TROXLER®

March 3, 2014

Margie Kotzalas
Chief, Licensing Branch
Division of Material Safety and State Agreements
Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Ms. Katzalas:

Enclosed you will find an application for a Sealed Source and Device Registration and the information to determine exempt status for the Troxler Model 3660 CoreReader. This device was previously approved by the NRC and has been distributed under license 32-05998-04E, but due to the change in regulations, a SS&D is now required. Also enclosed is a check for $8,000 for the SS&D review.

Additional enclosures include CoreReader prototype testing results, Section VII of the Troxler Quality Assurance Manual, Chapter 2 from the Manual Operation and Instructions for the CoreReader,

We have also submitted a request for exemption per 10 CFR 30.22, such that the NRC would be able to authorize the distribution of the CoreReader to persons exempt from licensing under this section of the regulations.

If you have any questions about the content of the application, please contact me or Henry Barnes by phone at 919-5485-2228 or e-mail at hbarnes@troxlerlabs.com.

Sincerely,

William F. Troxler, Jr.
President

Enclosures:
1. Application for Sealed Source Device Review
2. Exempt Product License Application (NRC Form 313 and supplementary information)
3. Prototype Testing of Model 3660 CoreReader
4. Section VII of the Troxler QA Manual, Rev. 9.
5. Operation and Instruction Manual, Chapter 2, Product Safety Information
6. Risk Assessment for CoreReader
7. Letter from NRC granting Exempt Request dated December 19, 2002

Troxler Electronic Laboratories, Inc.
3008 Cornwallis Rd. • PO Box 12057 • Research Triangle Park, NC 27709
Phone: 1.877.TROXLER (1.877.876.9537) • Outside the USA +1.919.549.8661 • Fax: +1.919.549.0761 • www.troxlerlabs.com

Enclosure 1

Application for Sealed Source Device Review

Application for Sealed Source and Device Registration

Summary Data

Name and complete mailing address of applicant:

Troxler Electronic Laboratories, Inc.
PO Box 12057
3008 Cornwallis Rd
Research Triangle Park, NC 27709

Name, title, and telephone number of the individual to be contacted if additional information or clarification is needed:

Henry E. Barnes
Corporate Radiation Safety Officer
919-485-2228
hbarnes@troxlerlabs.com

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:

Not applicable

If the applicant is a custom user, provide the name and complete address of the distributor:

Not applicable

Provide the name, complete mailing address, and function of other companies involved:

None

Model number: 3660

Principal Use Code: G

Name used by the industry to identify the product:

CoreReader
Bench-top Density Gauge

For use by:

	Specific licensees only
	General licensees only
	Both Specific and General Licensees
X	Persons Exempt from Licensing

Leak test frequency:

X	Period leak testing is not required
	6 months
	Attached is justification for leak test frequency of greater than 6 months

Principal section of the 10 CFR that applies to the user: **10 CFR 30**

Radionuclides and maximum activities:

Cs-137, each source 10 µCi (0.37 MBq)
8 sources tota - 80 µCi (2.96 MBq)

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, 1949 62 STAT. 749 MAKES IS 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 official (Typed name and Title): Henry E. Barnes, Corporate Radiation Safety Officer

Signature: Henry Barnes

Date: 3-5-2014

Enclosure 2

Exempt Product License Application (NRC Form 313 and supplementary information)

NRC FORM 313 (03-2013) 10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR MATERIALS LICENSE

APPROVED BY OMB: NO. 3150-0120 **EXPIRES: 05/31/2015**

Estimated burden per response to comply with this mandatory collection request: 4.3 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Information Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW. *AMENDMENTS/RENEWALS THAT INCREASE THE SCOPE OF THE EXISTING LICENSE TO A NEW OR HIGHER FEE CATEGORY WILL REQUIRE A FEE.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

OFFICE OF FEDERAL & STATE MATERIALS AND ENVIRONMENTAL MANAGEMENT PROGRAMS
DIVISION OF MATERIALS SAFETY AND STATE AGREEMENTS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA,

SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PA 19406-2713

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MISSISSIPPI, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING,

SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
1600 E. LAMAR BOULEVARD
ARLINGTON, TX 76011-4511

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER
- [x] C. RENEWAL OF LICENSE NUMBER 32-05998-04E

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*

Troxler Electronic Laboratories, Inc.
PO Box 12057
Research Triangle Park, NC 27709

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

3008 E. Cornwallis Road
Research Trialgle Park, NC 27709

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Henry E. Barnes, Corporate RSO

BUSINESS TELEPHONE NUMBER	BUSINESS CELLULAR TELEPHONE NUMBER
(919) 485-2228	

BUSINESS EMAIL ADDRESS

hbarnes@troxlerlabs.com

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
   a. Element and mass number; b. chemical and/or physical form; and c. maiximum amount which will be possessed at any one time.
6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.
7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.
8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.
9. FACILITIES AND EQUIPMENT.
10. RADIATION SAFETY PROGRAM.
11. WASTE MANAGEMENT.
12. LICENSE FEES (Fees required only for new applications, with few exceptions*) *(See 10 CFR 170 and Section 170.31)*

FEE CATEGORY ______ AMOUNT ENCLOSED $ ______

13. CERTIFICATION. *(Must be completed by applicant) 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, 32, 33, 34, 35 , 36, 39, AND 40, AND THAT ALL INFORMATION CONTANED 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 C RIMINAL 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/PRINTED NAME AND TITLE	SIGNATURE	DATE
William F. Troxler, JR, President, CEO	[signature]	3-6-2014

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

Exempt Product Distribution License Application

Item 5 - Description of radioactive material

a. Element and mass number:

Cesium-137

b. Chemical and physical form:

Each source is a Plexiglas disk (1.0 inch diameter x 0.175 inch thick) as shown in Troxler drawing A-109617. A 0.25 inch diameter hole is drilled in the center of the disk. The radioactive material is inserted in the bottom of the hole, which is then filled with epoxy to the level of the original surface.

Troxler may obtain the sources from various vendors. However, the sources will only be procured from persons or organizations with USNRC licenses that authorize distribution of such sources to persons exempt from licensing.

c. Maximum quantity:

Each individual source has a maximum quantity of 10 microcuries (0.37 MBq). Each device (Model 3660 CoreReader) contains 8 of the Cs-137 sources. Individually the sources are exempt from licensing consistent with NRC practice and an NRC determination of minimum health and safety hazard.[1] These 8 sources are not bundled, but are distributed in a specific pattern which is necessary for the device to perform its functions. A single source point source would not provide an equivalent level of measurement accuracy with the same limits on radiation exposure

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[1] Products containing calibration and reference sources which include no more than 10 times the Schedule B quantities for exempt sources do not require review by the NRC's Division of Industrial and Medical Nuclear Safety because the small amount of radioactive material involved presents a "minimum hazard to public health and safety." NUREG 1556, Vol. 3, Section 5.11.

Item 6 - Purpose for which the material will be used

The Cs-137 exempt-quantity sources will be incorporated into a device (Model 3660 CoreReader) to be distributed to persons exempt from licensing. The sources in the device serve two purposes: (1) internal calibration and standardization of the detector, and (2) measurement of sample properties. The CoreReader is an ionizing radiation measurement instrument (a gamma spectrometer) with specialized software for analysis and interpretation of the detected radiation in terms of the specific gravity of the sample.

As with other radiation measuring instruments, a calibration check is performed as a prerequisite to system operation for quality control purposes. Each time the instrument is operated, it measures the internal Cs-137 sources with the sample chamber empty to calibrate and standardize the gamma scintillation detector and associated multichannel analyzer electronics. When this check has been completed successfully, the instrument is ready for sample analysis operations.

The operation of the Model 3660 CoreReader for analyzing an asphalt sample is very simple. It does not require any special sample preparation procedures, such as wrapping the sample with Para-film, nor does it require a precision weighing scale and temperature-regulated water bath. The CoreReader is equipped with a sample tray that can accommodate either a 100-mm (4-inch) or a 150 mm (6-inch) diameter cylindrical sample. The asphalt sample is placed on the sample tray, which slides between the gamma-ray sources and the NaI(Tl) gamma scintillation detector. The instrument measures the ionizing radiation emitted from the internal sources that is transmitted through the sample and analyzes the spectrum. The CoreReader software then converts the gamma-ray spectrum to an estimate of the bulk specific gravity of the sample. The average measurement time of a sample is about 4.5 minutes.

As with other devices with multiple exempt sources, the multiple sources are intrinsic to the functioning of the CoreReader. The number and maximum activity of each source is within that which is allowed by 10 C.F.R. 30.15(a)(9). The use of the sources for the additional purpose of measurement of sample properties does not increase the radiological impact nor detract from the use of the material for the purposes of internal calibration and standardization.[2]

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[2] Where exempt material can be used in one device for related purposes, in this case calibration and measurement, and different, inconsistent regulatory requirements may apply to those different purposes, the conservative position would be to apply the regulatory requirements which address the purpose that presents the greater radiological hazard. In this case, the potential dose that may be experienced from exposure to radiation from the sources in the device is greater when the device is empty and being calibrated than when the device contains a sample which absorbs some of the radiation. Accordingly, since the NRC already has determined that the regulatory requirements in 10 C.F.R. 30.15(a)(9) are adequate to protect public health and safety when a device with the types and number of sources in the CoreReader uses those sources for calibration and standardization, these same regulatory requirements must suffice when the device is used for another purpose which presents even less of a radiation hazard.

Additional Information Supporting the Application for Exempt Distribution License

1. Details of design and construction of product

The Model 3660 CoreReader contains very small amounts radioactive material in the form of sealed sources. Each individual source is an exempt quantity under NRC regulations. Although the dose rate from the unshielded sealed sources is very low, the device incorporates fixed shielding for ALARA purposes. The design does not rely on any shutters or moveable parts for safety. The sources are isolated in a separate compartment which is inaccessible to the user and provides a high level of security against unauthorized removal of the sources. The sources cannot be removed without completely disassembling the entire device.

The device is constructed primarily of aluminum with lead for shielding. An overview of the gauge is shown in Troxler drawing A-109684 (sheets 1-4). The tower dimensions are 12.2 inches wide x 10.2 inches deep x 29.04 inches high. The tower is built on a 0.5 inch thick aluminum base plate that extends 6 inches beyond the front surface of the tower to add stability.

The device has three discrete sections: bottom, middle, and top. The sources are contained in the bottom section and are oriented to irradiate a compacted asphalt sample placed in the middle section. The radiation detector and electronics are contained in the top section. The following paragraphs describe the three sections in more detail.

<u>Bottom section</u>

The bottom section contains the radioactive sources. The Source Plate Assembly (Troxler drawing A-109684, sheet 2 of 4) is mounted 3.875 inches above the base plate. The assembly consists of a 1.0 inch thick aluminum plate with a 0.5 inch x 5.60 inch diameter lead shield cast into the bottom of the plate to reduce radiation escaping through the bottom. Eight holes (1.02 inch diameter x 0.185 inch deep) are machined just below the top surface of the plate to house eight radioactive sources. The sources are held in place by a 0.125 inch thick x 6.0 inch diameter aluminum cover plate with a neoprene cushioning pad between the sources and the plate to prevent any movement of the sources. The aluminum cover plate is secured with four 6-32 screws and lock washers.

A ring-shaped lead shield (7.0 inches O.D. x 6.0 inches I.D. x 1.975 inches high) sits atop the source plate to reduce the amount of radiation escaping radially from the device. The top of the ring extends into a 0.375 inch deep recess in the bottom of the 0.5 inch thick aluminum plate that serves as the floor of the sample chamber. Thus, the ring shield is completely secured against movement both vertically and horizontally.

No access is provided to the sources in the bottom section. The Cs-137 sources have a sufficiently long half-life that there is no need for source replacement during the working life of the device.

Middle Section

The middle section is the sample chamber. The Sample Chamber Base Plate and Sliding Tray are located 1.60 inches above the Source Plate Assembly. The base plate is 0.5 inch thick aluminum and the Sliding Plate is a 0.375 inch thick aluminum. The Sliding Tray rides on 0.25 inch diameter stainless steel ball bearings and is guided by aluminum rails. This is the only moveable part in the device with the exception of the chamber access door. The top of the sample chamber is defined by the 0.125 inch thick Detector Separator Plate located 7.725 inches above the Sample Chamber Base Plate.

Access to the sample chamber is provided by a transparent plastic door mounted to the front of the device with spring-loaded hinges. A sample is placed in the chamber by opening the door, pulling out the sliding tray, placing the sample on the tray, pushing the tray back into the chamber, and closing the door. The compacted asphalt sample is a right cylinder 1 – 7 inches tall and 4 - 6 inches in diameter) which sits in the center of the chamber between.

Top Section

The top section houses the detector, electronics, keyboard and display panel. A 0.5 inch thick aluminum Detector Mounting Plate is located just above the Detector Separator Plate. The top of this section and the gauge is a 0.25 inch thick aluminum top plate.

Assembly

The primary support for the gauge is provided by three 1.0 inch diameter x 28.75 inch long aluminum rods attached to the base plate with 5/16-18 flathead bolts and high-strength thread-locking adhesive. The rods extend upward and provide support for various horizontal plates. Each horizontal plate has holes drilled in it to allow it to slide down over the three rods. The device is constructed by building upward from the base with the spacing between the horizontal plates provided by aluminum tubes cut to specific lengths and placed over the 1.0 inch diameter rods. Three 1.0 inch I.D. steel split collars are installed on the top surface of Detector Mounting Plate and tightened in place to secure all lower plates from movement. The Top Plate is secured to the top of the three internal support rods with 5/16-18 threaded bolts. The outer shell of 1/16 inch aluminum sheet is attached with 8-32 screws.

