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1 GENERAL INFORMATION

1.1 Introduction

This Safety Analysis Report (SARP) has been prepared by Croft Associates Ltd for the new approval of the Safkeg-HS 3977A package as a Type B(U) design.

The Safkeg-HS 3977A package is a general purpose container for the transport of non-fissile nuclides, under non-exclusive and exclusive use. The contents may be in solid, liquid and gaseous form. The modes of transport specified are road, rail, sea and air. A detailed list of the nuclides can be found in Section 1.2.2. The contents of the package include some nuclides in excess of 3000 A_2 and therefore the package is classified as Category I as defined in NUREG 1609 [1.1].

The Safkeg-HS 3977A package was designed in 2008 and a prototype package fabricated and tested in 2010. Analysis of the safety of the design has also been carried out: the results of the tests and the analysis are provided in this SARP.

All design, manufacturing and testing has been carried out in accordance with the Croft Quality Assurance program which complies with 10 CFR 71 subpart H [1.2] and is approved by the NRC under Approval Number 0939. This SARP has been prepared in accordance with Regulatory Guide 7.9 [1.3] and demonstrates that the package meets all the applicable requirements in 10 CFR 71 [1.2].

1.2 Package Description [71.33]

1.2.1 Packaging

1.2.1.1 General

The general arrangement drawings of the Safkeg-HS 3977A are provided in Section 1.3.3. The drawings show the package and detail all the nominal dimensions and the major design features.

The Safkeg-HS 3977A package (generally called the package in this SARP) consists of a single resealable containment vessel with either a standard or split lid (generally called the CV in this SARP) Design No. 3978 (stainless steel with encased depleted uranium shielding), carried within insulating cork packing in an outer stainless steel keg Design No.3977 (generally called the Keg in this SARP).

Section and isometric views of the package and the CV are shown in Figures 1-1x and 1-2x respectively. These figures also give the nomenclature used throughout this report.

The maximum weight of the package excluding the contents is 154 kg (339 lbs). The maximum contents weight is 9.29 kg (21 lbs), therefore the maximum gross weight of the package is 163 kg (360 lbs).

1.2.1.2 3977 Keg

The keg Design No.3977 has a stainless steel outer shell and a stainless steel liner between which insulating cork is fitted. The keg is sealed as it has an O-ring weather seal in its closure, however, there is a fuse plug fitted at the bottom of the keg. This fuse plug contains a low melting point alloy which will vent during the HAC fire test providing pressure relief.

The keg is closed by a flat stainless steel lid which is bolted down with 8 stainless steel studs and nuts against a single O-ring which provides a weather seal to keep rain from entering the keg. The studs are fitted with seal holes for the fitting of a tamper indicating device in accordance with 10 CFR 71.43(b). The lid may also be further secured, to prevent unauthorized removal, by a padlock attached to a lock pin welded to the keg closure flange.

Due to the relatively low weight and size of the package, there are no specific design features to allow for the tie down and handling of the package.

An inner cork liner is fitted between the keg liner and the CV. The inner cork liner consists of a body and a top cork. There is no cork directly underneath the CV as it sits on the keg liner. The top cork varies in thickness between 48 mm and 84.5 mm; the variation in thickness is to accommodate the design of the CV lid. The side wall thickness of the inner cork varies from 18 mm at the top of the CV to 28 mm of cork at the bottom of the

CV. The surface of the cork is sealed with a water-based sealant to enhance its appearance and reduce the potential to produce dust.

1.2.1.3 3978 CV

The CV is composed of a body and a lid (see Figures 1-2a and 1-2b).

The CV body is fabricated from three pieces of stainless steel: the CV flange/cavity wall, the CV outer wall and the CV base. The CV flange/cavity wall and the CV base are machined from solid. The CV flange/cavity wall is welded to the CV outer wall to form the cavity into which the body DU shielding is fitted. The base is then welded to the outer wall. Drawings 1C-5946 and 1C-7506 in Section 1.3.3 show the general arrangement of the CV body.

The CV lid may be either standard or split. The standard CV lid is fabricated from two pieces of stainless steel, the CV lid top and the CV lid shielding casing. Both pieces are machined from solid. The CV lid shielding casing has 45.8 mm depth of depleted uranium placed inside; the CV lid shielding casing is then welded to the CV lid top. Drawing 1C-5945 in Section 1.3.3 shows the general arrangement of the standard CV lid.

The split CV lid (see Drawings 1C-7505 and 1C-7945 in Section 1.3.3) is similar to the standard CV lid with the stainless steel being machined from solid and with 45.9 mm thick depleted uranium clad in stainless steel, however, it varies in design from the standard CV lid in the following points:

- The CV lid top is not welded to the CV lid shielding. The CV lid shielding sits within the containment vessel body in the same position as the standard CV lid.
- The CV lid shielding plug casing extends to form a stainless steel plug in the CV body cavity. This plug ensures the correct location of the insert during transport.
- Two threaded holes are machined into the CV lid shielding plug. These holes allow the insert to be attached to the CV lid shielding plug and, once the CV lid top has been removed, a lifting attachment can be fitted to the top of the CV shielding lid plug to enable it and the insert to be lifted out.

For both standard or split lid designs of the CV, the lid is held in position by eight recessed alloy steel screws. The seal between the CV body and the CV lid is effected by two Fluoroelastomer (base material Viton GLT) O-ring seals of 3 mm cord diameter. Access to the interspace between the two O-rings is provided for operational and maintenance leak testing. Leak testing is required for the CV to ensure that it meets the regulatory release limits specified in 10 CFR 71.51.

The CV has a cavity of overall length of 157.1 mm and a diameter of 65.8 mm with the standard CV lid and an overall length of 132 mm and a diameter of 65.8 mm with the split CV lid. The vessel operates at atmospheric pressure, although the internal pressure may

vary due to heating of the gases within the CV by decay heat of the contents, gas generation and atmospheric temperature and pressure changes.

1.2.1.4 Containment Boundary

Figures 1-3a and 1-3b show the containment boundary of the Safkeg-HS 3977A package for the two versions of the CV lid. As shown, the containment boundary consists of the CV flange/cavity wall, the CV lid top and the inner O-ring containment seal of CV. The containment seal is tested on manufacture, during periodic maintenance and in operation, to ensure it remains within regulatory limits regarding leak rate under both NCT and HAC. Section 4 discusses the containment boundary in further detail.

1.2.1.5 Gamma Shielding

Figures 1-4a, 1-4b and 1-4c show the gamma shielding present in the Safkeg-HS 3977A package. Gamma shielding is provided principally by the depleted uranium present in the CV body and lid; the steel of the CV provides some additional shielding. The depleted uranium is machined from solid and placed within the CV body with the base being welded into position. The CV is designed so that the shielding in the lid and body are stepped to reduce radiation streaming. The upstanding ring on the lid also provides some additional steel shielding to reduce the radiation streaming from the gap between the CV Lid and CV Body.

The contents of the package are defined as being everything that is carried within the CV cavity. Additional shielding is provided by inserts as specified in Section 1.2.2 where these are required. These inserts provide different amounts of shielding and also provide confinement of the solid or liquid radioactive contents under NCT and HAC.

1.2.1.6 Energy Absorbing Features

The outer cork, top cork and inner cork provide insulation and energy absorption - thus providing protection to the CV during NCT and HAC (see Figures 1-1a and 1-1b).

The outer cork is located between the keg liner and the keg outer shell. The outer cork is protected by the keg liner and not intended to be replaced. The inner cork and top cork are readily removable and intended to be replaced if required at pre-shipment or annual maintenance if required.

1.2.1.7 Heat Transfer Features

The contents of the Safkeg-HS 3977A package are limited to have a maximum heat output of 30 W for solid or gaseous contents and 5W for liquid contents. With such a small heat source, no specific heat transfer design features are required.

Thermal protection of the contents from external heat sources such as insolation or fire is provided by the outer cork, top cork and inner cork. During HAC, the keg is designed to vent by melting of the low melting point alloy in the fuse plug, thus preventing any pressure build up within the keg cavity due to gasses arising from pyrolysis of the cork.

1.2.1.8 Labelling

The keg is fitted with a name plate to comply with the requirement in 10 CFR 71.85 [1.2] and 49 CFR 172.310 [1.4].

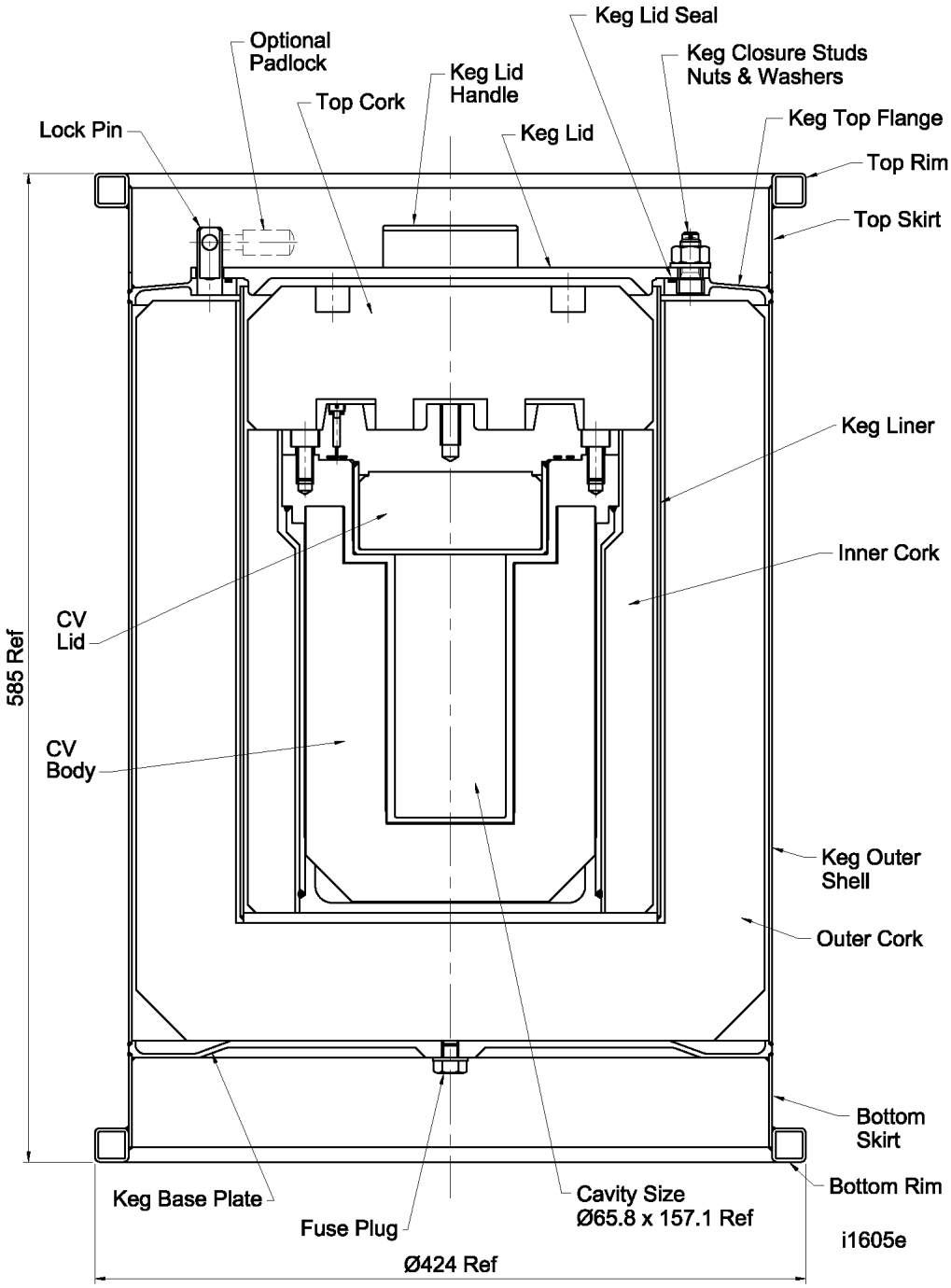


Figure 1-1a Safkeg-HS 3977A package with Standard Containment Vessel Lid– Section View and Nomenclature

