QUALITY INSTRUCTION NO. 120 REV.

TITLE: RECEIVING INSPECTION	ORIGINAL RELEASE DATE: 2/1/87	DATE OF REVISION:	PAGE 1 OF 3 PAGES
ACKNOWLEDGED:	APPROVED: William A. Clu... MANAGER, QUALITY ENGINEERING		

1.0 INTRODUCTION

1.1 Scope

This document has been prepared to provide detailed instructions for controlling the receipt and inspection of purchased articles and services.

1.2 Application

The requirements contained herein are applicable to all articles and services purchased by TASI which are ultimately deliverable to TASI customers. Specifically excluded from the controls defined in this document are purchased tools, gages, fixtures, templates, jigs, machine tools, standard supplies, and similar articles not normally deliverable to TASI customers.

2.0 ASSOCIATED DOCUMENTS

2.1 Applicable Documents

DOD Quality Program Requirements

2.2 Reference Documents

TASI Q.I. 110
Statistical Accpetance Sampling

TASI Q.I. 108
Instructions for Completing Failure and Rejection Report Form F-3807

3.0 REQUIREMENTS

3.1 Responsibility

3.1.1 Quality Engineering - The Quality Engineering section shall be responsible for planning and auditing the requirements of this document and for identifying and providing for any unique customer requirements affecting the controls maintained in the Receiving Inspection Area. In addition, Quality Engineering shall be responsible for preparing, issuing, and controlling detailed inspection instructions for each purchased article or service.

TITLE: RECEIVING INSPECTION	ORIGINAL RELEASE DATE: 2/1/87	DATE OF REVISION:	PAGE 2 OF 3 PAGES
ACKNOWLEDGED:	APPROVED: William Albertson MANAGER, QUALITY ENGINEERING		

3.3.2 Receiving Inspection - The Receiving Inspection section shall be responsible for performing the required inspection operations, accepting or rejecting articles as required, and for documenting and maintaining records of inspection results.

3.2 System

3.2.1 Purchased articles shall be moved to the Receiving Inspection Area after receipt and identification by the Receiving Clerk.

3.2.2 All purchased articles awaiting inspection shall be separated from accepted articles and shall be identified as awaiting inspection.

3.2.3 Prior to the starting of the actual inspection operation, the Inspector shall verify that definitive inspection instructions have been provided and are available.

These instructions, for purposes of this document, shall include as i minimum:

a) The required engineering drawing (and when necessary, supporting specifications, operation sheets, etc.)

b) A copy of the applicable TASI Purchase Order

c) The detailed inspection planning instructions

The revision status (letter change) of these documents shall be reviewed, and if not in agreement, shall be reported to the Inspection Supervisor. No further inspection shall be accomplished unless the required inspection instructions are available.

3.2.4 The vendor supplied data (test reports, certificates of conformance, certified test data, processing certificates, etc.) requested by the coded quality requirements of the purchase order (reference Q.I. 104) shall be reviewed for accuracy and completeness. If the required data package is not completed, this situation shall be reported to the Inspection Supervisor. The decision to complete or terminate the inspection operation at this time is reserved to the Inspection Supervisor, but in any case, the article(s) may not be accepted or forwarded for further processing until the required data has been received and reviewed by Receiving Inspection.

TITLE: RECEIVING INSPECTION	ORIGINAL RELEASE DATE: 2/1/87	DATE OF REVISION:	PAGE 3 OF 3 PAGES
ACKNOWLEDGED:	APPROVED: [signature] MANAGER, QUALITY ENGINEERING		

3.2.5 The actual inspection (or bench test) of purchased article(s) shall be accomplished as directed by the specific instructions, using only calibrated instrumentation.

3.2.6 Specific instructions for the recording of inspection results are contained in TASI Quality Instructions (Q.I.) 110.

3.2.7 Accepatble completed articles shall be forwarded to Stores. The authority for such movement shall be indicated by appropriate Inspection Department completion of a "TO STOCK TAG", Form F2398.

