Overview of Non-Destructive Testing and Inspection Course

Syllabus

This course reviews the general principles of seven non-destructive testing methods and their derivative techniques. The following class activities include lecture, demonstrations, and hands-on experience in an NDE lab environment.

**Agenda** (order and content may vary based on audience needs)

**Day 1**
Introductions
Safety Moment
Course overview

**Visual Inspection methods (VT)**
- Fundamentals of VT
- Weld Inspection: Overview of welding, weld flaws and weld inspection tools (gauges)
- In-service VT: Damage mechanisms, materials of construction,
- Class exercise
- Remote Visual Inspection (VTI): Fundamentals of remote optics, detectors imaging equipment
- Class exercise

**Liquid dye penetrant inspection (PT)**
PT theory
- PT material classifications
- Penetrant wetting ability
- Material wetting ability
- Capillary action
- Penetrant application processes
- Penetrant removal processes
- Viewing processes
- Surface preparation requirements
- Procedures

Demonstration, class exercise

**Magnetic Particle Testing (MT)**

Magnetic Particle testing theory
- Magnetization methods
- Surface conditions
- Recording media: Dry or wet visible or fluorescent particles, visible/fluorescent combination
- Magnetic particle equipment
- AC/DC, or permanent magnet yokes
Day 2

**Electromagnetic Testing (ET)**

Electromagnetic Technique Theory
- Principles of current flow
- Ohm’s Law
- Material conductivity (electrical and electromagnetic)
- Ferrous and non-ferrous materials
- Eddy current theory
- Probe designs
- Tubing inspection: Ferrous and non-ferrous materials
- Surface testing: Ferrous and non-ferrous materials
- Material sorting (PMI)
- Non-conductive coatings measurement

- Introduction to portable eddy current instruments

Class demonstration
Class exercise

Magnetic lift-off (MLO) coating thickness measurement
- MLO Theory
- Fisher MLO hand held instrument

Magnetic flux leakage: MFL pigging
MFL Tank Bottom Scanner systems

Ferrous tubing inspection systems
- Remote field inspection
- Near field inspection
- Low Frequency Electromagnetic testing: External, fast corrosion screening of piping

Saturated Low Frequency Eddy Current Testing (SLOFEC)

**Ultrasonic Testing (UT)**

Fundamentals of ultrasound
Ultrasonic applications
Ultrasonic equipment
Ultrasonic probe designs
Day 3

Ultrasonic Testing (cont.)

Ultrasonic thickness measurement (UT-TM)
13 primary sources of error
Point measurement and scanning techniques
UT-TM Procedures
Class demonstration
Class exercise

UT-TM contractor qualification
Ultrasonic Imaging (conventional UT)
Automated UT
Semi-automated UT
Class demonstration
Class exercise

Ultrasonic weld flaw inspection
Weld flaw detection programs
Weld flaw sizing programs
Original construction versus service induced flaws
Introduction to UT flaw detectors
Introduction to flaw characterization and sizing techniques:
  - Tip Diffraction
  - Creep Wave
  - Focused Dual Transducers
  - Time of Flight Diffraction (TOFD)
Class demonstration

Introduction to ultrasonic phased array techniques
  - UT-PA theory
  - UT-PA of welds
  - UT-PA of corrosion
  - Hand held UT-PA systems
Class demonstration
Class exercise

Guided Wave Ultrasonics (GWUT)

  - Ultrasonic Lamb Wave theory
  - Fundamentals of ultrasonic guided waves
  - Use and reliability of GWUT
Class exercise

Day 4

Industrial Radiography (RT)

- Radiographic Testing Overview
- RT theory
- Radiation sources
- RT technique Parameters
- RT for new construction
- RT for in-service inspection
- RT recording media: Film, film digitization, silicon, amorphous silicon, and cadmium tungstate imaging plates
- Weld quality RT
- Informational shots (corrosion, solids, etc.)
- Radiographic film interpretation (RFI)

Real time radiography
- Lixi Tangential scanning system
- Lixi Profiler system
- Omega International In-Motion, Real time radiography system
- GE Betz In-motion, real time radiography system

Class demonstration
Class exercise

Acoustic Emission Testing (AE)

- Fundamentals of AE
- AE applications
- AE equipment
- New fabrication testing
- In-service testing

Class demonstration

Leak Testing (LT)

Leak detection technology
Leak detection theory
Leak detection applications used in the Petrochemical industry
- Air borne acoustic leak detection
- Acoustic emission leak detection
- Bubble testing
- Trace gas sensitive leak testing: Helium mass spectrometry
-Leak detection equipment
  -Ultra Probe gun
  -Physical Acoustics V-Pac valve inspection unit
  -Varian helium mass spectrometry

Infrared Thermography (IR)

IR applications in the petrochemical industry
Infrared theory
  -IR spectrum
  -Emmissivity/Trasmissivity of materials
  -Reflectivity of materials
  -Definition of Temperature
  -Qualitative IR measurement
  -Qualitative Measurement
  -Compensating for IR reflectivity
IR equipment
  -IR imagers
  -Radiometric IR imagers
  -Point radiometers
  -Contact pyrometers
  -IR equipment selection

Special IR applications
  -Corona detection
  -Hydrocarbon gas detection system

Class demonstration
Class exercise

Day 5

NDE Method or Technique selection
  -Essential variables
  -Inspection effectiveness
  -Resourcing inspection services
  -NDE technician qualification and testing program
  -Selecting complimentary NDE techniques
  -Full-volumetric inspection: RT versus UT
  -Surface inspection: MT, PT, and ET
  -Fast screening (qualitative) versus quantitative techniques

Advanced NDE Technologies
  -R&D stage NDE technologies
  -Emerging stage technologies
  -Mature technologies