

# Industrial Radiography Overview



# Overview of Industrial Radiography

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- 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

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- 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

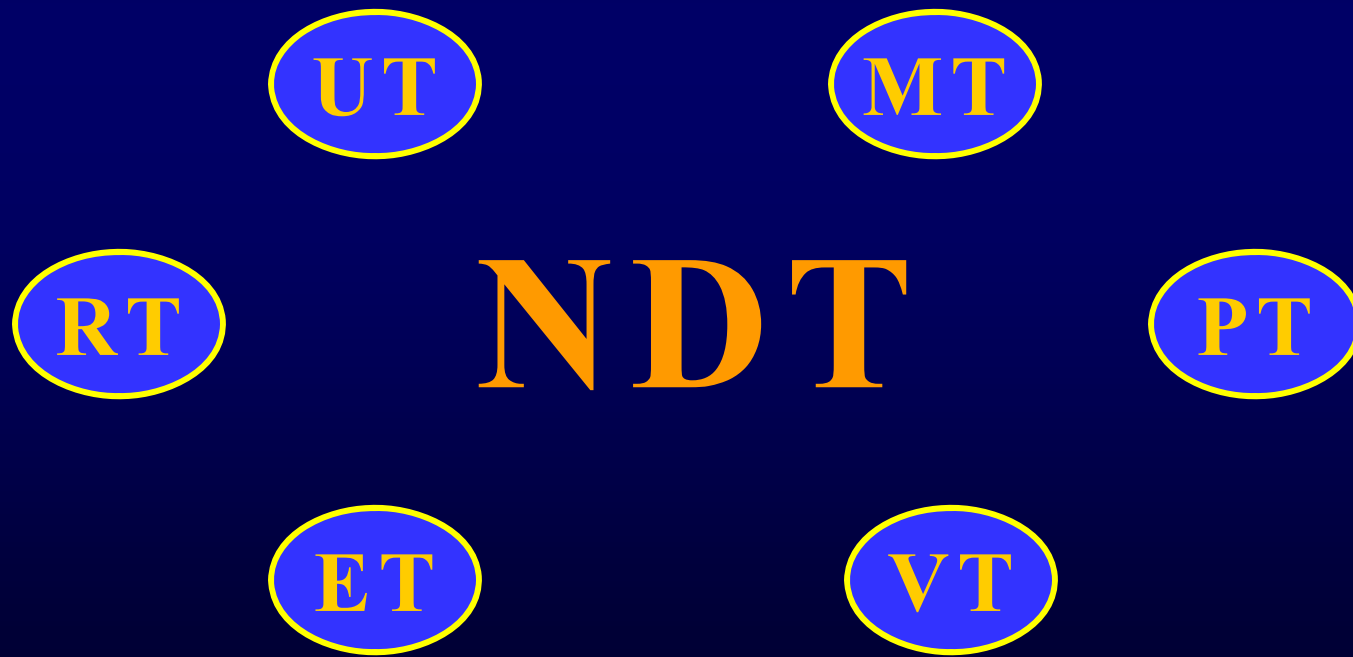
NDI

NDE

# Introduction

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





# What is NDT?

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- 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

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- 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

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- 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)

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- 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

# Radiographic Testing (RT)

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## 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



