



BAM Berlin, Main Building

Safety and Security of Sealed Radiation Sources for Industrial NDT Applications

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Non-destructive Testing means the use of non-destructive techniques to determine the integrity of a material, component or structure or quantitatively and/or qualitatively measure some characteristic of an object.

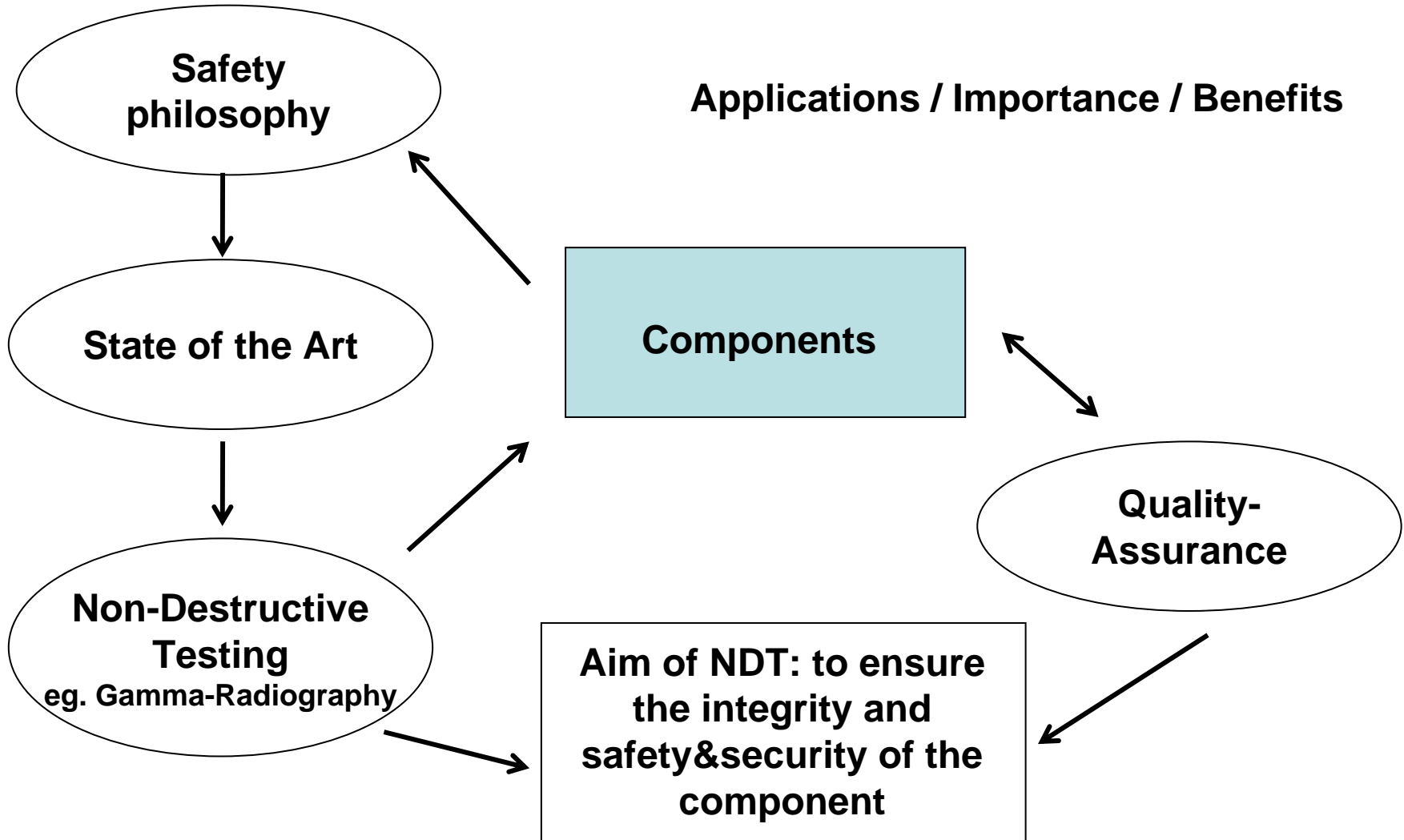
Safety means issues connected with health, the environment and being safe at work (e.g. "workplace safety")

Security means issues connected with the poise, preventing crime, terrorism etc. For example: border security means the measures taken to protect the borders.

Example:

It's safe to ride the train at night in Hamburg. My house is secure from intruders.

