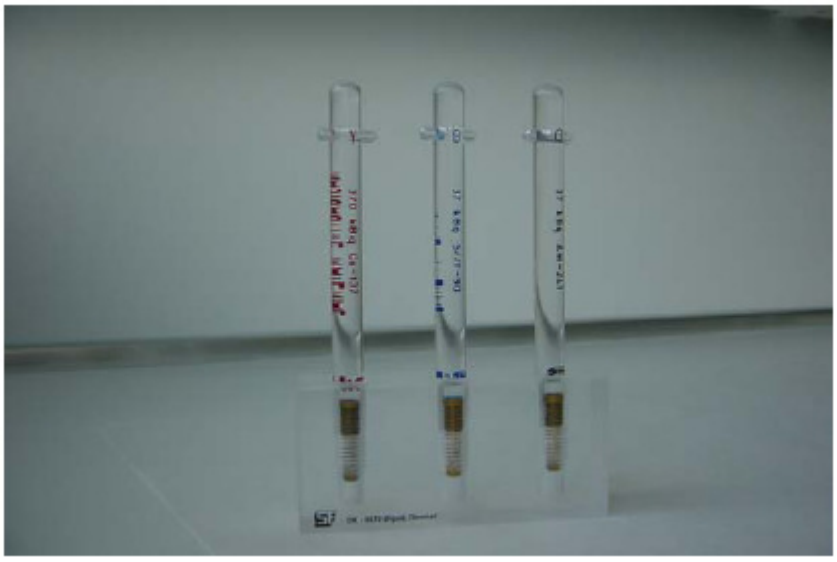
Safety Data Sheet
for
Risø Educational Sources



Risø National Laboratory

The Hevesy Laboratory

Frederiksborgvej 399
DK-4000 Roskilde

510000AE-0915

1. Introduction

This manual applies to the alpha, beta and gamma educational sources produced by Hevesy Laboratory at Risø National Laboratory. Of safety reasons and to ensure proper application of the Risø educational sources this SDS should be read before the sources are unpacked and put into service.

2. General precautions

2.1 All radioactive sources can pose a hazard if not handled, used, stored or transported properly. It is therefore important that these regulations are followed closely.

2.2 This manual should always accompany the educational sources and be accessible to all persons who use the sources.

2.3 Improper use may cause damage to the sources which may cause potentially hazardous radioactive material to be released.

2.4 The sources contain small amounts of activity, but as they emit ionizing radiation, they are all subject to the rules for handling and storage of radioactive substances.

3. When the package is received

3.1 The package should be examined immediately upon receipt. In the event that the package is severely damaged – to such an extent that there is a danger that the product is damaged – the parcel shall not be opened. The Hevesy Laboratory at Risø National Laboratory shall be informed immediately.

3.2 Check that the accompanying documentation is consistent with the content.

3.3 If the package is not opened immediately upon receipt, it should be placed in a safe place that meets the rules for storage of radioactive material.

4. Uses and safety rules

4.1 Risø alpha, beta and gamma sources are manufactured for use in teaching in schools and other educational institutions. The sources are approved for this purpose by the Danish National Board of Health.

4.2 If the sources are used as part of an apparatus, this must be constructed for this specific purpose.

4.3 The sources must not in any way be adapted or modified to fit as part of another apparatus.

4.4 When the sources are in use, nobody in the room is allowed to eat, drink, smoke or apply cosmetics.

4.5 National regulations for students' work with the radioactive sources must be observed. Exercises should always be supervised by the teacher.

