

**REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES  
SAFETY EVALUATION OF DEVICE  
(AMENDS IN ITS ENTIRETY)**

**NO.:** NC-646-D-126-S

**DATE:** July 10, 2006

**PAGE:** 1 of 7

**DEVICE TYPE:** Portable Surface Moisture Gauge

**MODEL No.:** 3216

**MANUFACTURER/DISTRIBUTOR:** Troxler Electronic Laboratories  
3008 Cornwallis Road  
P.O. Box 12057  
Research Triangle Park, NC 27709  
(919) 549-8661

**SEALED SOURCE MODEL DESIGNATION:**                      **ISOTOPE:**                      **MAXIMUM ACTIVITY:**

**Troxler Drawing No. A-102451 which covers:**  
**OSA Global, Inc.**

Am-241:Be                      44 millicuries (1.63 GBq)

Model No. AMNV.997  
Capsule Type X.1  
Special Form Certificate No. USA/0632/S

Isotope Product Laboratories  
Model # Am1.NO2  
Special Form Certificate No. CZ/1009/S-85

Am-241:Be                      44 millicuries (1.63 GBq)

**LEAK TEST FREQUENCY:**                      **12 months**

**PRINCIPAL USE:**                      (G) Portable Moisture Density Gauge

**CUSTOM DEVICE:**                      \_\_\_\_\_ YES                      \_\_\_\_\_ **X** \_\_\_\_\_ NO

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**DEVICE TYPE:** Portable Surface Moisture Gauge

**DESCRIPTION:**

The Troxler 3216 gauge is a portable surface gauge designed to measure moisture content. The most common application of this device is in moisture surveys of built-up, flat roofing.

The moisture measurement is based on the principle of neutron thermalization by hydrogen in the test material and incorporates a neutron-emitting, doubly-encapsulated radioactive source (Am-241:Be) and two (2) helium-3 proportional counter tubes. The neutron source is held stationary in the base of the gauge in a threaded cavity by a threaded plug made of stainless steel. A "Caution - Radioactive Material" label indicating the radioisotope, quantity, serial number and measure date covers the threaded plug. The base of the gauge is placed on the material under test. Fast neutrons emitted by the source traverse the material and are thermalized by hydrogen atoms in the sample. The thermal neutrons are then detected by the helium-3 proportional counters and counted over a specified time period. Due to the insensitivity of these detectors to fast neutrons, the number of thermalized neutrons detected is directly proportional to the number of water molecules present in the materials. The count data is taken at intersecting points of a grid laid out across a roof. This data is statistically analyzed to identify wet spots in the roofing.

The Model 3216 gauge can utilize either an A.E.A. Technology/QSA, Inc (AEAT) or Isotope Products Laboratory (IPL) neutron emitting Americium-241:Beryllium sealed source. The AEAT source is composed of a mixture of americium oxide and beryllium metal encapsulated in a stainless steel vessel that is arc welded closed. This vessel is then placed inverted into a second stainless steel vessel of slightly larger dimensions and arc welded closed. The doubly encapsulated source measures 0.394" (10 mm) long and has a 0.307" (7.80 mm) diameter. The source serial number is either stamped or engraved on one of the end faces and other pertinent data may be engraved on the cylindrical surface. The encapsulated material meet internationally-accepted specifications for special form certification and ANSI test criteria for classification as ANSI-E66545.

The IPL neutron source is fabricated by combining Americium-241 oxide and beryllium powders proportionally and compacting this mixture into a pellet. The pellet is then placed into an inner capsule and the plug is mechanically pressed in place and subsequently TIG welded. This inner capsule is placed into the outer source body, the plug mechanically pressed in place and also TIG welded. Both capsule and plug are made from high-grade stainless steel. The source is then laser engraved with the pertinent information. The encapsulated material meet internationally-accepted specifications for special form certification and ANSI test criteria for classification as ANSI-77C66545.

**DETAILS OF CONSTRUCTION:**

The basic mechanical construction is a gauge base fabricated from 18 gauge stainless steel and folded into a box 9.00" deep and 2.95" high with the four corner seams welded. A molded plastic top shell fits snugly over the base.

