

184 Hour NDT Program A

All Classes are in-person.

CONTENTS

Visual Testing II	24 hours
Magnetic Particle Testing II	24 hours
Liquid Penetrant Testing II	16 hours
Ultrasonic Testing I	40 hours
Ultrasonic Testing II	40 hours
Radiographic Testing I	40 hours
 TOTAL	 184 hours

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Visual Testing

Level I and II - 24 hours

Training Course Outline

SCOPE

This in-depth course prepares a candidate to conduct Visual Examinations.

This course prepares a candidate to

- Identify defects
- Interpret and Evaluate Results with respect to Applicable Codes, Standards and Specifications
- Write test reports

TRAINING

Training material is presented in modules that are followed by quizzes

PERSONNEL CERTIFICATION

ASNT SNT-TC-1A 2020

Training, experience and examination requirements

- Recommended Course Outline
- Training Hours
- Practicals
- Quizzes and examinations

GENERAL TRAINING

The course curriculum includes:

Module 1: Welding Methods

- Welding Positions – 1G, 2G, 3G, 4G, 5G and 6G
- Welding processes:
 - GTAW – Gas Tungsten Arc Welding
 - GMAW - Gas Metal Arc Welding
 - SMAW – Shielded metal Arc Welding
 - SAW – Submerged Arc Welding
 - FCAW – Flux Core Arc Welding

Module 2: Welding Joints and Symbols

- Weld nomenclature (parts of a weld)
- Welding joints
- Welding symbols

Module 3: Welding Process Control

- WPS – Welding Procedure Specification
- PQR – Procedure Qualification Record
- WPQ – Welder performance Qualification

Module 4: Weld Profile and Discontinuities

- Hi-Lo, Underfill, Undercut, excessive reinforcement, Concavity
- Cracks, LOF, Lack of Penetration, Slag, Porosity, etc
- Undercut, melt-thru, burn thru, arc strikes

Module 5: Weld Inspection and Gauges

- Weld Profile measurements
- Weld inspection tools: Fillet weld gage, high-low gauge, V-Wac gauge

Module 6: Welding Codes & Standards

- AWS D1.1(steel)
- ASME Section I, V, VIII, 31.1, 31.3

Inspection acceptance criteria: ASME and AWS

Module 7: Machine Vision - Light, Illumination, and Eye

- Definition of Visual Testing
- Eye and Vision
- Lighting and its measurement - lux
- Machine vision and contrast

Module 8: Optical and Mechanical Aids

- Direct and Remote Inspection
- Videoscopes, fiberscopes and borescopes
- Field of View and Depth of View

Module 9: Discontinuities – Inherent and Processing

- Inherent and Processing Discontinuities
- Casting and its defects
- Forging, rolling, drawing and defects
- Surface Texture

Module 10: Discontinuities – Service Induced

- Damage mechanisms
- Overload and Fatigue
- Corrosion
- Erosion
- Wear

Module 11: Bolts, Pumps, Valves and Supports

- Pumps and valves
- Corrosion
- Cavitation

Module 12: Visual Inspection of Composites and Ceramics

- Composites
- Ceramics
- Coatings
- Ropes and Slings

Module: MIL STD/NAVSEA Codes – As needed

- MIL-STD 2035A Class 3 Acceptance Criteria

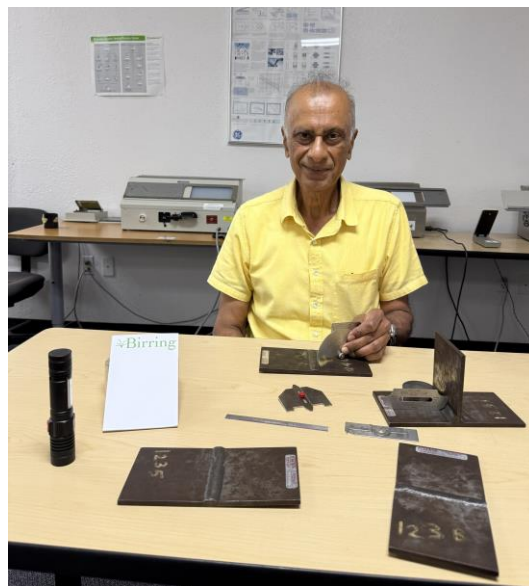
PRACTICAL TRAINING

- Evaluate defects in Weld Samples
- Weld Profile measurements with gauges

EXAMINATIONS

- General
- Specific
- Practicals

Candidates must score a minimum of 70 % in written tests, 80% in practicals, and a minimum of 80% average for all the three tests