Applications / Importance / Benefits



NDT – Non-destructive Testing: Methods

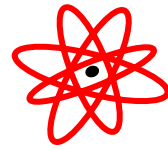
Visual Testing

Microwave

Thermography

Tap Testing

X-Ray Testing



Magnetic Particle

Acoustic Microscopy

Acoustic Emission

Magnetic Measurements

Liquid Penetrant

Ultrasonic

Replication

Flux Leakage

Laser Interferometry

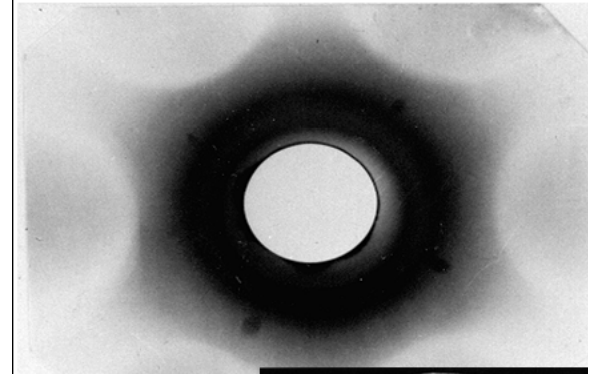
Eddy Current

NDT – Example: Rail Inspection

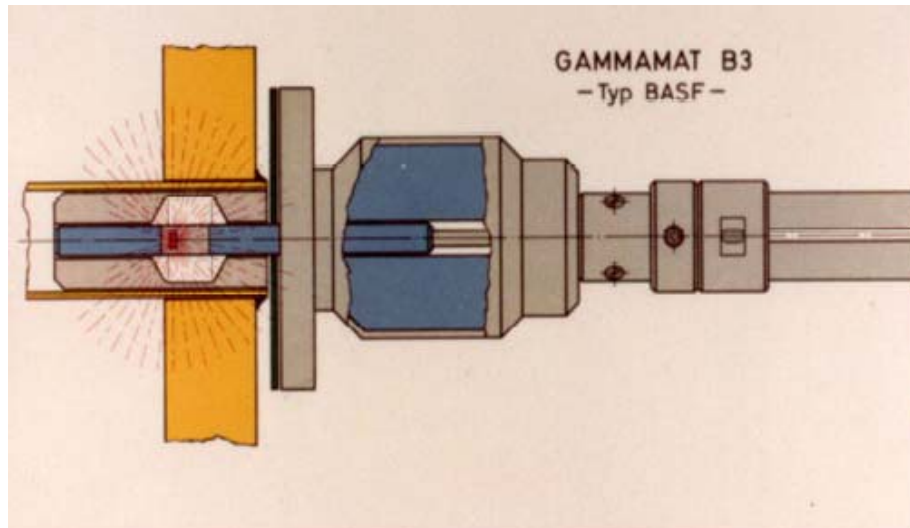
Special cars are used to inspect thousands of miles of rails to find cracks that could lead to a derailment. Rail inspection is a typical application for gamma-radiography.



NDT – Example: Power Plant Inspection



film radiography



Gammamat B3 isotope source with film holder (left side) at inspection position and set-up for inspection of a small heat exchanger in the field (right side) (Reference: Zscherpel et.al., WCNDT 2008)

NDT – Example: Pipeline Inspection

NDT is used to inspect pipelines to prevent leaks that could damage the environment. Visual inspection, radiographical techniques and electromagnetic testing are some of the NDT methods used.

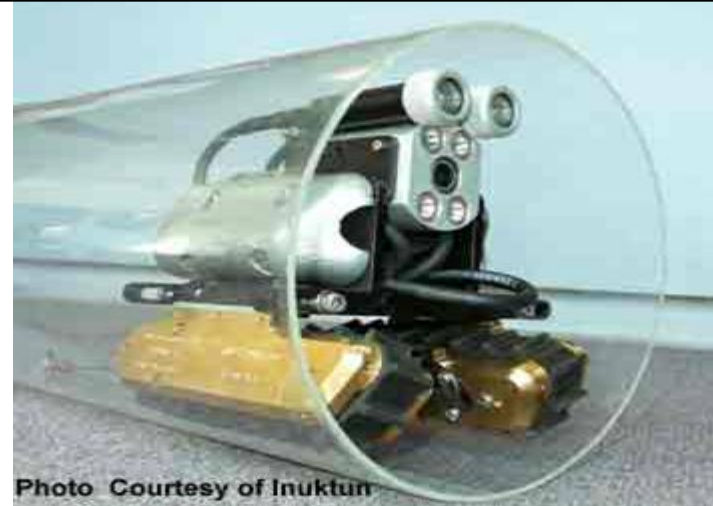
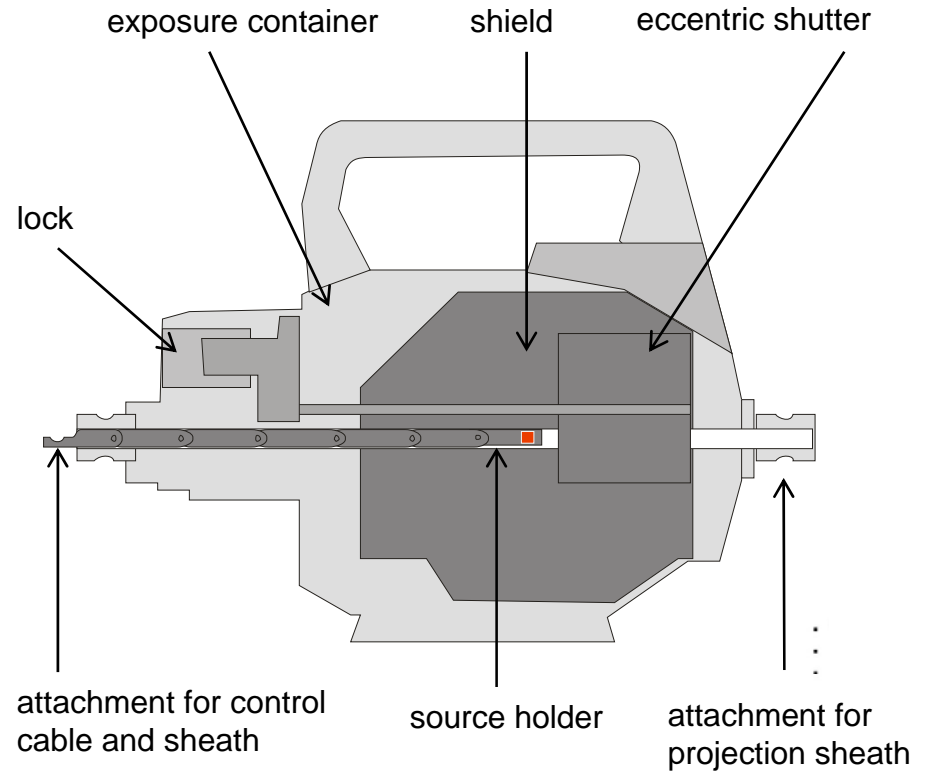


