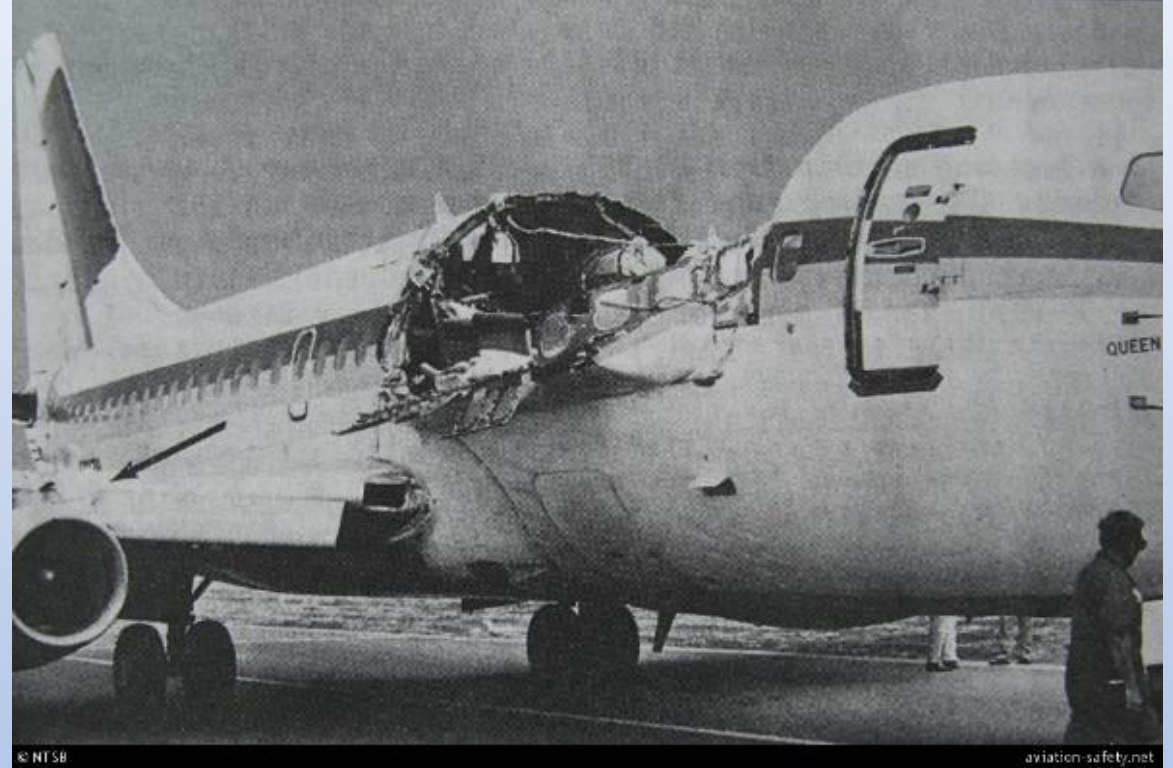




# Exploring Nondestructive Exploration Methods

*Question:* How can we investigate and measure the inside of an object or its structure if we cannot take it apart?

# Examples of Material Failures



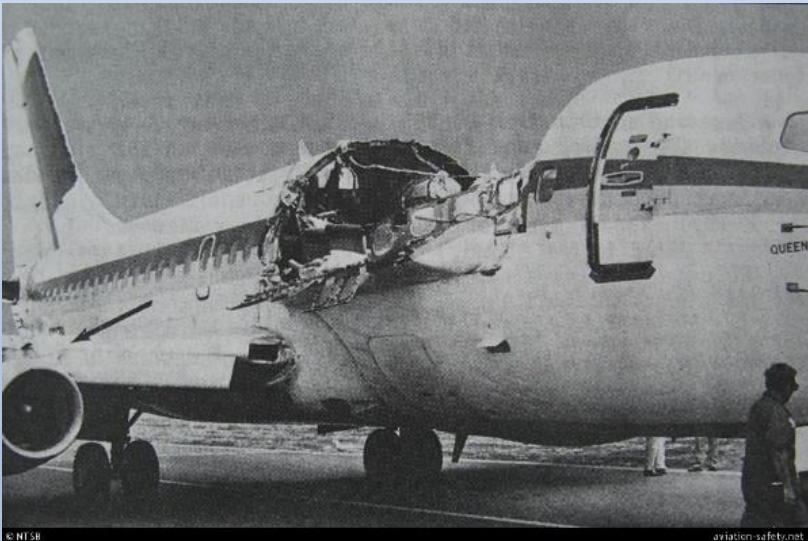
*Silver Bridge Disaster* video: <https://www.youtube.com/watch?v=dGQfUWvP0II>