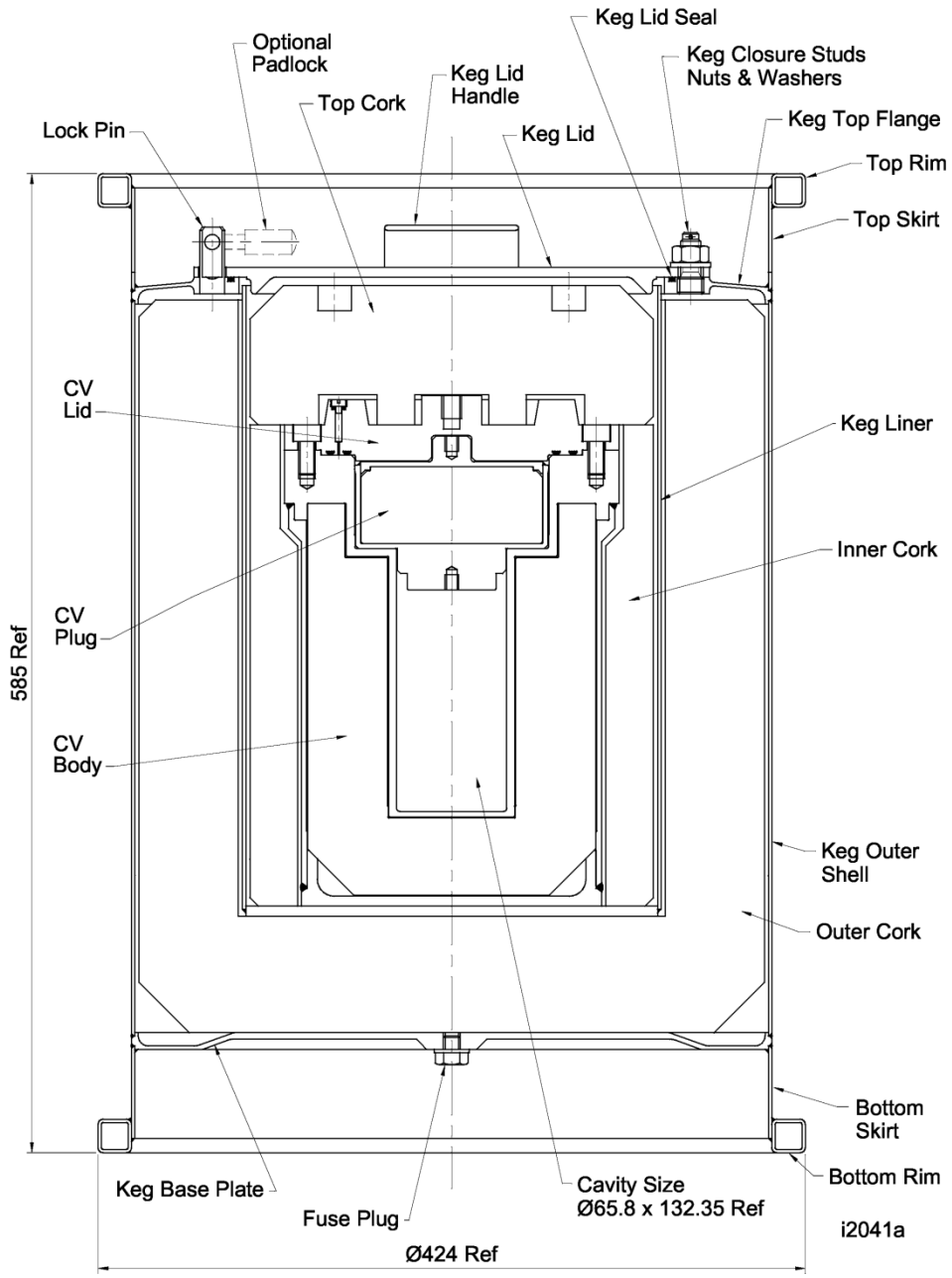
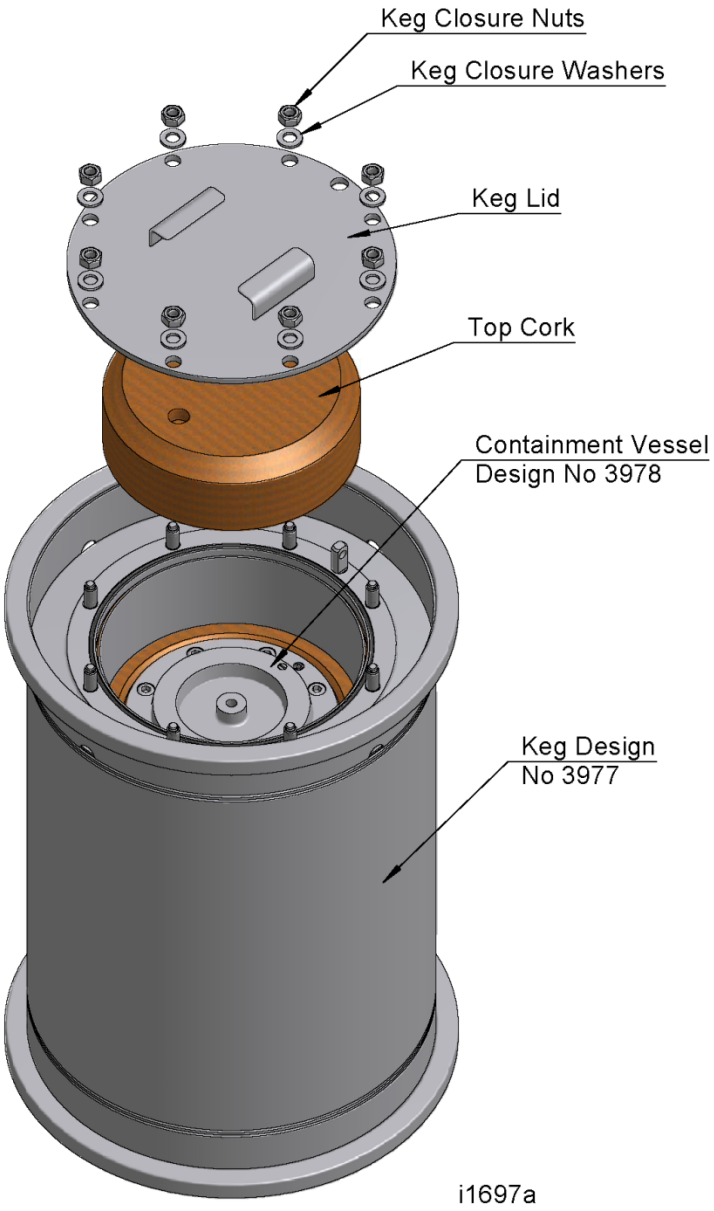


Figure 1-1b Safkeg-HS 3977A package with Split Containment Vessel Lid– Section View and Nomenclature



