

TESTASTRETTA VALVE ADJUSTMENT

This procedure applies to all Testastretta engines. Ducati motorcycles are beautiful expressions of form and function. Adhering to the maintenance intervals is important to ensure optimum performance. There is an urban legend that Ducati valve adjustment is mysterious and difficult. This guide will dispel that myth and help you understand the ease with which valve clearance measurement and adjustment can be accomplished.

There are several methods for taking the measurements of the shims. In much of the written information and on the web forums the terms “Loaded” and “Unloaded” are frequently used. These terms evolved from working on 2-Valve and earlier Desmoquattro (4 Valve) valve trains where access was limited due to the cylinder head design. These methods will give valid results for the Testastretta engines, but are not required. Ducati has made measuring these clearances very easy. If this is your first time measuring and adjusting the desmodromic engines, take your time and enjoy working on your bike. Getting to the cylinder heads is the first step in the process.

DISASSEMBLY

Secure the bike to a stand or a lift. Take pictures of everything, especially electrical connections and routing of leads, hoses, etc. to aid in reassembly.

Use a paint pen or other marking device to make alignment marks (i.e.-oil pressure sensor connection) for reassembly purposes.

Remove the side fairings

Disconnect the battery (the battery negative terminal is the first removed and the last installed)

Remove enough interference to gain access to the cylinder heads. This may include the fuel tank/seat cowling assembly, the air-box, and radiator. Get a picture of cooling fan connections (both sides). Place a catch pan underneath the radiator hoses to catch the fluid during removal

Remove coil

Remove the spark plugs

Remove the rocker cover

Remove the timing belt covers:

Undo the bolts securing the vertical timing belt cover and remove it from the vertical cylinder assembly. Some finesse may be required as this is a tight fit in the frame.

Undo the bolts securing the timing belt cover and remove it from the horizontal cylinder unit.

Remove the spark plugs. This is important: the engine will not rotate with the spark plugs installed. The engine will have to be rotated during valve adjustment/belt replacement and is made easier with the removal of the spark plugs.



Once the spark plugs are removed, the engine turning tool can be installed. Remove the cover on the left side of the engine and install the engine turning tool onto the end of the crankshaft. Note: the tangs on the engine turning tool fit neatly into indents on the crank shaft. Tighten the bolt to snug and the engine is ready to turn counter clockwise (CCW) into the correct position(s) for valve clearance checking.

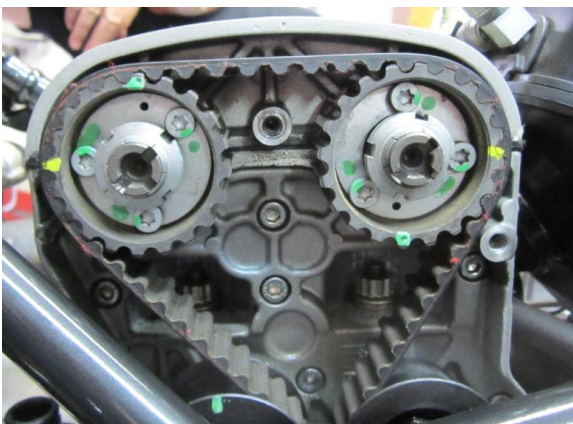
Place the engine in the “home” position. The “home” position is realized when the horizontal cylinder is at Top Dead Center (TDC): the compression stroke of the horizontal cylinder. From the left-hand side of the engine, rotate the engine slowly counterclockwise to locate TDC. There are several ways to find TDC. The easiest way is to stick your thumb in the spark plug hole on the horizontal cylinder and rotate the engine until you find compression coming from the cylinder. Stop at the top of the stroke.



With the belt covers removed check alignment on the belts and pulleys. The intermediate shaft drives the cam belts. There is a mark (dimple) on the pulley and a mark on the engine case. At TDC of the horizontal cylinder, the marks will align. Use the paint pen to mark this alignment. Slight rotation of the engine forward/back may be necessary to locate TDC at this point.

When the engine is in the “Home” position the mark on the intermediate shaft pulley will align with a mark on the engine cover.