*BINDT – Bridges and NDT* video: <https://www.youtube.com/watch?v=WVLT01V5Cq4>

# Online research topics > discussion > posters

- Organize into small groups
- Research the definitions and any graphics/illustrations for these **10 topics** →
- Share research with the class
- Each group makes poster about one topic

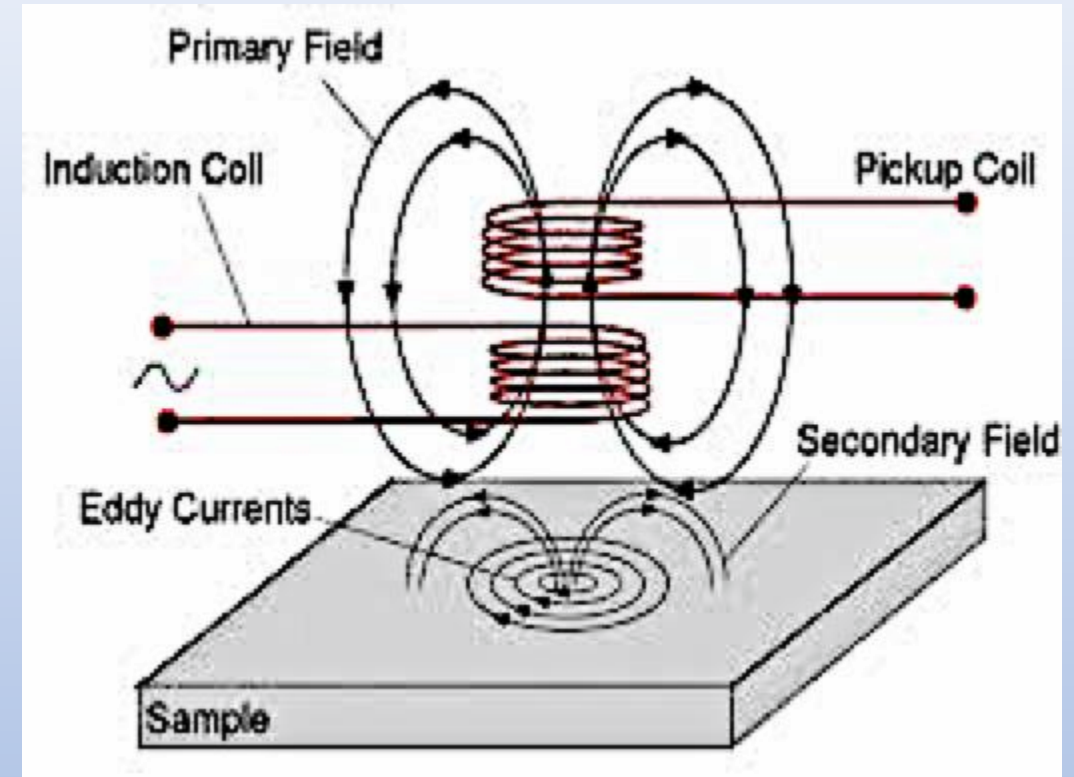
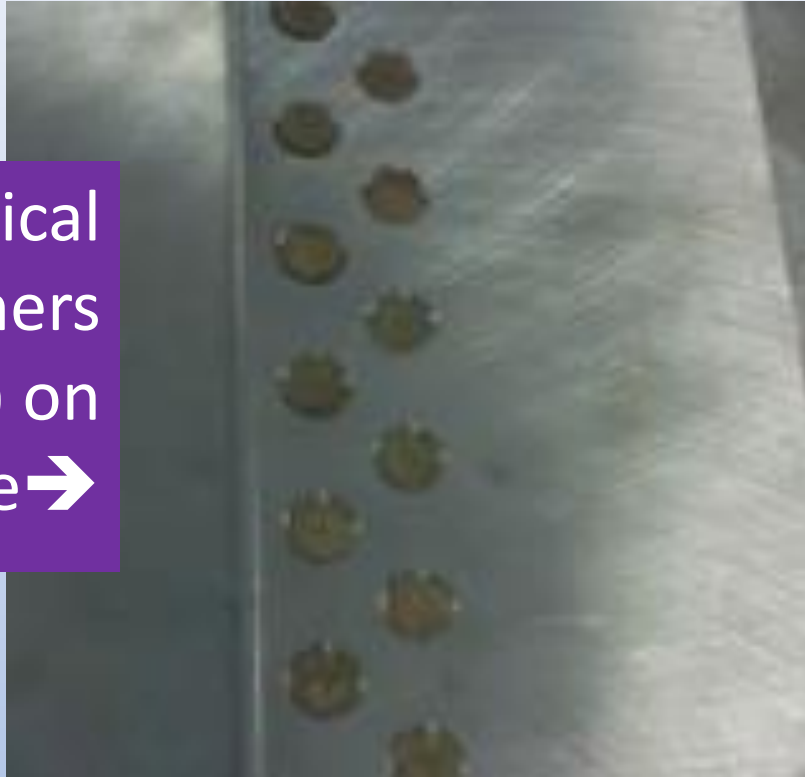
1. voltage
2. inductance
3. current
4. magnetic fields  
(dipolar nature and their lines)
5. eddy current
6. conductors
7. excitation
8. nondestructive evaluation (NDE)
9. finite element method (FEM)
10. Ohm's law