Safkeg HS Design No 3977A

Figure 1-1c Safkeg-HS 3977A package – Isometric view

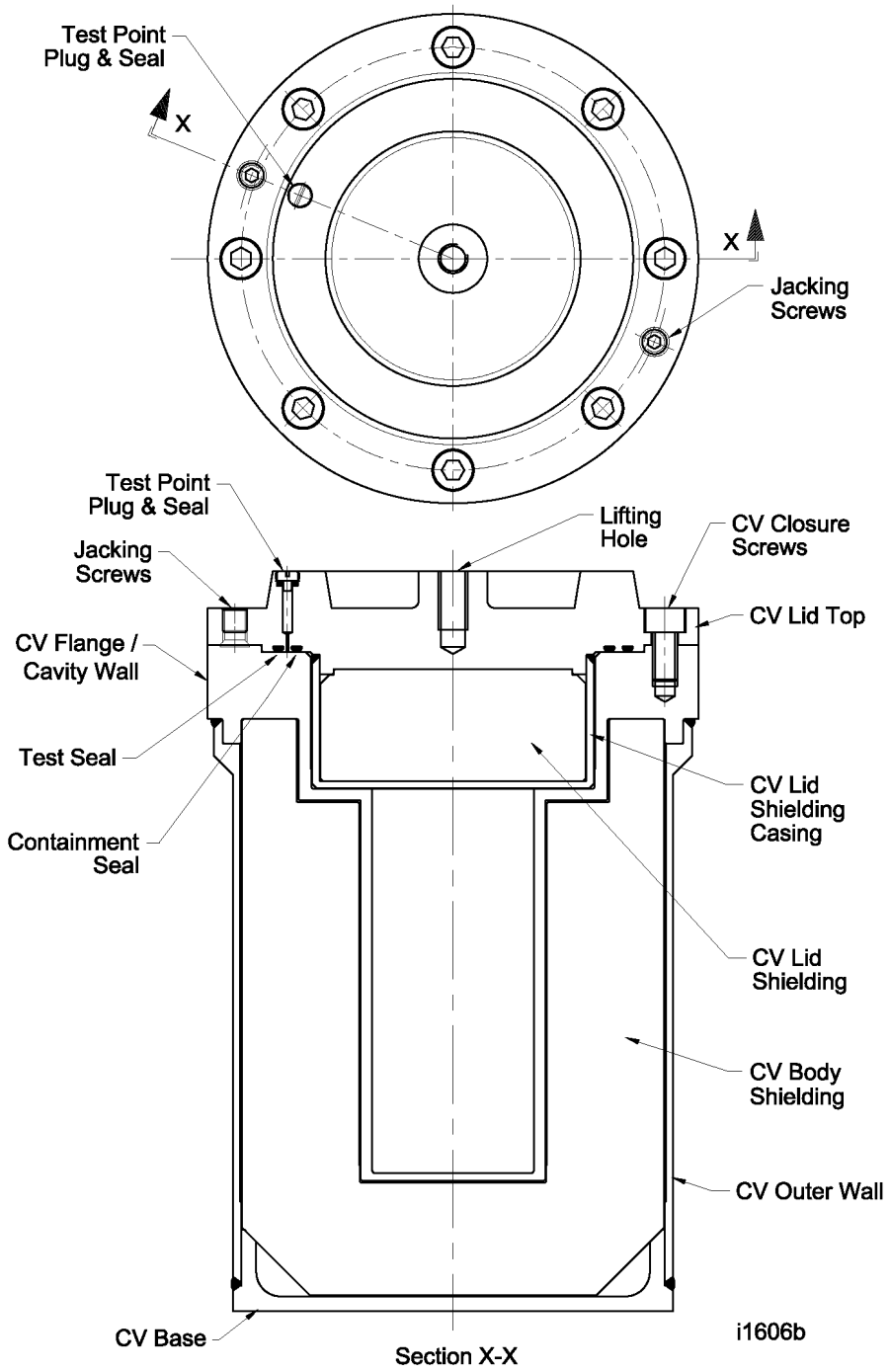


Figure 1-2a 3978 Standard CV Lid – Top and Section View and Nomenclature

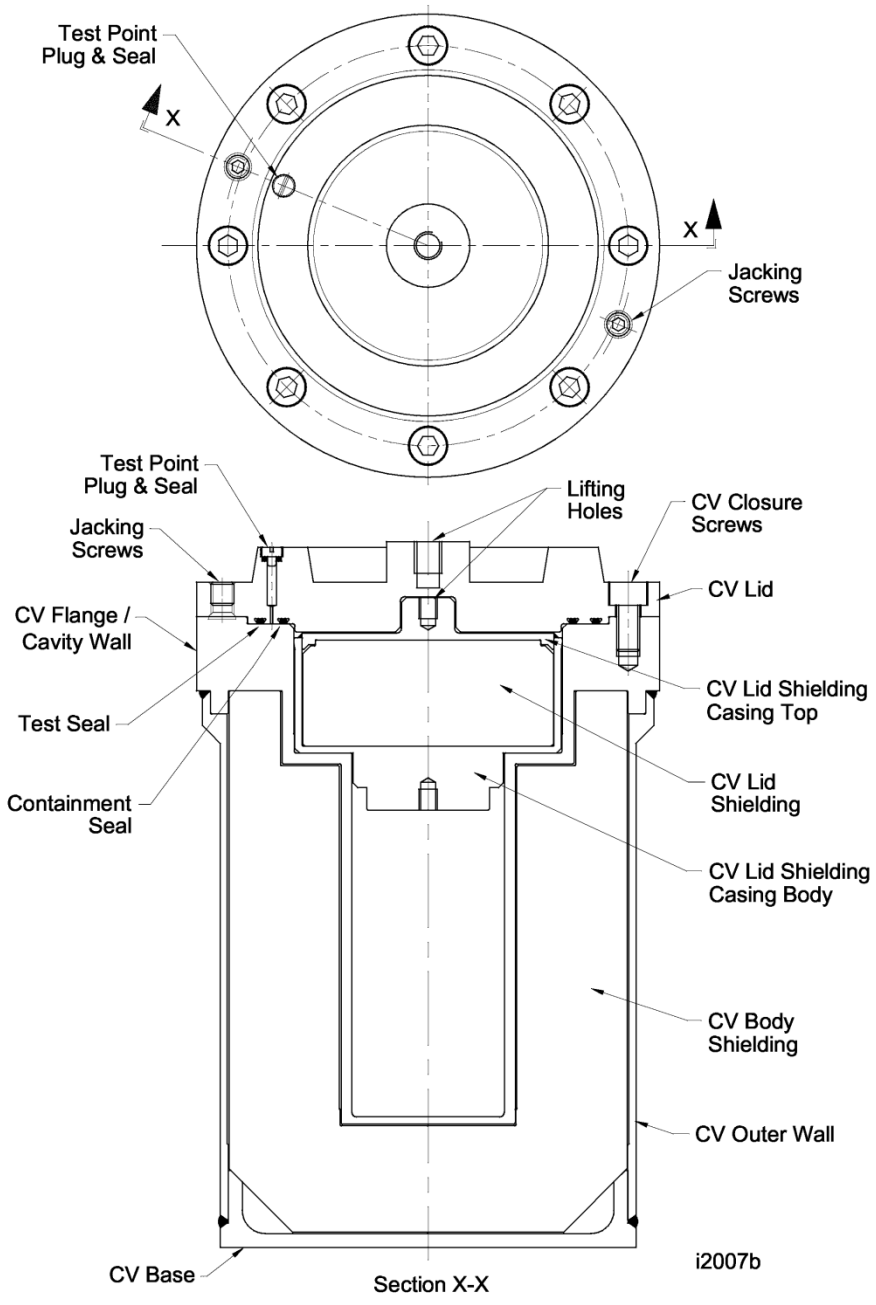
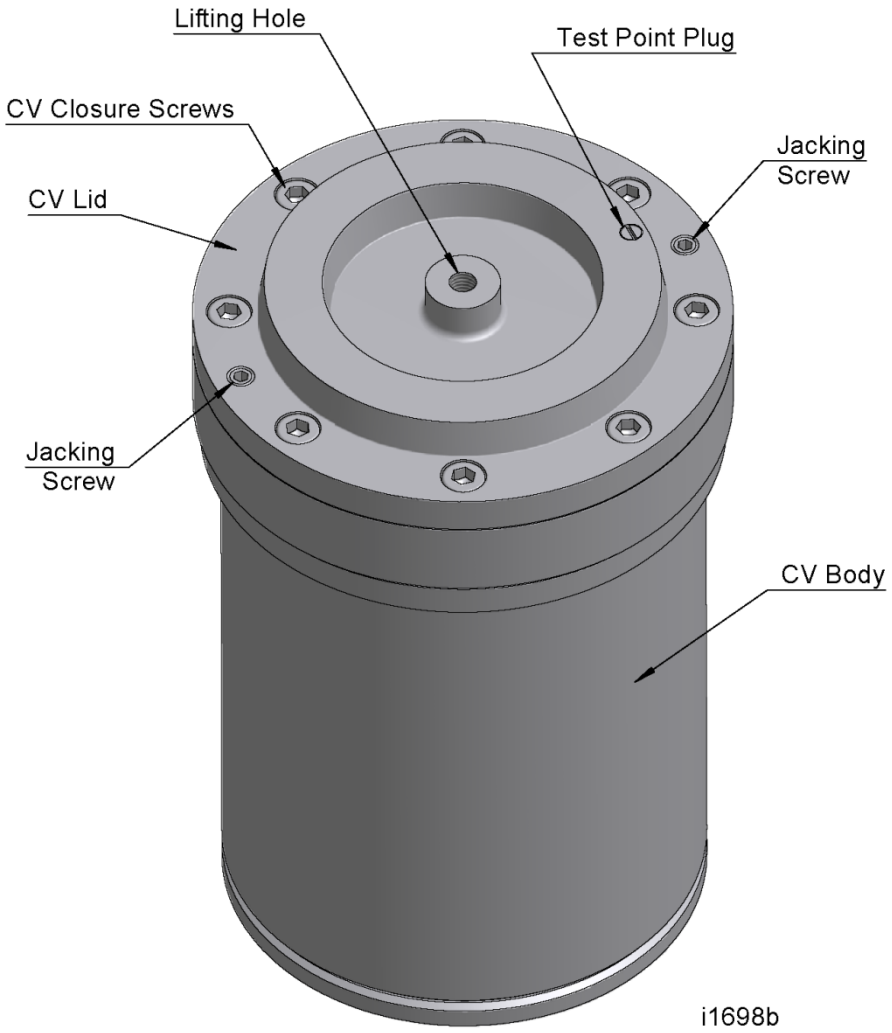


Figure 1-2b 3978 Split CV Lid– Top and Section View and Nomenclature



Containment Vessel Design No 3978

Figure 1-2c 3978 CV – Isometric View

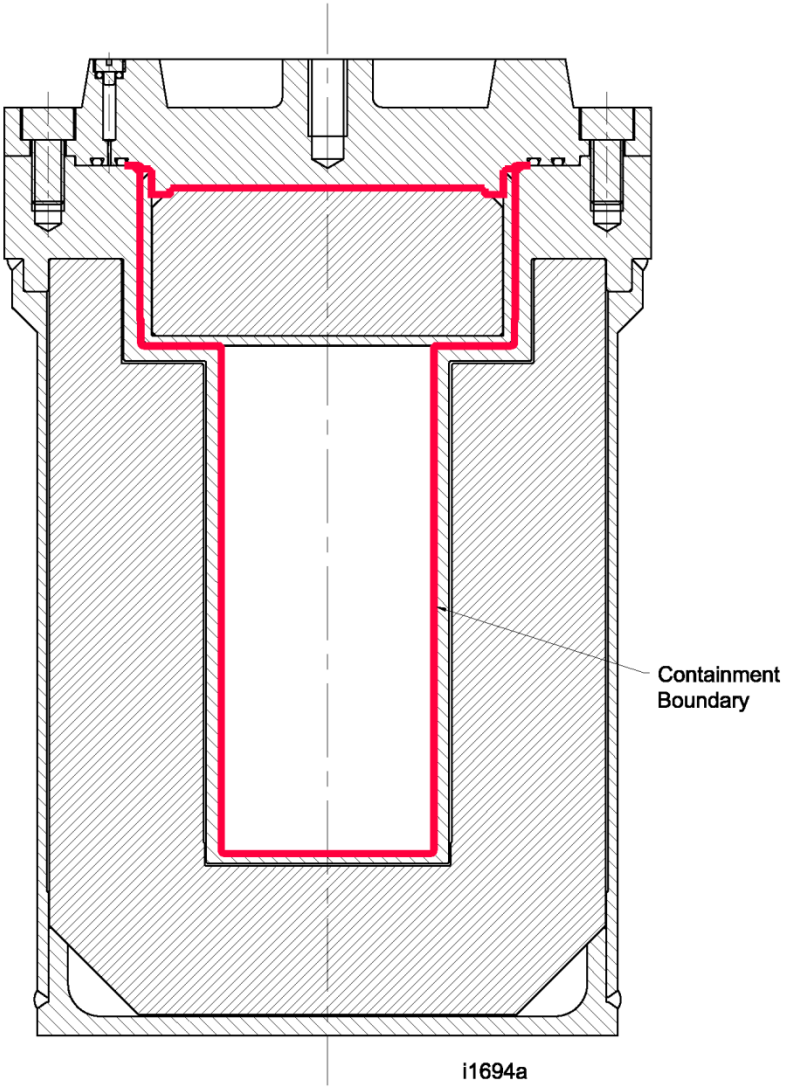


Figure 1-3a Containment boundary of the Safkeg-HS 3977A package with a Standard CV Lid

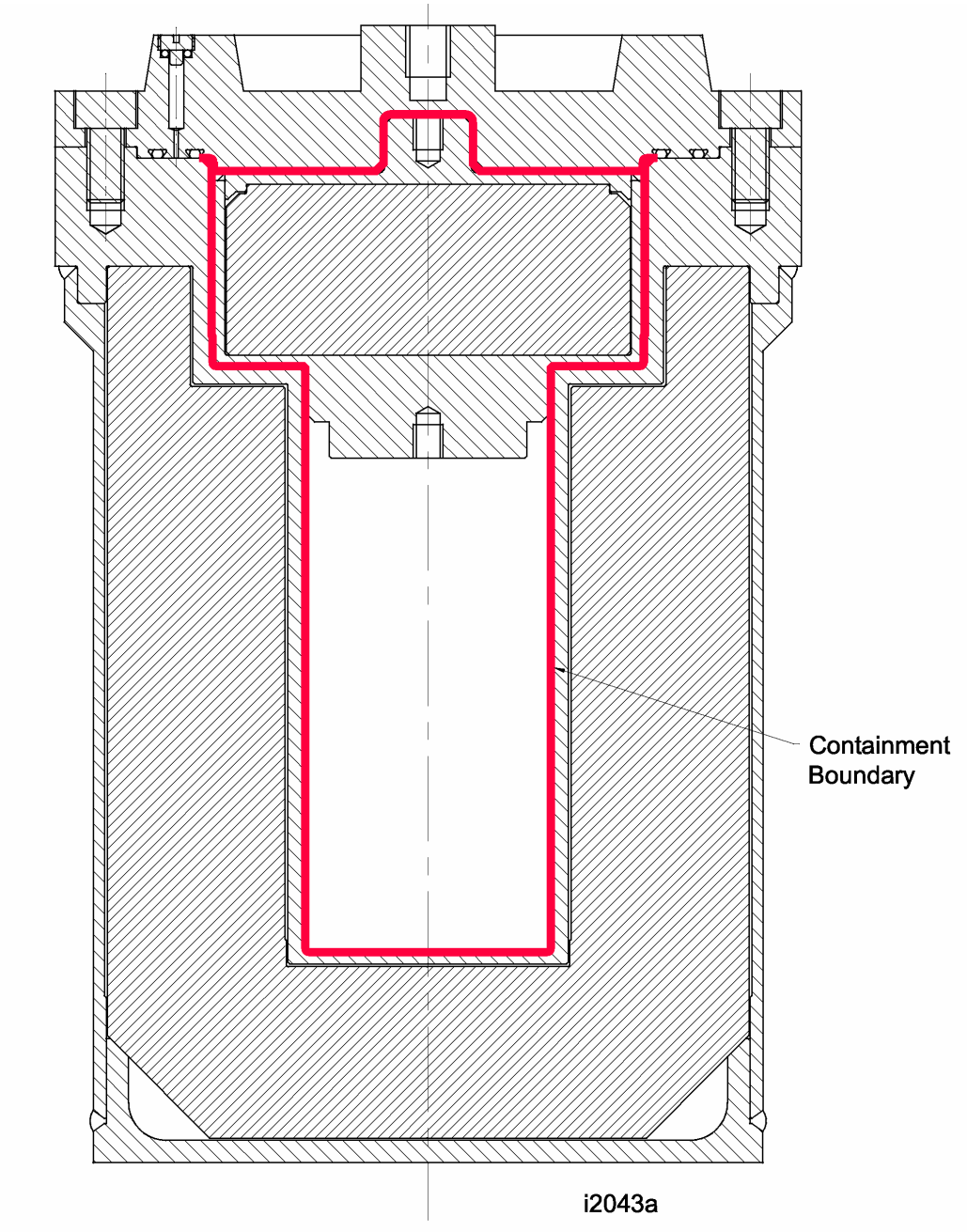


Figure 1-3b Containment boundary of the Safkeg-HS 3977A package with a Split CV Lid