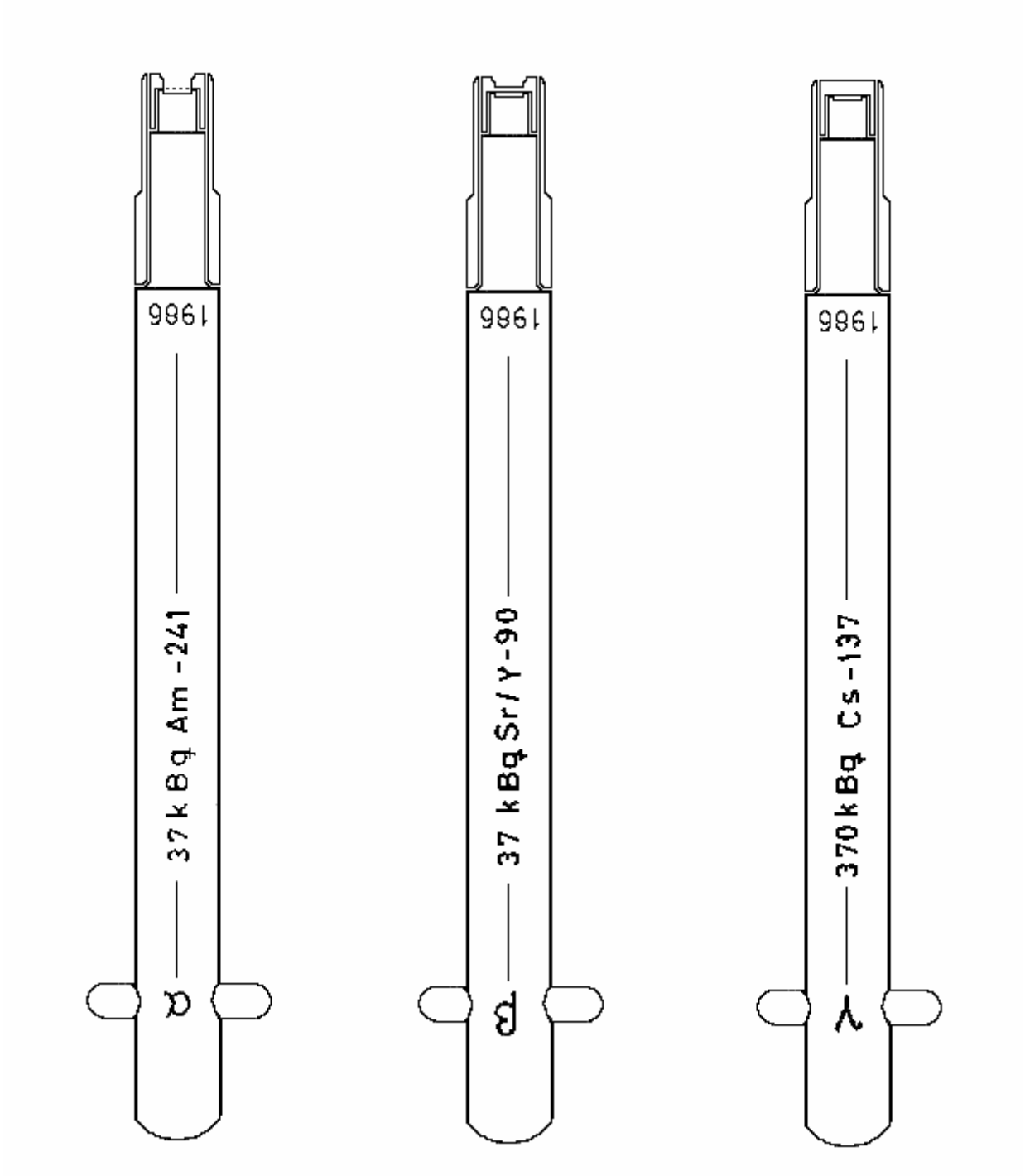
4.6 Teachers should ensure that students are handling the sources properly, and should promptly collect the sources after use.

4.7 The sources must not be exposed to heat or immersed in liquid.

4.8 When handling the sources, only the plastic handle should be touched – if possible only the end that is furthest away from the metal.

5. Design of the sources

All 3 types of sources consist of a Perspex source holder (see drawing below).
At the end of this holder the radioactive material is placed, protected by a metal cap. In the beta and gamma sources the radioactive material is encased in plastic and cannot under proper use be released into the environment. Alpha source consists of a thin film which is protected by a metal mesh that allows passage of alpha particles.



