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Level II Radiographic Testing

Training Course - NDT-RT-02

Module Plan

COURSE: This forty (40) hour Radiography Testing Level II training class will provide radiographic principals and math, darkroom facilities techniques and processing, radiographic film quality and techniques, film viewing equipment, radiographic interpretation, welding processes and discontinuities, casting processes and discontinuities, review of codes, standards and specifications typically utilized by the Level II.

REFERENCE MATERIALS:

1. Radiographic Testing Classroom Training Book – 2005
2. Gamma Radiation Safety Study Guide – 1999
3. Training Course Outline ASNT CP-105
4. QTC- Radiography training modules
5. QTC- Level II Radiography Exercise 1 through 5

Module One – 8 hours

1.0 Introduction

- A. Class rules and policies
 1. Grading System
 - a. Quizzes
 - b. Final Comprehension Examination
 2. Attendance
 3. Schedule
 4. Conduct
 5. Certificate of Completion
 6. Radiographic Qualification and Certification

2.0 Review of Basic Radiographic Principles

- A. Interaction of Radiation with Matter – Gamma Ray
- B. Interaction of Radiation with Matter – X-Ray
- C. Electromagnetic Radiation Characteristics

3.0 Radiography Math Review

- A. Inverse Square Law
- B. Time-Distance Relationships
- C. Millamperage-Time Relationships
- D. Millamperage-Distance Relationships
- E. Quiz

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Module Two – 4 hours

1.0 Darkroom Facilities, Techniques and Processing

- A. Darkroom
- B. Film storage (before and after)
- C. Film Cassettes
 - 1. Sizes
 - 2. Loading
- D. Manual film processing
 - 1. Developer
 - 2. Stop Bath
 - 3. Fixer
 - 4. Rinse
 - 5. Wetting Agent
 - 6. Drying
- E. Manual Film Processing Defects
 - 1. Pressure Marks
 - 2. Film Scratches and Lint
 - 3. Static Marks
- F. Automatic Film Processing
 - 1. Processor Components
 - 2. Processor Film Processing Artifacts
 - a) Micro Groove Lines
 - b) Delay Streaks
 - c) Shoe Marks
 - d) Dryer Pins Scratches
 - e) Hesitation Marks
 - f) Pi Lines
 - g) Surface Scratches
 - h) Black Comets
 - i) Kink or Crimp Marks
 - j) Wet Pressure Marks
 - k) Fixer Splash
 - l) Surface Drying Streaks
 - 3. Advantages – Manual versus Automatic Processing
- G. Quiz

Quality Consulting – Film Part One

Module Three – 2 hours

1.0 Radiographic Film Quality

- A. Image Quality Indicators
 - 1. Dimension Requirements
 - 2. Types of IQI
 - a) Hole Type
 - b) Wire Type
 - 3. Quality Levels
 - 4. Hole Type Material Groups
 - 5. Wire Type Material Groups
- B. Quiz

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Module Four – 2 hours

1.0 Radiographic Density

- A. What is Radiographic Density
 - 1. Illumination
 - 2. Measuring Film Density
 - a) Master film density strips
 - 3. Densitometer Calibration
 - 2. Working film density strips
 - 3. Calibration and limits of error
- B. Density Ranges
- C. Quiz

Quality Consulting Film – Part Two

Module Five – 6 hours

1.0 Radiographic Techniques

- A. Part Setup and Arrangement - Castings
- B. Part Setup and Arrangement - Pipe
- C. Part Setup and Arrangement - Plate
- D. Radiographic Contrast
 - 1. Subject Contrast
 - 2. Film Contrast
- E. Exposure Variables
 - 1. Source Size
 - 2. Kilovoltage
 - 3. Millamperage
 - 4. Time
 - 5. Source to Film Distance
 - 6. Object to Film Distance
 - 7. Film Speed
 - 8. Screens
 - 9. Film Processing

Mid-Course Examination – 40 Questions

Module Six – 2 hours

1.0 Film Viewing Equipment

- A. Film Viewer
- B. Viewing Environment
- C. Photometer
- D. Densitometer and Density Strips
- E. Optical Aids
- F. Marking Utensils

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Module Six – (cont.)

2.0 Radiographic Interpretation

- A. Radiographic requirements
- B. Radiographic Technique and Acceptance Criteria
- C. Reference Radiographs
- D. Radiographic Quality
- E. Process of Interpretation
- F. Quiz

Module Seven – 8 hours

1.0 Welding Processes

- A. GTAW
- B. GMAW
- C. SMAW
- D. SAW
- E. FCAW

2.0 Weld Discontinuities

- A. Weld Anatomy
- B. Root Concavity
- C. Underfill
- D. Weld Mismatch
- E. Weld Misalignment
- F. Incomplete Penetration
- G. Undercut
- H. Reinforcement
- I. Radiographic Exercise One - Weldments

3.0 Casting Processes

- A. Permanent Mold Castings
- B. Non-Permanent Mold Castings

4.0 Casting Discontinuities

- A. Inclusions
- B. Porosity and Gas
- C. Shrink
- D. Hot Tears
- E. Cold Shuts
- F. Blow Holes.
- G. Core Shift
- H. Misrun
- I. Segregation
- J. Unfused Chaplets
- K. Radiographic Exercise Two – Castings
- L. Quiz

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Module Eight - 5 hours

- 1.0 Codes, Standards and Specifications**
 - A. ASTM
 - B. ASME
 - C. AWS

- 2.0 Radiographic Interpretation Exercises #3, 4, & 5**

Module Nine - 3 hours

- 1.0 Filmless Radiography**
 - A. History of Filmless Radiography

- 2.0 Computed Radiography (CR)**
 - A. Components of a CR System
 - B. Radiation Source
 - C. Storage Phosphor Imaging Plate- SPIP
 - D. Scanning Process
 - E. Digital Image Acquisition
 - F. Digital Display
 - G. Performance Measurement

- 3.0 Digital Imaging**
 - A. Digital Images
 - B. Resolution
 - C. Pixel Dimensions
 - D. Bit Depth
 - E. Dynamic Range
 - F. File Size
 - G. Compression

- 4.0 Radioscopy Classifications**
 - A. X-Ray to Light Conversion
 - B. X-Ray to Electron Conversion
 - C. Scintillator Arrays, TV Readout
 - D. Semiconductor Diode Array
 - E. Semiconductor Diode Array w/ Fluorescence
 - F. Basic Fluoroscope Configuration
 - G. Various Fluoroscope Configurations
 - H. X-Ray Image Intensifier
 - I. Digital System Applications
 - J. Quiz

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Final RT Level II Comprehension Examination – 40 Questions

REFERENCE MATERIALS:

1. **ASTM – American Society of Testing and Materials**

E-1030	Radiographic Examination of Metallic Castings
E-1032	Radiographic Examination of Weldments
E-1079	Calibration of Transmission Densitometers
E-747	Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators
E-1025	Design, Manufacture and Material Grouping Classification of Hole-type Image Quality Indicators
E-1390	Illuminators used for Viewing Industrial Radiographs
E-1742	Radiographic Examination
E-186	Reference Radiographs - Heavy-walled (2 to 4-1/2 in. Steel Castings
E-1320	Reference Radiographs - Titanium Castings

2. **ASME – American Society of Mechanical Engineers**

Section V, Article 2	Radiographic Examination
Section VII	Pressure Vessels
B31.1	Pressure Piping Code
B31.3	Process Piping Code

3. **AWS – American Welding Society**

D1.1	Structural Steel
D1.5	Bridges