FEDERAL MOGUL

August 5, 2003

U.S. Nuclear Regulatory Commission
Regional Administrator
801 Warrenville Road
Lisle, Illinois 60532

RE: Notification of Loss of General License Device

Dear Regional Administrator,

On July 11, 2003, the Federal-Mogul Powertrain Systems plant located at 3605 West Cleveland Road, South Bend, Indiana 46545 discovered a general license device radioactive isotope used as a manufacturing gauging instrument was missing. Per requirements of 10CFR31.5, we have made verbal notification to the U.S. NRC Operations Center and are submitting written notification to the Regional office. Please reference Event # 40021, per Steve Sandin at the NRC Operations Center. We have also spoken to Ed Kulzer at Region 3 and will receive a copy of this notification.

Details of radioactive isotope missing:

Gage S/N:	010312
Description:	Beta Back Scatter
Model #:	CMI 601-B
Probe #:	610130
Isotope:	Promethium – 147 (PM-147)

Federal Mogul personnel investigated the incident and have implemented corrective measures to ensure this incident does not happen again.

Summary of Incident and Corrections

On July 11, 2003, a normal 6-month period gauge calibration was performed to the above mentioned unit. The Field Service Report from Oxford Instruments (Attachment 1) was our first indication of the loss of the isotope. Oxford Instruments performed a sweep of the production floor in an attempt to locate the isotope. None was found.

Detail information of events leading up to issue, corrections, and prevention measures

2/4/03 Attachment 2: Is an end of shift daily report from Pete Patterson, Quality Technician, indicating a problem with the gauging instrument. Pete discovered that only one of three screws were holding the aperture plate on the gauge and was loose.

Federal-Mogul Corporation • Powertrain Systems • 3605 West Cleveland Road • South Bend, Indiana 46628
Tel. (219) 272-5900 • Fax (219) 272-5918

2/4/03 Attachment 3: The Certificate of Calibration completed by Pete Patterson indicates that the isotope was in the gauge at the time. This is known due to the gauge providing a reading – note on the bottom of the first page under "Standard ID: 02 Coating Thickness" the After reading was 0.011 and on the second page, the before reading was 0.007. The gauge was removed from the production floor and taken to the quality lab where it was placed in its packaging bag.

7/11/03 Gauge calibration by Oxford Instruments identifies missing isotope. Quality Technicians notify Environmental, Health & Safety Engineer. Immediate review of process, procedures, prior events leading up to incident, and notification requirements were reviewed.

7/11-17/03 Attachment 4: E-mails pertaining to incident

7/18/03 Attachment 5: First meeting with key people to review information

7/21/03 Attachment 6: Second meeting with key people. The plant currently has 4 gauges listed with Oxford Instruments, the fourth gauge was not installed on the production floor and needed to be located and secured. The fourth unit has been secured in the Quality Dept.

7/22/03 Attachment 7: Notes from meeting to prevent reoccurrence

Attachment 8: SAF406-22 Beta Backscattering Device procedure

Attachment 9: GM-1 and GM-2 Probes Operating Manual

Corrective Measures Implemented:

- The fourth unit (spare unit) has been secured in the Quality Lab.
- Security stickers will be placed on one end of the beta back scattering device to prevent tampering
- Liquid marking to be placed on the aperture end to prevent tampering
- Quality Department will communicate security requirements and procedure to Oxford Instruments by 8/15/03
- Stores has deleted the stocking part # for the beta back scatter unit, this will prevent automatic reordering
- S406-22 Beta Backscattering Device procedure written and will be communicated to all Assembly and Finishing Department personnel by 8/7/03.
- Procedure will be communicated to all Quality Technicians by 8/11/03

Federal-Mogul Powertrain Systems has always had an open door policy. Employees are encouraged to bring forth concerns or suggestions to help improve the plant operations, specifically including safety and health concerns.

Should you have any questions or require additional information, please contact me at 574-243-3726.

Sincerely,

Paul Frodyma

Paul Frodyma
EHS Engineer
Federal-Mogul Powertrain Systems

CC: Ed Kulzer – U.S. NRC Region 3

ATTACHMENT - 1

Measurement Systems

Field Service Report

Customer Support
945 Busse Road
Elk Grove Village, IL, 60007 USA
Tel: (847) 439-4404
Fax: (847) 439-4425
Email: support@msys.oxinst.com
Web: www.oxford-instruments.com

OXFORD INSTRUMENTS

Customer # 312009	Order # 10086052	Type of Service	Factory Warranty	Contract	Chargeable	Courtesy
	Incident #	Payment Method	PO#		Check #	
Bill To:		Credit Card #	5425 0154 1493 8535		Exp. Date	6/05
		Contact	Pete Patterson			
Ship To: Federal Mogul 3005 W. Cleveland South Bend, IN 46628		Phone	574 247-3815			
		Email				
		Fax				
		Alternate Contact	Todd Forsythe			

