Industrial Radiography Overview

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Overview of Industrial Radiography

- Radiography vs. nondestructive testing
- Radiographic principles & techniques
- Typical types of radiographic testing
- Industrial gamma radiography sources
- X-ray systems
- Evolution of radiography equipment

Non Destructive Testing (NDT) Methods

- There are many different NDT methods in use; the six most widely known & applied methods are:

Radiographic Testing (RT)

Magnetic Particle Testing (MT)

Liquid Penetrant Testing (PT)

Ultrasonic Testing (UT)

Eddy Current Testing (ET)

Acoustic Emission (AT)

Infrared Testing (IT)

Visual Testing (VT)

NDT

NDI

NDE

Introduction

- Industrial radiography (IR), also known as radiographic testing (RT), is one of many methods of nondestructive testing (NDT)

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What is NDT?

- At some point, nearly every manufacturer must assure that its products meet standards of reliability, durability & safety
- No material is perfect, but it must have adequate properties to meet the demands made upon it




Introduction

- NDT allows inspection of internal structures without damaging the item being inspected
- NDT: any method of examining an object/material in any manner that doesn't impair its future usefulness
- NDT = TESTING WITHOUT DESTROYING

NDT

Nondestructive Testing

What is NDT?

- NDT is also known as nondestructive examination or evaluation (NDE) & nondestructive inspection (NDI); acronyms are used interchangeably

NDT = NDE = NDI

Where NDT is Used

- Aerospace
- Aircraft
- Automotive
- Casting & Forging
- Chemical & Petroleum
- Construction
- Electronics
- Food Processing
- Marine
- Materials Joining
- Security
- Metals
- Non-Metals
- Nuclear
- Ordnance
- Transportation
- Utilities

Bottom line: The NDT industry provides critical (but little recognized) services to society

Radiographic Testing (RT)

- Goes by many names: RT, industrial radiography, radiography or just "X-ray"
- Uses X-ray or gamma radiation (also neutrons)
- Source: X-ray machine or radioactive isotope
- Typically produces radiographs (though there are also film-less RT applications
- Defects appear as density changes in film

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Radiographic Testing (RT)

Advantages

- Can be used to inspect virtually all materials
- Detects surface & subsurface defects
- Can inspect complex shapes & multi-layered structures without disassembly
- Minimum part preparation is require

