Qynergy[SM]

Qynergy Corporation
3800 Osuna Road NE Suite 2
Albuquerque, NM 87109-4401
Office: (505) 890-6887
Fax: (505) 792-8508

4 December 2007

Joshua Palotay
United States Nuclear Regulatory Commission
Office of Federal and State Materials
And
Environmental Management Programs-MSSA/SSSB
Two White Flint North
11545 Rockville Pike
North Bethesda, MD 20852-2738

RE: Response to the request for additional information regarding the SS&D evaluation for the KRT-2000 Betavoltaic Power Cell

Dear Mr. Palotay:

This letter is in response to your request for more information regarding the KRT-2000 Betavoltaic Power Cell dated November 6, 2007. We have enclosed responses to each of your requests and provided supporting documents where necessary. We have also enclosed electronic files for those items requested in electronic format.

I will be temporarily out of the country until December 26, 2007. If you have any questions before that, please contact Dr. Christopher Eiting at (505) 314-1425 or chris.eiting@qynergy.com . I can be reached at either (505) 314-1422 or stephanie.jones@qynergy.com after December 26th. Thank you.

Sincerely,

Stephanie Jones
Quality Manager

Enclosure: Response
CD-Qynergy response to 11-6-07 request for info for the KRT-2000
Amended Page 1-Registry of Sealed Sources and Devices Safety Evaluation
Feedthrough Specifications (2 pages)
Excerpts from NAVSEA Crane Phase II Testing (9 pages)
Crimp Tool Specifications (2 pages)
Fluke Calibration Report (2 pages)
Impact Location Illustration

Cc: Todd Bisio, President, Qynergy
Christopher Eiting, Director of Engineering, Qynergy
Viswanath Krishnamoorthy, Director of Technology and Quality Assurance, Qynergy

Additional Information for the Application Requesting Sealed Source and Device Registry of the KRT-2000 Betavoltaic Power Cell (QynCell™)

1. **Summary Information**
   - **1.1.** In response to your inquiry regarding Specific or General Licensees, please replace page 1 with the amended form attached here. The product is intended for Specific Licensees only.

2. **Construction of the Product**
   - **2.1.** In response to your inquiry regarding the KALREZ gasket, the gasket is strictly intended as a water tight seal for the cap. This concerns the functionality of the device alone and does not contribute to the containment of the radioactive material.
   - **2.2.** In response to your inquiry regarding the electrical feedthrough, we have attached the specification sheets and drawings from CeramTec for this part. It is a Ceramaseal 9297-06-W. The material list includes 304 stainless steel for welding, alumina ceramic for electrical isolation, and Molybdenum for electrical connection. We have also attached excerpts from testing of an early design of the KRT-2000 performed at NAVSEA Crane. This testing was preliminary testing of prototypes for the express purpose of finding any potential areas of improvement in the design that would make the KRT-2000 more robust and reliable. The feedthroughs used in the final design of the KRT-2000 were also used in the early prototype with identical welds. These devices were subjected to 100 Mrad of radiation from a ^{60}Co gamma source and then helium leak checked. This dose far exceeds the dose expected under normal operating conditions. Calculations have determined that in a normal use environment for the KRT-2000, the components of the device would be exposed to a total of 0.25 Mrads of dose over its twenty year lifetime from a 5 Ci loading. Also, the dose is primarily from ^{85}Kr gammas which have a peak energy of 514 keV. These do far less damage than the high energy gammas from ^{60}Co (peak energy 1332 and 1173 keV). In all cases no leak was detected after the radiation hardness environmental test.
   - **2.3.** In response to your inquiry regarding the additional shielding referred to in the Handling and Installation section. No additional shielding is required to for containment or functionality of the device. The additional shielding is simply suggested based on normal ALARA principals. Please advise us as to whether this should be removed from the section in order to avoid confusion.
   - **2.4.** Please see the response to 2.2.
   - **2.5.** In response to your inquiry regarding the hand crimping process, we have attached the specifications of the crimp tool we use (POD-375). This process is completed at Eckert & Ziegler Isotope Products after the device has been filled with ^{85}Kr. A copy of their procedure will follow this response, however all KRT-2000 QynCells are leak checked after the crimp and cap using the test method on page 22 of 27 of the Prototype Test Report in order to ensure the seal produces leak rates of no more than $1x10^{-8}$ cc/s as per our assembly procedure.

3. **Drawings**
   - **3.1.** In response to your request for a color copy of the Design Report, we have enclosed a CD with an electronic copy. Please see the response to 2.2 for the requested drawing.
   - **3.2.** In response to your request for an electronic copy of Figure 1 and 2 from the Design Report, we have enclosed a CD with a non-proprietary electronic copy.

4. **Radiation Profiles**

4.1. In response to your request for information regarding the Fluke survey meter used for the radiation profile measurements, please see the attached Calibration Report.

5. **Prototype Testing**

5.1. In response to your inquiry regarding the leak testing in Section 7.1 of the Design Report, this leak testing is a preliminary test before adding ^{85}Kr and completing the final leak check fully assembled. At this point in the assembly process, the fill tube is open, but all other components are in their final configuration and are expected to be leak tight. Once the device passes this preliminary check, it is filled with ^{85}Kr and crimped. The cap is secured to the top, and the final leak check is performed using the test method on page 22 of 27 of the Prototype Test Report.

5.2. In response to your inquiry regarding the separate tests performed on the crimp joints, these tests refer to tests performed during the evaluation of the design of the device. In order to determine whether the device design was sound before building and testing the prototypes, various components were tested. As stated in 5.1, it is possible to test the case and all of the weld joints for leak tightness before final assembly. However, it is not possible to test the crimp joint as the fill tube is used to test the rest of the welds. In order to be confident that a crimp joint could maintain leak tightness and be a reliable and repeatable step in the assembly procedure, crimp joints were made and tested independently. As stated in 5.1, once the device is fully assembled, a final leak check is performed using the test method on page 22 of 27 of the Prototype Test Report.

