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3M Electrical Specialties Division TCAAP 590 New Brighton, MN 55112-5796 612/736 8300

3M

For. 192

January 9, 1990

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USNRC Division of Fuel Cycle, Medical, Academic and Commercial Use Safety Medical, Academic and Commercial Use Safety Branch Wushington, DC 20555

Attn: Steven L. Baggett

Dear Mr. Baggett:

Enclosed is the update of 3M Model 4P6E for sealed source and device registry sheets. This is in response to your letter of June 30, 1989. A complete print package and ANSI Test Report for the Model 4P6E is included.

Steve, if you have questions about this source registration please contact me at 612/736-8387.

Thank you.

Regards,

MR Beten

M. R. Peters Compliance Manager

MRP:plh

Enclosure

9805290142 960126 PDR RC # SSD PDR

SAFETY EVALUATION OF SEALED SOURCES

NO. NR- S- DATE: January 8, 1990 PAGE1

SOURCE TYPE: Sealed Source

MODEL: 4P6E

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MANUFACTURER/ Minnesota Mining & Manufacturing Company DISTRIBUTOR: TCAAP Building 590 New Brighton, MN 55112-5796

ISOTOPE: Cs-137 MAXIMUM ACTIVITY: 2.0 Curies

LEAK TEST FREQUENCY: 6 Months

PRINCIPAL USE: (D) Gamma Gaging

CUSTOM DEVICE: YES X NO

SAFETY EVALUATION OF SEALED SOURCES

NO. NR- S- DATE: January 8, 1990 PAGE 2

SOURCE TYPE: Sealed Source

DESCRIPTION:

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This is a cylindrical source .280" in diameter by .750" in length. The source is a doubly encapsulated Cs-137 source. The material used in the source construction is stainless steel. The inner capsule is filled with inert ceramic microspheres containing the Cs-137 material. Construction is per 3M Drawing No. B 12-1921-0683-4.

LABELING:

Sources are labeled with serial number, isotope, and number of millicuries.

SAFETY EVALUATION OF SEALED SOURCES



CONDITIONS OF NORMAL USE:

The sources are installed in gaging devices made by the customers.

PROTOTYPE TESTING:

3M Model 4P6E was tested to ANSI N542 and given the classification of 77C66545. Enclosed is 3M/Electrical Specialties Division, New Brighton Plant, Dept. 7485 Report No. 029, ANSI testing of Model 4P6E Industrial Radiation Source.

SAFETY EVALUATION OF SEALED SOURCES

NO. NR- S- DATE: January 8, 1990 PAGE 4

SOURCE TYPE: Sealed Source

EXTERNAL RADIATION LEVELS:

The following dose rates are calculated dose rates for a 2.0 curie Model 4P6E. The dose rates are based on NBS traceable 3M standard 71833. 71833 was read on an Eberline RO-1, serial No. 445, 3M instrument No. 10143. 71833 was 354 mCi as of 8/2/85. Calculated value of 2.0 curie sofulce is 842 mr/hr at 1 meter and 9,476 mr/hr at 30 cm.

Side Of Source

Window End Of Source

Side

Window End

QUALITY ASSURANCE AND CONTROL:

The Quality Group operates from policies and procedures described in the Electrical Specialties Division/Static Control Manual (New Brighton Plant). The quality system is based on Mil-Q-9858-A guidelines on file with the NRC. The program has been previously deemed acceptable for licensing purposes by the NRC.

SAFETY EVALUATION OF SEALED SOURCES

NO. NR- S- DATE: January 8, 1990 PAGE 5

SOURCE TYPE: Sealed Source

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- This source shall be distributed only to specific licensees of the NRC or Agreement States.
- This source shall be leak tested at six-month intervals using techniques capable of detecting the presence of 0.005 microcurie of activity.
- Handling, storage, use, transfer, and disposal: To be determined by the licensing authority.
- This registration sheet and all information contained within the references shall not be changed or transferred without the written consent of the NRC.

SAFETY EVALUATION OF SEALED SOURCES

NO. NR- S- DATE: January 8, 1990 PAGE 6

SOURCE TYPE: Sealed Source

SAFETY ANALYSIS SUMMARY :

REFERENCE:



SAFETY EVALUATION OF SEALED SOURCES

NO. NR- S- DATE: January 8, 1990 PAGE 7

SOURCE TYPE: Sealed Source

ISSUING AGENCY: USNRC

Date: _____ Reviewer: _____

Date: _____ Concurrence: _____





3M/ELECTRICAL SPECIALTIES DIVISION New Brighton Plant

REPORT SUMMARY

Date 11-06-89 Pages 9 Report No. 029 Dept. No. 7485

TITLE: ANSI TESTING OF MODEL 4P6E INDUSTRIAL RADIATION SOURCE TO: S.J. Duerr, R.T. Fuller M.R. Peters, R.T. Schweiss AUTHOR: D. J. Reimer

SCOPE: This report summarizes the ANSI qualification tests performed on Model 4P6E industrial radiation source. This report along with report # 028 supersede Report Summary # 026, 10-18-89.

