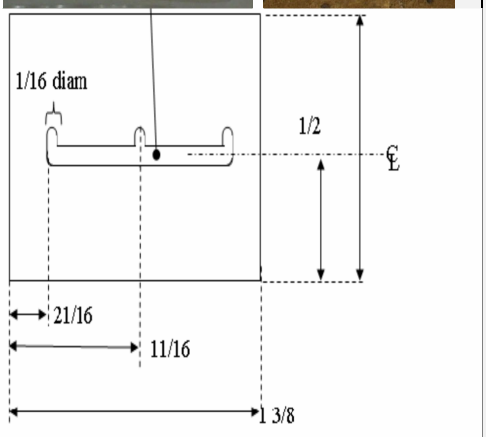
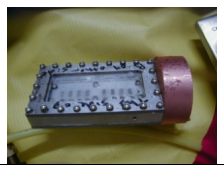
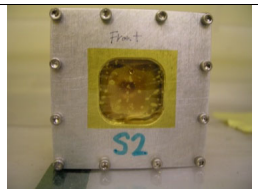
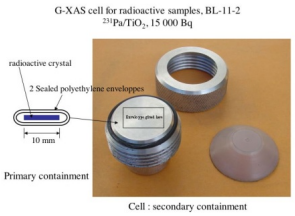
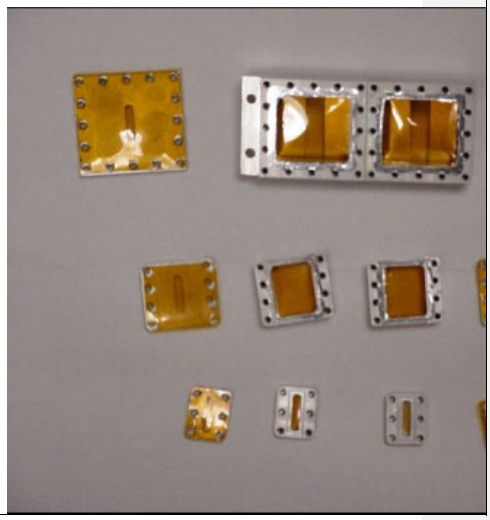
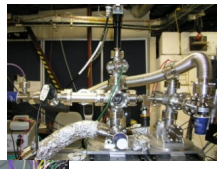
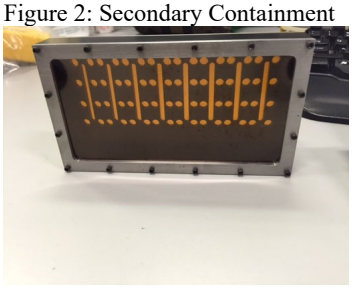
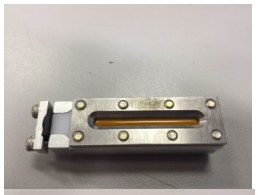
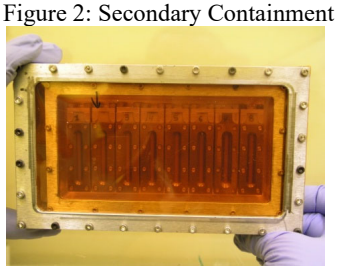
SSRL Radioactive Material sample holder catalog
02/08/2024

Hazard Class Category Containment #	**3 Layer containment for Very High and High Radiotoxicity (Group 1 and 2)**	
1.a	LBNL Lexan or aluminum sample holder with kapton tape surrounded by 2 each individual heat sealed plastic bag. Layer 1- Kapton Tape, sealed Layer 2- Heat sealed plastic bag Layer 3- Heat sealed plastic bag **Physical Approvals:** Ambient temperature	    Material: PCTFE or Lexan (polycarbonate), 1/16 in.
1.b	LANL cryostat sample holder Sample holder with kapton windows and indium seam Layer 1-kapton window with indium seal	 

	Layer 2-Aluminum with Kapton tape, screws Layer 3-durable plastic bag or BL11-2 prep room tent inside prep room. Cryostat S Steel housing assembly with kapton windows and bolting rings. outside of BL 11-2 prep room. **Physical Approvals:** Ambient temp Cryostat under vacuum	
1.c	LANL cryostat sample holder with kapton window and indium seal. Layer 1- Aluminum holder with solid sample and kapton windows. Layer 2- Sample bolted on aluminum holder with kapton windows. Layer 3-durable plastic bag or BL11-2 prep room tent inside prep room. Cryostat S Steel housing assembly with kapton windows and bolting rings. outside of BL 11-2 prep room. **Physical Approvals:** Ambient temp Cryostat cold finger under vacuum	
1.d	USGS cryostat holder Layer1- Layer 2- Layer 3- **Physical Approvals:**	
1.e	G-XAS cell One sample per cell = ^{231}Pa sorbed onto TiO_2 single crystal. Maximum activity : 15000Bq - Doubly contained crystal in two sealed kapton (thickness at least 2 mil) envelopes. Check for no contamination of each envelope. - External envelope glued onto the cell surface. - Cell cap (polyamide 0.7 mm thick) sealed with Viton o-ring. - Additional glue in the thread. Layer 1-kapton bag [2 mil thickness]	

	Layer 2-kapton bag[2 mil thickness] Layer 3- Cell cap (polyamide 0.7 mm thick) sealed with Viton o-ring. **Physical Approvals:** solid samples only Nominal operating conditions of BL 11-2 at 17 keV (focused beam).	
1.f	Diamond anvil cell Layer 1 Layer 2- Layer 3- **Physical Approval:** Pressure	
1g	**LBNL solid only , no liquids are allowed** Triple contained aluminum holders with Kapton or Mylar windows. Fit into cryostats. Layer 1-nested, 1 side is epoxied window, other side is indium wire pressed with lid and cap screws. Layer 2 – nested, 1 side is epoxied window, other side is indium wire pressed with lid and cap screws. Layer 3-Outer 1 side is epoxied window, other side is indium wire pressed with lid and cap screws. **Physical Approvals:** Ambient temp, Cold	

1h.	LANL Conradson Layer 1 polystyrene Layer 2 Stainless Steel Chamber Layer 3 Glovebag	   Figure 1: Primary Containment Front and Side View
1i	LANL Sample holder- Liquid samples Layer 1-liquid cells made of Teflon, with Teflon and Kapton windows and an aluminum shell septa and screws. Layer 2-Aluminum holder, Kapton window with O-ring seal, and screws. Layer 3-Aluminum or Teflon with Kapton tape, oring seal and screws. **Physical Approvals:** Ambient temp liquids Drawings available from LANL if desired to build one. Figure 2: Secondary Containment 	  Figure 2: Secondary Containment  Figure 3: Tertiary Containment

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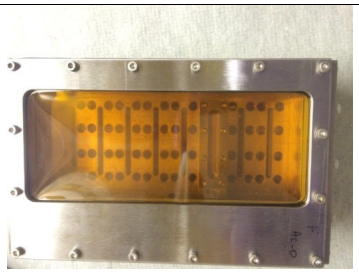
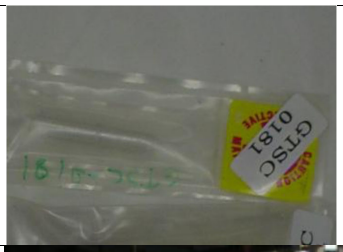
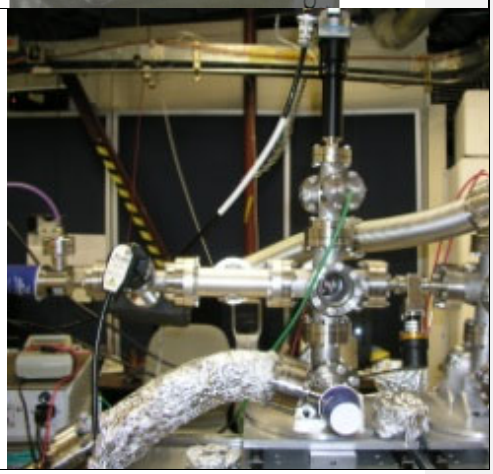
		