5.3. In response to your inquiry regarding the possible out gassing from two of the tested prototypes, the material that was suspected to be out gassing is a non-conductive epoxy that is applied to the wire leads at the top of the cap. This epoxy is used to create a hermetic seal inside the cap along with the gasket referred to in 2.1. This is not part of the containment for the radioactive material, and is only essential for the functionality of the device. It was therefore deemed acceptable as the tests we were conducting were for the radioactive material seal and not the functionality of the device.

5.4. In response to your inquiry regarding the impact and puncture test, the large face of the device was struck with the hammer as close to the center of the sealed cavity as possible. We have attached an illustration here.

5.5. In response to your inquiry regarding why this face is the most vulnerable, the finite element analysis (FEA) modeling presented in the Design Report (Section 6) indicated that under hydrostatic overpressure the large face experiences the highest level of deflection. In addition the large face allows for the greatest distance for impact away from the support structure (the walls) and therefore allows for the highest torque to be applied against the weld. It is important to note that the weakest point on the device in all cases is actually the welds. Impact and puncture on the large face puts the welds under the highest level of stress based on the FEA model results and basic principals of force.

6. **Labeling**

6.1. In response to your inquiry regarding an illustration of the label, Attachment 3 has been provided in electronic format on the enclosed CD. Please advise us as to whether this meets your requirements.

7. **Installation, Servicing, and Instructions to Users**
   7.1. In response to your inquiry regarding mounting device and apertures, there are no mounting devices or apertures for the KRT-2000. It is a stand alone device that attaches by wire to whatever the user wishes to power with it. Mounting referred to in the Instructions to Users describes the possibility that the user may wish to attach the KRT-2000 to the device they are powering for convenience sake.

8. **Proprietary Information**
   8.1. Qynergy formally withdraws any request to keep confidential or consider proprietary any of the documents submitted to the NRC. Please advise us as to whether we should resubmit the documents without the "proprietary and confidential" stamp in place.

REGISTRY OF SEALED SOURCES AND DEVICES SAFETY EVALUATION-Amended	
Name and Complete Mailing Address of the Applicant: Qynergy Corporation 3800 Osuna Rd NE Ste 2 Albuquerque, NM 87109-4401 505-890-6887 505-792-8508 (FAX)	**Name, Title, and Telephone Number of the Individual to Be Contacted if Additional Information or Clarification is Needed by the NRC:** Stephanie Jones Quality Manager 505-314-1422
The Applicant is (check one): [ ] Custom User [ ] Manufacturer [ ] Distributor [X] Manufacturer and Distributor	**If the Applicant is Not the Manufacturer, Provide the Name and Complete Mailing Address of the Manufacturer:** N/A
If the Applicant is a Custom User, Provide the Name and Complete Mailing Address of the Distributor: N/A	**Provide the Name, Complete Mailing Address, and Function of Other Companies Involved:** See page 2 for Details
Model Number: KRT-2000	**Principal Use Code (see Appendix C):** R (Gas)
Name Used by the Industry to Identify the Product (e.g., Radiography Exposure Device, Teletherapy Source, Calibration Source, etc.): Betavoltaic Power Cell: A device that captures electrons emitted by a decaying radioisotope for the purpose of producing usable electric power	**For Use by:** [X] Specific Licensees Only [ ] General Licensees Only [ ] Both Specific and General Licensees [ ] Persons Exempt from Licensing
Leak-Test Frequency: [X] Periodic Leak-Testing is Not Required (Exempt from leak test due to ^{85}Kr gas form) [ ] 6 Months [ ] Attached is justification for a leak test frequency of greater than 6 months	**Principal Section of the 10 CFR that Applies to the User (e.g., General Licensees under 10 CFR 31.5):** Specific Licensees under 10 CFR 33.11 **Radionuclides and Maximum Activities (including loading tolerance):** ^{85}Kr 166.5 GBq + 20% (4.5 Ci + 20%)

CERTIFICATION:

THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30 AND 32 AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

Certifying Officer – Typed Name and Title
Christopher Eiting, PhD, PE, Director of Engineering

Signature: Christopher Eiting **Date:** 12/4/07

Feedthrough Introduction

Description

Feedthrough: An assembly which provides for the transfer of electrical power, gases or fluids from outside a hermetic chamber to the inside. Feedthroughs can provide both a hermetic seal and electrical isolation from the chamber wall. Feedthroughs are sometimes referred to as 'passthroughs.'

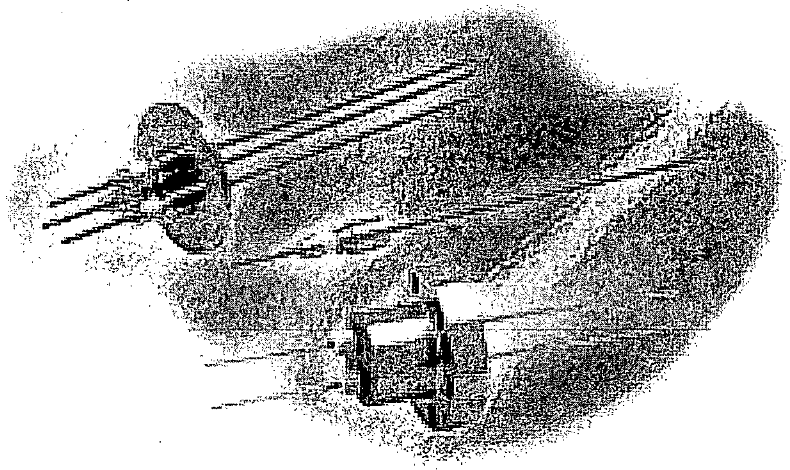
Ceramaseal feedthroughs provide the solutions for applications requiring hermeticity and electrical isolation. In addition to remaining leak-free in high and ultra-high vacuum, many of Ceramaseal's feedthroughs can accommodate:

- High temperatures
- Cryogenic temperatures
- High pressure
- Aggressive chemicals

A feedthrough is basically defined by the requirements for installation, insulation, and conductor material. The method of interconnection is flexible and left to the customer's discretion. A selection of push-on contacts can be found in the Accessories section of this catalog. If you require a feedthrough with an interconnection device (plug) refer to the Multipin Connector section of the catalog.

