IPE-381
Non destructive testing

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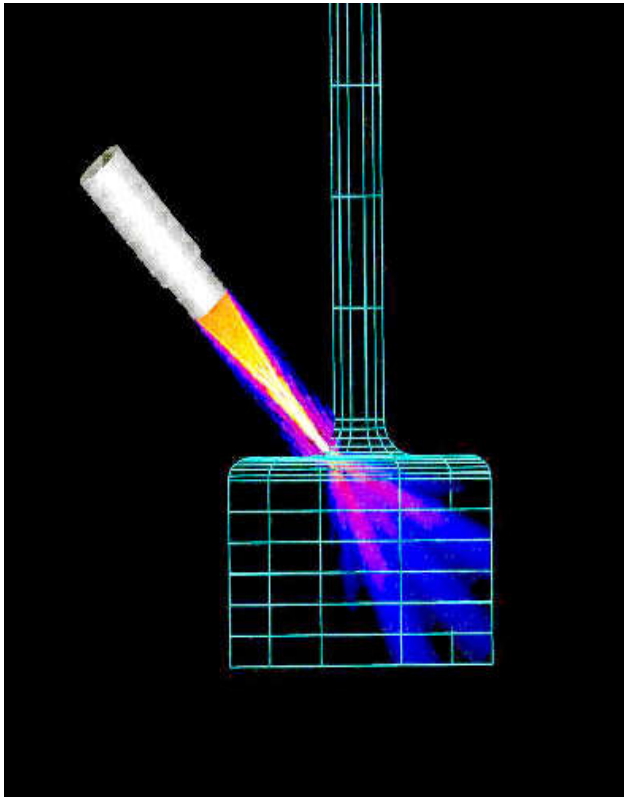
Definition of NDT

The use of noninvasive techniques to determine the integrity of a material, component or structure

or

quantitatively measure some characteristic of an object.



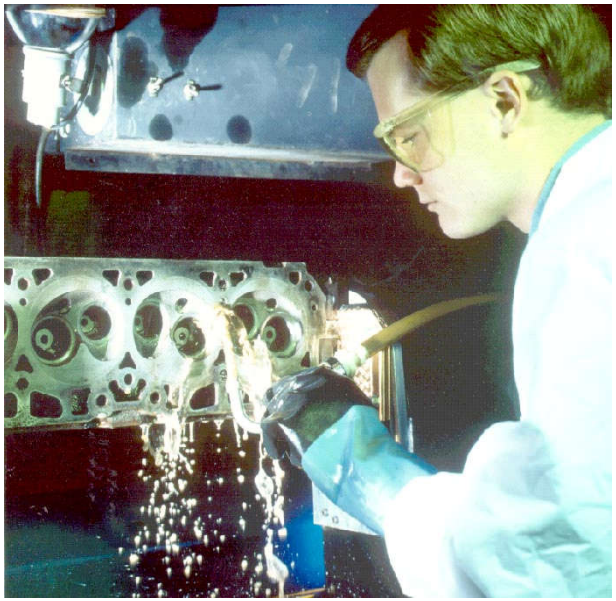
i.e. Inspect or measure without doing harm.

Methods of NDT

- Visual
- Microwave
- Thermography
- Magnetic Particle
- X-Ray
- Tap testing
- Acoustic microscopy
- Acoustic emission
- Magnetic measurement
- Liquid penetrant
- Ultrasonic
- Replication
- Flux leakage
- Laser interferometry
- Eddy current