Instrument Model		Date Worked On		Calibration Completed	Yes Date 7.11.03	No
Instrument Serial #		Date Completed		Calibration Due Date	1.11.04	
Service Engineer	Scott Weeks	Engineer Signature				

Info for Configuration Update

☐	Current Ag Counts (Largest/Spec Cal Collimator)	☐	X-ray Tube Time at Full Current
☐	Ag FWHM and Peak	☐	Hasp/SW Expiration Date (FP)
☐	Rules File (FP)	☐	SW Version (In/Out)

Summary of Work

Symptom	
Actions Taken	Performed Leak Test on 2 probes. Found another probe PM-147 610130P has a lost Isotope. I scanned all areas of plant with radiation gage and could not find anything. Made report to OIMS.

Summary of Charges

Part Number	Qty	Stk Loc EG/FSE	Description	Serial Number	Unit Price	Extended Price
BFC-Leak	1		S/N 610154P ←			130.00
BFC-Leak			S/N 610157P ←			130.00

	Parts Total	
	On Site Labor Hours	
	Travel Labor Hours	
	Airfare / Transportation	
	Hotel / Meals or Per Diem	
	Miscellaneous	
	Total Cost	260.00

The total cost of this visit is detailed on this service order and my signature below indicates I understand and accept responsibility for these charges on behalf of the company listed above. The Bill To address is correct and any exceptions or objections have been noted in the customer comments section below.

Customer Signature: Jan Patterson Date: 7.11.03

Customer Comments:

ATTACHMENT - 2

From: Pete Patterson on 02/04/2003 07:18 PM

To: Joseph Przygoda/SouthBend_IN_US/Federal-Mogul@Federal-Mogul
cc: Todd Forsythe/SouthBend_IN_US/Federal-Mogul@Federal-Mogul
Subject: daily report 2/4/03

Beta Backscatter at pad print. We have been having trouble with severe drifting. This morning I decided to change the probe. When I pulled the old probe out I found that only one screw was holding the aperture plate on. This allowed it to move and restrict the gamma ray flow. I latter found out that when the unit was serviced the tech lost the screws. I will be contacting Oxford.

Found glassware in phosphate area not in the system. All is entered. Found new indicators in the pad print machines for checking compression. Put reference only stickers on them.

Worked on 82082 line 4 gage records.

Removed an old valve pocket location gage from line 4. It is no longer being used.

Todd: I can not find the calibration report for the TSK formcorder. Try to find it or call them first thing and have it faxed.

I will be in tomorrow.

Pete

ATTACHMENT - 3

FEDERAL MOGUL - SOUTH BEND

3605 West Cleveland Road

South Bend, IN 46628

Certificate of Calibration

07/28/2003 **Certificate Number:**

Gage ID:	010312	**Pass:**	Yes
Gage S/N:	010312	**As Found Condition:**	Out
Description:	BETA BACK SCATTER	**Drawing No:**	
Asset No:		**Drawing Date:**	
Model No.:	CMI601-B	**Change Level:**	
Gage Set #:	GENERAL	**Change Date:**	
Manufacturer:		**NIST No:**	
Cal. Date:	02/04/2003	**Customer Information:**	
Next Due:	03/04/2003		
Cal. Freq.:	1 Months		
Location:	SKIRT COAT 1		
Uncertainty:			

Certification Statement: **Procedure Name:**

It is hereby certified that the above described instrument conforms to the original manufacturer's specifications and has been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology within the limitations of the Institute Calibration Services or have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration techniques. Our calibration system satisfies ISO-9000, QS-9000 and the ANSI Z-540 requirements.

Findings:

CHANGED PROBE. APERTURE WAS LOOSE. NOW USING PROBE 610154P. See daily report 02/04/2003. No containment because using verification master. UNIT WAS NOT USED IN OOT CONDITION.

Environmental Conditions

Temp.:	
Humidity:	
Pressure:	
Other:	

Standard ID:	01 BASE THICKNESS	**Uncertainty:**		**Units:**		**Type:**	V
Limited Use:	No	**Minimum:**	-.001	**Nominal:**	.	**Maximum:**	.001
Ref Type:		**Before:**		**Accuracy:**		**Fail Before:**	No
		After:	.	**Accuracy:**	.	**Fail After:**	No

Gage ID of Standard:
Std Due Date: **Gage S/N:** **Model No.:** **NIST No:**

VERIFIED WITH SCB-001: no before result because using verification master.

Standard ID:	02 COATING THICKNESS	**Uncertainty:**		**Units:**		**Type:**	V
Limited Use:	No	**Minimum:**	0.0104	**Nominal:**	0.0114	**Maximum:**	0.0124
Ref Type:		**Before:**		**Accuracy:**		**Fail Before:**	No
		After:	0.011	**Accuracy:**	-0.000400000	**Fail After:**	No

Gage ID of Standard:
Std Due Date: **Gage S/N:** **Model No.:** **NIST No:**

VERIFIED WITH SCM-00107/26/2003 no before result because using verification master.

