

Calcium-45

Radiological Safety Guidance

Revision Date: 09/27/18

Physical Data

BETA ENERGIES

- 254 keV (maximum/100%)
 - 77 keV (average)
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Physical Half-Life	164 days
Biological Half-Life	49 years (Bone)
Effective Half-Life	163 days
Specific Activity	17,786 curie/gram
Maximum Beta Range in Air	52.0 cm (20.5 inches)
Maximum Beta Range in Water/Tissue	0.07 cm (0.028 inch)
Fraction of Ca-45 betas transmitted through dead layer of skin = 37%	
Maximum Range in Plexiglas or Lucite	0.06 cm (0.020 inch)

Shielding

None Required; however, $\leq 3/8$ " plexiglass could be used

Exposure: Radiological Safety Information

Exposure Prevention

- **Always** wear a lab coat and disposable gloves when handling Ca-45.

Engineering Controls

- Drying can cause airborne Ca-45 dust contamination.
- Rapid boiling can cause airborne Ca-45 contamination.
- Expelling Ca-45 solutions through syringe needles and pipette tips can generate airborne aerosols.

Regulatory Compliance Limits (10 CFR 20/Appendix B)

REGULATION	UNIT OF MEASURE	NOTE
Derived Air Concentration (DAC)	4.0E-7 uCi/mL (occupational)	
Airborne Effluent Release Limit (Annual Average)	1.0E-9 uCi/mL (all comp'ds)	Applicable to the assessment and control of dose to the public (10 CFR 20.1302). If this concentration was inhaled continuously for over one year the resulting TEDE would be 50 millirem.
Unrestricted Area Removable Contamination Limit	1,000 dpm/100 cm ²	
Container Labeling Quantity (10 CFR 20.1905)	≥ 100 uCi	

Annual Limit on Intake (ALI)

- Ingestion: 2 mCi (all compounds)
 - 1.0 ALI = 2 mCi (Ca-45 ingestion) = 5,000 mrem CEDE (Whole Body)
- Inhalation: 800 uCi (Class W)

Contamination

Radiological Data

Critical Organ	Bone
Routes of Intake	<ul style="list-style-type: none"> • Ingestion • Inhalation • Puncture • Wound • Skin Contamination (Absorption)
External exposure (deep dose) from weak Ca-45 beta particles is not a radiological concern.	Radiation dosimeters are not needed.
Internal exposure and contamination are primary radiological concerns.	Committed Dose Equivalent (CDE): (Fat Tissue) = 63 mrem/hour (puncture/bone marrow)

Skin Contamination (Ca-45)

- Skin contamination (skin dose), ingestion, inhalation, puncture, absorption through skin, and area contamination are primary radiological concerns.
- Skin Contamination Dose Rate: 2,659 mrem/hour per 1.0 uCi/cm²
- Dose Rate to Basal Cells at 7 mg/cm² or 0.007 cm depth in tissue without air reflection
- Skin Contamination Dose Rate (Skin of Extremities): 42 mrem/h per uCi/cm² (30 mg/cm² or 0.3 cm of tissue)

Detect Contamination

Survey Instrumentation

- Monitor for removable surface contamination by smearing, swiping, swabbing, or wipe testing where Ca-45 is used. Count smears or swabs using a liquid scintillation counter (LSC).
- Monitor hands, shoes, lab coat, work areas, and floors using a survey meter equipped with a thin-window G-M probe for gross Ca-45 contamination. Preferably, a G-M pancake/frisker probe with a 15.5 cm² monitoring area (~6% counting efficiency)
- Can detect Ca-45 using a survey meter equipped with a thin-window G-M pancake/frisker probe (15.5 cm² detection area); however, the survey meter probe must be at close range (≤ 1 inch).
- G-M survey meter has a low counting efficiency for Ca-45 (~6% eff).
- Liquid scintillation counter should be used to detect removable surface Ca-45 contamination on smears, swipes, swabs, etc.

Required Personal Radiation Monitoring

Dosimeters (Whole Body Badge or Finger Tabs): Not needed (Ca-45 beta particle energy is too weak to penetrate badge).