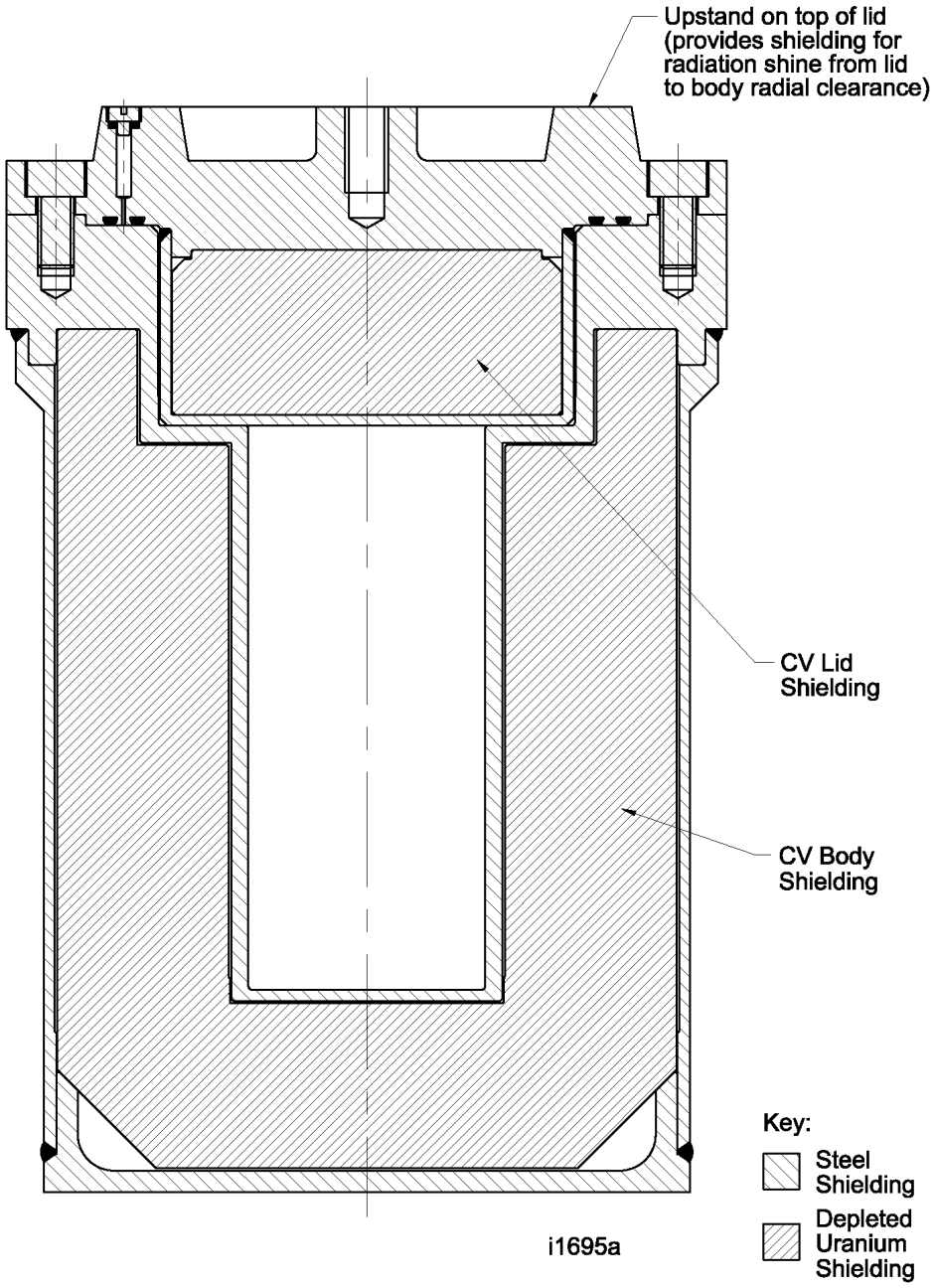


Figure 1-4a Gamma shielding present in the Safkeg-HS 3977A package with a standard CV lid

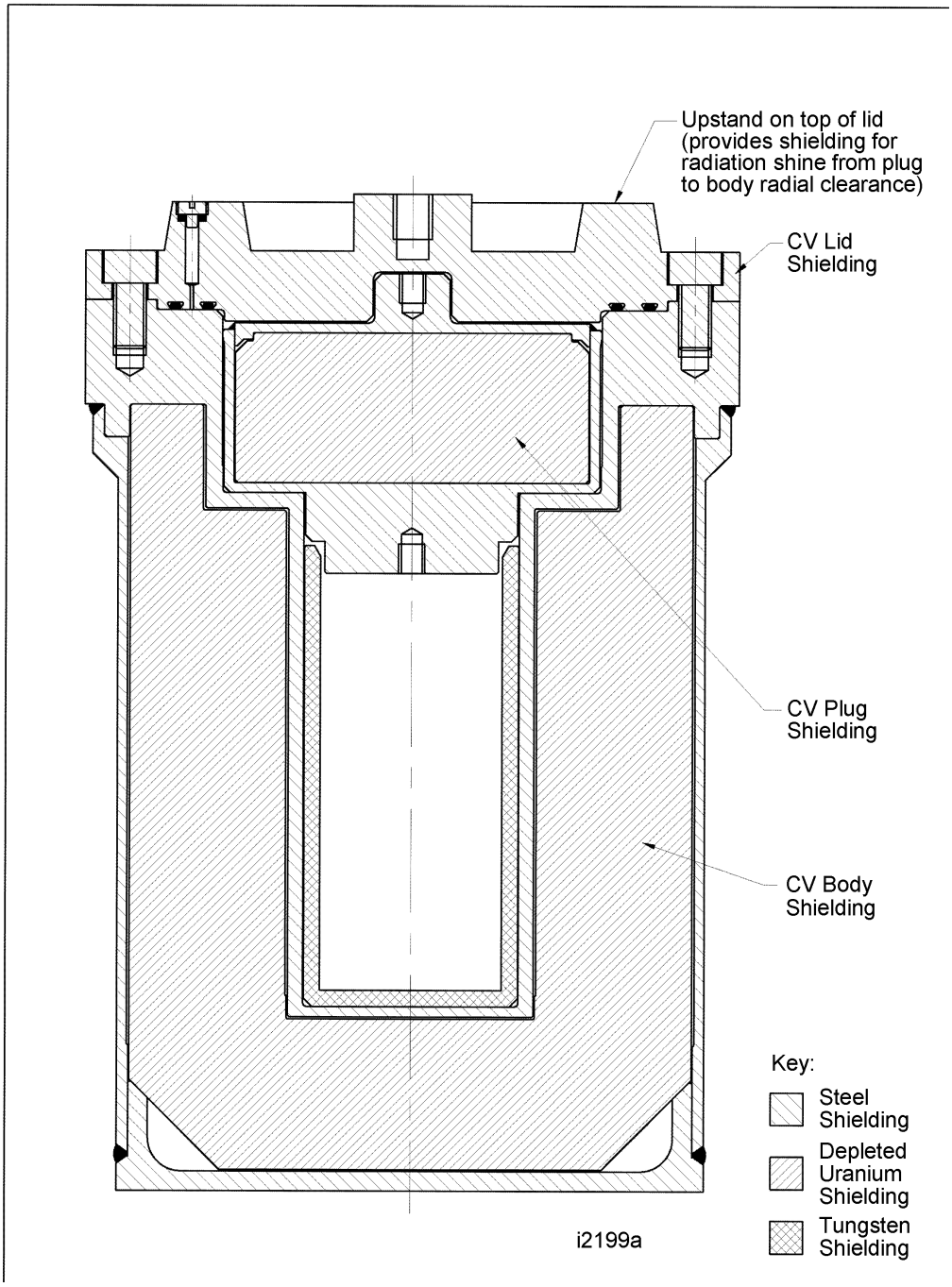


Figure 1-4b Gamma shielding present in the Safkeg-HS 3977A package with a Split CV Lid and tungsten liner

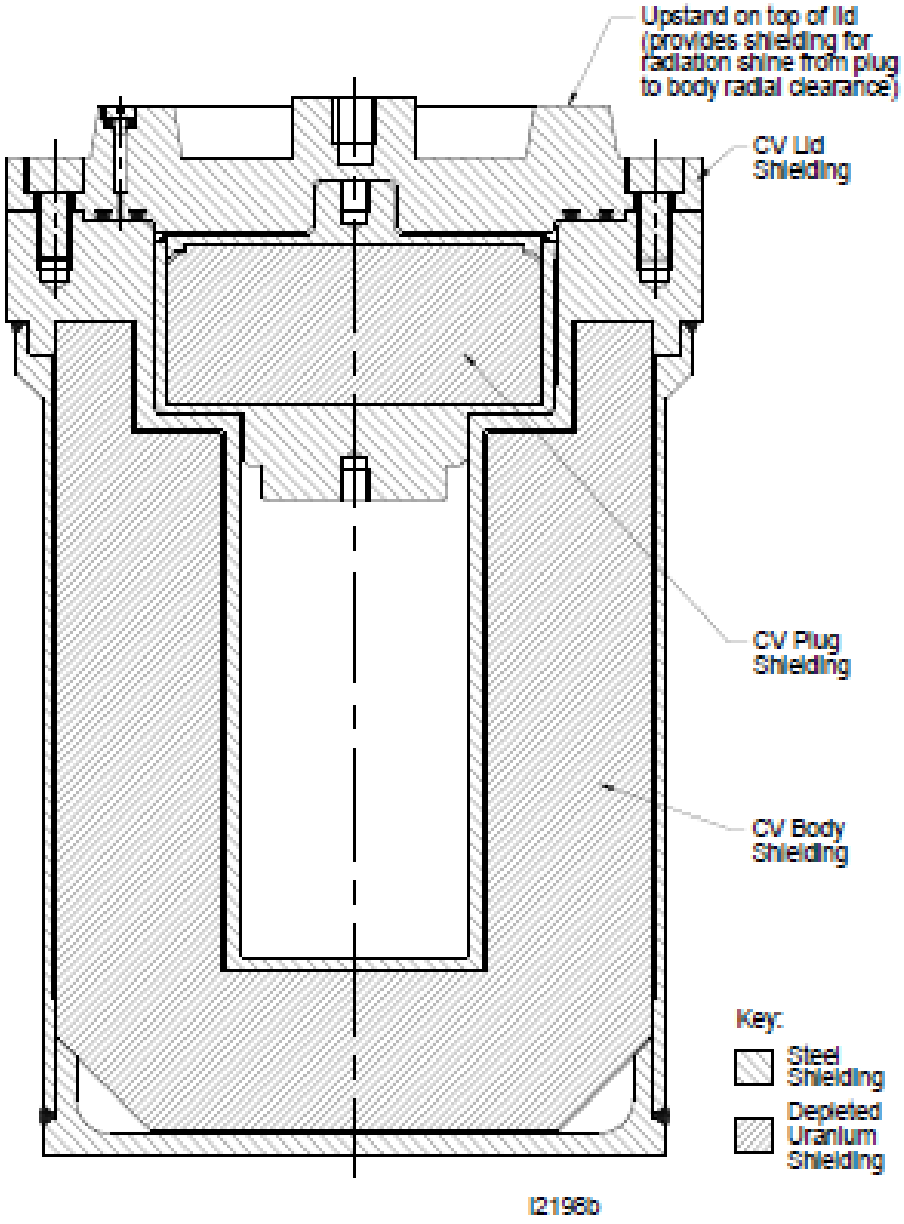


Figure 1-4c Gamma shielding present in the Safkeg-HS 3977A package with a Split CV Lid for insert Design No 4109

1.2.2 Contents

1.2.2.1 Contents - General

The Safkeg-HS 3977A package is designed as a general purpose package for radioactive material that requires shielding. The package is designed for radioactive material that emits neutrons, alpha, beta and gamma radiation.