Standard ID:	03 REFERENCE MASTER	**Uncertainty:** 0	**Units:**	**Type:**	V
Limited Use:	No	**Minimum:** 0.009	**Nominal:** 0.01	**Maximum:**	0.011
Ref Type:		**Before:** 0.007	**Accuracy:** -0.003	**Fail Before:**	Yes
		After: 0.01	**Accuracy:** 0	**Fail After:**	No

Gage ID of Standard:
Std Due Date: **Gage S/N:** **Model No.:** **NIST No:**
USING SCR1-001

Calibrated by : _____ **Date :** _____

Approved by : _____ **Date :** _____

ATTACHMENT - 4

From: Paul Frodyma on 07/17/2003 01:38 PM

To: Maury Hoban/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Randy Heideman/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Martin Bowers/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Pete Patterson/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Tony Meleski/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Joseph Przygoda/SouthBend_IN_US/Federal-Mogul@Federal-Mogul

cc:

Subject: Beta bacscatter isotope issue

Please attend the following meeting to discuss the **lost radioactive isotope issue**.
Friday 18th, at 10am in the Engineering conf room (David White's old office)

The purpose of the meeting is to

- Update everyone on the lost radioactive isotope issue
- Explain plants requirements on reporting to the Nuclear Regulatory Commission
- Develope containment and corrective measures
- Find the 4th unit - Tony, please bring with you if you found it

If we cannot find the 4th unit, we may have to report **2** lost devices!

Thanks,
Paul
From: Maury Hoban on 07/14/2003 11:28 AM

From: Maury Hoban on 07/14/2003 11:28 AM

To: Paul Frodyma/SouthBend_IN_US/Federal-Mogul@Federal-Mogul

cc:

Subject: Re: Beta bacscatter isotope update

Please contact LaGrange.

---------- Forwarded by Maury Hoban/SouthBend_IN_US/Federal-Mogul on 07/14/2003 11:33 AM ----------

From: Ed Fain on 07/14/2003 10:32 AM

To: Maury Hoban/SouthBend_IN_US/Federal-Mogul@Federal-Mogul

cc:

Subject: Re: Beta bacscatter isotope update

Maury,

You should discuss this incident with Denny Tester and the team at LaGrange, they had a similar incident a couple of years ago. Please find out what their corrective action plan was and make sure you take into account LaGrange's lessons learned in South Bend's corrective action.

Ed
From: Maury Hoban on 07/14/2003 08:40 AM

From: Maury Hoban on 07/14/2003 08:40 AM

To: Ed Fain/SouthBend_IN_US/Federal-Mogul@Federal-Mogul

cc:

Subject: Re: Beta bacscatter isotope update

I will discuss this with you sometime today. Friday, we found out that the isotope was missing from a probe that had been replaced on one of the beta backscanners in skirt coat. The probe had been replaced in April and the used one was in Quality.

Maury

---------- Forwarded by Maury Hoban/SouthBend_IN_US/Federal-Mogul on 07/14/2003 08:43 AM ----------

From: Paul Frodyma on 07/14/2003 08:23 AM

To: Pete Patterson/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Tony Meleski/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Dan Mathias/SouthBend_IN_US/Federal-Mogul@Federal-Mogul
cc: Joseph Przygoda/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Martin Bowers/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Maury Hoban
Subject: Re: Beta bacscatter isotope update

Tony M: Can you verify the location of the unit you have for Tin Plate - this is the 4th unit the plant has

To All: I have spoken with Dr. Howe about the incident and we will continue to resolve the reporting issue.

Suggestions for improving our system on control of these regulated units.

- Quality should keep all spare units under lock and key. This may be slightly extreme, but you can see the additional work required to resolve a lost item and very high visibility to reporting to the U.S. government agency.
- Stores should not keep in inventory and not have an automatic reorder point. One spare should be sufficient for the plant
- Maintenance activities of these units should be reviewed possibly by Pete, myself, and Oxford Technician.
- Create a work instruction under the Safety / Environmental system for handling these units (Paul and Pete)
- Coduct training on this work instruction for all of Assembly and Finishing Dept, Quality, and Engineers involved. (Paul and Pete)

If you have other suggestions, please share with the group, otherwise, depending on what the NRC says, we will implement these as part of corrective/preventive measures so this type of incident does not happen again.
Paul

From: Pete Patterson on 07/11/2003 07:14 PM

From: Pete Patterson on 07/11/2003 07:14 PM

To: Joseph Przygoda/SouthBend_IN_US/Federal-Mogul@Federal-Mogul
cc: Martin Bowers/SouthBend_IN_US/Federal-Mogul@Federal-Mogul (bcc: Paul Frodyma/SouthBend_IN_US/Federal-Mogul)
Subject: Beta bacscatter isotope update

I gave the contact information for NRC and Oxford Instruments to Paul Frodyma. He will be in contact with the NRC for future steps concerning the lost radioactive isotope. DR Howe from the NRC had not called me back as of yet. At any rate the incident has been reported and we are waiting for further instructions.

