

**Illustration #1. - Triumph used two dimensions for the valve guide location: The Unit construction engines 650 thru 1972 it was 3.140 in. Starting in 1973, with the 750 twin, this changed to 3.240 in. This gave the valve guide more support and accounts for the two different bottom valve spring cups.**

**Tech Notes by John Healy**

## Where is your Valve Seat?

What you need to know when installing valve seats.

To tell you the truth this started with a conversation with a club member about having his valve seats replaced. Triumph supplies little in the way of information as to the actual location of the valve seat in the cylinder head and this often makes the job daunting.

The only dimension in the Triumph Workshop Manual is the fitted valve spring lengths, and this is only offered in the 1963-1970 manual (and 750 twin supplements). It is given as  $1 \frac{7}{32}$  in. for the outer Inlet spring and  $1 \frac{5}{32}$  in. for the outer Exhaust spring. This gives us a good place to start.

The valve seat determines where the valve will sit in the head. It will also determine here the valve tip interfaces with the rocker arm and the position of the top valve spring collar.

Get it wrong and all kinds of mayhem can happen from bent valves, broken rocker arms to worn camshafts. And all this and we are only using stock lift camshafts. Install high lift cam, oversize valves, performance valve springs and you need to take more measurements and make adjustments.

I will try to explain why the factory fitted valve spring length is the only dimension you need to get your new valve seat properly installed. But first let's clear up a few things.

**The length of stock and aftermarket valves are pretty much all the same give-or-take a few thousandths.**

The dimension from the tip of the valve and top of the valve cotter groove are remarkably close. The one difference in some aftermarket valves is the thickness of the valves margin.

Note: The margin on Black Diamond valves are .020 in. thicker than factory valves. This can close up both the fitted valve spring length and the valve-to-piston clearance.

**Triumph finally got smart with the 750 twin.**

Triumph has two different castings as shown in Illustration 1. In 1973, with the introduction of the 750 twin, Triumph added another .100 in. to the casting where the valve guide sits against the head. This required removing the same amount from the bottom spring collar. This was a great improvement in how the valve guide was supported.

On the 650 models up through 1972, the bottom cup (70-6349) measured .229 in. from the bottom surface to the point where the outer spring seats. Starting in 1973 the T140/TR7 the same dimension measured .129 in.

**It is important to use the correct spring cup when doing your calculations.**

You are going to calculate the seat by measuring the distance from the tip of the valve stem to the cylinder head where the valve guide sits. To do this you need three measurements:

1. Thickness of bottom spring cup.
2. Fitted outer valve spring length. (Illust. #4)
3. Distance between top of outer valve spring and the valve tip. (Illust. #2)

For a Triumph 750 twin this would be:

- 0.129 in. bottom cup
- 1.218 in. intake fitted spring length
- 0.296 in. spring to stem tip (Illust. #2)
- 1.643 in. Valve stem protrusion

We want to install and cut our new intake seat in a 750 twin head so the valve stem protrudes out of the head 1.643 in. plus or minus .002 in.. For a 650 this would be 1.743 in.. For both models the exhaust would be .060 inch less. This dimension is measured from the head surface the valve guide sits on, to the valve stem tip (Illustration 7).

### A FEW WORDS OF CAUTION:

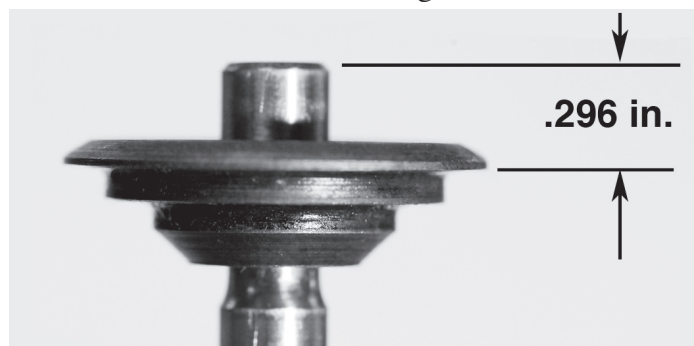
**The calculations given here are for a stock engine using standard components. This means your valve springs must have at least .060 inch of movement left before coil bind at the factory-installed length settings (1 7/32 in. intake and 1 5/32 in. exhaust). This gives you a starting point.**

Here are some things you should be aware of:

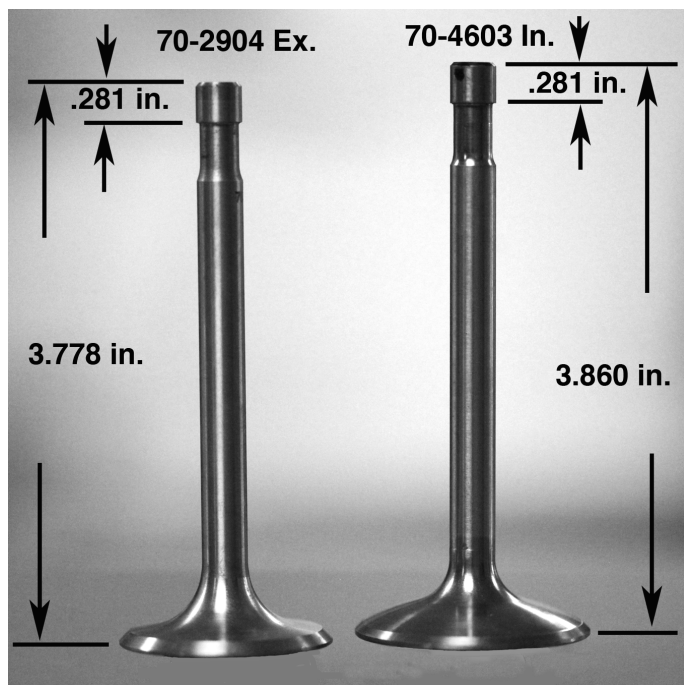
1. Cutting the cylinder head gasket surface instead of straightening it reduces the valve-to-piston clearance. It also changes the rocker arm angle to the valve stem. Thicker head gaskets are available to correct this.
2. Triumph gives the fitted length for the exhaust outer valve spring as 1 5/32 in. (1.156 in.). We have found that some replacement valve spring sets sold as replacements for 70-4221 (red dot inner) and 70-7400 (green dot outer) will coil bind at this dimension. We have found that you must use a 1.218 in. fitted length on the exhaust outer spring to keep these springs from coil binding: see Illustration #5.
3. Black Diamond valves have a thicker margin than the original valves (typically in the range of .020 in.), see Illustration #6. This will shorten the fitted valve spring dimension and in some cases cause coil bind or the top collar hitting the valve guide, especially if it has valve seals installed.

In the same vein, this will also change the valve-to-valve and valve-to-piston clearance, and will change the compression ratio by a small amount.

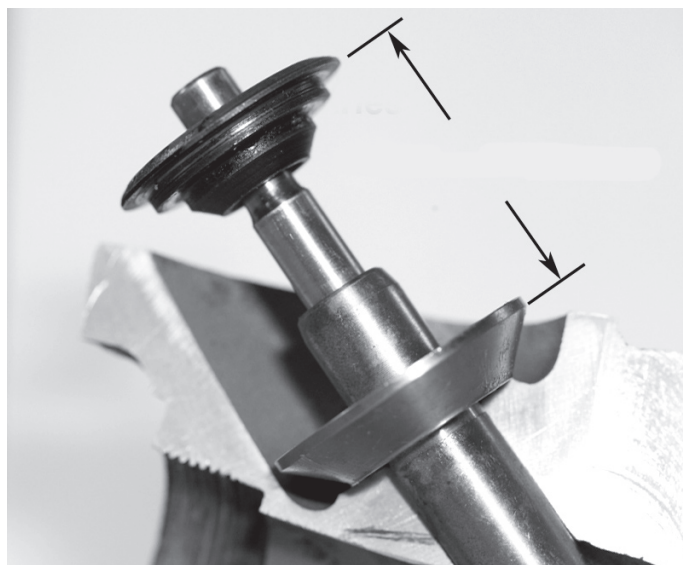
4. Changing the valve stems protrusion will change the rocker arm-to-valve stem angle. ..



**Illustration #2.** Outer valve spring seat to valve tip is used to calculate the valve stem protrusion



**Illustration #3.** Aftermarket valves are typically on dimension. The one exception we find is Black Diamond valves that can have a thicker margin.



**Illustration #4.** Use the valve spring fitted dimension in the Workshop Manual when calculating the valve stem protrusion. The exception is with some after market 70-4221/70-7400 valve sets. The exhaust spring can coil bind if fitted as 1 5/32 in.. Use 1.218 in instead.

## GENERAL SPECIFICATIONS:

### Intake 70-4603 (GS brand V24)

(Black Diamond #70-4228):

Overall length: 3.855 in.

Head diameter: 1.594 in.

Stem diameter: .3095/.310 in. Weight: GS (as o.e.m.)

.064 gram. Black Diamond .070 gram.

### Exhaust 70-2904 (GS brand V245)

(Black Diamond 70-4230)

Overall length: 3.780 in.

Head diameter 1.437 in.

Stem diameter: .309/.3095 in. Weight: GS (as o.e.m.)

.0595 gram. Black Diamond .0620 gram.

### Position of the valve spring bottom cup where it sits on the head.

It is measured from the Datum Point where the center line of both valve guides cross. Illust. #1

650 models thru 1972: 3.242 in.

750 twin models from 1973: 3.142 in.

**Distance from the head gasket surface to the Datum point: .084 in.** This gives you a way of measuring how much has been machined off the head gasket surface. Illust. # 1.