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**DETAILS OF CONSTRUCTION (Continued):**

The source holder which houses the 40 mCi (1.63 GBq) Am-241:Be source is mounted to the inside bottom of the stainless steel base with steel screws. The source holder is a stack-up of round parts (all 1.95" [49.5 mm] in diameter) which are held together with screws and is composed of disks of polyethylene, stainless steel, and lead. On the bottom of the source holder assembly is a 0.40" (10.2 mm) thick polyethylene disk. Immediately above the polyethylene disk is a 0.81" (42.4 mm) thick disk of stainless steel with a threaded hole in the top. The source is placed inside of a threaded plug which is then screwed into this stainless steel disk. A 0.063" (1.6 mm) thick disk of lead is then attached to the top of the assembly. The radiation label is placed directly on top of this lead disk.

Rechargeable nickel-cadmium batteries are mounted at the rear of the gauge base, and the He-3 tubes, with electronics, are mounted to the side of the base. An aluminum telescoping handle is attached to the rear of the base. The plastic top shell is attached to the gauge base with steel screws.

**LABELING:**

The Model 3216 gauge labeled in accordance with 15A NCAC 11 .1626. The labels contain the radiation symbol, isotope, activity, model number, serial number, name of distributor, and the words "CAUTION-RADIOACTIVE MATERIAL."

**DIAGRAM:**

See Attachment 1 for a diagram indicating source and label positions

**CONDITIONS OF NORMAL USE:**

The Model 3216 gauge is designed to be used by trained personnel to measure moisture content, particularly built-up, flat roofing. The user will normally be near the device only for the time period necessary to set up the gauge and perform the measurement. The gauge has a recommended working life of 20 or more years under normal use conditions and with proper maintenance. However, the gauge should be returned to Troxler Electronic Laboratories every five years for a thorough manufacturer's inspection.

The device is designed for the following environments:

Operating temperature    -10°C to 70°C ambient

Pressure                            Atmospheric

Vibration                            Ranges from zero to mild (tested @ a displacement of 0.1" @ 12.5 Hz)

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**CONDITIONS OF NORMAL USE (continued):**

Corrosion Ranges from zero to corrosive

Fire <sup>+</sup>1370°C (to melt the stainless steel capsule around the Am-241:Be source)

**PROTOTYPE TESTING:**

The Model 3216 underwent prototype testing in the early 1980's and was tested for vibration (2.5 mm displacement at 12.5 Hz for 24 hours), drop test (drop from a height of 5 meters onto a concrete floor), and impact (5.9 kg steel cylinder, 32 mm in diameter, dropped from a height of 1 meter onto the source holder). No increase in radiation levels was observed following each test. There were no tests to evaluate explosion or fire. Based on the melting points of the various metals used for the source holder, the gauge would support the assignment of an ANSI standard rating of ANSI-54-685-685-R2.

Since most of the testing was conducted over 20 years ago, a search of the Nuclear Materials Events Database was performed to determine if there were any incidents involving the Model 3216 that would influence the safety evaluation. There were no events noted in the NMED system that would indicate a design issue with this particular model of gauge.

**EXTERNAL RADIATION LEVELS:**

See Attachment 2 & 3 for radiation levels for the Model 3216 gauge and the gauge in its transport case (both the "pyramid" case (Attachment 2) and the "plastic case" (Attachment 3)).

**QUALITY ASSURANCE AND CONTROL:**

Troxler Electronic Laboratories maintains a quality assurance and control program which has been deemed acceptable for licensing purposes by the North Carolina Radiation Protection Section. A copy of the program is on file with the Radiation Protection Section.

**LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:**

**Distribution:** This device will be distributed as a specifically licensed device in accordance with the requirements of Section .0300 of 15A NCAC 11 and/or applicable regulations of the NRC or an Agreement State. This shall not preclude the exportation of this device to a foreign entity following the applicable regulations.

**Leak Testing:** The device shall be leak tested by the user following the instructions in the "Manual of Operation and Instruction" at intervals not to exceed **twelve** months using techniques capable of detecting the presence of 0.005 microcurie of removable contamination. If the level of contamination exceeds this limit, the device shall be returned to Troxler for repair/disposal. Please note, Troxler maintains a leak test service.

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**LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE (continued):**

**Servicing:** Other than replaceable electronic modules, these gauges contain no user serviceable components.

**Dosimetry:** All authorized users of these gauges should wear personnel dosimetry (film badges or TLD) in accordance with NRC or Agreement State regulations.

**Operating and Safety Instructions:** The device shall be operated in accordance with the written operating and safety instructions given in the device manual.

**Training:** Use of these gauges is limited to individuals who have completed an approved training class in the basic principles of radiation safety and the proper use of these gauges. Please note, Troxler provides a training program for gauge users.

**Use:** The operator should periodically inspect the gauge for loose and worn components. If any damaged components are found, the gauge should be returned immediately to the manufacturer for servicing.