Paul: Please keep me in the loop and let me know if I can be of any further assistance in this matter.

Joe: I will be in Monday morning if you need to touch base with me about this.

ATTACHMENT - 5

Alarm enabled: an alarm will occur 30 minutes before the start time of this entry.

Calendar Entry

● Appointment ○ Invitation ○ Event ○ Reminder ○ Anniversary

Brief description:

Radio active isotope issue

Date: 07/18/2003

Time: 10:00 AM - 11:00 AM ☐ Pencil in ☐ Not for public viewing

Detailed description:

ATTACHMENT - 6

Alarm enabled: an alarm will occur 240 minutes before the start time of this entry.

Calendar Entry

○ Appointment ● Invitation ○ Event ○ Reminder ○ Anniversary

Brief description:

URGENT - Lost radioactive isotope
See notes below

Date: 07/21/2003 Time: 02:00 PM - 03:00 PM ☐ Pencil in ☐ Not for public viewing

Detailed description:

This is an urgent meeting ! We currently have one lost radioactive isotope from the betabackscatter devices and one full unit that cannot be located. These lost units must be reported to the Nuclear Regulatory Commission by Friday July 25th via phone, then followed up with written notification and corrective measures by Aug. 20th.

Agenda:
Determine how the incident happened
Determine where the 4th unit is,
Determine preventive corrective measures

Invitations have been sent to: Todd Forsythe/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Pete Patterson/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Joseph Przygoda/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Martin Bowers/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Randy Heideman/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Steve Signorino/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Tony Meleski/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Maury Hoban

Display invitee responses...

ATTACHMENT - 7

From: Paul Frodyma on 07/22/2003 09:50 AM

To: David Hepworth/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Randy Heideman/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Martin Bowers/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Maury Hoban, Tony Meleski/SouthBend_IN_US/Federal-Mogul@Federal-Mogul, Pete Patterson/SouthBend_IN_US/Federal-Mogul@Federal-Mogul

cc:

Subject: Action Items - Beta back scatter control activities

Summary of action Items from our meeting on the loss of one radioactive isotope. These action items may be delegated, but they must be verified for completeness.

Randy H. - designate location and coordinate activities to install additional beta back scatter unit. Delete re-order and stocking quantity in Stores. Conduct training for department once procedure is finished.

Martin B. - designate storage area for beta back scatter (suggestion from meeting was a wall mounted lock box - if you want, i do have a wall mountable lock box that you can have. just see me) Develope control activities and assign responsibilities to people for calibrating beta back scatter. Conduct training for department once procedure is finished.

Paul F - Report incident

Paul F / Pete P - write procedure

Thanks, any question, just let me know,
Paul

ATTACHMENT - 8

FEDERAL-MOGUL SOUTH BEND	Subject: **Beta-Backscattering Device**	Procedure No.: **SAF406-22**
STANDARD OPERATING PROCEDURES	Author: Paul Frodyma	Page 1 of 4
	Revision Level and Date: **0, 8/5/03**	Origination date: **8/5/03**

Approval:		
Title(s):	Manufacturing Services Manager	EHS Engineer

1. PURPOSE

1.1. The purpose of this procedure is to establish practices and responsibilities for the use of beta-backscattering measurement probes.

2. SCOPE

2.1. This applies to all departments which require the use of measurement devices containing radioactive material.

3. RESPONSIBILITIES

3.1. Gauge Calibration Technician

- Keep an inventory of all radioactive measurement devices
- Maintain all radioactive measurement devices to include calibration of all gauges and security of spare gauges.
- Notify EHS Engineer if the event of theft or loss of the radioactive device.

3.2. EHS Engineer

- Notification of regulatory reporting requirements

3.3. Training Administrator

- Maintain training records

4. PRECAUTIONS

4.1. GM-1 and GM-2 probes contain radioactive material and are subject to government regulations.

4.2. Do not drop the probes or otherwise subject it to severe shock. This may loosen the radioactive isotope within the gauge.

4.3. Beta particles are constantly emitted through the aperture. Use tweezers or other appropriate tools to place small parts over the measuring opening.

4.4. Do not look directly into the measuring opening.

5. REFERENCE MATERIAL

- 10CFR31.5 Certain detecting, measuring, gauging, or controlling devices
- 10CFR20.2201 Reports of theft or loss of licensed material
- 10CFR20.2202 Notification of incidents
- Indiana Codes: 410 IAC 5 Radiological Health
- GM-1 and GM-2 Probes operating manual – CMI International
- Calibration work instruction

6. PROCEDURE

- Only personnel trained on the Calibration work instruction are authorized to use the beta-backscattering measurement devices.
- No Federal-Mogul employees are authorized to perform maintenance or disassembly of the probe.
- If during use of the probe, readings are inconsistent, no reading at all, or security seals are broken, notify your Production Manager or Quality Techs.