Standard Specifications

- Voltages to 125 kV
- Current to 1000 Amps
- Up to 41 conductors
- Temperature Range: -269° C to 450° C
- Internal Pressure 1 x 10^{-10} torr to 3000 psig



Extreme / Custom Design

- Multiple feedthrough flange assemblies
- 940-pin header assembly
- Corona-free designs to 180 kV DC
- Currents in excess of 2,500 Amps
- Pressures to 20,000 psig

Installation

Standard installation mountings include:

- Braze
- Weld (Pulse-TIG, TIG, Laser, E-Beam)
- ISO KF flange
- ConFlat flange
- NPT fitting (see Pressure section)
- 1" Baseplate (see Baseplate section)

Applications

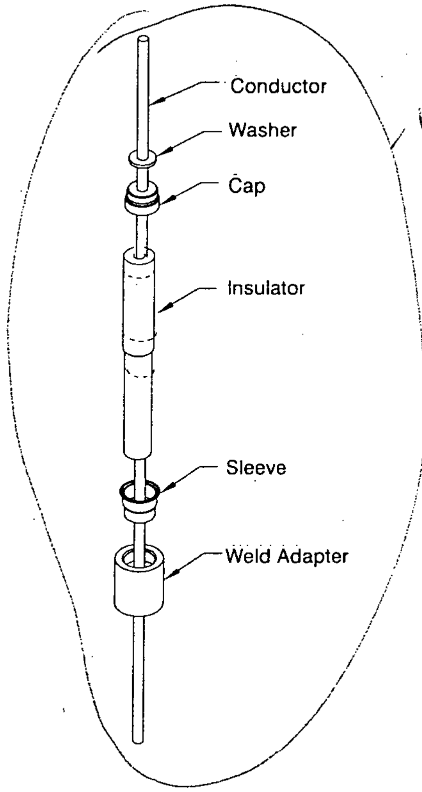
A few of the many applications in which these feedthroughs are commonly used are:

- Semiconductor processing equipment
- Particle accelerators
- Furnaces
- Analytical equipment
- In-vacuum coating
- Satellite instrumentation
- X-ray detection equipment

New Products

- RF Feedthroughs with non-magnetic materials and low coupling effects
- Feedthroughs now available in ISO KF flanges
- New high-density, low current feedthroughs

Typical Feedthrough Construction



www.ceramaseal.com

Ceramaseal A division of CeramTec
Tel: (518) 794-7800 • Within the USA: (800) 752-SEAL (7325) • Fax: (518) 794-8080 • sales@ceramaseal.com CeramTec
Leak Rate < 1x10^{-10} atm-cc/sec (He). Vacuum and pressure specifications apply to the right side of the drawing. All dimensions are in inches [millimeters]. All printed pricing and data are subject to change without notice. Contact Ceramaseal for quantity discounts.

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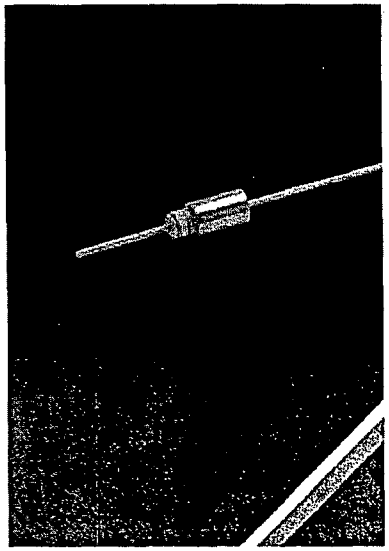
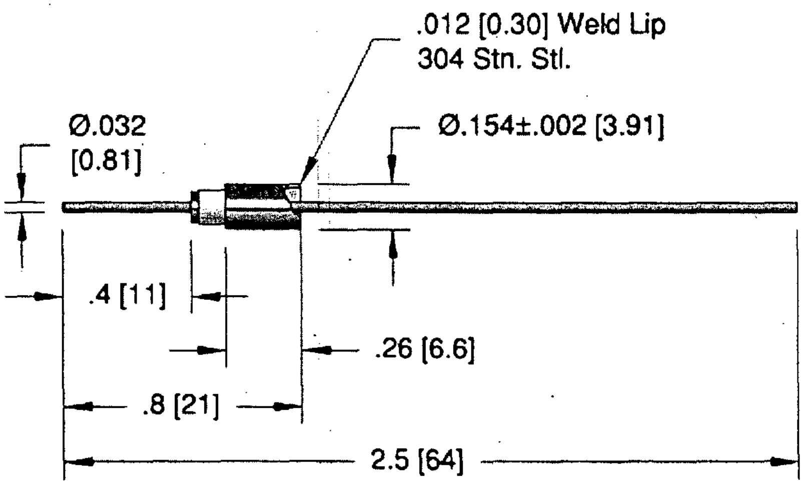
Instrumentation / Power - to 2 KV / to 16 Amps / 1 to 8 Pins

Feedthrough





Specifications

Materials

Housing: 304 Stainless steel
Pin: See table
Insulation: Alumina ceramic
Flange: 304 Stainless steel
Magnetic Materials: See table

Voltage Rating 1 kV DC

Current Rating See table

Temperature Range
-269° C to 450° C

Pressure @ 20°C
3500 PSIG (241 Bar)

Leak Rate <1x10^{-10} atm-cc/sec (He)

.032 [0.81] Dia. Single Conductor

Installation: Weld

No. Pins	Installation	Voltage DC	Conductor		Magnetic Materials	Drawing Files			Part Number
			Amps	Material		.GIF	CAD	3D	
1	Weld	1 kV	1.1	304 Stn. Stl.	No	.GIF	.DWG	.IGS	9297-03-W
1	Weld	1 kV	5	Nickel	Yes	.GIF	.DWG	.IGS	9297-01-W
1	Weld	1 kV	8.5	Molybdenum	No	.GIF	.DWG	.IGS	9297-06-W
1	Weld	1 kV	16	Copper	No	.GIF	.DWG	.IGS	9297-08-W

For welding instructions click here. For .032 lead attachment click here. A.1 PDF DATA SHEET.