The contents may be in solid, gaseous or liquid form.

The contents may also include inorganic non-radioactive materials associated with the radioactive materials, such as contents holders or fixtures and packing materials. No organic/hydrogenous materials are allowed in the cavity of the CV.

Pyrophoric materials are permitted under the conditions specified in Tables 1-3-x as the cavity of the CV is sealed, has limited oxygen and there is no source of ignition within the cavity.

As the maximum contents are > 3,000 A_2, the package is designated as Category I as defined in NUREG 1609 [1.1].

The contents are limited so that the surface dose on the external surface of the package is less than or equal to 10 mSv/hr under exclusive use.

The contents heat limit is 30 W for solid contents and 5W for liquid contents.

The contents will be carried in a product container appropriate for the contents and chosen by the shipper.

The product containers will be carried in shielding inserts as specified in the Table 1-2 and Tables 1-3-x. The CV version (using the standard lid design or the split lid design) to be used for each Contents Type (defined as CT-1, etc) is specified in Tables 1-3-x.

The maximum mass of all material (radioactive contents, product capsules or containers, shielding inserts, and all associated items such as product container holders and packing) inside the CV is 9.29 kg (21 lbs).

Various restrictions and limits of quantity of radionuclides apply according to the insert used and the form of the radioactive material (solid, gas or liquid). These restrictions and contents limits are detailed in Section 1.2.2 in the tables for the different Contents Types.

The maximum pressure assumed for the CV under NCT is 7 barg (102 psig) and 10 barg (145 psig) under HAC: this is the design envelope.

1.2.2.2 Inserts

The different inserts, which are required for most contents (in suitable product containers), provide different degrees of shielding, and confinement under NCT.

The inserts are as shown in Figures 1-5a, 1-5b, 1-5c, 1-5d and 1-5e. The weights of the inserts and the contents of the inserts are given in Table 1-1. The maximum mass of the contents is determined by calculating the mass of steel which would completely fill the cavity of the insert. No insert is required for Contents Type CT-6.

Table 1-1 Maximum mass of the radionuclides

Shielding Insert	Mass of Insert	Maximum Mass of Contents	Mass of insert + Maximum mass of contents
	g	g	kg (rounded)
HS-12x95-Tu Design No 3982	9,200	90	9.29
HS-31x114-Tu Design No 3985	7,930	690	8.62
HS-55x128-SS with Titanium liner Design No 3987	1,807	1,810	3.62
HS-50x85-SS Design No 4081 in Tungsten liner	3,271	1,615	4.89
HS-50x113-SS Design No 4109	1,200	2,100	3.30

The insert designation is coded as below.

1st 2 letters eg HS	Designate the insert fits the Safkeg-HS
Numbers eg 12x65	indicate the cavity size of the insert (dia mm x ht mm)
Last 2 letters	Tu indicates tungsten and SS indicates stainless steel

Figure 1-5a Shielding insert HS-12x95-Tu – Design # 3982

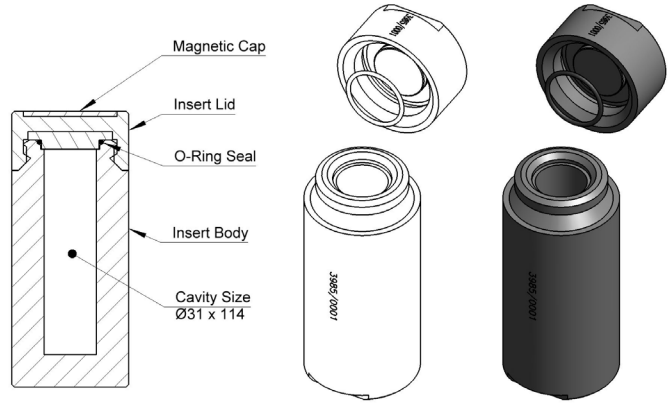


Figure 1-5b Shielding insert HS-31x114-Tu – Design # 3985

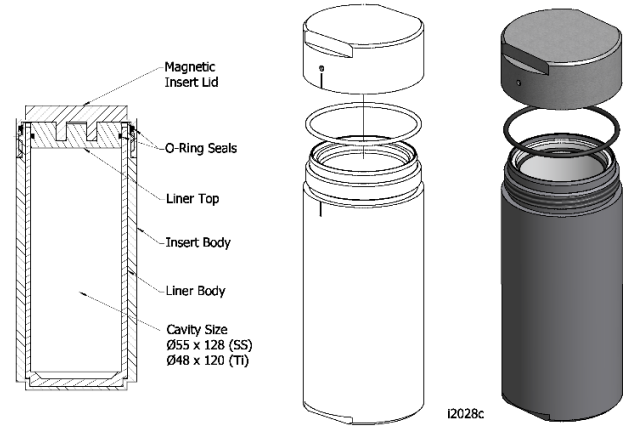


Figure 1-5c Shielding insert HS-55x128-SS with Titanium liner – Design # 3987

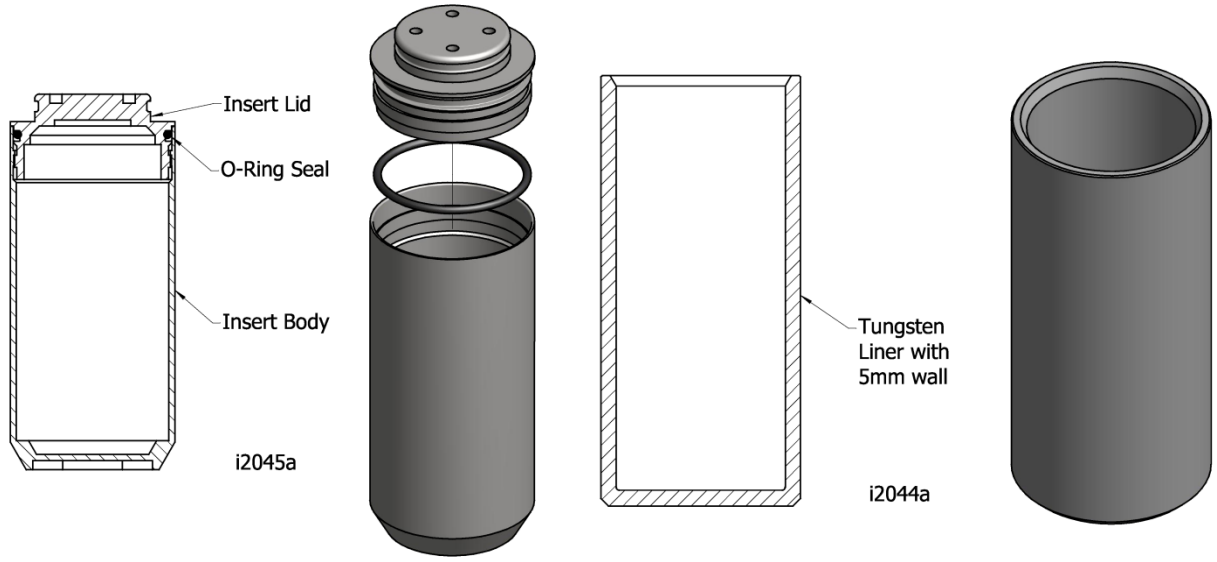


Figure 1-5d Shielding insert HS-50x85-SS– Design # 4081 and Tungsten liner

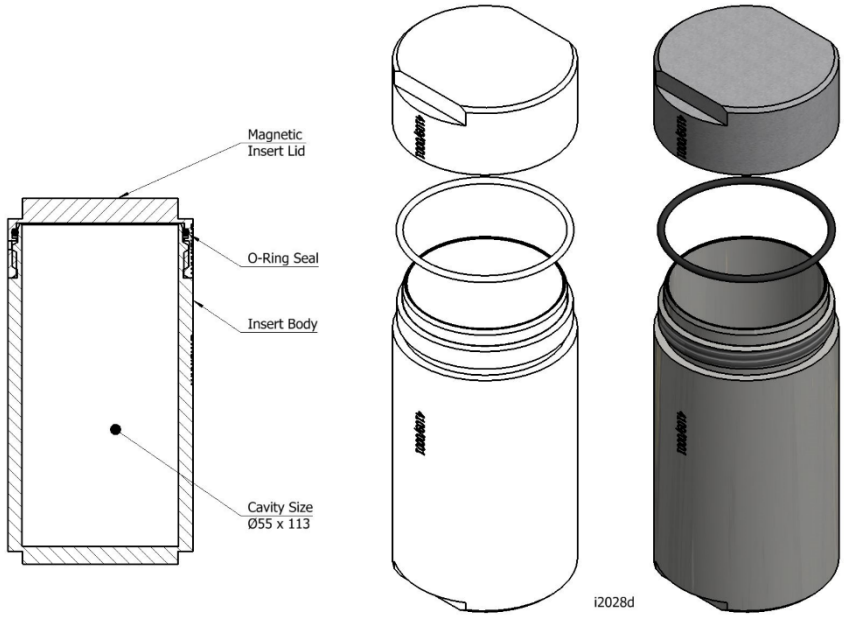


Figure 1-5e Shielding insert HS-55x113-SS– Design # 4109

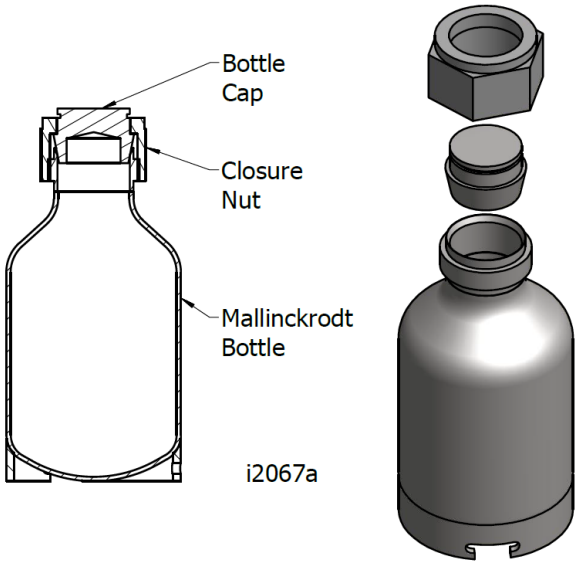


Figure 1-6 Mallinckrodt Product Bottle

(fits in shielding insert HS-50x85-SS)

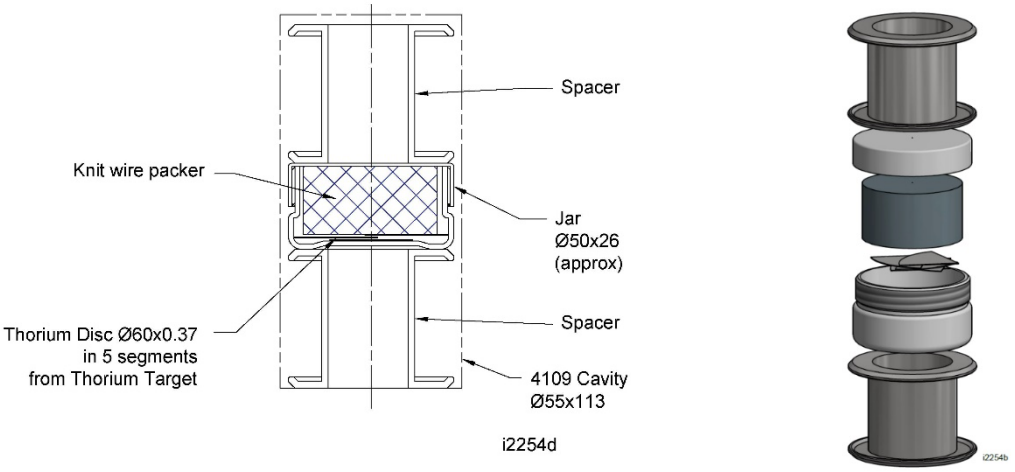


Figure 1-7 Thorium target packing within a 4109 Insert

1.2.2.3 Contents Types

The contents to be carried shall be as specified in the Contents Types listed in Table 1-2.