2. Method of containment or binding of the BPM in the product

The Cs-137 disk sources are contained in the Source Plate Assembly described above. This assembly provides complete protection against release of activity under normal use and likely accident conditions. The design and construction of the device makes the source cover plate inaccessible, even when the outer shell of the device is removed. The only way to access the sources is to completely disassemble the device from the top down.

3. Procedures for prototype testing to demonstrate that the material will not become detached from the product or that BPM will not be released under severe conditions

A prototype unit of the Model 3660 was assembled to undergo mechanical testing to determine the gauge's ability to withstand accidents during transportation or use. The prototype unit was identical to a finished gauge except that all the electronics as well as the detector were removed and replaced by aluminum plates to replicate the total unit weight.

The following tests were performed on the prototype unit to assure its mechanical integrity:

- Vibration of 1/8" total displacement at 15 Hz for 24 hours
- Drop tests on all six surfaces from a height of 36 inches
- Drop test on four bottom corners and four top corners from height of 1 foot followed by a drop from 40' height on a top rear corner which was believed to be the area of the gauge which would suffer the most damage.

The drop test sequence was based on the Type A testing for packages containing radioactive materials 49CFR, Subpart 1, paragraph 173.465(c). Although the quantity of radioactive material in the device does not required Type A packaging, this test sequence was believed to be representative of severe conditions during transportation or use of the device.

5. Results of prototype testing

The only damage sustained by the prototype unit was minor distortion of the outer sheet metal shell and rear panel. The unit was disassembled and the shielding and source holder were inspected. There was no damage to the source plate assembly and no movement of or damage to the lead shielding. Details of the prototype testing report are contained in a separate enclosure.

Radiation profile measurements of the prototype unit taken before and after mechanical testing showed no change in the radiation levels on the surface of the device.

Gauge Surface	Before Test 10/12/01 (mrem/hr)*	After Vibration Test 10/26/01 (mrem/hr)*	After Drop Test 11/7/01 (mrem/hr)*
Front	0.25	0.2	0.2
Back	0.16	0.16	0.15
Right side	0.17	0.15	0.15
Left side	0.16	0.14	0.15
Top	0.04	0.04	0.05
Bottom	0.14	0.15	0.15

6. Quality control procedures to be followed in the fabrication, and the quality control standards the product will be required to meet

This device will be manufactured under the quality assurance program that has been deemed acceptable for purposes of manufacturing portable nuclear gauges under North Carolina radioactive material license number 032-0182-1, expiration date December 31, 2017. A copy of the latest revision of the Troxler Quality Manual is maintained on file with the NC Division of Radiation Protection. The quality manual includes performing a leak test on each device prior to distribution to a licensee.

7. Proposed method of labeling or marking each unit

The device will have a nameplate label and two radiation labels. All labeling will be sufficiently durable to remain legible for the useful life of the product. Label locations are shown in Troxler drawing A-109756.

Nameplate Label

The nameplate label, shown in Troxler drawing A-109682, is located on the front of the device. This label contains the name and model number of the device, several informational statements, and Troxler's name and address.

Radiation Labels

The radiation labels are shown in Troxler drawing A-109692 and A-109774. Both labels contain the same information, including the words "Caution – Radioactive Material", the radionuclide name (cesium-137), and the total activity (80 microcuries). These labels differ in material and method of attachment. One label, an aluminum plate, will be riveted to the front of the device. The other label, metallicized polyester with adhesive backing, will be attached to the source cover plate. This will ensure that persons disassembling the gauge would be aware of the presence of radioactive material inside the Source Plate Assembly. In addition, each exempt quantity source has a label bearing the radiation caution symbol, type, and quantity of radioactive material.

8. Radiation level and method of measuring

Radiation levels on the Model 3660 CoreReader were measured using a Bicron Micro Rem survey meter. The detector in this instrument is a tissue equivalent organic scintillator calibrated using cesium-137. The range of the lowest scale is 0 – 20 microrem per hour.

The maximum radiation levels measured at 5, 30, and 100 cm from any external surface of the device and inside the sample chamber are shown below. Measurements were made both with and without a test sample in the chamber. The background exposure rate at the time of the measurements was 5 microrem per hour.

Distance or Location	**Dose Rate above Background (millirem per hour)**
In sample chamber	1.1
5 cm	0.2
30 cm	0.05
100 cm	Not detectable

Based on the measured dose rates, an individual working in close proximity (30 cm) to the device for 2000 hours per year (40 hours per week x 50 weeks per year) would not exceed the public dose limit of 100 mrem per year.

The sample chamber is accessed through a door on the front of the device. Asphalt samples are inserted and removed using a sliding support plate. There is no need for users to insert their hands inside the sample chamber during any aspect of operation or calibration of the device. Nevertheless, based on the measured dose rate inside the sample chamber an individual would not receive an extremity dose that requires monitoring even if the hands were kept inside the chamber for 2000 hours per year.

9. Additional information, studies, and tests regarding product safety

Installation

No special installation is required. The device is designed to sit on a bench top in a laboratory.

Servicing

Calibration of the device is performed by the user by counting standards of known specific gravity in the same manner as unknown samples are counted.

No routine maintenance is required and the sources are exempt from leak testing. All components that might need repair, such as the detector and electronics, are located in the top section of the device where dose rates are very low.

There are no serviceable components in the bottom section of the device that houses the sources. The sources and shielding are fixed and there is no shutter mechanism. The half-life of the Cs-137 sources is sufficiently long that replacement or exchange is not required during the working life of the device.

Training

The device is intended for use by technicians having no special radiation safety training.

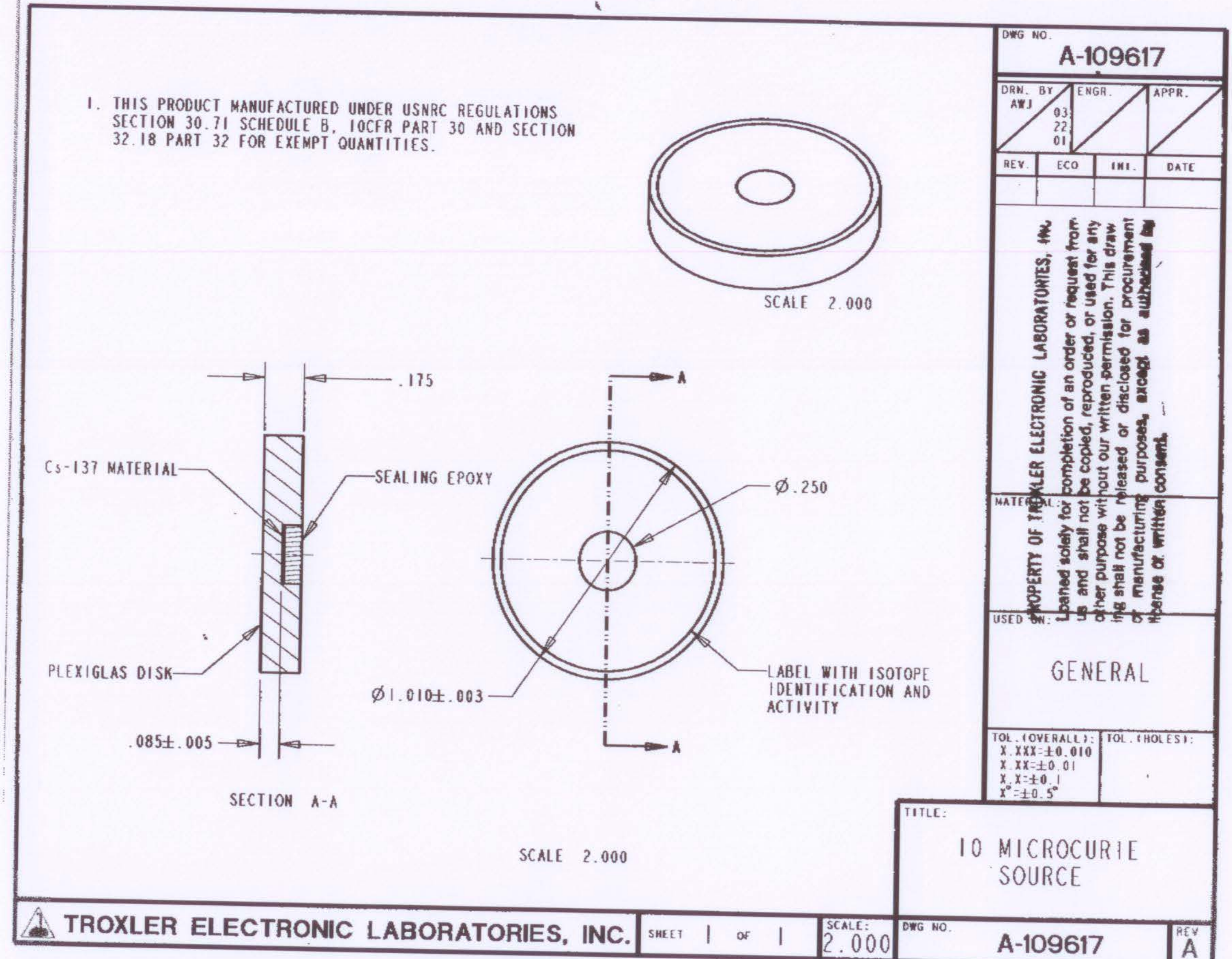
Expected working life of device

The estimated working life of the device is 10 years. The device is very simple in its mechanical design and is constructed of durable materials (aluminum) that will not wear out. There are no source shutters or on/off mechanisms that can fail.

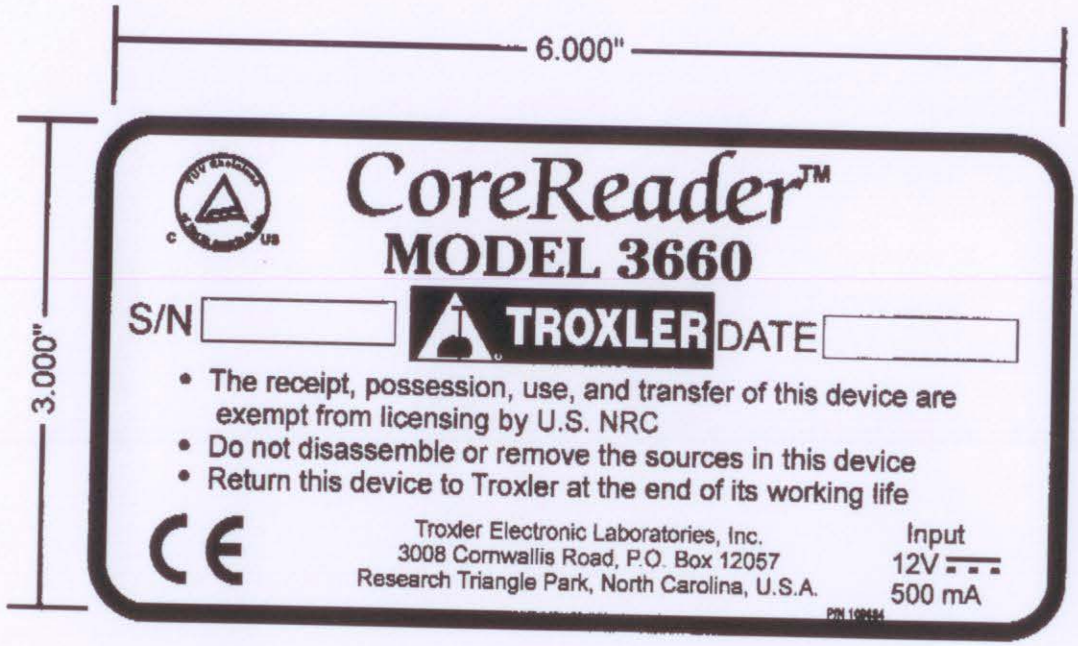
Risk from Theft

The CoreReader is a heavy, bulky laboratory instrument, whereas most thefts involve portable nuclear gauges stolen from parked vehicles, especially pickup trucks. This device would seldom be transported in a vehicle, so the risk of theft should be very low. If a theft occurred, the risk to the public would be negligible because of the low activity of the source material in the instrument. Further, the design and construction of the device is such that a person cannot do anything that would increase the exposure rate (such as open a shutter or operate a source rod), so the device is inherently safe.