Six Most Common NDT Methods

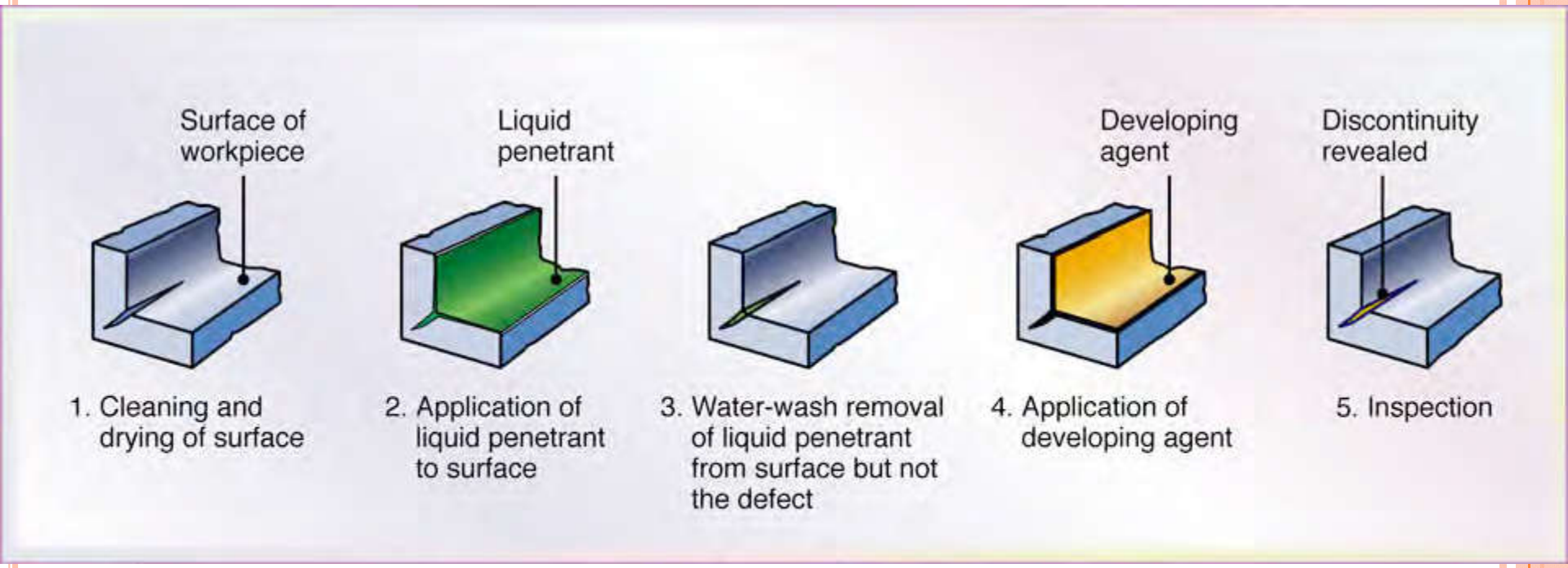
- Visual
- Liquid Penetrant
- Magnetic
- Ultrasonic
- Radiography
- Eddy Current



Liquid Penetrant Inspection

- In penetrant testing, a liquid with high surface wetting characteristics is applied to the surface of a component under test.
- The penetrant "penetrates" into surface breaking discontinuities via capillary action and other mechanisms.
- Excess penetrant is removed from the surface and a developer is applied to pull trapped penetrant back the surface.
- With good inspection technique, visual indications of any discontinuities present become apparent.
- Two common types of liquid used for this test are
  - Fluorescent penetrants
  - Visible penetrants

Sequence of operations for liquid-penetrant inspection

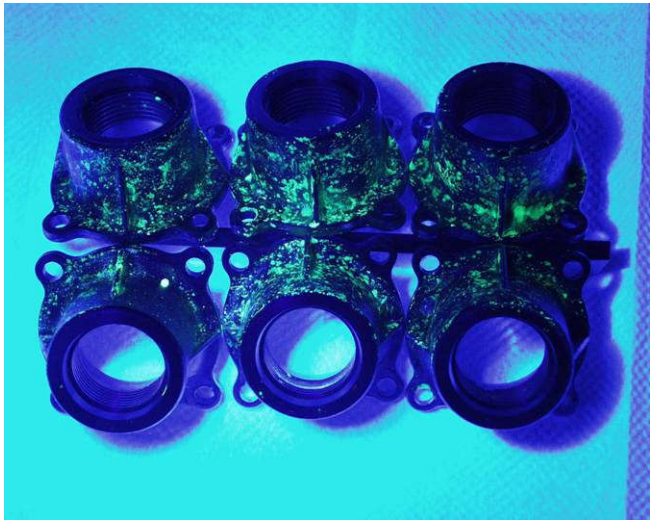


What Can Be Inspected Via PT?

Almost any material that has a relatively smooth, non-porous surface on which discontinuities or defects are suspected.

What Can NOT be Inspected Via PT?