The general requirements for each Contents Types listed in Table 1-2 are given in Tables 1-3-x. The package activity limit for each Contents Type is given in the Tables 1-4-x. These tables specify the shipping limits for the package.

The activity limit for each nuclide given in Tables 1-4-x is determined as the least of the limits determined on the basis of heat output, mass limit, shielding limit and for gas contents, the limit based on allowable leakage under NCT or HAC. The details of the determinations are given in report PCS 038 (Section 1.3.4).

Note that the shipping limits must not exceed any of the limits in Tables 1-3-x.

Table 1-2 Contents Types

Contents Type Designation	Material Form	Shielding Insert	General Requirements for each Contents Type	CV Lid arrangement	Activity Limits for each Contents Type
CT-1	Solid	HS-12x95-Tu Design No 3982	See Table 1-3-1	Standard	See Table 1-4-1
CT-2	Solid	HS-31x114-Tu Design No 3985	See Table 1-3-2	Standard	See Table 1-4-2
CT-3	Gas	HS-31x114-Tu Design No 3985	See Table 1-3-3	Standard	See Table 1-4-3
CT-4	Liquid (I-131)	HS-55x128-SS Design No 3987 in Titanium liner	See Table 1-3-4	Standard	See Table 1-4-4
CT-5	Liquid (Mo-99)	HS-50x85-SS Design No 4081 with Tu liner	See Table 1-3-5	Split	See Table 1-4-5
CT-6	Solid (thorium metal)	HS-55x113-SS– Design No 4109	See Table 1-3-6	Split	See Table 1-4-6

Table 1-3-1 CT-1 – Solid in heavy tungsten insert (HS-12x95-Tu Design No 3982)	
Parameter	**Restrictions**
Contents Type name	CT-1 – Solid in heavy tungsten insert
Comments on contents	General use including bulk medical and industrial source material.
Insert in CV cavity	HS-12x95-Tu Design No 3982 (mass 9,200 g)
Maximum quantity of radioactive material	See Table 1-4-1 for maximum quantities of each nuclide.
Maximum mass of radioactive material	45g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity allowed does not exceed unity.
Maximum decay heat of radioactive material	30W
Maximum quantity of fissile material	None
Physical form of radioactive material	Solid with melting point > 250°C and not to be volatile at < 250°C. The contents may be normal or special form however no credit is taken for special form material and so can only be carried up to normal form limits.
Chemical form of radioactive material	Element or compound Compound only for Cs, Hg, I, Na and P.
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material shall be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in a plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	9.29 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	90 g
Loading restrictions	None

Table 1-3-2 CT-2 – Solid in light tungsten insert (HS-31x114-Tu Design No 3985)	
Parameter	**Restrictions**
Contents Type name	CT-2 – Solid in light tungsten insert
Comments on contents	General use including bulk medical and industrial source material.
Insert in CV cavity	HS-31x114-Tu Design No 3985 (mass 7,930 g)
Maximum quantity of radioactive material	See Table 1-4-2 for maximum quantities of each nuclide.
Maximum mass of radioactive material	345 g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity allowed does not exceed unity.
Maximum decay heat of radioactive material	30W
Maximum quantity of fissile material	None
Physical form of radioactive material	Solid with melting point > 250°C and not to be volatile at < 250°C. The contents may be normal or special form however no credit is taken for special form material and so can only be carried up to normal form limits.
Chemical form of radioactive material	Element or compound Compound only for Cs, Hg, I, Na and P.
Pyrophoric contents	The contents may be pyrophoric.
Product containers	The radioactive material shall be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	8.62 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	690 g
Loading restrictions	None

Table 1-3-3 CT-3 – Gas in light tungsten insert (HS-31x114-Tu Design No 3985)	
Parameter	**Restrictions**
Contents Type name	CT-3 – Gas in light tungsten insert
Comments on contents	General use including bulk medical material.
Insert in CV cavity	HS-31x114-Tu Design No 3985 (mass 7,930g)
Maximum quantity of radioactive material	See Table 1-4-3
Maximum mass of radioactive material	Mass < 1g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity shown does not exceed unity.
Maximum decay heat of radioactive material	30W
Maximum quantity of fissile material	None
Physical form of radioactive material	Gas, Normal form
Chemical form of radioactive material	Elemental gas
Pyrophoric contents	Not applicable
Product containers	The product container shall be a quartz vial sealed by fusing or an aluminium capsule. The product container may be carried in packing (such as a plastic or metal can or wrapping) to minimize the contamination of the insert. The volume of the product containers and packing shall be <10cc.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	8.62 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	690 g
Loading restrictions	None

Table 1-3-4 CT-4 – Liquid I-131 in steel insert (HS-55x128-SS Design No 3987) with a Titanium liner	
Parameter	**Restrictions**
Contents Type name	CT-4 – Liquid I-131 in steel insert with a Titanium liner
Comments on contents	I-131 for medical use
Insert in CV cavity	HS-55x128-SS Design No 3987 (mass 1,807g) fitted with a Titanium liner (per drawing 2C-6176)
Maximum quantity of radioactive material	See Table 1-4-4 for maximum quantities of each nuclide.
Maximum mass of radioactive material	905 g
Mixtures of radionuclides	Mixtures of the nuclides are allowed providing that the sum of the proportionate amounts of each nuclide with respect to the quantity allowed does not exceed unity.
Maximum decay heat of radioactive material	5W
Maximum quantity of fissile material	None
Physical form of radioactive material	Liquid, normal form
Chemical form of radioactive material	Salts in solution which may be alkaline or acidic. Acids restricted to HCL, H_2SO_4, HNO_3, of maximum concentration 0.1N.
Pyrophoric contents	Not applicable
Product containers	The radioactive material shall be carried in any convenient product container such as a quartz vial or aluminum capsule. Irradiated items may be carried in plastic or metal can or wrapping to minimize the contamination of the insert.
Location of radioactive material	Within the shielding insert
Maximum weight of contents of the CV	3.62 kg This includes the insert, radioactive material, product containers and any other packing.
Maximum weight of contents of the insert	1,810 g
Loading restrictions	The insert shall be leak tested by the bubble immersion method before use for shipment. See Section 7.

Table 1-3-5 CT-5 – Liquid Mo-99 in steel insert in a Tungsten liner ((HS-50x85-SS Design No 4081)) with Split Lid CV	
Parameter	**Restrictions**
Contents Type name	CT-5 – Liquid Mo-99 in a steel insert in a Tungsten liner with Split Lid CV
Comments on contents	Mo-99 for use in medical imaging
Insert in CV cavity	HS-50x85-SS Design No 4081 in a tungsten liner shown in drawing 2C-7510
CV Design	CV with split lid shown in drawing 1C-7504.
Maximum quantity of radioactive material	See Table 1-4-5. The maximum specific activity shall be 60 Ci/ml Mo-99.
Maximum mass of radioactive material	808 g (subject to the limits below which provide a maximum for each case)
Mixtures of radionuclides	Mo-99 with its daughter products
Maximum decay heat of radioactive material	5 W
Maximum quantity of fissile material	None
Physical form of radioactive material	Liquid
Chemical form of radioactive material	Mo-99 with its daughter products as natrium molybdate ($NaNO_3$ 1M/NaOH 0.2M)
Pyrophoric contents	The contents shall not be pyrophoric.
Product containers	The Mo-99 liquid shall be carried in a 110 ml stainless steel product bottle (Figure 1-6) which locates into the tungsten liner using a snap ring.
Location of radioactive material	Within the insert
Maximum weight of contents of the CV	4.89 kg This includes the insert, radioactive material, product containers and tungsten liner.
Maximum weight of contents of the insert	1,615 g
Loading restrictions	The insert shall be leak tested by the bubble immersion method before use for shipment. See Section 7.

Table 1-3-6 CT-6 – Irradiated Thorium Target in steel insert (HS-55x113-SS Design No 4109) with Split Lid CV	
Parameter	**Restrictions**
Contents Type name	CT- 6 – Irradiated Thorium Target in steel insert
Comments on contents	The thorium target is a disc of metallic thorium nominally dia 60 mm x 0.37mm thick and cut into 5 equal pieces.
Insert in CV cavity	HS-55x113-SS Design No 4109 with jar or tin and spacers
Maximum quantity of radioactive material	Ac-225 up to 7.46 GBq (0.2 Ci) with other radionuclides arising from proton irradiation of the thorium target. See Table 1-4-6 for radionuclides arising from activation of the thorium target.
Mass of radioactive material	2.1 kg allowed but actual = 12g.
Mixtures of radionuclides	Mixtures of the nuclides arise as shown in Table 1-4-6.
Maximum decay heat of radioactive material	<1 W
Maximum quantity of fissile material	None
Physical form of radioactive material	Solid
Chemical form of radioactive material	Thorium as metal.
Pyrophoric contents	The thorium disc is not pyrophoric.
Product containers	A jar or tin (plastic or metal) shall be used to carry the thorium target (which is in 5 pieces) held at the bottom of the jar by knit wire flexible packing (see Fig 1-7).
Location of radioactive material	Spacers are required to locate the jar carrying the thorium target pieces at approximately the axial centre of theinsert.
Weight of Jar, packiing and spacers around the Thorium Target	< 1.0 kg. Also, the insert jar and spacers are required to leave a free volume of at least 225 cc within the CV cavity.
Maximum weight of contents of the CV	3.3 kg
Loading restrictions	The external dose rate on the package (top, side and bottom) shall be monitored and the package may not be shipped if this exceeds 10 mSv/hr.