Enclosure 2



1. THIS PRODUCT MANUFACTURED UNDER USNRC REGULATIONS SECTION 30.71 SCHEDULE B, 10CFR PART 30 AND SECTION 32.18 PART 32 FOR EXEMPT QUANTITIES.
SCALE 2.000
.175
Cs-137 MATERIAL
SEALING EPOXY
Ø.250
PLEXIGLAS DISK
Ø1.010±.003
LABEL WITH ISOTOPE IDENTIFICATION AND ACTIVITY
.085±.005
A
A
SECTION A-A
SCALE 2.000
DWG NO. A-109617
DRN. BY AWJ 03 22 01
ENGR.
APPR.
REV.
ECO
INI.
DATE
PROPERTY OF TROXLER ELECTRONIC LABORATORIES, INC. Loaned solely for completion of an order or request from us and shall not be copied, reproduced, or used for any other purpose without our written permission. This drawing shall not be released or disclosed for procurement or manufacturing purposes, except as authorized by license or written consent.
MATERIAL:
USED ON:
GENERAL
TOL. (OVERALL): X.XXX=±0.010 X.XX=±0.01 X.X=±0.1 X°=±0.5°
TOL. (HOLES):
TITLE: 10 MICROCURIE SOURCE
TROXLER ELECTRONIC LABORATORIES, INC.
SHEET 1 OF 1
SCALE: 2.000
DWG NO. A-109617
REV A



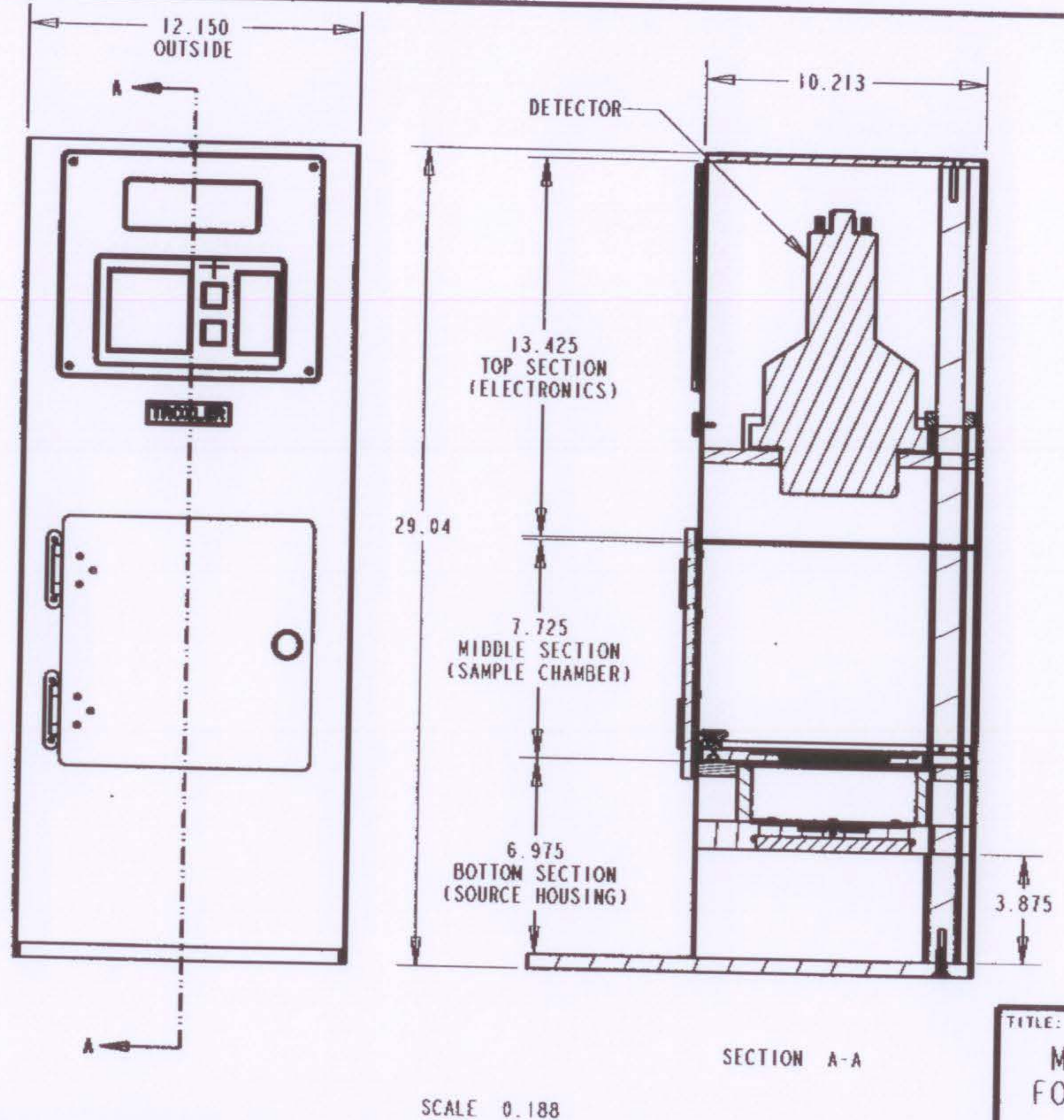
NOTES:

1. MATERIAL TO BE 2 MIL POLYESTER WITH 1 - 2 MIL MATTE PRINTABLE OVERLAMINATE AND 1 MIL PERMANENT ADHESIVE BACKING.
2. COLOR TO BE BLACK LETTERING EXCEPT LOGO WHICH IS TO BE "TROXLER BLUE"
3. LETTERING TO BE ARIAL OR HELVETICA MEDIUM, DEMI, OR BOLD, WHICHEVER SIZE AND STYLE IS APPROPRIATE AS SHOWN.
4. CAMERA READY ARTWORK TO BE SUPPLIED BY TROXLER FOR LOGO ONLY. LOGO IS TO BE LOCATED AS SHOWN. DRAWING OF LOGO IS FOR SIZE AND LOCATION REFERENCE ONLY.
5. A PROOF SHALL BE SUPPLIED TO AND APPROVED BY TROXLER ENGINEERING BEFORE ANY PRODUCTION RUN.

DWG NO.	A-109682
DRN. BY	BA DEC 01
ENGR.	AWJ DEC 01
APPR.	
REV. / ECO / INI. / DATE	
MATERIAL:	SEE NOTES
USED ON:	3660
TOL. (OVERALL):	± .050
TOL. (HOLES):	
TITLE:	CORE READER NAMEPLATE

TROXLER ELECTRONIC LABORATORIES, INC. | SHEET 1 OF 1 | SCALE: 1/1 | DWG NO. A-109682 | REV A

THIS DRAWING WAS PRODUCED ON COREL DRAW



DWG NO. A-109684

DRN. BY	ENGR.	APPR.
AWJ 04 06 01		

REV.	ECO	INI.	DATE

MATERIAL:

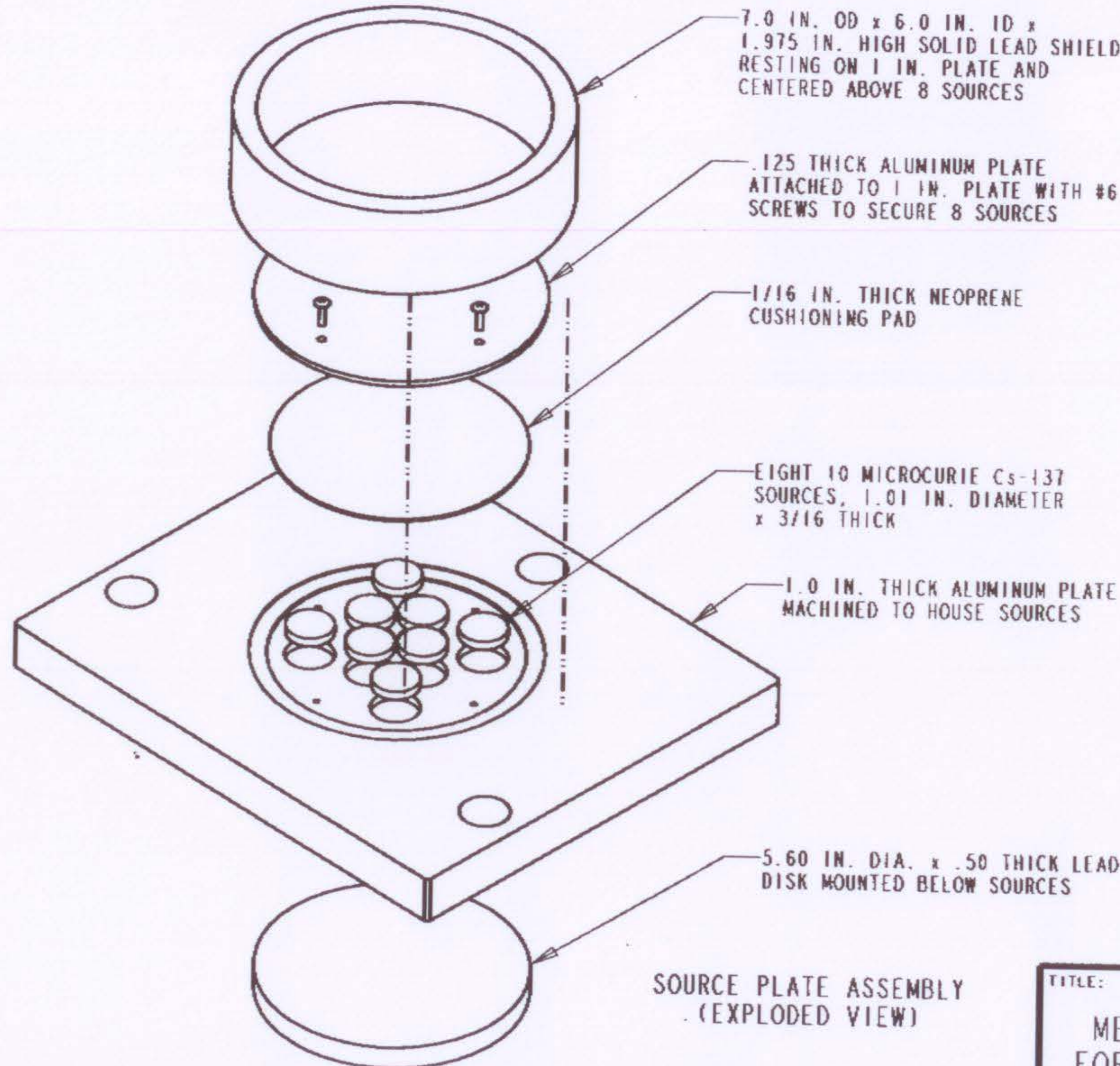
USED ON: MODEL 3660

TOL. (OVERALL): X.XXX=±0.010 X.XX=±0.01 X.X=±0.1 X°=±0.5°

TOL. (HOLES):

TITLE: MECHANICAL LAYOUT FOR SOURCE LOCATION

TROXLER ELECTRONIC LABORATORIES, INC. | SHEET 1 OF 4 | SCALE: 0.050 | DWG NO. A-109684 | REV A



SOURCE PLATE ASSEMBLY
(EXPLODED VIEW)

DWG NO. A-109684

DRN. BY	ENGR.	APPR.

REV.	ECO	INI.	DATE

MATERIAL:

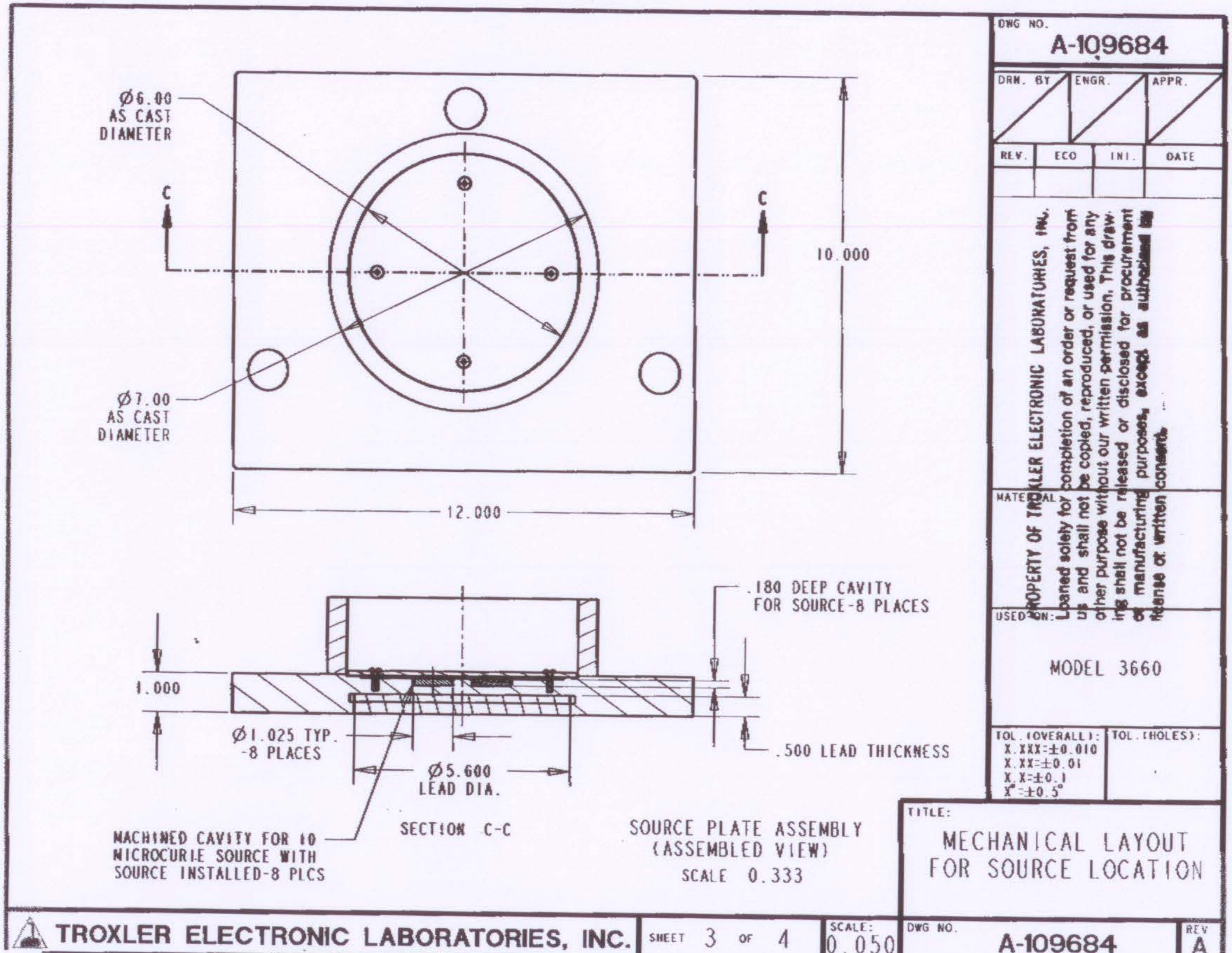
USED ON: MODEL 3660

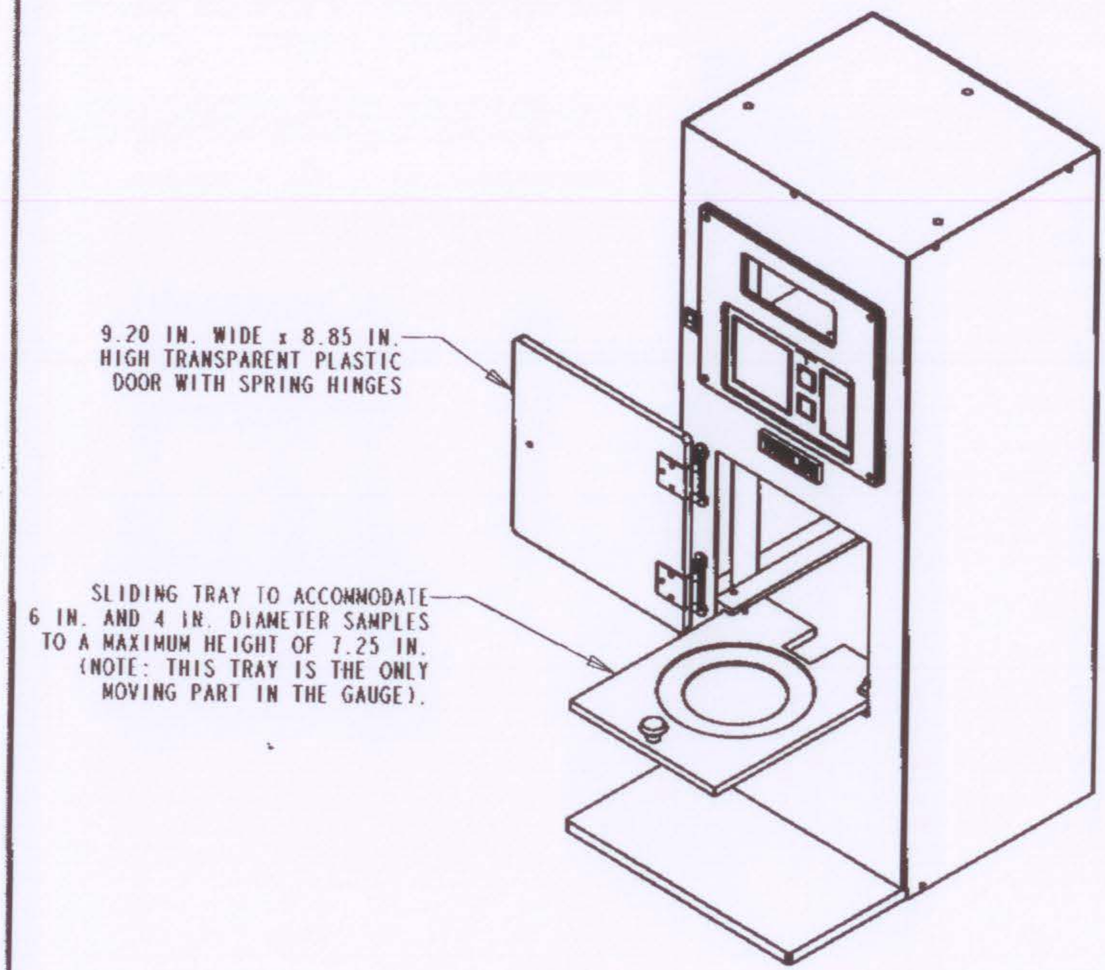
TOL. (OVERALL): X.XXX=±0.010 X.XX=±0.01 X.X=±0.1 X°=±0.5°

TOL. (HOLES):

TITLE: MECHANICAL LAYOUT FOR SOURCE LOCATION

TROXLER ELECTRONIC LABORATORIES, INC. | SHEET 2 OF 4 | SCALE: 0.050 | DWG NO. A-109684 | REV A


DWG NO.
A-109684
DRN. BY
ENGR.
APPR.
REV.
ECO
INI.
DATE
PROPERTY OF TROXLER ELECTRONIC LABORATORIES, INC.
Loaned solely for completion of an order or request from us and shall not be copied, reproduced, or used for any other purpose without our written permission. This drawing shall not be released or disclosed for procurement or manufacturing purposes, except as authorized
license or written consent.
MATERIAL
USED ON:
MODEL 3660
TOL. (OVERALL):
X.XXX=±0.010
X.XX=±0.01
X.X=±0.1
X°=±0.5°
TOL. (HOLES):
Ø6.00
AS CAST
DIAMETER
Ø7.00
AS CAST
DIAMETER
C
C
10.000
12.000
.180 DEEP CAVITY
FOR SOURCE-8 PLACES
1.000
Ø1.025 TYP.
-8 PLACES
Ø5.600
LEAD DIA.
.500 LEAD THICKNESS
MACHINED CAVITY FOR 10
MICROCURIE SOURCE WITH
SOURCE INSTALLED-8 PLCS
SECTION C-C
SOURCE PLATE ASSEMBLY
(ASSEMBLED VIEW)
SCALE 0.333
TITLE:
MECHANICAL LAYOUT
FOR SOURCE LOCATION
TROXLER ELECTRONIC LABORATORIES, INC.
SHEET 3 OF 4
SCALE: 0.050
DWG NO.
A-109684
REV
A



SCALE 0.167

DWG NO. A-109684

DRN. BY	ENGR.	APPR.

REV.	ECO	INI.	DATE

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MATERIAL:

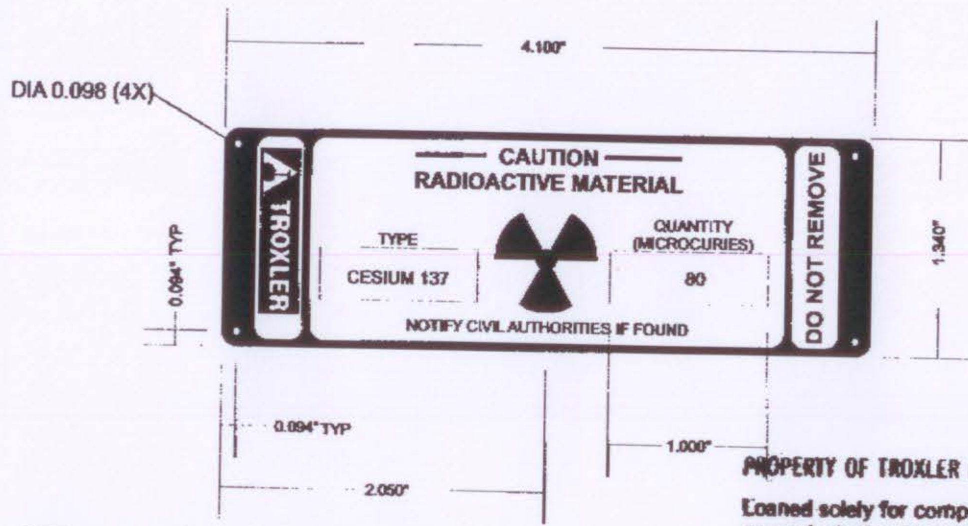
USED ON: MODEL 3660

TOL. (OVERALL): X.XXX=±0.010 X.XX=±0.01 X.X=±0.1 X°=±0.5°

TOL. (HOLES):

TITLE: MECHANICAL LAYOUT FOR SOURCE LOCATION

TROXLER ELECTRONIC LABORATORIES, INC. SHEET 4 OF 4 SCALE: 0.050 DWG NO. A-109684 REV A



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NOTES:

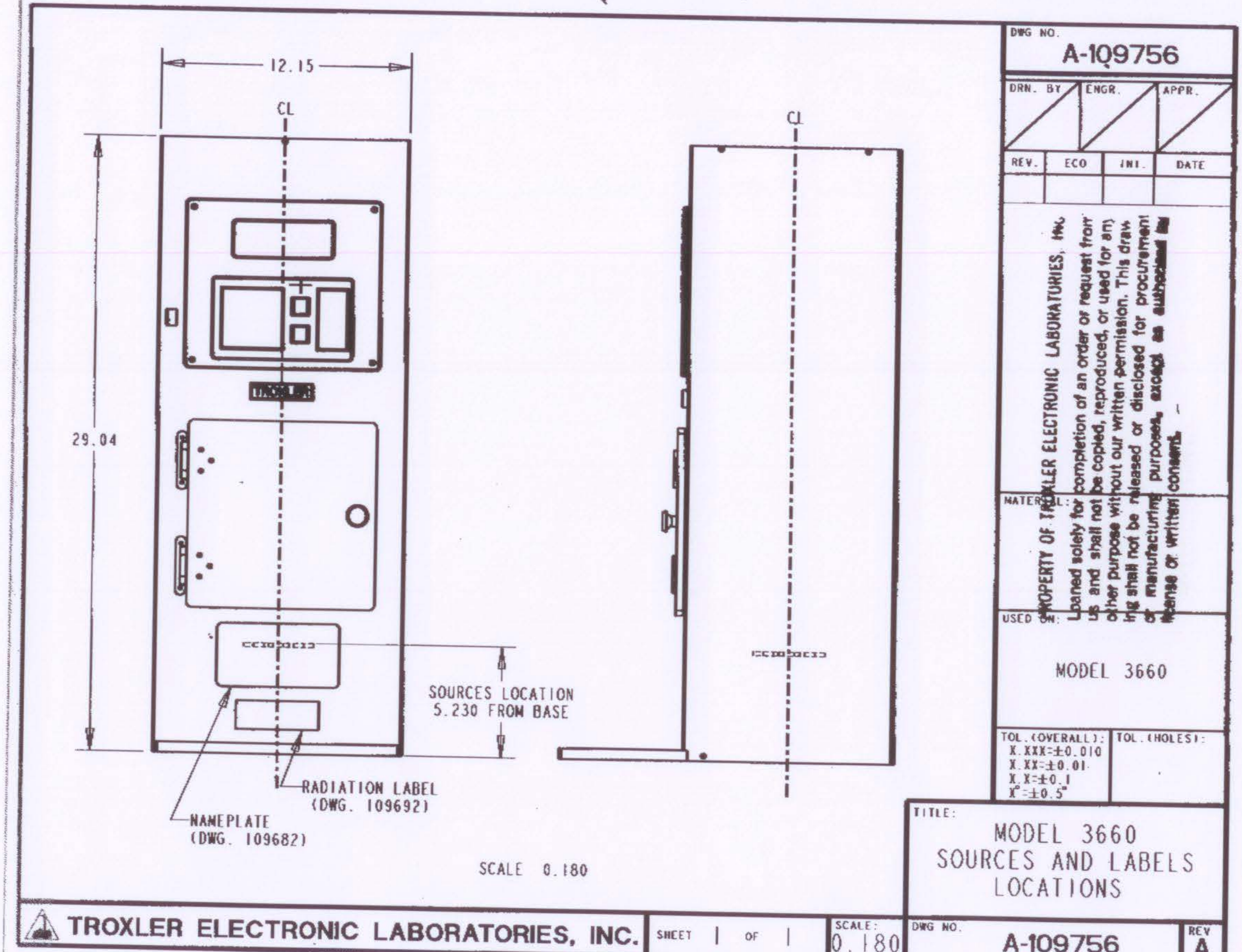
1. UNLESS OTHERWISE SPECIFIED, BORDER IS TO BE .050".
2. ALL CORNER RADII TO BE .05"
3. LETTERING AND GRAPHICS TO BE PANTONE PROCESS MEGENTA C, EXCEPT TROXLER LOGO.
4. BACKGROUND TO BE PANTONE PROCESS YELLOW C, EXCEPT THE .345 X 1.000 BOXES
5. MATERIAL SUBSTRATE SHALL BE CLEAR ANODIZED AND SEALED PRIOR TO PRINTING.
6. "CAUTION", "RADIOACTIVE MATERIAL", "DO NOT REMOVE" - 10 PT FUTURA BOLD, CENTERED
7. "TYPE", "QUANTITY (MICROCURIES)" - 7 PT FUTURA MEDIUM - CENTERED
8. "NOTIFY CIVIL AUTHORITIES IF FOUND: - 7 PT FUTURA BOLD
9. "CESIUM-137", "80" - 8 PTS FUTURA MEDIUM
10. LOGO TO BE PMS-280 BLUE AND AS PER ATTACHED SAMPLE, APPROXIMATE LOCATION
11. ARTWORK SUBJECT TO TROXLER ELECTRONIC LABORATORIES APPROVAL.