3.2.8 Acceptable articles which are to be subjected to further processing operations shall be forwarded to the respective processing or manufacturing area.

3.2.9 Articles requiring further inspection or testing by other departments (functional testing, non-destructive testing, laboratory verifications, etc.) shall be forwarded to the respective department assigned this responsibility and shall be routed for return to the Receiving Inspection Department after the completion of testing operations. Upon return of the article(s) and the required test or laboratory reports to the Receiving Inspection Area, the test reports shall be reviewed and shall become part of the inspection record package.

3.2.10 Articles rejected during inspection or test or which are not in complete conformance with the requirements of this document shall be identified as descrepant, separated from acceptable articles or those awaiting inspection, and be subjected to Preliminary Material Review Action. Specific instructions for the handling of rejected material are contained in TASI Quality Instruction 108.

3.3 Records

3.3.1 Documented evidence of inspections performed shall be maintained in the Receiving Inspection Area for a minimum of one (1) year from the date of last entry.

QUALITY INSTRUCTION NO. 120 REV.

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ACKNOWLEDGED:	APPROVED: William A. Clib... MANAGER, QUALITY ENGINEERING		

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THORN Automated Systems

October 10, 1991

THORN Automated Systems In
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
FAX (216) 871-8320

Ms. Susan L. Greene
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Dear Ms. Greene:

Pursuant to our recent communications, THORN Automated Systems, Inc. is requesting the N.R.C. amend our Distribution License Number 34-23772-02E, ~~to~~ include Autocall/Nittan smoke detectors:

Device Model	Maximum Quantity Americium 241 per Device
NID-68	1.0 Microcurie
NID-68AS	1.0 Microcurie
NID-68AS-1	1.0 Microcurie
IOB2 (P/N PU90-2000-1 & P/N PU90-41000-1)	1.0 Microcurie

We also request the N.R.C. terminate Autocall/Nittan Distribution License No. 12-16029-03E in conjunction with the transfer of authorization to THORN Automated Systems, Inc.

The following information is submitted to accomplish this transfer:

* (a) The name of the organization is THORN Automated Systems, Inc.

* (b) Radiation Safety Officer responsibilities will transfer from Mr. Ken Kimura, Autocall/Nittan, to E. Joseph Martini, THORN Automated Systems, Inc.

* (c) The transferrer will not remain in business in the United States without the license.

* (d) On December 5, 1990, THORN Automated Systems, Inc. purchased Autocall, Inc. by means of a stock purchase arrangement. On April 1, 1991, a corporate reorganization took place which resulted in the transfer of assets of Autocall's field offices to the parent company, THORN, by resolution of the Board of Directors of Autocall.

* (e) Organization changes include the transfer of Radiation Safety Officer responsibilities and location of storage and distribution facility; no equipment or procedures will change. All licensed material will be possessed in finished product authorized for distribution to persons exempt from license.

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ATTACHM

(f) There is no change in the use, possession, or storage of licensed material. The change in ownership, contact person, and facilities require an amendment of the THORN license and termination of the Autocall/Nittan license. Autocall was the sole customer of Nittan for the products containing licensed materials. Nittan was the only U.L.-approved source for these smoke detectors in Autocall's fire protection systems. Product lines will continue as they are; there will be no product changes made.

(g) All required surveillance items and records, including radioactive material inventory, accountability requirements, and records of transfer of persons exempt from license, are current and will be maintained by THORN Automated Systems, Inc.

(h) The new facility has previously been used for licensed activity. An inventory audit of licensed material for the Autocall/Nittan facility has been completed, and an instrument survey will be performed. THORN Automated Systems, Inc. agrees to assume full liability for decontamination of the Autocall/Nittan facility.

(i) No decontamination plans or financial assurance arrangements are required for this license.

(j) THORN Automated Systems, Inc. agrees to abide by all commitments or representations previously made to the N.R.C. by Autocall/Nittan with regard to condition 14 of License No. 12-16029-03E. It is our desire that the amended license when issued be without reference to any other previously submitted documents.

