

Slip the piston smoothly into the cylinder body.



3.3 Tightening the conrod bolts

Once the pistons are installed in the engine, you must tighten the conrod bolts to the crankshaft.

Note: Be sure to follow the Service Manual of the base kit.

3.4 Summary of piston installation

1. Install rings in piston ring grooves
2. Piston assembly with conrod
3. Insert piston in the brass cylinder with lubricant
4. Push the piston from brass cylinder to the engine body cylinder
5. Tighten the conrod bolts
6. Re-assemble the engine

4 Valve fitting

To simplify and make easier valve assembly, YEC has devised a VALVE ASSEMBLY TOOL and a VALVE STORAGE BOX.

4.1 Basic tools

Tool number	Tool name
MGC-A3108-07-06	STORAGE BOX and VALVE ASSEMBLY BOARD

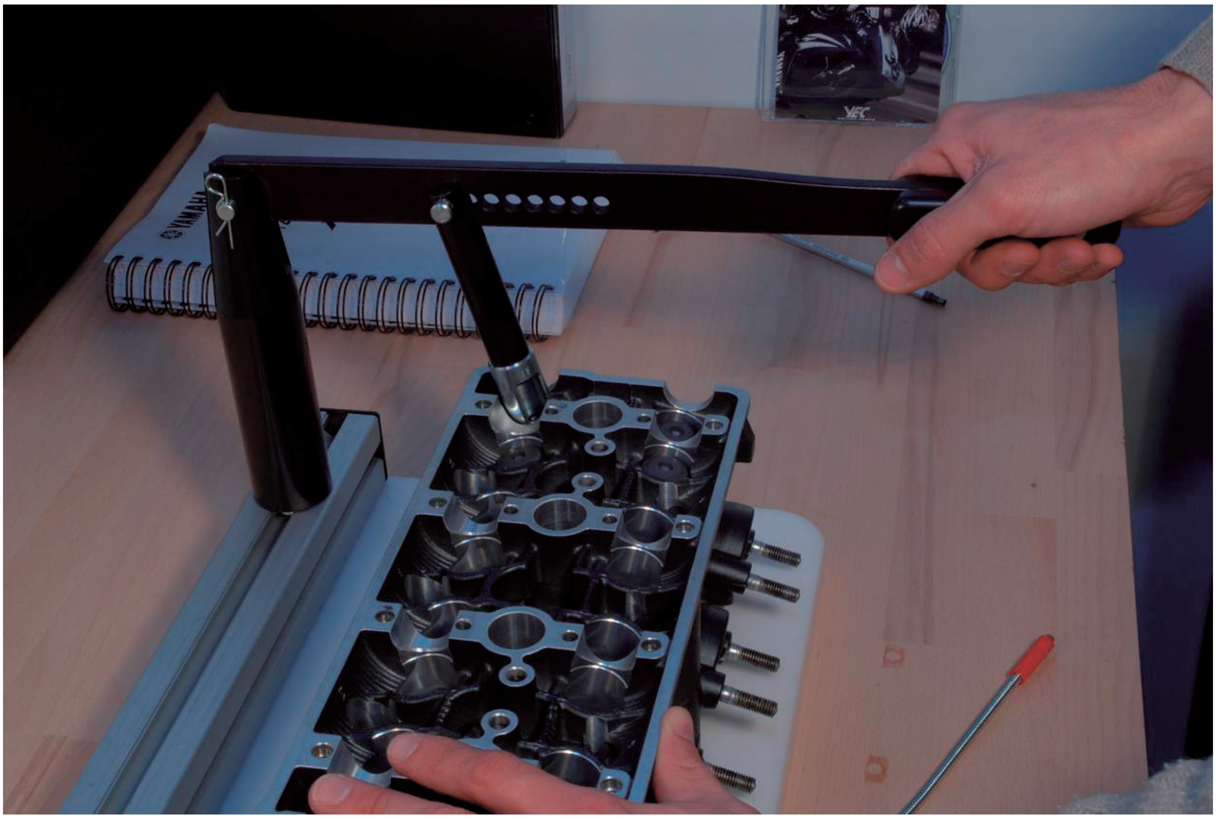
4.2 Other tools

A magnet is necessary to remove cotter valves

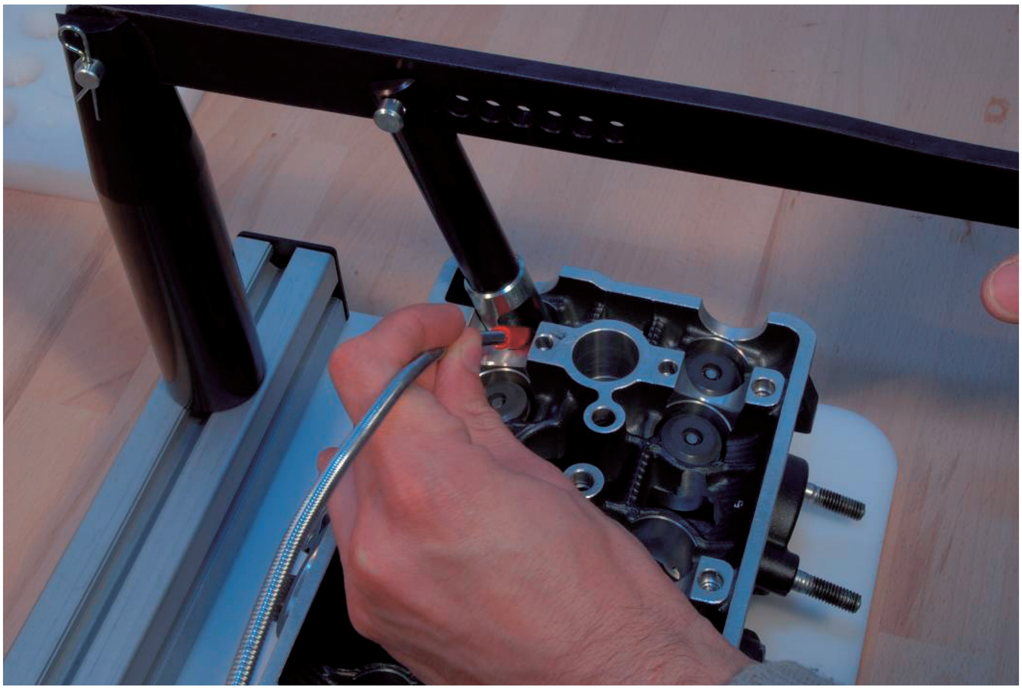
4.3 Fitting the valves

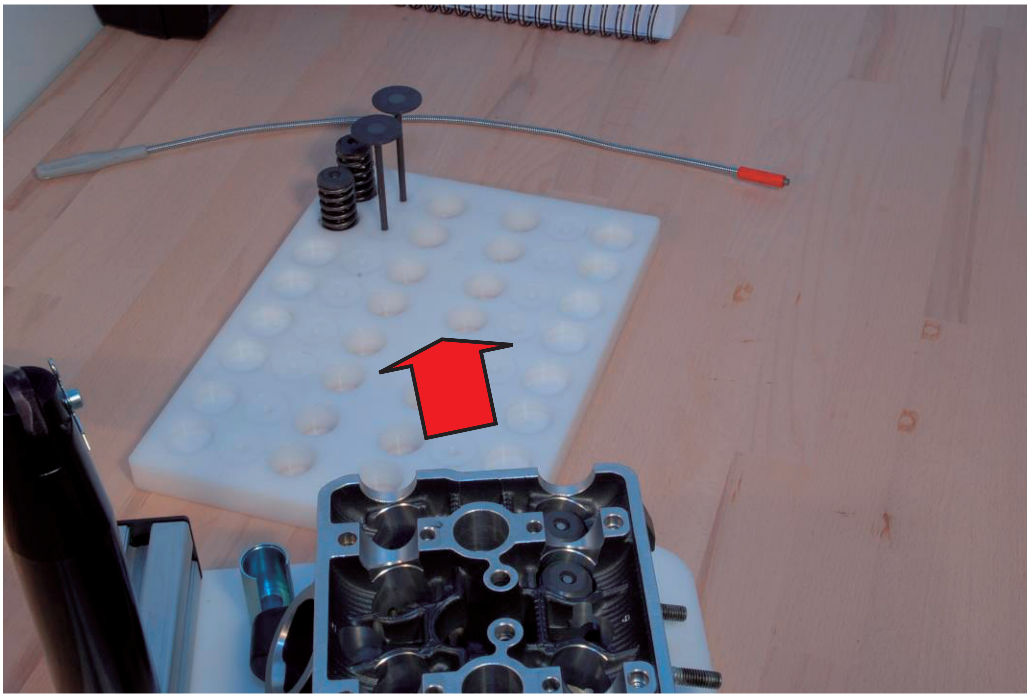
Particular caution should be taken during valve assembly especially during cotter valve installation.

The lever allows you to compress the valve spring without stress.



Cotter valves are released when pressure is applied on the lever. Then with a magnet, it becomes easy to remove the cotter valve. Once the cotter valve is stuck to the magnet, you may release the pressure on the lever. The spring may be removed and placed on the "Assembly board".





Once the work on the valve is finalised, it is time to fit it in again. Place the cotter valve in the retainer. Then, install the valve, washer, spring, and retainer.

Apply pressure on the lever to compress the valve spring. With your finger, push the cotter valve to drive around the valve stem. Release the pressure on the lever and push a little bit again to confirm the cotter valve is in the correct position.

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