DWG NO. A-109692			
DRN. BY: BA APR01	ENGR.: AWJ APR01	APPR.:	
REV.	ECO	INI.	DATE
MATERIAL: .020 MATTE ALUMINUM W/ PRESSURE SENSITIVE ADHESIVE BACKING			
USED ON: MODEL 3660			
TOL. (OVERALL): ±.015	TOL. (HOLES):		
TITLE: RADIATION LABEL			

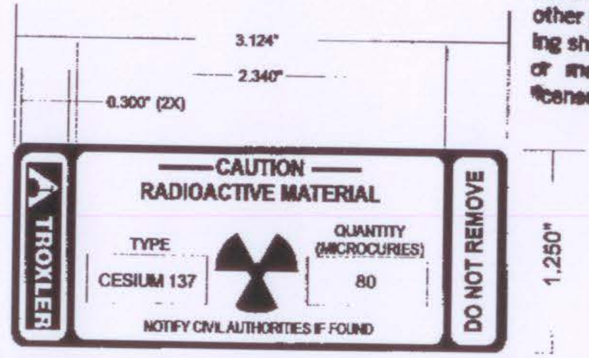
TROXLER ELECTRONIC LABORATORIES, INC.	SHEET 1 OF 1	SCALE: N/A	DWG NO. A-109692	REV A

THIS DRAWING WAS PRODUCED ON COREL DRAW

Enclosure 2



12.15
CL
29.04
SOURCES LOCATION
5.230 FROM BASE
RADIATION LABEL
(DWG. 109692)
NAMEPLATE
(DWG. 109682)
SCALE 0.180
DWG NO.
A-109756
DRN. BY
ENGR.
APPR.
REV.
ECO
INI.
DATE
PROPERTY OF TROXLER ELECTRONIC LABORATORIES, INC.
Loaned solely for completion of an order or request from us and shall not be copied, reproduced, or used for any other purpose without our written permission. This drawing shall not be released or disclosed for procurement or manufacturing purposes, except as authorized by license or written consent.
MATERIAL:
USED ON:
MODEL 3660
TOL. (OVERALL):
X.XXX=±0.010
X.XX=±0.01
X.X=±0.1
X°=±0.5°
TOL. (HOLES):
TITLE:
MODEL 3660
SOURCES AND LABELS
LOCATIONS
TROXLER ELECTRONIC LABORATORIES, INC.
SHEET 1 OF 1
SCALE:
0.180
DWG NO.
A-109756
REV
A



NOTES:

1. UNLESS OTHERWISE SPECIFIED, BORDER IS TO BE .050".
2. ALL CORNER RADII TO BE .05"
3. LETTERING AND GRAPHICS TO BE PANTONE PROCESS MEGENTA C, EXCEPT TROXLER LOGO.
4. BACKGROUND TO BE PANTONE PROCESS YELLOW C, EXCEPT THE .345 X 1.000 BOXES
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6. "CAUTION", "RADIOACTIVE MATERIAL", "DO NOT REMOVE" - 10 PT FUTURA BOLD, CENTERED
7. "TYPE", "QUANTITY (MICROCURIES)" - 7 PT FUTURA MEDIUM - CENTERED
8. "NOTIFY CIVIL AUTHORITIES IF FOUND: - 7 PT FUTURA BOLD
9. "CESIUM-137", "80" - 8 PTS FUTURA MEDIUM
10. LOGO TO BE PMS-280 BLUE AND AS PER ATTACHED SAMPLE, APPROXIMATE LOCATION
11. ARTWORK SUBJECT TO TROXLER ELECTRONIC LABORATORIES APPROVAL.

DWG NO. A-109774

DRN. BY	ENGR.	APPR.
BA APR01	AWJ APR01	

REV.	ECO	INI.	DATE

MATERIAL: SILVER 2 mil POLYESTER W/ 1 mil MATTE POLESTER LAMINATE AND PERMANENT ADHESIVE BACKING

USED ON: MODEL 3660

TOL. (OVERALL): ±.015

TOL. (HOLES): .

TITLE: RADIATION LABEL

TROXLER ELECTRONIC LABORATORIES, INC. | SHEET 1 OF 1 | SCALE: N/A | DWG NO. A-109774 | REV A

THIS DRAWING WAS PRODUCED ON COREL DRAW

Enclosure 3

Prototype Testing of Model 3660 CoreReader

Prototype Testing of Model 3660 CoreReader

Method

A prototype unit of the Model 3660 was assembled to undergo mechanical testing to determine the gauge's ability to withstand severe conditions that might occur during transport and use. The prototype unit was identical to a finished gauge except that all the electronics as well as the detector were removed. Drawing D-109684 of the finished Model 3660 gauge shows that the unit has three major sections—source housing, sample chamber, and electronics. The construction of both the source housing and the sample chamber sections in the prototype unit were identical to what would be found in a finished gauge. However, in the top section of the prototype unit, the weight of the electronics panel and the detector was duplicated by aluminum plates installed in the opening of the sheet-metal outer cover and on the detector mounting plate, respectively. The aluminum plates substituted for the electronics panel were mounted on the sheet-metal housing using the same mounting holes as the finished electronic panel itself, thus replicating the dynamic response of the electronic panel. In like fashion, the plates substituted for the detector were mounted using the fastener holes designed for holding the detector itself, thus, replicating the dynamic response of the mounted detector. Furthermore, the Source Plate Assembly (See Figure 2) is separated from the electronics section by the sample chamber thereby minimizing any effect on the source housing by the electronics. The overall weight of the prototype was 77 pounds which is identical to that of a finished gauge. A photograph of the prototype unit taken prior to testing is shown in Figure 1. Since the primary purpose of the prototype testing is to determine if any damage to the unit would result in an increase in radioactive exposure due to movement of the sources or shielding, a pre-test photograph was also made of the Source Plate Assembly (See Figure 2). The construction details of the Source Plate Assembly are shown in Drawing D-109684.

Based on experience, it was believed that the most severe damage to a finished gauge would occur during transportation or from a severe accident while in use. Therefore, the following tests were performed on the prototype unit to assure its mechanical integrity:

- Vibration of 1/8" total displacement at 15 Hz for an extended period of 24 hours
- Drop tests on all six surfaces from a height of 36 inches
- Drop test on four bottom corners and four top corners from height of 1 foot followed by a drop from 40' height on a top rear corner which was believed to be the area of the gauge which would suffer the most damage. This drop test sequence was chosen to determine if the gauge would meet the requirements of the Type A testing for packages containing radioactive materials. These requirements are given in DOT document 49CFR, Subpart 1, paragraph 173.465(c). Note: Due to the level of radioactive material in this gauge, it will not be required to meet Type A testing. However, this testing sequence was believed to be representative of major accidental drop test.

Radiation profiles surveys of the prototype gauge were done before and after the vibration test and then after the drop tests to determine if the tests resulted in any change to the gauge shielding ability.

Results

Vibration test

The initial test conducted on the prototype unit was vibration at 1/8" displacement at 15 Hz for a continuous 24 hours which simulates a typical transportation vibration level. There was no visible damage to the prototype unit. There was no loss of any of the fasteners securing the outer cover and rear panel and no visible signs of fasteners becoming loose. However, there did appear to be some loosening of the fasteners as indicated by a decrease in torque required to remove them. However, it would have taken an extended period of continued vibration to cause the fasteners to back away from the sheet metal surfaces. Furthermore, loosening or even loss of fasteners could have resulted only in the loss of the rear access panel and would not have affected the containment or shielding of the radioactive sources. Further proof that the mounting and shielding of the radioactive sources was not compromised was the lack of any movement or changes to either the Source Plate Assembly (See Drawing D-109601) or the 7" OD X 6" ID lead shield resting on the source plate. The radiation profile of the gauge was the same after the test as before (See Tables 1, Columns "Before Test" and "After Vibration").

Initial Drop Test

The prototype unit was dropped on all 6 surfaces from a height of 36" onto a concrete surface covered with a 1/8" thick hard—50 durometer—neoprene rubber layer. There was some distortion of the aluminum sheet-metal outer shell, and one screw securing the shell to the base plate was sheared off. There was no apparent damage to any of the internal construction. Since there was little damage to the prototype gauge by drop test on the unit's flat surfaces, the Type A drop test was undertaken.

Type A Free Drop Test

The Type A test regime calls for free drops on the corners of the test specimen from a height of 1 foot followed by a drop from 40" in such manner as to cause the maximum damage to the features being tested. The prototype unit was dropped from one foot on each of the eight corners and suffered minor cosmetic damage on each of these corners. The unit was then dropped from a height of 40" on one of the top rear corners. This point of contact was selected because there is less mechanical support in this area. The outer shell and rear panel suffered considerable bending on the corner hitting the contact surface. There was no appreciable damage to the top plate and no damage at all to the internal construction of the gauge. The Source Plate Assembly suffered no damage and the donut-shaped lead shield remained in position and was not damaged. The radiation profile obtained after the drop tests was the same as the profile prior to the tests (See Table 3). Figures 3 and 4 show the prototype gauge after the vibration and drop tests were completed. As previously stated, the major damage noted was the distortion of the outer sheet-metal and the rear panel. Figure 4 is a photograph taken looking into the rear of the unit with the rear panel removed. The donut-shaped lead shield can be seen mounted between the Source Plate and the Base Plate of the sample chamber. As evidenced in the photograph there was no damage or movement of the lead shield. Figure 5 is a post-test photograph of the Source plate Assembly. There was no change to this assembly as compared to the pre-test photograph Figure 2. The

Radiation Profile was the same both before and after the drop tests (See Table 1, Columns "After Vibration" and "After Drop tests").

Summary

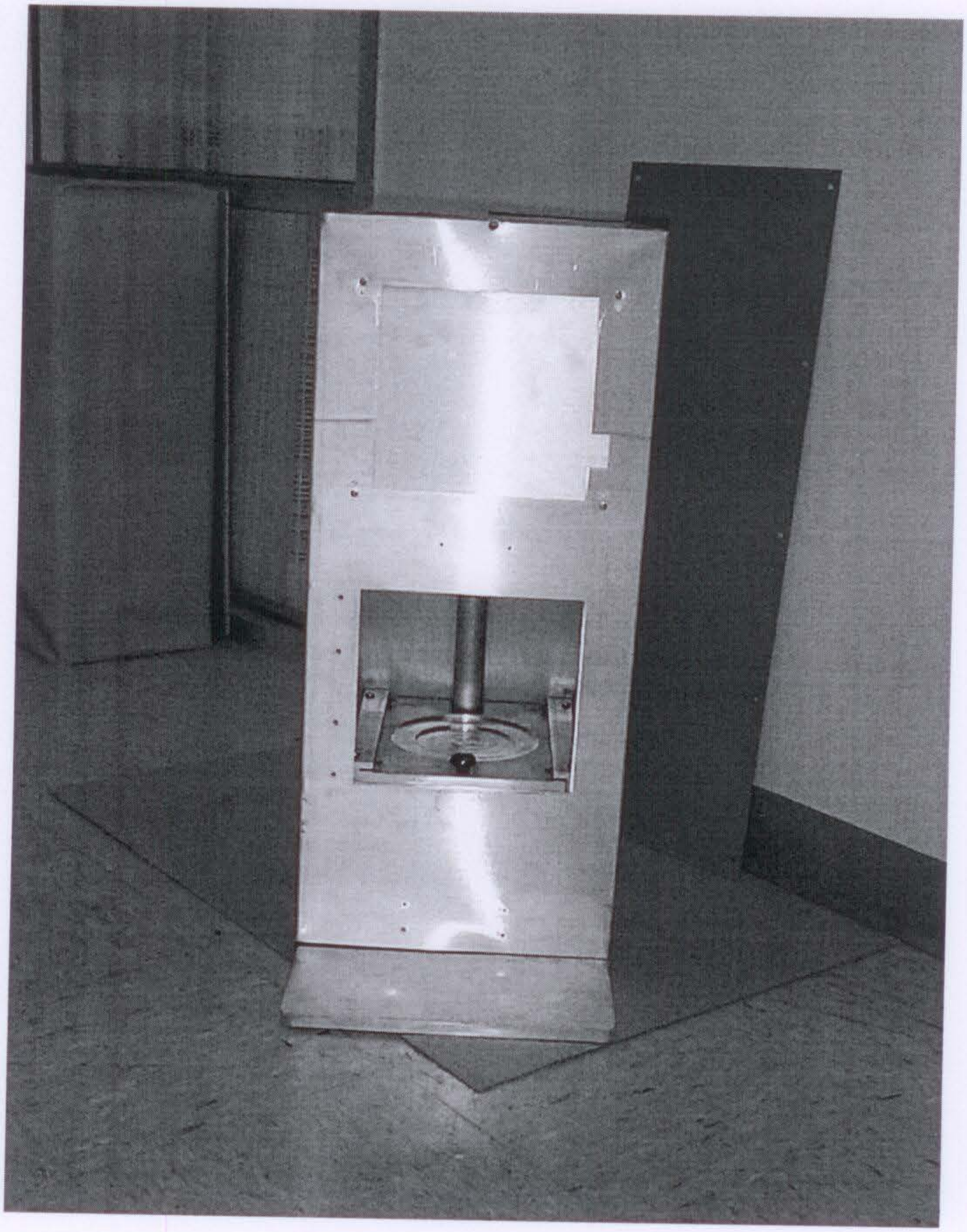
Vibration tests and high impact drop tests were performed on the prototype unit to evaluate the ability of Model 3660 gauge to withstand severe mishaps during transportation and use without an increase in the amount of radioactivity escaping from the gauge. The only damage sustained by the prototype unit was distortion of the outer sheet-metal shell and rear panel. As shown by the before and after photographs (Figures 1 thru 7) there was no damage to Source Plate Assembly and no movement of or damage to the lead shielding. Tables 1 of the radioactive profiles of the prototype gauge before and after mechanical testing further establish that the Model 3660 gauge will not have an increase in radioactive exposure if subjected to a severe accident during transportation and use.