This B-52 bomber from the 1950s is still in use.

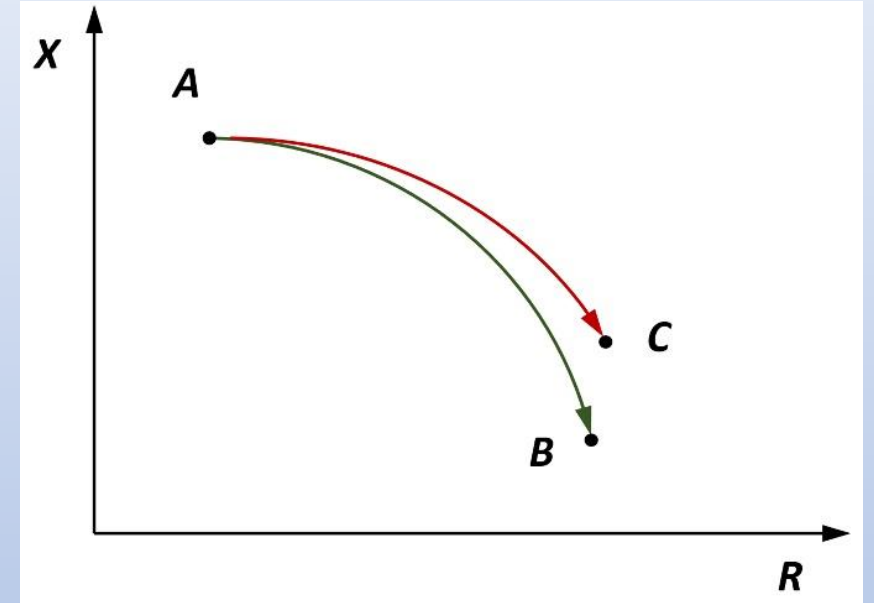
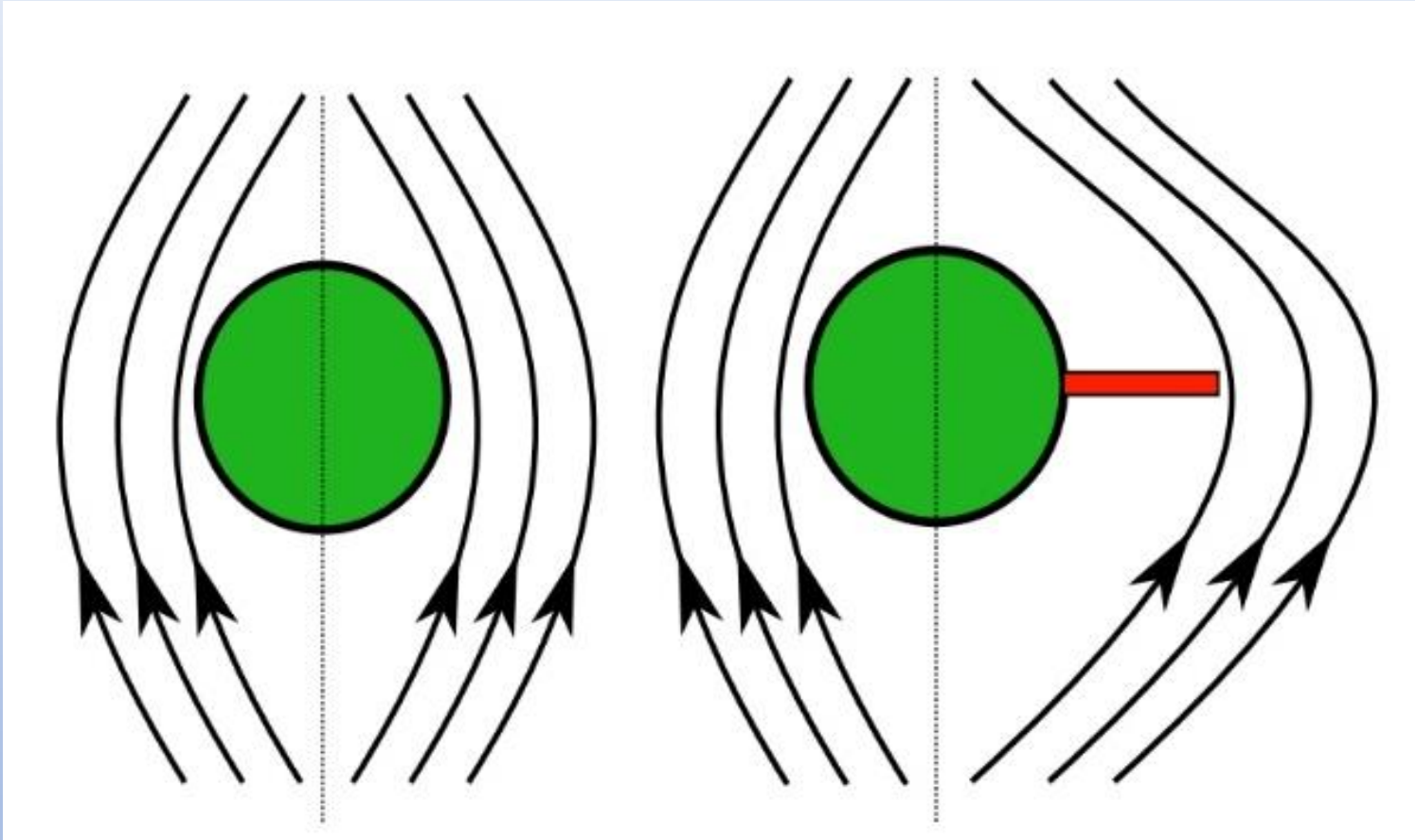
# Eddy current testing method