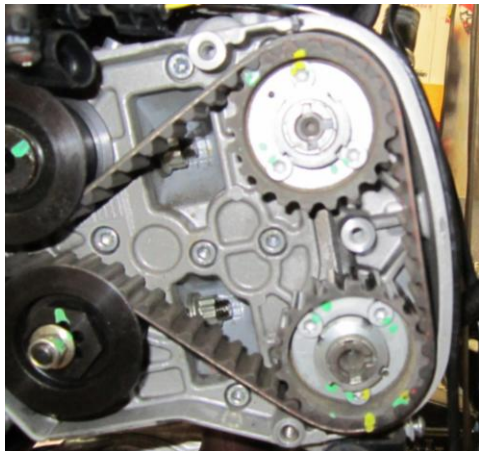
A note about markings: Once the cam belt covers are removed, various marks on nuts, pulleys, etc. are evident. These are “torque” stripes. Once a Factory Technician torques a component down, it is marked. This makes it easier to keep track of what has/has not been torqued and a visual aid for the QA person to check if everything is tightened.



The torque stripes (green marks) do not necessarily indicate alignment.

Look at the belt pulleys attached to the cams on the vertical and horizontal cylinders. The dimples (marks) on the pulleys will not align with anything useful. Use the paint pen to make some alignment marks you can refer to and always get the engine back to this “home” position. The yellow marks were made with

a paint pen to indicate where the pulleys align with the gasket with the engine in the “home” position.



The yellow marks pictured on this horizontal cylinder are made on the pulleys where the valve cover gasket sets on the cylinder head. The three previous pictures show the pulley alignment at the “home” position. The markings will be necessary for reassembly when the belts have to be removed for shim (or belt) changing.

Additional notes on setting the engine to “home” and/or TDC in general. At TDC the arm on the turning tool will point towards the spark plug of the cylinder at TDC.

The TDCs of the cylinders are 270 degrees apart. Once this “home” position has been established and the marks are made on the pulleys, turning the engine 270 degrees counterclockwise positions the vertical cylinder at TDC.

For ease of access and to build the foundation for taking valve clearance measurements, start with the vertical cylinder. Set the vertical cylinder to TDC. This is 270 degrees of rotation (counter clockwise) from the horizontal cylinder’s TDC. The opening cams will be “up” when at TDC (see picture). Use the recording work sheet while performing the measuring, determining, and replacing of shims.

VALVE CLEARANCE MEASUREMENT

For each cylinder, there are 4 valves: 2 for the intake and 2 for the exhaust. The intake valves on Ducati engines are inboard (the inside portion of the “L” configuration.) The exhaust valves are the ones on the outboard side of the engine.

For each cylinder there will be 8 measurements: 4 opening shim clearance and 4 closing shim clearance measurements to record. Use the accompanying worksheet to record the measurements. Before beginning, determine what clearance(s) will be acceptable. Ducati gives a factory recommended range (i.e. – 0.10mm – 0.25mm for the opening clearance). Some individuals prefer to set the opening/closing clearance to an exact number (i.e. - 0.10mm). Either way, the acceptable clearance should be entered into column B (opening shim clearance) or column G (closing shim clearance) on the worksheet.



This is what you will see when the cover is removed. Confusing at first, but after a few minutes it all makes sense. No black magic or voodoo is involved, just beautifully machined surfaces designed for a purpose. Note the opening cam lobes (the smaller, inner cam lobes) are pointing “up” which indicates the valves are in the “rest” position and ready for measurement.

OPENING SHIM CLEARANCE MEASUREMENT

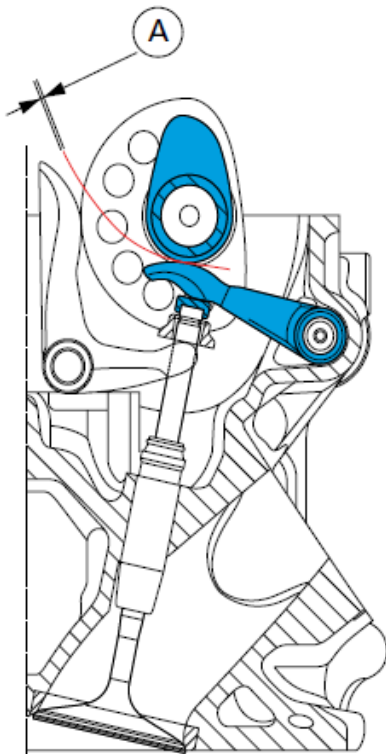
Move the piston of the cylinder being checked to TDC of the power stroke: in this condition all the valves are closed and the camshafts are in their rest position and pressure is relieved from the valve stem. Note the opening cam lobes are “up”, away from the cylinder when at TDC.