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Magnetic Particle Testing

Level I and II – 24 hours

Training Course Outline

SCOPE

This course covers the principles of Magnetic Particle Testing and prepares a candidate to

- Select equipment to conduct test
- Setup test equipment
- Steps to conduct test
- Familiarize with codes and standards
- Interpret results with respect to applicable codes and standards
- Understand limitation of the test method
- Write test reports.

TRAINING

Training material is presented in modules that are followed by quizzes

Module 1: INTRODUCTION AND PERSONNEL CERTIFICATION

ASNT SNT-TC-1A 2024

Training, experience and examination requirements

Training Requirements

- Recommended Course Outline
- Training Hours
- Practicals

Quizzes and examinations

MODULE 2: THEORY OF MAGNETISM

- Magnetic field, Lines of force, Flux density
- Permeability, Reluctance, Retentivity, Residual Magnetism and Coercive Force
- Diamagnetic, Paramagnetic and Ferromagnetic materials
- Leakage flux
- Fleming's Right Hand and Left Hand Rule
- Magnetic Fields: Circular, Longitudinal
- Hysteresis Curve

MODULE 3: METHODS OF MAGNETIZATION

- Faraday's Law: Electromagnetism
- Types of current AC, DC, HWDC
- Circular field: Head Shot (Direct Contact), Prods and Central Conductor Techniques, Offset Central Conductor
- Advantages and disadvantages of circular field
- Longitudinal field: Coils and Yoke
- Advantages and disadvantages of Longitudinal Field

- AC and DC Field Distribution in a Magnetic and a Nonmagnetic Conductor
- Demagnetization

MODULE 4: EQUIPMENT

- Equipment consideration
- Wet Horizontal, Mobile and Portable Equipment
- Coils and Yoke
- Fluorescent testing, Black Light
- Light meter
- Magnetic Media

MODULE 5: MEDIUMS AND THEIR PREPARATION

- Dry and Wet method
- Particles: Dry and Wet
- Properties of particles
- Visibility of particles
- Methods of Application
- Contamination of Magnetic Particles
- Settling Test Procedure
- Concentration for Wet suspensions as per ASME Sec V Article 7
- Bath Maintenance

MODULE 6: APPLICATIONS

- Residual and Continuous Method
- Magnetic Particle Inspection of Solid Cylindrical Parts, Gears, Multiple diameter Articles, Discs, Hollow Cylindrical Articles
- Selection of proper method of magnetization
- Verification of magnetic fields
- Checking the adequacy of field using the Pie gauge, shims
- Fluorescent Inspection
 - Black Light Warm Up Time
 - Minimum intensity and light meter
 - Visual Adaptation
- Visual Inspection
 - Minimum light intensity and light meter
- Magnetic Rubber Inspection

MODULE 7: TYPES OF INDICATIONS

- Interpretation including Relevant, False, Non-relevant indications

MODULE 8: CODES AND STANDARDS (Specific Training)

- MT Inspection Procedures

Codes

- ASME Section V Article 7: Magnetic Particle Examination

- ASME Section VIII (Accept/Reject Criteria)

Standards

- ASTM E-709: Standard Guide for Magnetic Particle Testing
- ASTM E-1444: Standard Practice for Magnetic Particle Testing

Other codes and standards can be discussed if prearranged with the instructor at the time of registration

PRACTICAL TRAINING

- MT Yoke: Dry Visible, Wet Visible, Wet Fluorescent
- Weld flaw samples
- Longitudinal Magnetism – Coils
- Ketos Ring – Depth of penetration

EXAMINATIONS

- General
- Specific
- Practical

Candidates must score a minimum of 70 % in written tests, 80% in practical test and a minimum average of 80% in all three tests.



