Advantage
i) Method is very convenient and economical.
ii) constant loss and stray loss can be determined by this test. Therefore efficiency for any load can be calculated.

Disadvantage
i) Since the test is in no load, temp rise and performance of commutation can't be accessed by
ii) This test can't be run for DC series motor.
iii) Change in iron loss for No load to full load are not accounted although change is prominent due to armature ~~cu~~ loss Reaction.

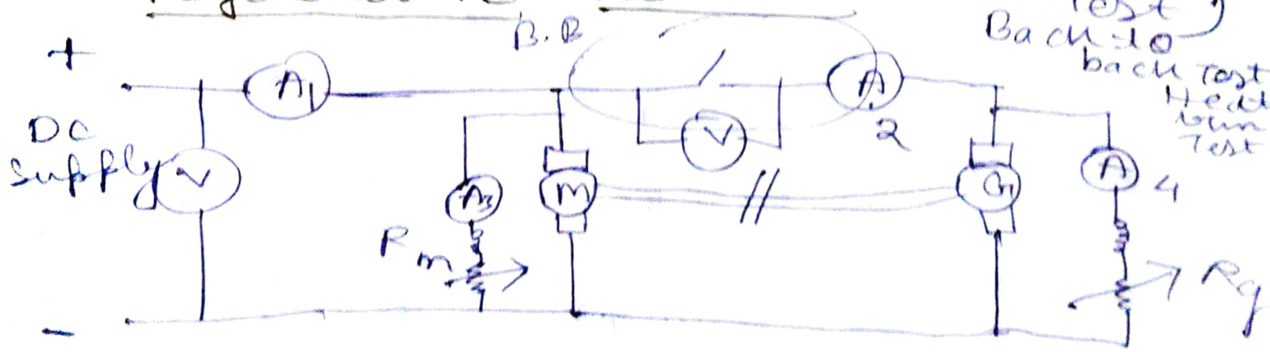
$\frac{110}{54.2306} > 1.8$ Peek's formula.

$$F \times \frac{1.11066 \times 10^{-4} \, \delta \, V^2}{(\ln \frac{d}{r})^2}$$

$= 0.0463$ uW

0.6.
0.012

Testing on DC Machine :-
Regenerative method :- (Hopkinson's Test) Back-to-back Test Heat Run Test



In the connection diagram, machine M acts as a motor and is started from supply with help of starter and S is kept opened. Field current of motor M is kept adjusted with help of field rheostat Rm to make the motor run at rated speed.

As the generator G is given by the motor M, it also run at rated speed of motor M. Field current of motor G or gen with help of field rheostat R_g: Arm. voltage of generator G is somewhat higher than supply voltage. When voltage of generator is equal to and of the same polarity of busbar voltage switch S is closed and generator is connected to the bus bar.

Both the M/C now are connected in parallel across the supply voltage. Under this condition, generator neither taking any current nor giving any current to supply from. So, generator is said to be in floating condition. Adjusting the excitation of M/C with help of field rheostat, any load can be thrown on the M/C.

Calculation of efficiency:-

Power input from supply

$= \text{total loss} = VI_L$

Armature cu loss for motor

$= I_{am}^2 R_{am}$

Field cu loss $= I_{shm}^2 R_{shm}$

Arm. cu loss of generator

$= I_{ag}^2 R_{ag}$

Field cu loss $= I_{shg}^2 R_{shg}$

Constant loss for both the Machine = Power drawn of supply - (~~Armature~~ cu loss)

$$P_C = VI_L - (I_{am}^2 R_{am} + I_{shm}^2 R_{shm} + I_{ag}^2 R_{ag} + I_{shg}^2 R_{shg})$$

$(P_C + I_{am}^2 R_{am})$. Power loss by per machine $P_C/2$

efficiency for generator =

$$\eta_g = \frac{\text{O/P of generator}}{\text{I/P of generator}}$$

~~Armature cu~~

$$\eta_g = \frac{VI_L}{VI_{ag} + \text{loss} + \frac{1}{2}P_C}$$

$$\eta_m = \frac{\text{O/P of motor}}{\text{I/P given motor}}$$

$\Rightarrow$ I/P = VI_m.