ABSTRACT: Five ANSI tests were performed:

1. Temperature - Class 6

- 2. External Pressure Class 6
- 3. Impact Class 5
- 4. Vibration Class 4
- 5. Puncture Class 5

These tests also comply with the design and performance criteria requirements of the United States Nuclear Regulatory Commission Rules and Regulations, Title 10, Chapter 1, Part 39, Licenses and Radiation Safety Requirements for Well-Logging Operations, subpart C, paragraph 41, line 3.

Upon completion of the external pressure test, the zero weight change test method, the wipe (smear) test, and the immersion with boiling test methods was used to determine the pass/fail criteria. Upon the completion of all other tests the wipe (smear) test and the immersion with boiling test methods were used to determine the pass/fail criteria for the sources in guestion.

SUMMARY:

1) The sources tested for external pressure met the no weight change pass/fail criteria.

2) All sources tested met the pass/fail criteria for the wipe (smear) test and the immersion with boiling test.

5) The ANSI classification code for the models 4P6E source will be ANSI/77C66545.

HISTORY

Classification of our models 4P6E source was conducted according to the American National Standards Institute N542 guidelines issued July 1978. The temperature, external pressure, impact, and puncture tests were conducted by D.J. Reimer at 3M buildings 575, 590, and 675. The vibration test was conducted on Model 4D6S by Environ Laboritories in Minneapolis, Minnesota as summarized in Report Summary # 018, 8-1-89. Model 4P6E was proved to pass the vibration test through engineering evaluation.

APPLICABLE DOCUMENTS

ANSI-N542 1977, Sealed Radioactive Source, Classification, issued July 1978.

3M Electrical Specialties Division Report Summary # 018, 8-1-89.

CLASSIFICATION CODE DEFINITION

The ANSI standards classification code contains two sections. The first section contains the standards initials, and the year of approval. The second section is an alpha numeric code which describes the activity level of the source and the level or severity of the test performed.

ACTIVITY LEVEL CODE DEFINITION

Two letters, "C" and "E", are used to designate the activity level of the isotope being classified. A "C" level source does not exceed the limit established for the radionuclide group. If the established limit is exceeded, an "E" designation is used. See Figure 1.

Maximum activity, Ci		
Leachable* and/or reactive*	Non-leachable * and non-reactive '	
0.3 30 300	300 8000	
	Maximum Leachable " and/or reactive " 0.3 30 30 300	

TABLE 3-Activity Level

* Leachable-greater than 0.1 milligram per gram in 100 ml still HrO at 20°C in 48 h. * Non-beschable-leas than 0.1 milligram per gram in 100 ml still HrO at 20°C in 48 h. * Reactive-reactive is ordinary atmosphere or water (Na. K. U. Ca. metals. etc.). * Non-reactive in ordinary atmosphere or water (Al. Au. Co. Kr. Ceramics. etc.).

Note-In the expression "milligram per gram" the "milligram" refers to the dissolved or removed radionuclide, and the "gram" to the total weight of radionactive material present, not including the weight of the capsule.

Figure 1

2

TEST CLASSIFICATION CODES

The five digit code represents the tests listed below. On each test the severity required increases by Class number 1 through 6 and special test. See Figure 2.

- 1. First digit represents temperature test.
- 2. Second digit represents external pressure test.
- 3. Third digit represents impact test.
- 4. Fourth digit represents vibration test.
- 5. Fifth digit represents puncture test.