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Liquid Penetrant Testing

Level I and II – 16 hours

Training Course Outline

SCOPE

This course covers the principles of Liquid Penetrant Testing and prepares a candidate to

- Select equipment to conduct test
- Setup test equipment
- Steps to conduct test
- Familiarize with codes and standards
- Interpret results with respect to applicable codes and standards
- Understand limitation of the test method
- Write test reports.

TRAINING

Training material is presented in modules that are followed by quizzes

PERSONNEL CERTIFICATION

ASNT SNT-TC-1A 2024

Training, experience and examination requirements

Training Requirements

- Recommended Course Outline
- Training Hours
- Practicals
- Quizzes and examinations

MODULE 1: INTRODUCTION

MODULE 2: PRINCIPLES

- Purpose of Liquid Penetrant Testing
- Physical Principles
- Wetting Ability and Contact Angle
- Surface Tension
- Capillary Action
- Viscosity
- Reversed Capillary Action
- Visibility of Indication
- Categories of Test Processes
- Types of Dye: Type I (Fluorescent) and Type II (Visible)
- Methods of Removal of excess Penetrant including Water Washable, Emulsifiers and Solvent Removable
- Sensitivity Levels - ½, 1, 2, 3, 4
- Selection of Process
- Limitations of Penetrant Testing

MODULE 3: BASIC STEPS

This module covers the basic steps involved in the following processes

- Method A - Water Washable
- Method B - Lipophilic Emulsifier
- Method C - Solvent Removable
- Method D - Hydrophilic Emulsifier

MODULE 4: SURFACE PREPARATION AND PRECLEANING

- Choice of Cleaning Method
- Different Cleaning Methods including Detergent, Solvent, Alkaline, Steam, Ultrasonic cleaning, Vapor Degreasing

MODULE 5: APPLICATION AND REMOVAL OF PENETRANTS

- Selection of Penetrant Materials
 - Cleaners
 - Penetrant
 - Developer
 - Selection based on family
- Application of Penetrant
- Standard Temperature Limits
- Dwell time
- Drying
- Drying Parameters
- Drying Time Limits
- Application of Developers
- Types of Developers
 - Aqueous
 - Non-Aqueous
- Developing Time
- Fluorescent Inspection
 - Black Light Warm Up Time
 - Minimum intensity and light meter
 - Visual Adaptation
- Visual Inspection
 - Minimum light intensity and light meter
- Post Cleaning
- Limitation of Penetrant Testing

MODULE 6: INTERPRETATION

- Interpretation of Test Results
- Flow Chart for Interpretation
- True, False, Relevant and Non Relevant indications
- Categories of Indications: - Rounded and Linear
- Evaluation of Indications

- ASTM E-433 Reference Photographs of Indications types

MODULE 7: CODES & STANDARDS (Specific Training)

Codes

- ASME Section V, Article 6
- ASME Section VIII, Appendix 8 (Accept/Reject Criteria)

Standards

- ASTM E-165 Standard Practice for Liquid Penetrant Examination
- ASTM E-1209 Fluorescent Water Washable Liquid Penetrant Testing

Other codes and standards can be discussed at the request of the students.
Please make such requests at time of registration

Module: MIL STD/NAVSEA Codes – As needed

- MIL-STD 2035A Class 3 Acceptance Criteria

PRACTICAL TRAINING

Test on Flawed Samples

Visible

- Solvent Removable

Fluorescent

- Water Washable
- Solvent Removable

EXAMINATIONS

- General
- Specific
- Practical Tests

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Ultrasonic Testing Level I

Level I - 40 hours

Training Course Outline

SCOPE

This course introduces the basic principles of ultrasonics and prepares the candidate for straight beam inspections and thickness measurement. (See Level II Course Outline for Angle Beam Testing)

This course prepares a candidate

- Select equipment to conduct test
- Steps to conduct test
- Calibration
- Familiarize with codes and standards
- Interpret results with respect to applicable codes and standards
- Understand limitation of the test method
- Write test reports.