# Radiographic Testing (RT)

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## Disadvantages

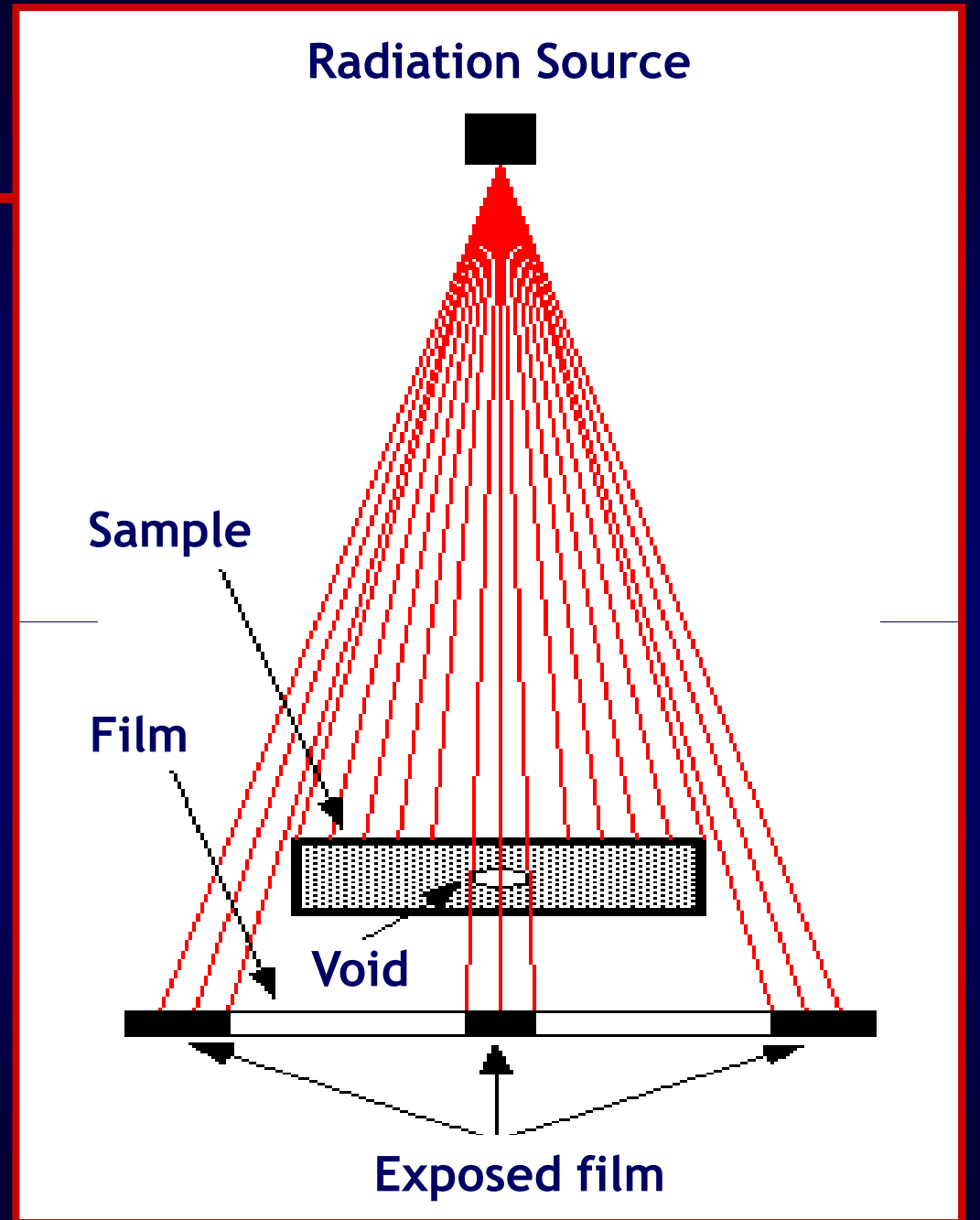
- Extensive operator training & skill required
- Access to both sides of item is usually required
- Long shot times for thick items
- Expensive equipment
- Radiation hazard