**Reviewer Notes:**

- 1) This registration sheet and the information contained within the references shall not be changed without the written consent of the North Carolina Division of Radiation Protection, Radioactive Materials Section.
- 2) **Troxler no longer manufactures the Models 3217 and 3218 gauges. Troxler will accept these gauges for service and disposal. Refer to NC-646-D-828-S for additional information on these devices.**

**DOCUMENTATION:**

The documentation enclosed with the device upon shipment to the user shall include the following:

1. manual of operation and instruction,
2. special form certificate,
3. type "A" package testing results,
4. a copy of the final leak test results made prior to packaging,
5. bill of lading,
6. an emergency response information sheet,
7. Model 3216 gauge certificate,
8. Troxler transportation guide.

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**SAFETY ANALYSIS SUMMARY:**

The design of the Model 3216 gauges makes the devices safe to operate by personnel trained in radiological safety. The inherent safety features of the device include: (1) a sealed source, doubly or triply encapsulated, and secured into the device; (2) the use of shielding to attenuate the radiation to lower exposure levels; (3) no extendable source rod. The radiation profile for the device both in and out of the transport case show relatively low radiation levels that are acceptable per federal regulations for exposure. Therefore, based on the information cited above and technical information provided in the application attachments, and with the condition that the licensee (*i.e.*, user) maintain the gauge(s) in accordance with the manufacturer's recommendations and the requirements of this registry sheet, we conclude that the Troxler Model 3216 gauges meet and exceed the requirements to be manufactured and distributed as specifically licensed devices pursuant to applicable regulations listed in 15A NCAC 11.

**REFERENCES:**

The following supporting documents are hereby incorporated by reference into this SS&D registry document:

1. Information and engineering drawings submitted by Troxler in the original application for a safety analysis of the Model 3216, 3217, and 3218 gauges and currently contained in the gauge SS&D review file; the operating and instruction manual for the 3216 series gauges; testing results for the classification of the Type "A" packages for 3216 gauges; test results from prototype testing carried out on the 3216, 3217, and 3218 gauges; and Sealed Source & Device Registry Certificate No. NC-646-D-126-S originally issued in May, 1990 and Letter with attachments dated November 21, 2001, and facsimile dated November 28, 2001, both signed by Stephen A. Browne, Corporate R.S.O;
2. **Letter with attachments dated February 14, 2006, signed by Stephen A. Browne, Corporate R.S.O.**

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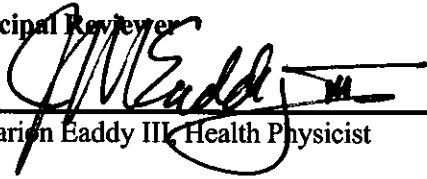
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**DEVICE TYPE:** Portable Surface Moisture Gauge

**ISSUING AGENCY:**

This Sealed Source & Device registry certificate is hereby amended July 10, 2006.