1j	Epi tube, screw top Layer 1-plastic vial, screw top with rubber gasket. Layer 2-Plastic heat sealed bag secondary. Layer 3-Plastic heat sealed bag	
1k	PE Tube Layer 1-plastic vial, screw top with rubber gasket. Layer 2-Plastic heat sealed bag secondary. Layer 3-Plastic heat sealed bag	
1l	Reserved Conradson, LANL BL 10-1, 8-2 Layer 1- polystyrene Layer 2-Stainless Steel vacuum structure Layer 3- glovebag	

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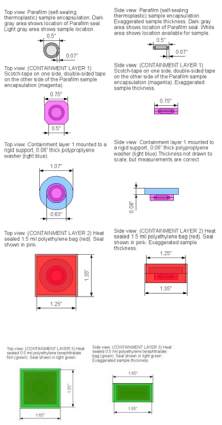
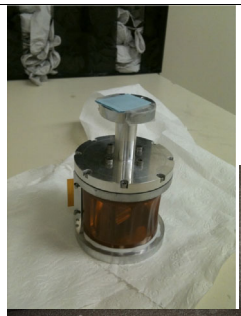
1m	LBNL, Hu Containment Pu239 wet paste Layer 1-Scotch Tape Layer 2- 1.5 mil polyethylene heat sealed bag Layer 3-.5 mil polyethylene heat sealed bag **Physical approvals** Ambient	 
1n	LANL Layers 1- polystyrene film with sample deposited on its surface 2- Kapton windows between aluminum clamps with cap screws and indium wire. 3- Vacuum shroud cryostat with kapton windows with torr seal, o-ring on stem of cold fingers (cannot use in cold environment). Approved to run in BL2-3 only **Physical approvals** Ambient temp and pressure	
1o	LANL Holder The **primary** consists of Pu coupons clamped or glued to an aluminum holder. This fits inside a cylindrical tube with a circumferential cutout (over the samples) that is just over 180 degrees in length. A Kapton	

	window is glued over the cutouts with Torr Seal. The ends are sealed with indium or gold wire. The **secondary** is identical to the primary, except larger, so that the primary is nested inside it. The **tertiary** is our standard one for diffraction. An aluminum container with two Kapton windows sealed with elastomer o-rings. The secondary mounts on the cold finger of an open cycle liquid He refrigerator. The end of the container and its mount on the refrigerator head are sealed with o-rings. **Physical approvals** Ambient temp and pressure	  
1p	LANL Holder **A detailed description of the sample containment.** The primary Layer 1 polystyrene. Layer 2- The secondary containment system an aluminum holder assembled with screws and elastomer o-rings and equipped with Kapton windows (fixed with Torr Seal), Layer 3- housing the first aluminum holder in a second aluminum holder assembled with screws and elastomer o-rings and equipped with Kapton windows (fixed with Torr Seal), Physical properties: ambient pressure and temperature	 

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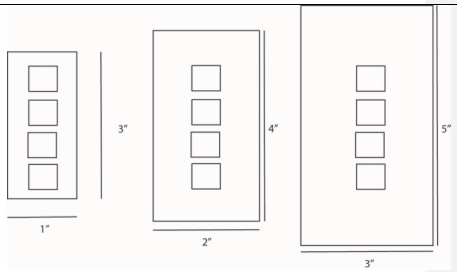
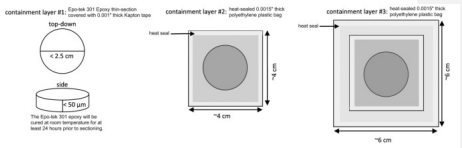
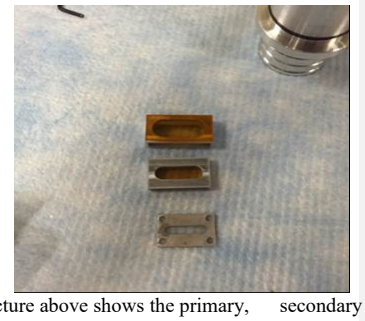
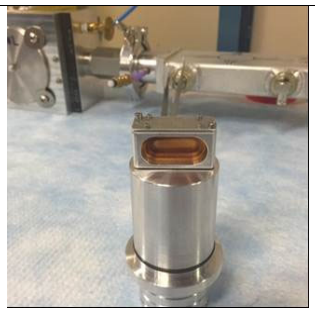
1q	Primary containment: **primary** will contain solid samples mounted between two Kapton windows that are sealed to an aluminum holder with Torr Seal.The dimensions of the aluminum holder are 1”x 3” Secondary Containment: The primary is housed within a **secondary** that consists of two Kaption windows sealed to an aluminum holder with In wire. The dimensions of the secondary aluminum holder are: 4”x2”. Tertiary Containment the secondary is mounted within the **tertiary** containment, which also consists of two Kapton windows sealed to an aluminum holder with In wire. The three Kapton windows are identical and the kapton thickness will be of 2 mil. The dimensions of the secondary aluminum holder are: 5”x3”. **The experiment will be conducted at ambient pressure and temperature in the hutch at beam line 6-2.**	
1r	University of Clemson, Th232. Limited to 0.2mg-	**Primary** containment- Epo-tek 301 Epoxy covered by 0.001 in thick Kapton tape (layer 1). **Secondary** Heat sealed plastic bag 0.0015 in thick. **Tertiary**-heat sealed plastic bag 

1s	LANL Holder-requested by Kozimor BL 4-3, 14-3 Radionuclides approved in limited amounts are: Pu-mixture, Np-237,Am-241, Am-243, Tc-99, Th-232 and U-238. **Primary containment:** The primary containment is a single slotted holder equipped with at least six layers of tape (1 mil thickness per piece) on the downstream facing window. A powder of the analyte is painted within the slot. The upstream polypropylene window (4.0 µm thick) is fixed to the holder with double sided tape. The edges of the tape are sealed with nail polish. **Secondary Containment:** The primary container is nestled within the secondary container. It is a metal slot equipped with polypropylene (4.0 µm) on the upstream side and Kapton tape (2 mil) on the downstream side. The top and bottom slots are also sealed with Kapton (2mil) tape. The edges of the tape are sealed with nail polish or epoxy. **Tertiary Containment:** The secondary container is nestled within the tertiary container. It is a metal slot equipped with polypropylene (4.0 µm) on the upstream side and Kapton tape (2mil) on the downstream side. The top and bottom slots are also sealed with Kapton tape (2mil). The edges of the tape are sealed with nail polish. The tertiary container is housed within a protective sleeve that is fixed to the sample paddle by screws. The screws avoid the 'easy to break	 Picture above shows the primary layer.  The picture above shows the primary, secondary and tertiary layers. The picture below, show the holder in the protective layer, and screwed to the paddle 

	seal. They also fasten from the bottom, which avoids a 'slip-of-the-wrench" and an accidental puncture of the windows. Each sample will be protected equipped with a Protective Sleeve at LANL and shipped to SSRL. Under no circumstances will the tertiary be removed from the Protective Sleeve at SSRL. **Drawings and approval memo are available per request.**	
1t	**LBNL/LANL Pu-242 –in solution and/or solid paste forms, BL 11-2** Amounts limited up to $5x10^{-5}$g total shipment. This holder has limited exposure in the beam up to 6 hours. **Primary containment:** The primary containment will consist of one micro-centrifuge tube, such as Neptune brand 37*n*3.S.X series, where *n*=3, 4, or 6.The screw cap will be wrapped with Parafilm to prevent cap loosening from handling/shipping and provide additional sealing. **Secondary containment:** The primary containment shall be placed into a secondary layer consisting of a heat sealed plastic bag into which sufficient absorbent material to contain the entire sample volume has been placed. **Tertiary containment:** The tertiary containment layer will also consist of heat sealed plastic with absorbent material. Absorbent material shall consist of a commercially available hazmat spill response liquid absorbent pad, compatible with water and other chemicals used in our liquid samples. **The experiment will be conducted at ambient pressure and temperatures in the hutch at beam line 11-2**	 Picture shows template of the holders