(k) Announcement of change of ownership and control of Autocall's physical assets (including licensed material) by THORN is attached.

(l) THORN Automated Systems, Inc. agrees to abide by all constraints, conditions, requirements, representations, and commitments made in the existing license.

Please contact me if you have any questions or require additional information.

Sincerely yours,
THORN Automated Systems, Inc.

E. Joseph Martini
Vice President, Manufacturing

EJM:cs

Attachments

THORN Automated Systems

THORN Automated Systems Inc.
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
FAX (216) 871-8320

News Release

December 6, 1990
For Immediate Release

Contact:

Bob Elzer, C.E.O.
THORN Security North America
(216) 871-9900

Casey Kroll, President & C.O.O.
THORN Automated Systems, Inc.
(216) 871-9900

Jim Frankow, President & C.O.O.
Autocall, Inc.
(419) 347-2400

THORN EMI ACQUIRES AUTOCALL

Westlake, Ohio — THORN EMI, the UK-based group with international businesses in electronics, music and rental, has acquired, through its subsidiary, THORN Security North America, 100% of the shares of Autocall, Inc.

THORN Security North America, which represents THORN Security's interest in the North American fire and security industry already has substantial U.S. market presence through its subsidiaries, Malco Plastics and THORN Automated Systems, Inc.

Autocall, Inc. is a major provider of state-of-the-art fire detection and control equipment. Headquartered in Shelby, Ohio, Autocall sells and services its fire products through an extensive network of sales representatives as well as its nine full-service field offices, located throughout the U.S.

MORE

THORN EMI ACQUIRES AUTOCALL

Bob Elzer, CEO of THORN Security North America, commented, "The acquisition of Autocall is a quantum step forward in our strategy of aggressive growth through both organic development and selective acquisitions. We are certain that Autocall's excellent fire product line will greatly enhance THORN Automated Systems' security products and integration capabilities."

THORN Automated Systems is a leading security systems integrator as well as a manufacturer of fire control, detection and access control equipment, and is based in Westlake, Ohio, with offices throughout the U.S.

Autocall will be an integral part of a coordinated strategy with THORN's other operating companies to expand THORN's position in the fire and security market throughout North America.

Jim Frankow, Autocall's President, commented, "The combining of Autocall's expertise in the alarm and detection industry with THORN Automated Systems' recognized integration capabilities catapults THORN into a front runner position in the fire and security industries. This winning combination will enable us to capitalize on the decade of the nineties and emerge as the leader."

###

SECTION TWO

CONTENTS:

1. Copy of current license 34-23772-01 Amendment No. 02
2. Application
3. Attachment B1 - Certificates of Recognition for RSO and Assistant RSO
4. Attachment B2 – Legal transfer documents
5. Attachment B3 – Site Map of 835 Sharon Drive

THORN Automated Systems

THORN Automated Systems, Inc.
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
FAX (216) 871-8320

April 25, 1994

Carl J. Paperiello
Director, Division of Industrial and
Medical Nuclear Safety
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: THORN Automated Systems, Inc.
Docket Nos. 030-31616, 030-31617
Request for NRC Consent to the Indirect Transfer of Control of THORN Automated Systems, Inc.'s Interest in materials License Nos. 34-23772-02E and 34-237772-01

Dear Mr. Paperiello:

THORN Automated Systems, Inc. ("TASI") hereby requests that the Nuclear Regulatory Commission ("NRC"), pursuant to 10 CFR, Sec. 30.34 (b), consent to the indirect transfer of control of TASI's interest in Materials License Nos. 34-23772-02E and 34-237772-01 that will occur as the result of the purchase of TASI's parent company, KAS Holdings, Inc. by Mattingly One Limited, either directly or through intermediate holding companies.

TASI, a Delaware Company, is a manufacturer and distributor of smoke detection devises containing Americium-241. Pursuant to Materials License Nos. 34-23772-02E and 34-237772-01, TASI is authorized to possess and distribute Americium-241 in the form of foil sources (Amersham Int., Inc. Model No. AMK 1001H).

