

Non- Destructive Testing

- Methods to test soundness or properties of a material , component , assembly without affecting the material's properties
- 100's of NDT methods available
 - Examples
 - Visual Inspection, Thermo graphic imaging , UT, Xray etc , MPI, LPI, strain guaging

Purpose for NDE

- To locate/assess defects in materials and assemblies
- To check dimensions , thickness, coating, hardness

NDE

- Advantages
 - Can be performed on actual material not on samples as in destructive tests
 - Can be performed at remote sites

LPI

- Used for surface defects only
- For non-porous materials
- Can be performed on variety of material, magnetic, non- magnetic, plastics etc

LPI....

- Method

- Apply Penetrant which seeps into defects (as low as 0.1micron size) by capillary action
- Red dye penetrant for use in in daylight
- Fluorescent penetrant for use under dark conditions
- After dwell time clean off the excess penetrant material
- Apply developer and observe the penetrant to come out of surface defects

Dye Penetrant Chemicals

- Wide range of Dye Penetrant Chemicals are used in various industries for various purposes.
- The Dye Penetrant Chemicals are available for checking the cracks in visible day light. Also they are available in two forms, viz. solvent removable and water washable.
- Fluorescent Penetrant Chemicals, which indicate defects as brilliant yellow green lines under UV Black Light are available. These Fluorescent Dye Penetrants are widely appreciated because of their water and solvent washable capabilities.

Dye Penetrant Chemicals



Magnetic particle Inspection

- Based on the principle of flux leakage around defects on ferromagnetic materials
- Can be performed only on ferromagnetic materials
- Defects must be presented at an angle to the magnetic lines of force

MPI... Limitations

- Can be performed only on ferromagnetic materials
- Can detect defect that are open or just below the surface
- Magnetic flux must cross the defect being sought
- **Can not be done at higher temperatures because** ferromagnetic material lose their magnetic property at elevated temperatures (above their Curie temperature)

Eddy Current Inspection

- Electrically conducting material generates eddy currents mostly on the surface or extending to a shallow depth when interacts with a electrically excited coil
- Used for detecting defects, sorting metals on the basis of their chemical analysis or their metallurgical structure
- Used extensively in aircraft industry to detect corrosion and the breakdown of bonding in laminated materials

Eddy Current Inspection

- Place the article within the coil
- Pass current (frequency 50Hz to 500Hz)
- Eddy currents which generate their own magnetic field
- Detect/measure eddy current using primary or secondary coil

Radiographic Inspection

- Uses X-rays OR
- Gamma rays (wave length shorter than X-ray)
- Very low wave lengths (10^{-7} to 10^{-12})
- Differential absorption of waves by the test object

Radiographic Inspection

- Uses special photographic film
- Amount of radiation that captured by film depends on material thickness, density, defects etc.
- Amount of darkening is proportional to amount of radiation absorbed just as what happens when light falls on photographic film.

Ultrasonic testing

- Pulses of High Frequency sound waves beamed into material under test
- Analyze reflected echoes from material
- Frequencies used : 1- 5 MHz (max 20Mhz)
 - Sound frequency- 20Hz to 20kHz

Ultrasonic testing

- Sound waves reflect off any interface eg- porosity, cracks, inclusions etc
- Principles of light reflections apply – angle of incidence, angle of reflection etc
 - So normal strike will be reflected back to its source
- Measures relative times for pulses to reflect back from defects or back wall

Ultrasonic testing

- Waves produced by thin wafers of quartz or barium nitrate
- Generate sound waves (vibrate at electrical frequency) when electrically excited