Test	Class						
	1	2	3	4	5	6	X
Temperature	No Test	-40°C(20 min) +80°C (1h)	-40°C(20 min) +180°C (1h)	-40°C(20 min) +400°C(1h) and thermal shock 400°C to 20°C	40°C(20 min) +600°C(1h) and thermal shock 600°C to 20°C	-40°C(20 min) +800°C(1h) thermal shock 800°C to 20°C	Special Test
External pressure	No Test	25 kN/m ² abs. (3.6 1b:/in ²) to atmosphere	25 kN/m ² abs. to 2 MN/m ² (290 lb//in ²) abs.	25 kN/m ³ abs. to 7 MN/m ³ (1 015 lb./ in ²) abs.	25 kN/m ² abs. to 70 MN/m ² (10 153 lb./ in ²) abs.	25 kN/m ² abs. to 170 MN/m ² (24 656 lb// in ²) abs.	Special Test
Impact	No Test	50 g (1.8 oz) from 1 m (5.28 ft.) and free drop ten times to a steei aurface from 1.5m (4.92 ft)	200 g (7 oz) from 1 m	2 kg (4.1 lb) from 1 m	5 kg (11 lb) from 1 m	20 kg (44 fb) from 1 m	Special Test
Vibration	No Test	30 min 25 to 500 Hz at 5 g peak amp.	30 min 25 to 50 Hz at 5 g peak amp. and 50 to 90 Hz at 0.635 mm amp. peak to peak and 90 to 500 Hz at 10 g	90 min 25 to 80 Hz at 1.5 mm amp. peak to peak and 80 to 2000 Hz at 20 g	Not Used	Not Used	Special Test
Puncture	No Test	1 g (15.4 gr) from 1 m(3.28ft)	10g (154 gr) from 1 m	50g (1.76 cz) from 1 m	300g (10.6 or) from 1 m	1 kg (2.2 lb) from 1 m	Special Test

TABLE 1-Classification of Sealed Source Performance Tests

Figure 2





NOTE: 3M Technical notebook #87081 contains test data for all following tests.

All equipment listed in this document that is followed by a 3M instrument number has been calibrated using NBS traceable standards.

INITIAL WIPE TEST

Reference Procedure: 3M/Electrical Specialties Division, Test Procedure ESSC. TP.NBGEN.2 (Wipe test).

Test Date: October 11,16,17, 1989.

Equipment:

Tap water.

Small sponge (approximately 1" cube).

Eberline Model MS-3 Mini-Scaler 3M Instr. #40540 with Model HP-190 detector, calibrated on 09/14/89 and 10/13/89, Cs 137 counting eff. 19.8% on both dates.

Procedure:

Wipe all the surfaces of the source with a moisten sponge using the same side of the sponge. Activity readings in counts per minute are determined by the counting equipment.

Requirements:

Wipe test must be less than .0001 µCi removable activity.

Results/Conclusion:

Both sources passed the wipe test with less than .0001 μ Ci removable activity.

ANSI PERFORMANCE TESTS

NOTE: Two sources were tested simultaneously for each test.

Equipment Used For All ANSI Tests:

Baird Dual Channel Automatic Planchet Counting System, 3M Instr. #40545. Calibrated on 08/22/89, Cs 137 counting eff. 29.4%.

Small sponge (approximately 1" cube).

Eberline Model MS-3 Mini-Scaler 3M Instr. #40540 with Model HP-190 detector, calibrated on 09/14/89 and 10/13/89, Cs 137 counting eff. 19.8% on both dates.

Aluminum counting planchets.

250 ml pyrex beakers.

Paper trays. Distilled water.

Tap water.

Drying oven for planchets.

Weston Model 2261 Thermometer, 0-150 degrees C.

Corning Model PC-35 Hot Plate.

Temperature Test - Class 6

Reference Standard: ANSI-N542, Section 7.2.

Test Dates: Low Temperature - October 13, 1989. High Temperature - October 30, 1989.

Equipment:

Associated Testing Laboratories Incorporated Environmental Chamber, 3M Number 360175, Serial Number 9728.

Sybron/Thermolyne Electric Furnace, Model F-B1315M, Series 264.

Biddle Versa-Cal Digital TC/mV Test Set, 3M Instr. #20217. Calibrated on 10/11/89.

Compressed Carbon dioxide Tank with siphon tube.

Ceramic crucibles.

1 liter SST beaker.

Tap Water.

Procedure:

Low Temperature

Two sources were placed in the environmental chamber on a raised shelf to promote even cooling. The sources were exposed to an atmosphere of carbon dioxide and cooled to minus 40 (+or-) 2 degrees centigrade. This temperature was obtained in

5

approximately 5 minutes. The temperature was maintained for a 20 minute period. At the end of 20 minutes the chamber was opened and allowed to return to ambient temperature.

High Temperature/Thermal Shock

Two sources were placed in the preheated electric furnace. The furnace was returned to a temperature of 800 (+or-) 5 degrees centigrade within 15 minutes and held at that temperature for one hour. Upon completion of the heat test the sources were removed from the oven and transferred to a water bath not exceeding 20 degrees centigrade and at least 20 times the volume of the source. This was done within 15 seconds of removal from the electric furnace.