mechanical fasteners (rivets) on airplane →



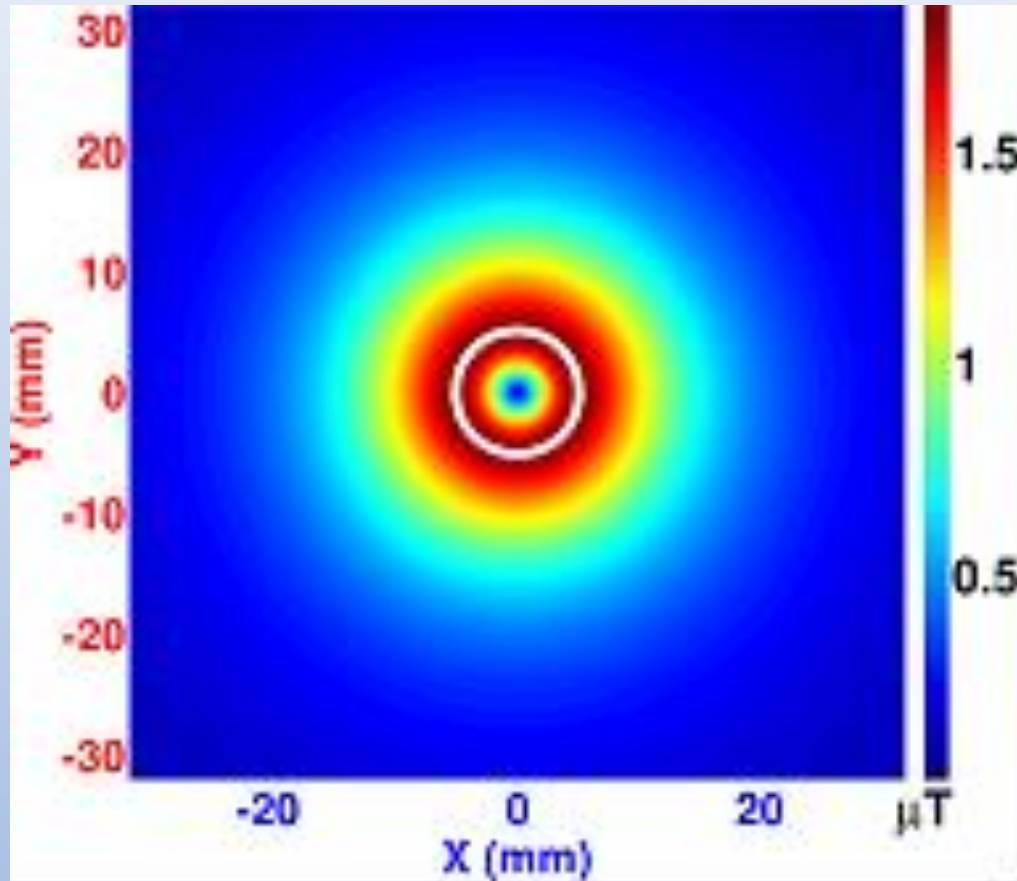
- A nondestructive evaluation method
- Widely used for crack detection
- Cracks cause very large local conductivity changes

