
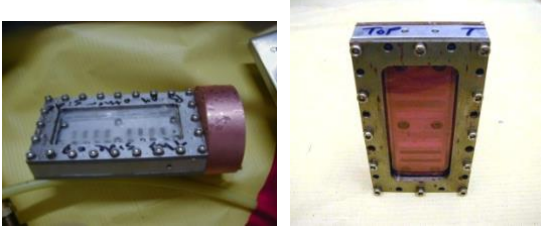
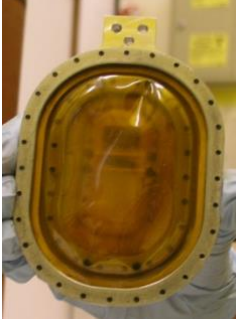
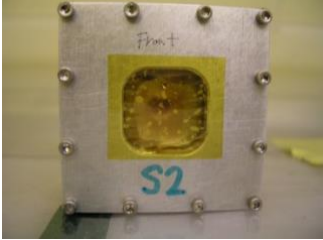
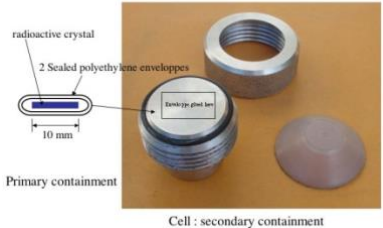

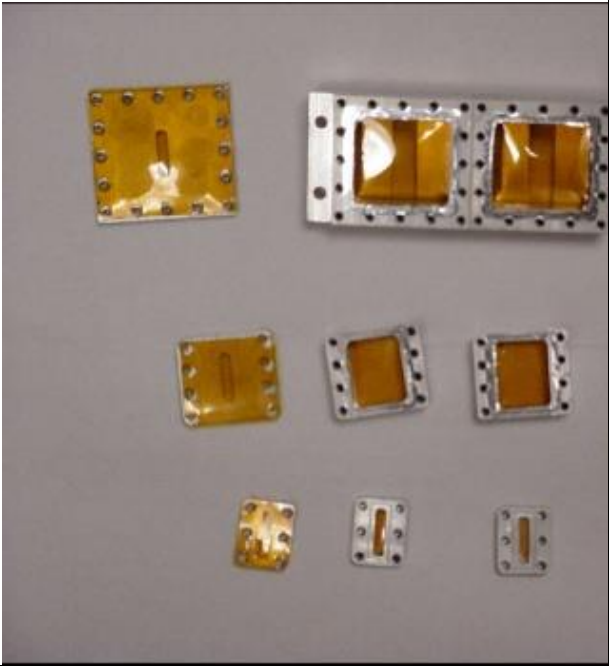
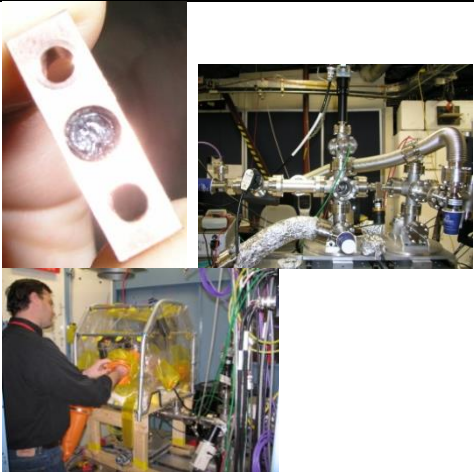



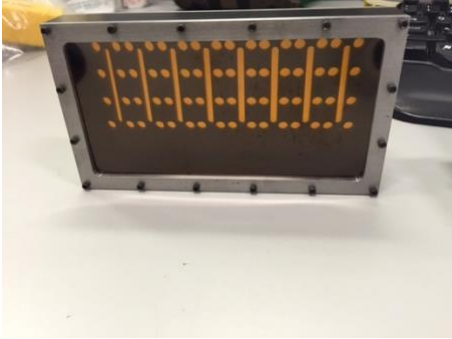

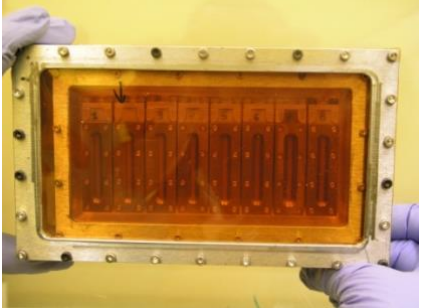
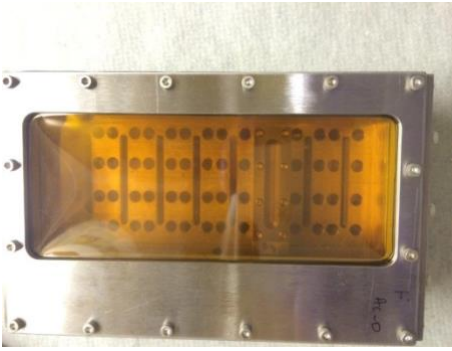

SSRL Radioactive Material sample holder catalog  
10/13/2021

| Hazard Class<br>Category<br>Containment # | <b>3 Layer containment for Very High and High Radiotoxicity (Group 1 and 2)</b>  |  |
|---|--|--|
| 1.a                                       | <p>LBNL<br/>Lexan or aluminum sample holder with kapton tape surrounded by 2 each individual heat sealed plastic bag.</p> <p>Layer 1- Kapton Tape, sealed<br/>Layer 2- Heat sealed plastic bag<br/>Layer 3- Heat sealed plastic bag</p> <p><b>Physical Approvals:</b><br/>Ambient temperature</p>  |    |
| 1.b                                       | <p>LANL cryostat sample holder<br/>Sample holder with kapton windows and indium seam<br/>Layer 1-kapton window with indium seal<br/>Layer 2-Aluminum with Kapton tape, screws<br/>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.</p> <p><b>Physical Approvals:</b><br/>Ambient temp<br/>Cryostat under vacuum</p> |   |
| 1.c                                       | <p>LANL cryostat sample holder with kapton window and indium seal.<br/>Layer 1- Aluminum holder with solid sample and kapton windows.<br/>Layer 2- Sample bolted on aluminum holder with kapton windows.<br/>Layer 3-durable plastic bag or BL11-2 prep room tent inside prep room. Cryostat S Steel housing</p>   |  |

