



INJOTECH INDIA PVT. LTD.

# INJOTECH INDIA PRIVATE LIMITED

NDE for Quality and Safety



## What is NDE?

- Non-Destructive Examination involves determining the properties and integrity of items, without sacrificing their usefulness.
- NDE can also be used for determining integrity of cultural items, along with figuring out the properties and constituents of various items such as textiles, papyruses, sculptures, statues and so on.



## Why carry out NDE?

- Items of heritage importance thousands of years old
- Once damaged, cannot be recovered
- Leads to loss of thousands of years of historical data and evidence



## Primary Advantages of NDE

- Immediate results – within a few seconds
- Reliable – inspections at locations/spots demarcated by clients
- Accuracy and Repeatability – multiple readings possible, enabling averaging
- Portability – carry equipment to site instead of sending samples to lab
- Planning and strategy – results useful for further analyses, calculations and budgeting



## Other Advantages of NDE

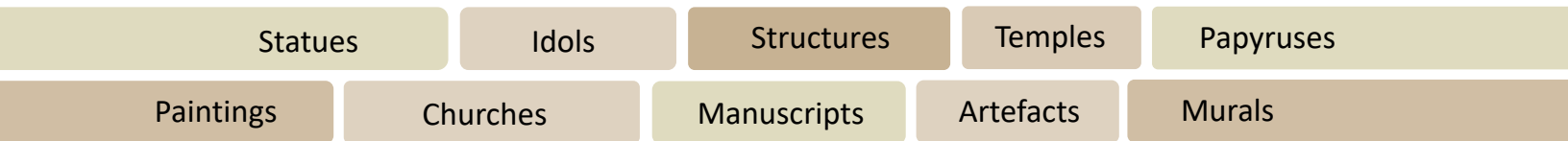
- Issues identified
- Harmless to humans if carried out properly
- Utility of items not compromised
- Offers reassurance
- Provides reliability
- Cost effective



# NDE in Heritage Conservation

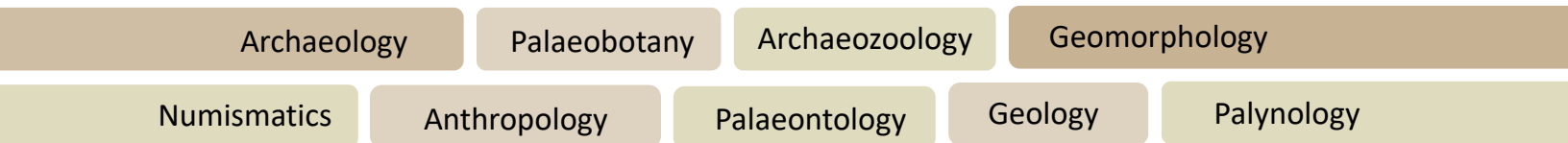
**Art and Culture** plays an important role in society. It enables understanding of the history of the society, which in-turn enables learnings about the life and its richness.

Art and culture includes various items including, but not limited to:



**Anthropological Sciences** include fields of science related to humans and other living organisms. Non Destructive Examination can be effectively used in the fields of Anthropology and its related disciplines.

The various fields and disciplines of anthropological sciences where NDE can be effectively used are:



## Advantages

- NDE provides information about integrity of items
- Helps in determining remaining life
- Helps in formulation of action plan for preservation
- Provides information regarding history of item
- Provides information regarding properties and constituents of items
- Helps in regeneration or reconstruction of damaged artefacts



# Various NDE Methods

- X-Ray Fluorescence Spectrometry (XRF)
- Remote Visual Inspection (RVI)
- Computerized/Digital Radiography (CR/DR)
- Computerized Tomography (CT)
- Infrared Thermography (IR)
- Surface Hardness Testing
- Coating Thickness Measurement
- Corrosion Mapping
- Thickness Gauging

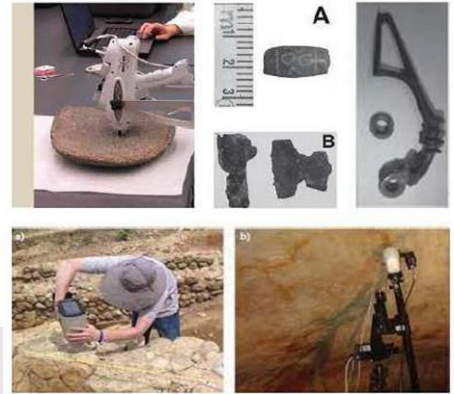


## X-Ray Fluorescence Spectrometry (XRF):

X-Ray Fluorescence Spectrometry (XRF) is a Positive Material Identification (PMI) Technique. PMI is useful in determining the constituents of any item, without causing any damage or loss of utility of the item, based on the principle that individual atoms, when excited by an external energy source, emit X-ray photons of different characteristic wavelengths.

### Typical Applications of XRF:

Determination of constitution of materials in soils, fossils, rocks, stones, idols, statues and other items.



## Remote Visual Inspection (RVI):

Remote Visual Inspection involves inspection of inaccessible and dangerous areas remotely. It involves the use of borescopes, videoscopes and Wireless Fidelity. RVI makes the inspection of underwater and underground areas possible, along with tunnels and gorges.