# Radiography Process

## Gamma or X-ray Radiography

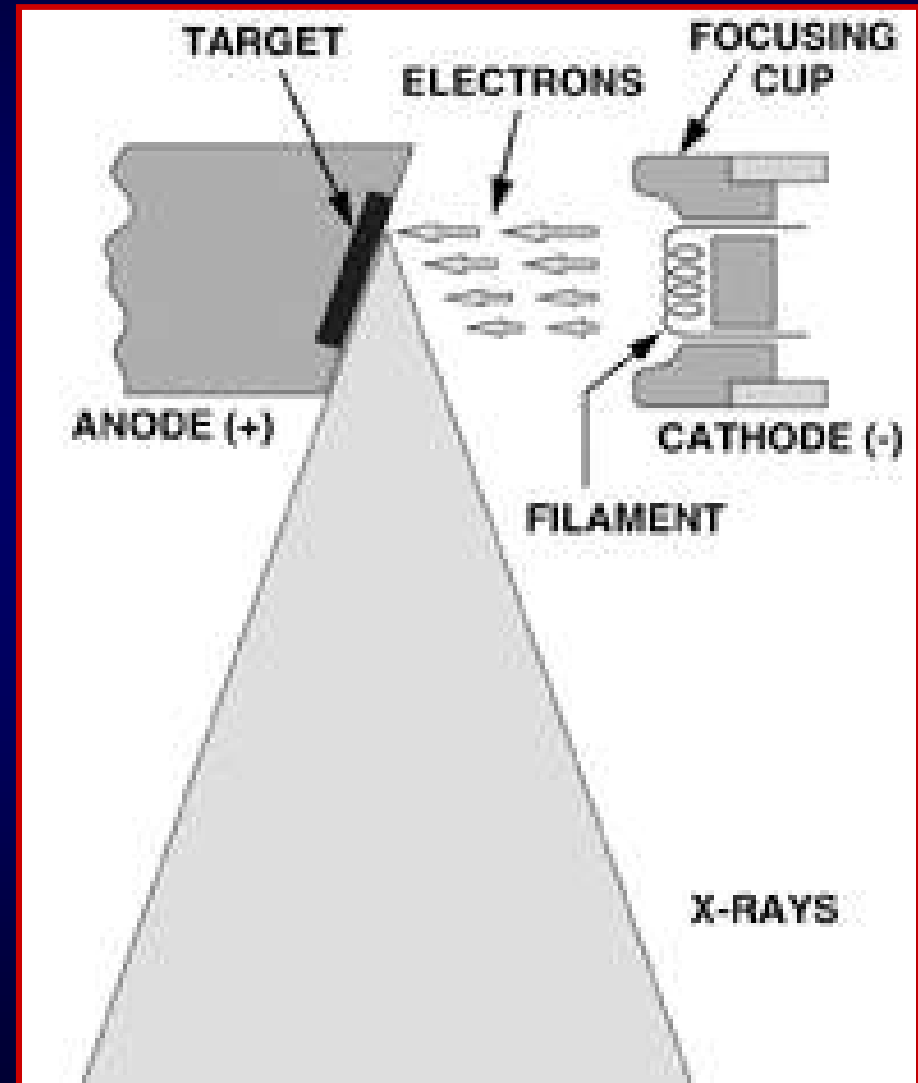
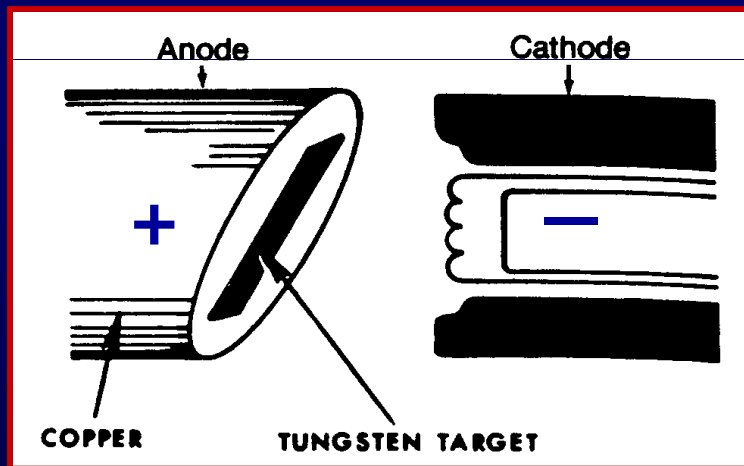
Void is revealed as dark region on exposed film