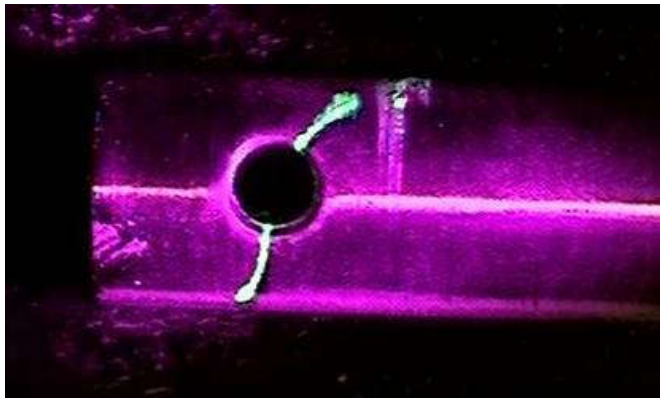
- Components with rough surfaces, such as sand castings, that trap and hold penetrant.
- Porous ceramics
- Wood and other fibrous materials.
- Plastic parts that absorb or react with the penetrant materials.
- Components with coatings that prevent penetrants from entering defects.

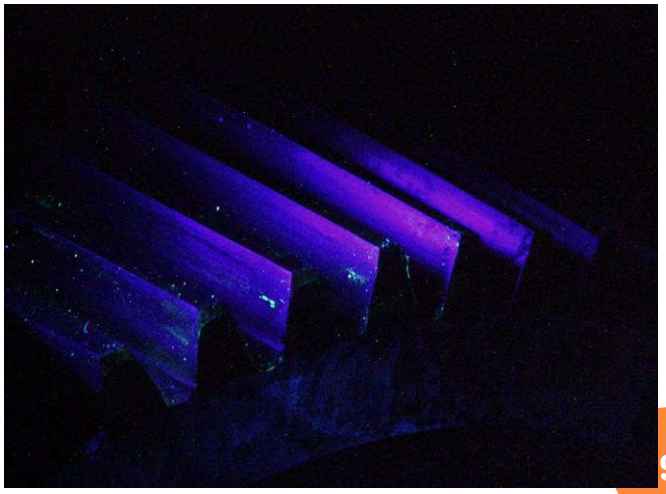


Defect indications become less distinguishable as the background "noise" level increases.

What Types of Discontinuities Can Be Detected Via PT?

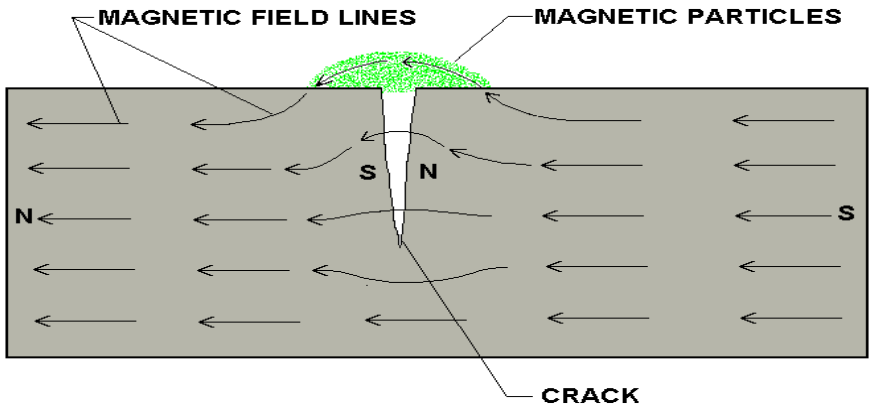
- All defects that are open to the surface.
  - Rolled products-- cracks, seams, laminations.
  - Castings--cold shuts, hot tears, porosity, blow holes, shrinkage.
  - Forgings– cracks, laps, external bursts.
  - Welds– cracks, porosity, undercut, overlap, lack of fusion, lack of penetration.





Magnetic-Particle Inspection

- Part is magnetized
- Finely milled iron particles coated with a dye pigment are then applied to the specimen.
- Particles are attracted to magnetic flux leakage fields and will cluster to form an indication directly over the discontinuity.
- Indication then visually detected under proper lighting conditions.



