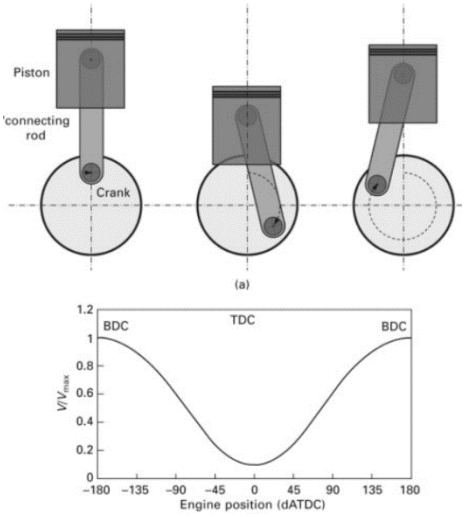
# Finding Top Dead Centre

## 1. Introduction

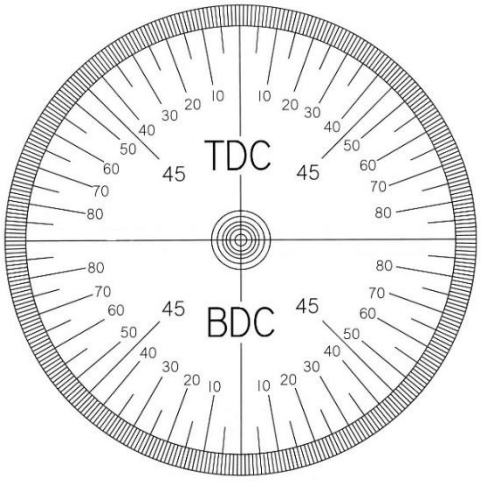
No matter what make of internal combustion engine you are working on one important skill to have is the ability to set it at top dead centre (DTC) so that you can then do things like checking and setting valve timing and checking and setting ignition timing. These two things can mean all the difference between a engine that's hard to start and one that not, an engine that lacks power and one with adequate power, an engine that runs hot and one that does not, an engine that is reliable and one that's prone to frequent, sometimes catastrophic failures.




Up front, if you plan to do things right then ignore any so-called manufacturers markings or suggestions in regard to finding Top Dead Centre.

I suggest that you need to accurately determine TDC for yourself.

Let's consider for a moment the relative movement of a piston within a motor. As the crankshaft rotates the distance the piston moves varies as can be seen in the diagram. Piston movement per degree of crank rotation is at its highest half way through the stroke and at is lowest at each end of the stroke. For all practical purposes the piston is virtually stationary within 1 to 2 degrees either side of top or bottom dead centre. This reduced vertical movement as the piston approaches TDC means that using a short probe to detect TDC can lead to errors.




Of course, you will need something to indicate the relative position of the engine. You will need a degree wheel that is attached to the crankshaft.

You will also need a means of accurately finding TDC. I suggest you use a piston stop that will stop the piston at a point at or close to the centre of the stroke where there is the greatest travel compared to degrees of crank rotation.