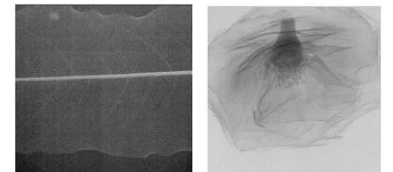
### Typical Applications of RVI:

Inspection of inaccessible areas such as tunnels, gorges, burrows, small openings and holes. It also involves inspection of underwater and underground areas and areas which are accessible but cannot be approached due to inherent dangers.



## Computerized/Digital Radiography (CR/DR):

Computerized(CR) and Digital(DR) are modern types of Radiographic Testing, which can be used for determination of internal structure and condition of various items. Certain advantages of CR include low initial investment and the availability of various sizes enabling flexibility. Certain advantages of DR include faster image capture, better quality images and high volume capacity.



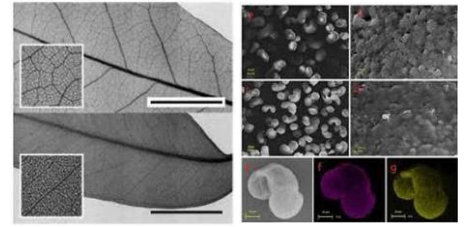
### Typical Applications of CR/DR:

To determine internal condition and structure of fossils, leaves, pollen grains, statues, artefacts etc.



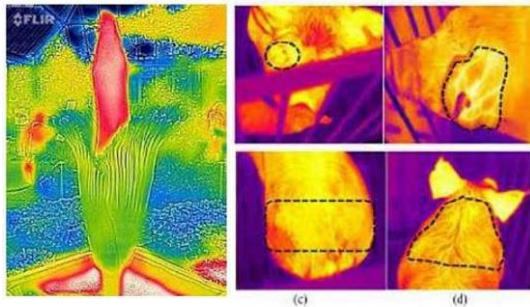
## Computerized Tomography (CT):

More popularly known as CT Scan, Tomography is utilized to obtain 2D and 3D images of small and minute objects such as pollen grains, flowers, leaves, textile threads and so on. The ability of X-ray to penetrate through varying densities allows CT inspection results to provide non-destructive physical characterization of internal features and structures of a part or component.



### Typical Applications of CT:

To determine internal condition and structure of fossils, leaves, pollen grains, idols, statues etc., research and development, reverse engineering.



## Infrared Thermography (IR):

Infrared Thermography involves determination of heat signatures of various objects, especially those that are exposed to weather conditions. IR uses a temperature gun to indicate surface temperatures. A range of temperatures over the surface can be detected. Heat areas are segregated by means of a colour palette where areas of different temperatures are indicated by different colours.

### Typical Applications of IR:

To determine temperatures and heat signatures of various items.



## Surface Hardness Measurement:

Hardness Measurement involves measurement of surface hardness of a component. Surface hardness is the resistance to surface penetration. Hardness of a component depends upon the material composition, process it has undergone and heat cycles it has been subjected to. There are very few material limitations for hardness testing.

### Typical Applications of Hardness Measurement:

Surface hardness measurement of stone, rock, metal, bone, fossils and all similar samples.





## Coating Thickness Measurement:

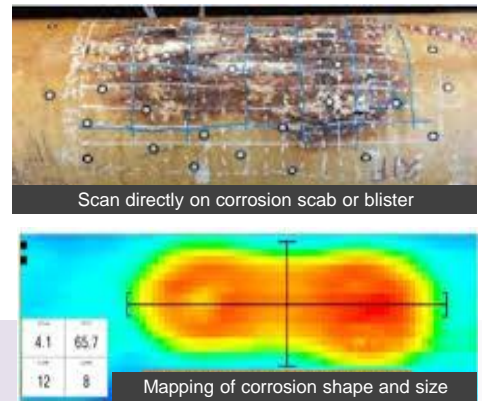
Various coatings can be applied onto objects to protect them from the effects of the environment. The thickness of the various coatings reduces over time. The thickness determines the life of the coating, which in-turn determines the protection it would afford the item in question. Coating thicknesses can be measured on either ferromagnetic or electrically conductive base materials as per the case.

### Typical Applications of Coating Thickness Measurement:

Measurement of thickness of various coatings on different substrates.

## Corrosion Mapping:

Corrosion of metals is a serious problems that causes loss of material and permanent damage to an item. Corrosion mapping is used to determine the loss in metal in percentage values. It provides a reading based on how much percentage of the original thickness/ dimension is remaining, in the form of a coloured image graph.



### Typical Applications of Corrosion Mapping:

Determination of loss of thickness in percentage values for ferromagnetic materials. Used to determine how much longer the item could last based on its current condition.



## Thickness Gauging:

Corrosion and wear of items causes their thicknesses to reduce. Reduction of thicknesses to below a certain value would make the item too thin and eventually fail. Thickness gauging is involves measuring the actual thickness of metallic items to determine their current condition and remaining life.

### Typical Applications of Thickness Gauging:

Measurement of actual thickness of metallic items to determine their current condition and remaining life.



# Other NDE Methods

- **Surface Roughness Measurement**
- **Grain Size / Nodularity Measurement**
- **In-situ Metallography**
- **Soil Analysis**
- **Aerial Inspection by Drone**



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