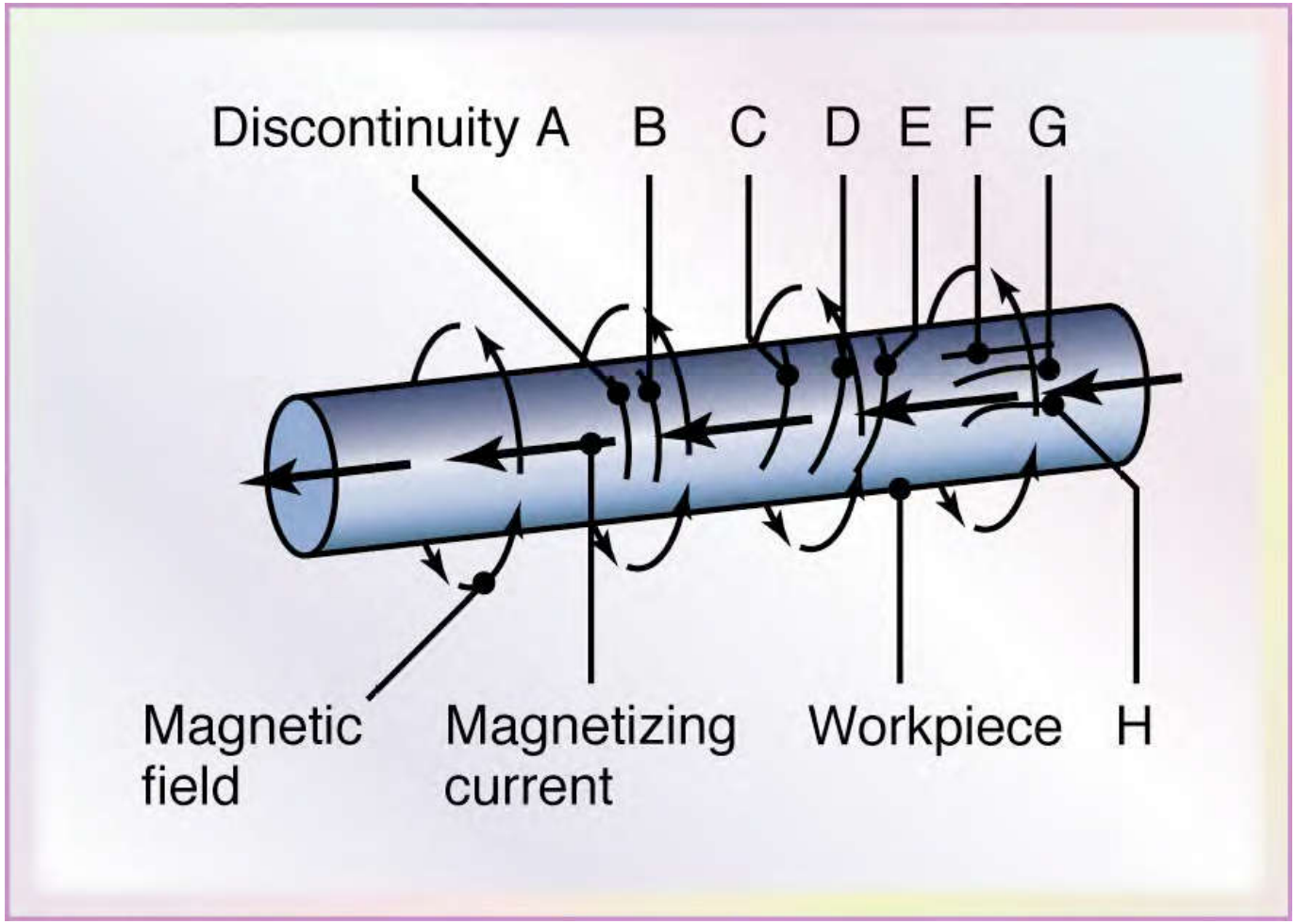
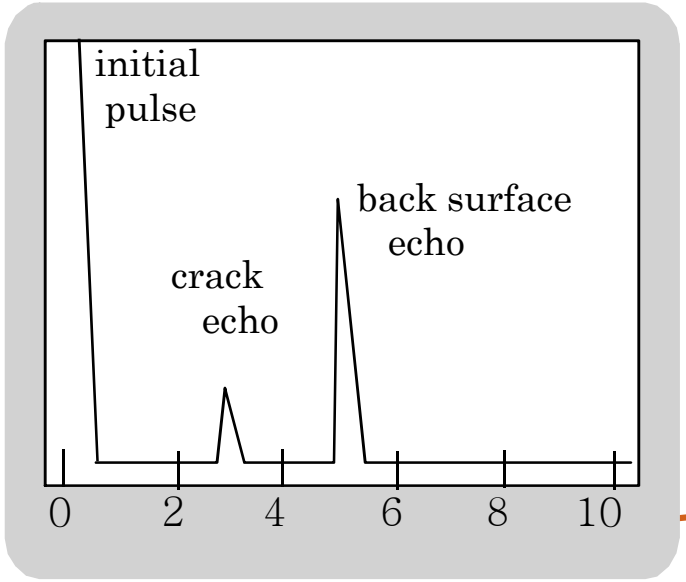