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Crane Division
Naval Surface Warfare Center
300 Highway 361
Crane, IN 47522-5001

ELECTRONIC DEVELOPMENT DEPARTMENT
POWER SYSTEMS DIVISION

Qynergy Krypton-85 Qyncell Phase II Testing

EDD 609 06-163

Prepared By:

12 / 5 / 06

JASON D. LEONARD, Lead Test Engineer
Primary Power Systems Branch

Reviewed By:

12 / 5 / 2006

THOMAS E. ADAMS, Alternative Energies IPT Lead
Primary Power Systems Branch

Approved By:

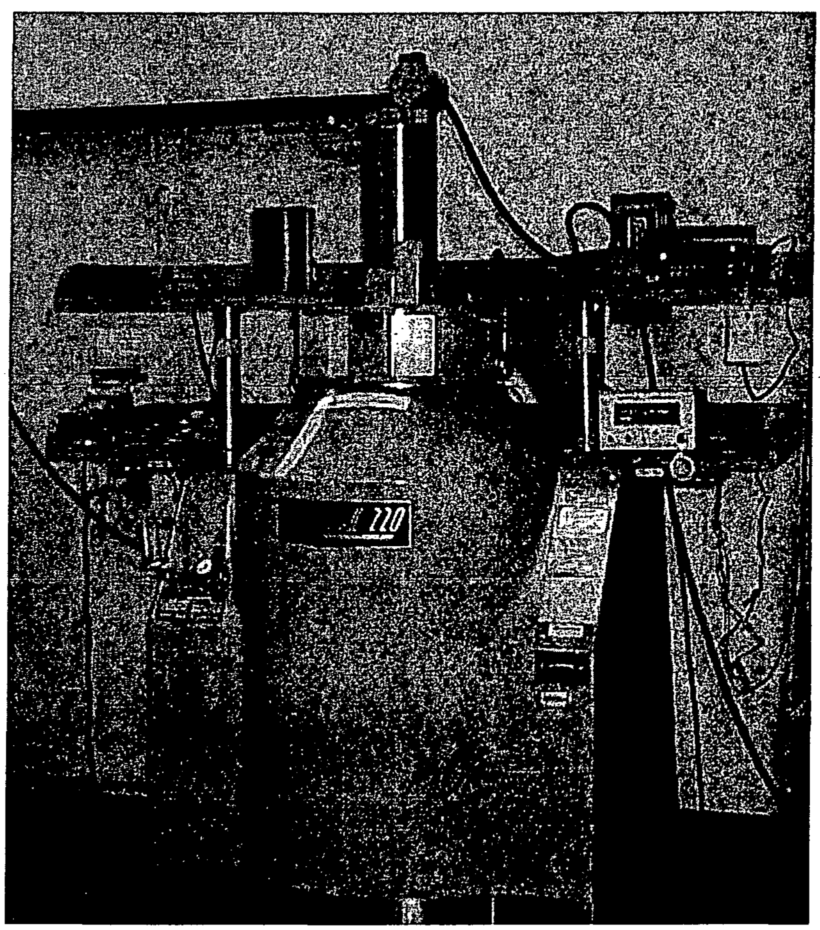
5Dec06

DAN S. KIEFFNER, Manager
Primary Power Systems Branch

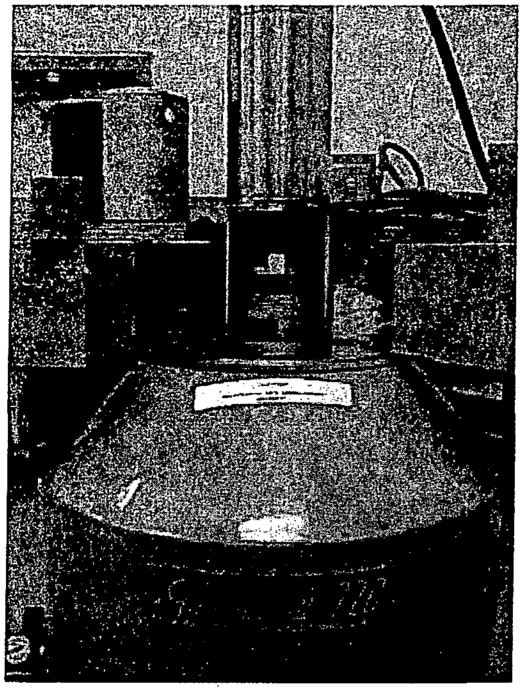
4.1.2 Radiation Hardening

Qyncells SN 15,16,17,19,20 and 22 were subjected to approximately 100 Mrad of radiation from a Cobalt-60 gamma source. After testing, a visual, dimensional, electrical, and helium leak test was performed. All cells passed the visual, dimensional and helium leak test with no notable difference from baseline. The radiation caused a voltage shift in the voltage vs. current curve of the Qyncell converter circuit board. This was considered a normal and expected response. The electronics boards in each Qyncell remained functional. See Appendix B for the electrical response graphs of each Qyncell.