7. INCIDENT REPORTING REQUIREMENTS

- In the event of theft or loss, notification to the NRC Region office and NRC Operations Center to be done:
    - Telephone notification within 30 days
    - Written report 30 days after telephone notification
- Nuclear Regulatory Commission contacts
    - NRC Operations Center – 301-816-5100
        - Johnathan Rivera – 301-415-5810
        - Dr. Howe – 301-415-7848

- NRC Region 3 - 630-829-9875 (Ed Kulzer)

  Regional Administrator

  801 Warrenville Rd.

  Lisle, Ill 60532

8. **REVISIONS:**

9. **ATTACHMENTS:**

- GM-1 and GM-2 PROBES Operating Manual

ATTACHMENT - 9

GM-1 and GM-2 PROBES

INTRODUCTION

This manual contains operating information for the GM-1 and GM-2 measurement probes. These devices are designed to be used for beta-backscatter coating thickness measurement in conjunction with an electronics unit which supplies the voltage to the Geiger tube and counts the pulses from it. These probes may be applied directly to the work to be measured or it may be used with various guides.

Precautions

1. The GM-1 and GM-2 probes contain radioactive material and are subject to various government regulations.
2. The Geiger tube and radioisotope source contained in the GM-1 and GM-2 probes are expensive components and should be handled carefully. Take care not to drop the probe or otherwise subject it to severe shock.

GENERAL INFORMATION

The GM-1 and GM-2 probes each consist of a cylindrical housing with a measuring opening (aperture) at one end and cable with a BNC connector at the other (see Figures 1 and 2). The cable supplies the operating voltage to the Geiger tube and conducts the signal back to the unit. The radioactive source is mounted behind the aperture, emitting beta particles through the opening. The sample being measured is laid across the opening and the particles are then backscattered from the sample, back through the aperture, and into the Geiger tube. The number of beta particles backscattered are counted by the Geiger tube.

CAUTION:

Beta particles are constantly emitted through the aperture. Use tweezers or other tools to place small parts over the measuring opening. Do not look directly into the opening.

Figure 1: GM-1 Probe

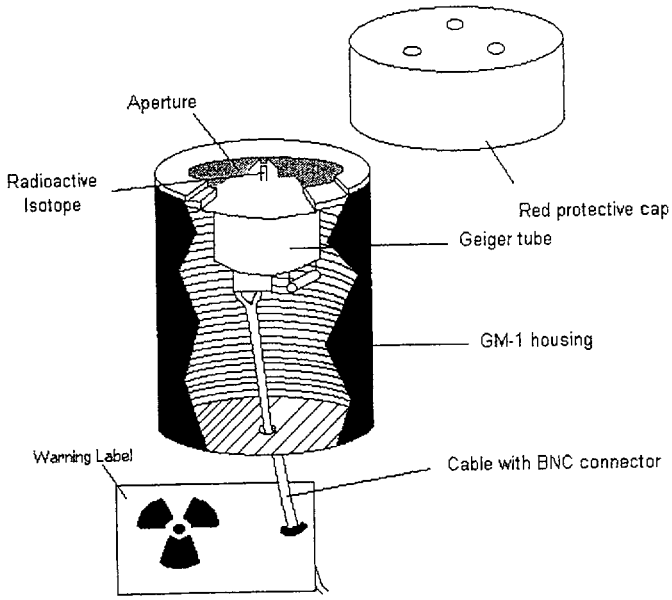
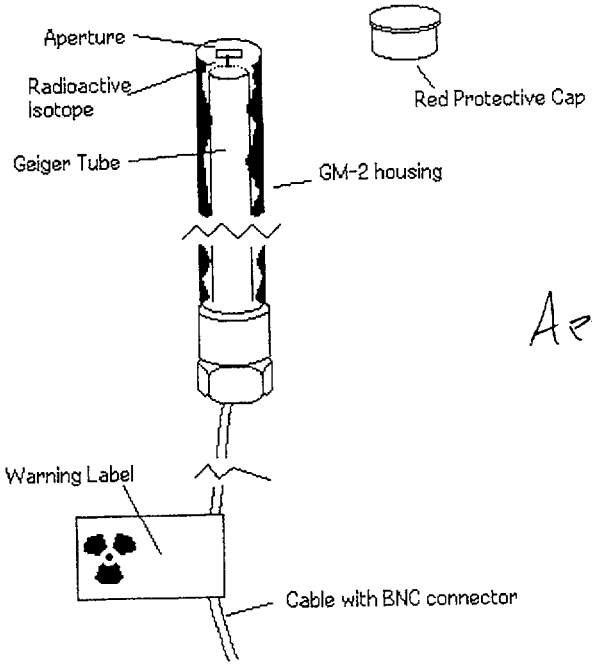


Figure 2: GM-2 Probe



APERATURE: 0.025

USAGE INFORMATION

The probe is used by keeping the measuring opening firmly against the work surface to be measured. This can be done by using the several probe guides available from CMI International or by making a fixture of your own. The probe must be held completely steady on the work during the measuring time. The measuring opening serves to mask off the exact area to be measured.