Figure: Schematic illustration of magnetic-particle inspection of a part with a defect in it. Cracks that are in a direction parallel to the magnetic field (such as in A) would not be detected, whereas the others shown would

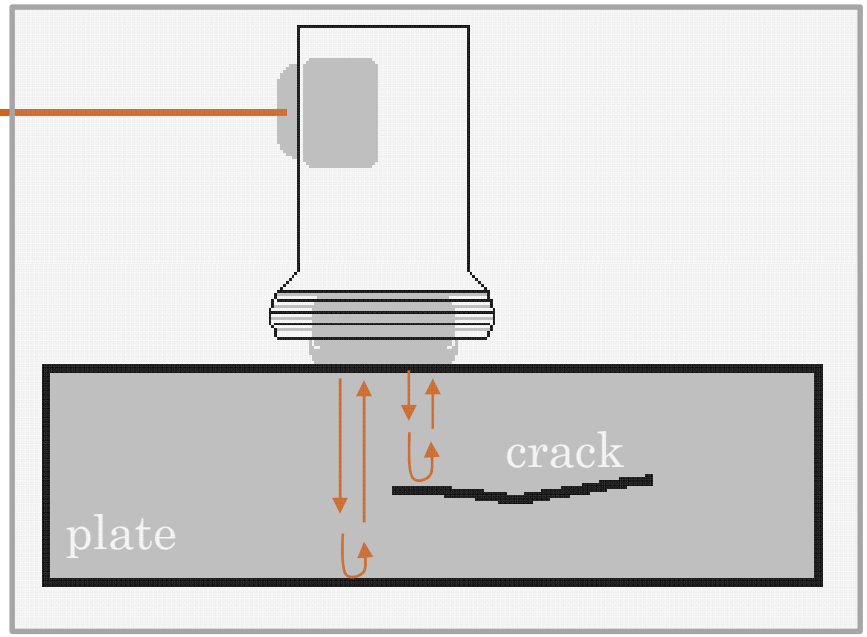
Ultrasonic Inspection

- High frequency sound waves are introduced into a material and they are reflected back from surfaces or flaws.
- Amplitude of the reflected energy and time required for return indicate the presence and location of any flaws in the workpiece
- Ultrasonic wave is generated by transducers which operates on the principle of piezoelectricity using materials such as quartz, lithium sulfate or various ceramics
- Couplants like water, oil, glycerin or grease are used to transmit ultrasonic wave from the transducer to the test piece