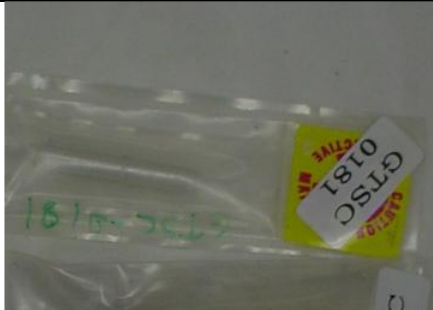

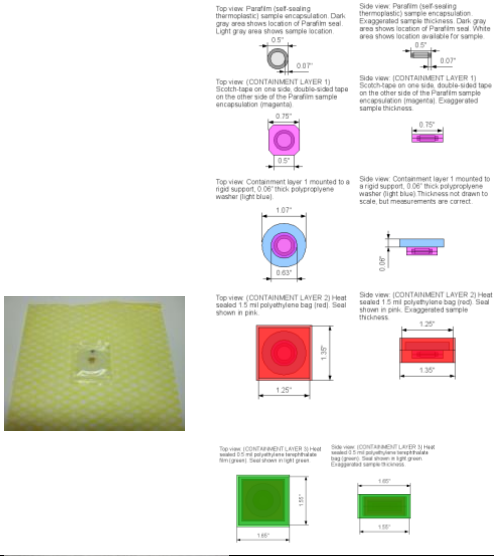

SSRL Radioactive Material sample holder catalog  
10/13/2021

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|     | <p>assembly with kapton windows and bolting rings. outside of BL 11-2 prep room.</p> <p><b>Physical Approvals:</b><br/>Ambient temp<br/>Cryostat cold finger under vacuum</p>   |  |
| 1.d | <p>USGS cryostat holder</p> <p>Layer 1-<br/>Layer 2-<br/>Layer 3-</p> <p><b>Physical Approvals:</b></p>   |    |
| 1.e | <p>G-XAS cell One sample per cell = <math>^{231}\text{Pa}</math> sorbed onto <math>\text{TiO}_2</math> single crystal.<br/>Maximum activity : 15000Bq<br/>- Doubly contained crystal in two sealed kapton (thickness at least 2 mil) envelopes. Check for no contamination of each envelope.<br/>- External envelope glued onto the cell surface.<br/>- Cell cap (polyamide 0.7 mm thick) sealed with Viton o-ring.<br/>- Additional glue in the thread.<br/>Layer 1-kapton bag [2 mil thickness]<br/>Layer 2-kapton bag[2 mil thickness]<br/>Layer 3- Cell cap (polyamide 0.7 mm thick) sealed with Viton o-ring.</p> <p><b>Physical Approvals:</b> solid samples only<br/>Nominal operating conditions of BL 11-2 at 17 keV (focused beam).</p> | <p>G-XAS cell for radioactive samples, BL-11-2<br/><math>^{231}\text{Pa}/\text{TiO}_2</math>, 15 000 Bq</p>  <p>radioactive crystal<br/>10 mm<br/>2 Sealed polyethylene envelopes<br/>Primary containment<br/>Kapton window<br/>Cell : secondary containment</p> |
| 1.f | <p>Diamond anvil cell</p> <p>Layer 1<br/>Layer 2-<br/>Layer 3-</p> <p><b>Physical Approval:</b><br/>Pressure</p>  |    |



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| <p>1g</p>  | <p><b>LBNL solid only , no liquids are allowed</b><br/>Triple contained aluminum holders with Kapton or Mylar windows. Fit into cryostats.<br/>Layer 1-nested, 1 side is epoxied window, other side is indium wire pressed with lid and cap screws.<br/>Layer 2 – nested, 1 side is epoxied window, other side is indium wire pressed with lid and cap screws.<br/>Layer 3-Outer 1 side is epoxied window, other side is indium wire pressed with lid and cap screws.<br/><b>Physical Approvals:</b><br/>Ambient temp, Cold</p> |   |
| <p>1h.</p> | <p>LANL Conradson<br/><br/>Layer 1 polystyrene<br/>Layer 2 Stainless Steel Chamber<br/>Layer 3 Glovebag</p>   |    |
| <p>1i</p>  | <p>LANL Sample holder- Liquid samples<br/>Layer 1-liquid cells made of Teflon, with Teflon and Kapton windows and an aluminum shell septa and screws.<br/>Layer 2-Aluminum holder, Kapton window with O-ring seal, and screws.<br/>Layer 3-Aluminum or Teflon with Kapton tape, oring seal and screws.<br/><b>Physical Approvals:</b><br/>Ambient temp</p>  | <p>Figure 1: Primary Containment Front and Side View</p>  |


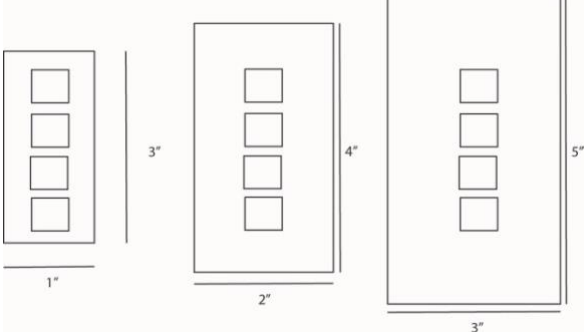
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|           | <p>liquids<br/>Drawings available from LANL if desired to build one.<br/>Figure 2: Secondary Containment</p>  |  <p>Figure 2: Secondary Containment</p>  <p>Figure 3: Tertiary Containment</p>  |
| <p>lj</p> | <p>Epi tube, screw top<br/>Layer 1-plastic vial, screw top with rubber gasket.<br/>Layer 2-Plastic heat sealed bag secondary.<br/>Layer 3-Plastic heat sealed bag</p>                          |    |

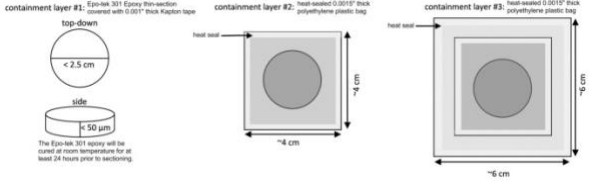

SSRL Radioactive Material sample holder catalog  
10/13/2021

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| <p>1k</p> | <p>PE Tube<br/>Layer 1-plastic vial, screw top with rubber gasket.<br/>Layer 2-Plastic heat sealed bag secondary.<br/>Layer 3-Plastic heat sealed bag</p>   |   |
| <p>1l</p> | <p>Reserved Conradson, LANL<br/>BL 10-1, 8-2<br/>Layer 1- polystyrene<br/>Layer 2-Stainless Steel vacuum structure<br/>Layer 3- glovebag</p>  |    |
| <p>1m</p> | <p>LBLN, Hu Containment<br/>Pu239 wet paste</p> <p>Layer 1-Scotch Tape<br/>Layer 2- 1.5 mil polyethylene heat sealed bag<br/>Layer 3-.5 mil polyethylene heat sealed bag</p> <p><b>Physical approvals</b><br/>Ambient</p> |  <p>Top view: Parafilm (self-sealing thermoplastic) sample encapsulation. Dark gray area shows location of Parafilm seal. Light gray area shows sample location.</p> <p>Side view: Parafilm (self-sealing thermoplastic) sample encapsulation. Enlarged sample thickness. Dark gray area shows location of Parafilm seal. White area shows location available for sample.</p> <p>Top view: (CONTAINMENT LAYER 1) Scotch tape on one side, double-sided tape on the other side of the Parafilm sample encapsulation (imagined).</p> <p>Side view: (CONTAINMENT LAYER 1) Scotch tape on one side, double-sided tape on the other side of the Parafilm sample encapsulation. (Imagined). Enlarged sample thickness.</p> <p>Top view: Containment layer 1 mounted to a rigid support. 0.005" thick polypropylene washer (light blue).</p> <p>Side view: Containment layer 1 mounted to a rigid support. 0.005" thick polypropylene washer (light blue). Thickness not drawn to scale, but measurements are correct.</p> <p>Top view: (CONTAINMENT LAYER 2) Heat sealed 1.5 mil polyethylene bag (red). Seal shown in pink.</p> <p>Side view: (CONTAINMENT LAYER 2) Heat sealed 1.5 mil polyethylene bag (red). Seal shown in pink. Enlarged sample thickness.</p> <p>Top view: (CONTAINMENT LAYER 3) Heat sealed 0.5 mil polyethylene bag (green). Seal shown in light green.</p> <p>Side view: (CONTAINMENT LAYER 3) Heat sealed 0.5 mil polyethylene bag (green). Seal shown in light green. Enlarged sample thickness.</p> |
| <p>1n</p> | <p>LANL Layers<br/>1- polystyrene film with sample deposited on its surface</p>   |   |