Requirements:

The wipe test and the immersion with boiling water test must be less than $.0001\mu$ Ci removable activity (ANSI limit is $.05\mu$ Ci).

Results:

The stainless steel capsules were discolored from the high temperature test.

Conclusion:

Both sources tested for low and high temperature passed the wipe test and the immersion with boiling water test. This meets Class 6 requirements.

External Pressure Test - Class 6

Reference Standard: ANSI-N542, Section 7.3.

Test Dates: High pressure test - October 16, 1989. Low pressure test - October 17, 1989.

Equipment:

Lab Con Company Vacuum Chamber.

Marshalltown Vacuum Gage, 3M Instr. Number 23450. Calibrated on 10/16/89.

Duo-Seal Vacuum Pump.

Enerpac Pump, Model PER 1321, Serial Number 0L9.

Enerpac Gauge, Model T6009-L, 3M Instr. #76707. Calibrated on 05/16/89.

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3M Pressure Test Vessel, Model B.O.M.B.

Sartorius Balance Model A200S, 3M Instr. #67806. Calibrated on 09/27/89.

Procedure:

Two sources of each model were weighed before testing to determine if there were any weight changes after testing. Model 4P6E has essentially no internal void, so the wipe test and the immersion with boiling water test were the leak test methods used.

High Pressure Test

Two sources were placed in the pressure test vessel, brought to the required pressure of 25,000 psi, and held for five minutes. The pressure was released and the vessels pressure was allowed to return to atmospheric pressure. The procedure was then repeated and the sources were reweighed.

Low Pressure Test

Two sources were placed in the vacuum chamber, brought to the required pressure of 3.6 pounds per square inch, and held for five minutes. The vacuum was released and the chamber was allowed to return to atmospheric pressure. This procedure was then repeated and the sources were reweighed.

Requirements:

Model 4P6E shall have no weight gain. The wipe test and the immersion with boiling water test must be less than $.0001\mu$ Ci removable activity (ANSI limit is $.05\mu$ Ci).

Results:

The weight results are shown in the table below. All weights are given in grams.

	4P6E # 3	4P6E # 4
Before both tests	4.7990	4.7964
After low pressure	4.7990	4.7964
After high pressure	4.7990	4.7964

There was no visual damage or changes to the sources after the pressure testing.

Conclusion:

No changes in weight were noted. Both sources used in the pressure tests passed the wipe test and the immersion with boiling water test. This meets Class 6 requirements.

Impact Test - Class 5

Reference Standards: ANSI-N542, Section 7.4.

Test Date: October 17, 1989.

Equipment:

5000 gram SST Hammer, 25mm in diameter with an edge circumference rounded to a radius of 3mm.

Steel Anvil with a mass at least ten times the mass of the hammer.

Drop tube with lab stand.

Tape measure.

Procedure:

The drop tube fixture was positioned at one meter from the top surface of the source to be tested to the top edge of the drop tube. This allowed positioning of the bottom or striking surface of the hammer at one meter by using the tube as a guide. The source was positioned with its most vulnerable (side) surface up. The hammer was dropped a distance of one meter onto the source.

Requirements:

The wipe test and the immersion with boiling water test must be less than $.0001\mu$ Ci removable activity (ANSI limit is $.05\mu$ Ci).

Results:

Both models 4P6E were flattened to 75% of their original thickness. No signs of cracking.

Conclusion:

Both sources used in the impact test passed the wipe test and the immersion with boiling water test. This meets Class 5 requirements.

Vibration Test - Class 4

Reference Standards: ANSI-N542, Section 7.5

Procedure:

Refer to Report Summary # 018, 8-1-89 for equipment and procedure used for this test.

Conclusion:

Model 4P6E has been proved to pass the vibration test through an engineering evaluation. This meets Class 4 requirements.

Puncture Test - Class 5

Reference Standards: ANSI-N542, Section 7.6.

Test Date: November 1, 1989.

Equipment:

300 gram hammer, with a 50 to 60 Rockwell C hardened pin having a diameter of 3mm, a free height of 6mm and a hemispherical end.

Steel Anvil with a mass at least ten times the mass of the hammer.

Drop tube with lab stand.

Tape measure.

Procedure:

The drop tube fixture was positioned at one meter from the top surface of the source to the top edge of the drop tube. This allowed positioning the striking portion of the pin at one meter by using the drop tube as a guide. All sources were struck in the middle of their total length. The hammer was dropped a distance of one meter onto the source.