Ultrasonic Inspection



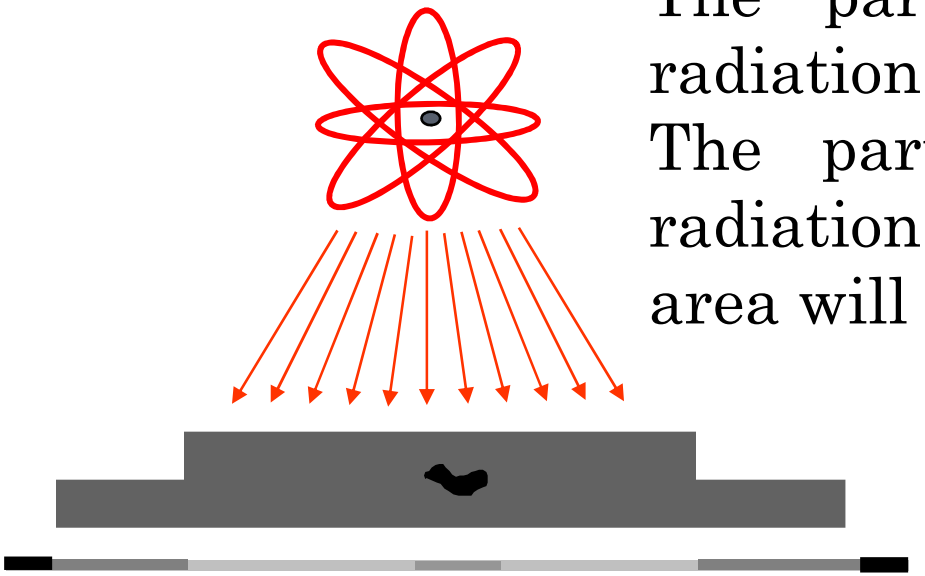
Oscilloscope, or flaw detector screen



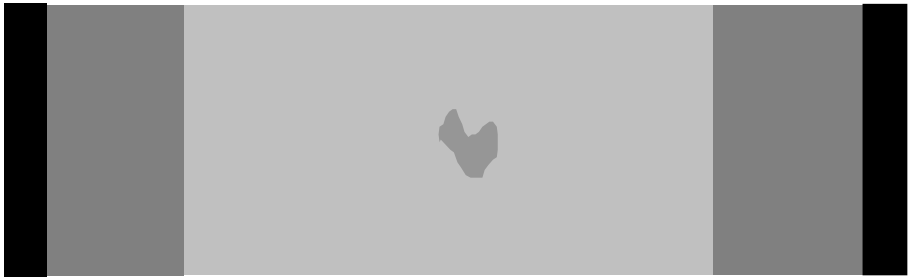
Radiography

- Radiation used in radiography testing is a higher energy (shorter wavelength) version of the electromagnetic waves that we see as visible light.
- Radiation source is typically an X-ray tube
- Detects the difference in density
- Metal surrounding the defects is denser and shows up as lighter then the flaws on an X-ray film.

Radiography



X-ray film



Top view of developed film

The part is placed between the radiation source and a piece of film. The part will stop some of the radiation. Thicker and more dense area will stop more of the radiation.

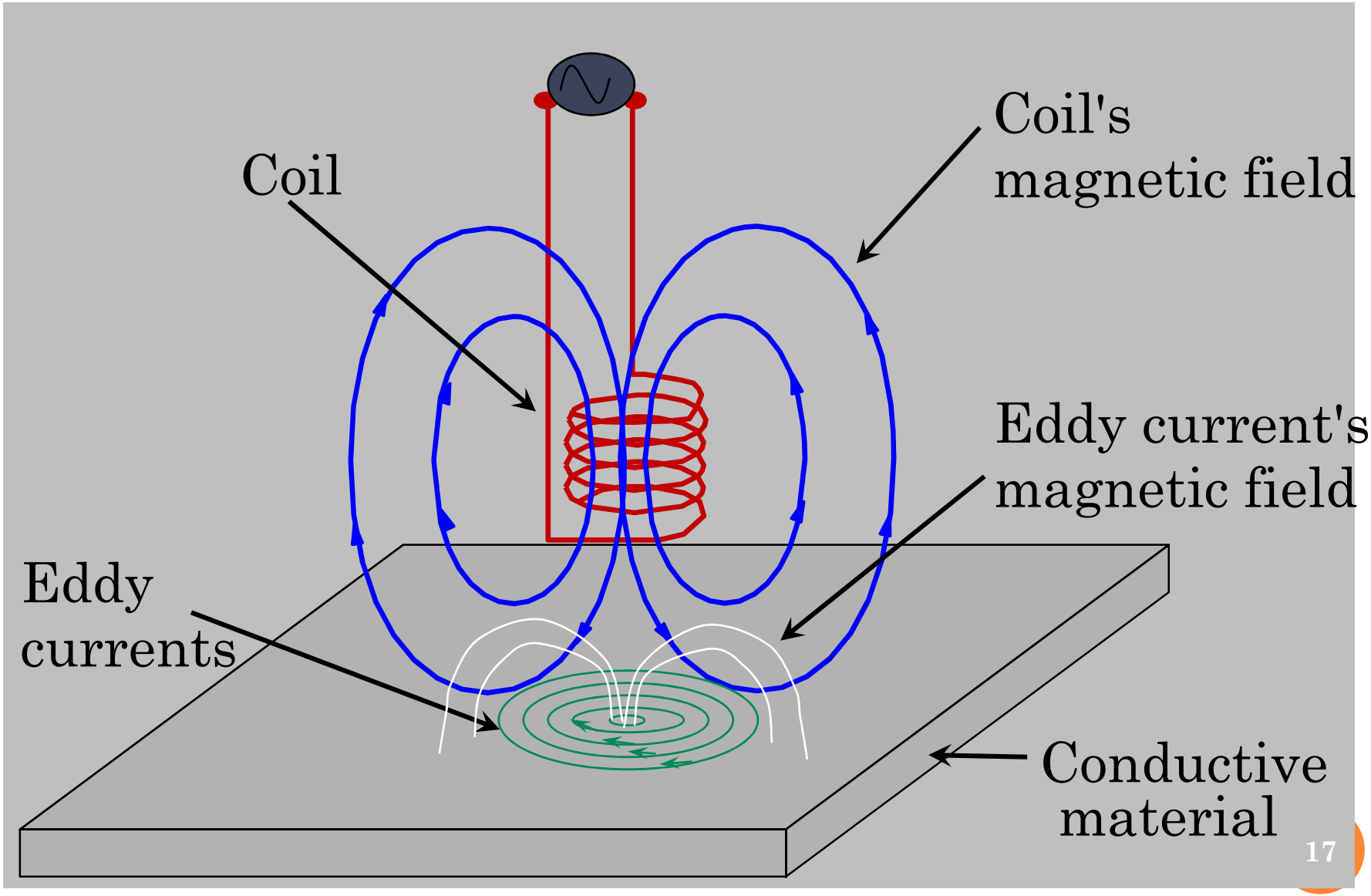
The film darkness (density) will vary with the amount of radiation reaching the film through the test object.