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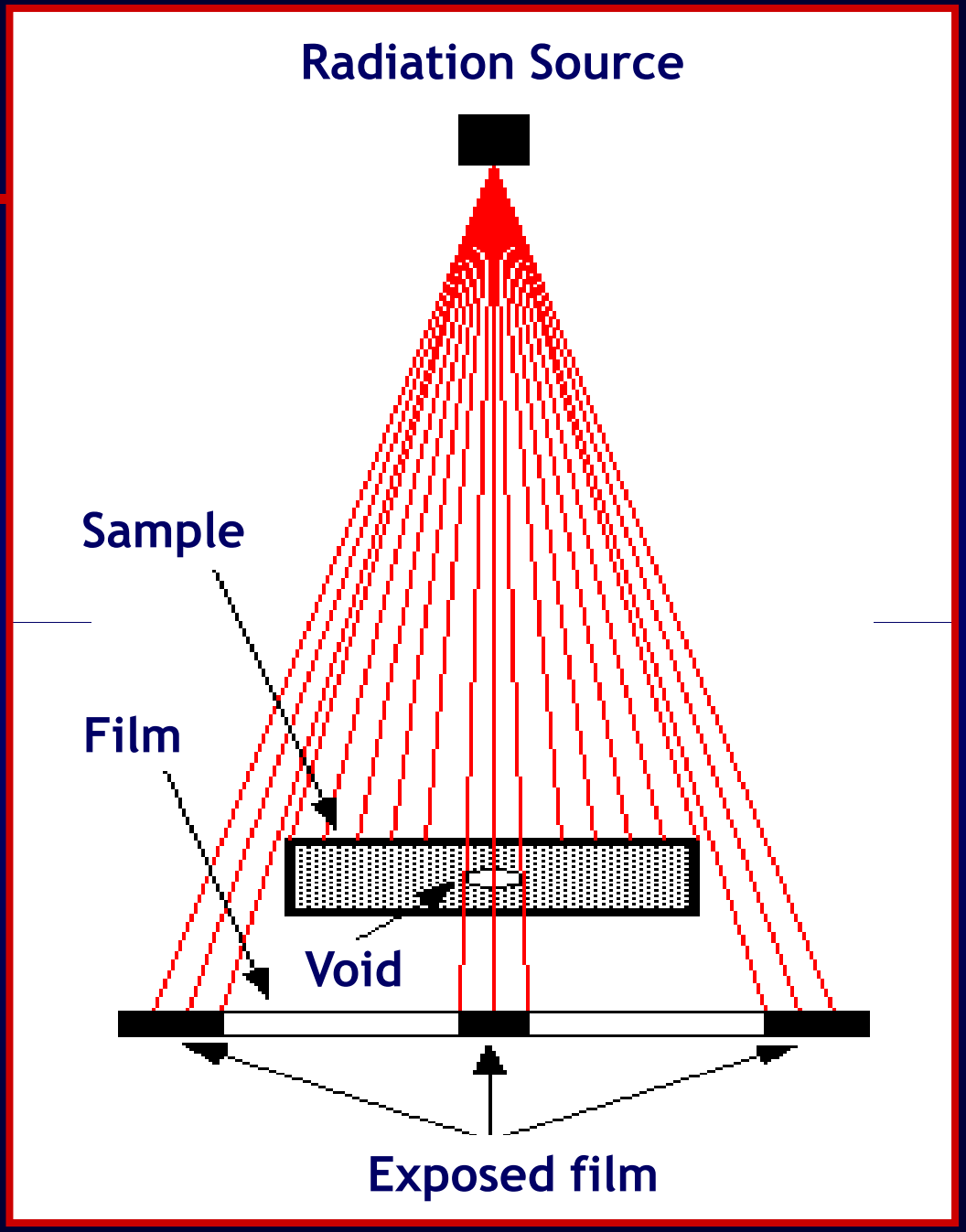
Radiographic Testing (RT)

Disadvantages

- Extensive operator training & skill required
- Access to both sides of item is usually required
- Long shot times for thick items
- Expensive equipment
- Radiation hazard

