Thermography - Principles, Contact and Non-Contact Inspection Methods, Techniques for applying liquid crystals, Advantages & Limitations - infrared radiation detection, Instrumentation & new methods, Applications.


Infrared inspection:

Infrared inspection allows us to see thermal images (radiation) much as our eyes see visual images.
Applications of infrared sensors:

- Transformers, Switchgear, and other electrical equipment that may be prone to overheating.

- Cathode Ray Tubes (Cathode Ray Tubes)

- Process equipment, fluid levels, etc.

- Steam trap operations.

Infrared Cautions:

- Two common errors are:

  - Reflections: In much the same manner as light reflects, Infrared radiations can also reflect and give erroneous readings.

Scanned by CamScanner
Applications of Infrared Inspection

- Transformers, Switchgear, and other electrical equipment where there may be poor connections.

- Insulation system effectiveness (Air Leaks and Wet Insulation)

- Process equipment liquid levels, etc.

- Steam trap operations.

Infrared Cautions:

Two common errors with scanners:

- Reflections - In much the same manner as light reflects, Infrared radiation can also reflect and give erroneous readings.
Black Body Objects have significantly different emissivity than polished and shiny objects and the images will differ.

Hand-Held Infrared Thermometer:

They will average the temperature over a given area, and that may be much larger than your area of interest.

Infrared Thermography Demonstration:

Rather than me give a demo of how an Infrared Scanner works, I will pass one of ours around so you can look through it. If the focus for the range from about 5 feet to infinity.
Know this to a bunch of engineers, that want to play with consoles, so I've keyed the console to cancel so that next person doesn't get a useless demo!

Introduction About YRFNND:

Infrared Thermography is equipment or method which detects infrared energy emitted from object, converts into temperature, and displays an image of temperature distribution.

The Image of temperature distribution is called Infrared Thermograph, and the method to be called as Infrared Thermography.
It was discovered by the British Astronomer, Herschel in 1800.

When dispersing sunlight using a prism, Herschel accidentally found that there was an invisible light on the outside of red light when it increases the temperature of an object.

It is known as an electromagnetic wave.

Principle of Infrared Thermography:

Every object whose surface temperature is above absolute zero (0 K) radiates energy at a wavelength corresponding to its surface temperature.
Utilizing our highly advanced infrared camera, it is possible to convert the radiant energy into a thermal image of the object being surveyed.

After surveying findings are provided through the use of two different types of images and control photos are provided for the problem areas uncovered during the inspection.

Thermographic camera converts radiant heat energy into an electrical signal which is then displayed on the monitor as a real-time heat image of the object being scanned.
The camera captures black contours for the coolest area and white color for the hottest area. This is commonly known as FLIR.

Construction

Detector

Electronics

Object

Optics

Atmosphere

Display

Overall equipment set up.

The overall working shown on Thermography was given in next page.
Scanning, Condensing, Detection, Amplification, Synchronizing, Display.

Skeuomorph of Warning of Infrared Thermography (ITT).

Type of Thermography.

There are two types of Thermography.

Active Thermography,

Passive Thermography.
In thermal thermography an energy source are required to produce a thermal contrast. The detection can be occurred either hot (active) or the cold (passive) for on the surface.

In the passive thermography, inspected part are at higher (or) lower temperature than the background.

Methods of Thermography:

1. Conventional Thermography or Step heating.
2. Pulled thermography.
3. Local in or Modulated Thermography.

It is necessary to synchronize heating and acquisition.
Advantages:

* It shows a visual hectic
* It is capable of saving many layers in real time.
* It can be used to measure or observe in areas inaccessible or hazardous for the other methods.
* It is used to find defects.
* It can be used to detect the object clairness.

Disadvantages:

High price range.

Images can be difficult to interpret accurately when based upon certain objects.
hindered by different emissivities and reflections from other sources. Most cameras have ±2% accuracy or worse.

Only able to directly derive the surface temperature.