1u	**LBNL- Corwin TRU,U-235, U-238 and Th-232** **Primary Containment:** The sample cell primary consists of a PVDF (polyvinylidene fluoride) body, all screws are nylon, and the window material is Kapton. The primary sample slot is enclosed with an epoxy-sealed kapton window. All kapton windows are a minimum **of 0.002" thick**. The sample is loaded from a vertical chamber and sealed with a Viton fluoroelastomer o-ring capped with a 6-32 nylon screw. **Secondary and Tertiary Containment:** The sample cell secondary and tertiary holders each encapsulate three vertically-stacked primary holders. Each consists of a body and two lids (one on each side), all made with PVDF and Kapton windows. The secondary and tertiary lids are all sealed with an interior Viton fluoroelastomer o-ring between the Kapton and body, and held together by a lid affixed with 2-56 screws that are separated by an amount conservatively estimated from a leak checking procedure using a vacuum-seal test. All kapton windows are a minimum **of 0.002"(2mil) thick. For details on how to build this holder request a copy of the approval memo.**	 Secondary body with interior o-ring in gland  Tertiary body **With six screws per lid, the secondary holder**

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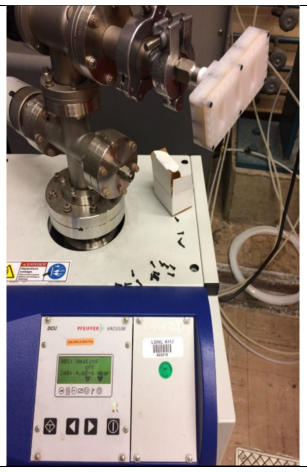
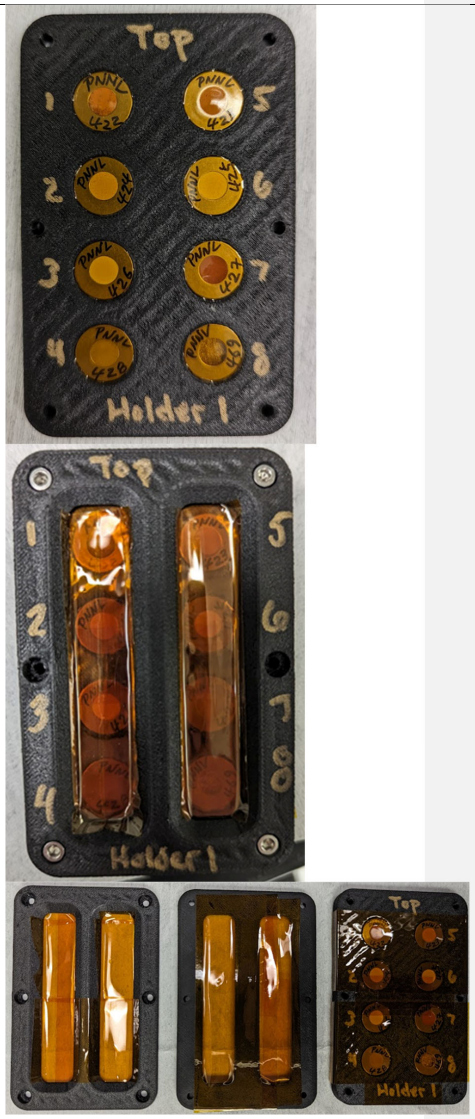
			

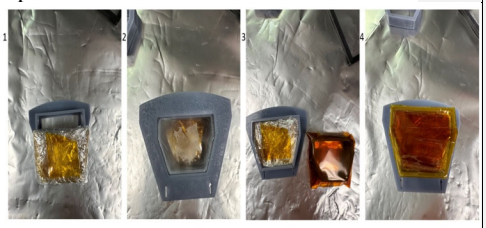
1v	**PNNL Sarah Saslow Pu mixture Am 241 solid samples ambient temperature and pressure** **Approval Memo RPQA-120722-MEM-01, RPQA-240126-MEM-01 Rev04** **Primary Containment Layer:** Kapton Film (≥0.001" thick) epoxied to each side of the stainless-steel shim Note, sample will be embedded in epoxy within the stainless-steel shim/Kapton film windows, which will improve containment **Secondary Containment Layer:** Kapton Film (≥0.001" thick) epoxied to 3D printed "clamshell" holder to create a window for measurement. The two pieces screw together and have cut-outs on the interior for placing O-rings that will secure and enclose the inner holder. **Third Containment Layer** sealed plastic bag consisting of po with 4.5 mil thickness (0.0045" or 0.1143 mm). Double sided tape will be used to loosely secure holder within the plastic bag to prevent shifting during measurement.) **Epoxy used**: Epothin 2 Epoxy hardener (Buehler, Lot# L203442016, Expiration date: May 2020) and Epothin 2 Epoxy Resin **Interior holder** is a stainless-steel shim (washer), 0.0254 mmthick with an inner diameter of 15.875 mm and an outer diameter of 25.4 mm **Exterior holder** is 3D printed with Onyx plastic composite	

	(blueprints and Onyx SDS attached) 3.5 – 6 mm thick with a 1.7” outer diameter and a 0.7” diameter window 	

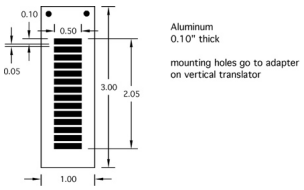
1w	PNNL Sarah Saslow- Approval memo: **RPQA-240207-MEM-01, BL 4-1, 11-2** Primary radionuclides of interest include, Tc-99, natural and depleted uranium, Pu, Am, and Np; however, this sample holder application is intended to broadly cover all future liquid radiological sample needs, regardless of the radionuclide isotope of interest. Liquid samples will be packed into individual 2.0 mL, freestanding polypropylene tubes with screw caps that come with an integrated O-ring for a leakproof seal, e.g., VWR CAT Number 10025-756, https://us.vwr.com/store/product/12134836/vwr-standard-line-screw-cap-microcentrifuge-tubes-pp). The cap will be wrapped with parafilm to reinforce the seal. Hazard Class 3 materials require 2 layers of containment, while groups 1 and 2 require 3 layers of containment. **Containment Layer 1** is an individual 2.0 mL, freestanding polypropylene tubes with screw caps that come with an integrated O-ring for a leakproof seal, e.g., VWR CAT Number 10025-756, https://us.vwr.com/store/product/12134836/vwr-standard-line-screw-cap-microcentrifuge-tubes-pp). The cap will be wrapped with parafilm to reinforce the seal. **Containment Layer 2** a polypropylene or mylar bag (at least 1 mil (0.001") thick) with heat seals that isolate each sample vial from the other sample vials and the exterior of the bag.	 Figure 1. (Top) Sample holder before bagging showing how the sealed liquid sample vials are secured with screws and bolts and pre-cut sample windows. (bottom) Assembled sample holder after heat sealing the sample holder in a bag for a third layer of containment. 

	Containment Layer 3 (Radiotoxicity Groups 1 and 2 Only): A bracket with Kapton or polypropylene film (>0.001”) or tape covered windows is secured with screws on the front and back of the heat sealed bagged vials, such that the samples are enveloped in the Kapton or polypropylene construct. The film is adhered to the brackets using epoxy, e.g., Buehler Epothin 2 epoxy.	