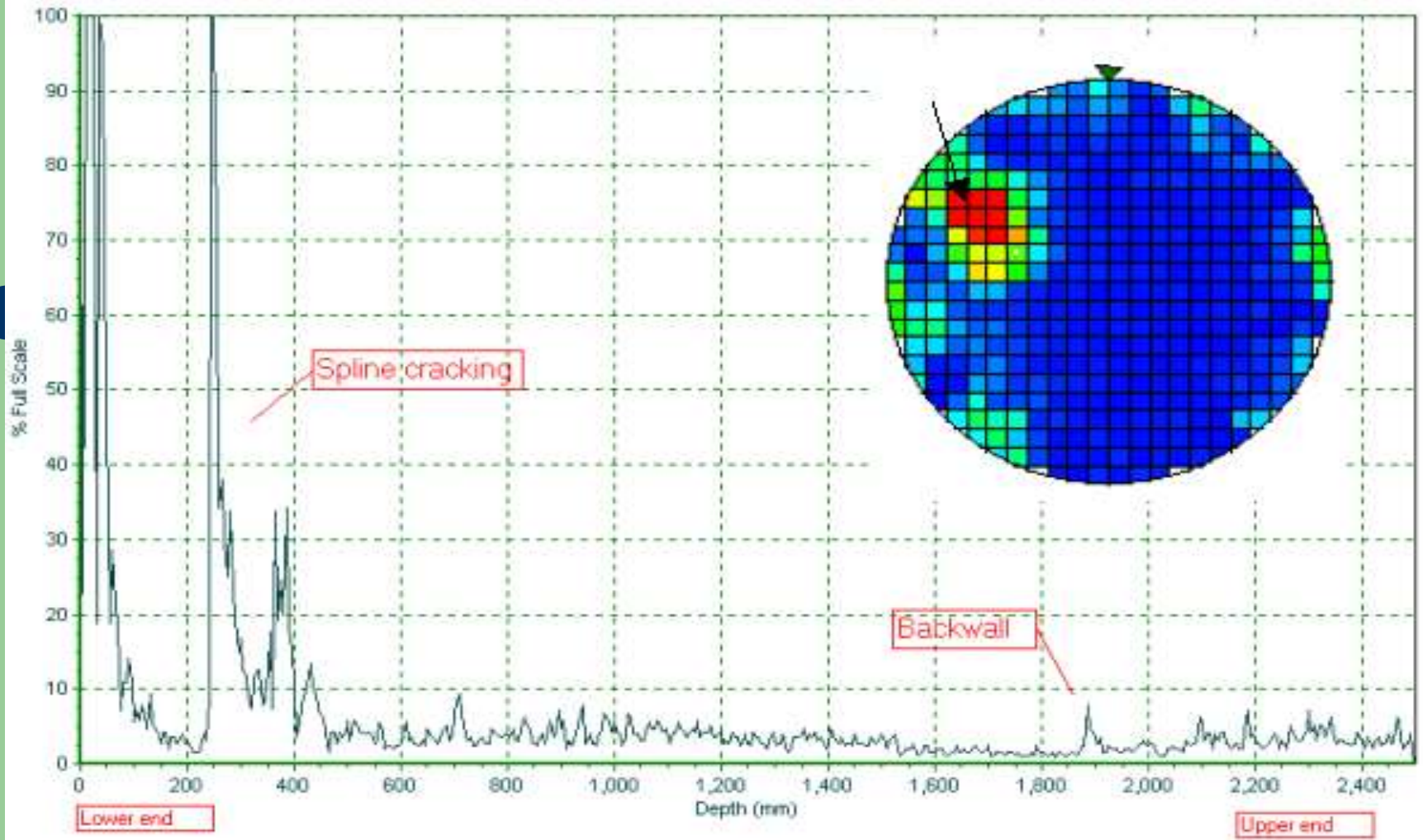
UT - Advantages

- High penetrating power, which allows the detection of flaws deep in the part.
- High sensitivity, permitting the detection of extremely small flaws.
- Only one surface need be accessible.
- Greater accuracy than other nondestructive methods in determining the depth of internal flaws and the thickness of parts with parallel surfaces.
- Some capability of estimating the size, orientation, shape and nature of defects.
- Nonhazardous to operations or to nearby personnel and has no effect on equipment and materials in the vicinity.
- Capable of portable or highly automated operation

UT - Disadvantages

- Manual operation requires careful attention by experienced technicians
- Extensive technical knowledge is required for the development of inspection procedures.
- Parts that are rough, irregular in shape, very small or thin, or not homogeneous are difficult to inspect.
- Surface must be prepared by cleaning and removing loose scale, paint, etc, although paint that is properly bonded to a surface usually need not be removed.
- Couplants are needed to provide effective transfer of ultrasonic wave energy between transducers and parts being inspected unless a non-contact technique is used. Non-contact techniques include Laser and Electro Magnetic Acoustic Transducers (EMAT).
- Inspected items must be water resistant, when using water based couplants that do not contain rust inhibitors.





NDT test of an V2500 engine blade



UT – animation

- <http://www.youtube.com/watch?v=9-BHDoiii2Y>

AINDT - Australia

- <http://www.aindt.com.au/certification/faqs/11-does-aindt-recognize-asnt-certifications-if-not-what-is-needed-to-meet-aindt-requirements.html>

Strain Guaging

- Used to measure the stress levels in a material , especially where stress concentration is suspected
- Method:
 - Measure strain and then calculate stress using the formula

$$\text{Stress} = \text{Youngs Modulus} \times \text{Strain}$$

Strain Guaging

- Photo elastic Strain Guaging
 - polarized light creates fringes of different shades can be obtained to stress/strain
 - Shade pattern is a function of strain/stress in the material
- Brittle Coatings
 - Uses brittle lacquer
- Resistance Strain Guaging
 - Measures resistance change under stress/strain

Coating Thickness Testing

- Several methods available
 - magnetic method (for magnetic or non-magnetic base materials)
 - Eddy current methods
 - X-ray, Beta ray used for coating/sheet thickness