Requirements:

The wipe test and the immersion with boiling water test must be less than $.0001\mu$ Ci removable activity (ANSI limit is $.05\mu$ Ci).

Results:

The hardened pin on the hammer made a small indentation on both sources but did not penetrate.

Conclusion:

Both sources used in the puncture test passed the wipe test and the immersion with boiling water test. This meets Class 5 requirements.











Lett Jeid SEPT. 20, 1990

3M/ELECTRICAL SPECIALTIES DIVISION New Brighton Plant

REPORT SUMMARY

Date 8-1-89 Pages 12 Report No. 018 Dept. Nc. 7485

TITLE: ANSI TESTING OF 4D6S SOURCES TO: S. J. Duerr, R. T. Schweiss M. R. Peters and R. T. Fuller AUTHOR D. E. Klepel

SCOPE: The Model 4D6S source is a doubly encapsuled radioactive source made of stainless steel. This report summarizes the qualification tests needed for NRC registration.

ABSTRACT: Five ANSI tests were performed:

- 1. Temperature Class 6
- 2. External Pressure Class 6
- 3. Impact Class 4
- 4. Vibration Class 4
- 5. Puncture Class 4

Upon the completion of the temperature, impact, vibration, and puncture tests the bubble leak test, wipe (smear) test, and 24 hour soak test methods were used to determine the pass/fail criteria for the sources in question. For the external pressure test, the zero weight change test method was used to determine the pass/fail criteria for the sources in question.

SUMMARY: The pass/fail criteria of the wipe (smear) test, 24 hour soak test, and the bubble leak test were met by all sources tested for ANSI-N542. The sources tested for external pressure met the no weight change pass/fail criteria. The ANSI classification code for the model 4D6S source will be ANSI/77C66444.

HISTORY

Classification of our model 4D65 sources was conducted according to the American National Standards Institute N542 guidelines issued July 1978. The tests were conducted at 3M building 575, with the exception of the vibration test which was conducted at Environ Laboratories in Minneapolis Minnesota.

APPLICABLE DOCUMENTS

ANSI-N542 1977, Sealed Radioactive Source, Classification, issued July 1978.

CLASSIFICATION CODE DEFINITION

The ANSI standards classification code contains two sections. The first section contains the standards initials, and the year of approval. The second section is an alpha numeric code which describes the activity level of the source and the level or severity of the test performed.

ACTIVITY LEVEL CODE DEFINITION

Two letters, "C" and "E", are used to designate the activity level of the isotope being classified. A "C" level source does not exceed the limit established for the radionuclide group. If the established limit is exceeded, an "E" designation is used. See Figure 1.

Radionuelide group	Maximum activity, Ci			
(from Table 2)	Leachable * and for reactive *	Non-leachable"		
A B1 B2 C	0.8 30 300 500	8 800 8000 8000		

Activity Level

Learhable-greater than 6.1 milligram per gram in 160 ml still H:O at 20°C in 46 h.
Non-heachable-leas than 0.1 milligram per gram in 160 ml still H:O at 20°C in 46 h.
Rearisse-reactive in ordinary atmosphere or water (Na. K. U. Ca. metals. etc.).
Non-martine in ordinary atmosphere or water (Al. Au. Ca. Kr. Ceramics. etc.).

Note-In the expression "milligram per gram" the "milligram" refers to the dissolved or removed redeongelide, and the "gram" to the total weight of redeongetive material present, not including the weight of the expanse.

Figure 1

TEST CLASSIFICATION CODES

The five digit code represents the tests listed below. On each test the severity required increases by Class number 1 through 6 and special test. See Figure 2.

- 1. First digit represents temperature test
- 2. Second digit represents external pressure test
- 3. Third digit represents impact test
- 4. Fourth digit represents vibration test
- 5. Fifth digit represents puncture test

