Use of Radioisotopes in Industrial Radiography

David P. Tebo – Corporate RSO

TEAM, Inc. is a worldwide leading provider of integrated digitally-enabled asset integrity solutions.

We deploy specialty inspection, maintenance, repair and engineering assessment services that result in greater operational safety, asset efficiency, and critical reliability. A professional team of experienced engineers, technicians, and client support personnel backs each service armed with the best training, equipment and technical support in the industry. With 220 branch locations in more than 20 countries, we fuse the delivery of technological innovation with over a century of integrity management experience to fuel a better tomorrow.

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Industrial Services to Support Any Industry

Refining

Petrochemical

Pipeline

Offshore

Power Generation


Nuclear

Mining

Manufacturing

Pulp Paper

Military

Municipalities

Automotive

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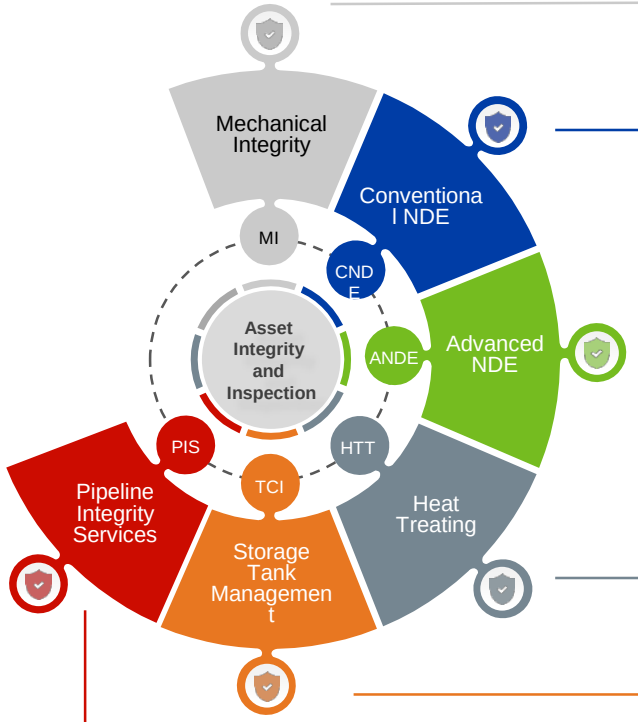
Inspection and Heat Treating Portfolio



- Asset Integrity/Performance Assurance
- Code Compliance

- Radiography (Film)
- Ultrasonic Thickness
- Visual Inspections
- Magnetic Particle Testing
- Dye Penetrant

- Positive Material Identification
- Metallurgical Assessment
- Hardness
- Leak Testing

- Advanced Ultrasonic Techniques
- Guided Wave Ultrasonics
- Advanced Radiography (CR and DR)
- Eddy Current Testing
- Laser Scanning

- Post Weld Heat Treating
- Dry out/Bake out
- Space Heating
- Line Thaws

- Process Heat Ups
- Coating Cures
- Permanent Warming Systems

- Inspection
- Engineering
- Consulting

- Pipeline Integrity Inspection (PII)
- Material Strength Verification (MSV)
- Coating Scan (PCS)