**Principal Reviewer:**



\_\_\_\_\_  
J. Marion Eaddy III, Health Physicist

Date: July 10, 2006

**Concurrence Reviewer:**



\_\_\_\_\_  
Gerald A. Speight, Health Physicist

Date: July 10, 2006

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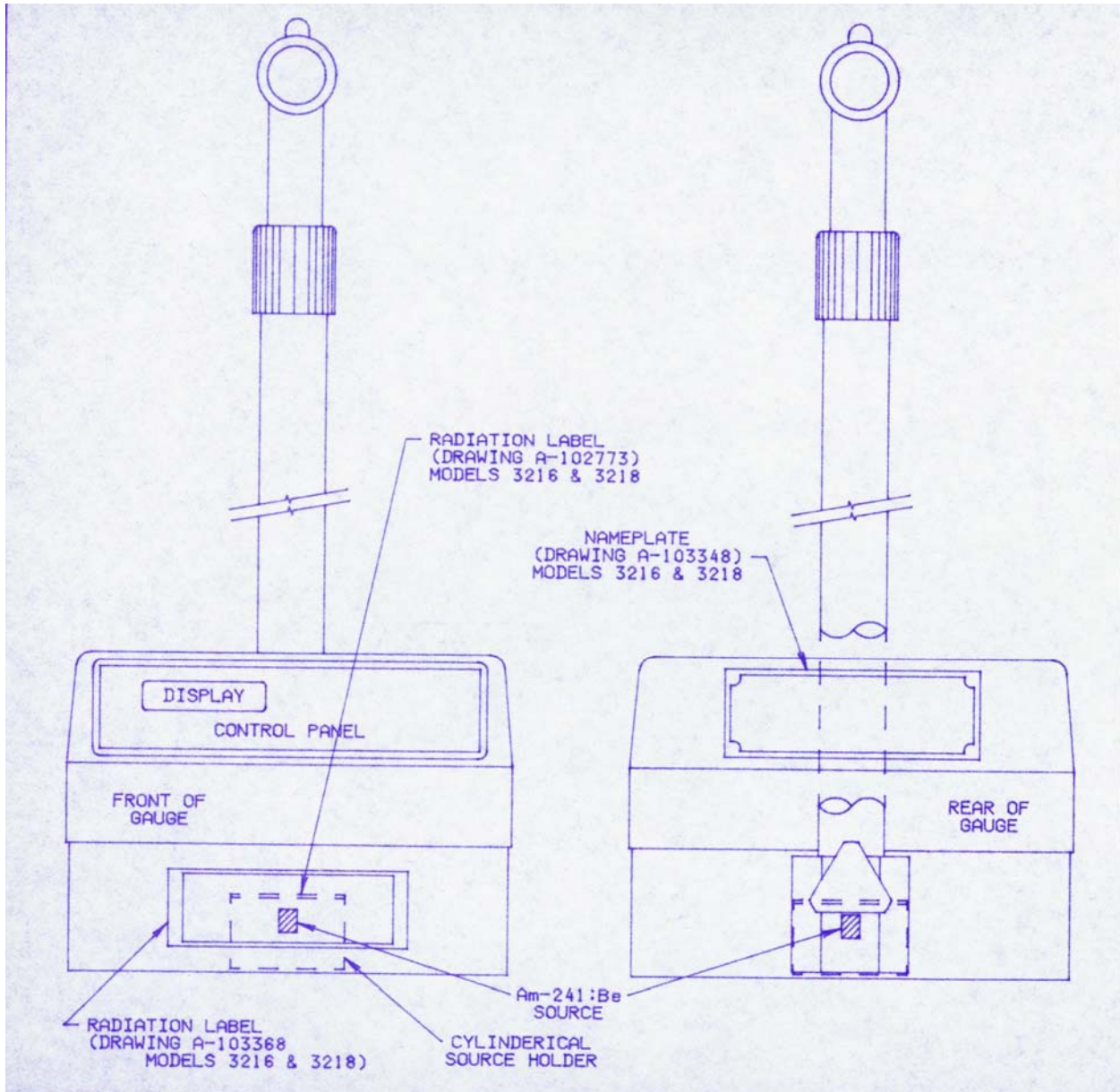
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**ATTACHMENT:** 1 of 3

**DEVICE TYPE:** Portable Surface Moisture Gauge

**Attachment 1: Three Dimensional View of the 3216 Source and Label Locations**





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## SAFETY EVALUATION OF DEVICE