Radiography Process

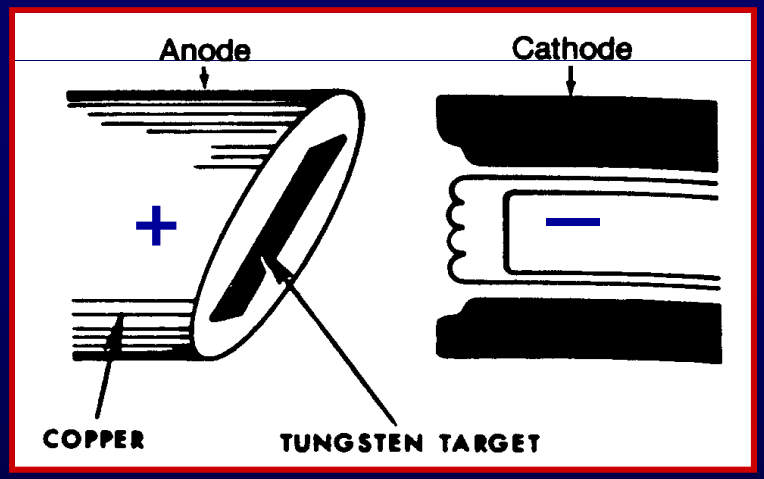
Gamma or X-ray Radiography

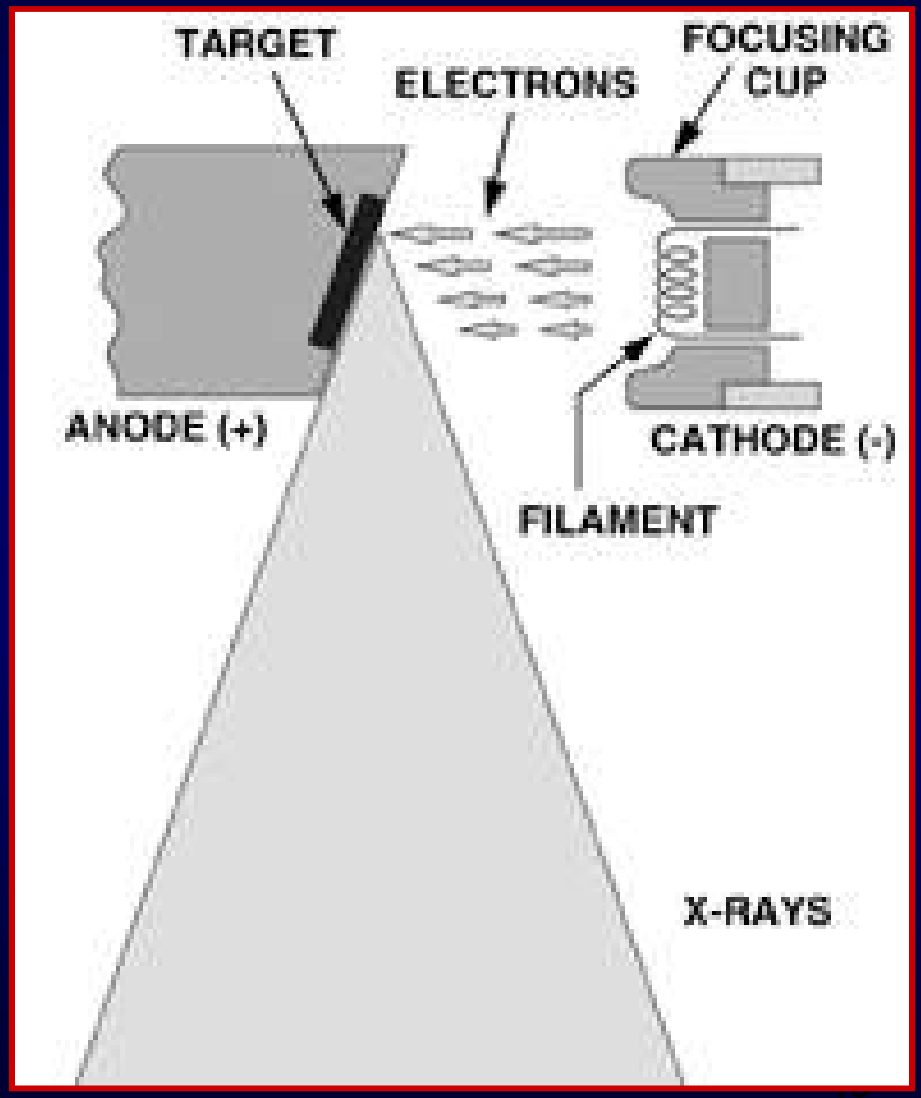


Void is revealed as dark region on exposed film