Photo Courtesy of Inuktun

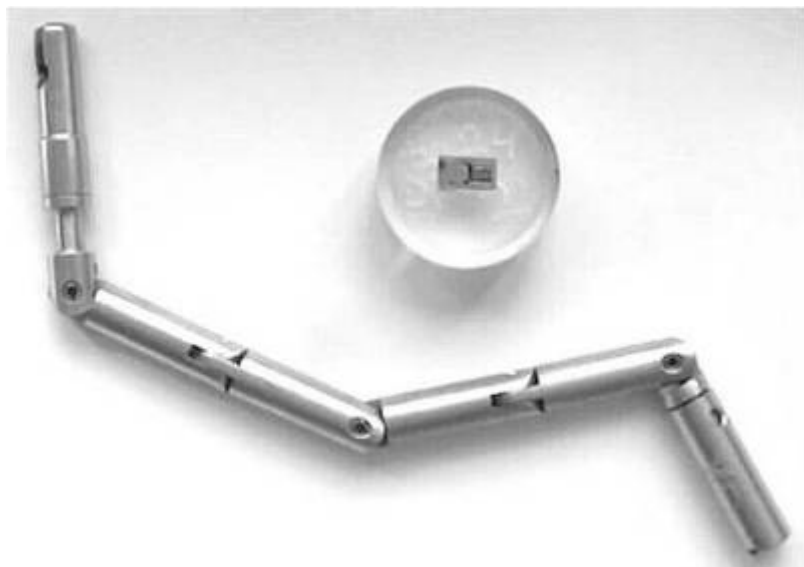


Photo Courtesy of Yxlon International

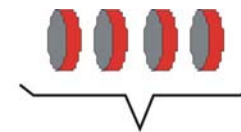
Technical description of sealed radiation sources



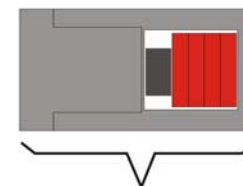
Technical description of sealed radiation sources



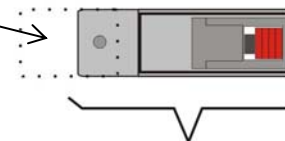
source pellets (isotope)



radioactive sealed source



source assembly



source holder



International Requirements: ICRP-IAEA-EURATOM

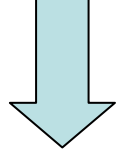
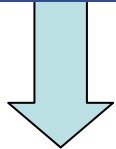
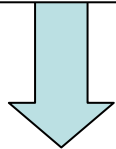
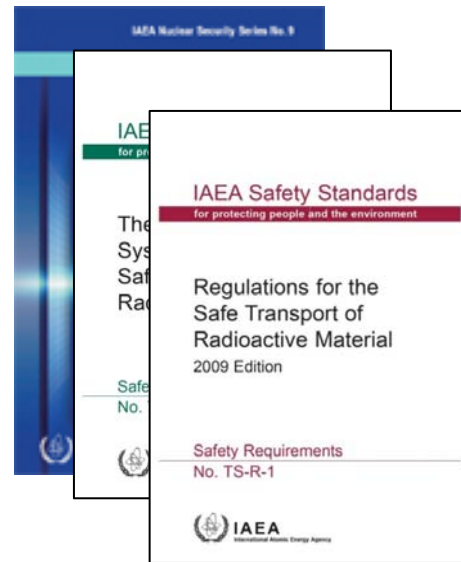
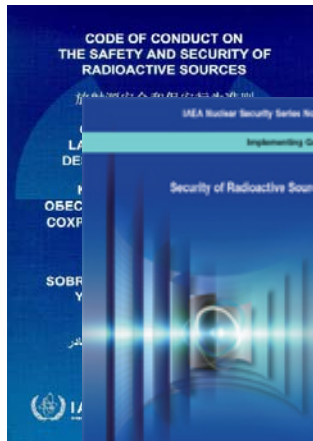
**ICRP
recommannation
No.103**

**Basic Safety
Standard**

**Radioactive
Sources**

**Radiation
Protection**

**Transport of
radioactive sources**



EURATOM
Council Directive

recommendations and standards shall be consider publishes its own directives, with a higher significance for the EURATOM-states