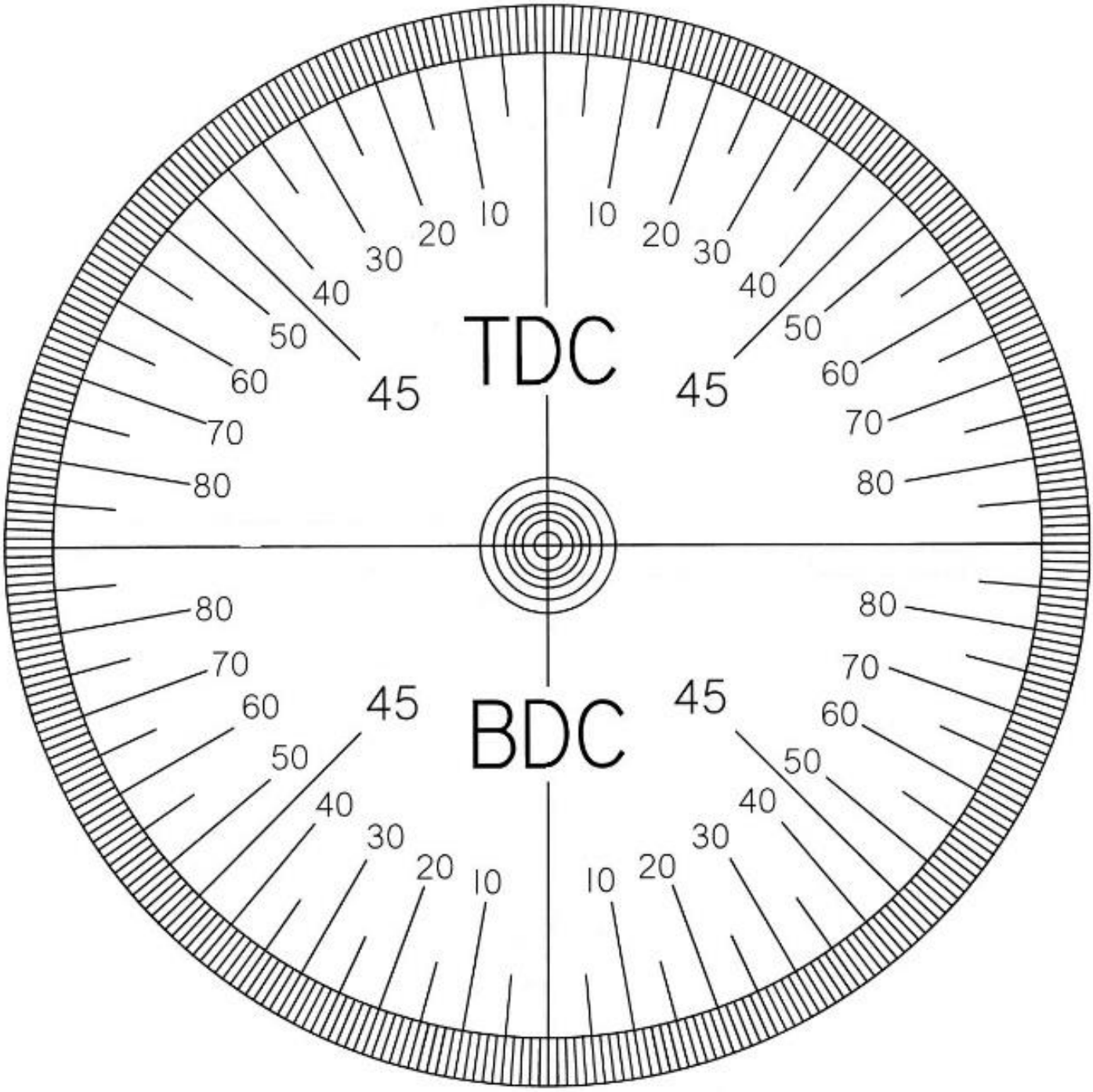
## 2. How to make your own degree wheel for use on a Vincent

The larger your degree wheel the better, a small disk may be easier to fit without the need to remove 'obstructing' bits such as gear levers but reading the scale will be almost impossible.

Print the degree disk template on a sheet of A4 stout paper. You will also need some white PVA adhesive, a metal chopstick, some scrap timber around ¾" to 1 inch thick and 2 to 3 inches wide and some good quality epoxy adhesive.

Glue the printout onto a solid board such a 3 ply or 3 to 5mm craft board. I suggest you use white PVA adhesive. Then cut out roughly around the outside of the degree wheel. To protect the face of the wheel when in use, dilute some white PVA glue 50% with water and apply that as a sealer to the edges of the wheel and its face as well.

Once the sealer coat is dry drill a small, approx. 1/8” diameter in the EXACT centre of the disk.



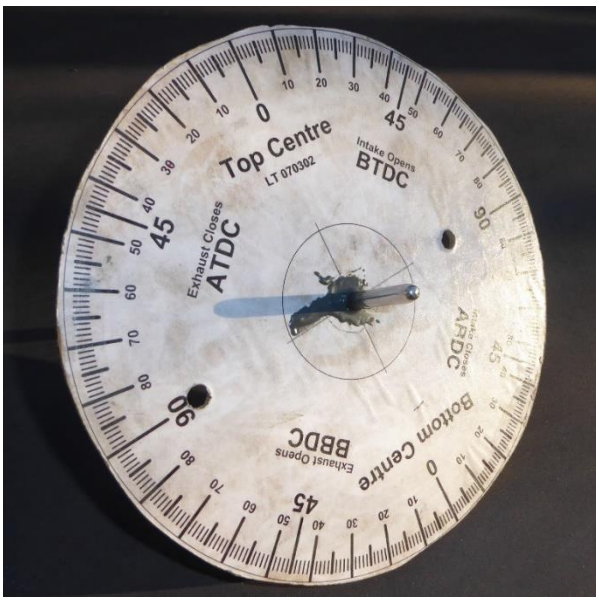

Now with a hole saw cut a disk of around 2 inches diameter from the piece of scrap wood, then with the PVA glue, glue that dish in the exact centre of the rear of the timing disk – use that 1/8” hole in the timing disk to assist in alignment. The next step is to insert the chop stick through the centre of the timing disk to act as the ‘spindle’ of the disk. Before proceeding measure the diameter of the chop stick. Be sure to drill the hole for the chop stick at EXACTLY 90 degrees to the surface of the disk.