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|           | <p>2- Kapton windows between aluminum clamps with cap screws and indium wire.</p> <p>3- Vacuum shroud cryostat with kapton windows with torr seal, o-ring on stem of cold fingers (cannot use in cold environment).</p> <p>Approved to run in BL2-3 only</p> <p><b>Physical approvals</b><br/>Ambient temp and pressure</p>  |   |
| <p>1o</p> | <p>LANL Holder</p> <p>The <b>primary</b> 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.</p> <p>The <b>secondary</b> is identical to the primary, except larger, so that the primary is nested inside it.</p> <p>The <b>tertiary</b> 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.</p> <p><b>Physical approvals</b><br/>Ambient temp and pressure</p> |  |

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| 1p | <p>LANL Holder<br/> <b>A detailed description of the sample containment.</b> The primary Layer 1 polystyrene.</p> <p>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),</p> <p>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),</p> <p>Physical properties:<br/> ambient pressure and temperature</p>   |    |
| 1q | <p>Primary containment:<br/> <b>primary</b> 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"</p> <p>Secondary Containment:<br/> The primary is housed within a <b>secondary</b> that consists of two Kapton windows sealed to an aluminum holder with In wire. The dimensions of the secondary aluminum holder are: 4"x2".</p> <p>Tertiary Containment<br/> the secondary is mounted within the <b>tertiary</b> 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</p> |  |

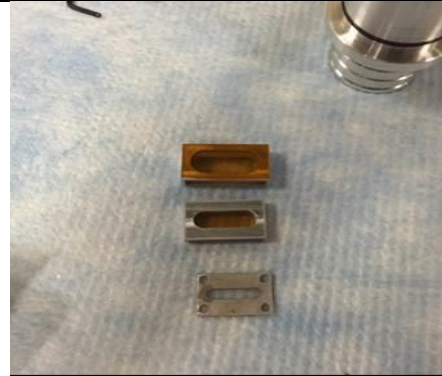
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|           | <p>secondary aluminum holder are: 5"x3".</p> <p><b>The experiment will be conducted at ambient pressure and temperature in the hutch at beam line 6-2.</b></p>   |   |
| <p>1r</p> | <p>University of Clemson, Th232.<br/>Limited to 0.2mg-</p>   | <p><b>Primary</b> containment- Epo-tek 301 Epoxy covered by 0.001 in thick Kapton tape (layer 1).</p> <p><b>Secondary</b> Heat sealed plastic bag 0.0015 in thick.</p> <p><b>Tertiary</b>-heat sealed plastic bag</p>  |
| <p>1s</p> | <p>LANL Holder-requested by Kozimor BL 4-3, 14-3</p> <p>Radionuclides approved in limited amounts are: Pu-mixture, Np-237, Am-241, Am-243, Tc-99, Th-232 and U-238.</p> <p><b>Primary containment:</b><br/>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 <math>\mu\text{m}</math> thick) is fixed to the holder with double sided tape. The edges of the tape are sealed with nail polish.</p> <p><b>Secondary Containment:</b></p> |  <p>Picture above shows the primary layer.</p>  |



The primary container is nestled within the secondary container. It is a metal slot equipped with polypropylene (4.0  $\mu\text{m}$ ) 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  $\mu\text{m}$ ) 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 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.**



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



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| <p>1t</p> | <p><b>LBNL/LANL Pu-242 –in solution and/or solid paste forms, BL 11-2</b> Amounts limited up to <math>5 \times 10^{-5}</math>g total shipment. This holder has limited exposure in the beam up to 6 hours.</p> <p><b>Primary containment:</b><br/>The primary containment will consist of one micro-centrifuge tube, such as Neptune brand 37n3.S.X series, where <math>n=3, 4,</math> or 6. The screw cap will be wrapped with Parafilm to prevent cap loosening from handling/shipping and provide additional sealing.</p> <p><b>Secondary containment:</b><br/>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.</p> <p><b>Tertiary containment:</b><br/>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.</p> <p><b>The experiment will be conducted at ambient pressure and temperatures in the hutch at beam line 11-2</b></p> |  <p>Picture shows template of the holders</p>          |
| <p>1u</p> | <p><b>LBNL- Corwin TRU,U-235, U-238 and Th-232</b></p> <p><b>Primary Containment:</b><br/>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 <b>0.002” thick</b>. The sample is loaded from a vertical chamber and sealed</p>  |  <p>Secondary body with interior o-ring in gland</p> |

with a Viton fluoroelastomer o-ring capped with a 6-32 nylon screw.



**Secondary and Tertiary Containment:**


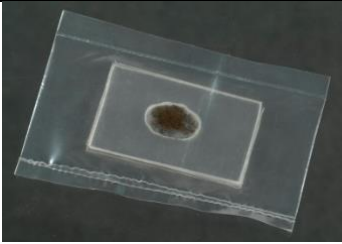
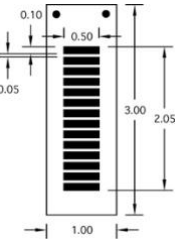

The sample cell secondary and tertiary holders each encapsulate three vertically-stacked primary holders. Each consists of a body and two lids (one on each side), all made with PVDF and Kapton windows. The secondary and tertiary lids are all sealed with an interior Viton fluoroelastomer o-ring between 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.**






