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Non Destructive Method by Penetrant Testing

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Abstract: This paper presents results from a literature review of defect characteristics essential for non-destructive testing (NDT). Most of the major NDT methods are included in the study – Penetrant Testing (PT), the study was performed by means of searching in scientific databases, etc. Mainly, the following It is concluded that for Penetrant testing, the defect geometry, the defect size and the defect. A number of investigations address the relationships between the defect parameters like roller depth, surface defects Also the phenomena of the electrical contacts between the defect surfaces (for a crack) was studied. Defect parameters that are essential to the quality of Penetrant testing are defect position in the object (includes the depth), orientation, size, crack surface roughness, closure and tip radius. This investigation has been focused on those parameters that are not that easy to reconstruct and only briefly discussed the influence on the signal response due to defect position, orientation and size.

Keywords: Pre-Cleaning, Removal of Excess Penetrant, Developer, Post-Cleaning, Water Soluble, Solvent Removable, Post-Cleaning, Clean Surface, Inspection,

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INTRODUCTION

Non-destructive testing (NDT) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage. The terms non-destructive examination (NDE), non-destructive inspection (NDI), and non-destructive evaluation (NDE) are also commonly used to describe this technology. Because NDT does not permanently alter the article being inspected, it is a highly valuable technique that can save both money and time in product evaluation, troubleshooting, and research. Common NDT methods include ultrasonic, magnetic-particle, liquid penetrant, radiographic, remote visual inspection (RVI), eddy-current testing and low coherence interferometry.Liquid penetrant testing (LPT) is a non-destructive testing1 (NDT) method used extensively in the aerospace industry to detect surface breaking cracks in metal components. It is relied on to assure the structural integrity of aircraft through inspections of critical components during production and throughout the aircraft service life.

NDT method depends on material deterioration in a given environment, and often several methods are combined. Various authors describe a wide range of ndt techniques which can be used on their own or in combination to effect condition monitoring in the mechanical engineering and processing industry (ref-1)

Non-destructive testing is the use of physical methods which will test materials, components and assemblies for flaws in their structure without damaging their future usefulness. NDT is concerned with revealing flaws in the structure of a product (ref-3)

OVERVIEW

liquid penetrant testing lpt) was one of the earliest methods used for non-destructive inspection and has been a mainstay of practical ndt for many years. it is the most common ndt method (apart from visual inspection) used for the detection of surface breaking cracks in metal components and is used extensively in the aerospace industry during production of aircraft and throughout their service life. lpt is the principal method used for ndt of turbine engine components, with over 90% of propulsion components being inspected using lpt at least once in their lifetime penetrant inspection relies on a liquid dye penetrating into a surface-breaking defect

Pre-cleaning. The presence of contaminants on the surface of the part may prevent an effective inspection by either filling a defect, thus preventing the penetrant solution (dye) from penetrating, or contaminating the fluorescent penetrant solution and interfering with the fluorescence process

Penetrant application. The penetrant dye is applied to the surface of the part for a dwell time which is sufficient to allow the dye to seep into any defects that are present.

Remove penetrant. This usually involves rinsing part,often using an emulsifier to assist with the removal of the excess penetrant. In some applications the penetrant may be wiped from the inspection area

Apply developer. A developer is used to draw the trapped penetrant dye out of the defect onto the component surface and also provide a background against which the defect indication will be readily visible. In fluorescent penetrant systems

EXPERIMENTAL SETUP Nondestructive testing (NDT) has been defined as comprising those test methods used to examine an object, material or system without impairing its future usefulness. The term is generally applied to nonmedical investigations of material integrity. Non Destructive Testing is the act of evaluating a welded component (or material to be welded) without affecting the serviceability of the part or material. The purpose of welding inspections is to locate and determine the size of any discontinuities Discontinuities that are to large or repeat too often within the weld become defects Defects will compromise the welds overall strength

DEFECTS: Porosity, Undercutting, Rollover or Cold Lap, Slag inclusion, Poor penetration, Voids.

PRINCIPLE- A liquid penetrant is applied at the surface of the specimen. The penetrant is drawn by the surface flaws due to capillary action and this is subsequently revealed by a developer, in addition with visual inspection.

PROCEDURE:

- Cleaning the surface
- Application of the penetrant
- Removal of excess penetrant
- Developing
- Inspection

Liquid penetrant testing is one of the oldest and simplest NDT methods where its earliest versions (using kerosene and oil mixture) This method is used to reveal surface discontinuities by bleed out of a colored or fluorescent dye from the flaw. The technique is based on the ability of a liquid to be drawn into a "clean" surface discontinuity by capillary action. After a period of time called the "dwell time", excess surface penetrant is removed and a developer applied. This acts as a blotter that draws the penetrant from the discontinuity to reveal its presence. Liquid penetrant testing is one of the most widely used NDT methods. Its popularity can be attributed to two main factors: its relative ease of use and its flexibility. It can be used to inspect almost any material provided that its surface is not extremely rough or porous. Materials that are commonly inspected using this method include; metals, glass, many ceramic materials, rubber and plastics, liquid penetrant testing can only be used to inspect for flaws that break the surface of the sample (such as surface cracks, porosity, laps, seams, lack of fusion

CONCLUSIONS

This project aims at introducing inspection and various testing methods to understand its purpose and importance in industries especially in fabrication industry. During the project, the study had been main in following areas: welding methods (tig.mig.saw) welding defects visual and dimensional inspection destructive testing methods (tensile, impact, bend, hardness) painting (Surface preparation and thickness check) welding is widely used by metal workers in the fabrication maintenance, and repair of parts and structures. While there are many methods for joining metals, welding is one of the most convenient and rapid method available and order to ensure its quality, the welding shall be flawless. or increasing the reliability of the equipment, all the defects flaw shall be detected as early as possible and correct repair has to be done before handing it over to client it is only necessary to repair defects that are considered detrimental to the structural integrity of the equipment welds have to be perfect. They need simply be within the acceptable working limits specified by the quality control code being used during the weld inspection

STEPS OF LIQUID PENETRANT TESTING

The exact procedure for liquid penetrant testing can vary from case to case depending on several factors such as the penetrant system being used, the size and material of the component being inspected, the type of discontinuities being expected in the component and the condition and environment under which the inspection is performed

Nature of the Defect ;

The nature of the defect can have a large effect on sensitivity of a liquid penetrant inspection. Sensitivity is defined as the smallest defect that can be detected with a high degree of reliability. Typically, the crack length at the sample surface is used to define size of the defect. However, the crack length alone does not determine whether a flaw will be seen or go undetected. The volume of the defect is likely to be the more important feature. The flaw must be of sufficient volume so that enough penetrant will bleed back out to a size that is detectable by the eye or that will satisfy the dimensional thresholds of fluorescence. The figure shows an example of fluorescent penetrant inspection probability of detection (POD) curve as a function of crack length

Application

• type1 -fluorescent penetrants: they contain a dye or several dyes that fluoresce when exposed to ultraviolet radiation. the rejectable defect size may be larger. the penetrants that are used to detect the smallest defects will also produce the largest amount of irrelevant indications.

• type 2 - visible penetrants: they contain a red dye that provides high contrast against the white developer background

fluorescent penetrant systems are more sensitive than visible penetrant systems because the eye is drawn to the glow of the fluorescing indication. however, visible penetrants do not require a darkened area and an ultraviolet light in order to make an inspection. penetrants are then classified by the method used to remove the excess penetrant from the part

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