= less exposure

= more exposure

Eddy Current inspection

- Based on the principle of electromagnetic induction
- Part is placed in, or adjacent to, an electric coil through which AC current of frequency 60 Hz to 6 MHz flows
- Defects in the part impede and change the direction of eddy current which causes the change in electromagnetic field
- Changes affect the exciting coil (inspection coil),voltage of which is monitored to determine the presence of flaws


Coil
Coil's
magnetic field
Eddy current's
magnetic field
Eddy
currents
Conductive
material

Eddy-Flow Current Changes

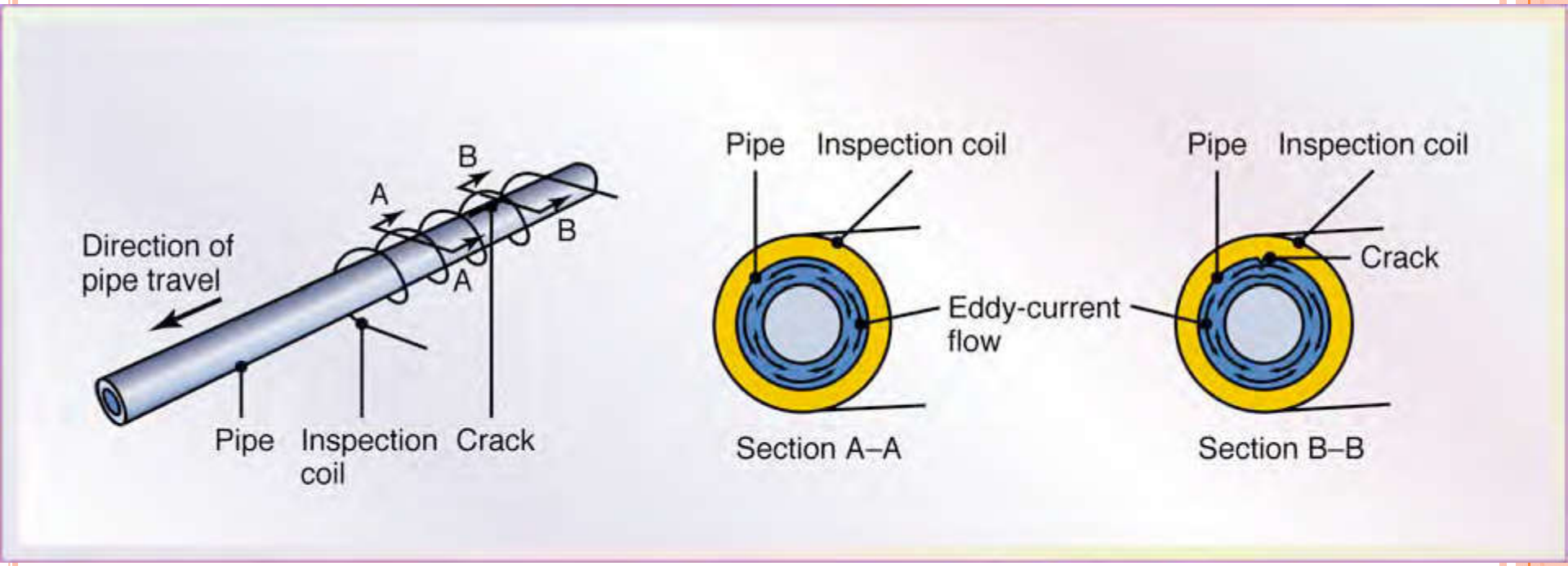


Figure: Changes in eddy-current flow caused by a defect in a workpiece.

Common Application of NDT

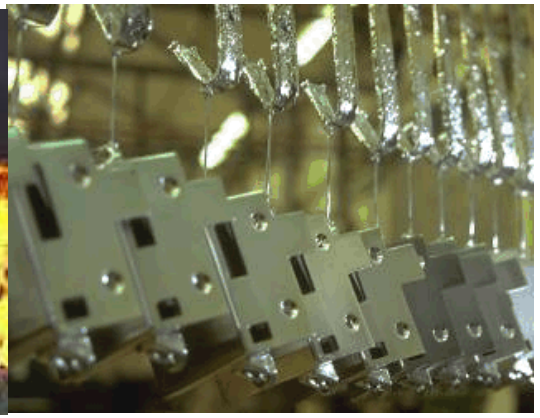
- Inspection of Raw Products