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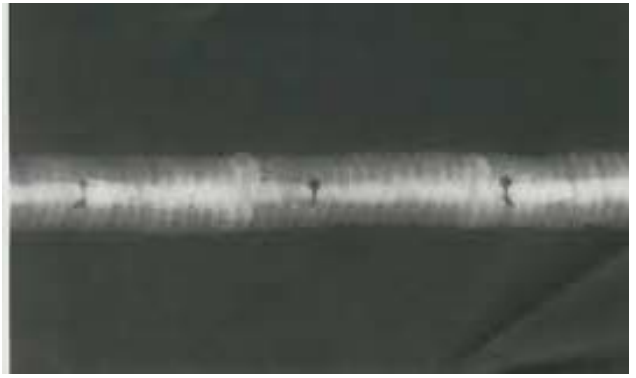
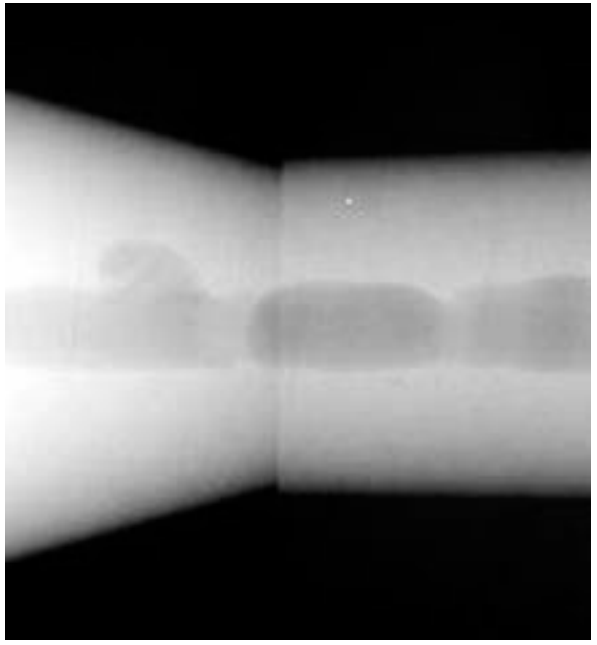
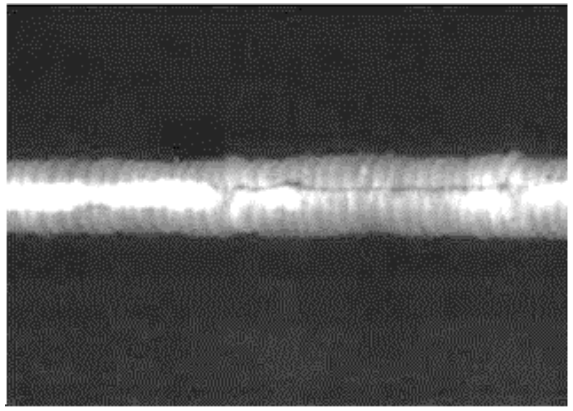
Industrial Radiography

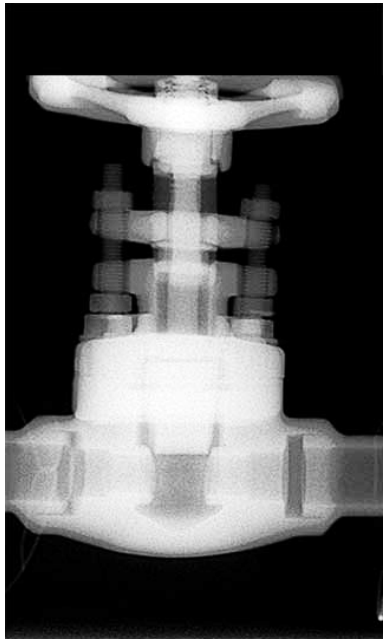
Radiographic Inspection

Radiographic Inspection (Radiography), also commonly referred to as RT or X-ray, utilizes electromagnetic radiation, in the form of x-rays or gamma rays, to volumetrically inspect materials. Industrial Radiography utilizes radiation machines (x-ray) or radioactive materials such as Iridium-192 or Cobalt-60 (gamma) to penetrate the object and expose a recording medium (film or digital plate). The resulting image can then be viewed to determine the integrity of the material and the presence of any discontinuities. The process is the same as doctors and dentists use in examining patients.









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Industrial Radiography

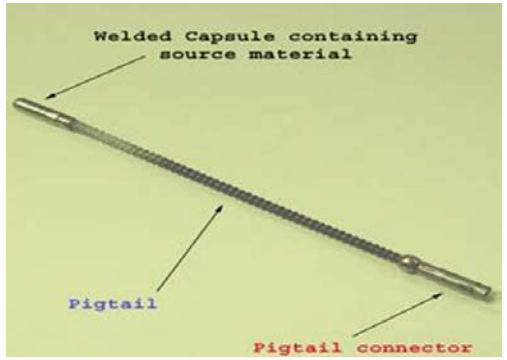
Sources of Radiation

Radiation Machines (X-Ray Tubes)

- On or off much like a light bulb
- Typical energy range: 150 kV to 8 MeV
- Emission is directional
  - Typically lower radiation dose

Radioactive Materials (Isotopes)

- Always on
- Only ways to control exposure are time, distance and shielding
- Typical activities: up to 150 curies
- Special Form Materials
  - Iridium 192 (357 kV equivalent)
  - Selenium 75 (215 kV equivalent)
  - Cobalt 60 (1.33 MeV equivalent)
-



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Industrial Radiography

In-House Radiography

Some radiography is performed in shielded enclosures or vaults to protect the individual and public from radiation exposure.

