

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

-Magnaflux coil machine

Class demonstration

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