Tertiary body

**With six screws per lid, the secondary holder**

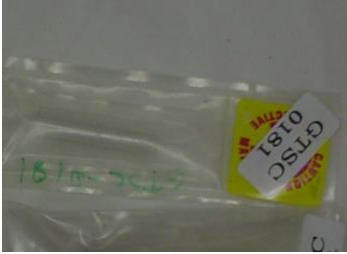
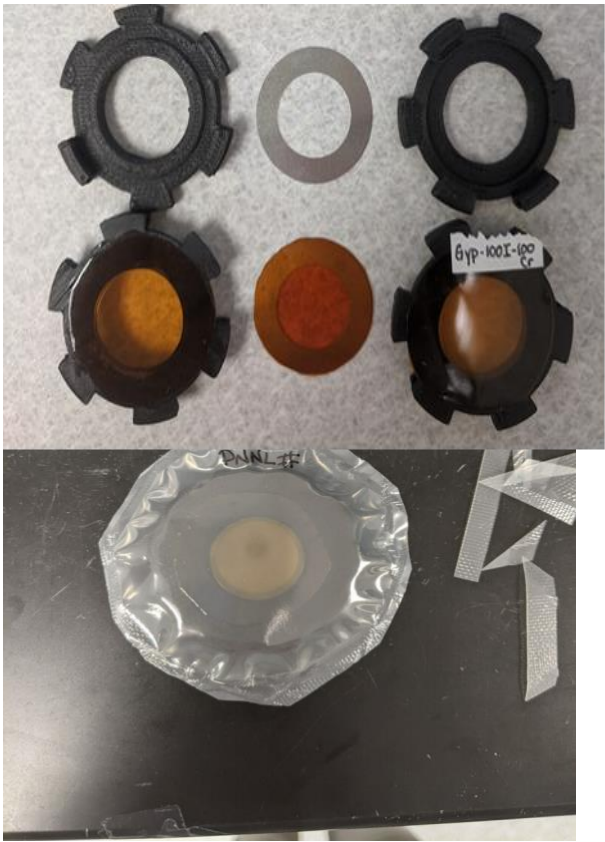
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|           | <p><b>2 Layers containment for Low Radiotoxicity (Group 3)</b></p>  |   |
| <p>3a</p> | <p>LBNL- User Lukens<br/>Lexan or aluminum sample holder with kapton tape. This is a piece of teflon (1.5 inch by 0.75 inch by 0.125 inch, if I remember 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.</p> <p><u>Layer 1- Kapton Tape, sealed</u><br/><u>Layer 2- sealed plastic bag</u><br/><b>Physical approvals</b><br/><b>Ambient</b></p> |  |
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| <p>3c</p> | <p>LBNL (Tc99)- User Lukens<br/>Layer 1-Kapton film with indium seal and cap screws. Mylar film may only be used for ambient conditions.<br/>Layer 2- cryostat holder with kapton</p> <p><b>Physical approvals</b><br/>Ambient, vacuum, cold</p>   |   |
| <p>3d</p> | <p><b>2 Layers</b><br/>Primary containment: Plexiglass (Lexan) holder with sample set into a window, sealed with adhesive tape with the following specifications:<br/><i>Adhesive tape: ISC Helicopter-IG Surface Guard Tape (Indoor Grade) (J" wide) with the following properties:</i><br/>Adhesive: rubber Carrier Backing: polyurethane film Thickness: 4.5 mils<br/>Adhesion: 40 ounces per inch (to stainless steel) Tensile Strength: 48 pounds per inch (longitudinal).</p> <p>Secondary containment: Heat sealed linear low density polyethylene bag, with thickness of 2 mil.</p>  |   |
| <p>3e</p> | <p><b>2 layers</b><br/><b>Tc99</b><br/>Two layers of containment for moderate toxicity radioisotope.<br/><b>First containment</b> 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. <b>The second containment</b> will be to encase the aluminum plate in 5 micron thick polypropylene film. This will be held in place with adhesive.</p> <p>At the beam line this wrapped plate will be installed into a sealed aluminum box that includes the detector system that is also</p> |  <p>Aluminum<br/>0.10" thick<br/>mounting holes go to adapter on vertical translator</p>  |

SSRL Radioactive Material sample holder catalog  
10/13/2021



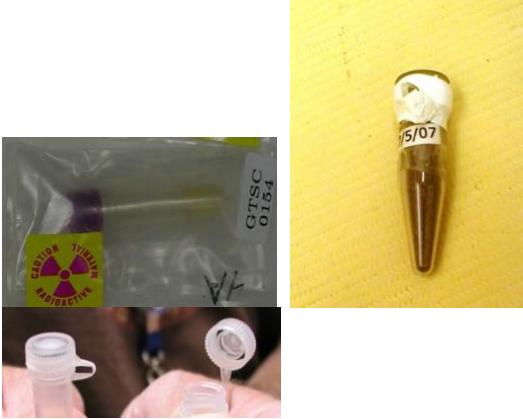
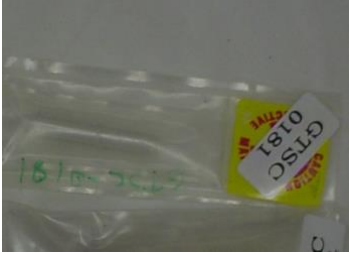
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|    | <p>fastened to the beam port and will be filled with 1 atm of helium.</p> <p><b>Physical approvals</b><br/>Ambient temperature and pressure.</p>   |   |
| 3f | <p>Epi tube, screw top<br/>Layer 1-plastic vial, screw top or pop top with glue with rubber gasket.</p> <p>Layer 2- Heat sealed Plastic bag</p> <p>Uses-Liquid sample in 2 mL, screw-top, polypropylene centrifuge tube inside three layers of heat-sealed plastic.</p> <p><b>Physical approvals:</b><br/>Room temperature</p> |    |

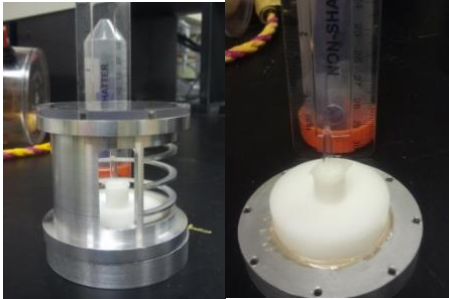
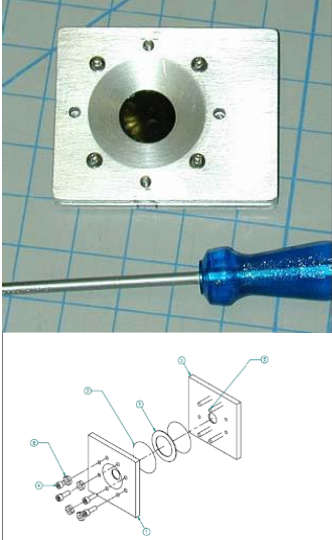


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| <p>3g</p> | <p>User: Lukens, LBNL</p> <p>Layer 1-Sample polyethylene tube with gasket epoxy glue.</p> <p>Layer 2 in heat sealed plastic bag.</p> <p>Powder sample in heat-sealed plastic tube (actually a plastic pipette in this case although I also use heat sealed Epi tubes) inside three layers of heat-sealed plastic.</p>  |   |
| <p>3h</p> | <p><b>User: Sarah Saslow PNNL</b></p> <p><b>Solid samples only</b></p> <p><b>Primary Containment Layer:</b><br/>Kapton Film (<math>\geq 0.001</math>" thick)<br/>epoxied to each side of the stainless-steel shim<br/>Note, sample will be embedded in epoxy within the stainless-steel shim/Kapton film windows, which will improve containment</p> <p><b>Secondary Containment Layer:</b><br/>Kapton Film (<math>\geq 0.001</math>" thick)<br/>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.</p> <p><b>Interior holder</b> 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</p> <p><b>Exterior holder</b> is 3D printed with Onyx plastic composite (blueprints and Onyx SDS attached) 3.5 – 6 mm thick with a</p> |  <p>Bottom updated Picture to include a third layer to account for the Pu and amounts as described by the PI</p> |

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|            | <p>1.7" outer diameter and a 0.7" diameter window.<br/>Updated on May 28, 2021 a third layer will be added for samples containing small amounts of Pu and or Am.<br/><b>Third Containment Layer (TRU Samples Only):</b> Heat sealed plastic bag consisting of po with 4.5 mil thickness (0.0045" or 0.1143 mm)<br/>The holder may contain, Pu up to 50 µg in solid form, and/or Am up to 1 µg in solid form.</p>  |  |
|            | <p><b>1 Layer containment for Low Radiotoxicity (Group 4)</b></p>   |  |
| <p>4.a</p> | <p><b>LBL- User Lukens</b><br/>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</p> |  |