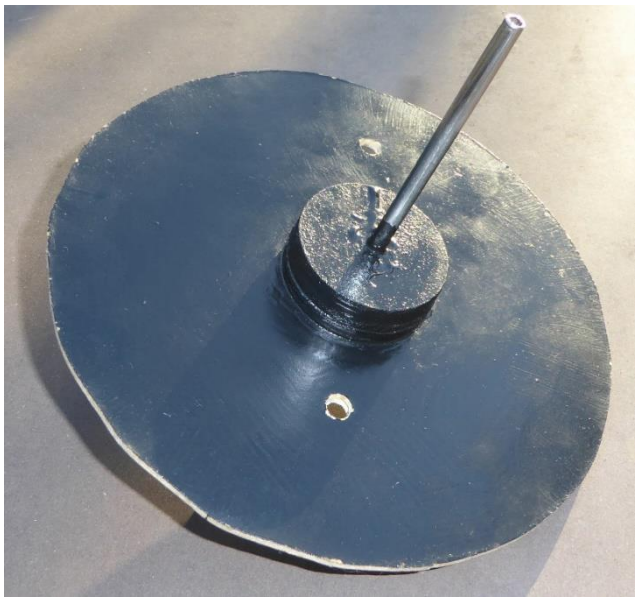
The timing disk, in use will be attached to the end of the mainshaft on the timing case side, through the oil quill hole, so the end of the chop stick that gets inserted into the quill hole needs to be no more than 5.5 mm diameter and taper UP to at least 7mm diameter . Do not be tempted to use a bamboo, plastic or timber chop stick – only metal. The reason being that in use as the spindle of the timing disk you do not want to risk anything getting stuck in the quill hole in the centre of the mainshaft as that would prevent oil getting to the big end quickly leading to big end bearing failure. Not nice.

Its most likely that you will need to cut/shorten the chop stick at its thinner end so that it becomes possible to gently but securely insert it thru the quill hole into the oilway in the centre of the drive side mainshaft. Having done this and worked out thru observation how far along the chop stick (aka timing disk spindle) you want to have the timing disk, open up the hole in the centre of the timing disk and the disk of wood glued to the back of it, but ensuring that it will be a snug fit for the chop stick.

Apply a generous amount of epoxy glue to the chop stick and into the hole in the centre of the disk then insert the chop stick into the hole to the position you have just selected, with the thinner end poking out the back. **Do whatever it takes to hold the chop stick axle at 90 degrees to the back of the disk** while the glue sets, if you do NOT do this then as the disk rotates in use it will wobble making it hard, if not impossible, to use.

Once the epoxy cures – normally after 24 hours, you can apply some protective paint to the REAR of your smart new timing disk.



Here are images of the front and rear of my timing disk – yes I did use a different image for the print. The holes are so I can hang it up in my workshop.

### 3. Making your Piston Stop

You will need an old spark plug, a 6mm x 60 mm long Philips head dome head setscrew with one plain nut and one nylock to suit it.

The first and messiest part of the procedure is to completely remove the guts of the spark plug and the washer, without any significant damage to the metal body – if you damage the thread – then it's no longer of use – go get another old spark plug and start again.

Here is a photo of my finished piston stop. Note that the nut is of a size that can pass thru the spark plug hole.

In use the piston stop is screwed into the spark plug hole but as you will be slowly turning the motor over by hand you want as little resistance as possible so you need to cut a channel into the side of the stop to allow compression gases/air to escape as you turn the motor over. I used a Dremel with a thin cutting disk to cut the channel in my piston stop.

Put the plain nut onto the setscrew and run it around half way down its length, poke it up into the spark plug body and fit the nylock nut on the inside. Snug up the two nuts so that the set screw cannot wobble about – it must be firm. But resist any temptation to put any glue on the threads just yet.

When the piston stop is inserted into the spark plug hole the aim is to stop the piston close to the middle of its stroke. With my Comet that resulted in the distance from the end of the setscrew to the underside of the spark plug body being approx. 55mm.


**4. Finding Top Dead Centre**

For the rest of this activity, the rear wheel MUST be clear of the ground.

Remove the oil quill from the timing cover then gently push the spindle of the timing disk into the quill hole, engaging the oilway in the centre of the mainshaft

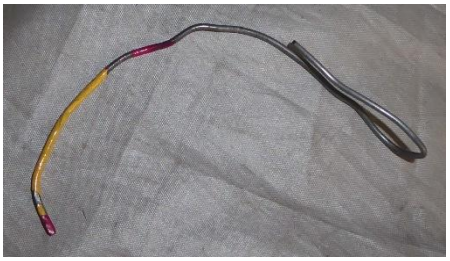
Press gently, sufficient for the spindle to engage with the mainshaft.