### (AMENDS IN ITS ENTIRETY)

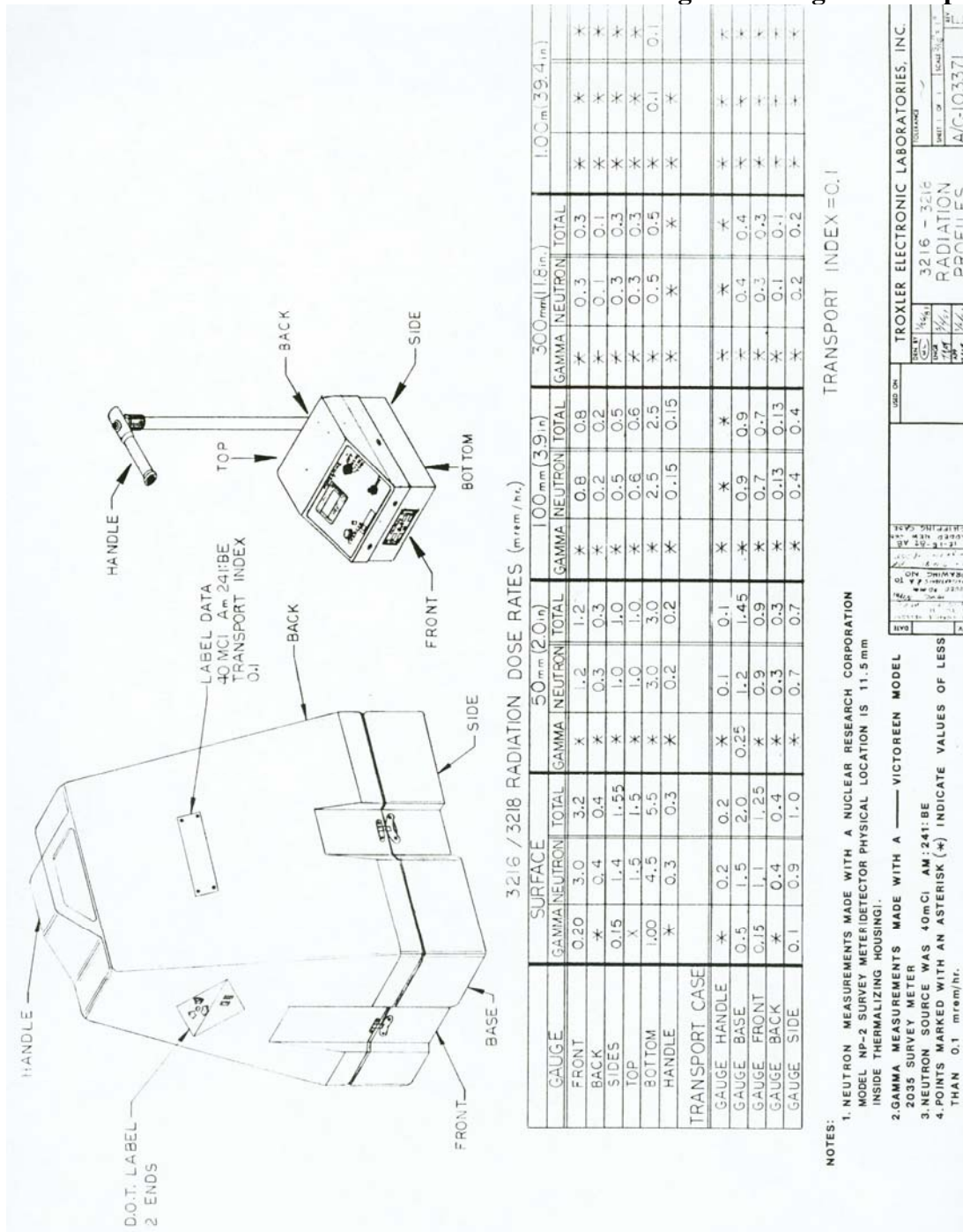
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**ATTACHMENT:** 2 of 3

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## Attachment 2: Radiation Profile for Model 3216 Gauge and Gauge in Transport Case



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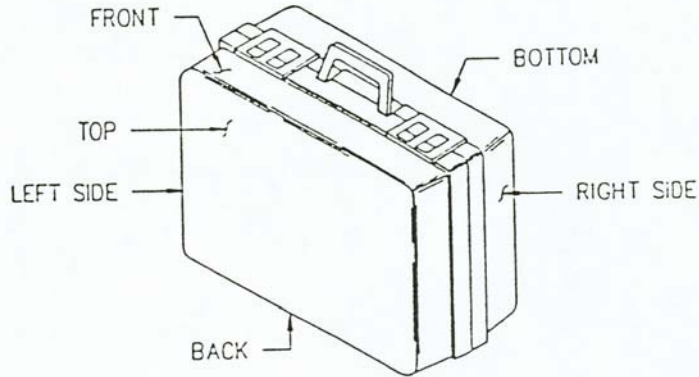
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**ATTACHMENT:** 3 of 3

**DEVICE TYPE:** Portable Surface Moisture Gauge

**Attachment 3: Radiation Profile for Model 3216 Gauge in "Plastic" Transport Case**



TRANSPORT INDEX = 0.1

RADIATION PROFILE FOR 3216 GAUGE IN PLASTIC CASE

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
LEFT	0.4	1.3	1.7				*	0.4	0.4	*	0.1	0.1
BACK	*	0.2	0.2				*	*	*	*	*	*
RIGHT	*	0.2	0.2				*	*	*	*	*	*
FRONT	*	0.7	0.7				*	0.2	0.2	*	*	*
BOTTOM	*	0.4	0.4				*	0.2	0.2	*	*	*
TOP	*	0.3	0.3				*	*	*	*	*	*

**NOTE: RADIATION DOSE RATES IN MILLIREMS PER HOUR**

1. Gamma Measurements made using Ludlum 14C Survey Meter, Calibrated March, 1990.
2. Neutron Measurements made with Nuclear Research Corp. Model NP-2 Survey meter, calibrated March 1990.
3. Dose rates for 40 mCi Americium-241:Beryllium source.
- 3.\* indicates a reading less than 0.1 millirems/hour.
4. Surface indicates surface of the case