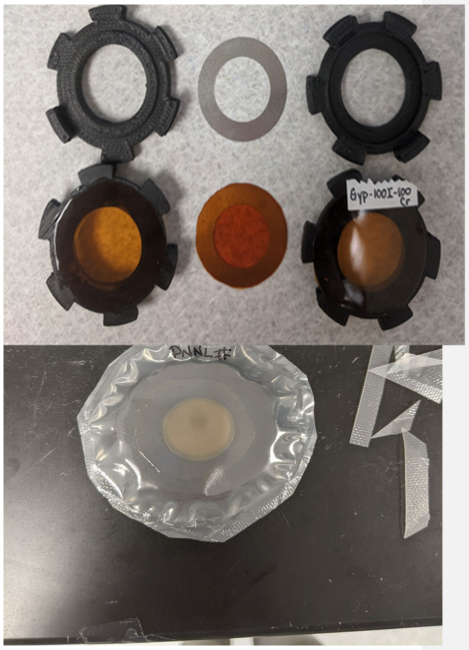
1x	**PNNL- Sarah Saslow approval memo: RPQA-240207-MEM-02 BL 4-1, 11-2** This experiment is adapting SSRL Containment catalog holder number **4zc** for use with radiotoxicity groups 1 – 3. Hazard Class 3 materials require 2 layers of containment, while groups 1 and 2 require 3 layers of containment. **Containment Layer 1** is a stainless-steel washer (0.25” inner diameter, 0.562” outer diameter, and 0.04” – 0.06” thick made of 18-8 stainless steel) packed with the sample and covered on both open faces with Kapton tape. These washers are loaded into an 8-slot holder. **Containment Layer 2** Kapton or polypropylene tape or film (>0.001”) is secured to the 8 sample holder (see Figure 2, bottom right image). If using a film, the film is secured by epoxy, e.g., Buehler Epothin 2 epoxy. The epoxy is sufficiently applied so no gaps in adhesion form around each sample slot on both the front and back bracket. **Containment Layer 3 (Radiotoxicity Groups 1 and 2 Only):** A bracket with Kapton or polypropylene film (>0.001”) or tape covered windows is secured with screws on the front and back of the 8-slotted holder, such that the sample holder is enveloped in the Kapton or polypropylene construct. The film is adhered to the brackets using epoxy, e.g., Buehler Epothin 2 epoxy.	 Figure 1. (Top) Sample holder with Kapton covered stainless steel washers containing sample powder in each of the eight slots. (middle) Assembled sample holder with screws shown at each corner. (Bottom) Image of the front bracket, rear bracket, and sample holder after covering the windows with Kapton tape.

		The brackets have a layer of Kapton tape on the front and back of each window so particles do not accumulate on the exposed tacky side of the tape.
1y	**Northwestern University** **Tatjana BL 2-3 solid sample only** **A detailed description of the sample containment.** **First layer of containment:** Tissue sample with Pu microparticles is embedded in paraffin. Paraffin is sectioned at 5 micron thickness, while microparticles are 0.44 micron big. **Describe second layer of containment:** Paraffin adheres to a 4 micron thick Ultralene membrane that is wrapped around a 3D printed frame, with the sample placing towards the inside of the frame. Membrane is secured with 1 mil Kapton tape on the side opposite from the sample. **Describe third layer of containment:** Assembly generated in previous step is covered in succession with two 3 micron thick layers of Mylar and each piece is individually, one by one secured with 1 mil Kapton tape on the side opposite from the sample. Next, a second frame is used to wedge the frame with the sample into the 3D printed imaging holder compatible with setup at station 2-3. This frame wrapped in 2 mil Kapton (thus two layers of 2 mil Kapton are added between sample and the beam) and placed over the back of the first frame. Finally the back of the whole assembly is secured by 1mil Kapton tape. (See figures 1-4). Due to the small amount of radioactive material used by this	 1) The IF is getting placed into the outer frame compatible with 2-3 beamline sample imaging wheel 2) Tissue side of the IF is close to the surface of outer frame which is necessary for successful scanning of tissue material 3) Back of the outer frame with the IF stuck in it. Second, thin inner frame is wrapped into 2 mil Kapton and secured with Kapton tape 4) The back of the outer frame is closed with Kapton tape

	experiment the committee gives a variance on the thickness of Kapton used on TRU samples. In this experiment Kapton of 1 mil thickness is allowed. Samples are solid and are approved to run at ambient pressure and temperature**.**	
	2 Layers containment for Low Radiotoxicity (Group 3)	
3a	LBNL- User Lukens Lexan or aluminum sample holder with kapton tape. This is a piece of teflon (1.5 inch by 0.75 inch by 0.125 inch, if I remember correctly). It has a 0.5 inch x 0.125 inch slot milled into it. One side was sealed with a piece of Kapton tape, then the sample was pressed into the slot and the holder was sealed with Kapton tape (the tape goes completely around the holder so that there are two layers of tape everywhere. The taped-up holder was decontaminated unto there was no detectable removable contamination. The holder is inside two heat-sealed 2.8 mil thick plastic bags (tough polyethylene bags from Autobag). Since this is a Tc-99 sample (21 keV), thick plastic bags for containment are not an issue. Both the incident X-ray beam and the fluorescence X-rays (18 keV) are only minimally scattered/absorbed by the bag. <u>Layer 1- Kapton Tape, sealed</u> <u>Layer 2- sealed plastic bag</u> **Physical approvals** **Ambient**	
3c	LBNL (Tc99)- User Lukens Layer 1-Kapton film with indium seal and cap screws. Mylar film may only be used for ambient conditions. Layer 2- cryostat holder with kapton	

	Physical approvals Ambient, vacuum, cold	
3d	**2 Layers** Primary containment: Plexiglass (Lexan) holder with sample set into a window, sealed with adhesive tape with the following specifications: *Adhesive tape: ISC Helicopter-IG Surface Guard Tape (Indoor Grade) (J" wide) with the following properties:* Adhesive: rubber Carrierl Backing: polyurethane film Thickness: 4.5 mils Adhesion: 40 ounces per inch (to stainless steel) Tensile Strength: 48 pounds per inch (longitudinal). Secondary containment: Heat sealed linear low density polyethylene bag, with thickness of 2 mil.	
3e	**2 layers** **Tc99** Two layers of containment for moderate toxicity radioisotope. **First containment** is polystyrene, the sample is embedded in polystyrene pellets that are cast in 0.1” by 0.5” slots in a 0.1” thick aluminum plate containing 14 of these slots. This is identical to holder 4b for U. **The second containment** will be to encase the aluminum plate in 5 micron thick polypropylene film. This will be held in place with adhesive. At the beam line this wrapped plate will be installed into a sealed aluminum box that includes the detector system that is also fastened to the beam port and will be filled with 1 atm of helium. **Physical approvals** Ambient temperature and pressure.	 

3f	Epi tube, screw top Layer 1-plastic vial, screw top or pop top with glue with rubber gasket. Layer 2- Heat sealed Plastic bag Uses-Liquid sample in 2 mL, screw-top, polypropylene centrifuge tube inside three layers of heat-sealed plastic. **Physical approvals:** Room temperature	  
3g	User: Lukens, LBNL Layer 1-Sample polyethylene tube with gasket epoxy glue. Layer 2 in heat sealed plastic bag. Powder sample in heat-sealed plastic tube (actually a plastic pipette in this case although I also use heat sealed Epi tubes) inside three layers of heat-sealed plastic.	

3h	**User: Sarah Saslow PNNL** **Solid samples only** **Primary Containment Layer:** Kapton Film (≥0.001" thick) epoxied to each side of the stainless-steel shim Note, sample will be embedded in epoxy within the stainless-steel shim/Kapton film windows, which will improve containment **Secondary Containment Layer:** Kapton Film (≥0.001" thick) epoxied to 3D printed "clamshell" holder to create a window for measurement. The two pieces screw together and have insets on the interior for O-rings that will secure and enclose the inner holder. **Interior holder** is a stainless-steel shim (washer), 0.0254 mm thick with an inner diameter of 15.875 mm and an outer diameter of 25.4 mm **Exterior holder** is 3D printed with Onyx plastic composite (blueprints and Onyx SDS attached) 3.5 – 6 mm thick with a 1.7" outer diameter and a 0.7" diameter window. Updated on May 28, 2021 a third layer will be added for samples containing small amounts of Pu and or Am. **Third Containment Layer (TRU Samples Only):** Heat sealed plastic bag consisting of po with 4.5 mil thickness (0.0045" or 0.1143 mm) The holder may contain, Pu up to 50 µg in solid form, and/or Am up to 1 µg in solid form.	 Bottom updated Picture to include a third layer to account for the Pu and amounts as described by the PI
	1 Layer containment for Low Radiotoxicity (Group 4)	