The following information, regarding the proposed purchase of KAS Holdings, Inc., relates to the NRC Information Notice No. 89-25:

a. There will be no change in the name of the licenses organization.

b. There will be no change in the personnel named in the license.

c. The current licensee will continue to manufacture and distribute smoke detection devices.

d. See Attachment I.

e. There are no plans to change the organization, location, facilities, equipment,

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THORN Automated Systems, Inc.
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
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procedures, or personnel.

f. There are no plans to change the use, possession, or storage of the licensed materials.

g. All required records such as calibrations, leak tests, surveys, radioactive material inventories and personal exposure records are current and will be kept current up to, at, and after the transaction.

h. There are no plans for any changes in the status of TASI's Westlake, Ohio facility. There is no contamination present at the TASI Westlake, Ohio facility.

i. TASI will retain control of the assets involved in the production of the smoke detection devices.

j. TASI will retain control of the materials licenses.

k. TASI will continue to abide by all constraints, conditions, requirements, representations, and commitments to assure compliance with the license and regulations.

Please contact the undersigned if further information is required. The sale of KAS Holdings, Inc. is scheduled to close on April 29, 1994. I would appreciate receiving a response from your office prior to that date. Thank you for your attention to this matter.

Very truly yours,

THORN Automated Systems, Inc.

H. T. Swanson III
Vice President of Administration

Enclosure: Attachment I

CC: John B. Martin, Administrator
Nuclear Regulatory Commission
Region 3
801 Warrenville Road
Lisle, Illinois 60532

Bramble\Nuclear.Let

THORN Automated Systems, Inc.
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
FAX (216) 871-8320

ATTACHMENT I

Description of Transaction

THORN Automated Systems, Inc. ("TASI"), a Delaware Company, is presently owned by KAS Holdings, Inc. ("KAS"), a Delaware Company. KAS owns 100 percent of the common stock of TASI. THORN EMI North American Inc. ("TENA"), a [Delaware] Company currently owns 100 percent of the common stock of KAS. Mattingly One Limited ("Mattingly"), a British Company, will acquire control of TASI as an ongoing entity (the "Transaction"). To effectuate the Transaction, Mattingly will either (i) acquire from TENA 100 percent of the common stock of KAS or (ii) acquire from KAS 100 percent of the common stock of TASI.

TASI will retain its name and personnel and will continue to operate in Westlake, Ohio. TASI will remain the license holder of its two Materials Licenses issued by the NRC.

The Transaction, which also contemplates the acquisition of several overseas companies, is scheduled to be completed in 2 - 3 weeks.

Bramble\Nuclear.Let

THORN Automated Systems

THORN Automated Systems, Inc
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
FAX (216) 871-8320

August 18, 1994

Ms. Michelle Burgess
U.S. Nuclear Regulatory Commission
Mail Stop T-8F5
Washington, D.C. 20555-0001

Re: Change of Status

Dear Ms. Burgess:

I am writing to report certain changes which have transpired in recent months which may have a bearing on the Distribution License held by Thorn Automated Systems, Inc. Those changes are as follows:

1. Change of Address for the Thorn Security Technology Centre - Our Technology Centre, which includes research & development and approvals activities has been relocated to our new UK head office site:

   Thorn Security Ltd. Technology Centre
   The Summit
   Hanworth Road
   Sunbury-on-Thames
   Middlesex
   TW16 5DB

   Tel: 0932 743333
   Fax: 0932 743155

2. Change in Parent Company - Prior to May 27, 1994, Thorn Automated Systems, Inc. was a wholly owned subsidiary of THORN EMI plc., a corporation based in the UK. On May 27th, the security division of THORN EMI underwent a Management Buy-Out which included Thorn Automated Systems. Therefore, we are now a wholly owned subsidiary of Thorn Security Ltd. of the UK (THORN EMI retains a 40% ownership share in Thorn Security). In effect, this change in ownership has no effect on the conduct of business and continues to reflect the same management reporting structure as existed before the MBO.