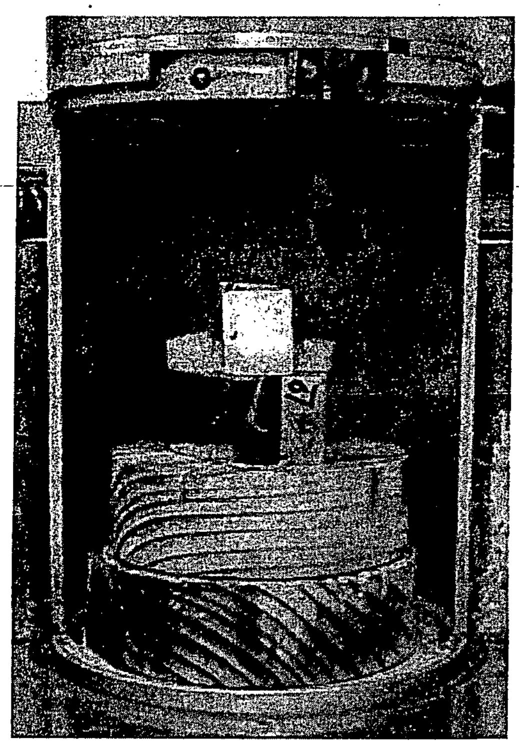
One interesting result of the radiation applied to the Qyncell was that the rubber components (wire insulation, rubber grommet, and heat shrink tubing) became brittle and began to flake off. This resulted in exposed wire leads. A special type of wire insulation called "Kynar" will be used in future Qyncell applications. This wire insulation is more resistant to the effects of radiation than standard wire insulation.



Cobalt-60 Gamma Radiation Chamber



Test Items in Gamma Chamber



Close-up of Test Items in Gamma Chamber

APPENDIX A: INSPECTION DATA SHEETS

SN 15

Test	Baseline Inspection	Post Rad-Hard	Post Vibration	Post Shock	Post Pressure	Post Temp Cycling	Post Salt Fog	Post Crush #1	Post High Temp #2
Visual									
Defects in Case?	N	N	N	N	N	N	Corrosion on outside	N	-
Defects in Welds?	N	N	N	N	N	N	Corrosion along welds	N	-
Dimensions									
Bottom to Top (1.938 in. nominal)	1.933	1.929	1.932	1.932	1.936	1.929	1.929	1.929	1.929
Front to Back (0.625 in. nominal)	0.622	0.623	0.623	0.623	0.624	0.622	0.623	0.623	0.622
Side to Side (1.125 in. nominal)	1.249	1.249	1.249	1.249	1.249	1.249	1.249	1.249	1.248
Weight (85g nominal)	89.045	89.134	89.067	89.068	89.050	89.145	89.838	89.072	87.585
Helium Leak Test									
Fine Reading (1 E-7 atm-cc/sec max.)	3.7 E-9	5.10 E-9	4.90 E-9	1.55 E-9	5.20 E-9	5.15 E-9	5.50 E-9	3.55 E-9	3.65 E-4
Electrical Test									
V @ Imax	10.40	10.50	10.40	10.30	10.30	10.70	10.30	10.20	N/A

Other Observations

Electrical leads were backwards for SN 15 (red = neg. , black = pos.).
Qyncell was not electrically functional after High Temperature Test #2.
Qyncell was used for both the High Temperature #2 test and the Crush #1 test.

SN 16

Test	Baseline Inspection	Post Rad-Hard	Post Vibration	Post Shock	Post Pressure	Post Temp Cycling	Post Salt Fog	Post Crush #1	Post High Temp #2
Visual									
Defects in Case?	N	N	N	N	N	N	Corrosion on outside	N	-
Defects in Welds?	N	N	N	N	N	N	Corrosion along welds	N	-
Dimensions									
Bottom to Top (1.938 in. nominal)	1.932	1.930	1.933	1.932	1.931	1.933	1.931	1.932	1.929
Front to Back (0.625 in. nominal)	0.624	0.623	0.623	0.623	0.623	0.624	0.624	0.623	0.636
Side to Side (1.125 in. nominal)	1.249	1.249	1.251	1.251	1.249	1.249	1.249	1.249	1.249
Weight (85g nominal)	89.203	89.313	89.227	89.233	89.230	89.312	90.148	89.284	87.505
Helium Leak Test									
Fine Reading (1 E-7 atm-cc/sec max.)	2.95 E-9	4.45 E-9	2.05 E-9	1.38 E-9	3.70 E-9	4.70 E-9	4.65 E-9	2.98 E-9	3.45 E-5
Electrical Test									
V @ Imax	4.60	4.60	4.60	4.60	4.60	4.70	4.40	4.40	N/A

Other Observations

Qyncell was not electrically functional after High Temperature Test #2.
Qyncell was used for both the High Temperature #2 test and the Crush #1 test.

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SN 17

Test	Baseline Inspection	Post Rad-Hard	Post Vibration	Post Shock	Post Pressure	Post Temp Cycling	Post Salt Fog	Post Penetration
Visual								
Defects in Case?	N	N	N	N	N	N	Corrosion on outside	-
Defects in Welds?	N	N	N	N	N	N	Corrosion along welds	-
Dimensions								
Bottom to Top (1.938 in. nominal)	1.927	1.923	1.924	1.925	1.924	1.924	1.924	1.923
Front to Back (0.625 in. nominal)	0.623	0.623	0.623	0.622	0.623	0.623	0.623	0.621
Side to Side (1.125 in. nominal)	1.250	1.249	1.250	1.249	1.250	1.249	1.249	1.337
Weight (85g nominal)	88.511	88.620	88.528	88.534	88.530	88.622	89.428	88.579
Helium Leak Test								
Fine Reading (1 E-7 atm-cc/sec max.)	3.10 E-9	4.05 E-9	3.70 E-9	3.00 E-9	4.10 E-9	4.60 E-9	4.50 E-9	3.50 E-3
Electrical Test								
V @ Imax	5.00	5.20	4.90	5.10	5.20	5.20	5.10	N/A

Other Observations

Qyncell developed a helium leak as a result of the penetration test. Helium test results are as follows:
Gross reading: 3.50 E-3
2-hour: 4.25 E-5
4-hour: 1.18 E-6
7-hour: 5.65 E-7
24-hour: 2.85 E-7
Qyncell was not electrically functional after Penetration test.

