UNIT - IV

ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)

ULTRASONIC TESTING - PRINCIPLE, Transducers, transmission and pulse-echo method, Straight beam and angle beam, Instrumentation, data representation, A-Scan, B-Scan, C-Scan, Phased Array Ultrasonic time to flight Diffraction. Acoustic emission Technique Principle, AE Parameters, Applications.

ULTRASONIC TESTING:

INTRODUTION:-

This Module presents an Introduction to the NDT method of Ultrasonic Testing.

Ultrasonic Testing uses high frequency of sound energy to conduct examinations and make measurements.

Ultrasonic examinations can be conducted on a wide variety of material forms including castings, forgings, Welds, and Composites.

A considerable amount of information about the part being examined can be collected such as the presence of discontinuities; part or coating thickness; and acoustical properties can often be correlated to certain properties of material.

Basic Principle of Sound :-

Sound is produced by a vibrating body and travels in the form of a wave.

Sound waves travel through materials by vibrating the particles that make up the material.

The pitch of a sound is determined by the frequency of the wave

Ultrasound is sound with a pitch too high to be detected by the human ear.

Basic Principles of Sound :-

The Measurment of sound waves from crest to crest determine its wavelength (λ).

The time it takes a sound wave to travel a distance of one Compute wavelength is the same amount of time it takes to source.

The sound wavelength is inversely proportional to its frequency ($\lambda = 1/f$)

Several wave modes or vibrations are used in Ultrasonic inspection. The most common are longitudinal, shear, and Rayleigh (surface) waves.

Ultrasonic waves are very similar to light waves in that they can be reflected, refracted and focused.

Reflection and refraction occur when sound waves interact with interfaces of differing acoustic properties.

The velocity of sound in a given material is constant and can only be altered by a change in the mode of energy.

Principles of Ultrasonic

Ultrasonic waves are introduced into a material where they are travel in a straight line and at a constant speed, Until they encounter a surface.

At surface interfaces some of the wave energy is reflected and some is transmitted.

The travel time of the sound can be measured and that provides information on the distance that sound has travelled.

Test Techniques :-

Ultrasonic testing is a very versatile inspection method, and inspections can be accomplished in a number of different ways.

Equipment :-

Equipment for Ultrasonic testing is very diversified. Proper selection is important to insure accurate inspection data as desired for specific applications.

In genal, the are three basic Components that Comprise an Ultrasonic test system :-

- Instrumentation.
- Transducer.
- Calibration Standards

Transducers :-

Transducers are manufactured in a variety of forms, shapes and sizes for various applications.

* Transducers are categorized in a Number of way which include :-

* Contact or Immersion.

Single or dual

Normal or angle beam.

In selecting a transducer for a given applications, it is important to choose the desired frequency, bandwidth size, and in some cases beam which Optimize the Inspection capabilities.

Instrumentation :-

Ultrasonic equipment is usually Purchased to satisfy specific Inspection needs, some users may purchase general purpose equipment to fulfill a Number of Inspection.

Test equipment can be classified in a Number of different ways, this may include portable or stationary Contact.

further classification of Transducers Commonly divided them into four general categories.

D-meters,

flaw detectors,

Industrial and Special Applications.

Calibration Standards :-

* Calibration is a operation or Configuration the Ultrasonic test equipment to known values. This provides the inspector with a means of comparing test signals to known measurements.

* Calibration Standards come in a widely variety of material types, and Configuration due to the diversity of Inspection applications.

Calibration standard are typically manufactured from materials of the same acoustic properties as those of the test articles.

Thickness calibration standard may be flat (or) curved for pipe and tubing applications, consisting of simple variation in material thickness

Data presentation :-

Information from Ultrasonic testing can be presented in a Number of different formats.

* Three of the more common formats include :-

A - Scan.

B - Scan.

C - Scan.

A-Scan Presentation display the amount of recived Ultrasonic energy as a function of time.

B-Scan represents the display a Profile View (Cross sectional) of a test Specimen.

C-Scan It represents displays a plan type View of the test Specimen and discontinuties.

Advantages of UT :-

* Sensitive to small discontinuities both surface and subsurface.

* Depth of Penetration for flaw detection or measurement is superior to other methods.

* Minimal part preparation required.

* Electronic equipment provides instantaneous results.

* High Accuracy in determining reflector.