Commented [AJ1]: And the radioactivity here

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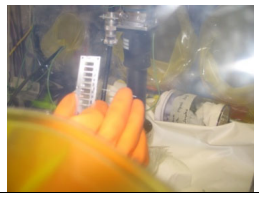
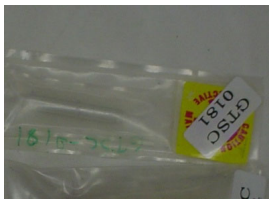
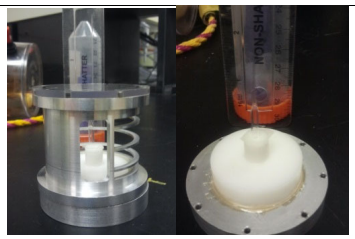
4.a	**LBNL- User Lukens** Lexan or aluminum sample holder with kapton tape. This is a piece of teflon (1.5 inch by 0.75 inch by 0.125 inch). It has a 0.5 inch x 0.125 inch slot milled into it. One side was sealed with a piece of Kapton tape, then the sample was pressed into the slot and the holder was sealed with Kapton tape. The tape goes completely around the holder so that there are two layers of tape everywhere. The taped-up holder was decontaminated unto there was no detectable removable contamination. The holder is inside two heat-sealed 2.8 mil thick plastic bags (tough polyethylene bags from Autobag). Since this is a Tc-99 sample (21 keV), thick plastic bags for containment are not an issue. Both the incident X-ray beam and the fluorescence X-rays (18 keV) are only minimally scattered/absorbed by the bag. Layer 1- Kapton Tape, sealed Physical approvals: Ambient	
4.b	Slotted metal sample holder with unpolished polystyrene sample material Layer 1-polystyrene	 
4.c	Slotted metal Al sample holder with kapton tape and bolting ring Layer 1-Epoxied sealed kapton tape 1 side, indium sealed cap screw inside bolting ring, cap screws on kapton tape other side.	

	Physical approvals: Ambient, Cold, vacuum w	 
4.d	Epi tube, screw top Layer 1-plastic vial, screw top with rubber gasket. Plastic seal bag secondary. Uses-Liquid sample in 2 mL, screw-top, polypropylene centrifuge tube inside three layers of heat-sealed plastic. **Physical approvals:** Room temperature	 
4.e	Epi tube, heat sealed Layer 1-Sample polyethylene tube with glue sealed cap in plastic bag. Uses: Lukins, LBNL Powder sample in heat-sealed plastic tube (actually a plastic pipette in this case although I also use heat sealed Epi tubes) inside three layers of heat-sealed plastic. **Physical approvals:** Room temperature	
4.f This holder is not automatically approved.	Layer 1-quartz capillaries with flame sealed ends or epoxy. Mounted with double back tape X-ray scattering. Layer 2-Must be used with a secondary protective containment cylinder. **Physical approvals:** Room temperature Ambient pressure	

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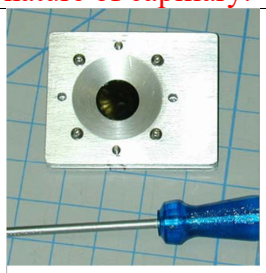
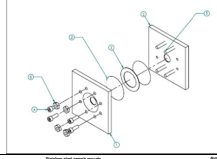
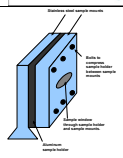
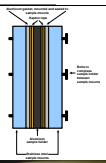
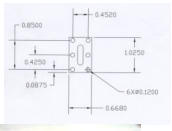
		This holder needs review and approval each time to run. This holder will be reviewed by the entire committee due to the fragile nature of capillary.
4.g	John Barger Holder kapton (polyimide) or mylar (PET, polyester) or mica window adhesive-backed film with thickness .0025 to .010 in. Windows will be self-secured (via adhesive backing) to sample holders. A layer of window material will be applied to overlap around the margins of the sample holder to reinforce the seal provided by the adhesive of the primary tape layer. Layer 1 –Capton , Myl,ar Mica window Al gasket ID of bolting ring	 
4.h	Bolted Aluminum Holder Layer 1- Kapton Tape Aluminum gasket or indium gasket. **Physical approvals:** - Room temperature - Cold in cryostat under vacuum.	    
4.i	Carbon Films, LANL loaded inside vacuum chamber device Uranium Layer 1-Polished polystyrene inside plastic. (polished polystyrene alone is not approved as primary containment) **Physical Approvals:**	 

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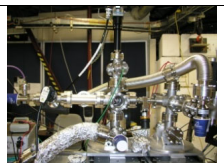
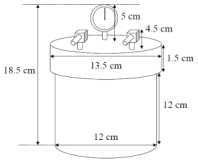
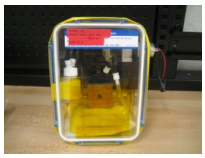
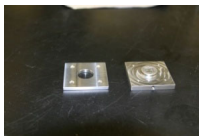
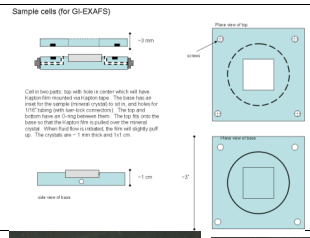
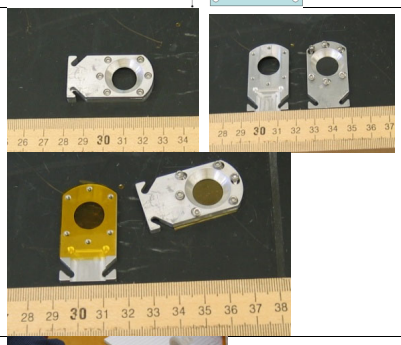
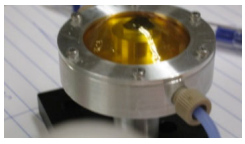
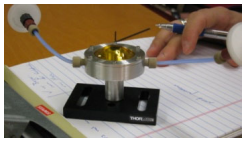
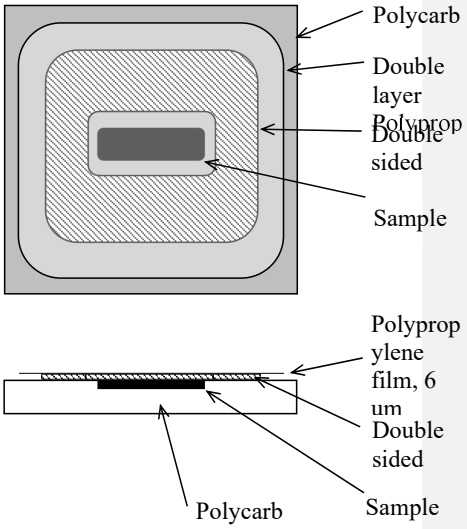
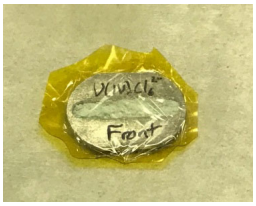
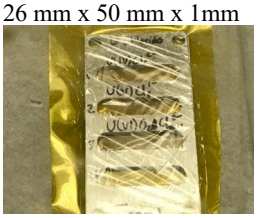
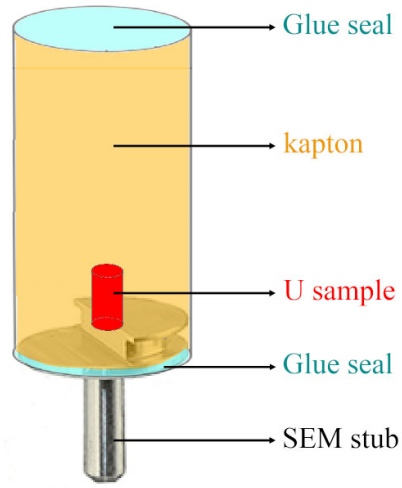
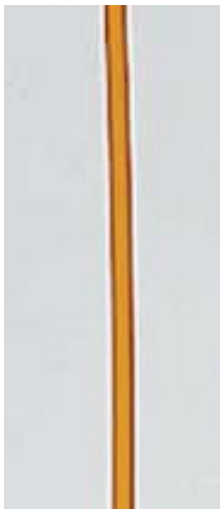
		