TRAINING

Training material is presented in modules that are followed by quizzes

PERSONNEL CERTIFICATION

ASNT SNT-TC-1A, 2024

Training, experience and examination requirements

Training Requirements

- Certification of NDT Personnel: Level I, Level II and Level III
- Recommended Course Outlines for NDT training
- Required Training Hours
- Practicals
- Quizzes and examinations

MODULE 2: WAVE MODES

- Waves - velocity, wavelength and frequency
- Wave Modes: Longitudinal and Shear waves
- Velocity of Waves
- Factors Affecting Velocity - temperature

MODULE 3A: ULTRASONIC TRANSDUCER

- Piezoelectric Crystal
- Single and Dual transducers
- Resolution in flaw detection: frequency and damping
- Transducer selection: frequency and diameter

MODULE 3B: SOUND FIELD OF A ULTRASONIC TRANSDUCER

- Near field concept
- Beam spread and sound loss
- Reducing beam spread: frequency and diameter

MODULE 4: THICKNESS MEASUREMENT

- Thickness Measurement Concept
- Probe selection: Single vs Dual
- Setting the UT equipment for thickness measurement
- Laboratory - Thickness measurement practicals

MODULE 5: UT EQUIPMENT

- Pulser Receivers
- Instrument Controls: gain, range, velocity, delay
- Displays. A-, B- and C-scans
- UT Equipment demonstration
- Epoch 650
- USM 36

MODULE 6: SOUND LOSS - ATTENUATION

- Attenuation – loss of sound with distance
- Maximum range of inspection
- What are decibels (dB)?
- Reducing attenuation – ultrasonic frequency
- Attenuation and its effects on testing of materials
- Attenuation and probe selection

MODULE 7: ACOUSTIC IMPEDANCE

- Reflection and transmission at interfaces
- Impedance matching

MODULE 8: REFRACTION AND MODE CONVERSION

- Reflection and Refraction at interfaces
- Snell's Law
- Mode Conversion to shear waves at interfaces
- Introduction to Angle Beam testing of welds (covered in detail in UT Level II class)

MODULE 9A: FLAW DETECTION – STRAIGHT BEAM

- Flaw detection, lamination, Corrosion Mapping, Bolts
- Use of Flat bottom holes for establishing reference
- Compensating sound loss from beam spread: distance amplitude correction curves (DAC)

MODULE 9B: CLADDING INSPECTION – ASME V, ART 4

- Technique One
- Technique Two

PRACTICALS

- Thickness Measurement and Scanning
- Backsurface echo technique
- Flaw detection

EXAMINATIONS

- General
- Specific
- Practical

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Ultrasonic Testing II

Level II – 40 hours

Training Course Outline

Prerequisite for this Class is Level I Ultrasonics

SCOPE

This course introduces prepares the candidate for flaw detection and angle beam inspections of welds.

This course prepares a candidate to

- Select equipment to conduct test
- Setup test equipment
- Steps to conduct weld inspections, plotting and locating flaws
- Range and sensitivity calibration for weld inspections, DAC
- Familiarize with codes and standards
- Interpret results with respect to applicable codes and standards
- Understand limitation of the test method
- Write test reports.

UT Equipment and welded test samples available for the UT II class.

- Epoch 650, Epoch 600, USN 36 and USN Go
- practicals on welded test samples with embedded flaws

TRAINING

Training material is presented in modules that are followed by quizzes

Modules Covered in UT Level I

Module 1: Contents and Personnel Certification
Module 2: Wave Modes
Module 3A: Ultrasonic Transducer
Module 3B: Sound Field from ultrasonic transducer
Module 4: Thickness Measurement
Module 4A: Epoch 600, 650 and USM 36 Thickness measurement
Module 5: Equipment
Module 6: Sound Loss – Attenuation
Module 7: Acoustic Impedance
Module 8: Refraction and reflection
Module 9A: Flaw Detection - 0 Degree
Module 9B: Cladding Inspection