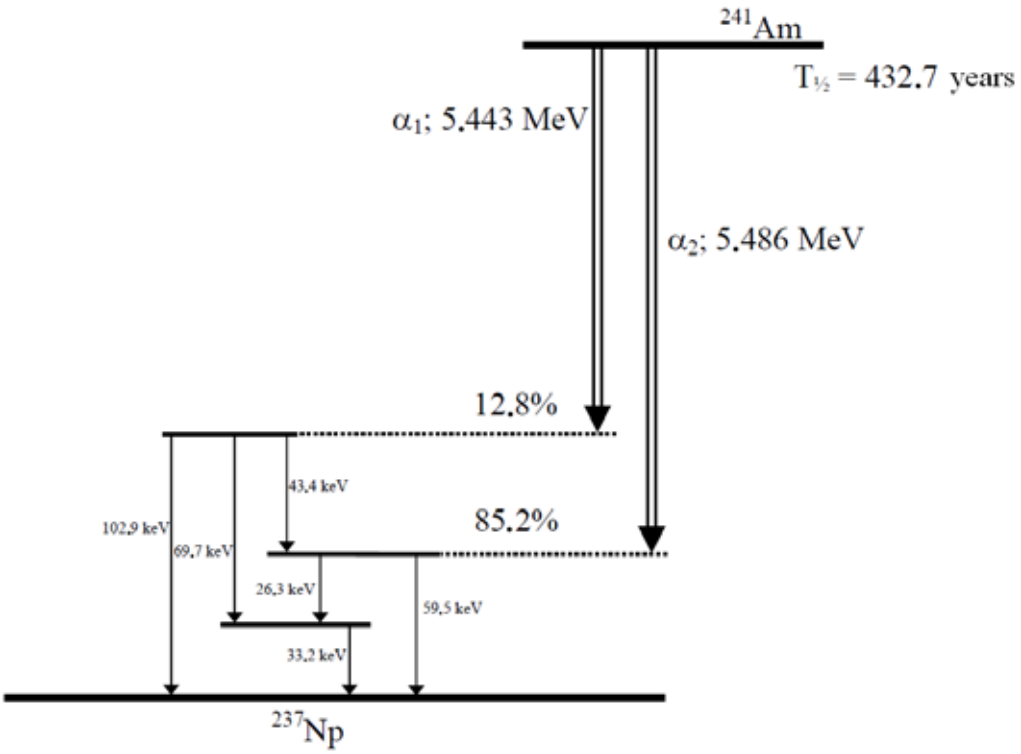
Drawing of the 3 types of sources: alpha, beta and gamma.

5.1 Alpha educational source

The alpha Source nominally contains 37 kBq of the radioactive isotope Americium-241 (^{241}Am) which decays to Neptunium-237 (^{237}Np) by emission of alpha particles. The particles are emitted with different energies, the 2 most likely is seen in the table below. In addition to the alpha radiation, a range of gamma rays are emitted.

The decay scheme for ^{241}Am can be seen below.

Radionuclide and half life	Type of decay	Particle Energy and intensity		Gamma Transitions	
		Energy (MeV)	Intensity (%)	Photon energy (KeV)	Intensity (%)
Americium-241	α	5.443	12.8	26.3	2.4
432.7 years		5.486	85.2	33.2	0.126
		Others	Low	43.4	0.073
				59.5	35.9
				69.7	0.003
				102.9	0.0195
				Others	Low



Decay scheme for ^{241}Am

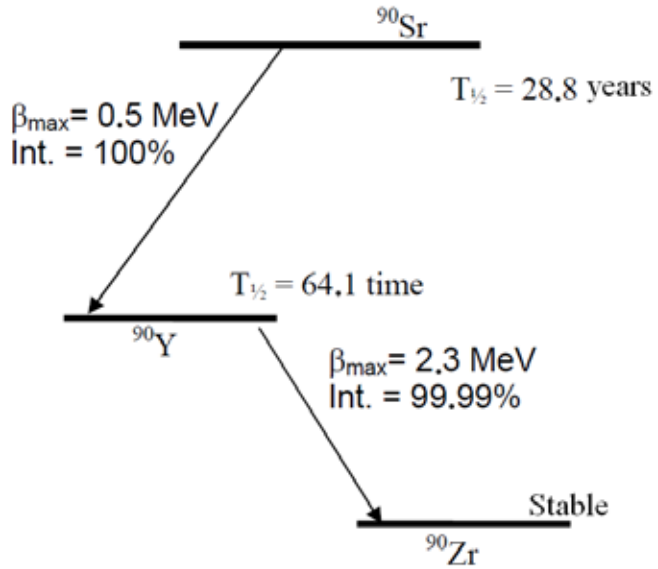
5.2 Beta educational source

The beta source contains 37 kBq of the radioactive isotope Strontium-90 (^{90}Sr) which decays to Yttrium-90 (^{90}Y) by the emission of electrons (β^- decay). The maximum β-energy is 0.5 MeV.