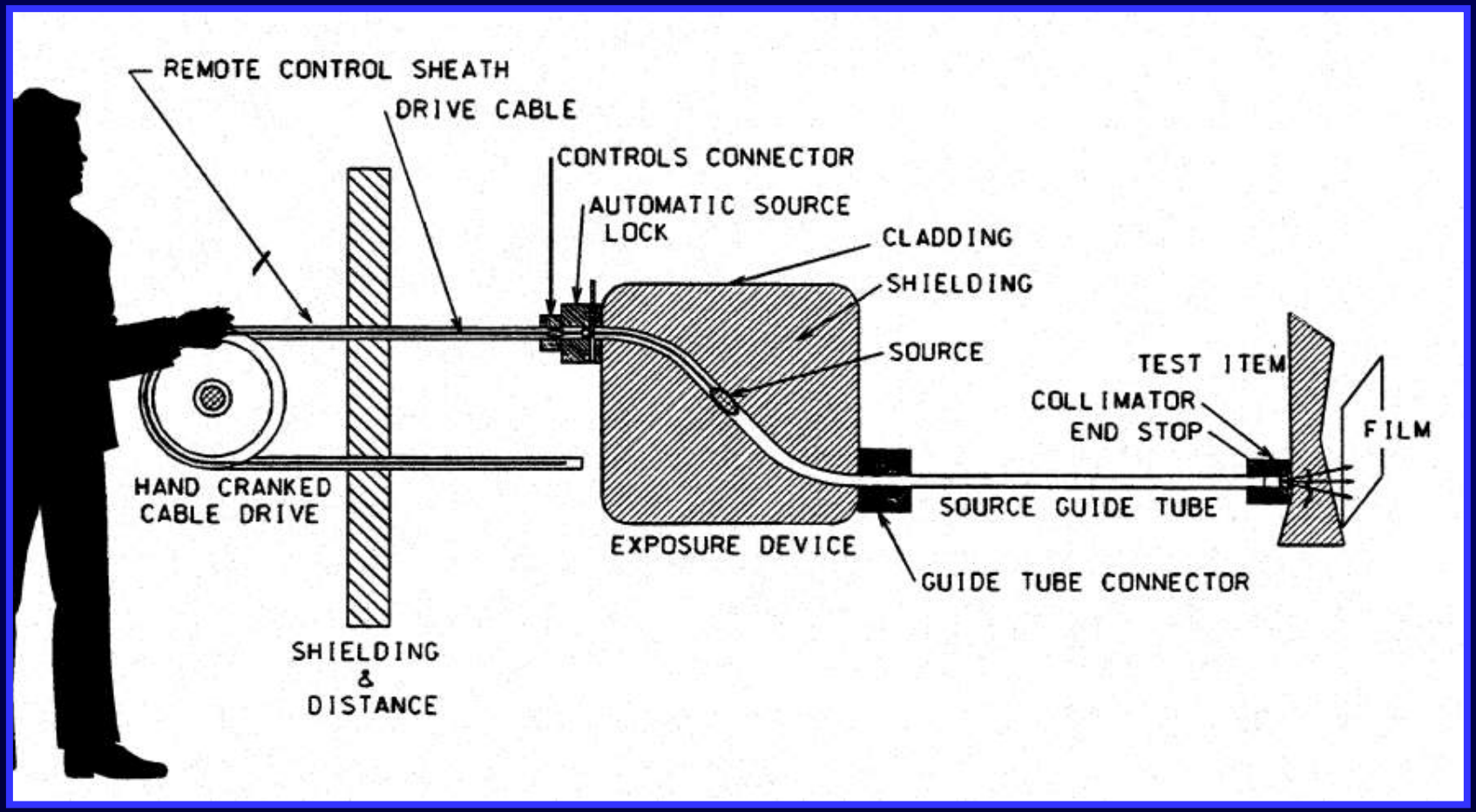
X-ray Radiogrpahy

Production of X-rays

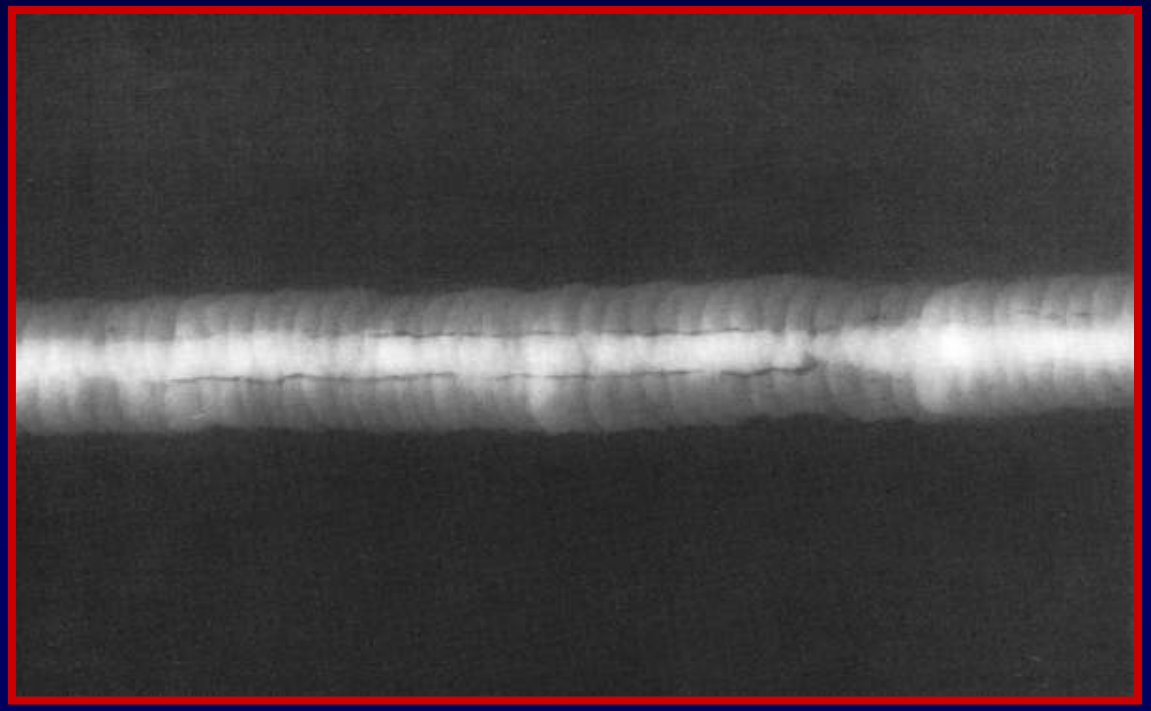


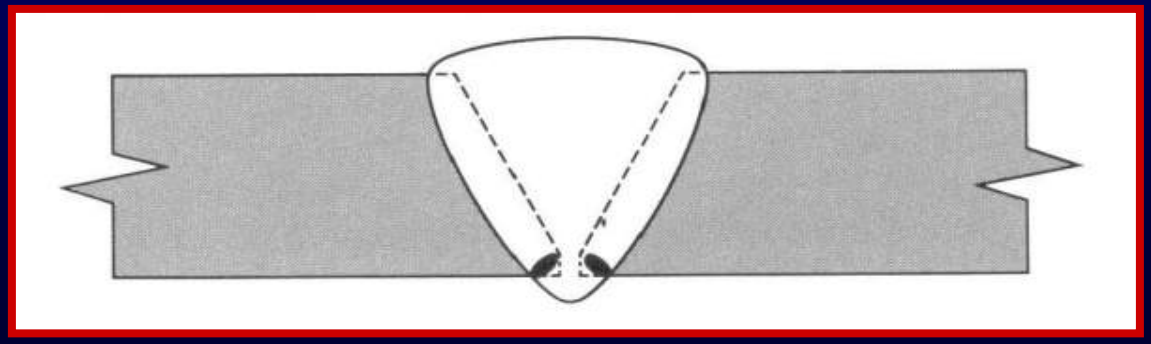


Radiography Process: Isotopes



Sample Radiographs: Wagon Tracks





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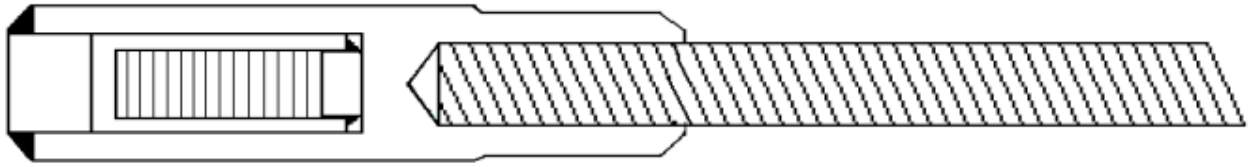
Radioisotopes Used in Ind. Radiography