ISOTOPE SPECIFICATIONS

The GM-1and GM-2 probes are available in three strengths. The desired strength is determined by the thickness of the coating being measured.

Isotope	Symbol	Half-Life/*Working life (years)	Energy (MeV)
Promethium-147	PM-147	2.6	0.22
Thallium-204	TL-204	3.8	0.76
Strontium/Yttrium-90	SR-90	28.9/62.4 hr	0.54/2.27

*Working-life is defined as point in time when the energy emitted by the source will have degenerated to a point where measurement times will more than double in order to get a specific performance as defined by standard deviation. For example, to the user, the measurement will require twice the time as compared to when first purchased due to a gradual loss in energy over time.

STORAGE

When not in use, the GM-1 and GM-2 probes must be stored in a secure place. The red protective cap should be placed on the probe to prevent the escape of beta particles.

CLEANING

Should your GM-1 and GM-2 require exterior cleaning, we suggest the use of a general detergent. Be sure not to saturate cloth to point that liquid runs along the barrel and into the aperture. Wipe dry after cleaning. Should debris get lodged into aperture, DO NOT attempt to clean. Return to CMI International for service.

SELECTION OF APERTURE SIZE

NOTE:

Due to NRC and state regulations, the aperture can only be changed at the factory by a qualified technician.

The ideal aperture choice is the one with the largest opening that will completely cover or be covered by the part being measured. If the opening is too large, beta particles will escape into the air instead of being backscattered into the Geiger tube. If the opening is too small, the counts being backscattered will be reduced, affecting the repeatability of the readings.

Because of the small effective area of the source, any opening over .062" can be considered "large" and larger openings will have little effect on the repeatability of the measurements.

Cylindrical Surfaces

- In order to permit the use of flat thickness standards even when the measurement surface is curved, it is necessary to use a slit-type opening of a width which makes the effect of curvature negligible. The part will rest slightly down into the slit, but if the slit is narrow enough, this will be insignificant.
- The length of the slit should be shorter than the length of the part being measured.
- As with flat parts, choose the largest possible opening that can be used on the parts being measured. If the opening is too small, the measurement area will be reduced, reducing the reproducibility of the readings.

The following chart shows the maximum aperture widths recommended for various cylindrical diameters.

Minimum cylinder diameter		Maximum aperture width	
inches	mm	inches	mm
.016	.41	.010	.25
.020	.51	.014	.36
.037	.94	.020	.51
.060	1.6	.025	.64
.120	3.0	.035	.89
.180	4.6	.045	1.1

RADIOISOTOPE PRECAUTIONS AND REGULATIONS

The radioactive isotopes used in the GM-1 and GM-2 probes systems emit beta particles and proper precautions should be taken when handling these devices. All of the source elements are sealed sources of low activity and present a minimal health hazard.

The following precautions should be taken when handling the GM-1 and GM-2 probes.

- The GM-1 and GM-2 probes may only be disassembled by a qualified technician carrying a license to do so.
- The plastic cap must be kept on the probe when not in use to block the emission of radioactive output.
- Do not look directly into the opening.
- Avoid radioactive exposure by keeping hands (or any part of the body) away form the opening. Use tweezers to position small parts for measuring.
- Protect the probe from physical damage by keeping it in its box or in the probe guide at all times.
- Never poke anything through the measuring opening.
- When shipping probe back to the factory put the red protective cap on the probe.

DISPOSAL OF RADIOACTIVE PROBES

NRC regulations require that the GM-1and GM-2 probes may not be discarded, transferred, or sold except by a licensed facility.

- A radioactive probe cannot be sold directly to another company. The probe must be returned to CMI so that a legal transfer can be made. It will then be sent to the new company.
- Radioactive material must be lawfully disposed. When the probe is no longer needed or used, return the probe to CMI so that the disposal can be properly reported.

LABELING

The actual activity in the device is shown on the yellow and magenta label which is attached to the probe cable. This label must **not** be removed. When shipping any probe, the package need not be labeled on the outside if the probe is properly labeled on the inside.

LEAK TESTING

The United States Nuclear Regulatory Commission regulations require that the GM-1 and GM-2 probes be leak tested every six (6) months after being received. Testing for leakage of radioactive material is accomplished by sending the entire probe, with the red protective cap, with a purchase order to CMI International for servicing. CMI will perform the necessary leak tests and test the performance of the probe.