Determine which cylinder to work on first and record the Ducati recommended valve clearance in column B opening clearances



Spread out the feeler gauges in order. This makes the progression much easier. The feeler gauges are “consumable” and don’t need to be returned.

Start with the desired valve clearance feeler gauge (i.e. -.15mm) and use larger/smaller gauges until the correct clearance can be determined.

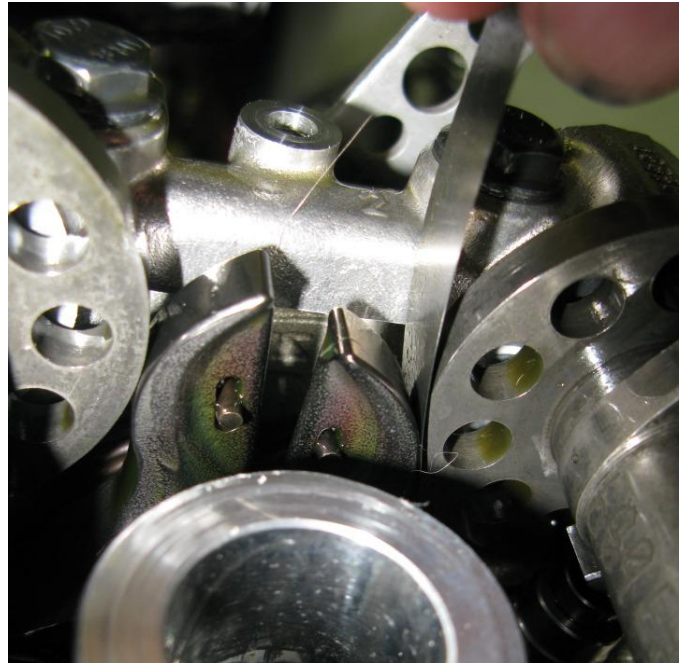
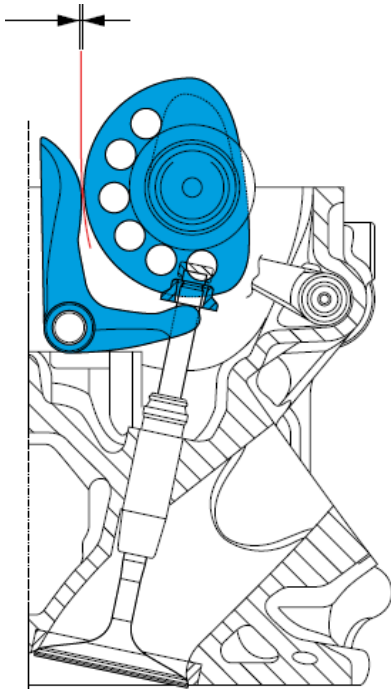


Use a feeler gauge (A), to measure the clearance between the opening rocker arm and the lower edge of the camshaft lobe: Use progressively larger/smaller feeler gauges until the size of the clearance can be determined. The proper feel is if the resistance on the feeler gauge is similar to inserting the gauge into a large book. Once the clearance is determined, record this as measurement “A” on the worksheet.

If measurement “A” is outside the specification (or is not the specification you want) subtract B from A (smaller from larger) and record this number in column C for the opening shim just measured. The result (C) will be used later to determine the new shim size.

Measure and record the opening shim clearances for the remaining valves on the cylinder being worked.

MEASURING THE CLOSING SHIM CLEARANCE



Record the Ducati recommended valve clearance in column G (closing clearances).

Use a feeler gauge to measure the clearance between the closing rocker arm shoe and the camshaft lobe, taking care not to compress the rocker arm return spring. Record this measurement in column F (closing shim measured clearance) for the valve being measured.

If measurement "F" is outside the specification (or is not the specification you want) subtract G from F (smaller from larger) and record this result in column H for the closing shim clearance just measured.

Measure and record all the closing shim clearances for the remaining valves on the cylinder being worked.