With my Comet, in order to get the disk into position I had to first remove the gear lever.

NOTE: subsequently you will want to be able to rotate the rear wheel in order to have the engine rotate, so if you do need to remove the gear lever, before you remove it put the bike into 4th gear.



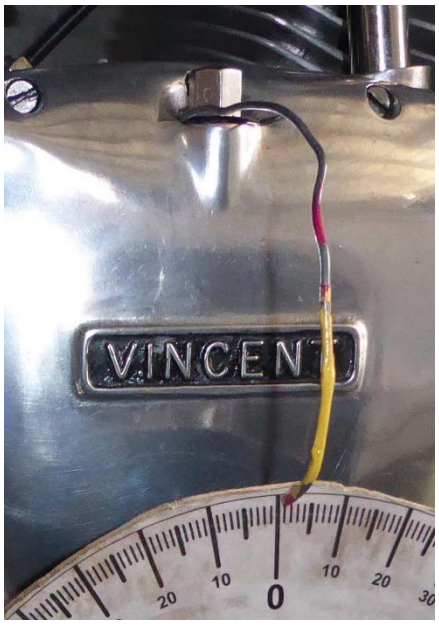
This is an opportune time to also remove the cap over the inlet valve adjuster and also the spark plug (with a twin, remove both spark plugs). The cap is removed so you can observe the movement of the inlet rocker as the motor is rotated; the spark plugs are removed so you are not 'fighting' against the compression pressure.



You need a pointer, a fixed position relative to the timing disk. I made mine from a length of soft wire (an old wire coat hanger) bent to shape. I painted the end just to make it easier to see.

Then I attached my pointer to the motor by clamping it under the cylinder oil jet nut OP40.

At this stage the position of the timing disk, what the pointer is indicating, is NOT important.




Make sure the piston is not near the top of its stroke. You can do this by putting a long rod into the spark plug hole, move the rear wheel to move the piston down if needed – make the rod of sufficient length so as NOT to fall completely into the cylinder!

It is time to install the piston stop you have made – first be sure the setscrew nuts are secure and that the setscrew cannot move in the spark plug body. The stop must NOT contact the piston just yet.

Next, very slowly rotate the rear wheel in a REVERSE direction till the piston makes GENTLE contact with the piston stop.

Now position (rotate) the timing disk - **NOT the motor** – so that the pointer is aligned to top dead centre as shown.

GENTLY tap the outer end of the timing disk spindle (chop stick) to secure it in the mainshaft. Gripping the rear wheel start rotating it gently FORWARD till the piston again makes contact with the top of the piston – work slowly!

Make a note of where the pointer is on the timing disk as Top Dead Centre will be EXACTLY at the mid point between what is indicated and the Top Dead Centre position on the timing disk.

Examples:

If the pointer is at 90 degrees from TDC then the mid point is at 45 degrees (90 divided by 2)
If the pointer is at 84 degrees then the mid point is at 42 degrees
If the pointer is at 75 degrees then the mid point is at 37.5 degrees

**BUT** – if your pointer is between TDC and 50 degrees your piston stop is **too short**. Remove the stop, using the two nuts in the stop, lengthen it and start again

If the pointer is between 90 degrees and bottom dead centre your piston stop is **too long**. Remove the stop and shorten it, then start again

The **ideal range** is for the piston stop to be of a length that has the pointer in the range of 70 to 90 degrees from Top Dead Centre

Once you are happy with the length of your piston stop you can continue.

Making sure that the motor does not move, gently rotate the timing disk till the pointer is at your calculated mid point. You must now take every precaution NOT to move the timing disk in the mainshaft or disturb the position of your pointer.



In my case the pointer was at 80 degrees when the piston made contact with the stop, so the mid-point to TDC on the DISK is 40 degrees, which is actually TDC of the MOTOR.

Rotate the rear wheel in a reverse direction just a small amount then remove the piston stop – its done its work and the timing disk is now showing you the actual position of the crankshaft and piston.

Now slowly rotate the rear wheel in a FORWARD direction keeping an eye on the movement of the inlet rocker AND the position indicated on the timing disk. You will see the inlet rocker rise and once the inlet rocker starts to fall (close) then the piston is on the upward path in the compression stroke with the timing disk showing the true position of the piston.

Continue gently rotating the rear wheel in a forward direction till the timing disk shows Top Dead Centre on the compression stroke – **Job Done.**

Once finished you may consider mixing up a bit more epoxy adhesive and putting it into the inside of the spark plug body of your piston stop so there is no possibility of your piston stop being inadvertently lengthened or shortened in the future.