X460993

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Department of Electrical Engineering

Rotational Losses in a D.C. Machine

INTRODUCTION

The rotational losses in a D.C. machine consist of wind and friction losses, brush losses, core losses and stray load losses. Core losses consist of eddy-current and hysteresis losses. These can be approximated by the following formula:

$$Pc = KhNBm^{1.6} + KeN^2Bm^2 \text{ (watts)}$$

where Kh and Ke are proportionality constants, N is speed and Bm is flux density. These can be separated by plotting core loss per speed, Pc/N, versus speed, N. The above equation takes the following form:

$$y = mx + b$$

where y is Pc/N, m is $KeBm^2$ (slope of the curve), b is $KhBm^{1.6}$ (y intercept), and x is N. Therefore,

$$Ph = bN$$
$$Pe = Pc - Ph = mN^2$$

Stray load losses are additional eddy current and hysteresis losses that occur under full-load current conditions (about 1% of output power for large machines).

In addition to rotational losses, there are copper losses (I^2R). These occur in the field and armature.

ASSIGNMENT

The student is to devise and run such tests as needed on a given DC shunt motor to determine its rotational losses.

EXPECTED RESULTS (as a minimum)

1. Explaination of eddy current and hysteresis.
2. A plot of armature rotor resistance, brush resistance, and total armature resistance versus armature current.

3. A plot of brush losses, wind and friction losses, core losses, and total rotational losses versus speed.
4. A plot to separate core losses (watts/rpm vs rpm).
5. A determine of the efficiency of the machine for rated conditions. and an answer to the question as to whether it agrees with the name-plate data, and, if not, why not?