	Chan						
Test	1	2	3	4	6	6	X
Temperature	No Test	40°C(20 min) +80°C (1h)	-#0°C(20 min) +380°C (1h)	-40°C (20 min) +400°C (1h) and thermal shock 400°C to 25°C	-40°C(20 min) +600°C(1h) and thermal shock 600°C to 20°C	-40°C(20 min) +800°C(1h) thermal shock 800°C to 20°C	Special Tent
External	No Test	25 kN/m ² abs. (3.6 bb./in ²) to atmosphere	25 kN/m [*] abs. se 2 MN/m [*] (290 lb./in [*]) se.	25 kN/m [*] abs. to 7 MN/m [*] () 015 lb/ [*] in [*]) abs.	25 kN/m ^o ahs. to 70 MN/m ^o (10 153 ib// im ^o) als.	25 kN/m [*] abs. to 170 MN/m [*] (24 656 ib./ in [*] 1 abs.	Special Test
Impact	No Test	50 g (1.8 or) from 1 m (3.28 ft.) and free drop ten timen to a steel murfare from 1.5m (4.92 ft)	200 g (7 oz) from 1 m	2 kr (4.4 lb) from 1 m	5 kg (11 lb) from 1 m	20 kg (44 lb) from 1 m	Special Test
Vibration	No Test	30 min 25 to 500 il at 5 g peak amp.	30 min 25 to 50 Hz at 5 g reak ann. and 50 to 90 Hz at 0.635 mm ann. peak to peak and 90 to 500 Hz at 10 g	90 min 25 to 90 Hz at 1.5 mm amp. peak to peak and 80 to 2000 Hz at 20 g	Not Used	Not Used	Special Test
Puncture	No Test	1 # (15.4 #r) from 1 m(3.28(t))	10g (154 gr) from 1 m	50g (1.76 oz) from 1 m	360gr (10.6 est) from 1 m	1 kg (2.2 lb) from 1 m	Special Test

TABLE 1-Clamification of Scaled Source Performance Tests

Figure 2

INITIAL BUBBLE TEST

Reference Standard: ANSI-N542 Appendix A, Section A2.2.2. Note: FC-40 flourinert brand electronic liquid was used for testing instead of glycerol.

Equipment:

Trio-Tech Model 481 Bubble Tester

Procedure:

The sources are immersed in a bath of FC-40 heated to 125-130 degrees centigrade. The sources are observed for bubble leaks for a period of at least 2 minutes.

Requirements:

A negative leak test prior to ANSI testing. (No bubbles observed coming from the source with a leak test lasting a minimum of 2 minutes).

Results/Conclusion:

All sources bubble leak tested negative.

INITIAL WIPE TEST

Reference Procedure: 3M/Electrical Specialties Division, Test Procedure ESSC. TP.NBGEN.2, (Wipe test)

Equipment:

Tap water Small sponge (approximately 1" cube) Eberline Model HP-190 detector with an Eberline Model MS-3 scaler or equivalent.

Procedure:

Wipe all the surfaces of the source with a moisten sponge using the same side of the sponge. Activity readings in counts per minute are determined by the counting equipment.

Requirements:

Wipe test must be less than .0001 µCi removable activity.

Results/Conclusion:

All sources passed the wipe test with less than .0001 μCi removable activity.

INITIAL SOAK TEST

Reference Procedure: 3M/Electrical Specialties Division, Test Procedure ESSC. TP.NBMED.2, (Soak Test for Inner/Outer Assemblies) Modifications to the test procedure are as follows: Only 3 ml of distilled water was used, the sample taken from the vial was the 3 ml of water not 1 ml as done in the standard, and the sources were keep at the 50°C for the full 24 hours.

Equipment:

Distilled water Glass vials Aluminum counting planchets Paper trays Drying oven for planchets Oven for maintaining constant temperature during test (set at 50°C) Baird Dual Channel Automatic Planchet Counting System

Procedure:

The source to be tested is immersed into a vial containing 3 ml of distilled water. In this case 3 ml of distilled water is enough to completely cover the source in the test vial. The vial is capped, placed into an open lead container and placed into an oven for 24 hours at 50°C. After the 24 hours in the heat the 3 ml of water is removed from the vial, placed into an aluminum planchet, and completely dried. The planchet samples are then evaluated on the Baird Dual Channel Automatic Planchet Counting System.

Requirements:

Soak test must be less than .0001 µCi removable activity.

Results/Conclusion:

All sources passed the soak test with less than .0001 μCi removable activity.

ANSI PERFORMANCE TESTS

Temperature Test Class 6

Reference Standard: ANSI N542 Section 7.2 and IAEA Safety Series No. 6 Section 735

Equipment:

Associated Testing Laboratories Incorporated Environmental Chamber, 3M Number 360175, Serial Number 9728

Sybron/Thermolyne Electric Furnace, Model F-B1315M, Series 264

Biddle Versa-Cal Digital TC/mV Test Set, Serial Number 84699

Compressed Carbon dioxide Tank with siphon tube

Trio-Tech Model 481 Bubble Tester

Baird Dual Channel Automatic Planchet Counting System

Distilled water which meets IAEA testing requirements

Small sponge (approximately 1" cube)

Eberline Model HP-190 detector with an Eberline Model MS-3 scaler or equivalent.