When the opening and closing clearances have been measured, rotate the engine to place the other cylinder at TDC. Repeat the measurements for the other cylinder and record on the work sheet.

SHIM REPLACEMENT

After the valve clearances have been measured for both cylinders, shim replacement (if necessary) is the next step. Determine which clearances are out of specification ($A > B$ opening shim or $F > G$ closing shim) and rotate the engine so the cylinder receiving shim replacement is at TDC. Proceed as follows.

Note: with the belts removed, either cylinder's shims can be replaced and set back into the correct valve timing using the marks made on the pulleys.

Measure belt frequency and record (for reference): It isn't unusual for belts that have been used for a few thousand miles to have a frequency reading of 80Hz (or less!)

Important -If the belts are to be re-used, mark the location (horizontal or vertical cylinder) and direction of rotation with the paint pen.



Loosening the tensioning pulley is accomplished by loosening the Fuji nut and rotating the tensioning pulley clockwise (away from the cam drive gears). Loosen the nut and remove the tensioning pulley from its mounting stud on the cylinder head. Removing the tensioning pulley facilitates belt removal/installation. Label the tensioning pulley (horizontal or vertical).

Remove the timing belt from the horizontal cylinder assembly.

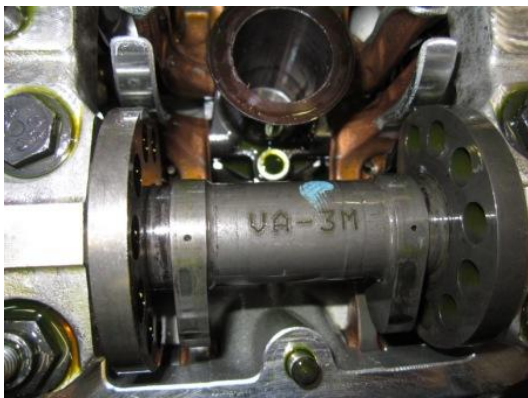
Repeat the procedure for the vertical cylinder.

REMOVE THE CAMS



When removing the cam hold-down clamps loosen the inner and then the outer retaining nuts. These nuts are $\frac{1}{2}$ the normal height and it is best to use a 6pt socket.

The vertical cylinder intake cam pulley will rotate (CCW) when the belt is removed. This is normal and will be addressed upon reassembly.



Each cam is marked to its location.

Here is the key to cam markings:

A= intake (Italian word aria)

S= Exhaust (Italian word scarico)

V= Vertical (Italian word verticale)

O= Horizontal (Italian word orizzontale)

The markings (VA) indicate this is the vertical intake cam.

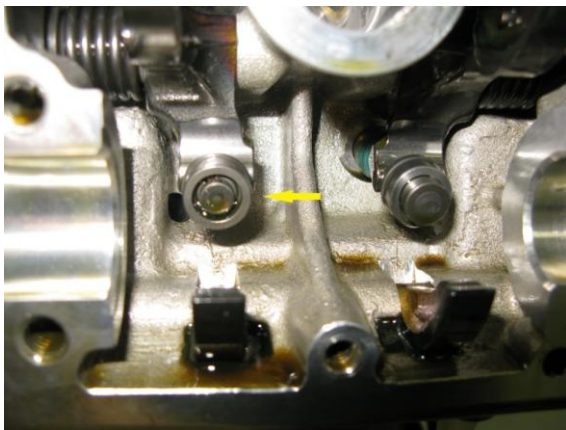


Use a punch and gently tap on the pulley to loosen the cam/cam retainers so the cam shafts can be removed.

OPENING SHIM REPLACEMENT:

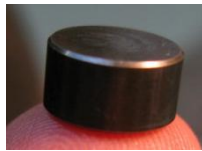


With the cam removed, the opening shim will lift off of the valve. Hold the opening rocker out of the way. Use a magnet or needle nose pliers to remove the opening shim. If replacing more than one opening shim put it in a marked container (plastic bag, egg crate, etc. so it doesn't get mixed up with other shims.



Here is the horizontal cylinder with the cams removed. You can see the opening shim has been removed from the valve on the left and the closing shim is accessible.