Concrete block exposure room

Lead lined enclosure

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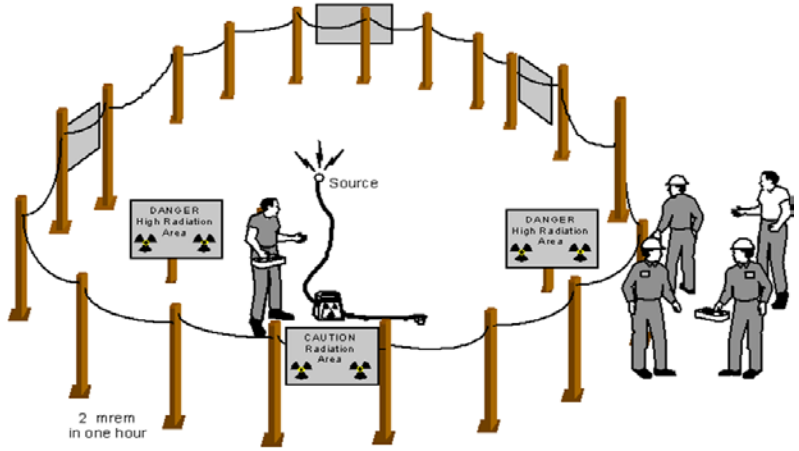
Industrial Radiography

Field Radiography

However, most often radiography is performed at field locations.



This requires transporting of the materials to the location, typically in a mobile darkroom truck.

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Industrial Radiography

Examples where industrial radiography is performed in the field include:

Oil Refineries & Chemical Plants

Offshore Platforms and Lay-barges

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Industrial Radiography

Examples where industrial radiography is performed in the field include:

Storage tanks and pressure vessels

Pipelines

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Industrial Radiography

Examples where industrial radiography is performed in the field include:

Power Plants
(including fossil, nuclear and solar)

Bridges and Buildings

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Industrial Radiography

Examples where industrial radiography is performed in the field include:

Fabrication shops,

Casting foundries,

Airport hangars,

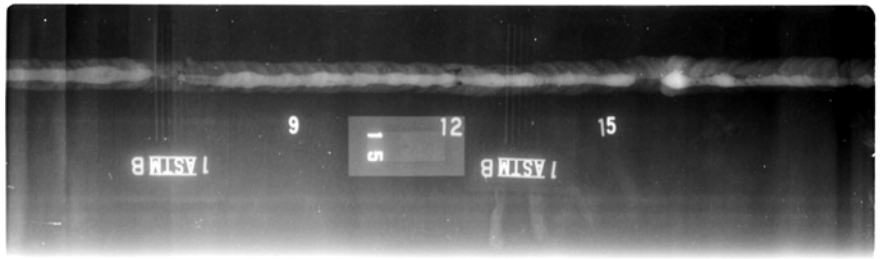
Military Bases

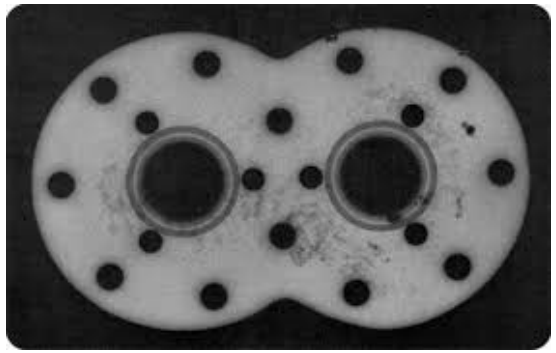
Etc.