Glass vials

Aluminum counting planchets

Paper trays

Drying oven for planchets

Oven for maintaining constant temperature during test (set at 50°C)

Procedure:

Two sources were placed in the environmental chamber on a raised shelf to promote even cooling. The sources were exposed to an atmosphere of carbon dioxide and cooled to minus 40 degrees centigrade. This temperature was obtained in approximately 5 minutes, well under the 45 minutes cooling allowance. The temperature was maintained for a 20 minute period. At the end of 20 minutes the chamber was opened and allowed to return to ambient temperature. Upon returning to ambient temperature, the sources were placed in the electric furnace. The sources were brought up to a temperature of 800 degrees centigrade within 45 minutes and held at that temperature for one hour. Upon completion of the heat test the sources were removed from the oven and transferred to a water bath not to exceed 20 degrees centigrade and be at least 20 times the volume of the source. This was done within 15 seconds of removal from the electric furnace.

Requirements:

The wipe test must be less than $.0001\mu$ Ci removable activity (ANSI limit is $.005\mu$ Ci). A negative leak test after the cooliny and the heat test (no bubbles observed coming from the source with a leak test lasting a minimum of 2 minutes). The 24 hour soak and the IAEA-Special Form four hour soak/seven days in air/four hour soak test must be less than $.0001\mu$ Ci removable activity (IAEA limit is $.005\mu$ Ci).

Results:

The only visual change to the sources after the testing was a

darkening or discoloring of the stainless steel capsule due to the heat test.

Conclusion:

Both test sources used in the cooling/heat temperature tests passed the wipe test, 24 hour soak, four hour soak/seven days in air/four hour soak test, and the bubble leak test and therefore met Class 6 requirements.

External Pressure Test Class 6

Reference Standard: ANSI-N542 Section 7.3

Equipment:

Lab Con Company Vacuum Chamber, 3M Number 23450

Duo-Seal Vacuum Pump

Enerpac Pump, Model PER 1321, Serial Number 019

Enerpac Gauge, Model 31-302

3M Pressure Test Vessel, Model B.O.M.B.

Mettler Balance Model A30, 5/N 741052, 3M #13641

Trio-Tech Model 481 Bubble Tester

Baird Dual Channel Automatic Planchet Counting System

Distilled water which meets IAEA testing requirements

Small sponge (approximately 1" cube)

Eberline Model HP-190 detector with an Eberline Model MS-3 scaler or equivalent.

Glass vials

Aluminum counting planchets

Paper trays

Drying oven for planchets

Dven for maintaining constant temperature during test (set at 50°C)

Procedure:

<u>Vacuum Test</u> Two sources were weighed, placed in a vacuum chamber, brought to the required pressure of 3.6 pounds per square inch, and held for the required five minute time period. The vacuum was released and the chamber was allowed to return to atmospheric pressure. This procedure was then repeated and the sources were reweighed.

<u>Pressure Test</u> Two sources were placed in the pressure test vessel, brought to the required pressure of 25,000 psi, and held for five minutes. The pressure was released and the vessels pressure was allowed to return to atmospheric pressure. The procedure was then repeated and the sources were reweighed.

Requirements:

There should be no gain in weight by the source. The wipe test must be less than .0001 μ Ci removable activity (ANSI limit is .005 μ Ci). A negative leak test after the pressure tests (no bubbles observed coming from the source with a leak test lasting a minimum of 2 minutes). The 24 hour soak test must be less than .0001 μ Ci removable activity.

Results:

The weight results are shown in the table below. All weights are given in grams.

So	urce # T27	Source # T31
Balance used	Mettler	Mettler
Before vacuum	2.0011	2.0146
After vacuum	2.0011	2.0146
Before pressure	2.0011	2.0146
After pressure	2.0011	2.0146

There was no visual damage or changes to the test sources after the pressure testing.

Conclusion:

No changes in weight were noted. Both test sources used in the pressure tests passed the wipe test, 24 hour soak test, and the bubble leak test and therefore met Class 6 requirements.

Impact Test Class 4

Reference Standards: ANSI-N542 Section 7.4 and IAEA Safety Series No. 6 Section 732

Equipr.nt:

2000 gram / 4.4 pound steel hammer, 25mm in diameter with an edge circumference rounded to a radius of 3mm.

Steel Anvil with a mass at least ten times the mass of the hammer, drop tube and stand, meter stick, and tape measure

Trio-Tech Model 481 Bubble Tester

Baird Dual Channel Automatic Planchet Counting System

Distilled water which meets IAEA testing requirements

Small sponge (approximately 1" cube)

Eberline Model HP-190 detector with an Eberline Model MS-3 scaler or equivalent.

