CHARACTERIZATION OF WELD DEFECTS IN SINGLE V-BUTT WELDED MILD STEEL PLATES USING ULTRASONIC A-SCAN TECHNIQUE

Dissertation submitted in partial fulfillment of the requirements for the degree of

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DECLARATION

I hereby declare that this dissertation is my own work and that, to the best of my knowledge and behalf, it contains no material previously published or written by another person nor material which, to substantial extent, has been accepted for the award of any other academic qualification of a university or other institute of higher learning except where an acknowledgement is made in the text.

Authors name; **T.M.R. Tennakoon**   **Date;** 01.03.2010

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This is to certify that this dissertation is based on the work carried-out by Mr.T.M.R.Tennakoon under my supervision. This dissertation has been prepared according to the format stipulated and is of acceptable standard.

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Abstract

In Ultrasonic A-Scan technique the depth and the size of the defects in a material can be determined by the position and amplitude of the reflected echo on the CRT screen. However the main difficulty in ultrasonic testing is that the precise recognition of the defect type.

In conventional ultrasonic A-scan methods recognition of the defect type (porosity, slag, crack etc.) is ascertained by a series of movement of the probe as rotational, orbital, lateral and transverse to observe the echo pattern. Here the human eye perceives many facts simultaneously by moving a transducer in infinite increments in 3D to seek out additional information-the mind sorts and processes the accumulated real-time facts and combines them with empirical data from experience and case history before making final decision on the defect.These uultrasonic echo patterns are quite complex since those may contain many signals other than defect echoes, same defect may display different echo patterns, different defects may display similar echo patterns and the amplitude and shape of the signal may change due to slight movement of the testing probe.

Therefore the interpretation of defects using this technique is very complicated and totally depends on the experience of the operator who carries out the testing. Hence only well-experienced NDT personnel can identify defect type using this method. This is one of the main drawbacks related to Ultrasonic A-scan technique.

The objective of this research is to study the relationship between type of defect and echo amplitude in single-V butt welded steel plates and to propose a new concept to identify defect type with the help of a self developed software which will be cheep, portable and simple to understand by the operator.

To achieve this objective initially a mathematical relationship between echo amplitude and defect type was developed for common weld defects in single-V butt welded steel plates (slag, porosity, crack etc.) using newly derived mathematical equations for above defects.

Since the amplitude of the echo signal affects by the defect size this parameter alone can not be used to identify the type of defect. As such the possibilities of using few other features such as width of defect echo, position of defect and change of probe angle also were considered.

Experimental results show that any individual defect in single-V butt welded mild steel plates produces echo signals with unique pulse width and range of amplitude levels. In addition the results show that lack of penetration can be identified using a second probe angle in addition to single probe angle as use in conventional methods. Lack of side-wall fusion can be identified by using position of probe with respect to weld center line.

These individual characters of defects, which are inherent to those defects, were used to predict the type of unknown defects using a self developed software programme named "ULTRASL1".

The significance of this work is that the introduction of a specialized procedure with a software programme to identify type of defect, so that Non-Destructive Testing personnel with any level of experience can share the expertise of the best operators in the industry. Hence it will support to reduce one of the main problems concerning ultrasonic testing i.e. the difficulties in recognition of defect type.

The work was limited for defects like slag(volumetric), isolated pore, porosity, lack of inter-run fusion, lack of side-wall fusion, crack and lack of penetration in single-V butt welded mild steel plates.

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Abbreviations

NDT   -Non Destructive Testing

UT   -Ultrasonic Testing

RT   -Radiographic Testing

MT   -Magnetic Particle Testing

PT   -Liquid Penetrant Testing

ET   -Eddy Current Testing

CRT   -Cathode Ray Tube

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