Model 3660 Prototype Gauge Prior to Mechanical Testing

Figure 1

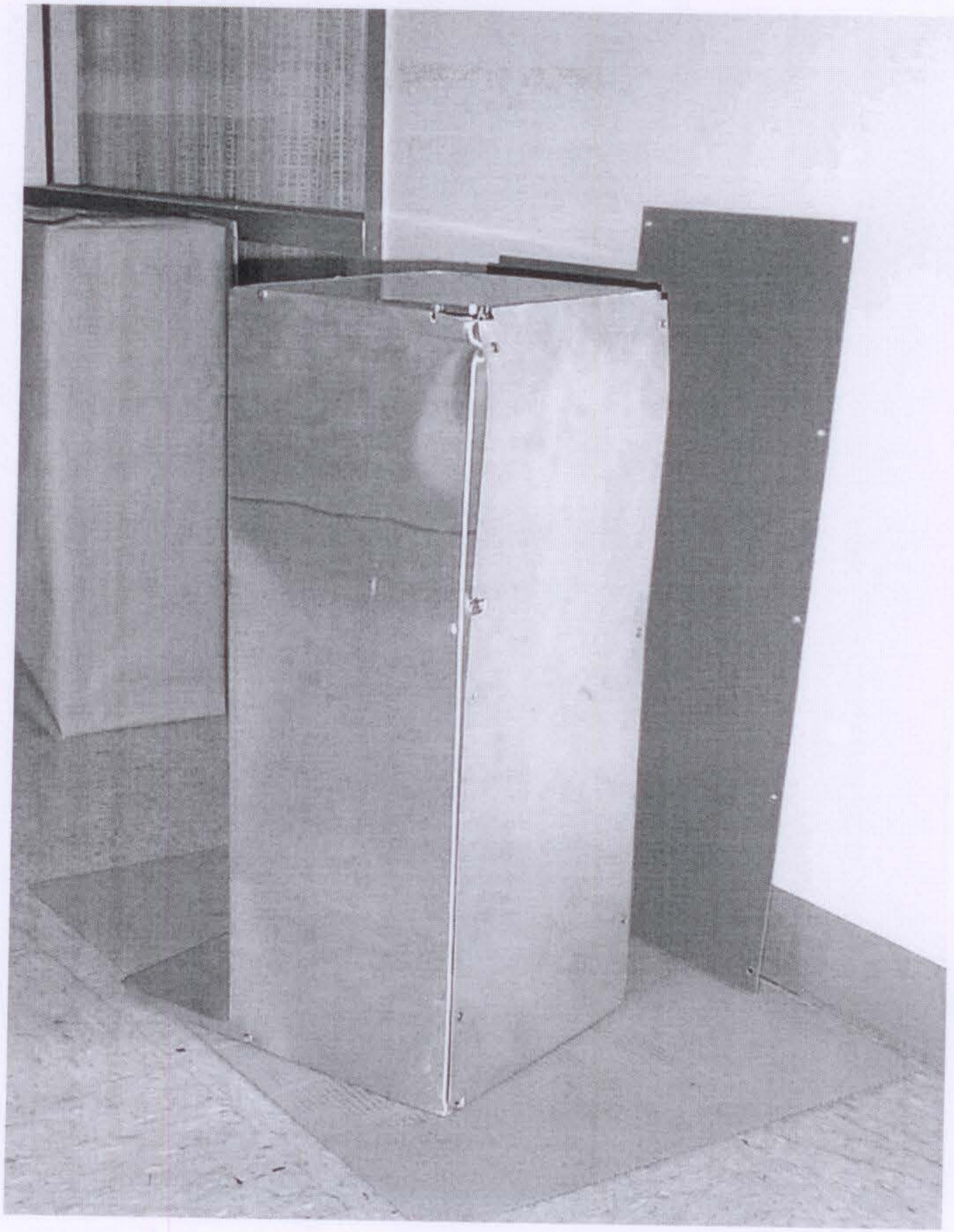
Source Plate Assembly Prior to Mechanical Testing

Figure 2



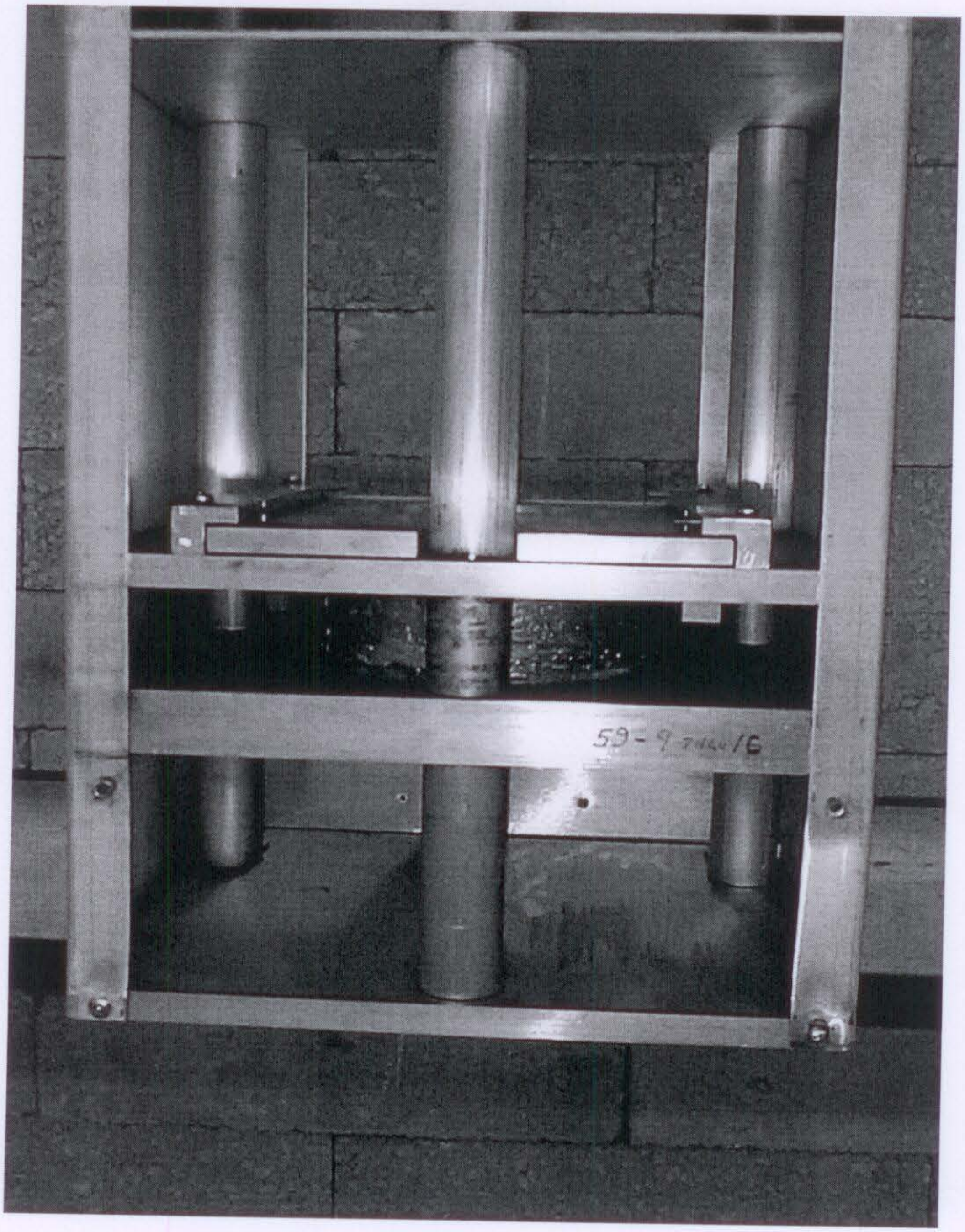
Prototype unit after Mechanical Testing (Front View)

Figure 3



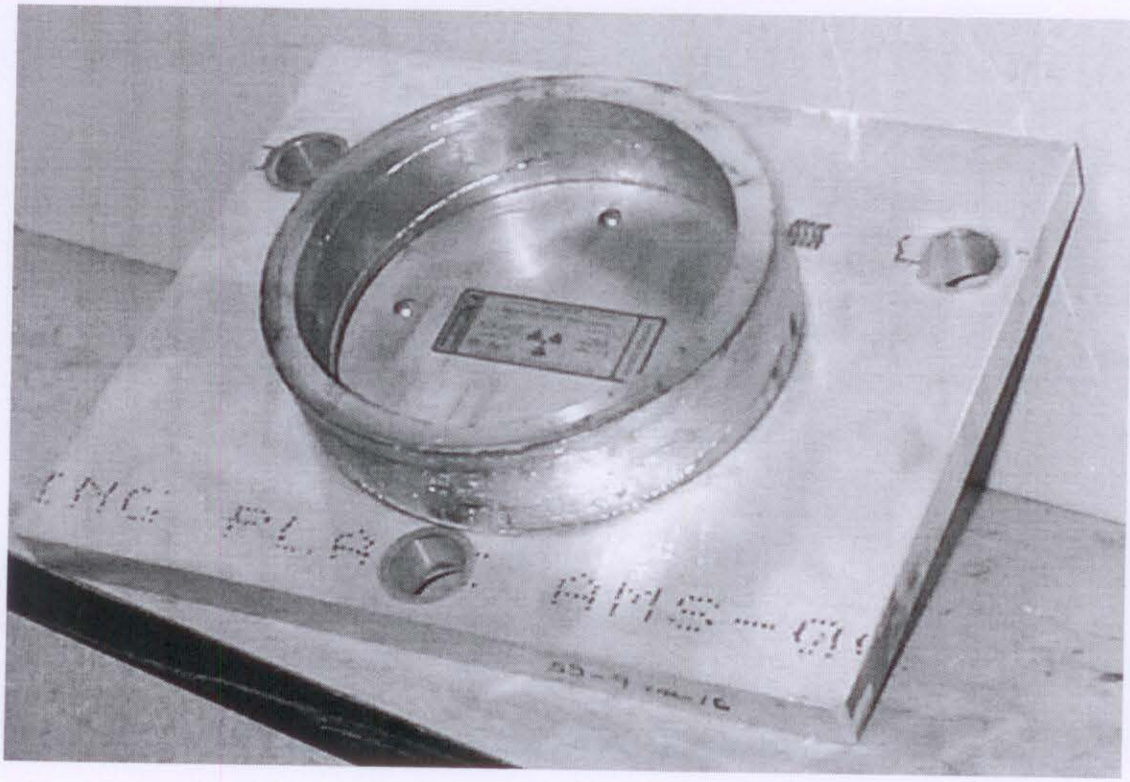
Prototype Unit after Mechanical Testing (Rear View)

Figure 4



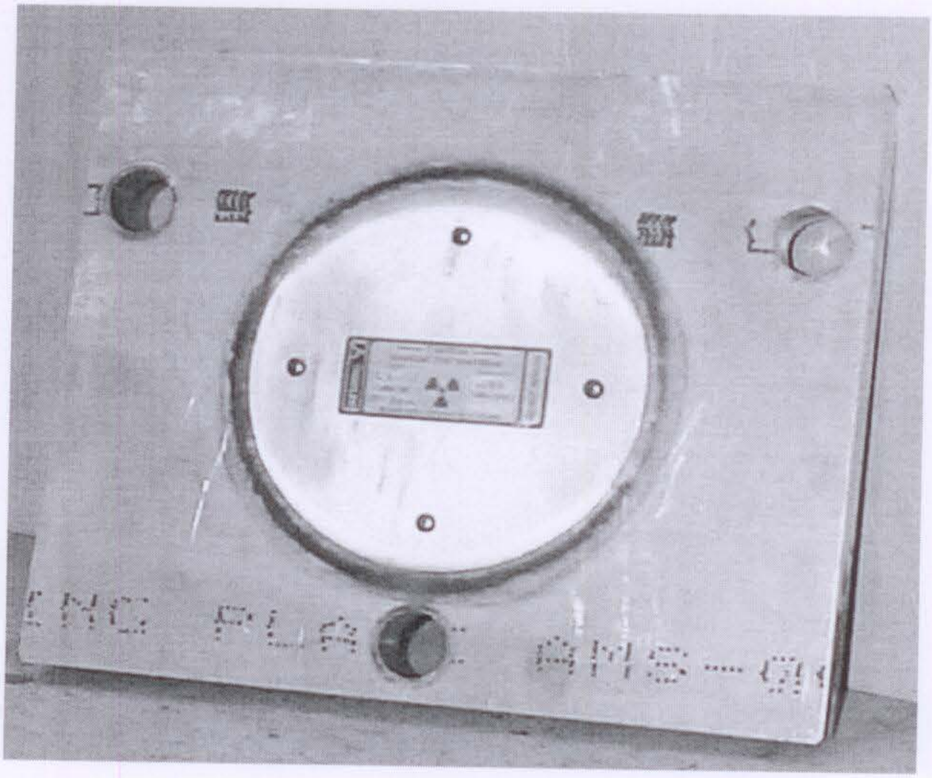
Rear of Prototype Gauge after Testing Showing Lead Shield in Place

Figure 5



Source Plat Assembly after Mechanical Testing (With Lead Shield)

Figure 6



Source Plate Assembly after Mechanical Testing

Figure 7

TABLE 1

CoreReader Prototype Testing Radiation Surveys

Instrument used: Bicron microrem, s/n B464Y Calibrated: 1/19/2001

Performed by: James Byron

Gauge Surface	Before Test 10/12/01 (mrem/hr)*	After Vibration Test 10/26/01 (mrem/hr)*	After Drop Test 11/7/01 (mrem/hr)*
Front	0.25	0.2	0.2
Back	0.16	0.16	0.15
Right side	0.17	0.15	0.15
Left side	0.16	0.14	0.15
Top	0.04	0.04	0.05
Bottom	0.14	0.15	0.15

* All readings on contact in the center of the applicable gauge surface.