4j	LBNL Kapton film with indium seal and cap screws. Mylar film may also be used. **Physical approvals** Ambient, Cold, vacuum	
4k This holder is not automatically approved	SLAC, Uranium capillary Kapton film with plexiglass and aluminum/plastic caps. cap screws and O- ring on ends. A request needs to be submitted for each run due to the fragile nature of capillary.	
4l	Containment for transport to Campus Container is stainless steel with installed gasket sealing lid to container in order to maintain anaerobic environment inside. This vessel is placed in a PG 1 package. Inner package of radioactive Uranium is contained in a sealed plastic bag.	 
4m	LBNL, Singer Containment **Aneropak Box** **Primary Containment-** The lid of the Anaeropak box locks down, and tape will be wrapped around the lid for additional sealing and to prevent the locks from opening. On the side of the sample box, two windows will be made of Kapton film, which will be taped 2X on both sides with Kapton tape. The base and top part of the sample cell are connected by screws, with an O-ring seal. The top part of the sample cell has a	   

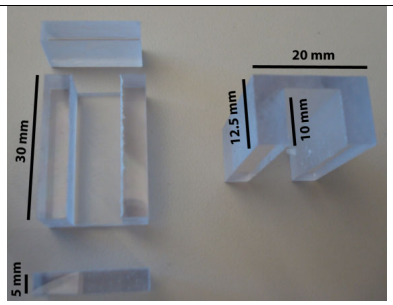
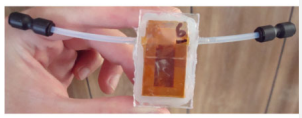
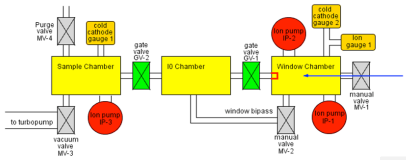
	window made of Kapton film, that will be 2X taped on both sides with a single piece. The sample cell will be housed within a modified Aneropak Box: **Physical approvals** Ambient	
4n	LANL containment Conradson **Physical approvals** Ambient	
4o	Dave Singer, LBNL Magnetite dipped in U238 Primary Containment-Kapton, on steel housing with cap screws and o-ring between platform and window ring. Particulate filter on inlet and outlet of gas flow tubing. Relief valve before inlet filter to avoid kapton window from over pressurization	  

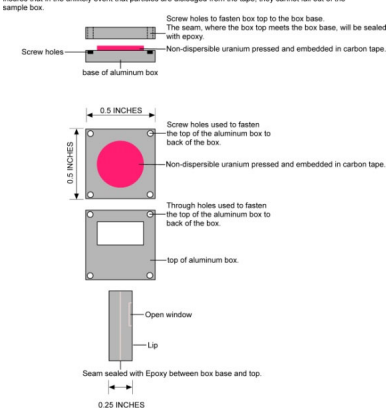
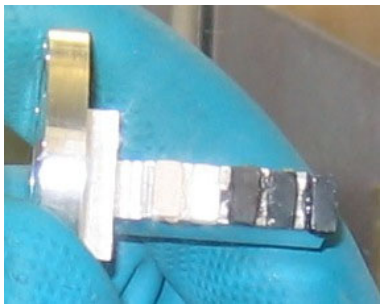
4p	Sample holder is machined from polycarbonate sheet (see dimensions in Figure 1). The sample is packed in the recess, then capped with 0.2 mil (6 um) polypropylene (PP) film attached via a piece of double sided tape (Figure 2). The tape has an opening removed to allow beam impingement on the sample after passing through the PP window. The film and the holder serve as primary containment of the sample material. Samples will be packed as a wet paste, then the tape will be applied, followed by the first layer of PP film. Once the holder is prepared it will then be placed inside a PP film pouch which will be sealed with tape (Figure 3). Stosh LANL The three holders may contain up to 50 mg DU, in solid form. The holders are made of aluminum plate with the following dimensions: a) 26 mm x 17 mm x 1 mm square one slot b) 16.5 mm x 25.4 mm x 1 mm (rounded edges) c) 26 mm x 50 mm x 1 square four slots <u>Primary layer</u> There are 5 pieces of low sulfur tape (1 mil) on backside. Polypropylene window (4 um) fixed to the front side with double sided tape. <u>Secondary layer</u> The holder is placed on a wide piece of Kapton tape (1 mil; wider than the primary) on the back side and a polypropylene window (4	 Figure 2. A schematic of a loaded sample holder complete with sample, PP film, and adhesive tape.  Figure 3. Showing second layer of PP film as an envelope (secondary containment) with a folded and taped tab for closure. Square single slot; 50 mg DU; solid: 26 mm x 17 mm x 1 mm 

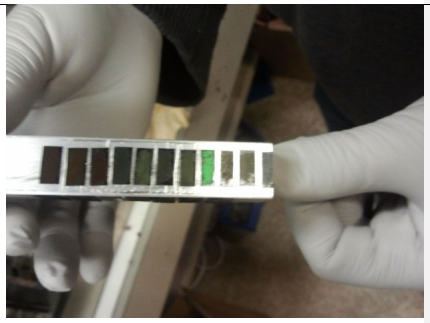
	um) is placed on the front, such that the sample holder is enveloped in the Kapton/polypropylene construct. Vincent Noel- Stanford Modified 4p ***Total sample matrix, weight, and dimensions.*** Square eight slot; 80 mg DU; solid: 26 mm x 50 mm x 1 ***2. The amount (weight) of each radioactive isotope in the sample.*** 80 mg DU per sample holder (10mg DU by sample). ***3. A detailed description of the sample containment.*** The holders are made of PEEK plate with the following dimensions: 26 mm x 50 mm x 1 square eight slots **Primary** There are 5 pieces of low sulfur tape (1 mil) on backside.	Round Single slot; 50 mg DU; solid: 16.5 mm x 25.4 mm x 1 mm (rounded edges)  Square four slot; 50 mg DU; solid: 26 mm x 50 mm x 1mm  

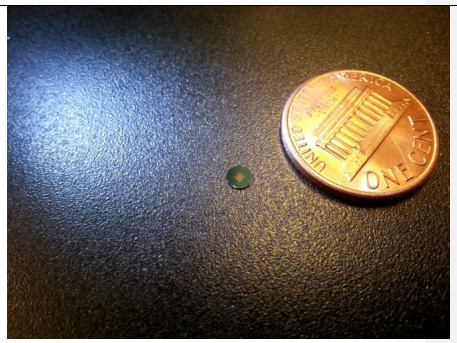
	Polypropylene window (4 um) fixed to the front side with double sided tape. **Secondary** The holder is placed on a wide piece of Kapton tape (1 mil; wider than the primary) on the back side and a polypropylene window (4 um) is placed on the front, such that the sample holder is enveloped in the Kapton/polypropylene construct.	