90Y is a radioactive isotope with a half life of 64.1 hours. This also decays via β^- decay to the stable isotope zirconium-90 (^{90}Zr). The maximum β-energy of this decay is 2.3 MeV.

The decay scheme for ^{90}Sr can be seen below.

Radionuclide and half life	**Type of decay**	**Particle Energy and intensity**	
		Maximum energy (MeV)	**Intensity (%)**
Strontium-90 28.8 years	β^-	0.5	100
Yttrium-90 (64.1 hours)	β^-	2.3	99.99



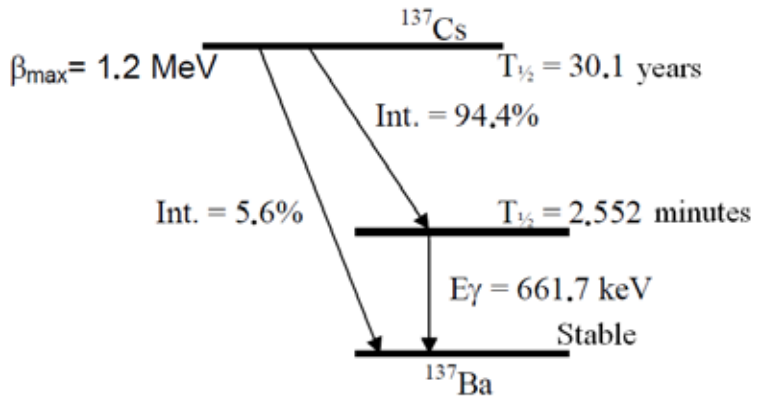
Decay Scheme for ^{90}Sr

5.3 Gamma educational source

The gamma source contains 370 kBq of the radioactive isotope Cesium-137 (^{137}Cs) which decays to Barium-137 (^{137}Ba) by the emission of electrons (β^- decay). 94.4% of the β^- decays results in an excited state with a half-life of 2.552 minutes in ^{137}Ba. By the decay of this excited state to the ground state a photon is emitted with the energy 661.7 keV.

The decay scheme for ^{137}Cs can be seen below.

Radionuclide and half life	Type of decay	Particle Energy and intensity		Gamma Transitions	
		Max. energy (MeV)	Intensity (%)	Photon energy (KeV)	Intensity (%)
Cesium-137	β^-	0.5	94.6	661.7	85.1
30.1 years		1.2	5.6		



Decay scheme for ^{137}Cs

6. Classification and tests

6.1 Before shipment the educational sources following tests:

- Test for activity
- Test for freedom from surface contamination. ISO 9978 Dry wipe test
- Test for freedom from leakage. ISO 9978 Immersion test

6.2 ISO Classification: ISO/99/C11111

7. Storage

7.1 The sources must be kept safe from fire, theft and water damage in a locked cupboard.

7.2 The dose rate at the outside of the storage cabinet should not exceed 7.5 mSv/h. This will usually be satisfied if the sources are stored in a metal cabinet. At permanent working places, the dose rate as a result of storage must not exceed 2.5 mSv/h.

7.3 Storage sites must be clearly marked with a warning sign for radioactivity.

8. Disposal

8.1 Disposal of the sources must obey national guidelines for disposal of radioactive material.

8.2 The sources must not be send by mail! Transportation of the sources must meet rules described in Section 9 below.

9. Road transport of Risø educational sources

9.1 Risø educational sources can be transported as excepted packages (Package =Packaging + Content).

9.2 The sources must be securely packaged so that the packaging keeps the contents under conditions that are common in routine transportation.

9.3 Dose rate on the outside of the package must not exceed 5µSv / h.

9.4 The package must be marked with UN number 2911. The sender and the recipient of the package must be clearly indicated.

9.5 The package shall bear on an inner surface of the marking "Radioactive" – so that by opening the package one is warned that radioactive material is to present.

9.6 The package must be followed by a transport document.

9.7 In the car there must be an approved portable fire extinguisher with at least 2 kg powder.