Table 1-4-1 CT-1 – Solid in heavy tungsten insert (HS-12x95-Tu) – Activity Limits

1	2	3	4	5	6	7	8	9	10
Nuclide	Max Activity		A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Ac-225	2.51E+00	6.78E+01	6.00E-03	417.95	2.10E+03	1.19E-03	3.46E-02	2.34E+00	B
Ac-227	7.24E-01	1.96E+01	9.00E-05	8049.19	2.70E+00	2.68E-01	4.72E-04	9.24E-03	B
Ac-228	4.28E-01	1.16E+01	5.00E-01	0.86	8.40E+04	5.09E-06	8.04E-03	9.30E-02	A
Am-241	3.58E+00	9.68E+01	1.00E-03	3581.11	1.30E-01	2.75E+01	3.28E-02	3.18E+00	B
As-77	7.90E+02	2.13E+04	7.00E-01	1128.38	3.90E+04	2.03E-02	1.41E-03	3.00E+01	B
Au-198	2.56E+02	6.92E+03	6.00E-01	426.50	9.00E+03	2.84E-02	4.34E-03	3.00E+01	B
Ba-131	1.88E+02	5.08E+03	2.00E+00	94.05	3.10E+03	6.07E-02	3.06E-03	1.55E+01	B
C-14	7.20E+00	1.95E+02	3.00E+00	2.40	1.60E-01	4.50E+01	2.93E-04	5.71E-02	B
Co-60	2.38E-01	6.44E+00	4.00E-01	0.60	4.20E+01	5.68E-03	1.54E-02	9.94E-02	A
Cs-131	6.71E+03	1.81E+05	3.00E+01	223.73	3.80E+03	1.77E+00	1.65E-04	3.00E+01	B
Cs-134	7.05E+00	1.90E+02	7.00E-01	10.07	4.80E+01	1.47E-01	1.02E-02	1.94E+00	B
Cs-137	1.44E+02	3.89E+03	6.00E-01	240.00	3.20E+00	4.50E+01	1.01E-03	3.94E+00	B
Cu-67	6.91E+02	1.87E+04	7.00E-01	986.75	2.80E+04	2.47E-02	1.61E-03	3.00E+01	B
Hg-203	3.57E+01	9.66E+02	1.00E+00	35.75	5.10E+02	7.01E-02	1.99E-03	1.92E+00	B
Ho-166	2.04E+00	5.52E+01	4.00E-01	5.10	2.60E+04	7.85E-05	4.29E-03	2.37E-01	B
I-125	3.19E+03	8.61E+04	3.00E+00	1062.52	6.40E+02	4.98E+00	3.48E-04	3.00E+01	B
I-129	2.93E-04	7.91E-03	< 1	< 1	6.50E-06	4.50E+01	4.68E-04	3.70E-06	B
I-131	3.28E+02	8.85E+03	7.00E-01	468.01	4.60E+03	7.12E-02	3.39E-03	3.00E+01	B
In-111	4.27E+02	1.15E+04	3.00E+00	142.34	1.50E+04	2.85E-02	2.60E-03	3.00E+01	B
Ir-192	1.81E+02	4.90E+03	6.00E-01	302.02	3.40E+02	5.33E-01	6.13E-03	3.00E+01	B
Ir-194	3.87E+01	1.04E+03	3.00E-01	128.87	3.10E+04	1.25E-03	5.35E-03	5.59E+00	B
Lu-177	1.03E+03	2.78E+04	7.00E-01	1470.30	4.10E+03	2.51E-01	1.08E-03	3.00E+01	B
Mo-99	5.27E+01	1.42E+03	6.00E-01	87.87	1.80E+04	2.93E-03	3.27E-03	4.66E+00	B
Na-24	2.63E-02	7.12E-01	2.00E-01	0.13	3.20E+05	8.23E-08	2.77E-02	1.97E-02	A
Np-237	1.17E-03	3.16E-02	2.00E-03	0.59	2.60E-05	4.50E+01	2.88E-02	9.10E-04	A
P-32	5.58E+00	1.51E+02	5.00E-01	11.15	1.10E+04	5.07E-04	4.12E-03	6.21E-01	B
P-33	2.44E+03	6.61E+04	1.00E+00	2444.45	5.80E+03	4.21E-01	4.54E-04	3.00E+01	B
Pb-203	5.20E+02	1.40E+04	3.00E+00	173.28	1.10E+04	4.73E-02	2.14E-03	3.00E+01	B
Pb-210	8.04E+00	2.17E+02	5.00E-02	160.79	2.80E+00	2.87E+00	2.31E-04	5.01E-02	B
Pd-109	2.96E+02	7.99E+03	5.00E-01	591.05	7.90E+04	3.74E-03	2.14E-03	1.71E+01	B
Ra-223	1.02E+01	2.75E+02	7.00E-03	1451.55	1.90E+03	5.35E-03	3.50E-02	9.60E+00	B
Ra-224	8.86E-02	2.40E+00	2.00E-02	4.43	5.90E+03	1.50E-05	3.37E-02	8.08E-02	B
Ra-226	1.02E-01	2.75E+00	3.00E-03	33.89	3.70E-02	2.75E+00	2.84E-02	7.80E-02	B
Re-186	1.56E+02	4.23E+03	6.00E-01	260.64	6.90E+03	2.27E-02	2.14E-03	9.04E+00	B
Re-188	1.22E+00	3.31E+01	4.00E-01	3.06	3.60E+04	3.40E-05	4.97E-03	1.64E-01	B
Rh-105	8.12E+02	2.19E+04	8.00E-01	1014.40	3.10E+04	2.62E-02	1.37E-03	3.00E+01	B
Se-75	4.61E+02	1.25E+04	3.00E+00	153.81	5.40E+02	8.55E-01	2.41E-03	3.00E+01	B
Sm-153	6.12E-01	1.65E+01	6.00E-01	1.02	1.60E+04	3.82E-05	1.94E-03	3.21E-02	B
Sr-89	1.22E+01	3.30E+02	6.00E-01	20.34	1.10E+03	1.11E-02	3.46E-03	1.14E+00	B

1	2	3	4	5	6	7	8	9	10
Nuclide	Max Activity		A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Sr-90	1.73E+00	4.67E+01	3.00E-01	5.76	5.10E+00	3.39E-01	3.46E-03	1.61E-01	B
Tb-161	1.61E+01	4.36E+02	2.00E-02	806.28	4.35E+03	3.71E-03	1.16E-03	5.06E-01	B
Th-227	1.01E+01	2.73E+02	5.00E-03	2020.21	1.10E+03	9.18E-03	3.59E-02	9.79E+00	B
Th-228	6.79E-02	1.84E+00	1.00E-03	67.95	3.00E+01	2.26E-03	3.21E-02	5.90E-02	B
Tl-201	1.45E+03	3.92E+04	4.00E+00	362.71	7.90E+03	1.84E-01	7.65E-04	3.00E+01	B
W-187	2.24E+01	6.06E+02	6.00E-01	37.36	2.60E+04	8.62E-04	4.54E-03	2.75E+00	B
W-188	1.23E+00	3.31E+01	3.00E-01	4.08	3.70E+02	3.31E-03	5.98E-04	1.98E-02	B
Y-90	1.73E+00	4.67E+01	3.00E-01	5.76	2.00E+04	8.63E-05	5.54E-03	2.59E-01	B
Yb-169	4.42E+02	1.19E+04	1.00E+00	442.11	8.90E+02	4.97E-01	2.51E-03	3.00E+01	B
Yb-175	1.11E+03	2.99E+04	9.00E-01	1228.91	6.60E+03	1.68E-01	1.00E-03	3.00E+01	B
Max	6.71E+03	1.81E+05		8.05E+03		4.50E+01		3.00E+01	

Column

1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

Supplement to Table 1-4-1 re daughter nuclides

The following nuclides may be present in the contents in the quantities indicated in the table below.

Table 1-4-1a – Supplement re daughter radionuclides			
1	2	3	4
Nuclide	Max Activity	Parent material	Comments
Daughter radionuclides present in contents in significant quantities			
Se-77m	As As-77	As-77	Se-77m will have the same activity as its parent As-77 as it is formed by beta decay and Se 77 is stable.
Tc-99m, Tc-99	As Mo-99	Mo-99	Tc-99 will grow in to equilibrium with Mo-99

Table 1-4-2 CT-2 – Solid in light tungsten insert (HS-31x114-Tu) – Activity Limits

1	2	3	4	5	6	7	8	9	10
Nuclide	Max Activity		A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Ac-225	1.09E+00	2.96E+01	6.00E-03	182.45	2.10E+03	5.21E-04	3.46E-02	1.02E+00	B
Ac-227	3.26E-01	8.81E+00	9.00E-05	3622.61	2.70E+00	1.21E-01	4.72E-04	4.16E-03	B
Ac-228	1.86E-01	5.03E+00	5.00E-01	0.37	8.40E+04	2.21E-06	8.04E-03	4.04E-02	A
Am-241	1.58E+00	4.28E+01	1.00E-03	1584.58	1.30E-01	1.22E+01	3.28E-02	1.41E+00	B
As-77	7.90E+02	2.13E+04	7.00E-01	1128.38	3.90E+04	2.03E-02	1.41E-03	3.00E+01	B
Au-198	2.43E+02	6.57E+03	6.00E-01	405.30	9.00E+03	2.70E-02	4.34E-03	2.85E+01	B
Ba-131	6.12E+01	1.65E+03	2.00E+00	30.60	3.10E+03	1.97E-02	3.06E-03	5.05E+00	B
C-14	5.52E+01	1.49E+03	3.00E+00	18.40	1.60E-01	3.45E+02	2.93E-04	4.38E-01	B
Co-60	9.37E-02	2.53E+00	4.00E-01	0.23	4.20E+01	2.23E-03	1.54E-02	3.91E-02	A
Cs-131	6.71E+03	1.81E+05	3.00E+01	223.73	3.80E+03	1.77E+00	1.65E-04	3.00E+01	B
Cs-134	2.63E+00	7.11E+01	7.00E-01	3.76	4.80E+01	5.48E-02	1.02E-02	7.24E-01	B
Cs-137	3.16E+02	8.55E+03	6.00E-01	527.06	3.20E+00	9.88E+01	1.01E-03	8.65E+00	B
Cu-67	6.91E+02	1.87E+04	7.00E-01	986.75	2.80E+04	2.47E-02	1.61E-03	3.00E+01	B
Hg-203	5.58E+02	1.51E+04	1.00E+00	557.87	5.10E+02	1.09E+00	1.99E-03	3.00E+01	B
Ho-166	9.20E-01	2.49E+01	4.00E-01	2.30	2.60E+04	3.54E-05	4.29E-03	1.07E-01	B
I-125	3.19E+03	8.61E+04	3.00E+00	1062.52	6.40E+02	4.98E+00	3.48E-04	3.00E+01	B
I-129	2.24E-03	6.06E-02	< 1	< 1	6.50E-06	3.45E+02	4.68E-04	2.84E-05	B
I-131	3.28E+02	8.85E+03	7.00E-01	468.01	4.60E+03	7.12E-02	3.39E-03	3.00E+01	B
In-111	4.27E+02	1.15E+04	3.00E+00	142.34	1.50E+04	2.85E-02	2.60E-03	3.00E+01	B
Ir-192	1.81E+02	4.90E+03	6.00E-01	302.02	3.40E+02	5.33E-01	6.13E-03	3.00E+01	B
Ir-194	1.47E+01	3.96E+02	3.00E-01	48.84	3.10E+04	4.73E-04	5.35E-03	2.12E+00	B
Lu-177	1.03E+03	2.78E+04	7.00E-01	1470.30	4.10E+03	2.51E-01	1.08E-03	3.00E+01	B
Mo-99	1.91E+01	5.17E+02	6.00E-01	31.85	1.80E+04	1.06E-03	3.27E-03	1.69E+00	B
Na-24	1.28E-02	3.45E-01	2.00E-01	0.06	3.20E+05	3.99E-08	2.77E-02	9.55E-03	A
Np-237	8.97E-03	2.42E-01	2.00E-03	4.49	2.60E-05	3.45E+02	2.88E-02	6.98E-03	B
P-32	2.49E+00	6.73E+01	5.00E-01	4.98	1.10E+04	2.26E-04	4.12E-03	2.77E-01	B
P-33	2.44E+03	6.61E+04	1.00E+00	2444.45	5.80E+03	4.21E-01	4.54E-04	3.00E+01	B
Pb-203	5.20E+02	1.40E+04	3.00E+00	173.28	1.10E+04	4.73E-02	2.14E-03	3.00E+01	B
Pb-210	3.31E+00	8.96E+01	5.00E-02	66.28	2.80E+00	1.18E+00	2.31E-04	2.07E-02	B
Pd-109	9.61E+01	2.60E+03	5.00E-01	192.26	7.90E+04	1.22E-03	2.14E-03	5.57E+00	B
Ra-223	4.14E+00	1.12E+02	7.00E-03	591.20	1.90E+03	2.18E-03	3.50E-02	3.91E+00	B
Ra-224	4.37E-02	1.18E+00	2.00E-02	2.18	5.90E+03	7.40E-06	3.37E-02	3.98E-02	B
Ra-226	4.80E-02	1.30E+00	3.00E-03	16.00	3.70E-02	1.30E+00	2.84E-02	3.68E-02	B
Re-186	5.31E+01	1.43E+03	6.00E-01	88.45	6.90E+03	7.69E-03	2.14E-03	3.07E+00	B
Re-188	5.67E-01	1.53E+01	4.00E-01	1.42	3.60E+04	1.57E-05	4.97E-03	7.60E-02	B
Rh-105	8.12E+02	2.19E+04	8.00E-01	1014.40	3.10E+04	2.62E-02	1.37E-03	3.00E+01	B
Se-75	4.61E+02	1.25E+04	3.00E+00	153.81	5.40E+02	8.55E-01	2.41E-03	3.00E+01	B
Sm-153	5.71E+02	1.54E+04	6.00E-01	952.23	1.60E+04	3.57E-02	1.94E-03	3.00E+01	B
Sr-89	5.17E+00	1.40E+02	6.00E-01	8.62	1.10E+03	4.70E-03	3.46E-03	4.83E-01	B