3. Change in Radiation Safety Officer - These responsibilities are being transferred from E. Joseph Martini to H.T. Swanson III.

featuring
THORN Autocall
life safety systems

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4. Change in Primary Warehousing Location - Thorn Automated Systems has been licensed for the storage of smoke detectors in two locations, 799 and 835 Sharon Drive, Westlake, Ohion 44145. We previously designated our primary warehousing location as 799 Sharon Drive. This location has since been closed. Thorn now does all of its warehousing at the 835 Sharon Drive location.

All other matters relating to the conduct of business remain unaltered. If you have any questions, or require any additional information, please feel free to contact me.

Sincerely,

H.T. Swanson III
Vice President of Administration

cc: E. Joseph Martini

NK NITTAN CHICAGO REPRESENTATIVE OFFICE

P.O. Box 334, Des Plaines, Illinois 60016, U.S.A.
Phone (312) 640-0270
FAX (312) 640-0809

November 15, 1989

030-31404

US NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

Attention: Mr. Bruce Carrico

Subject: Updated Documents For License Renewal
No. NR-481-D-101-E / License No. 12-16029-01E

Dear Mr. Bruce:

In accordance with our telephone conversation in the early part of October, 1989, we have prepared an updated documents as requested and are sending it along with a check of $320 as for the renewal fee.

We have eliminated those models which are no longer being marketed from the list. As a result, we have decided to keep the following models:

1). Model NID-58
2). Model NID-68AS
3). Model NID-68AS-1
4). Model OIB (P/N PU90-2000-1 and P/N PU90-41000-1)

Please note that there are 2 sets of documents, one for the models 1). through 3)., and the other for 4). above. We regarded that those models 1). through 3). can be regarded as being in a same category. The reason for this is that they are built same way using many identical parts. The differences among them are electrical circuits.

We hope that the enclosed information will meet your requirement. If there is any additional information is necessary, please do not contact with us.

Very truly yours,

Ken Kimura
Manager

Lcg NOV. 1
Remitter 8267
Check No. 2225 + 260
Amount $320 +
Fee Category 3H
Type of Fee APP
Date Check Rec'd. 11/22/89
Date Completed
By:

NOV 20 REC'D

020897

TECHNICAL INFORMATION ON NITTAN IONIZATION TYPE SMOKE DETECTORS

FOR

MODELS: NID-58, NID-68-AS, and NID-68AS-1

October, 1989

9907080098

TABLE OF CONTENTS

October, 1989

SECTION I

1.0 Description of Products

The All Models of Nittan Ionization Type Smoke Detectors which discussed in this report are product which detect products of combustion material in an early stage of fire and send a signal to the control panel which, in turn, sounds an alarm both audibly and visibly. They are intended to be used as a part of an early fire warning system.

The following models are covered in this report: NID-58, NID-68AS, and NID-68AS-1. All of these models use the same radioactive sealed source, which will be described in the following sections.

Construction-wise the all models are built with the same parts and components as illustrated in the attached drawing. The only difference among them are slight variation in the electrical circuits.

1-1 General Structure of the Detectors

The complete unit of all three models consist of a detector head and a socket as a complete unit. The major parts and components of the detector head are an outer cover, an ionization chamber with a radioactive source, a printed circuit board with all electrical parts and a body. The Socket consists of only wiring terminals to the control panel.