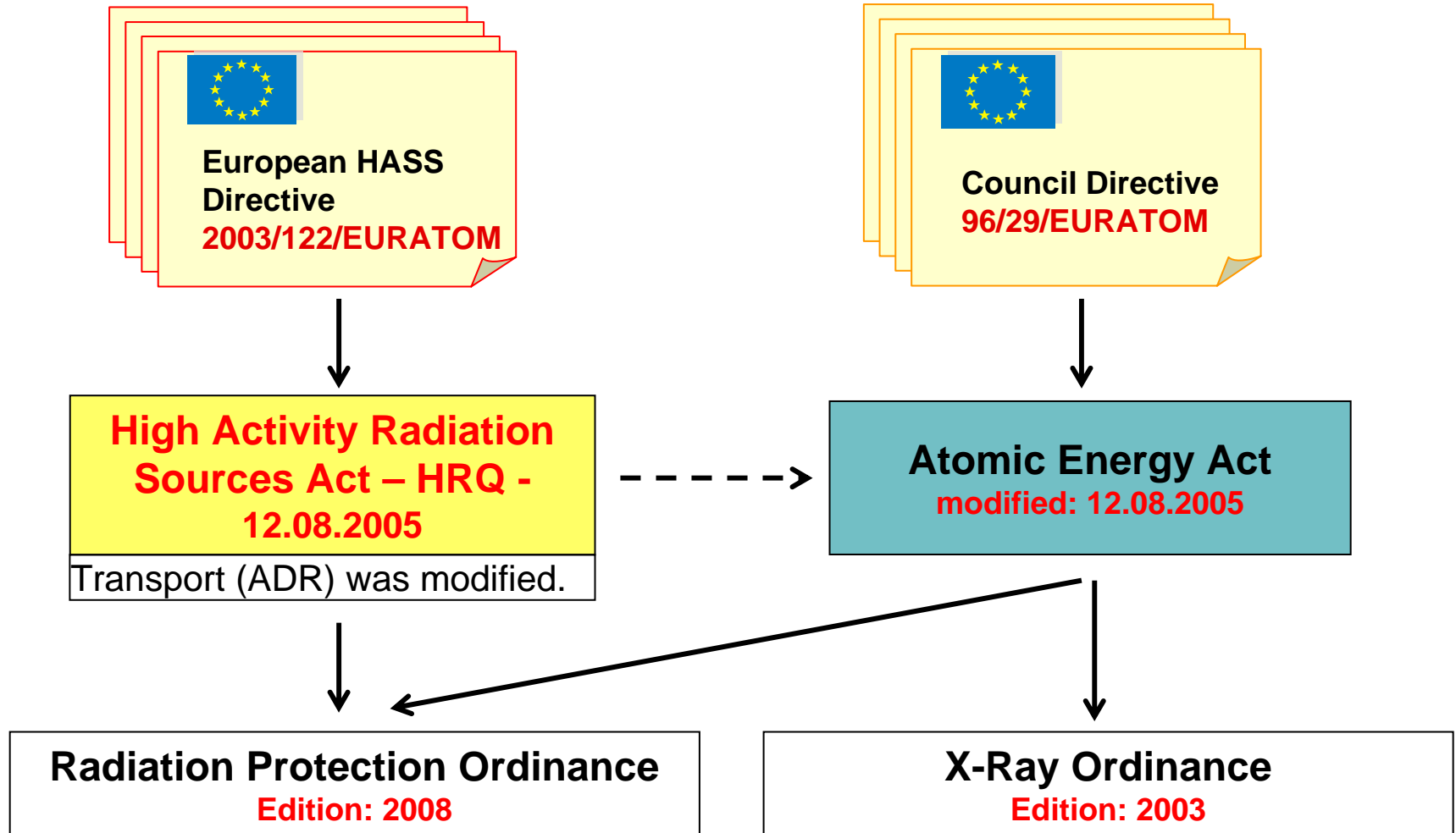
Safety and Security of Sealed Radiation Sources for Industrial NDT Applications

Redmer et.al. – 12th. EAN Workshop 2009, Vienna, 20.-23.10.2009





National Requirements



Requirements of sealed radioactive sources for NDT applications

international regulations of apparatus for industrial gamma radiography

ISO 3999

part 1 – Specifications
for performance, design
and tests

European Convention on the Transport
of Dangerous Goods by Road (ADR)
eg. certification of type B(U)- exposure container

common criterium
Dose Rate (mSv/h)