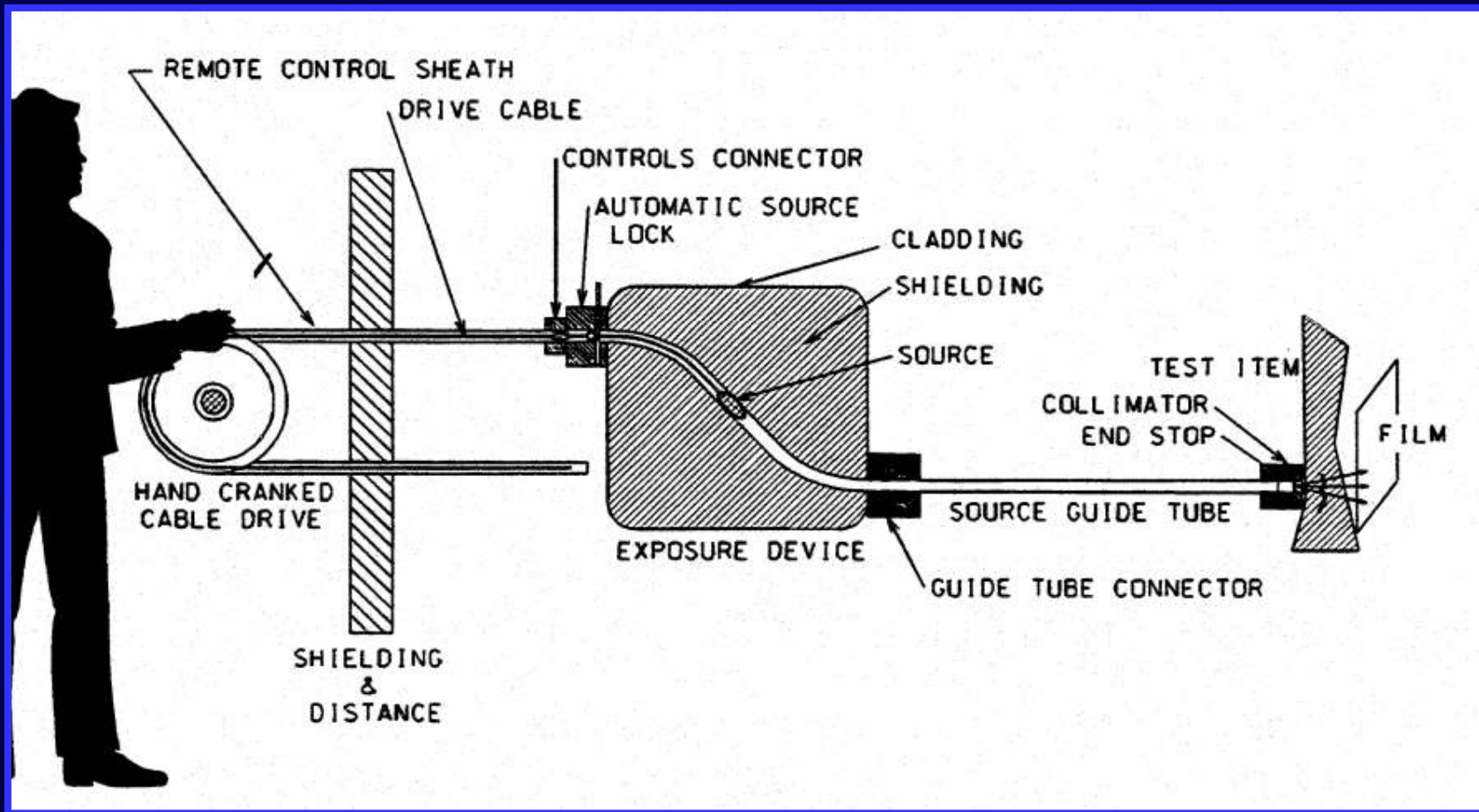


# X-ray Radiography

## Production of X-rays

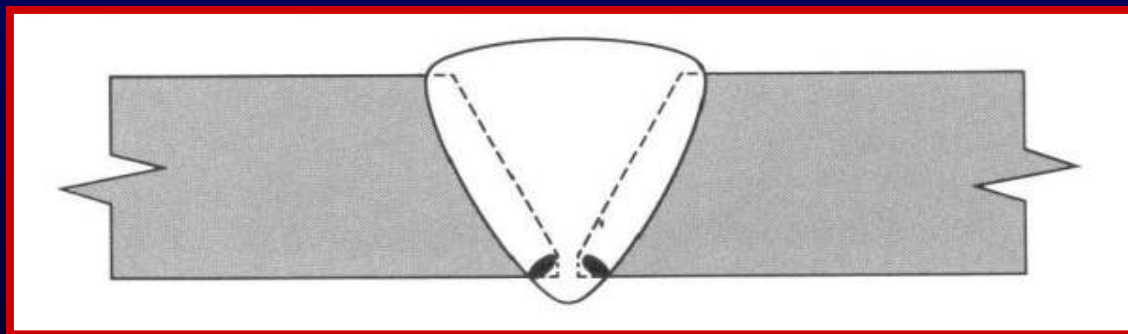
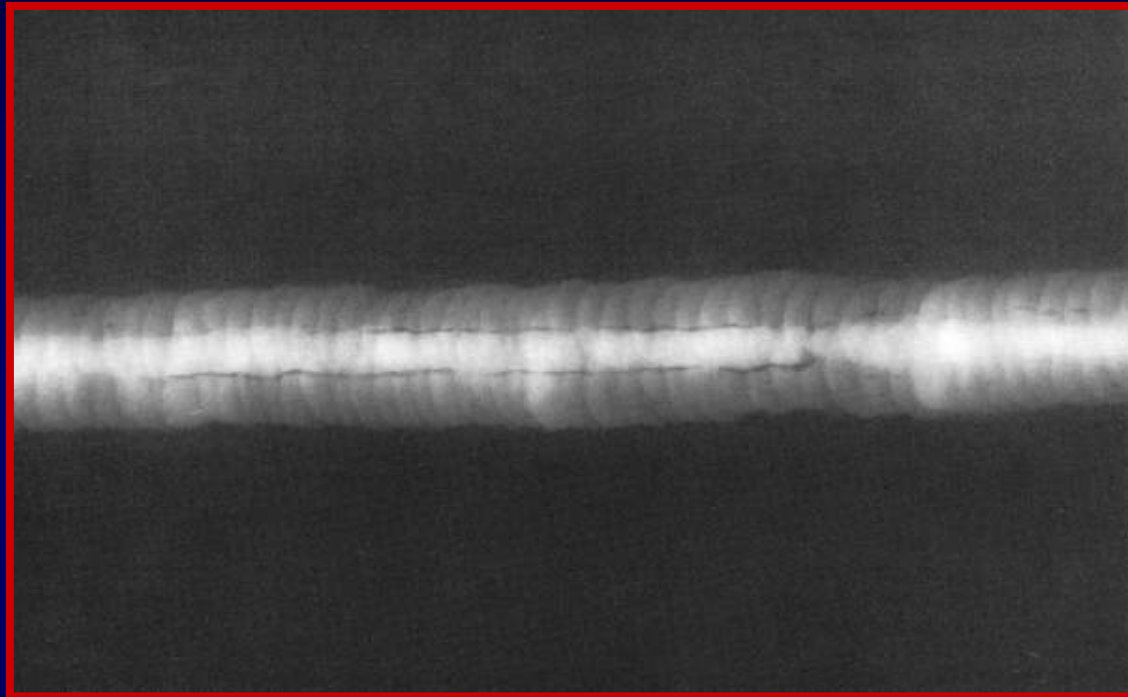


# Radiography Process: Isotopes



# Sample Radiographs: Wagon Tracks

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# Radioisotopes Used in Ind. Radiography