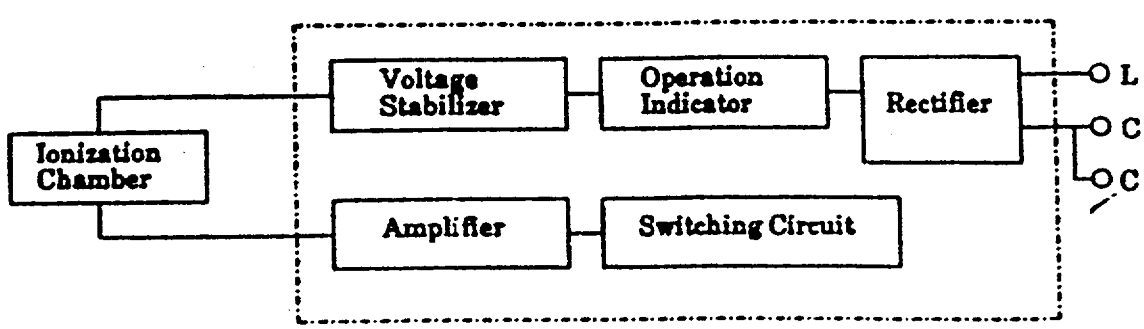
The outer cover, the body, and the head, which house all internal parts and components are made of a modified polycarbonate plastic manufactured by Teijin Chemical Co., Ltd. The brand name of this plastic is "Mulltilon". It is UL-Listed as flammable class form 94 V-0.

The Socket is also made of "Multilon".

1-2 Structural Details

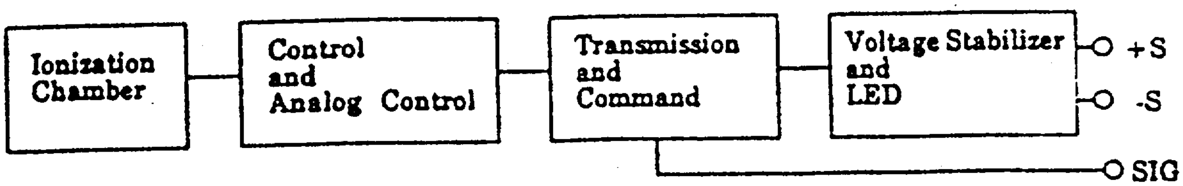
The schematic diagram of each model is shown below.

(a) Model NID-58



Signal Disposition Circuit

(b) Models NID-68-AS, and NID-68-AS-1



Signal Disposition Circuit

1-2-1 Ionization Chamber

As shown in the assembly drawings of Fig. 1 of Section V, in each of model, three stainless steel electrodes (the outer chamber, the gate plate and the anode plate) which form two ionization chambers (one is the reference chamber and the other is the measuring chamber). The air inside of the chambers is ionized by one piece of the radioactive source (Am241/0.7μCi) which is mounted on the anode plate by the RI-holder. The gate plate and the anode plate are supported by separate supporters made of a high insulation polycarbonate resin which are fixed on the shield case. The outer chamber is directly fixed to the shield case.

Products of combustion entering into these chambers reduces the ionization current and changes the voltage across the measuring chamber, changes the impedance balance between both chambers. This voltage change, correlated to the density of the combustion products, is to be sent to the signal disposition circuit as a smoke signal.

Several opening are provided on the outer chamber for the smoke to enter and the outer cover has many slits which serve as a mechanical buffer to eliminate influence of wind. Furthermore, the stainless steel mesh provided between the outer cover and the outer chamber protects both from insects and dust entering into the chamber which may cause a faulty operation of the detector. This mesh also works as a protector against static electricity and electric noise generated by external devices.