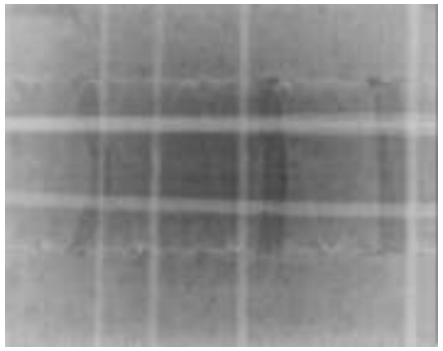
Industrial Radiography

Common Uses

Inspection of welds and castings for internal defects;

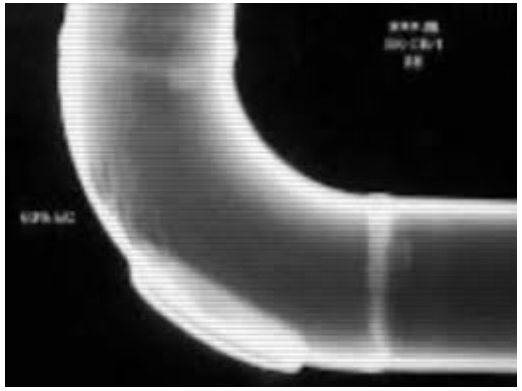






concrete for the detection of rebar, post-tension cables and electrical conduit;

piping systems to detect blockage, corrosion and pipe wall thickness.



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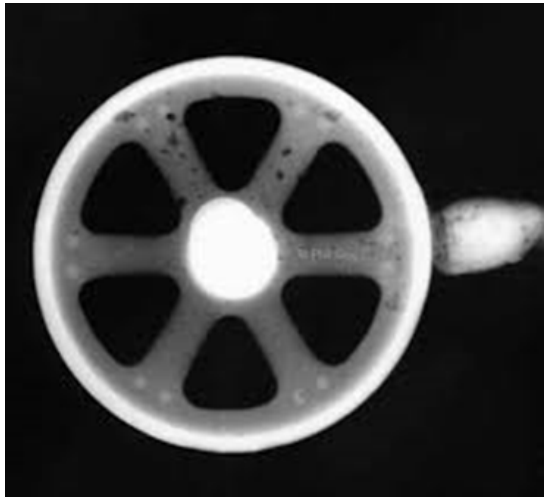
Industrial Radiography

Common Uses

Other uses include the inspection of aircraft and automobile parts for defects.



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Industrial Radiography

How are these sources regulated?

In the US, Federal and State agencies regulate the use of radioactive material and radiation machines for Industrial radiography. Companies must be specifically licensed or registered for the use and must comply with regulations established by these agencies.

Examples include: US Nuclear Regulatory Commission (NRC), Agreement State Agencies, US Department of Transportation (DOT).

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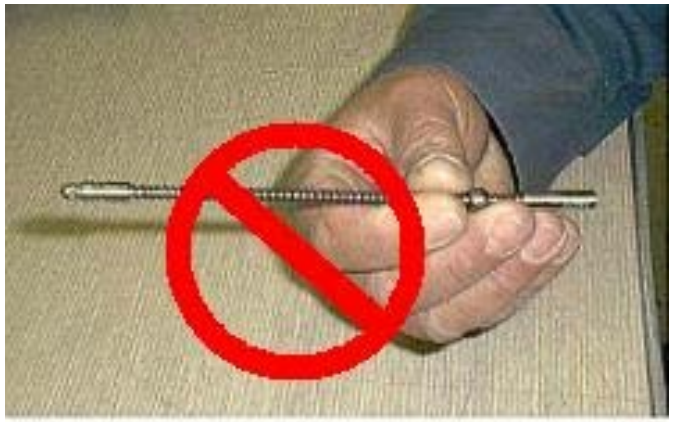
Industrial Radiography

Safety and Security Concerns

Risks involved in Industrial Radiography include:

Lost, stolen or missing material/devices

Exposure to personnel and the public



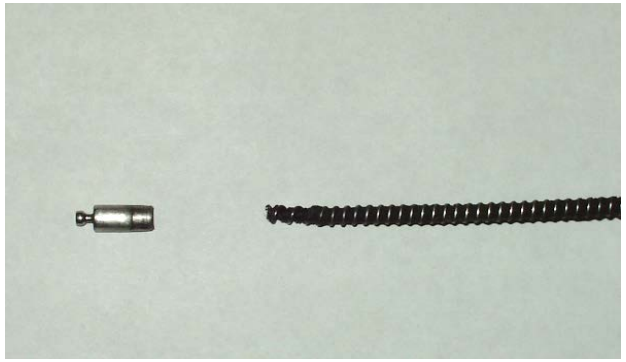
Very dangerous source from radiography camera (should never be picked up)

Industrial Radiography

Safety and Security Concerns

Risks involved in Industrial Radiography include:

Damaged Equipment / Source Disconnects



Vehicle Accidents / Fires

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Use of Sources

Past – Present - Future

Use of Sources in Industrial Radiography

Improvements over Past 10 Years

- Radiography Equipment
  - Not much has changed
  - Small changes in equipment design that have improved safety of operation
  - New Isotopes – Selenium 75 – Provides for smaller controlled areas, reduction in exposure
  - Otherwise same manual crank-out system used in 1970's
  - Pulse x-ray system developed – However has not replaced sources
- Recording Medium
  - Digital plates vs film
- Personal Monitoring
  - Advancements in instrumentation – Improved monitoring of exposure to personnel
    - New digital personal monitoring badges – Direct Ion Storage
    - Electronic Dosimeters / Alarming Ratemeters combined in single unit with improved features
- Regulations
  - New regulations for security of sources
  - Implementation of National Source Tracking System
  - Acceptance of personal monitoring advancements

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Use of Sources in Industrial Radiography

Future Improvements – Next Decade

Forecast:

- Industrial Radiography Inspection will still be widely utilized
  - Some uses there is no alternative yet developed
    - Example: Profile radiograph of valve body checking to see if valve stem fully closed
- Advanced Ultrasonic equipment and techniques will continue to develop
  - However most still unwilling to accept or understand results
- Industry-wide battle between what regulators want and what clients want
  - Changes will be needed to reduce radiation related incidents

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Use of Sources in Industrial Radiography

Challenges in Considering Alternative Technologies

- Client Acceptance
  - Basic technologies still the accepted methods – Unwillingness to adapt to new technologies - Takes time for change to be accepted
    - Example 1: Digital / Computed Radiography vs Film Radiography
    - Example 2: Use of Advanced Ultrasonic techniques in lieu of radiography
      - Many still want to “see the picture”
  - Production still viewed as priority over safety
    - Example 3: Use of Selenium-75 vs Iridium-192
    - Example 4: Some clients require sources with activities no less than 70 curies
  - Cost
    - Higher level of equipment = Higher cost
    - Higher level of technician expertise/qualifications = Higher cost
    - Clients unwilling to pay higher cost for alternative technologies when basic methods work at lower cost

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Use of Sources in Industrial Radiography

Challenges in Considering Alternative Technologies

- Cost of New Technology
  - Employers unwilling to “buy” into new technologies
    - Expense of equipment
    - Expense to train technicians
    - Clients unwilling to pay

- Availability of Qualified Technicians
  - Newer technologies may require higher level of education or advanced training than basic methods
  - Companies experiencing shortage of qualified personnel

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Use of Sources in Industrial Radiography

Possible Solutions

- Clients
  - Improve knowledge of clients concerning advanced technologies
    - Acceptance of data / Confidence in results
  - Enforce safety over production
    - Use of smaller activities, Se-75 or x-ray
    - Use of Advanced Ultrasonic Methods in lieu of Radiography

- Radiography Equipment
  - Engage Manufacturers to develop new equipment
    - Change to robotic or automated systems – Reduce/remove technician “human error”
    - Improve design to eliminate events involving source recovery efforts
      - Crush resistant guide tube
      - Improved materials in cable design

- Advanced Ultrasonic Methods
  - Needs to become the new Normal

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Thank You!

Questions?