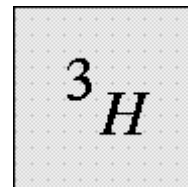


**INDIVIDUAL NUCLIDE INFORMATION**

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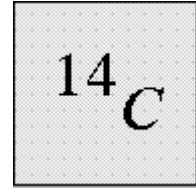
**900.10**

Tritium



Type of Radiation	Beta
Energy of Radiation	19 keV $E_{\text{max}}$
Half-Life	12.28 years (long-lived)
Shielding	Not required
Range (In Air)	Approximately 6 mm
Dosimetry	Not required
Bioassay	Required
Sewer Releases Allowed	8.0 mCi/month/authorized user group
Air Concentration Allowed	Restricted area - $1 \times 10^{-7}$ $\mu\text{Ci/ml}$ Unrestricted area - $2 \times 10^{-8}$ $\mu\text{Ci/ml}$
Recommended Contamination Survey Method	
Wipe tests:	Liquid scintillation counting
Survey meter:	Not applicable
Allowable Contamination Levels	
Wipe tests:	Restricted area - 20,000 dpm/100 $\text{cm}^2$ above background Unrestricted area - 2,200 dpm/100 $\text{cm}^2$ above background
Survey meter:	Not applicable
Activity Level Required for Labeling	1000 $\mu\text{Ci}$ or greater

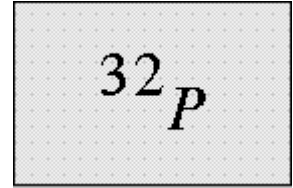
**900.20** Carbon-14



Type of Radiation	Beta
Energy of Radiation	156 keV $E_{\max}$
Half-Life	5730 years (long-lived)
Shielding	Not required
Range (In Air)	Approximately 30 cm
Dosimetry	Not required
Bioassay	Not required
Sewer Releases Allowed	1.5 mCi/month/authorized user group
Air Concentration Allowed	Restricted area - $3 \times 10^{-9}$ $\mu\text{Ci/ml}$ Unrestricted area - $6 \times 10^{-10}$ $\mu\text{Ci/ml}$
Recommended Contamination Survey Method	
Wipe tests:	Liquid scintillation counting
Survey meter:	Not applicable
Allowable Contamination Levels	
Wipe tests:	Restricted area - 20,000 dpm/100 $\text{cm}^2$ above background Unrestricted area - 2,200 dpm/100 $\text{cm}^2$ above background
Survey meter:	Not applicable
Activity Level Required for Labeling	100 $\mu\text{Ci}$ or greater

**900.30**

## Phosphorus-32

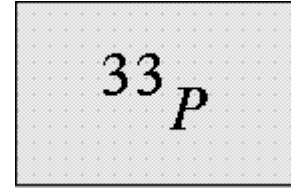


Type of Radiation	Beta
Energy of Radiation	1710 keV $E_{max}$
Half-Life	14.3 days (short-lived)
Shielding	Acrylic plastic, 3/8" thick
Range (In Air)	Approximately 610 cm
Dosimetry	Required
Bioassay	Not required
Sewer Releases Allowed	0.15 mCi/month/authorized user group
Air Concentration Allowed	Restricted area - $5 \times 10^{-10}$ $\mu$ Ci/ml Unrestricted area - $1 \times 10^{-10}$ $\mu$ Ci/ml
Recommended Contamination Survey Method	
Wipe tests:	Liquid scintillation counting
Survey meter:	Thin-window GM detector
Allowable Contamination Levels	
Wipe tests:	Restricted area - 2,000 dpm/100 cm <sup>2</sup> above background Unrestricted area - 220 dpm/100 cm <sup>2</sup> above background
Survey meter:	Restricted area - 11,000 dpm/100 cm <sup>2</sup> above background Unrestricted area - 1,100 dpm/100 cm <sup>2</sup> above background
Activity Level Required for Labeling	10 $\mu$ Ci or greater

**900.40** Phosphorus-33

Type of Radiation  
Energy of Radiation  
Half-Life

Beta  
249 keV  $E_{\max}$   
25.4 days (short-lived)



Shielding  
Range (In Air)  
Dosimetry  
Bioassay

Acrylic plastic, 1/4" thick  
Approximately 60 cm  
Required  
Not required

Sewer Releases Allowed

0.15 mCi/month/authorized user group

Air Concentration Allowed

Restricted area -  $4 \times 10^{-9}$   $\mu\text{Ci/ml}$   
Unrestricted area -  $8 \times 10^{-10}$   $\mu\text{Ci/ml}$

Recommended Contamination  
Survey Method

Wipe tests:

Liquid scintillation counting

Survey meter:

Thin-window GM detector

Allowable Contamination Levels

Wipe tests:

Restricted area - 2,000 dpm/100  $\text{cm}^2$  above background  
Unrestricted area - 220 dpm/100  $\text{cm}^2$  above background

Survey meter:

Restricted area - 11,000 dpm/100  $\text{cm}^2$  above background  
Unrestricted area - 1,100 dpm/100  $\text{cm}^2$  above background

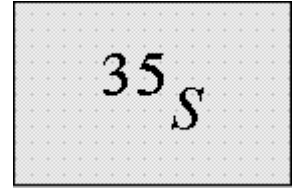
Activity Level Required for Labeling

100  $\mu\text{Ci}$  or greater

**900.50** Sulfur-35

Type of Radiation  
Energy of Radiation  
Half-Life

Beta  
167 keV  $E_{\max}$   
87.4 days (short-lived)



Shielding  
Range (In Air)  
Dosimetry  
Bioassay

Not required  
Approximately 30 cm  
Not required  
Not required

Sewer Releases Allowed

0.15 mCi/month/authorized user group

Air Concentration Allowed

Restricted area -  $3 \times 10^{-9}$   $\mu\text{Ci/ml}$   
Unrestricted area -  $6 \times 10^{-10}$   $\mu\text{Ci/ml}$

Recommended Contamination  
Survey Method

Wipe tests:

Liquid scintillation counting

Survey meter:

Not applicable

Allowable Contamination Levels

Wipe tests:

Restricted area - 20,000 dpm/100  $\text{cm}^2$  above background  
Unrestricted area - 2,200 dpm/100  $\text{cm}^2$  above background

Survey meter:

Not applicable

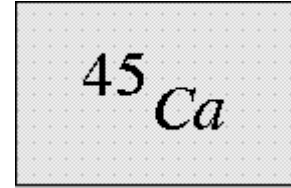
Activity Level Required for Labeling

100  $\mu\text{Ci}$  or greater

**900.60**          Calcium-45

Type of Radiation  
Energy of Radiation  
Half-Life

Beta  
257 keV  $E_{\max}$   
163 days (long-lived)



Shielding  
Range (In Air)  
Dosimetry  
Bioassay

Acrylic plastic, 1/4" thick  
Approximately 60 cm  
Required  
Not required

Sewer Releases Allowed

0.15 mCi/month/authorized user group

Air Concentration Allowed

Restricted area -  $1 \times 10^{-9}$   $\mu\text{Ci/ml}$   
Unrestricted area -  $2 \times 10^{-10}$   $\mu\text{Ci/ml}$

Recommended Contamination  
Survey Method

Wipe tests:

Liquid scintillation counting

Survey meter:

Thin-window GM detector

Allowable Contamination Levels

Wipe tests:

Restricted area - 2,000 dpm/100  $\text{cm}^2$  above background  
Unrestricted area - 220 dpm/100  $\text{cm}^2$  above background

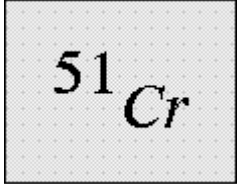
Survey meter:

Restricted area - 11,000 dpm/100  $\text{cm}^2$  above background  
Unrestricted area - 1,100 dpm/100  $\text{cm}^2$  above background

Activity Level Required for Labeling

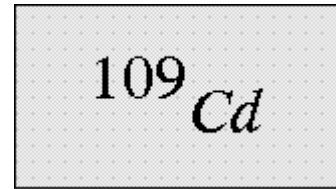
100  $\mu\text{Ci}$  or greater

**900.70** Chromium-51



Type of Radiation	Gamma
Energy of Radiation	320 keV
Half-Life	27.7 days (short-lived)
Shielding	Lead, half-value layer thickness = 1.7 mm
Range (In Air)	Significant
Dosimetry	Required
Bioassay	Not required
Sewer Releases Allowed	0.15 mCi/month/authorized user group
Air Concentration Allowed	Restricted area - $3 \times 10^{-8}$ $\mu$ Ci/ml Unrestricted area - $6 \times 10^{-9}$ $\mu$ Ci/ml
Recommended Contamination Survey Method	
Wipe tests:	Gamma counter or thin-window GM detector
Survey meter:	GM detector
Allowable Contamination Levels	
Wipe tests:	Restricted area - 20,000 dpm/100 cm <sup>2</sup> above background Unrestricted area - 2,200 dpm/100 cm <sup>2</sup> above background
Survey meter:	Restricted area - 110,000 dpm/100 cm <sup>2</sup> above background Unrestricted area - 11,000 dpm/100 cm <sup>2</sup> above background
Activity Level Required for Labeling	1000 $\mu$ Ci or greater