Applications:

- Condition Monitoring
- Digital Infrared Thermal Imaging
- Thermography
- Veterinary Thermal Imaging
- Night Vision
- Research
- Process Control
- Chemical Imaging
- Volcanology
- Building
Electrical currents are produced in a conductive material by an induced alternating magnetic field. These electrical currents are called eddy currents.

Because the flow is circular at and just below the surface of the material.

Interruptions in the flow of eddy currents caused by imperfections, dimensional changes, or changes in the material, conductive, and permeability properties, can be detected with the proper equipment.

Eddy current testing can be used on all electrically conducting materials with a reasonably smooth surface.
The equipment consists of:

1. A generator (AC Power supply), a test coil, and recording equipment (e.g., a galvanometer or an Oscilloscope).
2. Used for crack detection, material thickness measurement (corrosion detection), monitoring materials, coating thickness measurement, metal detection, etc.

Principle of Eddy Current Testing:

1. When an AC power through a test coil, a primary magnetic field is set up around the coil.
2. The AC primary field induces eddy current in the test object held below the test coil.
3. A secondary magnetic field arises due to the eddy current.
The magnetic field produced by Circuit 1 will interfere with the wire in Circuit 2 and create current flow.

The induced current flow in Circuit 2 will have its own magnetic field which will interact with the magnetic field of Circuit 1.

At the same point P on the magnetic field, consider a part due to i1, and a part due to i2. These fields are proportional to the currents or Biot-Savart law.

The flux \( \Phi \) through circuit 2 is the sum of the flux due to two parts,

\[
\Phi_{B1} = B_1 i_1 + i_2 M \\
\Phi_{B2} = B_2 i_2 + i_2 M
\]
The inductance of each of the coils. The constant $N_1$ called the mutual inductance of the two circuits and it is dependent on the geometrical arrangement of both circuits.

The strength of the secondary field depends on electrical and magnetic properties, structural integrity, etc., or some object.

If the cracks or other inhomogeneities are present, the eddy current and hence the secondary field is affected. Hence, the change in the secondary field will be a feedback to the primary current.

The variations of the primary current can be easily detected by a simple circuit which is discussed properly beforehand.
Depth of Penetration

Eddy currents are closed loops of induced current circulating in planes perpendicular to the magnetic flux. They normally travel parallel to the coil's winding and flow in the limit to the area of the inducing magnetic field.

The depth at which eddy current density halves is denoted as $1/e$, or about 87% of surface density is called the boundary depth of penetration ($D_s$).
The text coils are commonly used in three configurations:

- Surface Probe
- Internal bobbin Probe
- Encircling Probe

Report on Presentation:

The Impedance plane diagram is a very useful way of displaying eddy current data. The strength of the magnetic field, magnetic field, and eddy current in the test material cause the impedance plane to react in a variety of different ways.
Crack detection
Material Thickness Measurement
Coating Thickness Measurement
Conductivity Measurement

* Material Identification
*Heat Damage Detection
* Case Depth Determination
* Heat Resealant Monitoring

Surface breaking cracks:

Fuller current inspection is an excellent method for detecting surface and near surface defects. When the probable defect location and orientation is well known.
1) A knowledge of probe details, type, position and orientation.

2) Selection of the probe. The probe should fit the geometry of the part and the coil must produce eddy currents that will be disturbed by the flow.

Selection of a reasonable probe drive frequency. For distant flaws, the frequency should be as high as possible for minimum resolution as high frequency.

For sub-surface flaws, low frequencies are necessary to get the required depth of penetration.
Advantages of ET:

* Sensitive to small cracks and other defects.
* Detects surface and near surface defects.
* Inspection gives immediate results.
* Equipment is very portable.
* Method can be used for much more than flaw detection.
* Minimum part preparation is required.
* Test probe does not need to contact the part.

Limitation of ET:

* Only conductive materials can be inspected.
* Surface must be accessible for the probe.
Skill and training required is more intensive than other techniques.

Surface finish and roughness may interfere.

Depth of penetration is limited.

Reference standard needed for setup.