Glass vials

Aluminum counting planchets

Paper trays

Drying oven for planchets

Oven for maintaining constant temperature during test (set at 50°C)

Procedure:

The drop tube fixture was positioned at one meter from the top surface of the source to be tested to the top edge of the drop tube. This allowed positioning of the bottom or striking surface of the hammer at one meter by using the tube as a guide. The source was positioned with its most vulnerable surface up and the hammer was dropped onto the source. In this case we were not sure whether the source is more vulnerable on the end or the side, so one source was tested each way.

Requirements:

The wipe test must be less than .0001µCi removable activity (ANSI limit is .005µCi). A negative leak test after the impact test (no bubbles observed coming from the source with a leak test lasting a minimum of 2 minutes). The 24 hour soak and the IAEA-Special Form four hour soak/seven days in air/four hour soak test must be less than .0001µCi removable activity (IAEA limit is .005µCi).

Results:

Under the impact of a 2000 gram hammer, both capsules were deformed or shorten.

Concl. ; on:

Both sources used in the impact test passed the wipe test, 24 hour soak, four hour soak/seven days in air/four hour soak test, and the bubble leak test and therefore meet Class 4 requirements.

Vibration Test Class 4

Reference Standards: ANSI-N542 Section 7.5

Equipment: Vibration Exciter MB Model C-10E

MB Electronic Power Supply Model T251

Unholtz-Dickie Model ØSP-4 Oscillator - Servo - Programer and TF-22 Tracking Filter

Trio-Tech Model 481 Bubble Tester

Baird Dual Channel Automatic Planchet Counting System

Distilled water which meets IAEA testing requirements

Small sponge (approximately 1" cube)

Eberline Model HP-190 detector with an Eberline Model MS-3 scaler or equivalent.

Glass vials

Aluminum counting planchets

Paper trays

Drying oven for planchets

Oven for maintaining constant temperature during test (set at 50°C)

The above equipment was calibrated and is traceable to the National Bureau of Standards.

Procedure:

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The sources were securely fixed to the platform of the vibrating machine so that the sources were in contact with the platform at all times. The test was conducted by sweeping through all the frequencies, for that particular class, at a uniform rate from the minimum frequency to the maximum frequency and returning back to the minimum frequency. All three axis of the sources were tested.

Requirements:

The wipe test must be less than $.0001\mu$ Ci removable activity (ANSI limit is $.005\mu$ Ci). A negative leak test after the vibration test (no bubbles observed coming from the source with a leak test lasting a minimum of 2 minutes). The 24 hour soak test must be less than $.0001\mu$ Ci removable activity.

Results:

There was no visual damage or changes to the test sources after the vibration testing.

Conclusion:

Both test sources used in the vibration test passed the wipe test, 24 hour soak, and the bubble leak test and therefore met Class 4 requirements.

Puncture Test Class 4

Reference Standards: ANSI-N542 Section 7.6

Equipment:

1000 gram hammer, with a 50 to 60 Rockwell C hardened pin having a diameter of 3mm, a free height of 6mm and a hemispherical end.

Steel Anvil with a mass at least ten times the mass of the hammer, drop tube and stand, meter stick, and tape measure

Trio-Tech Model 481 Bubble Tester

Baird Dual Channel Automatic Planchet Counting System

Distilled water which meets IAEA testing requirements

Small sponge (approximately 1" cube)

Eberline Model HP-190 detector with an Eberline Model MS-3 scaler or equivalent.

Glass vials

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Aluminum counting planchets

Paper trays

Drying oven for planchets

Oven for maintaining constant temperature during test (set at 50°C)

Procedure:

The drop tube fixture was positioned at one meter from the top surface of the test source to the top edge of the drop tube. This allowed positioning the striking portion of the pin at one meter by using the drop tube as a guide. One source was struck on the window end and the other on the plug or welded end. The hammer was dropped a distance of one meter onto the source.

Requirements:

The wipe test must be less than .0001µCi removable activity (ANSI limit is .005µCi). A negative leak test after the vibration test (no bubbles observed coming from the source with a leak test lasting a minimum of 2 minutes). The 24 hour soak test must be less than .0001µCi removable activity.

Results:

The hardened pin on the hammer made an indentation into the capsules but did not penetrate. Both test sources leak tested negative.

Conclusion:

Both test sources used in the puncture test passed the wipe test, 24 hour soak, and the bubble leak test and therefore met Class 4 requirements.