NRC REGULATIONS

A copy of the relevant portion of the U.S. Nuclear Regulatory Commission (US NRC) regulations, part 31.5, is attached at the end of the manual. In summary, the regulations state:

- There is no specific license required by the user.
- The probe can be used under general license provision 31.5 and/or specific regulations in the agreement, if applicable.
- Within the required time period, CMI International will notify the US NRC and/or the appropriate state agency that a device containing a radioactive isotope has been shipped to that state.
- If you are in an agreement state, you are required to notify the state agency.
- Notify the regulatory agency of your state for any special registration that may be required.

POTENTIAL RADIATION EXPOSURE LEVELS

In addition to the low activity of the sources, most of the beta particles given off by the radioactive sources used in the GM-1 and GM-2 probes are of low enough energy that they will be stopped by clothing. The actual amount of beta radiation to which an operator may be exposed depends on many variables, including:

- The type of guide used
- The actual isotope being used
- The size of the aperture being used
- The length of time that the operator's hands are within the radiation emitted by an uncovered source (note that if the aperture is covered by a sample or standard, there is virtually zero radiation above the sample or standard).
- Assuming one worker measures 100 parts per day at a 10 second placement time per part, for 250 days per year, using tweezers to place and remove the part, we can estimate the following maximum dosage (to the hand).
  - PM-147: 1,200 micro currie 2,044 mrem/yr (20.4 mSv/yr)
  - TL-204: 75 micro currie 3,694 mrem/yr (36.9 mSv/yr)
  - SR-90: 5 micro currie 4,025 mrem/yr (40.3 mSv/yr)

The maximum allowable dose to the hands according to 32 ILL. Adm. Code 330.280 (d) (1) (ii) (10 CFR 32.51) is 5000 mrem/yr (50mSv/yr) for generally licensed items.

CUSTOMER SERVICE/TECHNICAL SUPPORT

In the event that you should experience problems with your GM-1 or GM-2, our System Support Group is prepared to assist you. Please call 847-439-4404 and ask for customer service. Be prepared with the following information:

- Model number
- Serial number
- Description of problem

Your call will be instantly recorded in an "Incident Report" data base. You will be directed by the customer service representative with clear directions as to how to proceed. Should your probe require service, a **R**eturn **A**uthorization number will be assigned and you will be asked to ship the unit back to CMI. Please follow the instructions below for returning probes.

SHIPPING INSTRUCTIONS

When shipping probes back to the manufacturer, the following guidelines must be observed.

- The red cap must be placed on the end of the probe. If the red cap is not on the probe, it will automatically be replaced and you will be charged accordingly for a new cap.
- The yellow and magenta label must be attached to the probe cable.
- Place the probe in a sturdy cardboard box. Use cushioning material to minimize movement and any possible damage.
- Enclose a purchase order and packing slip describing the service to be done (i.e. leak testing, performance, disposal, etc.). **These written instructions must include the name of the consignee, and the notice "This package conforms to the conditions and limitations specified in 49CFR173.422 for excepted radioactive material, instruments, and articles, UN2911."**
- Indicate any adverse conditions to which the probe may have been subjected (i.e. dropping, lack of performance, disposal, etc.).
- No labeling of radioactive material is needed on the outside of the box as long as the yellow and magenta label is attached to the probe cable.
- Any common carrier, postal service, etc., may be used to transport the sealed box. The shipper is responsible for compliance to U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, and other applicable regulations.

FURTHER INFORMATION

If you have any further questions about safety, use of the GM-1 or GM-2 probe, or the regulations governing its use, please contact the Radiation Safety Officer or Assistant Radiation Officer of CMI International. We will be pleased to be of assistance.

AGREEMENT STATES

These various state agencies should be contacted regarding regulations for the possession of radioactive material. These 31 states operate independently of the US NRC. If you reside in any other state, the NRC should refer you to the appropriate agency.

Alabama 205-261-5315
Division of Radiological Health
Environmental Health Administration
State Office Building
Montgomery, Alabama 36130

Arizona
Arizona Radiation Regulatory Agency
4814 S. 40th Street
Phoenix, Arizona 85040

Arkansas 501-661-2301
Division of Radiation Control
Arkansas Department of Health
4815 West Markham
Little Rock, Arkansas 72205

California 916-445-0931
Department of Health Services
Radiologic Health Branch
Attn: General Licensing
PO Box 94273, MS 178
Sacramento, California 94234

Colorado 303-692-3030
Department of Public Health and Environment
Laboratory and Radiation Services Division
8100 Lowry Blvd.
Denver, Colorado 80220-6928

Florida 904-487-1004
Office of Radiation Control
Department of Health & Rehabilitative Service
1317 Winewood Blvd.
Tallahassee, Florida 32301

Georgia 404-362-2675
Radioactive Materials Program
4244 International Parkway
Suite 114
Atlanta, Georgia 30354