# Eddy current testing method

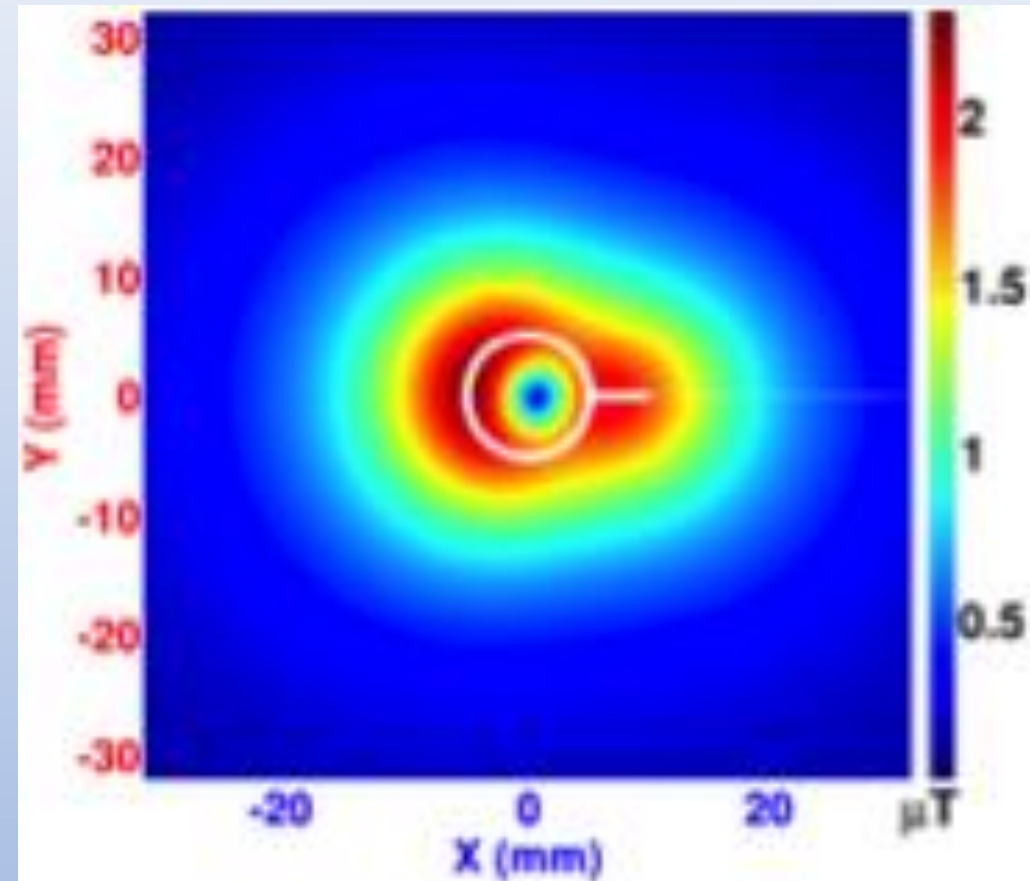


- A = Coil in the air
- B = Coil over defective specimen
- C = Coil over defect-free specimen

# Nondestructive testing results



Rivet with no defects



Rivet with defect

# Maxwell's equations

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

← Faraday's law

Time-varying magnetic field creates electric field, and vice versa

$$\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$$

← Ampere's law

Electric current creates circular magnetic fields

$$\nabla \cdot \vec{D} = \rho$$

← Gauss' law

Electric charges create electric flux

$$\nabla \cdot \vec{B} = 0$$

← Gauss' law for magnetism

No magnetic charges