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SN 19

Test	Baseline Inspection	Post Rad-Hard	Post Vibration	Post Shock	Post Pressure	Post Temp Cycling	Post Salt Fog	Post Penetration
Visual								
Defects in Case?	N	N	N	N	N	N	Corrosion on outside	-
Defects in Welds?	N	N	N	N	N	N	Corrosion along welds	-
Dimensions								
Bottom to Top (1.938 in. nominal)	1.934	1.930	1.929	1.929	1.928	1.929	1.929	1.932
Front to Back (0.625 in. nominal)	0.624	0.624	0.624	0.624	0.623	0.624	0.624	0.623
Side to Side (1.125 in. nominal)	1.250	1.248	1.249	1.249	1.249	1.249	1.249	1.281
Weight (85g nominal)	89.068	89.020	89.101	89.106	89.110	89.104	89.903	89.078
Helium Leak Test								
Fine Reading (1 E-7 atm-cc/sec max.)	5.4 E-9	3.6 E-9	5.05 E-9	5.45 E-9	4.45 E-9	4.65 E-9	4.40 E-9	3.70 E-9
Electrical Test								
V @ Imax	5.80	5.60	5.90	6.00	6.10	5.90	N/A	N/A

Other Observations

Qyncell was not electrically functional after salt fog test. This was due to corrosion of the wire leads. During the radiation hardening test wire insulation became brittle and fell off. Afterwards Kynar insulation was applied to as much of the wire leads as possible, but some of the wire near the Qyncell cap was still exposed. This exposed wire became corroded during the salt fog test.

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SN 20

Test	Baseline Inspection	Post Rad-Hard	Post Vibration	Post Shock	Post Pressure	Post Temp Cycling	Post Salt Fog	Post Crush #2	Post High Temp #1
Visual									
Defects in Case?	N	N	N	N	N	N	Corrosion on outside	-	-
Defects in Welds?	N	N	N	N	N	N	Corrosion along welds	-	-
Dimensions									
Bottom to Top (1.938 in. nominal)	1.929	1.929	1.927	1.927	1.927	1.929	1.927	-	1.928
Front to Back (0.625 in. nominal)	0.628	0.628	0.628	0.628	0.627	0.628	0.628	-	0.648
Side to Side (1.125 in. nominal)	1.254	1.252	1.252	1.252	1.251	1.251	1.251	-	1.251
Weight (85g nominal)	89.491	89.460	89.519	89.523	89.520	89.530	90.068	-	88.720
Helium Leak Test									
Fine Reading (1 E-7 atm-cc/sec max.)	3.85 E-9	3.2 E-9	4.05 E-9	4.90 E-9	3.65 E-9	3.85 E-9	3.60 E-9	4.5 E-9	2.38 E-6
Electrical Test									
V @ Imax	4.60	6.50	4.90	6.40	6.30	4.90	N/A	N/A	N/A

Other Observations

Qyncell was not electrically functional after salt fog test. This was due to corrosion of the wire leads. During the radiation hardening test wire insulation became brittle and fell off. Afterwards Kynar insulation was applied to as much of the wire leads as possible, but some of the wire near the Qyncell cap was still exposed. This exposed wire became corroded during the salt fog test.
Qyncell was used for both High Temperature test #1 and Crush test #2.

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SN 22

Test	Baseline Inspection	Post Rad-Hard	Post Vibration	Post Shock	Post Pressure	Post Temp Cycling	Post Salt Fog	Post Crush #2	Post High Temp #1
Visual									
Defects in Case?	N	N	N	N	N	N	Corrosion on outside	-	-
Defects in Welds?	N	N	N	N	N	N	Corrosion along welds	-	-
Dimensions									
Bottom to Top (1.938 in. nominal)	1.932	1.931	1.930	1.930	1.930	1.930	1.930	-	1.930
Front to Back (0.625 in. nominal)	0.622	0.623	0.623	0.623	0.624	0.622	0.622	-	0.654
Side to Side (1.125 in. nominal)	1.248	1.248	1.248	1.248	1.248	1.248	1.248	-	1.248
Weight (85g nominal)	88.380	88.350	88.386	88.391	88.358	88.395	88.392	-	86.470
Helium Leak Test									
Fine Reading (1 E-7 atm-cc/sec max.)	5.30 E-9	2.30 E-9	3.95 E-9	4.00 E-9	3.30 E-9	3.65 E-9	3.55 E-9	1.35 E-8	3.20 E-9
Electrical Test									
V @ Imax	5.20	5.10	5.60	5.60	5.60	5.60	5.60	N/A	N/A

Other Observations

-

Qyncell was not electrically functional after High Temperature test #1.
Qyncell was used for both High Temperature test #1 and Crush test #2.