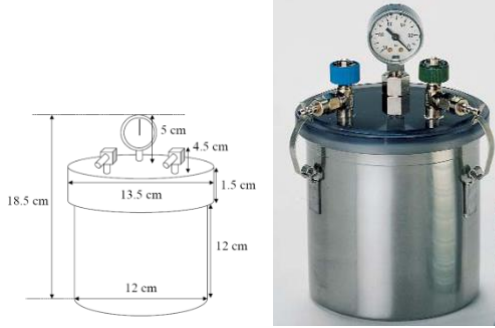
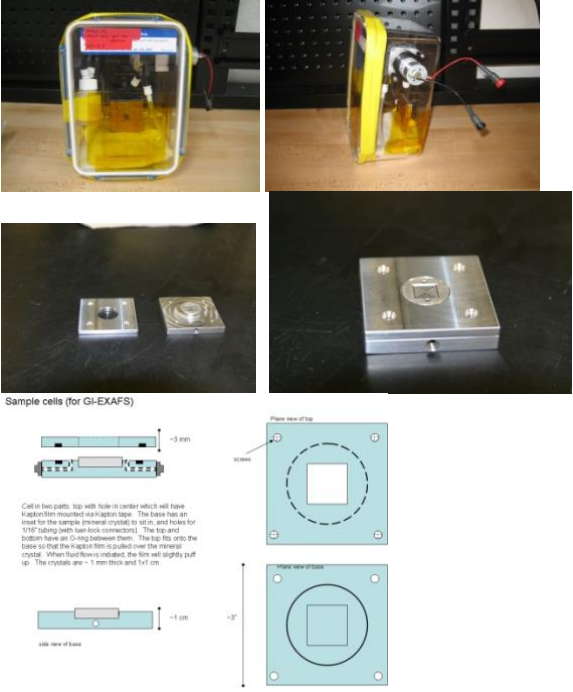
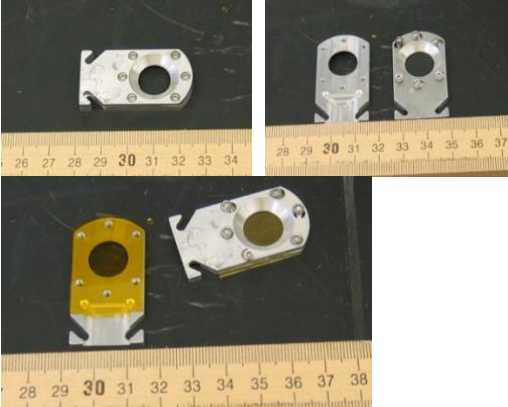
SSRL Radioactive Material sample holder catalog  
10/13/2021

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|            | <p>only minimally scattered/absorbed by the bag.<br/>Layer 1- Kapton Tape, sealed<br/>Physical approvals:<br/>Ambient</p>  |  |
| <p>4.b</p> | <p>Slotted metal sample holder with unpolished polystyrene sample material<br/>Layer 1-polystyrene</p>   |    |
| <p>4.c</p> | <p>Slotted metal Al sample holder with kapton tape and bolting ring<br/>Layer 1-Epoxyed sealed kapton tape 1 side, indium sealed cap screw inside bolting ring, cap screws on kapton tape other side.<br/><br/><b>Physical approvals:</b><br/>Ambient, Cold, vacuum w</p>  |    |
| <p>4.d</p> | <p>Epi tube, screw top<br/>Layer 1-plastic vial, screw top with rubber gasket.<br/>Plastic seal bag secondary.<br/><br/>Uses-Liquid sample in 2 mL, screw-top, polypropylene centrifuge tube inside three layers of heat-sealed plastic.<br/><br/><b>Physical approvals:</b><br/>Room temperature</p>            |  |
| <p>4.e</p> | <p>Epi tube, heat sealed<br/>Layer 1-Sample polyethylene tube with glue sealed cap in plastic bag.<br/><br/>Uses: Lukins, LBNL<br/>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.</p> |  |

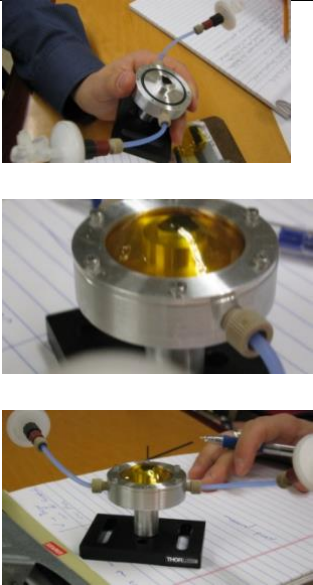
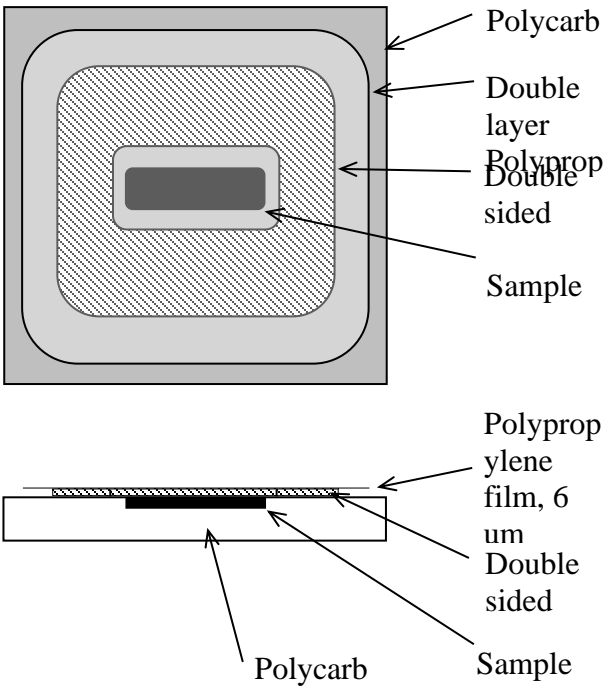

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|  | <p><b>Physical approvals:</b><br/>Room temperature</p>   |   |
| <p>4.f<br/><b>This holder is not automatically approved.</b></p> | <p>Layer 1-quartz capillaries with flame sealed ends or epoxy. Mounted with double back tape X-ray scattering.<br/>Layer 2-Must be used with a secondary protective containment cylinder.</p> <p><b>Physical approvals:</b><br/>Room temperature<br/>Ambient pressure</p>  |  <p><b>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.</b></p> |
| <p>4.g</p>   | <p>John Barger Holder<br/>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.</p> <p>Layer 1 –Capton , Mylar Mica window<br/>Al gasket ID of bolting ring</p> |    |

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| <p>4.h</p>   | <p>Bolted Aluminum Holder<br/>Layer 1- Kapton Tape<br/>Aluminum gasket or indium gasket.</p> <p><b>Physical approvals:</b><br/>- Room temperature<br/>- Cold in cryostat under vacuum.</p>                                       |  |
| <p>4.i</p>   | <p>Carbon Films, LANL loaded inside vacuum chamber device<br/>Uranium<br/>Layer 1-Polished polystyrene inside plastic. (polished polystyrene alone is not approved as primary containment)</p> <p><b>Physical Approvals:</b></p> |  |
| <p>4j</p>  | <p>LBNL<br/>Kapton film with indium seal and cap screws. Mylar film may also be used.</p> <p><b>Physical approvals</b><br/>Ambient, Cold, vacuum</p>   |  |
| <p>4k<br/><b>This holder is not automatically approved</b></p> | <p>SLAC, Uranium capillary<br/>Kapton film with plexiglass and aluminum/plastic caps. cap screws and O- ring on ends.<br/><b>A request needs to be submitted for each run due to the fragile nature of capillary.</b></p>        |  |