Idaho 208-334-4108
Radiation Control Section
Idaho Department of Health and Welfare
Statehouse
Boise, Idaho 83720

Illinois 217-785-9900
Division of Radioactive Materials
Department of Nuclear Safety
1035 Outer Park Drive
Springfield, IL 62704

Iowa 515-281-3478
Radiological Health Program
Iowa Department of Health
Lucas State Office Building
Des Moines, Iowa 50319

Kansas 913-862-9360
Bureau of Radiation Control
Department of Health & Environment
Building 740, Forbes Field
Topeka, Kansas 66620

Kentucky 502-564-3700
Radiation Control Branch
Cabinet for Human Resources
275 East Main Street
Frankfort, Kentucky 40621

Louisiana 504-925-4518
Nuclear Energy Division
Office of Environmental Affairs
P.O. Box 14690
Baton Rouge, Louisiana 70898-4690

Maine 207-287-5676
Department of Human Services
Division of Health Engineering
10 State House Station
Augusta, Maine 04333-0010

Maryland 301-383-2744
Division of Radiation control
O'Conor Office Building
201 W. Preston Street
Baltimore, Maryland 21201

Mississippi 601-354-6657
Division of Radiological Health
State Board of Health
3150 Lawson street
P.O. Box 1700
Jackson, Mississippi 39215

Nebraska 402-471-2168
Division of Radiological Health
State Department of Health
301 Centennial Mall South
P.O. Box 95007
Lincoln, Nebraska 68509

Nevada 702-885-5394
Radiological Health
Department of Human Resources
505 East King Street
Carson City, Nevada 89710

New Hampshire 505-984-0020
Radiological Health Program
P.O. Box 148
Concord, New Hampshire 03301

New Mexico 505-984-0020
Radiation Protection Bureau
Department of Health and Environment
P.O. Box 968
Santa Fe, new Mexico 87504-0968

New York 518-473-3621
Bureau of Environmental Radiation Protection
State health Department
Empire State Plaza
Corning Tower, Room 421
Albany, New York 12237

North Carolina
North Carolina Department of Environmental Health
Natural Resources Division of Radiation Protection
Radioactive Materials Section
P.O. Box 276817
Raleigh, North Carolina 27611-7687

North Dakota 701-224-2348
Division of Environmental Engineering
State Department of Health
1200 Missouri Avenue
Bismarck, North Dakota 58501

Ohio 614-644-2727
Ohio Department of Health
Bureau of Radiation Protection
246 North High Street
Columbus, Ohio 43216-0118

Oregon 503-229-5797 Fax; 503-731-4017
Radiation Control Section, Division of Health
Department of Human Resources
Attn. Ms. Martha Dibblee
Mgr. of Radioactive Material Controls
800 NE Oregon St. Suite 260
Portland, Oregon 97232

Rhode Island 401-277-2438
Division of Occupational Health and Radiation Control
Rhode Island Department of Health
Cannon Building
75 Davis Street
Columbia, South Carolina 29201

South Carolina 803-758-5548
Bureau of Radiological Health
Sate Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Tennessee 615-532-0364
Division of Radiological Health
3rd Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1532

Texas 512-835-7000
Bureau of Radiation Control
Texas Department of Health
1100 W. 49th Street
Austin, Texas 78756-3189

Utah 801-538-6734
State of Utah Department of Environmental Quality
Larry F. Anderson, Director
Division of Radiation Control
288 North 1460 West
Salt Lake City, Utah 84114-4850

Washington 206-753-3353
Washington State Department of Health
Division of Radiation Protection
Airdustrial Center, Building #5
P.O. Box 47827
Olympia, Washington 98504-7827

Indiana State Department of Health

INDOOR & RADIOLOGICAL HEALT
DIVISION

2 North Meridian St., 5th Fl
Indianapolis, IN 46204-30C

REPORTING OF RADIATION INCIDENTS

Incidents* involving radioactive materials or radiation producing devices shall be reported to the Indiana State Department of Health, Indoor and Radiological Health Division at one of the following numbers:

PRIMARY CONTACTS:	317/233-7153	EMERGENCY RESPONSE/ RADIOACTIVE MATERIAL PROGRAM COORDINATOR
	317/233-7564	RADIATION MACHINE PROGRAM COORDINATOR
	317/233-7146	DIVISION MANAGER
NORMAL OFFICE HOURS: 8:15AM - 4:45PM	317/233-7147/49	GENERAL OFFICE NUMBERS
	317/233-7154	TELEFAX
	317/233-3015/17	RADIOCHEMISTRY LABORATORY
	317/233-8115	AFTER HOURS EMERGENCY

* Incidents include, but are not limited to, theft or loss of radioactive material or devices; damaged or leaking radiation packages or devices; transportation accidents; fires or explosions that impact radiation sources; radiation monitor alarms at scrap, solid waste, and recycling facilities; overexposures; and misadministrations.