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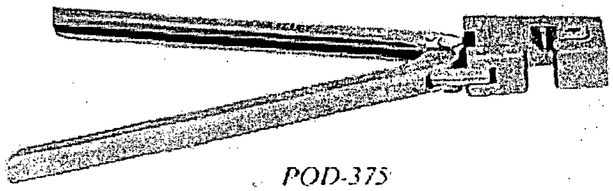
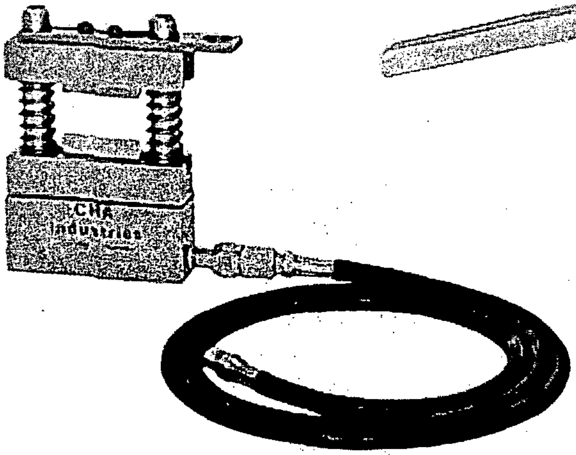
CHA Industries
4201 Business Center Drive • Fremont, CA 94538 • 510/683-8554 • Fax 510/683-3848

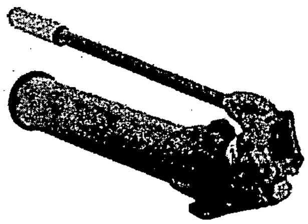
Cold-Weld Pinch-Off Devices



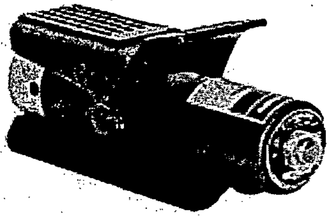
POD-375



POD-749



POD-750 (includes 749)



POD-751 (includes 749)

Device dimensions on reverse of this sheet.

CHA devices for pinching off tubing produce a hermetically perfect cold-weld of tube walls; ends are neat and clean. The most common application is pinching off vacuum exhaust tubing of fully annealed OFHC copper. Other soft metals, such as fully annealed aluminum, .070" OD × .010 wall Kovar, annealed nickel, thin wall 52 alloy and platinum, can be pinched off. While not primarily for pressure applications, the CHA vacuum seal will hold relatively low pressures (75-100 lbs.)

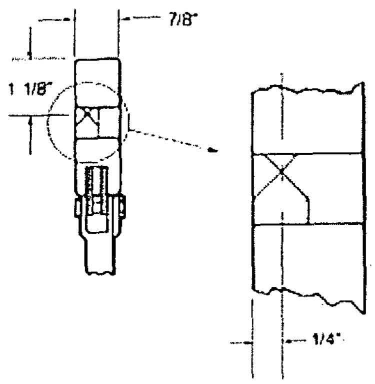
Jaws are hardened, ground, high speed tool steel (Rockwell C 60 to 65). Extra jaws are available for replacement if required by heavy usage.

Model POD-375-O, with offset jaws, permits pinch-off access in confined situations. Jaws for POD-375 and POD-375-O are interchangeable. Extra jaws for each are available for interchange.

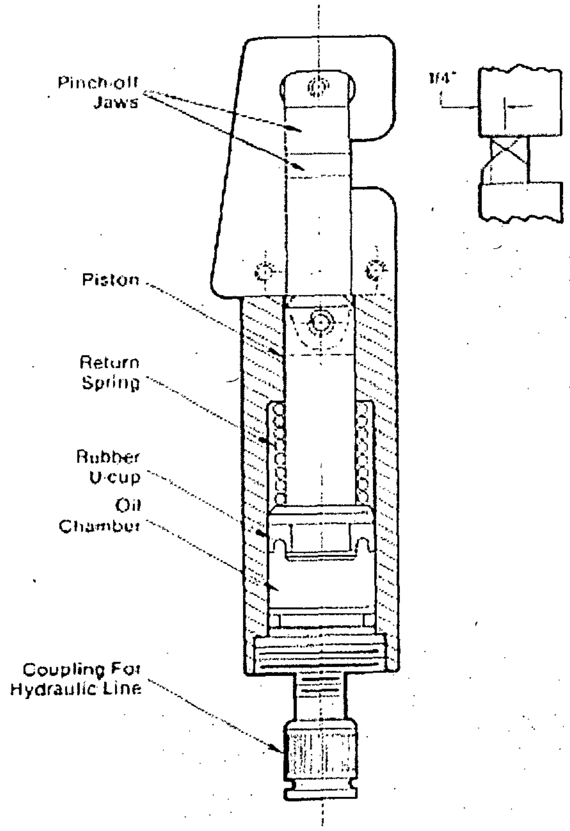
Model POD-375-H hydraulic actuated, pinch-off tool can be used single-handed by the operator, leaving a free hand for holding or supporting the part to be sealed. This tool is not available with offset jaws.

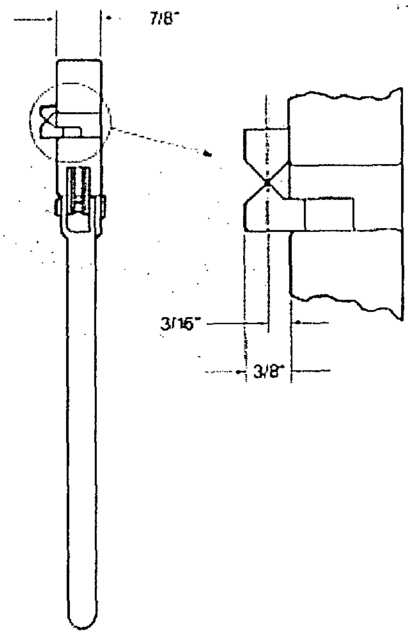
Model Number	Capacity (OFHC Copper)
POD-375, 375-H	0 to 3/8" OD × .049 wall
POD-749, 750, 751	0 to 3/4" OD × .060 wall