Limitation of UT :-

* Surface must be accurate to transmit Ultrasound

* Skill and training is more extensive than with some other methods.

* Linear defects oriented parallel to the sound beam may go undetected.

* Reference Standards are required for both equipment calibration and characterization of flaws.

ACCOUSTIC EMISSION :-

Principle :-

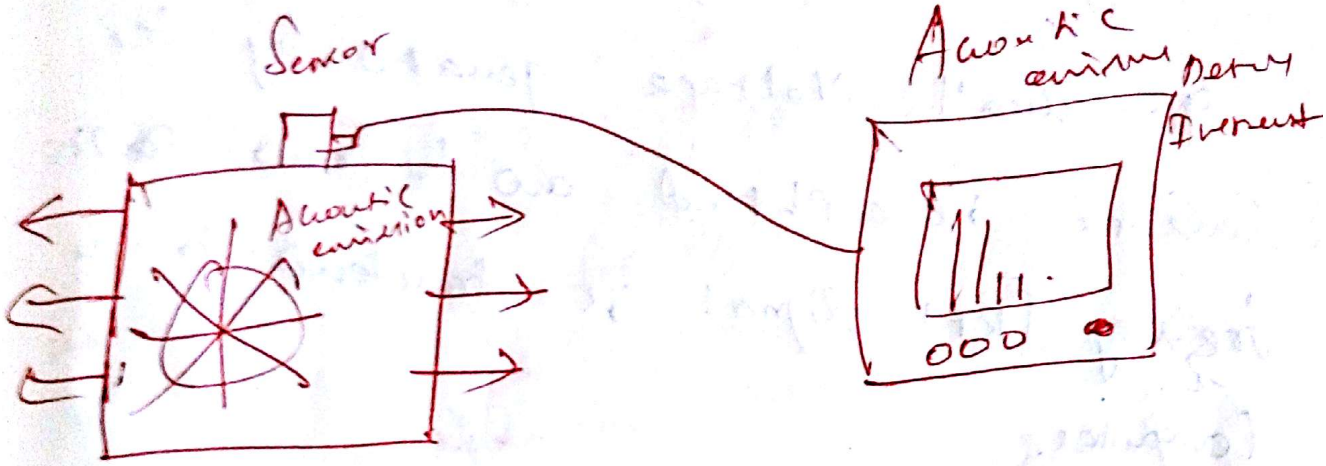
Acoustic emission may be defined as a transient elastic wave generated by the rapid release of energy within a material.

* When a structure is subject to an external stimulus, localized source triggers the release of energy, in the form of stress waves, which propagate to the surface and are recorded by sensors.

Testing process :-

Material in trouble with Acoustic Emission equipment you can listen to the sounds of cracks, grinding fibres breaking as may other most

Active damage in the Stressed material.



Detection of AE :-

* Source of A include many different Mechanism of deformation and fracture whilst the detection process remains the same.

* At a crack grow a number of emission are relased.

* The function of AE sensors is to detect this Mechanical movement and Convert it into a Usable electric signal.

Processing of AE Signals :-

The small voltage generated by the sensors is applied and the raw radio frequency (RF) signal is transferred to the computer.

Based on User defined characteristics, the RF signal is split into two discrete wave forms.

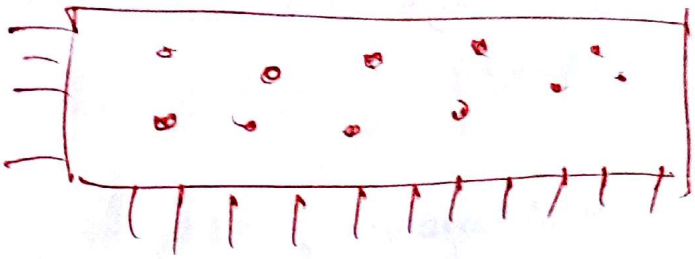
Displaying Signals :-

The collected waveforms can then be displayed in two ways.

One, function of waveform parameters.

Two, as the collected waveform.

Most AE Tests currently only record the waveform parameter and ignore the collected waveform.



Locating AE SIGNALS :

The Automated source Location Capability of AE is perhaps its most significant attraction as a non destructive Testing Technique.

* The predominant method of source location is based on the measurement of time difference between the arrival of individual AE signals.

Application of AE :-

* Welding Monitoring.
* BUCKET Truck integrity evaluation.
* Bridges.
* Aerospace structures.