Enclosure 4

Section VII of the Troxler QA Manual, Rev. 9

TROXLER
QUALITY ASSURANCE MANUAL

Revision 9
October 2010

TROXLER ®

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Research Triangle Park, NC 27709
Phone: 1.877.TROXLER
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Fax: +1.919.549.0761
www.troxlerlabs.com

SECTION VII

SPECIAL PROCESS/MATERIALS CONTROL

1.0 Control of Special Form Radioactive Materials

1.1 It is the responsibility of the Radiation Safety Department to monitor and review all matters relating to the proper receipt, handling, storage, shipment, and disposal of radioactive materials. Please refer to Radiation Safety Procedures RSP-001, Radiation Protection Program Plan.

1.2 All communications between Troxler and nuclear regulatory agencies are to be handled by the Corporate Radiation Safety Officer and the Radiation Safety Department. If circumstances are such that this is not possible, then the NC DRP can be contacted at (919)-571-4141.

2.0 Source Suppliers

2.1 Vendors supplying special form radioactive sources must provide proof of NRC Sealed Source and Device registration for the sources and provide a copy of the Certificate of Competent Authority to demonstrate compliance with Title 49 CFR 173.469 (US DOT Hazmat rules).

2.2 Vendors must certify and provide documentation that sources supplied meet American National Standards Institute ("ANSI") specifications as required on Troxler drawings.

2.3 Vendors must certify and provide documentation that each radioactive sealed source supplied has been leak tested within 6 months of receipt by Troxler.

3.0 Internal Control of Radioactive Materials

3.1 Each sealed source shall be leak tested after being removed from storage if six or more months have elapsed since the last leak test.

3.2 Each source shall be leak tested as part of the gauge's final QC after calibration and before it is placed in finished goods.

3.3 A certification of the most recent leak test is supplied to the customer.

4.0 Records

4.1 Records shall be maintained in accordance with applicable requirements.

4.2 Records of leak tests shall be maintained for a minimum of three years.

4.3 Records shall be maintained on all sources both received in or transferred out of Troxler's possession. These records shall indicate shipper, receiver, date of transfer, source type, serial number, activity, date of measure, radioactive material license number of the customer, and all other appropriate information. The incoming records shall be maintained for a minimum of three years and the transfer records shall be maintained for a minimum of five years.

5.0 Packaging

5.1 All transport cases for instruments containing Type A quantities of radioactive materials are designed and tested to meet the Type A package test requirements of 49 CFR 173.465. A record of the tests shall be maintained for inspection.

5.2 Markings and labeling of packages containing radioactive sources shall comply with the requirements of 49 CFR Subparts D and E.

Enclosure 5

Operation and Instruction Manual, Chapter 2, Product Safety Information

CHAPTER 1

PRODUCT SAFETY INFORMATION

This chapter provides basic product safety information concerning the Model 3660 CoreReader, as well as cautions and warnings related to the safe use of the unit.

CONTENTS

RADIOLOGICAL INFORMATION

The CoreReader contains 2.96 MBq (80 µCi) of cesium-137 (Cs-137) in a sealed source holder below the sample chamber. The sources are inaccessible to operators.

WARNING

Do not attempt to disassemble or remove the radioactive sources from this device.

The radiation levels near the CoreReader are very low. As a consequence, no special radiological precautions are necessary for operation of the device:

- Operators do not require radiation training or experience.
- Personnel radiation monitoring is not required.
- Sealed source leak testing is not required.

The maximum radiation levels are shown in the table below:

Location	Dose Rate	
	mrem/h	µSv/h
External surface	0.2	2
Distance of 30 cm	0.05	0.5
Inside sample chamber	1.1	11

Canada

- A radiation warning sign, as prescribed in the regulations, must be posted at the boundary of and at every access point to the area or room in which the device is used or stored.
- The possession, transfer, or use of this device requires a license issued by the Canadian Nuclear Safety Commission (CNSC).

United States

- No radiation signs are required to be posted in the room or area where the device is located.
- The receipt, possession, use, and transfer of the CoreReader are exempt from licensing by the U.S. Nuclear Regulatory Commission (NRC) or Agreement States.

OTHER CONSIDERATIONS

The CoreReader uses low-level gamma-ray sources and a highly efficient gamma-ray detector. However, the operator must ensure that there are no other nuclear sources in the vicinity of this equipment. An excess of background radiation from a nearby source may affect the accuracy of the bulk specific gravity reading. The presence of another source may cause:

- The standard count to be higher than usual. For more information on the standard count, see page **Error! Bookmark not defined.**.
- The bulk specific gravity reading for a known sample to be lower than expected.

DISPOSAL

The CoreReader contains several small radioactive sources. It is recommended that users return the device to Troxler at the end of its useful life for removal and disposal of the radioactive sources in the most environmentally responsible manner. Please contact Troxler for further information.

CAUTIONS AND WARNINGS

Upper Rear of Unit (Identification of Interconnect)

- Connector for 12 V dc input from the ac adapter.

Upper Side of Unit (Identification of Interconnect)

- 9-pin serial interface, used to calibrate the CoreReader and to download test data to a computer or serial printer.

Inside the Unit (Battery Holder)

- Carefully note the polarity of the two AA batteries when installing them in the battery holder. A battery may explode or leak if installed improperly.
- Do not dispose of batteries in a fire. A battery may explode if exposed to excessive heat.

SAFETY WARNINGS

The CoreReader is a safe, durable unit. Troxler cannot anticipate every example of improper or unauthorized use of this unit that may lead to malfunction or accident. If a particular use is *not specifically mentioned* in this manual as authorized, then assume that the use is unauthorized and improper.

Always follow the safety warnings in this manual and the safety procedures of your laboratory/company. Troxler recommends the following safety precautions.

- The CoreReader is designed as a bench-top laboratory test instrument. Place the unit on a level, sturdy surface.
- The ambient temperature should be between 10 and 50 °C (50 and 122 °F), and the relative humidity should be less than 92%.
- Locate the CoreReader *no more than* 2.4 m (8 ft) feet from the required 120 V ac outlet. Ensure that the distance does not place stress on the ac adapter cables.
- Only personnel who are familiar with the proper operation of the CoreReader should operate the device.
- Only qualified personnel (Troxler service representatives) should perform service and maintenance on the CoreReader when disassembly is required.
- Always unplug the CoreReader before performing service or maintenance.
- Do not attempt to disassemble or remove the radioactive sources from this device.

Enclosure 6

Risk Assessment for CoreReader

Enclosure 6

Risk Assessment for CoreReader

1 Introduction

1.1 The CoreReader is a specialized instrument designed to be used for purposes of quality control of asphalt mixtures used in road construction. It is a bench-top instrument that would be used in a laboratory setting (as classified in Section 2.10.2 of NUREG-1717) by trained technicians.

1.2 NUREG-1717 contains a generic risks analysis for ionizing radiation measuring instruments, containing for purposes of internal calibration or standardization, one or more source of byproduct material (Section 2.10). This analysis employs the same general methods, but takes into account the specific design and construction of the CoreReader, the type and activity of sources contained in the device, and the actual external radiation levels measured in and around the device. This analysis also addresses the security concerns identified by the NRC regarding the potential for diversion of the radioactive sources.

1.3 The CoreReader is a sophisticated specialty instrument that will be manufactured and distributed in relatively small quantities. It is estimated that no more than about 30 devices will be distributed per year and that the total number of devices in the field would eventually peak at about 300. After that, it is assumed that the devices would be replaced at a rate of about 30 per year.

2 Description of CoreReader

2.1 The CoreReader is an ionizing radiation measurement instrument with specialized software for analysis and interpretation of a gamma-ray transmission spectrum to determine the specific gravity of a compacted asphalt sample. It is a bench-top laboratory instrument with overall dimensions of 12.2" w x 10.2" d x 29" h and weight of 77 lbs. The construction is all metal and includes some lead shielding around the sources.

2.2 The CoreReader contains 8 exempt-quantity cesium-137 sources (10 Ci (0.37 MBq) each) with a total activity of 80 Ci (2.96 MBq). Each individual source consists of a Plexiglas disk (1" dia x 0.175" thick). The cesium-137 is placed in a small hole in the center of the disk which is then filled and sealed with epoxy even with the surface. The sources are used for analysis of the asphalt sample as well as for calibration and standardization of the sodium iodide scintillation detector.

2.3 Sources are held in a subassembly (Source Plate Assembly) inside the device. This assembly is constructed from 1" thick aluminum plate with 1" diameter recesses for each of the sources. The sources are held in place by a 0.125" aluminum cover plate with neoprene cushion fastened with four screws. There is 0.5" thick x 5.6" diameter lead shield mounted directly below the sources and a 0.5" thick x 6" diameter ring shield sitting atop the source plate assembly. The source plate assembly is mounted inside the lower third of the device below the sample chamber. It is not removable and is completely inaccessible to the user. As noted in NUREG-1717, Section 2.10.4, the safety of such sources is enhanced by their inaccessibility, secondary containment, and further sealing within subassemblies which themselves are mounted inside the device.

3 Analysis

3.1 General

3.1.1 As noted in NUREG-1717, Section 2.10.4, there is no ingestion or inhalation concern during either distribution or routine use of the device as the byproduct material is contained in an epoxy matrix and further sealed in a subassembly within the device. The principal exposure pathway is external irradiation of the whole body.

3.1.2 The maximum radiation levels measured inside the sample chamber directly above the source plate and at various distances from any side of the device are shown below. The measurements were performed with a Bicron Micro Rem survey meter with organic scintillator detector calibrated to cesium-137.

Maximum Dose Rates Above Background	
Distance or Location	Millirem per Hour
Inside sample chamber	1.1
5 cm from any side	0.2
30 cm from any side	0.05
100 cm from any side	Not detectable

3.1.3 Users would not ordinarily place their hands inside the sample chamber, since a sample tray slides in and out of the unit for inserting and removing samples. Significant extremity dose is considered unlikely during distribution and transport, routine use, or disposal of the device. Therefore, extremity dose was only considered in connection with misuse.

3.2 Distribution and Transport

3.2.1 Individual Dose

1. The devices will be fabricated on demand and shipped directly to the user without intermediate storage in a warehouse facility consistent with the assumptions in NUREG-1717, Section 2.10.4.1. Distribution is assumed to involve five steps.

- Express delivery (small truck) from Troxler to the Raleigh-Durham International (RDU) airport (13 km).
- Processing at the airport freight terminal and loading on the outbound plane
- Air transport
- Unloading the plane and processing at the receiving airport freight terminal
- Local delivery (small truck, within 400 km of the receiving airport) to the user

2. A single driver is assumed to transport all devices (30 per year) in a small truck from Troxler to the same outbound airport terminal. The transit time from Troxler to the airport is assumed to be 0.4 hours based on heavy traffic in I-40. Shipments are further assumed to be equally distributed among 5 regional airports. At the receiving airport separate drivers are assumed to deliver each device to a different individual user. Therefore, the individual receiving the highest effective dose equivalent in this scenario is the express truck driver who delivers all of the devices to the outbound airport terminal.

3. The maximum dose rate measured dose at 30 cm from the CoreReader is 0.05 mrem/h. This value was measured using a radiation survey instrument with an organic scintillator detector and corresponds closely to the dose equivalent in tissue. The dose equivalent rates at all other distances are calculated based on the inverse square law. Driving time is based on the actual distance to RDU airport under heavy traffic conditions. All other times and all distances are from the small delivery truck scenario in NUREG-1717. The total dose for delivery of a single device is shown in the table below.

Dose from Delivering a Single Device				
Exposure Event	Distance (cm)	Exposure Time (h)	Dose Rate (mrem/h)	Dose Equivalent (mrem)
Driving	180	4.0E-1	1.4E-3	5.6E-4
Handling	30	3.3E-2	5.0E-2	1.6E-3
In truck	90	3.0E-1	5.6E-3	1.7E-3
Near truck	210	6.6E-1	1.0E-3	6.6E-4
			Total	4.5E-3

Based on delivery of 30 devices in a year by the driver, the total dose to the driver would be 0.135 mrem. The effective dose equivalent (EDE) based on rotational geometry would be even less.

3.3 Routine Use

3.3.1 Individual Dose

1. The CoreReader is a bench-top laboratory instrument that would be used by a dedicated technician. The typical laboratory would have a single CoreReader. This analysis assumes the technician analyzes 10 samples/day x 5 days/wk x 26 wk/y = 1300 samples/y. No routine user maintenance is required and it is assumed that any special maintenance or repairs would be performed by Troxler.

2. Sample analysis can be broken down into three steps: (1) inserting the sample in the device, (2) counting and analyzing the sample, and (3) removing the sample from the device. The maximum dose rate at 30 cm (0.05 mrem/h) is used for steps 1 and 3. While the sample is being counted the technician is assumed to be doing other tasks at an average distance of 2 meters from the device. The dose rate for step 2 was estimated based on the inverse square law from the dose at 30 cm. The table below summarizes the dose for a single analysis.

Activity	Distance (cm)	Exposure Time (h)	Dose Rate (mrem/h)	Dose Equivalent (mrem)
Inserting sample	30	4.2E-2	5.0E-2	2.1E-3
Counting sample	200	8.3E-2	1.1E-3	9.4E-5
Removing sample	30	4.2E-2	5.0E-2	2.1E-3
			Total	4.3E-3

The total annual dose equivalent to the technician from analyzing 1300 samples would be 11 mrem.