1	2	3	4	5	6	7	8	9	10
Nuclide	Max Activity		A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Sr-90	8.30E-01	2.24E+01	3.00E-01	2.77	5.10E+00	1.63E-01	3.46E-03	7.75E-02	B
Tb-161	7.39E+00	2.00E+02	2.00E-02	369.26	4.35E+03	1.70E-03	1.16E-03	2.32E-01	B
Th-227	4.17E+00	1.13E+02	5.00E-03	834.00	1.10E+03	3.79E-03	3.59E-02	4.04E+00	B
Th-228	3.35E-02	9.07E-01	1.00E-03	33.54	3.00E+01	1.12E-03	3.21E-02	2.91E-02	B
Tl-201	1.45E+03	3.92E+04	4.00E+00	362.71	7.90E+03	1.84E-01	7.65E-04	3.00E+01	B
W-187	8.56E+00	2.31E+02	6.00E-01	14.26	2.60E+04	3.29E-04	4.54E-03	1.05E+00	B
W-188	5.68E-01	1.53E+01	3.00E-01	1.89	3.70E+02	1.53E-03	5.98E-04	9.18E-03	B
Y-90	8.30E-01	2.24E+01	3.00E-01	2.77	2.00E+04	4.15E-05	5.54E-03	1.24E-01	B
Yb-169	4.42E+02	1.19E+04	1.00E+00	442.11	8.90E+02	4.97E-01	2.51E-03	3.00E+01	B
Yb-175	1.11E+03	2.99E+04	9.00E-01	1228.91	6.60E+03	1.68E-01	1.00E-03	3.00E+01	B
Max	6.71E+03	1.81E+05		3.62E+03		3.45E+02		3.00E+01	

Column

1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

Supplement to Table 1-4-2 re daughter nuclides

The following nuclides may be present in the contents in the quantities indicated in the table below.

Table 1-4-2a – Supplement re additional nuclides			
1	2	3	4
Nuclide	Max Activity	Parent material	Comments
Daughter radionuclides present in contents in significant quantities			
Se-77	As As-77	As-77	Se-77m will have the same activity as its parent As-77 as it is formed by beta decay and Se 77 is stable.
Tc-99m, Tc-99	As Mo-99	Mo-99	Tc-99 will grow in to equilibrium with Mo-99

Table 1-4-3 CT-3 – Gas in light tungsten insert (HS-31x114-Tu) – Activity Limits

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Kr-79	2.30E+01	6.21E+02	2.00E+00	11.49	9.24E+04	2.49E-04	1.67E-03	1.04E+00	B
Xe-133	1.04E+03	2.80E+04	1.00E+01	103.74	6.90E+03	1.50E-01	1.07E-03	3.00E+01	B

Notes

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type - from Col 17
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

Table 1-4-4 CT-4 – Liquid I-131 in steel insert (HS-55x128-SS Design No 3987) with a Titanium liner – Activity Limits

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	Package Type
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
I-131	7.40E+00	2.00E+02	7.00E-01	10.57	4.60E+03	1.61E-03	3.41E-03	6.82E-01	B

Table 1-4-5 CT-5 – Liquid Mo-99 in steel insert in a Tungsten liner (HS-50x85-SS Design No 4081) with Split Lid CV – Activity Limits

1	2	3	4	5	6	7	8	9	10
Nuclide	Max	Activity	A2	# A2s	Spec Ac	Mass	Heat gen	Heat output	PackageType
	TBq	Ci	TBq		TBq/g	g	W/Ci	W	A or B
Mo-99	3.70E+01	1000	3.00E-01	123.33	3.10E+04	1.19E-03	3.43E-03	3.43	B

Notes

Column	
1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71
5	# of A2's of nuclide at package activity limit
6	Specific activity from 10CFR71
7	Mass of nuclide at package activity limit
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide at package activity limit
10	Package Type [A or B] based on individual nuclide limit

Supplement to Table 1-4-5 re daughter nuclides

The following nuclides may be present in the contents as indicated in the table below.

Table 1-4-5a – Supplement re additional nuclides			
1	2	3	4
Nuclide	Max Activity	Parent material	Comments
Daughter radionuclides present in contents in significant quantities			
Tc-99m, Tc-99	As Mo-99	Mo-99	Tc-99 will grow in to equilibrium with Mo-99

Table 1-4-6 CT-6 – Irradiated Thorium Target – Typical Activity and maximum external surface dose rates

1	2	3	4	5	6	7	8	9
Nuclide	Max Activity		A2	# A2s	Spec Ac	Mass	Heat gen	Heat output
	TBq	Ci	TBq		TBq/g	g	W/Ci	W
Ac-225	7.46E-03	2.01E-01	6.00E-03	1.24	2.15E+03	3.48E-06	3.46E-02	6.97E-03
Ag-112	3.01E-02	8.15E-01	4.00E-01	0.08	2.10E+04	1.44E-06	1.21E-02	9.86E-03
Withheld per 10 CFR 2.390								
I-132	3.94E-03	1.06E-01	4.00E-01	0.01	3.80E+05	1.04E-08	1.63E-02	1.73E-03
Withheld per 10 CFR 2.390								
Nb-96	4.13E-03	1.12E-01	2.00E-02	0.21			1.61E-02	1.80E-03
. . . . Withheld per 10 CFR 2.390								
Sr-91	4.75E-03	1.28E-01	3.00E-01	0.02	1.30E+05	3.65E-08	8.07E-03	1.04E-03
Zr-97	9.40E-03	2.54E-01	4.00E-01	0.02	7.10E+04	1.32E-07	9.49E-03	2.41E-03
Max	9.20E-02	2.49E+00		2.50E+00		7.71E-06		3.58E-02

Notes

Column

1	Identifies nuclide
2	Package activity limit for this Contents Type
3	Calculated from Bq amount in Col 2
4	A2 from 10CFR71 (default used where not listed)
5	# of A2's of nuclide

Colour codes

	Radionuclides
	Package limit
	Physics data

6	Specific activity from 10CFR71
7	Mass of nuclide - where blank data is not available
8	Heat generation rate of nuclide - from Microshield.
9	Heat output of nuclide

1.2.3 Special Requirements for Plutonium

Plutonium is not carried in this package therefore no special requirements are needed.

1.2.4 Operational Features

The package has no complex operational features. All the operational features of the package are given in the General Arrangement drawings listed in Section 1.3.3 and the operational instructions presented in Section 7.

1.3 Appendix

1.3.1 References

[1.1] NUREG-1609, Standard Review Plan for Transportation Packages for Radioactive Material, 1999

[1.2] Title 10, Code of Federal Regulations, Part 71, Office of the Federal Register, Washington, DC

[1.3] Regulatory Guide 7.9, Standard Format And Content Of Part 71 Applications For Approval Of Packages For Radioactive Material

[1.4] Title 49, Code of Federal Regulations, Part 171, Office of the Federal Register, Washington, DC

1.3.2 Calculation Model Drawings

The drawings listed below and appended to this section show the details used for setting up the calculation models for stress FEA, thermal FEA and shielding calculations (Monte Carlo and Microshield).

These drawings specify nominal dimensions with particular reference to key features (such as gaps for shielding calculations).

These drawings also specify the materials: details of the materials are given in Section 2.

Drawing No.	Title
0C-5949	Safkeg-HS Construction
1C-5997	CV HS Lid Construction
1C-5999	CV HS Body Construction
3C-6850	HS-12x95-Tu Insert Design No.3982 (construction)
3C-6851	HS-31x114-Tu Insert Design No. 3985 (construction)
3C-6852	HS-55x128-SS Insert Design No. 3987 (construction)

1.3.3 Licensing Drawings

The package is defined by the drawings listed below for which the revision status is given in Section 0. The drawings are appended to this section.

The drawings specify dimensions, fasteners, welding requirements, non-destructive examination requirements, O-ring specifications, method of O-ring retention, and closure surface requirements.

The drawings also specify the materials: details of the materials are given in Section 2.

1.3.3.1 Standard CV Lid Design

Drawing No.	Title
1C-5940	Cover sheet for Safkeg-HS design no. 3977A (licensing drawing)
0C-5941	Safkeg-HS design no. 3977A (licensing drawing)
0C-5942	Keg design no. 3977 (licensing drawing)
0C-5943	Cork set for Safkeg-HS (licensing drawing)
1C-5944	CV design no. 3978 (licensing drawing)
1C-5945	CV lid (licensing drawing)
1C-5946	CV body (licensing drawing)
2C-6173	HS-12x95-Tu insert design no. 3982 (licensing drawing)
2C-6174	HS-31x114-Tu insert design no. 3985 (licensing drawing)
2C-6176	HS-55x128-SS insert design no 3987 (licensing drawing)
2C-6920	Silicone Sponge Rubber Disc

1.3.3.2 Split CV Lid Design - Mallinckrodt Version

Drawing No.	Title
1C-7500	Cover sheet for Safkeg-HS design no. 3977A - Mallinckrodt Version
0C-7501	Safkeg-HS design no. 3977A - Mallinckrodt Version
0C-7502	Keg design no. 3977 - Mallinckrodt Version
0C-7503	Cork set for Safkeg-HS - Mallinckrodt Version
1C-7504	CV design no. 3978 - Mallinckrodt Version
1C-7505	CV lid - Mallinckrodt Version
1C-7506	CV body - Mallinckrodt Version
1C-7507	Containment vessel plug – Mallinckrodt version
2C-7508	HS-50x85-SS insert design no 4081
2C-7509	Snap Ring
2C-7510	Tungsten Liner

1.3.3.3 Split CV Lid Design –Split Lid Version with Insert 4109

Drawing No.	Title
1C-7940	Cover sheet for Safkeg-HS Design No. 3977A
0C-7941	Safkeg-HS Design No. 3977A
0C-7942	Keg Design No. 3977
0C-7943	Cork set for Safkeg-HS
1C-7944	CV Design No. 3978
1C-7945	CV lid
1C-7946	CV body
1C-7947	Containment vessel plug
2C-8094	HS-55x113-ss SS insert Design No 4109
2C-8090	Silicone Sponge Rubber Disc
1C-7975	Packing for Thorium Target in Design No. 3978

1.3.4 Supporting Documents

Document Reference	Title
PCS 038	Package Contents Specification for Safkeg-HS - Package Design No 3977A