Pinch-off Device Dimensions



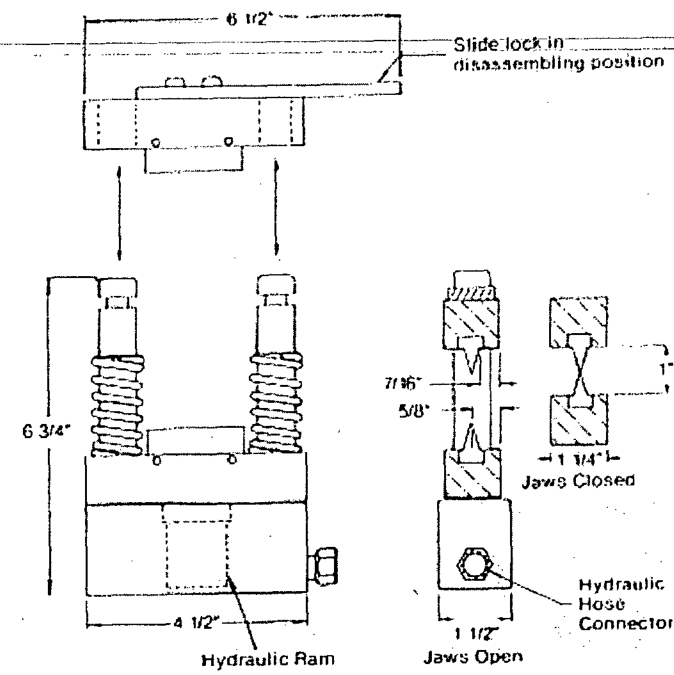
POD-375





POD-375-O

POD-375-H



POD-749

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HBG

FLUKE.
Biomedical

Calibration Report
10/20/2006
As Calibrated-876-10-20-2006

Survey Meter Model #:	451B-RYR
Survey Meter S/N:	876
Customer Name:	New Unit
Customer P.O.:	N/A
Received:	N/A
Fluke Biomedical WO/RO/SO:	N/A
Customer #:	N/A
Survey Meter Description:	Ion Chamber Survey Meter
Tolerance Condition:	The % Error must be less than 10%.
Tolerance Statement:	451B-RYR Serial Number 876 is In Tolerance
Calibration Source:	Cs-137
Check Source Reading (mR/hr):	N/A
Notes:	None

Environmental Constraints:
The Model 451B-RYR Survey meter is designed to read accurately from -40 C to 70 C. The meter is capable of reading from 0 to 50 R/hr. The 451B-RYR is an open air chamber and requires air density corrections, using the following formula:

A.D.C.F. = (760/Pressure) * ((273.2+Temperature) / 295.2)

where the Temperature is in degrees Celsius and the Pressure is in mm Hg.

Calibration Description:
The Model 451B-RYR is exposed through the side of the detector and calibrated on all ranges according to CAL-450/451, Revision 4.

All readings were corrected for background.

The % Error is calculated using the following formula:

% Error = ((Indicated - Actual) * 100) / (Actual)

The uncertainty of the calibration is 3.6%, with 2.2% associated with the uncertainty of the source.

This calibration is traceable to the National Institute of Standards and Technology.

The calibration is warranted to be within specified accuracy limits, at the time of calibration. In the event of a calibration error, our liability is limited to standard recalibration cost. We cannot be responsible for injury or damages resulting from improper use.

Proper function and reliability of the instrument described in this document are highly dependent upon handling and use. It is recommended the user establish a technique to monitor the constancy of the instrument response before and after its return to the manufacturer.

This certificate shall not be reproduced except in full, without the written approval of the manufacturer.

If there are any problems with the calibration of the instrument, please contact the calibration laboratory director.

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Pg 1 of 2

Global Calibration Laboratory
6045 Cochran Road Cleveland OH 44139-3303 USA
Telephone 440.498.2564 Facsimile 440.542.3682 Email service@globalcal.com Internet www.globalcal.com

FLUKE. Biomedical

Calibration Data

As Calibrated-876-10-20-2006

Calibration Data: As Calibrated
Temperature (C): 21.9
Pressure (mm Hg): 729.8
Relative Humidity (%): 39.2

Rate Calibration Point	Range	Rate	Net	% Error
		(mR/hr)	(mR/hr)	
20 Ci Cs-137 at 350 cm w/ 5 Att	0-5 mR/hr	1.43	1.43	-0.3 % - Pass
20 Ci Cs-137 at 350 cm w/ 4 Att	0-5 mR/hr	2.73	2.74	0.3 % - Pass
		(mR/hr)	(mR/hr)	
20 Ci Cs-137 at 350 cm w/ 3 Att	0-50 mR/hr	13.5	13.6	0.7 % - Pass
20 Ci Cs-137 at 350 cm w/ 2 Att	0-50 mR/hr	26.2	25.9	-1 % - Pass
		(mR/hr)	(mR/hr)	
20 Ci Cs-137 at 350 cm w/ 1 Att	0-500 mR/hr	135	136	0.7 % - Pass
20 Ci Cs-137 at 350 cm w/ 0 Att	0-500 mR/hr	281	281	-0.1 % - Pass
		(R/hr)	(R/hr)	
2000 Ci Cs-137 at 300 cm w/ 2 Att	0-5 R/hr	2.75	2.77	0.7 % - Pass
		(R/hr)	(R/hr)	
2000 Ci Cs-137 at 300 cm w/ 0 Att	0-50 R/hr	28.7	28.8	0.5 % - Pass

Integration Calibration Point	Range	Exposure (mR)	Net (mR)	
281 mR/hr, 100 seconds	0-50 mR	7.82	7.79	-0.4 % - Pass

Calibration Performed by: Bruce Mahood **Date:** 20-Oct-06

Technical Review: [signature] **Date:** 10-22-06

The suggested recalibration date is: 20-Oct-07

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Global Calibration Laboratory
6045 Cochran Road Cleveland OH 44139-3303 USA
Telephone 440.498.2564
Facsimile 440.542.3682
Email service@globalcal.com
Internet www.globalcal.com

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