### Factory spring fitted outer valve spring length:

Intake outer spring 1 7/32 (1.218 in.)

Exhaust outer spring 1.5/32 (1.156 in.)

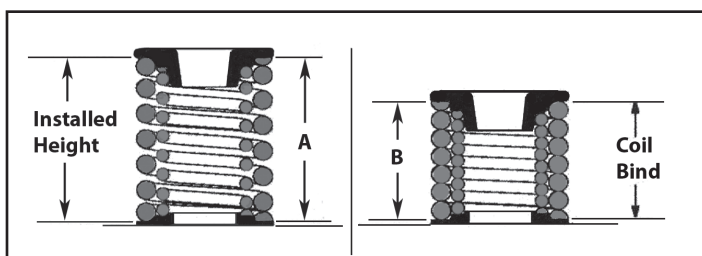
(These are the figures given in the Workshop Manual— some exhaust valve springs available under the factory part number for this model will coil bind at .350 in. valve lift if fitted at 1 5/32 in.)

### Thickness of the two valve spring bottom cups:

(Measured at outer spring seat):

70-6349 (650 to 1972): 0.229 in.

71-3296 (750 - 1973 -up): 0.129 in ..



**Illustration #5.** Installed height is measured from the spring cup to the underneath of the top collar. At full valve lift the spring must not be allowed to coil bind. You need at least .060 in. of additional spring movement before the spring coil binds.

**Distance from the tip of the valve to the outer valve spring seat of the top collar: 0.296 in. Illust. #2.**

**Valve Stem protrusion or distance from the tip of the valve stem to cylinder head casting at the point where the valve spring bottom cup sits.: Illust. #7.**

### 650 models thru 1972:

Intake:

Bottom cup 0.229 in.

Spring 1.218 in.

Top 0.296 in.

1.742 in. Stem Protrusion

Exhaust:

Bottom cup 0.229 in.

Spring 1.156 in.

Top 0.296 in.

1.681 in. Stem Protrusion

### 750 models 1973-up:

Intake:

Bottom cup 0.129 in.

Spring 1.218 in.

Top 0.296 in.

1.643 in. Stem Protrusion

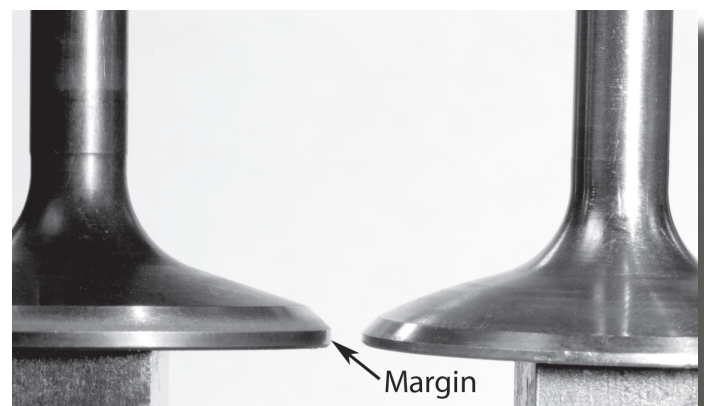
Exhaust:

Bottom cup 0.129 in.

Spring 1.156 in.

Top 0.296 in.

1.581 in. Stem Protrusion



**Illustration #6.** Black Diamond (left) valves can have as much as .020 in. Additional margin than a stock valve. This can be good as it does toughen up the engine against detonation, but it will change piston to valve clearance, valve protrusion, and fitted valve spring length.



