UNIVERSITI TEKNOLOGI MARA

EXPERIMENTAL STUDIES OF FABRICATED EDDY CURRENT PROBE

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Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referred work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

Eddy current testing (ET) is one of the Non destructive testing (NDT) techniques for the detection and evaluation of surface and sub-surface defects in electrically conducting materials. This technique is the most effective technique for the assessment of heat exchanger tubes in monitoring the integrity of a heat exchanger system. In performing the eddy current inspection, probe is the most important component in acquiring information from the heat exchanger system. It is the main factor that determines the success of an eddy current testing for optimum and reliable inspection results.

This research work covers the experimental and numerical approach in fabricating an eddy current probe for tube inspection. The aim of the research is to study the physics and engineering parameters which can enable us to produce eddy current probes with the focus of studying the probe coil configuration that affect its sensitivity and resolution for eddy current testing. With the achievement in fabricating an eddy current probe that fulfill the requirement of code and standards for tube inspection, the work is proceed in the study of the effect of inter-coil spacing and coil width to the probe sensitivity and resolution. The sensitivity and resolution of the fabricated probes have been studied by measurement of Vpp values and signal phase separation between internal groove defect (ID) & external groove defect (OD) wall loss at different inter-coil spacing and different coil width.

The results obtained by both experimental and numerical work have shown that with reduced inter-coil spacing and coil width, the sensitivity and the resolution of the fabricated probes will be increased thus giving a better inspection reliability and performance. This behavior is mainly attributed to the physical parameter of the probe geometry. With reduced spacing and coil width, the eddy current density becomes denser in the test specimen at a specific region. This reflects that the resistance for the eddy currents to flow in the sample is reduced and the phase will be increased. In addition, with reduced inter-coil spacing between the two coils, the mutual impedance of the two coils will become dominant thus a denser eddy current will be induced in the sample. In eddy current testing, defect detection is based on how the eddy current is disturbed in the sample, with more induced current, more current will be affected by the presence of a defect thus increase the sensitivity and the resolution of the probe.

In this study, there are good agreement between the experimental data and numerical model in determining the reliable eddy current probe for engineering application.

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CHAPTER 1

INTRODUCTION

1.1 Background

Non destructive testing (NDT) is the testing of engineering material or component to detect internal and surface defects or discontinuities using methods which do not damage or destroy the material under test [1]. NDT techniques are essential in various sectors of industries, including the transportation, aerospace, automotive, manufacturing, petrochemical and defense industries [2]. It plays a critical role in assuring that structural components and systems perform their function in a reliable and cost effective fashion. They are employed to detect and characterize flaws, as well as to measure material and structure properties to ensure the continued safety and performance reliability of components in industry. These techniques improve the performance reliability of components through periodic In-Service Inspections (ISI), by way of preventing premature and catastrophic failures [3].

In NDT applications, the eddy current technique is one of the most commonly performed techniques and has been used for more than four decades for metal inspection. There are many advantages that make this technique so popular [4]. The technique is sensitive to various magnetic and structural properties of conductive samples. This leads to diverse applications of eddy current testing, such as flaw detection, proximity measurement, metal thickness measurement, non-conductive coating thickness measurement, conductivity measurement and metal sorting [5]. Surface preparation prior to inspection is generally not necessary or very minimum,