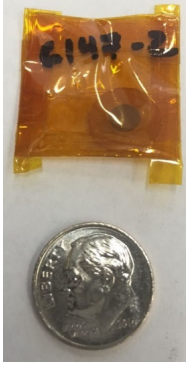
4q	Johanna Weker SLAC BL 2-2 and 6-2 Holder description: Enriched uranium (4% ^{235}U) as cylindrical pillars of dimension (≤400 µm length, ≤75 µm diameter) Total solid uranium mass (per cylinder): < 1 mg of enriched uranium(3.5%) U Each as-received sample previously prepared at LANL will have been welded on to the flat surface of an SEM stub (see picture 1 in the attachment A) One end of the kapton capillary will be fit, like a sleeve, around the SEM stub and glued to it, while the other open end will be glued shut to completely contain the pellet in it. The total length of the kapton capillary will be ~2cm, so that the sample is effectively contained in the capillary. The sample will have one layer of containment. **Primary containment layer** is Kapton capillary (~12.7 mm diameter) and thickness ≥3 mil (≥0.762 mm)	  Kapton capillary (below) and SEM stub onto which the uranium sample are machined (right). The figure on top is illustrated for clarity and not to scale

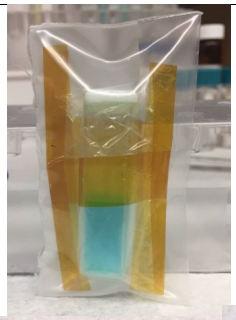
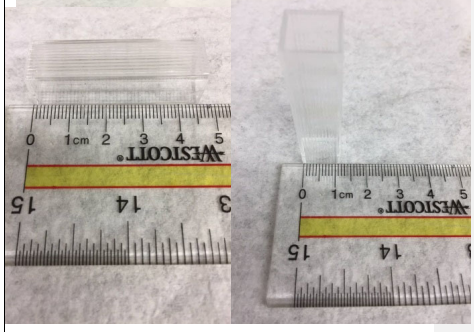
4q	**Primary containment:** The sample holder is constructed from clear polycarbonate. The space for the sample is a channel 3 cm long, 1 cm wide, and 1 cm deep. See attachment A. The sidewalls are 5 mm thick, and the rear wall is 2.5 mm thick (Figure 1). End-caps of 5 mm thick polycarbonate (Figure 1) are secured with cyanoacrylate adhesive (LocTite formula 401 super glue). **Secondary containment:** Kapton film is secured to the fourth side using LocTite formula 401 super glue to form a watertight seal. A second layer of Kapton (0.3 mm or greater) tape over the Kapton film provides an additional layer of containment. **Physical approvals** Ambient	    
4r	**LANL** **Primary Containment** **Uranium 238 and Unat only** - During shipping is a stainless steel coffin, see Scheme 1. - During chamber loading is a glovebag over the chamber opening. - During the experiment is the chamber. **Physical approvals** Ambient	

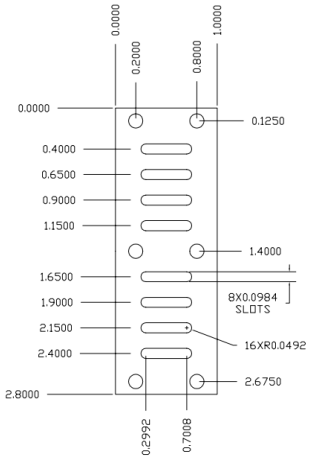
		a.) Non-dispersible uranium samples are obtained by embedding the analyte into carbon tape with a press. The carbon tape is fixed to the base of the aluminum box. b.) The box top has an offset open window that provides a lip to back up the carbon tape. This lip insures that in the unlikely event that particles are dislodged from the tape, they cannot fall out of the sample box. 
4s	**LANL- Stosh** **BL 6-2** **1st layer –** Polystyrene (not the primary containment) in a containment is a cylinder aluminum holder with a top cap made of polycarbonate and bottom cap made of aluminum which is assembled with elastomer o-rings in the groove and screws on top and bottom. On the front window of the cylinder Kapton is adhered to the surface with Torr seal to the aluminum holder 2nd Layer- Kapton and plexiglass U-238, U-nat only Uranium is Powder Room temperature and ambient pressures	 

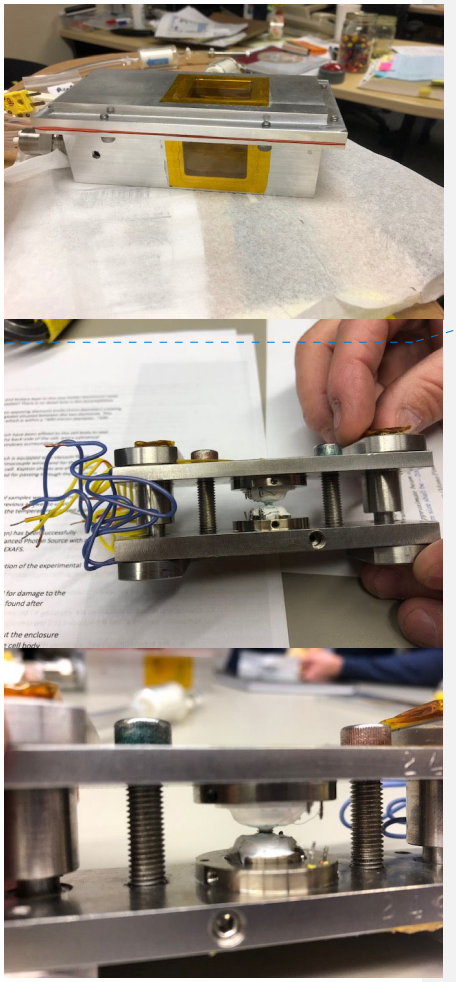
4t	**SSRL – Bargar Thin sections** The thin sections will be epoxied/glued to a standard glass/plastic microscope slide. U-nat **Primary Containment:** The epoxy will be the containment for the thin section. Monochromatic beam 2 to 38 keV **Physical approvals** Ambient	
	PNNL- Saslow-U_{nat} Particles in polymer film The polymer film thin sections will be glued or taped to a standard glass/plastic microscope slide the particles are imbedded in polymer. **Primary Containment:** The polymer film will be the containment for the particles. Monochromatic beam 2 to 38 keV **Physical approvals** Ambient	
4u	Sediments will be adhered to sample holders in one of three manners. Samples cannot be covered with any material because of the low energies of x-rays at the carbon K-edge and the low penetration ability of electrons to be detected. a. Sediments will be deposited onto a clean silicon wafer in water or an organic solvent and allowed to dry in place. b. Sediments will be deposited onto carbon tape. c. Sediments will be pressed into a metal foil such as indium or copper.	

	Primary Containment: Monochromatic beam 2 to 38 keV	
4v	Samples are uranyl fluoride microparticles (~ 1 micron diameter) sealed between two silicon nitride windows with epoxy. 14 **µg** of UO_2F limit. Window frames are 3 mm in diameter, and 200 microns thick, while the windows are 1 mm x 1 mm square, and 50 nanometers thick. Only approved for BL 13-1 for PNNL	
4w	The primary containment is a Teflon or aluminum block, which is compatible with the solvents. Within the block a sample well has been milled. The window is equipped with at **two polypropylene window**s and a **Viton** gasket held in place by a stainless steel plate. There are two ports for sample loading on top, which are closed with screw type plugs. • The holder is only approved for less than 0.1 molar solutions of uranium with a total volume of 1 mL (24 mg U-238; 3.0E+02Bq). • The holder is only approved for room **temperature measurements at ambient pressure**.	  

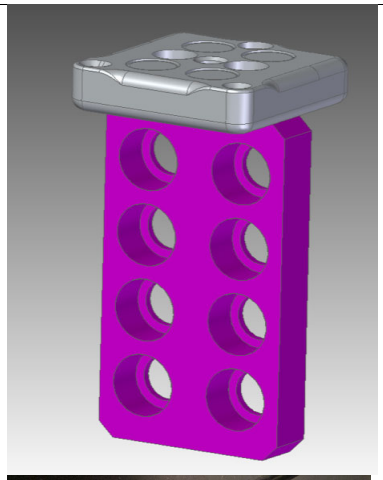
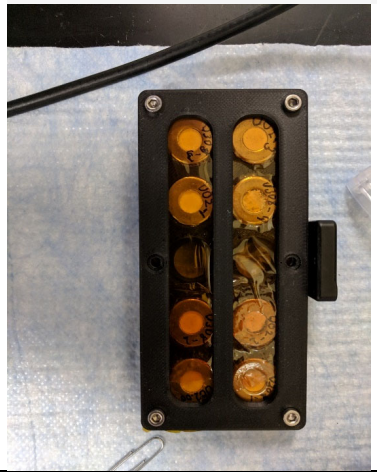
	• Upstream facing (beam side) windows are 4 μm thick and composed of polypropylene. LANL	
4x	Kristin Boye The sample pellets will be inserted into circular slots in an aluminum holder and sealed with a single layer of kapton tape on both front and back. Layer 1-single layer of Kapton (0.002-0.01) self-adhesive tape on both front and back.	
4y	**Abney Carter-ORNL- Udep and Unat BL 11-2** All samples are prepared as powders, contained within a nylon flat washer. The inner area of the washer is 0.193 cm2; 0.195" ID, 0.437" OD, 0.031" thickness. The sample mass typically fills this area sufficiently. When not true, the samples have been diluted with boron nitride, carbon black, or dextrose. The samples are no more than 25 mg in mass, not including the washer, Kapton tape 2 mil, Mylar 6 mil, or other secondary containment. Samples are contacted with either a brine solution containing depleted uranium, or filtered environmental seawater. Samples contacted with brine contain no more than 6.25 mg depleted uranium (6.23 mg U-238, 0.01 mg U-235). Samples contacted with environmental seawater contain 1.25 mg Unat (1.24 mg U-238, 0.01 mg U-235).	

