UNIT - 1

Overview of NDT

Overview of Non Destructive Testing

Methods for the detection of manufacturing defects as well as material characterisation.

Relative merits and limitations, Various physical characteristics of materials and their applications in NDT. Visual Inspection Vs Mechanical Unaided and Aided NDT.
Testing of Materials broadly classified into two types:

1. Destructive Testing.

Destructive Testing:

It is also known as Mechanical Testing. In this type of Testing, we are testing a Workpiece and properties or the Workpiece is analysed. By the end of the test, the Workpiece will be destructed. And it will not be used for future work.

So, by the end of Mechanical testing, the Workpiece was damaged. To overcome these failuers, Non-Destructive Testing are invented.
* Tensile Test
* Hardness Test
* Fatigue Test
* Impact Test
* Compression Test
* Bend Test

These are some Destructive Testing.

Non Destructive Testing:

Its name itself indicates that we are going to test a material without disturbing it.

The main aim of non-destructive testing is testing of materials without destroying the integrative of the material. Testing without disturbing its properties. So, after this test, it can be used for future work.
Testing materials primarily

(i) Inherent defects which are created during the initial production of the material.

(ii) Processing defects which are created during the processing/manufacturing of the equipment.

(iii) Service defects which are created in the equipment.

Some of the Non-Destructive Testing are:

* Penetrant Testing
* Magnetic Particle Testing
* Ultrasonic Testing
* Radiactive Testing
* Eddy Current Testing
* Infrared
* Vibration Analysis
* Neutron Radiography
Purposes of Non-Destructive Testing:

- Modern Non-Destructive Tests are used by manufacturers.
- To avoid failures, prevent accidents, and save human life.
- To make a profit for the user.
- To ensure customer satisfaction and maintain the manufacturer's reputation.
- To aid in better product design.
- To control manufacturing processes.

Selection of the NDT Method:

The selection of one method over another is based on the following factors:

- Type and origin of discontinuity
- Material manufacturing process
- Accessibility of the component to perform NDT
- Type of equipment available
- Time available
We know that the aim of non-destructive inspection is to determine if the object being inspected is to be accepted or rejected.

During the inspection, the inspector looks for discontinuities in the object and identifies their nature and size. Then, these discontinuities are evaluated according to an acceptance criterion to determine if they are considered to be defects.

A Discontinuity is defined as an imperfection or interruption in the normal physical characteristics or structure of an object (crack, porosity, inhomogeneity, etc.).

On the other hand, a Defect is defined as a flaw (or flaws) that by a nature or accumulated effect renders a part (or) product unable to meet minimum acceptance standards or
It should be noted that a discontinuity is not necessarily a defect. Any imperfection that is found by the inspector is called a discontinuity until it can be identified and evaluated as to the effect it will have on the service of the part or to the requirement of the specification.

Types of Discontinuity:

Discontinuity are generally categorized according to the scope of the manufacture, or the in which they initiate.

Therefore, discontinuity are categorized in four groups, which are:

- Inherent Discontinuity
- Primary Processing discontinuity
- Secondary Discontinuity
- Service Discontinuity
This group refers to Ingot discontinuities that originate during the initial casting process, and also in the discontinuities itself caused as produced when metal is cast and in arriving at the final shape. The parts of any given shape are usually subjected, to different casting defects. Some of these defects are:

- Cold shut
- Shrinkage cavity
- Microshrinkage cavity
- Hot tears
- Blow holes
- Porosity
- Non-metallic inclusions
- Segregation
Primary Processing Discontinuities

This group refers to the discontinuities that originate during hot or cold forming process (extrusion, forging, rolling, drawing, welding etc.). Also, some of the inherent discontinuities in the material could propagate and become significant.

- Seams
- Lamination
- Stringers
- Cupping
- Cooling cracks
- Forging and Rolling laps
- Internal and External Burrs
- Slugs
- Grooving
- Hydrogen flakes
This group refers to the discontinuity that originate during grinding, machining, heat treating, plating, and related finishing operations.

- Grinding cracks
- Pickling cracks
- Heat treatment quenching cracks
- Machining tears
- Plating cracks

Service Discontinuity:

This group refers to the discontinuity that originate or develop while the component is in service. The service conditions (loading, mechanical and chemical environment, maintain) of a component affect its service life.
Creep cracks
Axe corrosion cracks
Hydrogen cracks

Welding defects

This defects in the weld can be defined as irregularities in the weld metal produced due to welding parameters or combination of filler metal and present.

Type of defects are:
* Cracks
* Porosity
* Solid Inclusion
* Imperfect shape
* Miscellaneous Defects
* Swell
Visual Inspection is the most common inspection method.

**Basic Principles:**

* Illuminate the test specimen with light - examine the specimen with the eye.
* VT reveals: spatter, exudation, build up, incomplete slag removal, cracks, heat distortion, undercutting & poor penetration.
* Simple, easy to apply, quickly carried out and very low in cost.

**Visual Inspection Equipment:**

1. Magnifying Glass.

The eye can not focus sharply on objects closer than approximately 250 mm.
Visual Inspection:

- Magnifying Mirror
- Fillet gages / weld gage
- Fillet gage / measure

Visual Inspection:

It is one of the very important methods of Non-Destructive testing. It only needs an experienced and skilled person to perform this test. An experienced person will be able to look into the surface of the material by normal eye (or) even with the help of extreme aids. He can watch the surface of the workpiece and predict what are the defects present in it.
can know what are all the defects that can be detected in materials. In order to inspect the new surface of the material and can predict defects of the material.

For example: An experienced candidate can know the defects that are caused due to welding. It may be blow holes, porosity. It will be seen via normal eye itself. So, an experienced candidate can know this type of defects and can know this type of defect and can reject the finding out of it. And reject the potential work piece. If it seems OK then future work.

No. Visual Inspection is very easy and quick process compared to other type of NDT Method.
A well experienced person can predict the approximate size of the material by seeing normally the material.

**Visual Inspection Equipment:**

- Microscope
- Boreoscope
- Endoscope (or) Endo probes
- Flexible fiber optic Boreoscope
- Video image scope

**Endoscope:**

An endoscope can consist of:

- A rigid or flexible tube
- A light delivery system to illuminate the object under inspection. The light source is normally outside the object and the light is typically directed via an optical fiber system.
A lens system focuses the image from the objective lens to the viewer.

An eyepiece. Modern instruments may be videorecorders, with no eyepiece. A camera transmits the image to a screen for image capture.