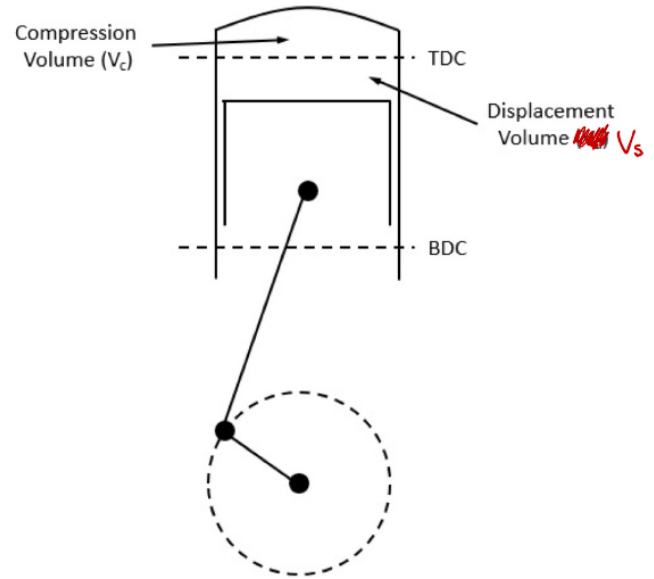


Powertrain + Control

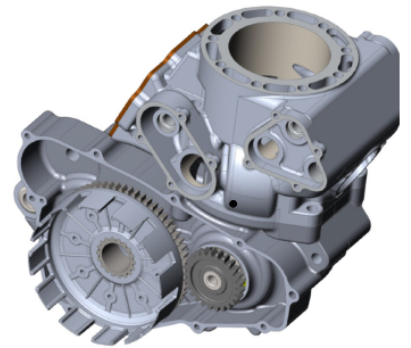
Compression Ratio:

$$CR = \frac{V_s + V_c}{V_c}$$



So, for a CR500 491 cc
Compression ratio 9:1

We need to find V_c



$$CR \times V_c = V_s + V_c$$

$$(CR \times V_c) - V_c = V_s$$

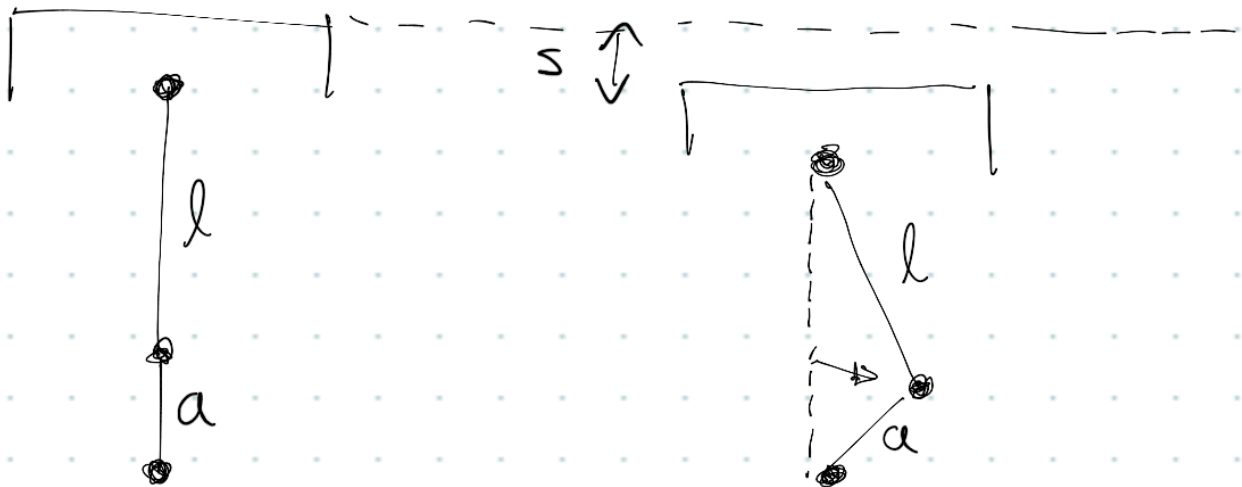
$$V_c (CR - 1) = V_s$$

So $V_c = \frac{V_s}{(CR-1)}$

For CR500

$$V_c = \frac{4a^3}{8} = 61.375 a$$

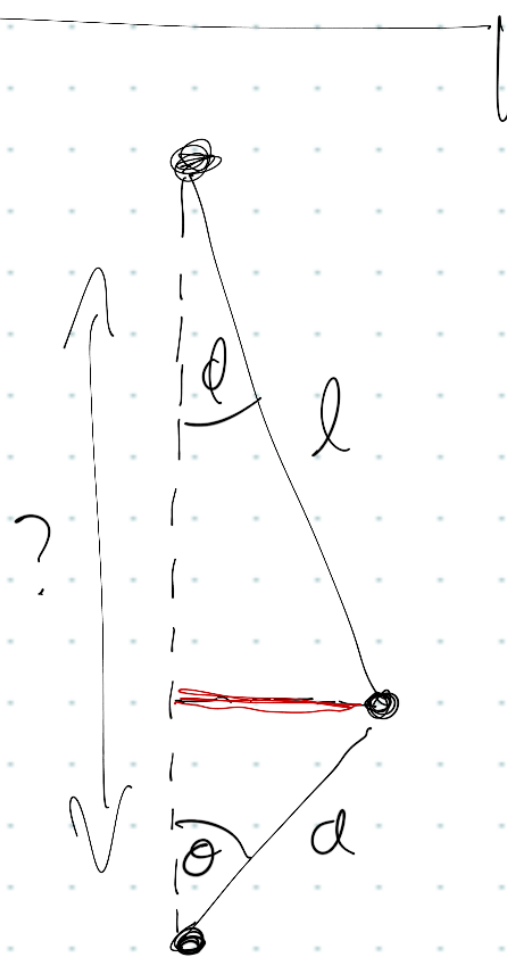
Volume Calculation as crankshaft plates?



l = Con rod length
 a = Crank radius

θ = Crank angle
 ϕ = Rod angle

$$\cos \phi = \frac{\text{adj}}{\text{hyp}}$$



$$? = a \cos \theta + l \cos \phi$$

$$S = a + l - a \cos \theta - l \cos \phi$$

ϕ is a problem, need to get rid of it.

$$a \sin \theta = l \sin \phi$$

$$\sin \phi = \frac{a}{l} \sin \theta$$

$$\phi = \sin^{-1} \left(\frac{a}{l} \sin \theta \right)$$

So this gives us ...

$$S = a + l - a \cos \theta - l \cos(\sin^{-1}(a/l \sin \theta))$$

So the Volume is

$$\text{Volume} = V_c + \left(\frac{\pi B^2}{4} \times S \right)$$

Next step is Pressure! and temperature ...

Start with $PV^n = C$ and $\frac{PV}{T} = C$

$$P_1 V_1^n = P_2 V_2^n \quad \text{and} \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

I want some equations for the relationships between Pressure, volume and temperature.

Using the equations above, get similar terms together

$$\textcircled{1} \quad \frac{P_1}{P_2} = \frac{V_2^n}{V_1^n}$$

$$\textcircled{2} \quad \frac{P_1}{P_2} = \frac{V_2}{V_1} \times \frac{T_1}{T_2}$$

Put those together, getting rid of P_1 and P_2

$$\Rightarrow \frac{V_2^n}{V_1^n} = \frac{V_2}{V_1} \times \frac{T_1}{T_2} \quad \text{get } \frac{T_2}{T_1} \text{ on its own}$$

$$\frac{T_2}{T_1} = \frac{V_2}{V_1} \times \frac{V_1^n}{V_2^n}$$

$$\frac{T_2}{T_1} = \frac{V_2}{V_1} \times \left(\frac{V_1}{V_2} \right)^n \quad \text{get all the } V_1 \text{ on top}$$

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2} \right)^{-1} \left(\frac{V_1}{V_2} \right)^n$$

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2} \right)^{n-1}$$

How about Pressure and temperature Same process

$$\textcircled{1} \quad \frac{P_1}{P_2} = \frac{V_2^{\frac{1}{n}}}{V_1^{\frac{1}{n}}}$$

$$\textcircled{2} \quad \frac{P_1}{P_2} = \frac{V_2}{V_1} \times \frac{T_1}{T_2}$$

We will need to get rid of V . So rearrange ...

$$\frac{V_2}{V_1} = \frac{P_1^{\frac{1}{n}}}{P_2^{\frac{1}{n}}}$$

Now stick this in $\textcircled{2}$

$$\frac{P_1}{P_2} = \frac{P_1^{\frac{1}{n}}}{P_2^{\frac{1}{n}}} \times \frac{T_1}{T_2} \quad \text{Rearrange for } \frac{T_2}{T_1}$$

$$\frac{T_2}{T_1} = \frac{P_1^{\frac{1}{n}} P_2}{P_2^{\frac{1}{n}} P_1}$$

get all the P_2 on top

$$\frac{T_2}{T_1} = \frac{P_2^{-\frac{1}{n}} P_2}{P_1^{-\frac{1}{n}} P_1}$$

Now sort out the indices

$$\frac{T_2}{T_1} = \frac{P_2^{-\frac{1}{n}} P_2^{\frac{1}{1}}}{P_1^{-\frac{1}{n}} P_1^{\frac{1}{1}}} \quad \left| \quad \begin{array}{l} \text{To sort the indices} \rightarrow \text{add fractions} \\ \frac{1}{1} + \frac{-1}{n} \\ \Rightarrow \frac{n-1}{n} \end{array} \right.$$

So

$$\frac{T_2}{T_1} = \frac{P_2^{\frac{n-1}{n}}}{P_1^{\frac{n-1}{n}}}$$

So

$$\boxed{\frac{T_2}{T_1} = \left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}}}$$

And obviously Pressures and Volumes are

$$P_1 V_1^n = P_2 V_2^n$$

$$\boxed{P_2 = P_1 \left(\frac{V_1}{V_2} \right)^n} \Rightarrow \text{Simulation!}$$