I/P = $\cancel{\frac{P_C}{2}+}$ and O/P = $\left(VI_{am} - \frac{P_C}{2} - I_{mg}^2 R_{am} - I_{mg}\right)$

$$\eta_g \eta_m = \frac{I_m}{I_G}$$

#

$E_g = V + I_{ag} R_{ag}$

$E_m = V - I_{am} R_{am}$.

$\therefore E_g > E_m$. but $\boxed{\begin{matrix} E_g \propto \phi_g N \\ E_m \propto \phi_m N \end{matrix}}$

$\therefore \phi_g > \phi_m$

$A_G > A_3$

$\cancel{B}_g > \cancel{B}_m$.

If η_m and η_g are efficiency of generator and motor ~~respectively~~ reverse motor

O/P = $VI_m \eta_m$ (I/P ~~of~~)

generator I/P = VI_g/η_g.

$$\therefore VI_m \eta_m = \frac{VI_g}{\eta_g}$$

$$\eta_m \eta_g = \frac{I_g}{I_m}$$

Since the armature, field, stray power loss in both are ~~considered~~ equal, there fore $\eta_m = \eta_g$

$$\eta_g = \eta_m = \sqrt{I_g/I_m}.$$

Advantages of Hopkinson's Test

i) Method is very economical.
ii) Temp rise and commutation condition can be checked under rated load condition.
iii) Stray loss are considered as both m/c are operated under rated load condition.
iv) Large m/c can be tested at rated load without consuming much load from supply.
v) η from diff Load can be determined

Disadvantage

i) The main disadvantage is that the necessity of 2 practically identically m/c are req. for this test, which is impractical.

ii)

Q. A 200 V DC shunt motor take 10A current when running at no load condition. at higher load, brush drop (total) is 2V, Light load, it is negligible. stray load loss at any line current of 100A is 50% of the no load loss. Calculate efficiency at the line current of 100A if $R_a = 0.2\,\Omega$ $R_f = 100\,\Omega$

$I_{L_0} = 10A$ $I_f = 2A$ $I_a = 8A$

$E_g = V_t + I_a R_a$ I/P of motor $\Rightarrow (200 \times 10)$ $= 2$ kW

$= 200 +$

No load loss $= (I_a^2 R_a + I_{sh}^2 R_a)$

shunt field cu loss $=$ 400 W

at load condition,

$I_L = 100A$ $I_f = 2A$

$I_a = 98A$

so, (loss $=$ 1920.8 W) arm. cu losss

at no load $= 12.8$ W arm cu loss.

~~stray loss~~

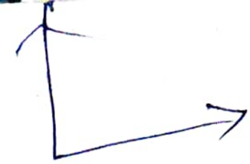
No load = (400 + 0) W

no load = 400 W

(stray load loss) = ~~200 W~~ 2 kW

$\frac{(2000\ W)}{2}$

= 1000 W



O/P of ~~motor~~

Brush loss = (2 × 98) W

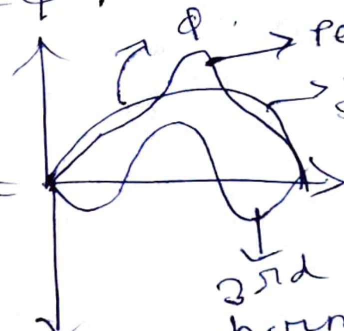
= 196 W

1920.8 W (No load losses)

η = 82.416 %

Harmonics

From the figure, it is found that the fundamental component of the magnetizing current I_ϕ is in the same phase with flux ϕ. Since ϕ is 90° out of phase with the supply voltage V_1, the power loss due to this fundamental component is zero. $V_1 I_\phi \cos 90 = 0$



Similarly all odd harmonics including the 3rd harmonic components of a magnetizing current has a time phase difference of $n \times 90°$ with the supply voltage V_1. n is order of harmonics. Thus the power associated with the voltage V_1 and fundamental current is zero. Thus even if there is saturation in core without hysteresis, there is no associated power loss. Effect of saturation is only to distort the magnetising current. The magnitude of 3rd harmonic component is predominant and it may be upto as high as 10 % of the fundamental component under loaded condition. Primary current composes of both the no load current and the load current.