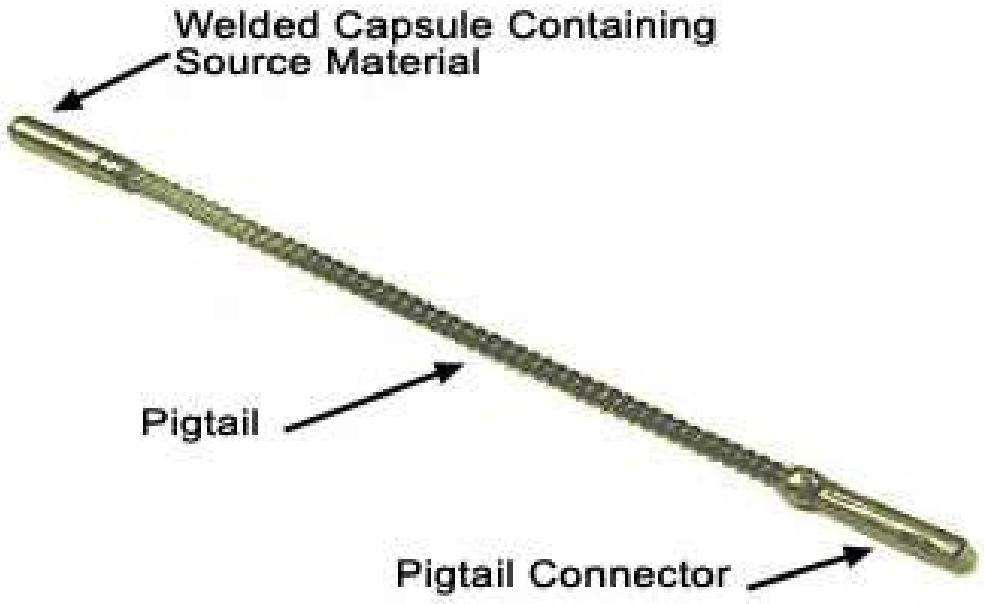
Gamma Emitters

Isotope	Gamma Constant	Energy	Half Life
Ir-192	5.2 R/hr @1 ft	375 keV	74 days
Co-60	14 R/hr @1 ft	1.25 MeV	5.2 years
Se-75	2.2 R/hr @1 ft	400 keV	120 days
Yb-169	1.3 R/hr @1 ft	300 keV	32 days

Radioisotopes Used in Ind. Radiography

Radiography Sealed Source Design





Types of Radiographic Testing

- Crank Out
- Self Contained
- X-Ray
- Crawlers
- Real Time

Examples of Radiography Work Sites

- Fabrication Shops/Yards
- Pipelines
- Offshore Structures
- Pipe Spool Yards
- Pipe Lay-Barges
- Boilers

NDT Technical Qualification & Certification

Trainee

Level I

Level II

Level III

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Technical Certification Methods

ASNT SNT-TC-1A — developed in 1968

- Recommended practice
- Sets minimum education, training & experience
- Levels I, II & III qualification
- Employer certification

ANSI/ASNT CP-189 — Mar. 1991

- Minimum requirements for Level III certs
- Employer certification

ISO 9712 — May 1992

- International standard
- Third party certification

Technical Certification Methods

EN473 – Nov. 1992 (current: Dec. 2000)

- European regional standard
- Third party certification

ACCP – Nov 1997 (current: Jan. 2007)

- ASNT Central Certification Program
- Minimum education, training & experience requirements
- Level II & III qualification
- Third party certification based on written & practical exams

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Safety Certification

Certification offered by several states & ASNT

- Certification in rad. materials, X-Ray, or both
- Minimum training & experience requirements
- Written exam
- Complies with 10 CFR Part 34 requirements

ASNT Program

- IRRSP (Ind. Radiography Radiation Safety Personnel)
- Defined in ASNT Practice No. ASNT-CP-IRRSP-1A (available at www.asnt.org)

NDT Personnel

	Level I	Level II	Level III	Overall Avg
Full Time Annual Salary	$49,887	$69,812	$89,551	$80,622
Full Time Hourly Wage	$14.72	$24.00		
Contractor Hourly Rate	$16.73	$29.00	$49.00	$38.10
Contractor Avg OT Hrs/week	23.22	21.52	13.10	21.78
Male	75 %	91%	91%	92%
Female	11 %	5%	5%	4%
(not specified)	14 %	4%	4%	4%
Average Age	32	38	46	43
Average Years Experience	6.6	13.3	24.1	16
Certification	3%	36%	31%	17%

Source: PQNDT 2007 NDT Salary Survey

Field Radiography

Radiography "Rig"

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Field Radiography

High Mountain Inspection Services

Water Pipeline Project (New York)

Field Radiography

Pipeline Project

Field Radiography

Pipeline Project

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Field Radiography

Field Radiography

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Field Radiography

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Field Radiography

RT of gas pipeline – Pensacola, FL

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Field Radiography

RT of vessel – Saudi Arabia

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Field Radiography

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Field Radiography

Pensacola, FL

Monsanto
Chemical Refinery

Field Radiography

Pipe Crawler

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Field Radiography

Pipe Crawler

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Field Radiography

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Field Radiography

Radiography of dragline support cables.