4.3E-3 mrem/sample x 1300 samples/y = 5.6E0 mrem/y

3. When not counting samples, the technician is assumed to be performing other tasks in the laboratory at an average distance of 3 meters from the device.

1870 h x 5E-4 mrem/h = 0.9 mrem

Therefore, the total annual dose to the technician would be 6.5 mrem.

4. It is assumed that 2 additional persons spend half of their time at other workstations in the lab an average distance of 3 meters from the CoreReader. The total annual dose received by other individuals would be 10 mrem.

2 persons x 1000 h/y x 5E-4 mrem/h = 1.0 mrem/y

3.4 Disposal

3.4.1 General

1. Doses to landfill and recycle facility workers and to members of the public are estimated using the disposal scenarios and dose calculation methods described in NUREG-1717, Appendix A.2. It was assumed, consistent with the assumptions in NUREG-1717, Section 2.10.4.3, that the disposal of the devices would be distributed as follows: 90% municipal waste, 5% recycled, and 5% radioactive waste. This is considered to be a worst case assumption, since Troxler will encourage the return of the devices for disposal as radioactive waste (not in municipal landfills) and it seems reasonable to expect a compliance rate greater than the 5% can be achieved. No incineration is assumed since the sources are incorporated in a metal subassembly and the instrument is noncombustible consistent with NUREG-1717, Section 2.10.4.3.

2. At steady-state, it is estimated that 30 CoreReader devices would be disposed of annually. Assuming a device is used for 10 years, it would contain 80% of the original activity at the time of disposal (64 Ci/unit). Therefore, the total quantity of radioactive material disposed of annually at steady-state would be:

   30 units x 64 Ci/unit = 1.9E3 Ci.

   Based on the distribution assumed in NUREG-1717, the annual quantities going to each disposal method would be:

Disposal Method	Fraction	Annual Quantity (Ci)
Municipal Landfill	0.9	1.8E3
Metal recycling	0.05	9.6 E1
Radioactive waste	0.05	9.6 E1

3. Assuming there are 3500 operating landfills (NUREG-1717), it is unlikely that any landfill will receive more than one CoreReader device in any year.

3.4.2 Disposal in Landfills

1. Waste Collectors at Landfills

   In accordance with guidance in NUREG-1717, Section A.2.3.1.5, Inhalation and ingestion exposures are assumed to be zero because of the nondispersible form of the radioactive material, therefore all dose is assumed to be from external exposure.

Individual dose = 4.6E-10 rem/ Ci x 2.88E2 ci = 3.82E-7 rem

2. Workers at Landfills

In accordance with guidance in NUREG-1717, Section A.2.3.1.5, Inhalation and ingestion exposures are assumed to be zero because of the nondispersible form of the radioactive material, therefore all dose is assumed to be from external exposure.

Individual dose = 5.7E-11 rem/ Ci x 1.8E3 ci = 8.2E-8 rem

3. Offsite Residents at Landfills Due to Airborne Releases

Since it is assumed that the material is in nondispersible form, the dose to offsite residents due to airborne releases is zero.

4. Offsite Residents at Landfills Due to Releases to Groundwater

According to the footnotes to Table A.2.7 of NUREG-1717, if no entry is given in the table, the travel time of the radionuclide from the landfill to off-site municipal well is much greater than the half-life of the radionuclide, therefore the doses are essentially zero. Such is the case for Cs-137.

5. Future On-Site Residents at Landfills

The DSR values from NUREG-1717, Tables A.2.8 and A.2.9 were used to calculate the individual and collective EDEs to future on-site residents. Because the form of the radioactive material (Plexiglas/epoxy matrix) should result in reduced leachability in water, the DSR values for inhalation and ingestion were reduced by a factor of 10 in accordance with guidance in Section A.2.3.4.3.

Individual Dose

External = 6.8E-11 rem/ Ci x 1.8E3 ci = 1.21E-7 rem

Inhalation = 8.6E-18 rem/ Ci x 1.8E3 ci = 1.53E-14 rem

Ingestion = 3.8E-16 rem/ Ci x 1.8E3 ci = 6.76E-13 rem

6. Landfill Disposal Dose Summary

	External	Inhalation	Ingestion	Total
Individual Dose (rem)				
Waste Collectors	8.2E-7	0	0	8.2E-7
Landfill Workers	1.0E-7	0	0	1.0E-7
Off-Site Residents	0	0	0	0
Future On-Site Residents	1.2E-7	1.5E-14	6.8E-13	1.2E-7

3.4.3 Metal Recycling

1. Only individual doses are estimated for this disposal option, because recycling is expected to be an unusual occurrence. Tables A.2.15 and A.2.16 from NUREG-1717 present the annual individual EDEs for 1 year's disposals of a unit quantity. Table A.2.15 gives the estimated dose to an individual slag worker or user of an automobile, which is greater. For Cs-137, the automobile user is the highest exposed individual. Table A.2.16 gives the estimated dose to an off-site member of the public from airborne emissions.

Auto User = 1.1E-8 rem/ Ci x 1.6E1 Ci = 1.8E-7 rem

Off-Site Resident = 6.6E-14 rem// Ci x 1.6E1 Ci = 1.06E-12 rem

3.5 Accidents and Misuse

3.5.1 Transportation accidents and laboratory fires are considered applicable to the CoreReader. The CoreReader will not be warehoused, so that scenario is not applicable. No laboratory or vehicle is likely to be carrying more than 1 device. Table 2.10.3 of NUREG-1717 shows that the individual annual effective dose equivalent from transportation and laboratory fires, based on 10 instruments containing 3 sources with 0.05 Ci Am-241, 1 Ci Co-60, and 10 Ci Cs-137, would be less than 0.001 mrem. The greatest contribution to the estimated dose is from Am-241. Since a single CoreReader contains only 8 sources with 10 Ci Cs-137 and no Am-241, the estimated dose from the accident scenarios would be significantly less than the above estimate

3.5.2 10 CFR 32.31(b) also has a misuse criteria for exempt devices. The criteria states: An applicant for a license under § 32.30 shall demonstrate that, even in unlikely scenarios of misuse, including those resulting in direct exposure to the unshielded source removed from the device for 1,000 hours at an average distance of 1 meter and those resulting in dispersal and subsequent intake of 10–4 of the quantity of byproduct material (or in the case of tritium, an intake of 10 percent), a person will not receive an external radiation dose or committed dose in excess of 100 mSv (10 rem), and, if the unshielded source is small enough to fit in a pocket, that the dose to localized areas of skin averaged over areas no larger than 1 square centimeter from carrying the unshielded source in a pocket for 80 hours will not exceed 2 Sv (200 rem).

3.5.3 A single source was measured using a radiation survey instrument with an organic scintillator detector, which corresponds closely to the dose equivalent in tissue. The survey instrument was exposed to the source at a distance of 30 cm. The reading was then corrected for decay to assume a new 10 ci source. The dose equivalent rates at all other distances are calculated based on the inverse square law.

1. 1000 hr Exposure to Source at 1 meter (Limit is 10 Rem)

Calculations were performed for both a single source and for a total of 8 sources.

	Dose Rate (mr/hr)
Bicron reading at 30 cm	0.04
Decay Corrected	0.052
Bicron reading at 100 cm	0.0046
Device Total (x 8 sources)	0.037
1000 hr exposure	37.2 mr

2. Contact Exposure to Source (Limit is 200 rem for 80 hr skin exposure)

A single source was placed on contact with the window of a Bicron uRem survey instrument. The reading was then corrected for decay to assume a single new 10 ci source.

	Dose Rate (mr/hr)
Bicron contact reading	4.2
Decay Corrected	5.4
80 hr exposure	432 mr

Since the device can contain 8 exempt 10 ci sources, the worst case scenario all 8 sources in the pocket. Since all 8 sources would create unknown geometries and source distances, the single source reading is multiplied by 8.

Decay Corrected single source	5.4
Decay corrected Device Total (x 8 sources)	43.2
80 hr exposure	3460 mr

Both evaluations show that the Troxler 4590 gauge meets the misuse criteria for an exempt device.

4.0 Summary

4.1 The table below summarizes the individual doses estimated for various exposure pathways.

Exposure Pathway/Individual	Individual Annual Effective Dose Equivalent (rem)
Distribution and Transport	1.3E-4
Routine Use	
Laboratory Technicians	6.5E-3
Other Lab Technicians	1.0E-3
Disposal as Ordinary Trash	
Landfill	
Waste Collectors	8.2E-7
Landfill Workers	1.0E-7
Off-Site Residents	0
Future On-Site Residents	1.2E-7
Recycle Facility	
Auto User	1.8E-7
Off-Site Resident	1.0E-12
Accidents and Misuse	
Transportation fire	<0.001
Laboratory fire	<0.001
1000 hr @ 1 meter	3.7E-2
Contact for 80 hrs	3.5

5.0 Security

5.1 Developments after the publication of NUREG-1717 have led to concerns that radioactive materials may be diverted from their intended purposes and put to unintended uses. Of particular concern is that the distribution of material as exempt and, thus, not subject to the tracking requirements for material distributed under a general license, could increase the availability of the exempt material, presumably for use by a malefactor. These concerns are not credible for the radioactive materials in the CoreReader even if it is distributed as exempt instead of under a general license.

5.2 As discussed above, there is only a limited amount of exempt material in each CoreReader, the material is difficult to get at, the CoreReader is a bulky and heavy bench-top, laboratory instrument, and no more than one CoreReader is expected to be at any one location. The devices would be used in laboratories where they would not be visible to the general public and would be relatively secure. These circumstances make the CoreReader a singularly unattractive target for the deliberate diversion of radioactive materials. The theft of a CoreReader would be difficult and is likely to be perceived by any malefactor as creating too great a risk of getting caught as compared with the amount of radioactive material that could be obtained. It would be much easier for a malefactor to buy exempt sources than to steal them.

5.3 Required tracking of the location of a CoreReader, as would result if it were distributed under a general license, would not substantially further decrease the unavailability of the exempt material in the CoreReader. Nevertheless, Troxler will maintain permanent records of all device transfers including the name and address of the transferee, the model and serial number of the device, and the date of transfer. This is the same information that Troxler would maintain for devices distributed to general licensees, thus offsetting one of the main differences between exempt and general license distribution with respect to the initial tracking.

5.4 Troxler does not expect an aftermarket in the sale of CoreReaders. But even if some original owners of CoreReaders were to sell them, the likely purchasers of the devices would be other similarly situated users who would use the device under the same conditions that limit its attractiveness as a target for diversion. Moreover, tracking the location of a CoreReader would not affect its diversion by malefactors. As for purchases by malefactors, general licensing would not prevent a malefactor from purchasing a CoreReader directly from Troxler. Indeed, it would be much less expensive for a malefactor to simply buy exempt sources than to buy a CoreReader for its sources.

Enclosure 7

Letter from NRC granting Exempt Request dated December 19, 2002

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 19, 2002

Troxler Electronics Laboratories, Inc.
ATTN: William F. Troxler, President
3008 Cornwallis Road
P.O. Box 12057
Research Triangle Park, NC 27709

Mail Control No. 022268

SUBJECT: ISSUANCE OF NRC LICENSE NO. 32-05998-04E WITH AN EXEMPTION TO DISTRIBUTE 10 CFR 32.14 PRODUCTS DESCRIBED IN 10 CFR 30.15(A)(9)

Dear Mr. Troxler:

This is a response to your letter dated August 30, 2002, to Mr. Martin J. Virgilio, requesting an exemption from the provisions of 10 CFR 32.14 to distribute the Model CoreReader densitometer to persons exempt from NRC regulations; as well as to your letter to Dr. Donald A. Cool, dated August 30, 2002, requesting an exempt distribution license. We understand that you intend to distribute the CoreReader for measuring the porosity of asphalt samples for road construction, and that multiple exempt cesium-137 sources, similar to those that are delineated in 10 CFR 30.15(a)(9)(ii), will be used to provide both internal standardization and calibration of the detector as well as for measurement of sample properties.

In accordance with the requirements of 10 CFR 51.30, we have prepared the enclosed environmental assessment (EA) in which the staff evaluated the information you provided on the design, use, and distribution of the Model CoreReader in terms of the regulatory requirements, the potential environmental impacts, and the risks to public health and safety. In accordance with 10 CFR 51.31, we have prepared a Finding of No Significant Impact (FONSI). The FONSI was published in the **Federal Register** on December 19, 2002, as required by 10 CFR 51.35. Based on this assessment, we believe it is appropriate to issue you a license to distribute the Model CoreReader to persons exempt from NRC regulations.

I have also enclosed your NRC exempt distribution License No. 32-05998-04E. Please review the enclosed new license document carefully and be sure that you understand all the conditions. If there are any errors or questions, please contact me so that appropriate corrections and answers can be provided.

In accordance with 10 CFR 2.790 of NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in NRC's Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC web site at http://www.nrc.gov/NRC/ADAMS/index.html (the Public Electronic Reading Room).

If you have any questions regarding the exemption or the license, please contact Dr. John Jankovich or Mr. Anthony Kirkwood of my staff. Dr. Jankovich can be reached at (301) 415-7904, electronic mail: jpj2@nrc.gov, and Mr. Kirkwood can be reached at (301) 415-6140, electronic mail: ask@nrc.gov.

Sincerely,

Thomas H. Essig, Chief,
Materials Safety and
Inspection Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Materials Safety
and Safeguards

Docket No. 030-36117
License No. 32-05998-04E
Mail Control No. 022268

Enclosures:
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Environmental Assessment and Final
Finding of No Significant Impact

cc:
Stephen A. Browne, RSO

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