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| <p>4l</p> | <p>Containment for transport to Campus</p> <p>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. <b>Inner package of radioactive Uranium is contained in a sealed plastic bag.</b></p>  |    |
| <p>4m</p> | <p>LBNL, Singer Containment<br/><b>Aneropak Box</b></p> <p><b>Primary Containment-</b> 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.</p> <p>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 Anaeropak Box:</p> <p><b>Physical approvals</b><br/>Ambient</p> |   |
| <p>4n</p> | <p>LANL containment<br/>Conradson</p> <p><b>Physical approvals</b><br/>Ambient</p>   |  |



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| <p>4o</p> | <p>Dave Singer, LBNL</p> <p>Magnetite dipped in U238</p> <p>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</p>   |   |
| <p>4p</p> | <p>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).</p> <p>Stosh LANL<br/>The three holders may contain up to 50 mg DU, in solid form.</p> |  <p>Figure 2. A schematic of a loaded sample holder complete with sample, PP film, and adhesive tape.</p>  |

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

Primary layer

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.

Secondary layer

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.

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

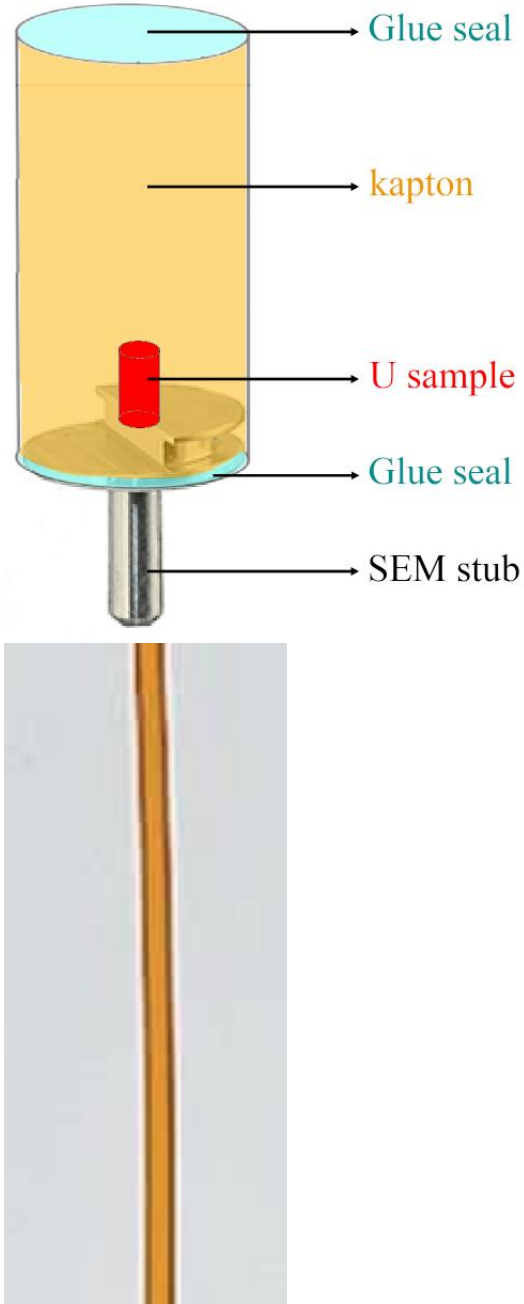


Round Single slot; 50 mg DU; solid:  
16.5 mm x 25.4 mm x 1 mm (rounded edges)



Square four slot; 50 mg DU; solid:  
26 mm x 50 mm x 1 mm






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| <p>4q</p> | <p>Johanna Weker SLAC<br/>BL 2-2 and 6-2<br/>Holder description:<br/>Enriched uranium (4% <math>^{235}\text{U}</math>) as cylindrical pillars of dimension (<math>\leq 400\ \mu\text{m}</math> length, <math>\leq 75\ \mu\text{m}</math> diameter)<br/>Total solid uranium mass (per cylinder): <math>&lt; 1\ \text{mg}</math> of enriched uranium (3.5%) U<br/>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 <math>\sim 2\ \text{cm}</math>, so that the sample is effectively contained in the capillary.<br/>The sample will have one layer of containment.<br/><b>Primary containment layer</b> is Kapton capillary (<math>\sim 12.7\ \text{mm}</math> diameter) and thickness <math>\geq 3\ \text{mil}</math> (<math>\geq 0.762\ \text{mm}</math>)</p> |  <p>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</p> |
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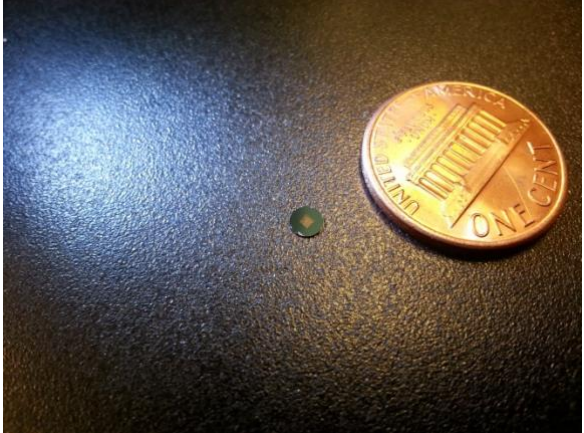

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| <p>4q</p> | <p><b>Primary containment:</b><br/>The sample holder is constructed from clear polycarbonate. The space for the sample is a channel 3 cm long, 1 cm wide, and 1 cm deep. See attachment A. The sidewalls are 5 mm thick, and the rear wall 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).</p> <p><b>Secondary containment:</b><br/>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.</p> <p><b>Physical approvals</b><br/>Ambient</p> |  |
| <p>4r</p> | <p><b>LANL</b><br/><b>Primary Containment</b><br/><b>Uranium 238 and Unat only</b></p> <ul style="list-style-type: none"> <li>- During shipping is a stainless steel coffin, see Scheme 1.</li> <li>- During chamber loading is a glovebag over the chamber opening.</li> <li>- During the experiment is the chamber.</li> </ul> <p><b>Physical approvals</b><br/>Ambient</p>  |  |

SSRL Radioactive Material sample holder catalog  
10/13/2021



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|           |   | <p>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.</p> <p>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.</p> |
| <p>4s</p> | <p><b>LANL- Stosh<br/>BL 6-2</b><br/> <b>1<sup>st</sup> layer</b> – 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<br/> <b>2<sup>nd</sup> Layer-</b><br/>         Kapton and plexiglass</p> <p>U-238, U-nat only</p> <p>Uranium is Powder</p> <p>Room temperature and ambient pressures</p> |  |