The view is looking down from the top of a single access stairway.

The X-ray rig is on left side of stairs, 300 feet down.

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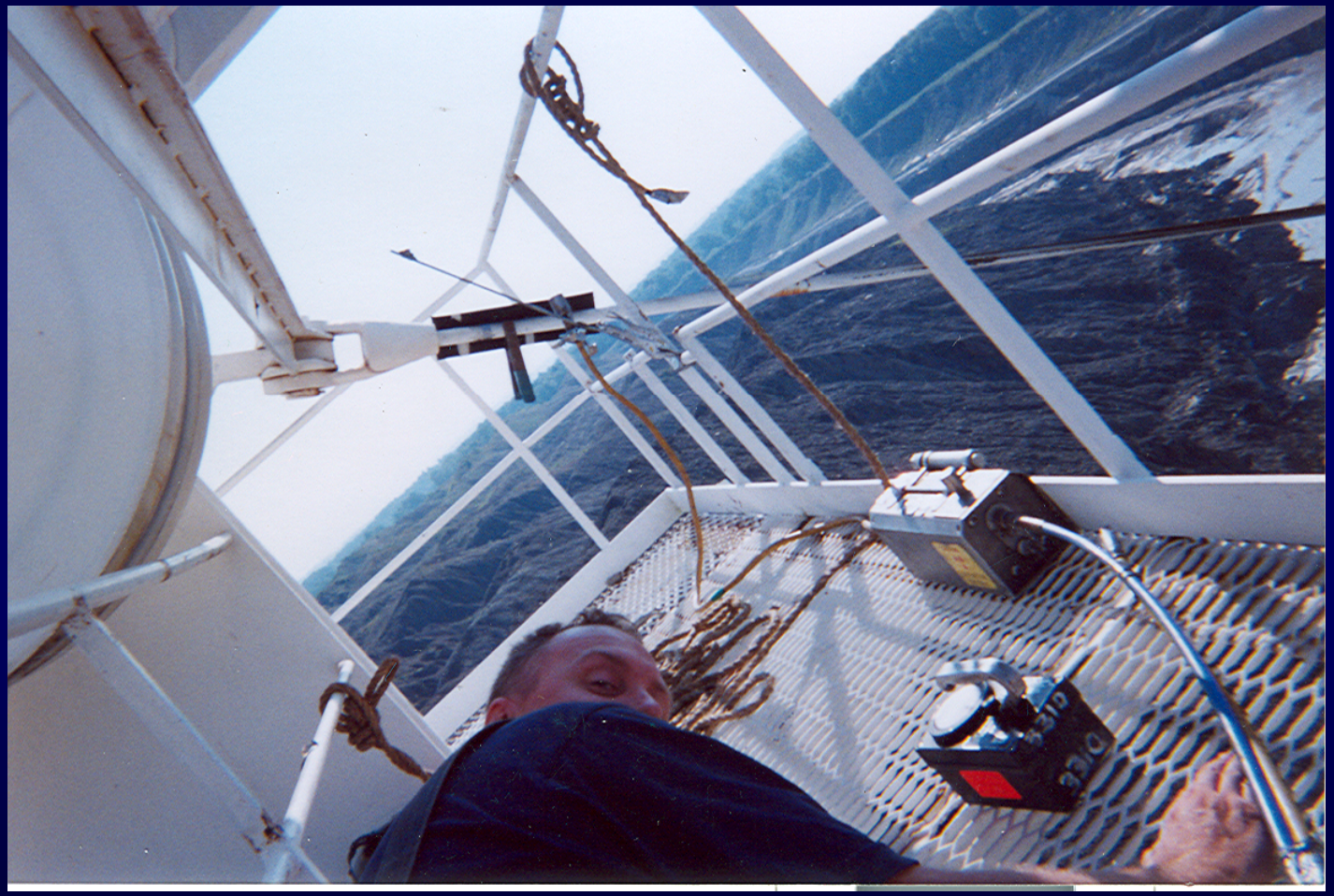
Field Radiography