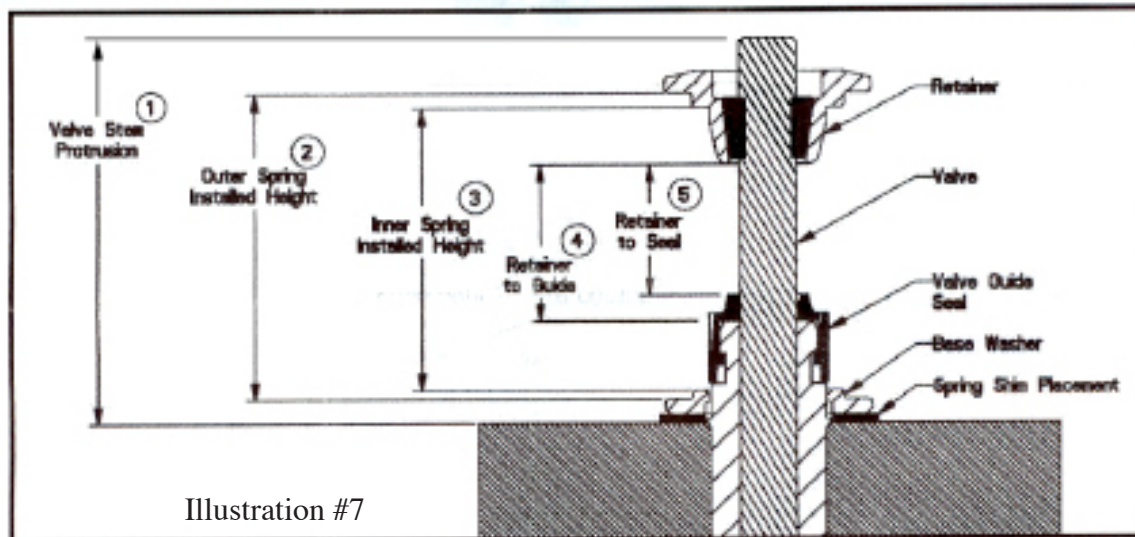


Illustration #7

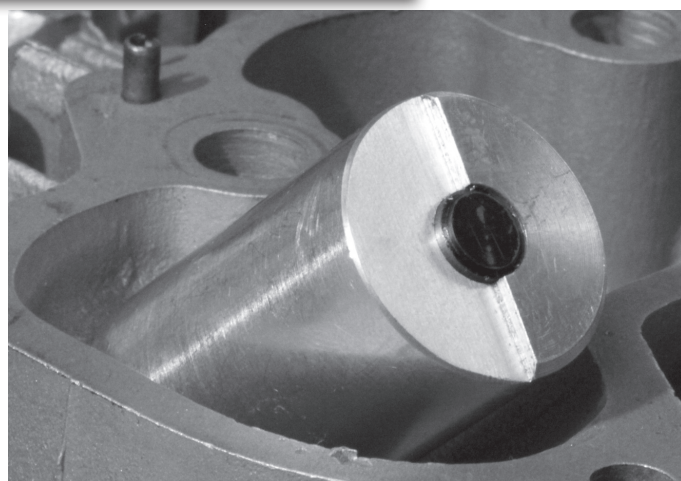
## TRICKS OF THE TRADE

Pictured below and right is an aluminum measuring tool. I have two. One is 1.743 in. long, used to check 650 heads and the other is 1.643 in. long, used to check 750 twin heads. With the valve guide in the way, accurately measuring valve stem protrusion is awkward, at best.

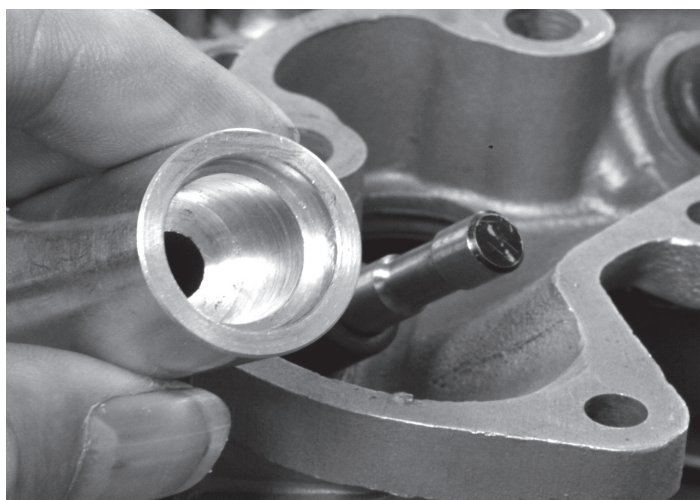
Using this tool gives me a quick visual check of the valve stem protrusion. It also gives me a stable surface to measure the tip if it is above or below the tool. From this I can determine if I need to cut the valve seat deeper or shim the bottom valve spring cup.

The small hole is reamed to 5/16 in and then counter bored so it will clear the valve guide. This allows it to sit firmly on the cylinder head to give accurate readings. Note that a step is cut in the face .060 in. deep. The lower face measures the protrusion of the exhaust valve stem.

What you have been reading is "Valve Seat 10 1". It assumes you are using standard parts including



valves, camshafts (and cam timing), valve springs, top and bottom spring collars, etc. While the theory given here applies to all Triumphs, the measurements given are for Triumph 650 and 750 twins only. If you installed new valve seats (and especially if you machined the head flat), and are using after-market pistons, it is always wise to measure the valve-to-piston clearance. It needs to be at least .060 in.! If there is material available on the piston (you don't want the valve pocket piston aluminum thinner than .125" in.) you can take some material of the piston. Otherwise it has to be taken off the valve or valve seat.



**When you use nonstandard parts you must take a lot more into consideration: Coil bind, top valve collar to rocker box clearance (typical when you make changes to Triumph 500 twin models), valve to valve contact (aka as "hooking", common to early squish-head Triumph 500 twins) and valve to piston contact must be checked, and corrected as necessary. Most experts agree that you need a minimum of .060 in. clearance in all of these areas.**