TEMPERATURE RISE IN WINDING

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SAFUAN YAACOB
Faculty of Electrical Engineering
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR, DARUL EHSAN

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ABSTRACT

Temperature changes in winding are one of the important factors that need to be precisely concerned in most electrical instruments. The increment of the temperature should be known to be constant at certain level or otherwise it may damage the respected instrument. There are two basic approaches in analyzing the temperature effects in winding, such as by the thermocouple measurement and calculations.

This thesis will focus into the determination of empirical heat transfer coefficient of concentrated motor windings for ventilated and total enclosed conditions. And the process will consider the calculation approach, which is more applicable and efficient.

Under steady state condition, the winding temperature rise may be approximated in terms of the winding loss I^2R, the surface area for heat dissipation A and the heat transfer coefficient α.

The thermal design of winding is a complicated process. Current design practice still involves the use of experimental derived empirical factors. The use of 3-D finite element thermal analysis package may provide more accurate result but is complex, time consuming and expensive.

The results and findings obtained through some experiments that involved various sizes of winding. This thesis showed the construction of a few concentrated windings of different total surface areas, loading them under various conditions and records the temperature rise at steady state in each case. The project output is list of empirical heat transfer coefficient a to be use in motor winding design.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Introduction

The temperature rise in electrical components has a significant effect on the design of most electrical equipment. The size of these conductors in such apparatus (in this case coils) will determine the overall size, cost and feasibility of the entire apparatus. In turn, the permissible temperature rise or heat capacity, and electrical impedance requirements usually determine physical size

Heat transfer characteristics can also be critical to the design of other components in electrical apparatus, including insulation, housing enclosures and contact. This project is to provide an understanding of the methods that can be used to determine the heat transfer coefficient in electrical system.

The overall heat transfer equation that determines the temperature of an electrical conductor given by:

$$Q_1 = Q_2 + Q_3 + Q_4$$

where;

Q_1 = heat generated due to electrical current flow, W-sec

Q_2 = heat stored in an electrical component, W-sec

Q_3 = heat dissipated by radiation, W-sec

Q_4 = heat lost by convection and conduction, W-sec

This formula states that equilibrium will exist between the heat losses and gains. The computation of temperature rise will involve two cases, which are the homogeneous body and non-homogeneous body, which is more complex case.