1-2-2 Signal Disposition Circuit

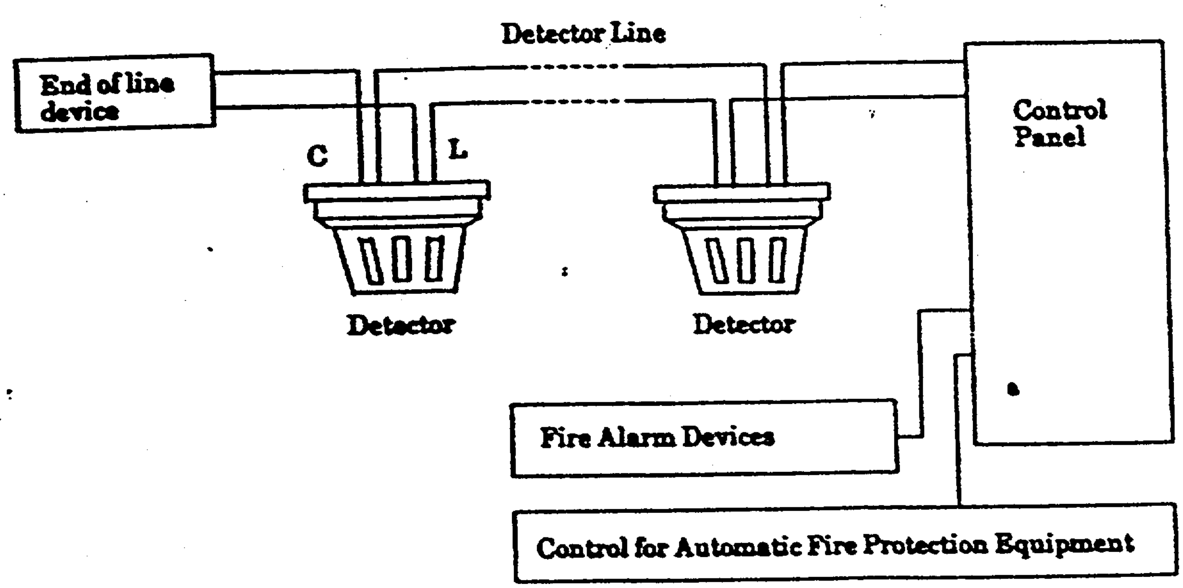
The smoke signal from the ionization chambers is amplified in the amplifier, and when the density of the combustion products reaches a predetermined level, the switching circuit is triggered and the operation indicator is lit.

Since the smoke signal voltage in the ionization chamber varies with the voltage supplied to the chamber, and the voltage supplied to the amplifier is limited in normal operation. The voltage stabilizer controls the voltages of to the chamber and to the amplifier. The rectifier produces non-polarity of the external terminals L and C.

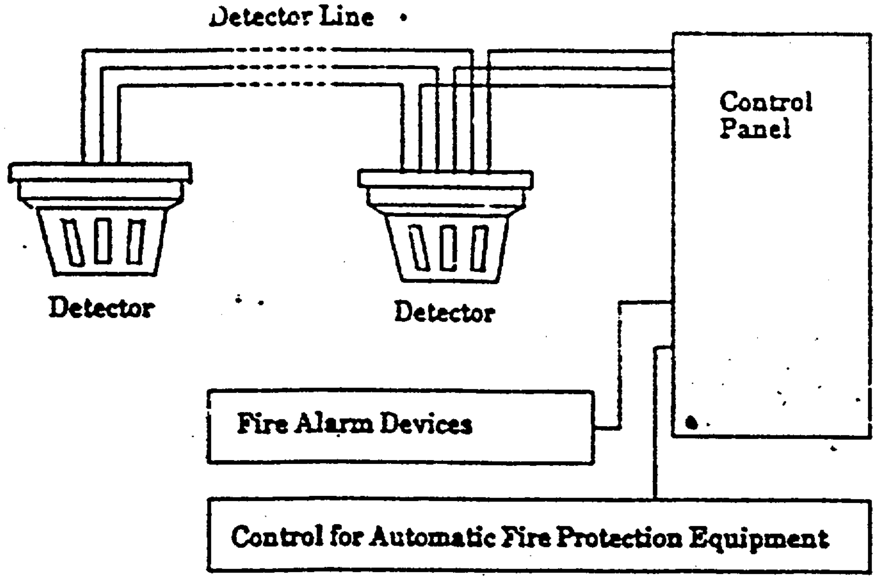
2.0 Intended Use

Each detector is used as a part of fire alarm system which normally consists of a control panel, alarm indicating devices (audio and visual alarm indicators) and remote control devices. Two examples are shown below.

Typical Application of Model NID-58



Typical Application of Models NID-68AS and NID-68AS-1



The control panel supplies the power to the detectors. The lines are also used as signal lines. Removal of any the detector head and the interruption of lines are supervised by the end-of-line device.