**900.80** Cadmium-109

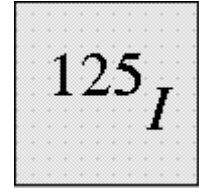


Type of Radiation	Gamma/x-ray
Energy of Radiation	22 - 88 keV (gamma)
Half-Life	464 days (long-lived)
Shielding	Lead, half-value layer thickness = 0.4 mm
Range (In Air)	Significant
Dosimetry	Required
Bioassay	Not required
Sewer Releases Allowed	0.15 mCi/month/authorized user group
Air Concentration Allowed	Restricted area - $7 \times 10^{-11}$ $\mu$ Ci/ml Unrestricted area - $1.4 \times 10^{-11}$ $\mu$ Ci/ml
Recommended Contamination Survey Method	
Wipe tests:	Gamma counter or thin-window GM detector
Survey meter:	Thin-window GM detector or thin crystal scintillation detector
Allowable Contamination Levels	
Wipe tests:	Restricted area - 2,000 dpm/100 cm <sup>2</sup> above background Unrestricted use - 220 dpm/100 cm <sup>2</sup> above background
Survey meter:	Restricted area - 11,000 dpm/100 cm <sup>2</sup> above background Unrestricted area - 1,100 dpm/100 cm <sup>2</sup> above background
Activity Level Required for Labeling	1 $\mu$ Ci or greater



900.90

Iodine-125



Type of Radiation  
Energy of Radiation  
Half-Life

Beta/Gamma  
27 - 35 keV (gamma)  
60 days (short-lived)

Shielding  
Range (In Air)  
Dosimetry  
Bioassay

Lead, half-value layer thickness = 0.04 mm  
Significant  
Required  
Required

Sewer Releases Allowed

0.08 mCi/month/authorized user group

Air Concentration Allowed

Restricted area -  $3 \times 10^{-10}$   $\mu$ Ci/ml  
Unrestricted area -  $6 \times 10^{-11}$   $\mu$ Ci/ml

Recommended Contamination  
Survey Method

Wipe tests:

Gamma counter or liquid scintillation counting

Survey meter:

Thin-window GM detector or thin crystal scintillation detector

Allowable Contamination Levels

Wipe tests:

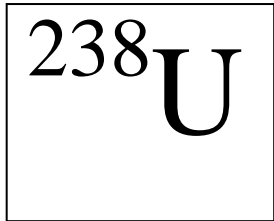
Restricted area - 2,000 dpm/100 cm<sup>2</sup> above background  
Unrestricted area - 220 dpm/100 cm<sup>2</sup> above background

Survey meter:

Restricted area - 11,000 dpm/100 cm<sup>2</sup> above background  
Unrestricted area - 1,100 dpm/100 cm<sup>2</sup> above background

Activity Level Required for Labeling

1  $\mu$ Ci or greater



900-91

# Uranium-238 (Natural or depleted)

<b>Type of Radiation</b>	Alpha
<b>Energy of Radiation</b>	4.2 MeV
<b>Half-Life</b>	4.5 Billion Year
<b>Shielding</b>	Not required for quantities less than 7 kg
<b>Range (In air)</b>	Insignificant (internal hazard only)
<b>Dosimetry</b>	Not required
<b>Bioassay</b>	Not Required
<b>Sewer Release Allowed</b>	0.15 mCi/month/authorized user
<b>Air Concentration Allowed</b>	Restricted area – $6 \times 10^{-10}$ $\mu\text{Ci/ml}$ Unrestricted area – $2 \times 10^{-12}$ $\mu\text{Ci/ml}$
<b>Specific Activity</b>	DU $5.0 \times 10^{-7}$ Ci/g NU $7.1 \times 10^{-7}$ Ci/g

## Recommended Contamination Survey Method

<b>Wipe Tests:</b>	Liquid Scintillation counting
<b>Frequency:</b>	Biannual. Monthly if more than 100 g being used/month. After sewer releases.

**Survey meter:** Thin-window GM detector

## Allowable Contamination Levels

<b>Wipe tests:</b>	Restricted area – 20,000 dpm/100 cm <sup>2</sup> above background Unrestricted area – 2,200 dpm/100 cm <sup>2</sup> above background
<b>Survey meter:</b>	Restricted area – 11,000 dpm/100 cm <sup>2</sup> above background Unrestricted area – 1,100 dpm/100 cm <sup>2</sup> above background

**Activity Level Required for Labeling** 100  $\mu\text{Ci}$  (200 g of DU or 141 g of NU)

**900.99** Other Nuclides - For nuclides not listed, contact the radiation safety officer for necessary information.