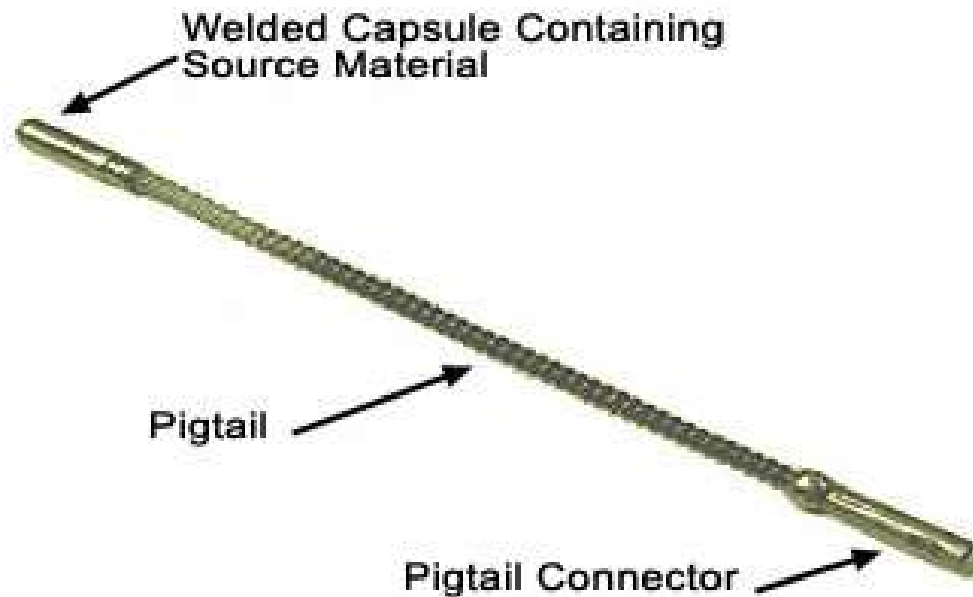
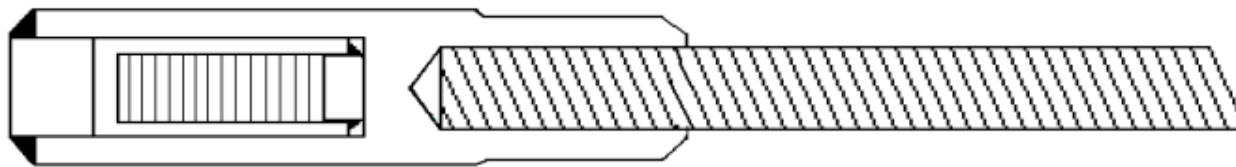
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## Gamma Emitters

<u>Isotope</u>	<u>Gamma Constant</u>	<u>Energy</u>	<u>Half Life</u>
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

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- 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



# Technical Certification Methods

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## 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

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**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



# Safety Certification

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## 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](http://www.asnt.org))

# NDT Personnel

	<u>Level I</u>	<u>Level II</u>	<u>Level III</u>	<u>Overall Avg</u>
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"