	The samples are enclosed by a Nylon washer (described above in point 1) which is sealed with two pieces of Kapton 2mil tape or transparent “Scotch” tape. Secondary containment is formed by creation of a “baggie” completely enclosing the sample and washer composed of Kapton or Mylar. In either instance, the “baggie” is sealed with Kapton tape. Samples will be enclosed on a tertiary layer consisting of heat sealed bag made of polyethylene.	
4z	**Abney Carter-ORNL- Udep liquid form BL 11-2** The samples are depleted uranyl nitrate dissolved in an aqueous sodium chloride solution, buffered to pH 8.3 with sodium carbonate. The total sample mass is approximately 2 g, and will be contained in a sample area of 1×1×4.5 cm, affording > 50% volume headspace for the primary containment system. The total mass of depleted uranium will be 12 mg per sample (or less). This equates to 11.96 mg U-238 and 36 µg U-235 (or less). Samples will be investigated under ambient temperatures. Under these conditions, all components of sample holder and containment *have previously been exposed to high flux synchrotron radiation for extended times, similar to the energy and flux on BL 11-2*. No material failures have been observed. Experiment Conducted in Ambient temperature and pressure	 

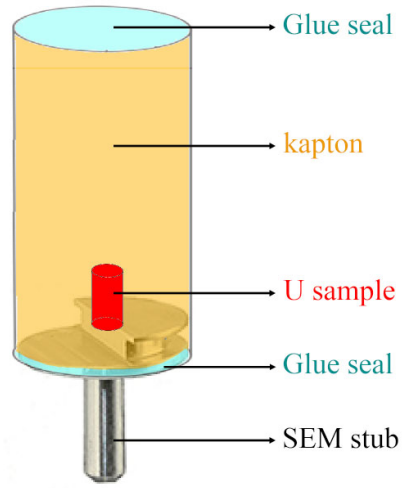
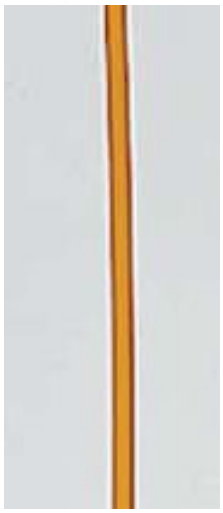
4za	**Tyler Kane- USGS- BL 11-2** All samples are prepared with sediments about 125 mg (solids) or synthetic apatite with < 10 mg of uranium either in the form of Unat or U-238 and is contained with one layer of Kapton tape with at least a 2.5 mil of thickness. Sample holder combination has been tested in cold and they are stable in liquid nitrogen. **Primary containment:** The samples are placed in a Poly(methyl methacrylate) PMMA (Acrylic trade name Plexiglas) or Aluminum holder with eight slots and are enclosed by a one layer of Kapton tape with at least 2.5 mil of thickness.	 CRYO SAMPLE PLATE, 1/2"SLOT MAT'L; 1100 H14 ALUM. .050THK. TOL; +/-.005" 

4zb	**Jason Baker- LANL BL 11-2 approved on December 4, 2018** **U-238 and U depleted** **Sample description:** The sample (solution and/or solid) is kept inside the hydrothermal diamond anvil cell (HDAC). The sample chamber is 500 (700) micron in diameter and ~30 (~ 75 – 100) micron in depth. Weight of sample is in the order of micrograms. Sample (solution and/or solid) will be contained between two diamonds and a metal (Rhenium) gasket in between. Pressure generated by the two diamonds can effectively contain the sample. **Primary and secondary containments:** The primary layer is the diamond/gasket/diamond interface. The secondary layer is the aluminum box with 4 windows sealed with kapton. The kapton thickness is 25 microns each (2 layers used, each are 25 micron in thickness, for a total thickness of 50 microns). The kapton is sealed with a high-temperature epoxy adhesive called Loctite Hysol, can sustain temperature 95°C. The cell enclosure will not reach 95°C. The rubber used to seal the aluminum box is silicone 100%, it can sustain max temp ranging of 205°C. A Pressure relief valve is installed. It is blue/white plug at the end of the inlet side of the plumbing system. It is shown in the plumbing diagram in attachment E. The temperature controller does have a power shut-off alarm setting built in. This will shut the power off	

Commented [TMMC2]: Are you planning to change diamonds? What are the exactly dimensions of the diamond?

	immediately if the temperature is raised above the highest set point.	
4zc	**Arjen van Vellen SSRL** **U-natural** **Sample description** The holder may contain up to 50 mg DU, in solid form, it contains 8 slots. The holder is made of Onyx plastic (carbon/nylon fibers) with the following dimensions: a) 8 slots holder: 30 x 45 x 6 mm b) Pellet holder: 1.5 x 12 mm washer with 7.5 mm hole. **Primary** There is one piece of Kapton tape stuck to the back of the washer. Polypropylene window (4 um) fixed to the front side of the washer with double sided tape. **Secondary** A bracket with polypropylene foil is placed on the front and back of the 8-slotted holder such that the sample holder is enveloped in the polypropylene construct.	 

4zd	**Arjen Van Veleen SSRL** **Depleted-Uranium** **Sample description** The holder may contain up to **5 mg DU, in solid form, it contains 8 slots**. Soil samples with trace amounts of uranium or dilute samples mixed in boron nitride. Sample plate dimensions are: 25 x 16.5 x 1 mm. Sample slot size is 19 x 4 mm with both ends rounded off. Sample holder to be used in *the liquid He cryostat at beamline 7-3*. The holder consists of: 1: Rod with the cold finger made of copper 2: Sample plate (aluminum) with sample pressed in the slot and sealed off with Kapton tape on either side. 3: Sample holder backplate, sample plate and sample front plate. All are made of aluminum. 4: 4 screws which sandwiched the sample plate between the back plate and front plate. Physical approvals 1.Samples are approved to run at *the liquid He cryostat at beam line 7-3* 2. Samples approved to run at ambient pressure and temperature	 

4ze	Johanna Weker SLAC BL 2-2 and 6-2 Holder description: Enriched uranium (4% ^{235}U) as cylindrical pillars of dimension (≤400 µm length, ≤75 µm diameter) Total solid uranium mass (per cylinder): < 1 mg of enriched uranium(3.5%) U Each as-received sample previously prepared at LANL will have been welded on to the flat surface of an SEM stub (see picture 1 in the attachment A) One end of the kapton capillary will be fit, like a sleeve, around the SEM stub and glued to it, while the other open end will be glued shut to completely contain the pellet in it. The total length of the kapton capillary will be ~2cm, so that the sample is effectively contained in the capillary. The sample will have one layer of containment. **Primary containment layer** is Kapton capillary (~12.7 mm diameter) and thickness ≥3 mil (≥0.762 mm)	  Kapton capillary (below) and SEM stub onto which the uranium sample are machined (right). The figure on top is illustrated for clarity and not to scale

4zf	LANL- Stosh	This holder is temporarly suspended until further review.