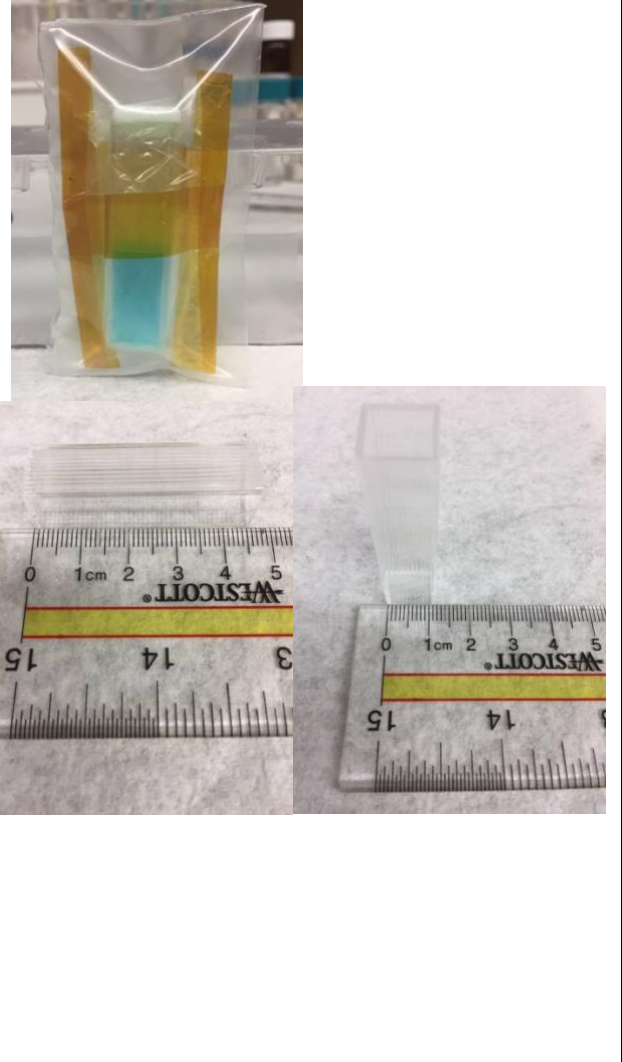
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| <p>4t</p> | <p><b>SSRL – Bargar Thin sections</b><br/>The thin sections will be epoxied/glued to a standard glass/plastic microscope slide.<br/>U-nat<br/><b>Primary Containment:</b> The epoxy will be the containment for the thin section.</p> <p>Monochromatic beam<br/>2 to 38 keV</p> <p><b>Physical approvals</b><br/>Ambient</p>  |    |
|           | <p><b>PNNL- Saslow-U<sub>nat</sub> Particles in polymer film</b><br/>The polymer film thin sections will be glued or taped to a standard glass/plastic microscope slide the particles are imbedded in polymer.</p> <p><b>Primary Containment:</b> The polymer film will be the containment for the particles.</p> <p>Monochromatic beam<br/>2 to 38 keV</p> <p><b>Physical approvals</b><br/>Ambient</p>  |    |
| <p>4u</p> | <p>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.</p> <p>a. Sediments will be deposited onto a clean silicon wafer in water or an organic solvent and allowed to dry in place.</p> <p>b. Sediments will be deposited onto carbon tape. c. Sediments will be pressed into a metal foil such as indium or copper.</p> |  |



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|           | <p><b>Primary Containment:</b></p> <p>Monochromatic beam<br/>2 to 38 keV</p>  |  |
| <p>4v</p> | <p>Samples are uranyl fluoride microparticles (~ 1 micron diameter) sealed between two silicon nitride windows with epoxy.</p> <p>14 <math>\mu\text{g}</math> of <math>\text{UO}_2\text{F}</math> limit.</p> <p>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.</p> <p>Only approved for BL 13-1 for PNNL</p>   |    |
| <p>4w</p> | <p>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 <b>two polypropylene windows</b> and a <b>Viton</b> 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.</p> <ul style="list-style-type: none"> <li>• 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).</li> <li>• The holder is only approved for room <b>temperature measurements at ambient pressure.</b></li> </ul> |  |

SSRL Radioactive Material sample holder catalog  
10/13/2021

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|    | <ul style="list-style-type: none"> <li>Upstream facing (beam side) windows are 4 <math>\mu\text{m}</math> thick and composed of polypropylene.</li> </ul> <p>LANL</p>   |   |
| 4x | <p>Kristin Boye</p> <p>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.</p> <p>Layer 1-single layer of Kapton (0.002-0.01) self-adhesive tape on both front and back.</p>  |   |
| 4y | <p><b>Abney Carter-ORNL- Udep and Unat BL 11-2</b></p> <p>All samples are prepared as powders, contained within a nylon flat washer. The inner area of the washer is 0.193 cm<sup>2</sup>; 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.</p> <p>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).</p> |  |

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|    | <p>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.</p>   |   |
| 4z | <p><b>Abney Carter-ORNL- Udep liquid form BL 11-2</b></p> <p>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 &gt; 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).</p> <p>Samples will be investigated under ambient temperatures. Under these conditions, all components of sample holder and containment <i>have previously been exposed to high flux synchrotron radiation for extended times, similar to the energy and flux on BL 11-2.</i> No material failures have been observed.</p> <p>Experiment Conducted in Ambient temperature and pressure</p> |  |