UT II MODULES

MODULE 10: UT TEST MODES

- Pulse-echo mode
- Pitch-catch mode

- Thru-transmission mode
- Scan Plans and weld volume coverage

MODULE 11: IMMERSION TESTING

- Normal beam
- Angle Beam
- Focused Immersion Probes
- Immersion Tanks

MODULE 12: CALIBRATION BLOCKS

- IIW Blocks Type I and II
- Miniature Angle Beam / Rompass Block
- DSC Block
- AWS Resolution Block
- Step Wedge
- Area Amplitude Block
- Distance Amplitude Block

MODULE 13A: ANGLE BEAM INSPECTIONS - BASICS

- Selection of Screen Range
- Measurement of Beam Exit Point
- Measurement of Refracted Angle
- Range Calibration using IIW, Rompass and DSC Block
- Angle Selection for Weld inspection
- Surface Distance, Skip Distance, Depth, ½ vee and full V Path
- Weld Inspection and plotting discontinuities like crack, lack of fusion, lack of penetration, slag, porosity in welds

MODULE 13B: ANGLE BEAM INSPECTIONS- SENSITIVITY AND DAC

- Sensitivity Calibration: Piping and non-piping calibrations
- Distance Amplitude Correction (DAC) Curve
- Time Corrected Gain (TCG)
- Weld volume coverage and scan plan
- High Temp Angle Beam Inspections
- Discontinuity Length Sizing using 6 dB and 20 dB drop method
- Worksheet: Plotting of discontinuities for butt welds

MODULE 14: WRITING UT PROCEDURE

MODULE 15: ASME V, ARTICLE 4, UT OF WELDS

- Probe
- Calibration reflectors– notches and side drilled holes
- Reference Level - DAC

- Scan Plan

MODULE 16: AWS D1.1 AND API RP 2X

- Establishing reference level - b
- indication level – a , attenuation factor $c = 2$ (mp-1)
- Indication rating $d = a-b-c$

PRACTICALS

Shear Wave Testing on Pipe Samples with embedded weld defects – ID Cracks, OD Cracks, Slag, Porosity, Lack of Fusion, Lack of Penetration

EXAMINATIONS

- General
- Specific
- Practical
- Candidates must score a minimum of 70 % in written tests, 80% in practical test and a minimum average of 80% in all three tests.



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Radiography Testing Level I

Level I - 40 hours

Training Course Outline

SCOPE

This course will prepare a candidate to perform Industrial Radiography

COURSE OUTLINE

Module 1: Types of Radiation

- Particulate Radiation – Alpha, Beta, neutron
- Electromagnetic radiation – X-Ray, gamma ray
- Energy Characteristics of common radioisotopes

Module 2: Scattering and Attenuation

- Photoelectric Effect
- Compton Scattering
- Linear Attenuation
-

Module 3 Units and Radiological Safety

- Roentgen
- Rad
- Rem and Seivert
- Safe Boundary
- Inverse square law
- Shielding and half value layer

Module 4: Exposure Devices and Radiation Sources

- X-Ray Tube
- Seleninum-75, Ir-192, Co-60

Module 5: Detector Systems

- Film
- Imaging Plates – Computed Radiography
- DDA – Digital Detector Array

Module 6: Shadow formation and Geometrical unsharpness

- Shadow formation
- Sources of radiography
- Geometrical unsharpness

Module 7: Exposure Techniques

- Single Wall Exposure
- Double Wall Exposure
- Contact shot
- Panoramic

Module 8: Radiographic Sensitivity - Image Quality Indicators – IQI

- Wire Type
- Hole Type
- IQI Placement

Module 9: Shooting a Radiograph

- Film Type Selection
- Exposure Time and Density
- Radiographic Technique setup
- Setup and Geometrical Unsharpness
- Establishing 2mR boundary
- Sensitivity: IQI Selection and Placement
- Location markers

TRAINING PROGRAM EXAMINATIONS

- General
- Specific
- Practical

Candidates must score a minimum of 70 % in written tests, 80% in practicals and a minimum of 80% average for all the three tests.



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