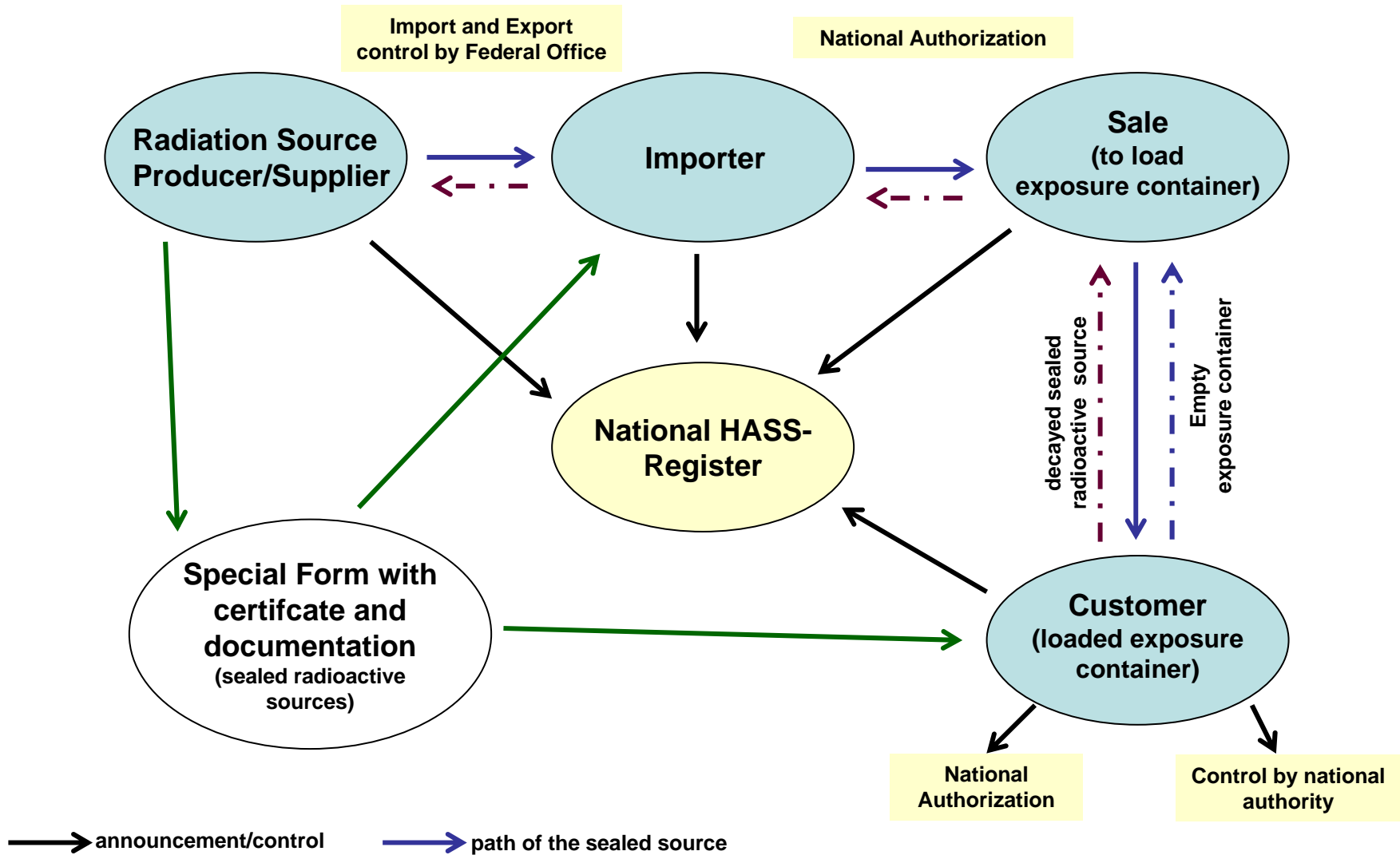
national regulations

DIN 54115

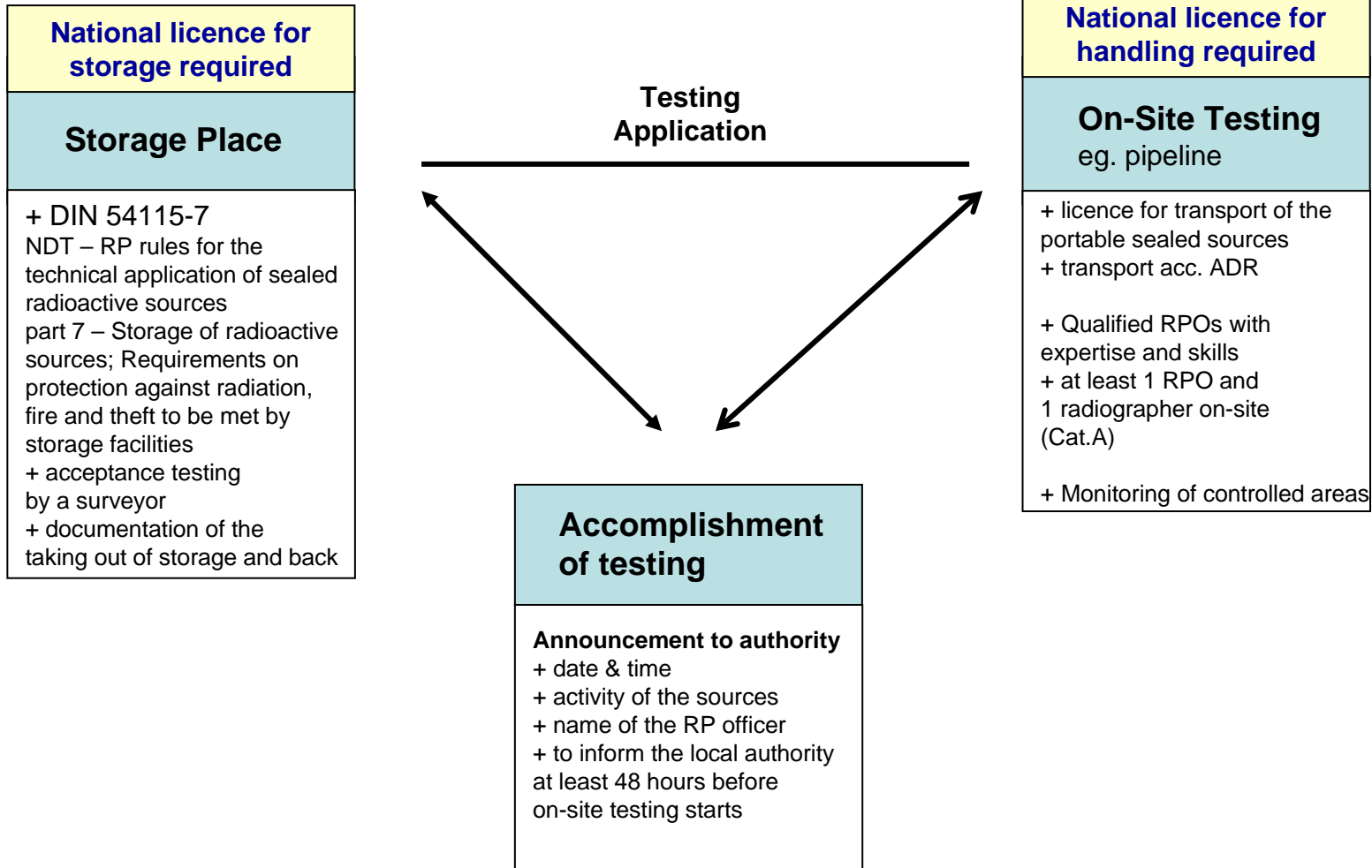
NDT –RP rules for the technical application
of sealed radioactive sources
part 4 – Construction and testing of mobile apparatus
for Gamma-radiography
(prototype testing of the construction/design)