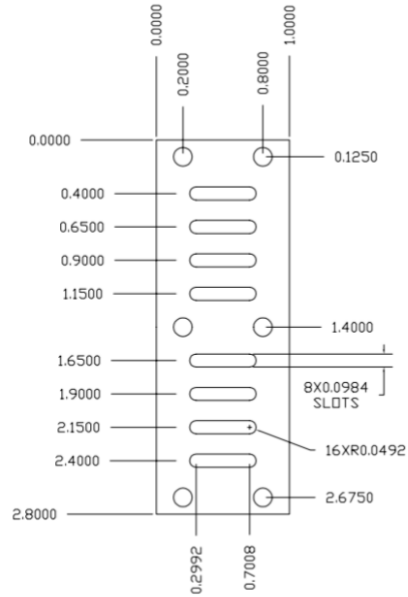
4za

**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"





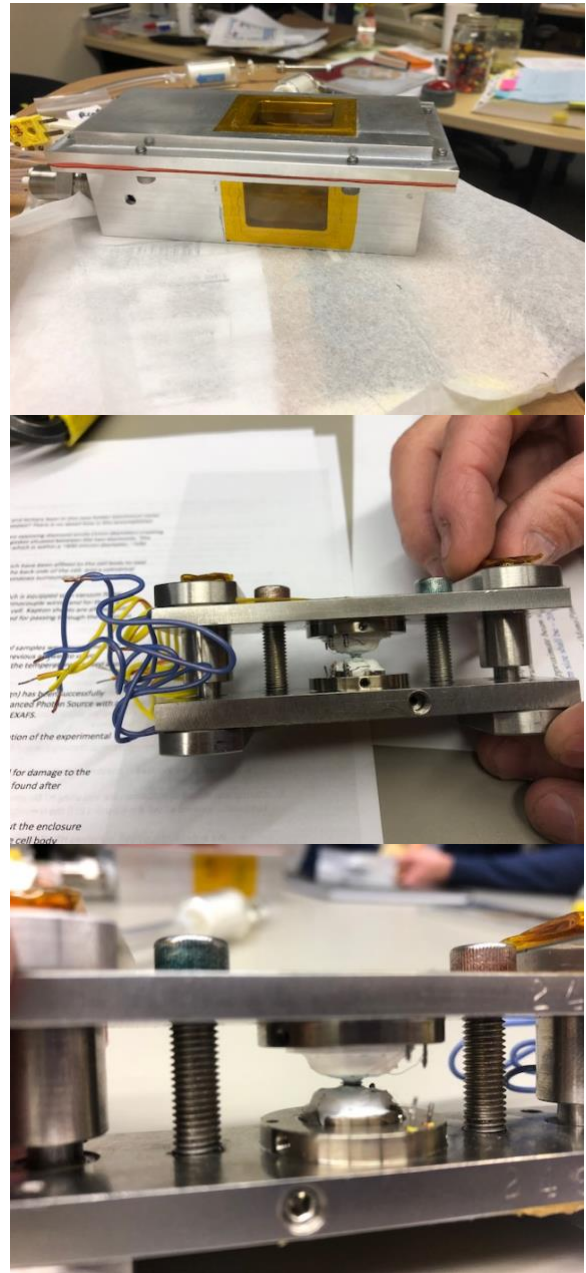
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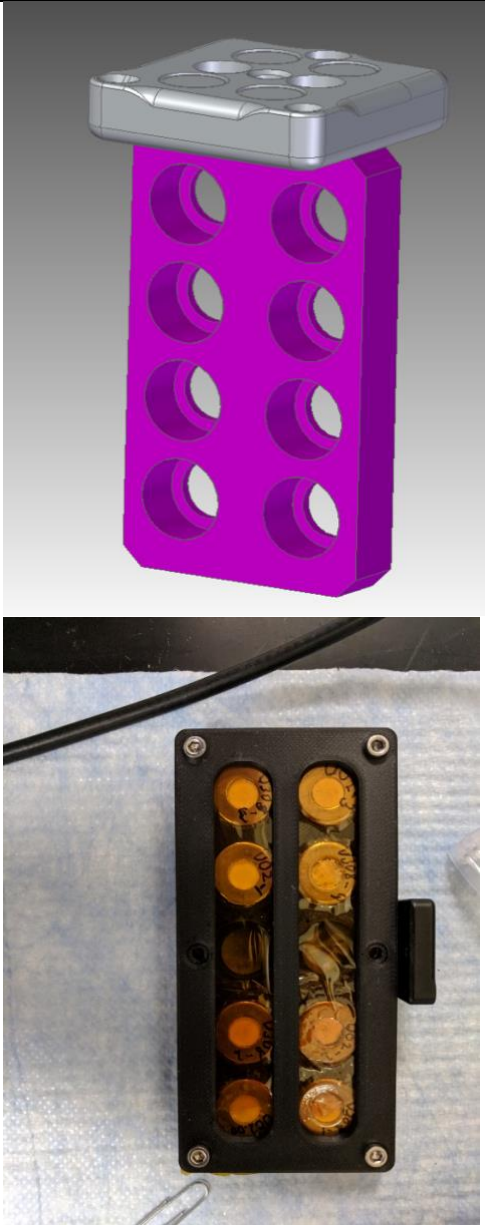
**Jason Baker- LANL BL 11-2  
approved on December 4, 2018  
U-238 and U depleted  
Sample description:**

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



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|     | <p>immediately if the temperature is raised above the highest set point.</p>  |   |
| 4zc | <p><b>Arjen van Vellen SSRL<br/>U-natural</b><br/><b>Sample description</b><br/>The holder may contain up to 50 mg DU, in solid form, it contains 8 slots.<br/>The holder is made of Onyx plastic (carbon/nylon fibers) with the following dimensions:<br/>a) 8 slots holder: 30 x 45 x 6 mm<br/>b) Pellet holder: 1.5 x 12 mm washer with 7.5 mm hole.<br/><b>Primary</b><br/>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.<br/><b>Secondary</b><br/>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.</p> |  <p>The image shows two views of the sample holder. The top view is a 3D CAD model of a purple rectangular holder with eight circular slots arranged in two columns of four. A grey top cap with eight corresponding circular openings is shown above it. The bottom view is a photograph of the physical black holder, which is filled with eight yellowish-orange pellets. The holder is mounted on a blue surface with a black cable running across it.</p> |



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.*

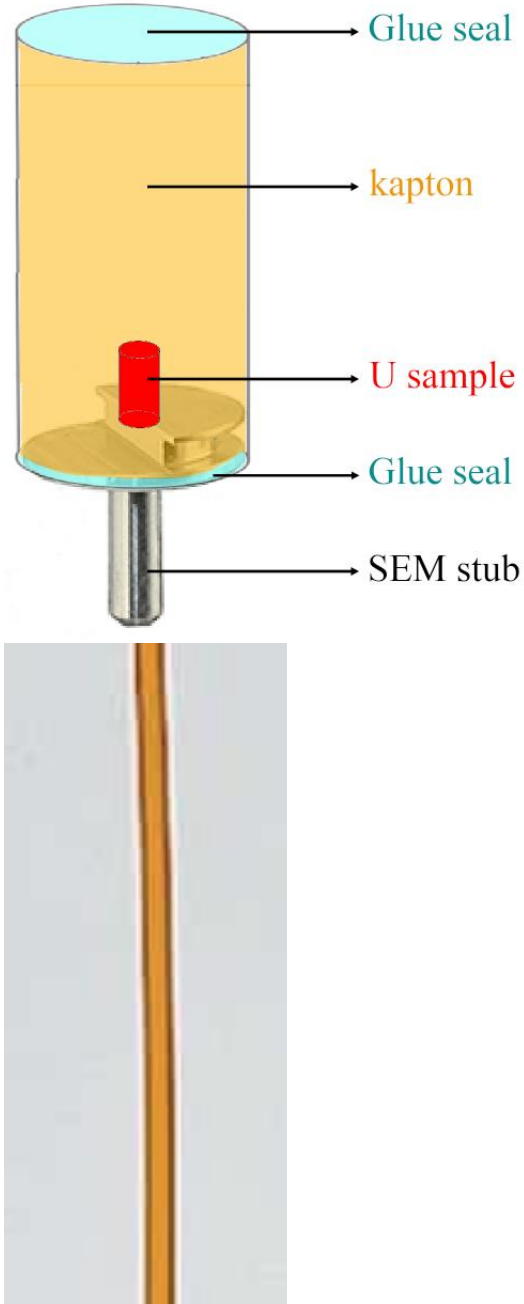
The holder consists of:

- 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



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| <p>4ze</p> | <p>Johanna Weker SLAC<br/>BL 2-2 and 6-2<br/>Holder description:<br/>Enriched uranium (4% <math>^{235}\text{U}</math>) as cylindrical pillars of dimension (<math>\leq 400\ \mu\text{m}</math> length, <math>\leq 75\ \mu\text{m}</math> diameter)<br/>Total solid uranium mass (per cylinder): <math>&lt; 1\ \text{mg}</math> of enriched uranium (3.5%) U<br/>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 <math>\sim 2\text{cm}</math>, so that the sample is effectively contained in the capillary.<br/>The sample will have one layer of containment.<br/><b>Primary containment layer</b> is Kapton capillary (<math>\sim 12.7\ \text{mm}</math> diameter) and thickness <math>\geq 3\ \text{mil}</math> (<math>\geq 0.762\ \text{mm}</math>)</p> |  <p>Glue seal<br/>kapton<br/>U sample<br/>Glue seal<br/>SEM stub</p> <p>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</p> |
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SSRL Radioactive Material sample holder catalog  
10/13/2021

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