Lower support cable ready for shot. Height over excavation 400 feet plus

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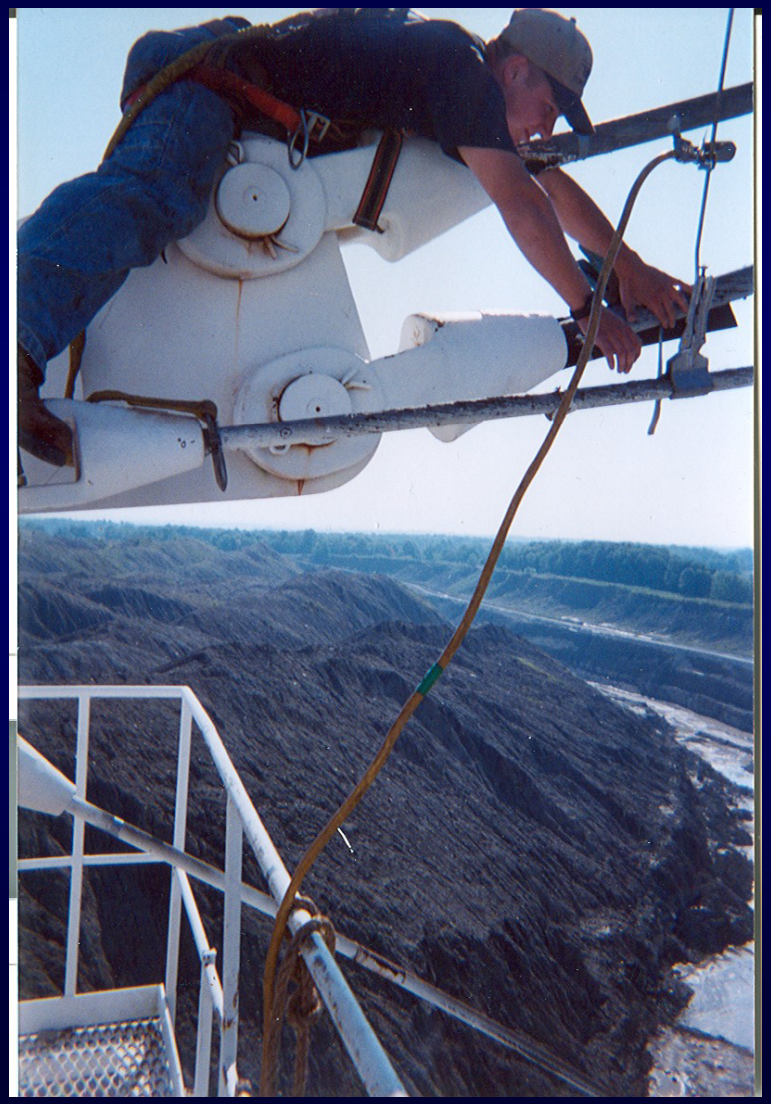
Field Radiography



Radiographer positioning film for shot on upper support cable.

Exposure device on platform below radiographer, guide tube extending to positioning rod to right of radiographer.

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Fixed Location Radiography

Permanent Radiographic Installation

Quality Inspection Services
Jacksonville, FL

Fixed Location Radiography

Permanent Radiographic Installation

NDE, Inc. Tampa, FL

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Fixed Location Radiography

Vault equipped with
X-ray machine

Visible/audible alarm system

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Fixed Location Radiography

X-ray Radiography

NASA Kennedy Space Center

Fixed Location Radiography

Manufactured X-ray Vault

Honeywell Clearwater, FL

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Fixed Location Radiography

Entryway to Shooting Booth

Fixed Location Radiography

Entryway to Shooting Booth

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Fixed Location Radiography

Shooting Booth

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Radiography Overview

Questions?

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