The valve on the right still has the opening shim installed

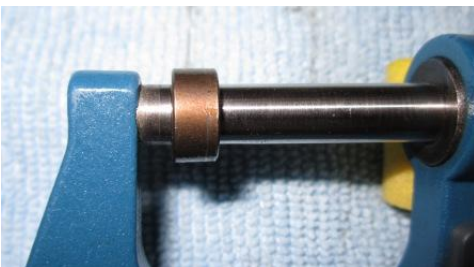


The opening shims are flat on the top and recessed on the bottom so the shim fits on top



of the valve stem securely

MEASURE THE OPENING SHIM



Close the micrometer. Do not over tighten. Press the "zero" button to set the reading to 0.00. Open the micrometer and place the shim on the stationary shaft of the micrometer, with the flat side towards the fixed portion of the micrometer. Measure the opening shim and record the measurement in column D of the worksheet. Determine the size of the replacement shim by adding column C to column D and record this number in column E. The number in column E is the ideal shim size to

bring the valve clearance into specification. Shims are manufactured in .05mm increments and if the exact size needed isn't in the shim kit, there is a solution:

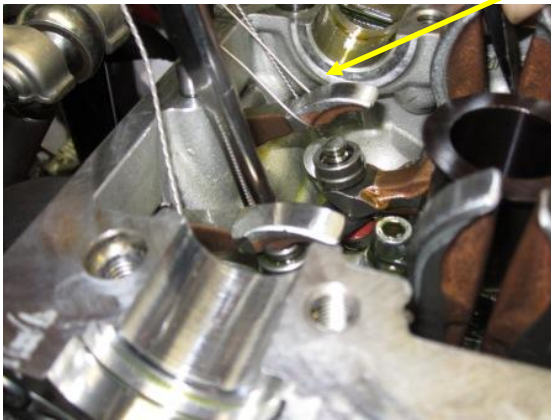
Take the next larger size shim and make it the right size using 400 wet/dry sandpaper. Place the sandpaper on a flat surface (a piece of glass works nicely) and sand the shim into the desired measurement. Turn the shim every few strokes to provide even sanding. After some time sanding, re-measure the shim to see if it has been sanded into the correct size. If not, continue sanding. Once the shim is the correct size, reinstall it onto the valve stem or put it aside in a well marked spot if the closing shim on the same valve requires replacement.

CLOSING SHIM REPLACEMENT



If a closing shim requires replacement to bring the valve clearance into specification the opening shim will have to be removed from the valve. Remove the opening shim and set it aside, marking the shim's location for reassembly.

Place the forceps clamp onto the valve stem below the closing rocker arm. This will prevent the valve from falling into the cylinder when the closing shim is removed. The forceps may have to be re-positioned during the valve shim removal process.



Use safety wire to hold the opening rocker arm up and out of the way. Remove the opening shim and set it aside.

Block the oil return holes to prevent the retaining rings from falling into the cylinder.

Use a screwdriver and pry the closing rocker arm towards the camshaft to relieve pressure on the closing shim. Push the closing shim down so it slides on the valve stem, revealing the retaining rings (half-rings).

Use the magnet in the kit to remove the half-rings from the stem and slide the closing shim up and off the valve stem.

MEASURE THE CLOSING SHIM

Place the closing shim measuring tool inside the closing shim and measure. The closing shim measuring tool fits inside the closing shim and allows accurate measurement with the enclosed electronic calipers. The closing shim measuring tool adds 10.00 mm to the shim measurement. Remember to subtract 10.00 mm from the shim measurement prior to recording the measurement on the worksheet. Record this measurement (minus the 10.00 mm) in column I of the worksheet.



Add column H to column I to find j: the size of the closing shim to bring the clearance into specification. The closing shims can be sanded into the exact size with 400 wet/dry sandpaper if one of the standard sizes doesn't

bring the clearance close enough to the desired measurement. Sand the closing shims on the “top” part of the shim: the wider part that contacts the closing rocker arm.

Slide the new shim onto the valve stem.