# Field Radiography

## High Mountain Inspection Services



### Water Pipeline Project (New York)



# Field Radiography

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## Pipeline Project





# Field Radiography

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## Pipeline Project





# Field Radiography

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# Field Radiography

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# Field Radiography

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# Field Radiography



RT of gas pipeline - Pensacola, FL

# Field Radiography



RT of vessel — Saudi Arabia



# Field Radiography

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# Field Radiography



Pensacola, FL

Monsanto  
Chemical Refinery





# Field Radiography

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Pipe Crawler



# Field Radiography

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Pipe Crawler

# Field Radiography

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# Field Radiography

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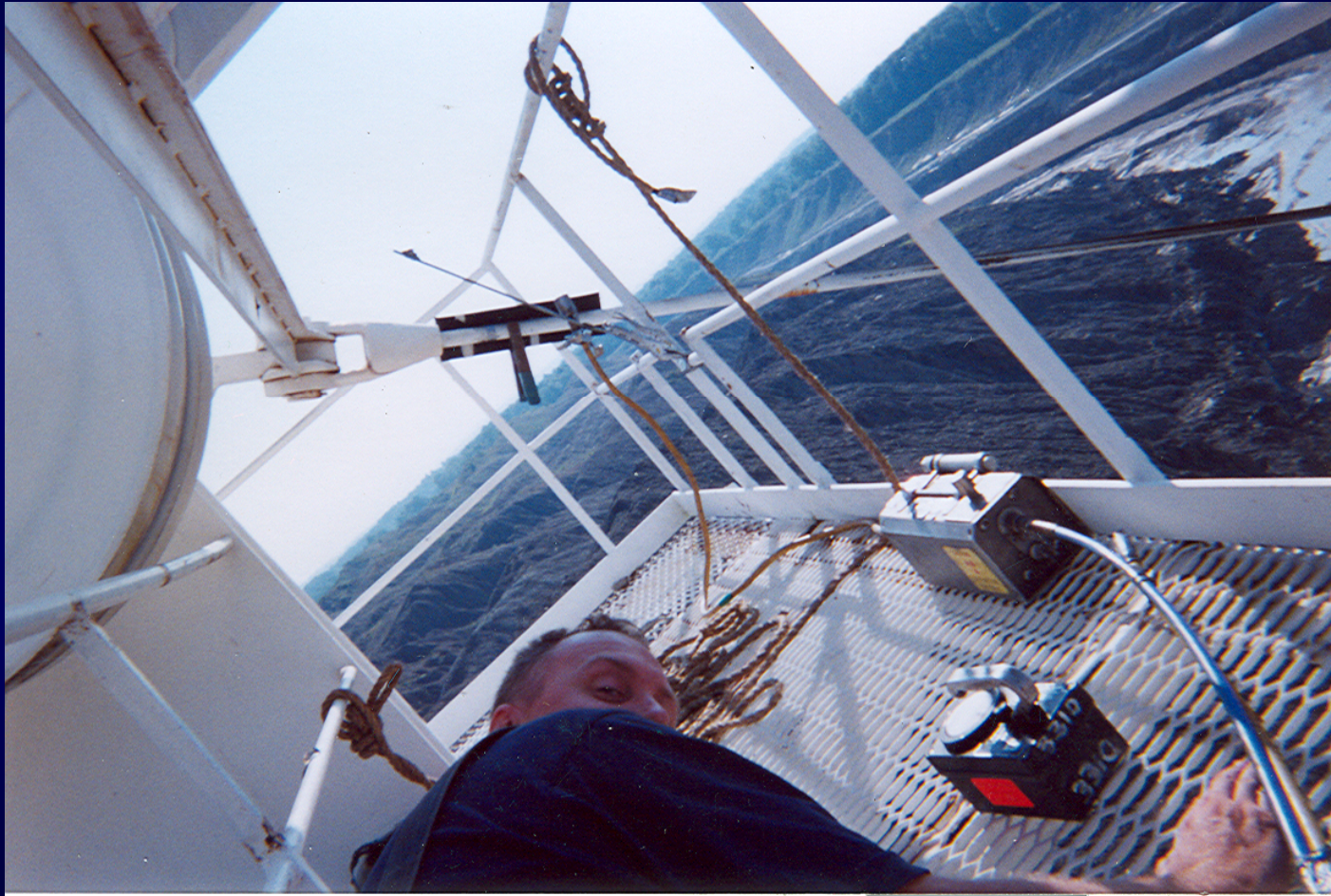
Radiography of dragline support cables.

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.

# Field Radiography

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

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# Field Radiography

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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.

# Fixed Location Radiography



**Permanent Radiographic  
Installation**

**Quality Inspection Services  
Jacksonville, FL**



# Fixed Location Radiography

## Permanent Radiographic Installation NDE, Inc. Tampa, FL





# Fixed Location Radiography



Vault equipped with  
X-ray machine



Visible/audible alarm system



# Fixed Location Radiography

## X-ray Radiography

NASA Kennedy  
Space Center



# Fixed Location Radiography



**Manufactured  
X-ray Vault**

**Honeywell  
Clearwater, FL**



# Fixed Location Radiography

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Entryway to  
Shooting  
Booth



# Fixed Location Radiography

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Entryway  
to  
Shooting  
Booth



# Fixed Location Radiography

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Shooting  
Booth

# Radiography Overview

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Questions?