Define all requirements for the protection against fire and theft and the safety of the equipment





Requirements for on-site testing



Storage at the user (customer)

Storage Place

- + lockable
- + secured by alarm
- + access through authorized persons

documentation: book of records



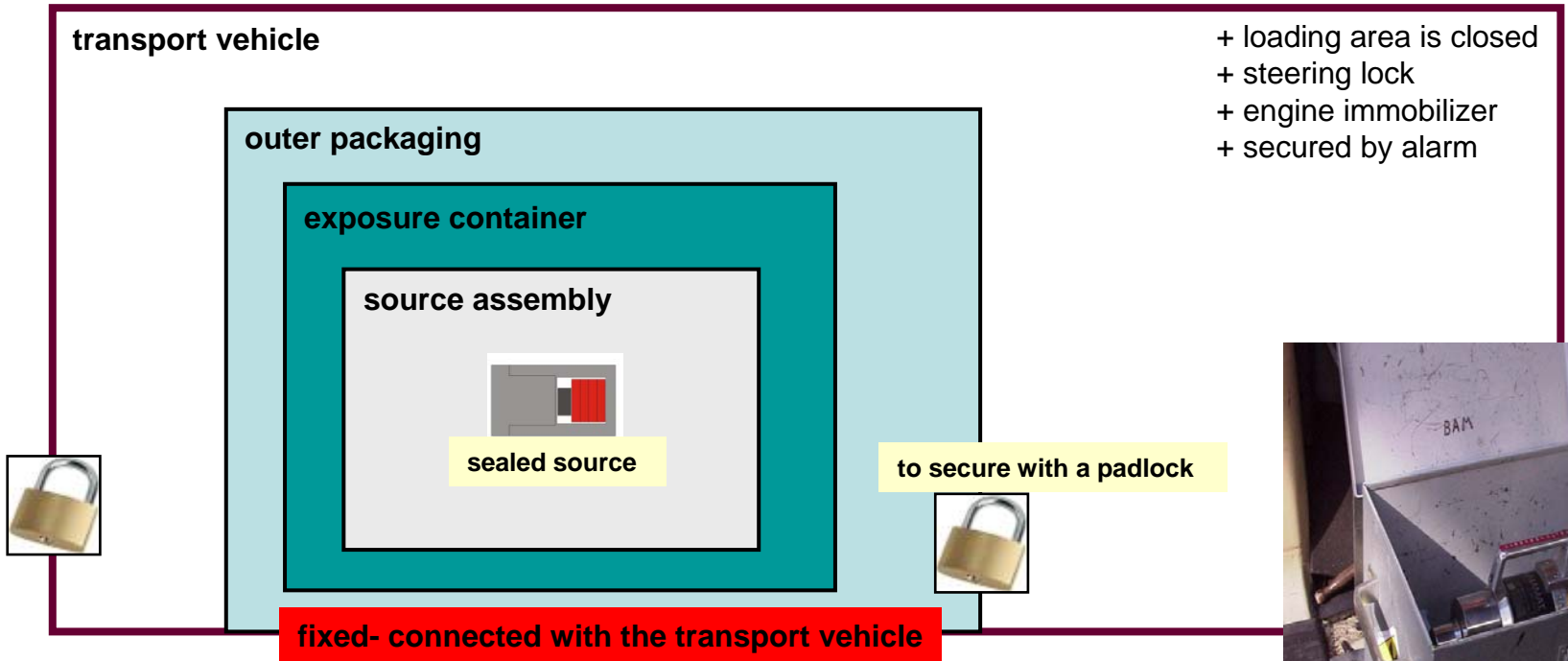
storage room



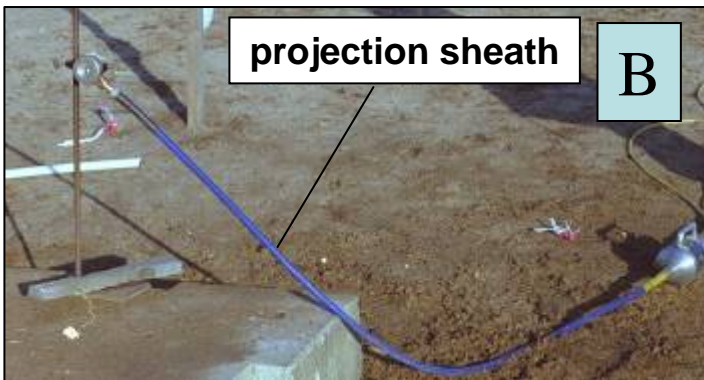
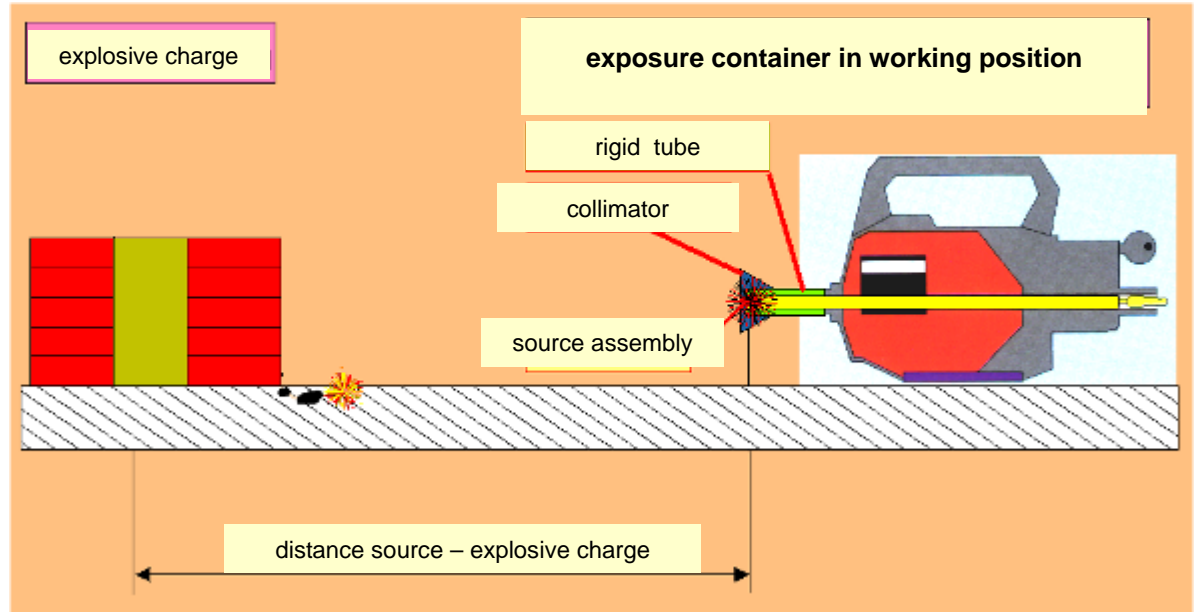
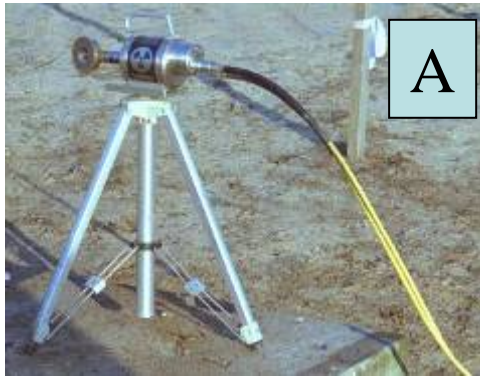
safe