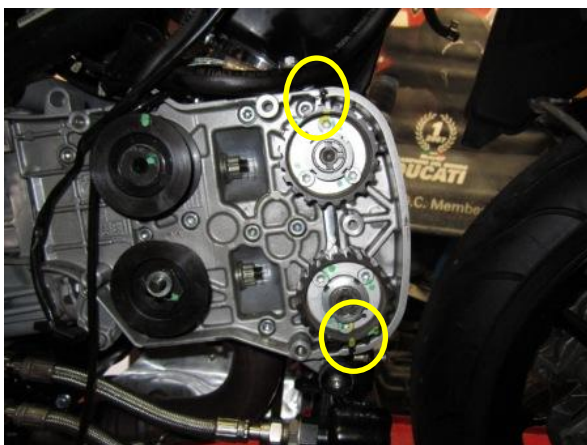
Use a screwdriver and release the spring pressure on the valve so the closing shim can slide down the valve stem far enough to allow the half-rings to be installed. Put a little oil on your finger and place a half-ring on the fingertip. Place the shiny side down on the half-rings (this has rubbed against the closure shim and is shiny). While exposing the valve stem, place the half-ring onto the stem and rotate it to the opposite side to make room for the other half-ring. Place the SECOND half-ring onto the valve stem. Release the pressure on the closing rocker slowly until the half-ring seat and the closing shim is secure. The top of valve and closer shim should line up flush on top, reseal the valve several times to seat the half-rings and bring to flush.

REASSEMBLY

After the shims have been replaced (if required) install the camshafts. Apply oil or other lubricant to all mating (rotating) surfaces.



Align the marks on the intermediate shaft and the engine cover.



Align the marks on the cams with the engine cases for the vertical and horizontal cylinders.

The vertical cylinder will require the small (included with the tool kit) cam holding tool to keep the intake cam in position while the belt is installed.

Install the belts, vertical cylinder first: bottom pulley first and work your way up.

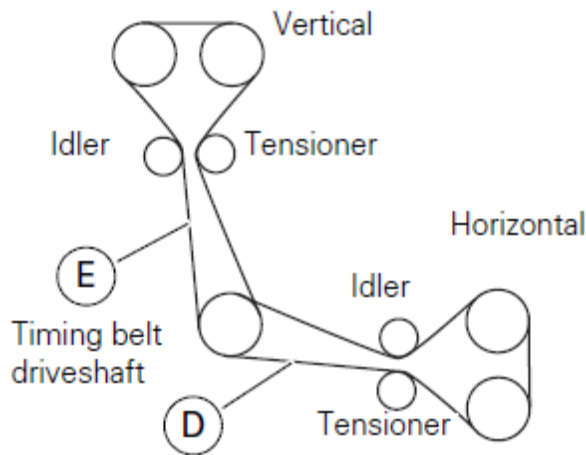


Install the tensioning pulleys and the Fuji nuts, but don't tighten them yet.

When putting tension on the belt, rotate the tensioning pulley counter clockwise and tighten (moving them toward the top of the cylinder head).

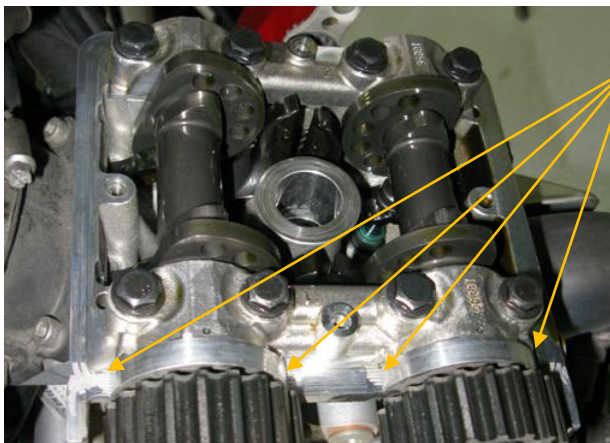
Use the meter to measure the frequency per the instructions.

Once the belts are installed and tensioned, rotate the engine to verify everything lines up and check the tension again - Adjust as necessary.



Use 19 ft lbs of torque on the belt tensioning nuts

Set the belt frequency at 110HZ for all 4 cam engines.
Measure at points D and E to get an accurate frequency measurement.



Put gasket sealant on the mating corners where the cam retainers meet the flat surface of the cylinder head/valve cover for sealing. Torque in 2 stages to 7ft lbs.

Refit the rocker cover

Install the spark plugs

Refit the radiator

Refit the air box

Refit the fuel tank: Use new O-rings on the fitting lubricated with Vaseline prior to assembly.

Reinstall the seat cowling assembly and fairings.