



**NDE Professionals, Inc.**  
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## **Level I Radiographic Testing**

### **Training Course - NPI-RT-01**

#### **Lesson Plan**

**COURSE:** Forty (40) hours of Radiographic Testing Level I formal classroom training.

#### **REFERENCE MATERIALS:**

1. ASNT – Radiographic Testing Classroom Training Book – 2005
2. NPI – Power Point Presentation Radiographic Testing Training Material - 2011
3. ASNT Study Guide – Industrial Radiography Radiation Safety - 2009
4. ASTM E-1742-11 – Radiographic Examination
5. ANSI/ASNT – Topical Outlines for Qualification of Nondestructive Testing Personnel – CP-105-2011

### **Module One**

#### **1.0 Introduction**

- 1.1 Class rules and policies
  1. Grading System
    - a. Quizzes
    - b. Final Comprehension Examination
  2. Attendance
  3. Schedule
  4. Conduct
  5. Certificate of Completion
- 1.2 NDT Personnel Qualification and Certification Process
- 1.3 History and discovery of radioactive materials
- 1.4 Definition of industrial radiography
- 1.5 Radiation protection – why?
- 1.6 Basic math review – exponents

#### **2.0 Fundamental Properties of Matter**

- 2.1 Elements of atoms
- 2.2 Molecules and compounds
- 2.3 Atomic particles
- 2.4 Atomic structure
- 2.5 Atomic number and weight
- 2.6 Isotopes verses radioisotopes

#### **3.0 Radioactive Materials**

- 3.1 Production
  - 3.1.1 Nuclear activation
  - 3.1.2 Nuclear fission
- 3.2 Stable and unstable atoms
- 3.3 Becquerel – the unit of activity

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- 3.4 Radioactive material half-life
- 3.5 Radioactive decay
- 3.6 Specific activity – becquerels/gram

## 4.0 Types of Radiation

- 4.1 Particulate radiation
- 4.2 Electromagnetic radiation
- 4.3 X-ray production
- 4.4 Gamma ray production
- 4.5 Gamma ray energy
- 4.6 Energy characteristics of common radioisotopes
- 4.7 Energy characteristics of X-ray machines

## Module Two

### 5.0 Interaction of Radiation with Matter

- 5.1 Ionization
- 5.2 Radiation interaction with matter
  - 5.2.1 Photoelectric effect
  - 5.2.2 Compton effect
  - 5.2.3 Pair production
- 5.3 Unit of Radiation Exposure – coulomb per kilogram (C/kg)
- 5.4 Emissivity of commonly used radiographic sources
- 5.5 Emissivity of X-ray exposure devices
- 5.6 Attenuation of electromagnetic radiation – shielding
- 5.7 Half value layers, tenth value layers
- 5.8 Inverse square law

## Module Three

### 6.0 Exposure Devices and Radiation Sources

- 6.1 Radioisotope sources
  - 6.1.1 Sealed source design and fabrication
  - 6.1.2 Gamma ray sources
  - 6.1.3 Beta and Bremsstrahlung sources
  - 6.1.4 Neutron sources
- 6.2 Radioisotope exposure device characteristics
- 6.3 Electronic radiation sources – 500 keV and less (low energy)
  - 6.3.1 Generator – high-voltage rectifiers
  - 6.3.2 X-ray tube design and fabrication
  - 6.3.3 X-ray control circuits
  - 6.3.4 Accelerating potential
  - 6.3.5 Target material and configuration
  - 6.3.6 Heat dissipation
  - 6.3.7 Duty cycle
  - 6.3.8 Beam filtration

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## Module Four

### 7.0 Radiological Safety Principles Review

- 7.1 Controlling personnel exposure
- 7.2 Time, distance and shielding
- 7.3 ALARA – As low as reasonably achievable
- 7.4 Radiation detection equipment
- 7.5 Exposure-device operating characteristics

## Module Five

### 8.0 Basic Principles of Radiography

- 8.1 Geometric exposure principles
  - 8.1.1 Shadow formation and distortion
  - 8.1.2 Shadow enlargement calculation
  - 8.1.3 Shadow sharpness
  - 8.1.4 Geometric Unsharpness
  - 8.1.5 Discontinuity depth factors
- 8.2 Time, Distance, MA Relationships
- 8.3 Quiz

### 9.0 Film Handling, Loading and Processing

- 9.2 Radiographic screens
  - 9.2.1 Lead intensifying screens
  - 9.2.2 Fluorescent intensifying screens
  - 9.2.3 Intensifying factors
  - 9.2.4 Screen to film contact
  - 9.2.5 Screen cleanliness and care
- 9.3 Radiographic cassettes
- 9.4 Composition of radiographic film

### 10.1 Safelight and darkroom practices

- 10.2 Loading bench and cleanliness
- 10.3 Loading film into cassettes
- 10.4 Handling of film
- 10.5 Manual film processing
- 10.6 Final Review
- 10.7 Final Comprehension Examination Level I 40 questions, closed book