Transportation to the testing place

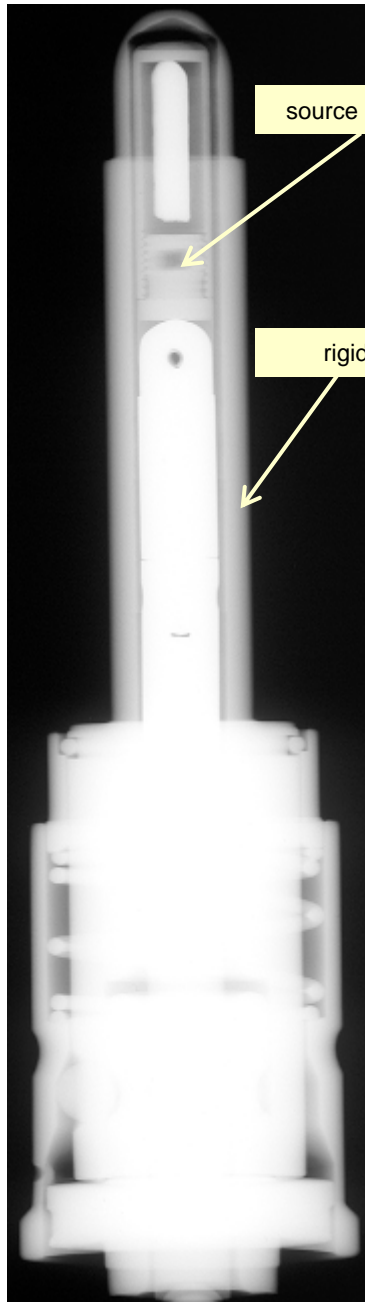


Safety of exposure container and source assembly

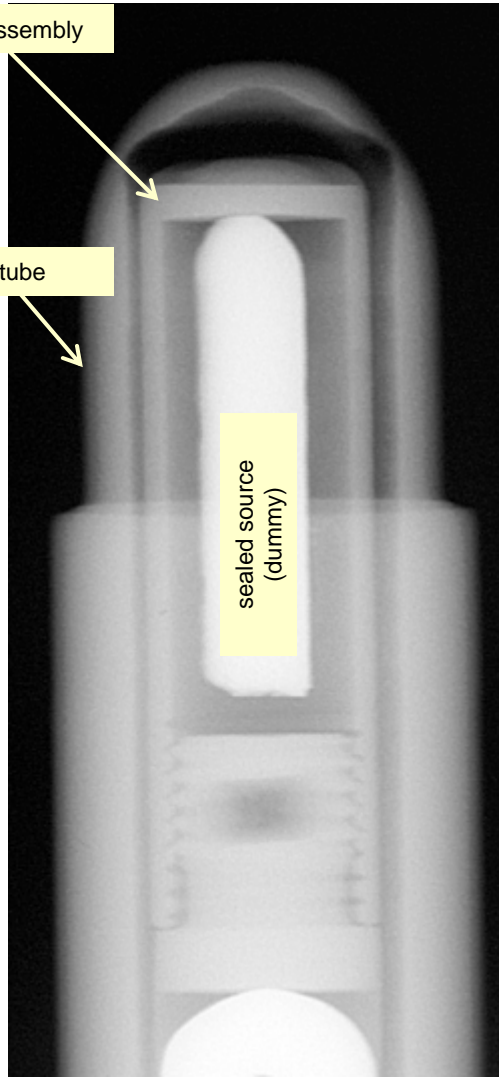


Explosion sequence

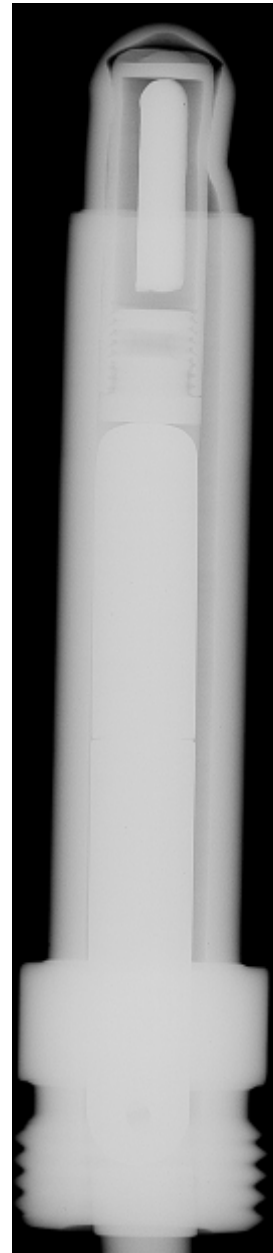




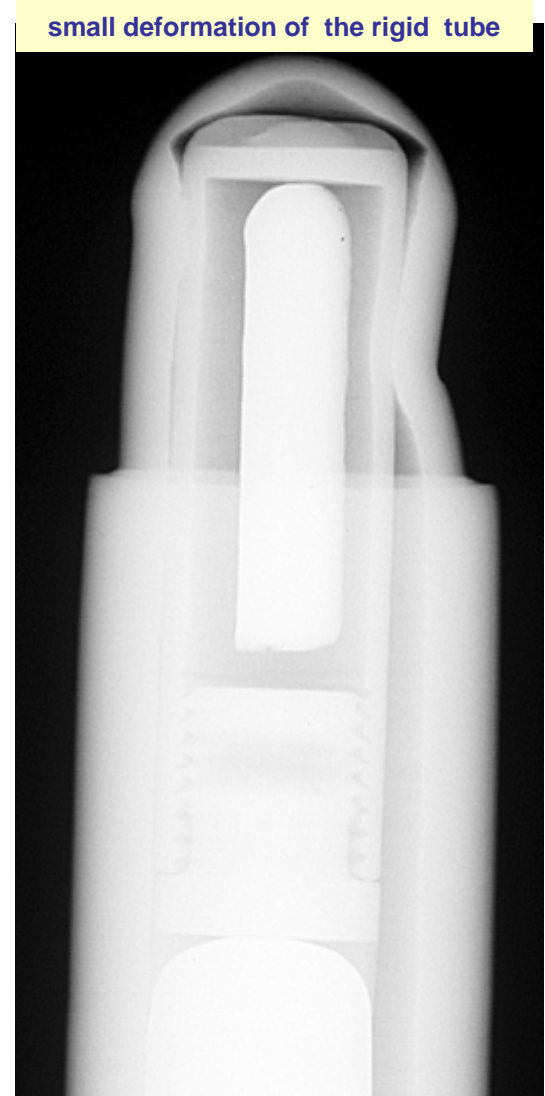
before explosion



(I)



after explosion



(II)

Summary

- + The protection of employees and the public and the safe handling of the sealed sources in the technical gamma-radiography is guaranteed through the observance of all rules (acts, ordinances, standards).
- + The access to the sealed radioactive sources by unauthorized persons can be excluded technically as well as by the supervision of the RPO.
- + Orphen or stolen sealed radioactive sources of the gamma-radiography are not registered in the national (german) registers for the registration of accidents and injuries (for the last 20 years cases for the NDT are unknown).
- + The location of a radioactive source is traceable through their registration at the register HRQ and the local regulatory authority as well as an announcement at the local relevant authority at the on-site gamma-radiography.
- + Safety is ensured by technical measures.
- + Security is guaranteed through licensing, technical rules, skills, education&training and company organization.
- + According to current knowledge the measures outlined are sufficient for the gamma-radiography; further new requirements do not lead to added value of Safety and Security.