- Inspection Following Secondary Processing
- In-Services Damage Inspection

Inspection of Raw Products

- Forgings,
- Castings,
- Extrusions,
- etc.

Inspection Following Secondary Processing

- Cracking
- Corrosion
- Erosion/Wear
- Heat Damage
- etc.



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- Cracking
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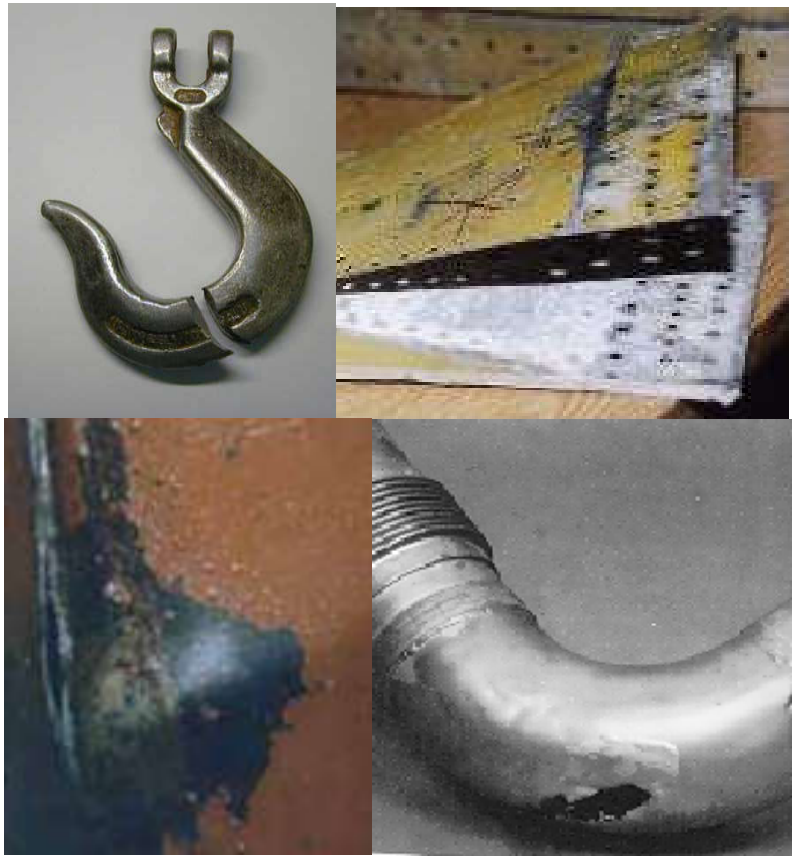

When to use?

- There are NDT application at almost any stage in the production or life cycle of a component.
  - To assist in product development
  - To screen or sort incoming materials
  - To monitor, improve or control manufacturing processes
  - To verify proper processing such as heat treating
  - To verify proper assembly
  - To inspect for in-service damage

That's All For Today