2-1 Condition of Use

2-1-1 Under normal condition

When the necessary electric power for normal operation of the detector is supplied form the control panel and no combustion products are present in the ionization chambers, only a very small quiescent current of the detector and line supervising current are fed to the end-of-line device through the detector lines. Under these conditions the control panel indicates "Normal Condition".

2-2 Conditions When Fire is Present

When the products of combustion enter the ionization chambers of the detector, the signal voltage (smoke signal) corresponding to the density of this smoke is sent to the gate section. When this voltage exceeds the fixed barrier value in the amplifying circuit, the amplified signal is transferred to the switching circuit which switch to ON condition. At this time, the detector current increases by approximately 1000 times more than that of normal conditions triggers the signal detection circuit in the control panel so that a fire condition is indicated both audibly and visibly, while the operation indicator in the detector is lit. Furthermore, the control for automatic fire protection equipment is activated by the signal from the control panel if so connected.

2-3 Tampering and Removal of the Detector

For all models of detectors, the following protection is provided to prevent the detector from theft of the installed detector or system trouble due to tampering.

In the case of intentional removable of the detector head results in a line interruption condition and the control panel gives an audible line trouble warning signal. On the other hand, in the case of attempted destruction of the detector mounted on the socket, that is to say, removal the outer cover and outer chamber, no ionization current in the measuring chamber and, thus, resulting in the same condition as fire, in this case, the control panel sounds an alarm. With these protection features, it is less likely that theft or tampering of the detector to will be encountered.

3.0 Radioactive Source Assembly

The radioactive source employed in each model is exactly the same. It is a sliver foil covered with a gold-palladium alloy and held between the anode plate and the RI-holder which are made of stainless steel and are fixed together by spot welding.

The anode plate supported by the anode supporter is covered with the outer chamber. All of these parts are covered with the outer cover. The anode supporter, the gate supporter and the outer chamber are fixed on the shield case. The outer cover and shield cased are fixed on the body. The gate plate, the outer chamber and the shield case are made of stainless steel, while the outer cover and the base are made of UL-Listed polycarbonate, "Mulltilon" classified as a self-extinguishing group 0. Moreover the anode supporter and the gate supporter are made of the UL-Listed Polycarbonate classified as a self-extinguishing group 0. As explained above the radioactive source is covered with threefold covers made of strong material which withstand against strong mechanical stress and high temperature and so located in the inner-most part of the detector, thus, providing extremely high safety features.

SECTION II

1.0 General

1-1 All models of detector are equipped with one piece of Americium-241 sealed foil radioactive source.

This radioactive foil is manufactured by R.C.C. in England, and is sent to Japan Isotope Association where the foil is cut into the appropriate sizes needed for use in the detectors in question prior to shipment to Nittan Company, Ltd,. Each piece of foil is washed clean with water and is subject to a wipe test to assure its leakage does not exceed the standard level (0.005μ Ci). The dose is measured. The manufacturing process is shown in the attached Technical Date #1.

Manufacturing Process

The radionucleoide, amrecium oxide, is uniformly distributed and sintered in a matrix of pure fine gold at temperatures in excess of 800 deg. C. It is further contained between a backing of pure fine silver and front covering of gold palladium alloy (94% gold and 6% palladium) by hot forging. The metal layers now continuously welded together are extended by mean of a power rolling mill to give the required active and overall foil areas.

1-1-1 Type and Quantity of By-product Material

By-product Material	:	Am-241
Activity	:	Typical 0.7μCi, Max. 0.91uCi
Base Material	:	Silver
Active Layer	:	AmO + Fine Gold
Face Covering	:	Gold Palladium Alloy
Total Thickness	:	0.15mm - 0.20mm
Code Number	:	AMMQ-423

1-1-2 Chemical and Physical Form

The radioactive source Am241-used in each of the model is an oxide (AmO2), is insloluable in water and stable to chemicals. This radioactive source is a sealed source sandwiched between two layers of pure fine silver and gold palladium alloy. This sealing method is considered to be the most effective and safest means of capsule-enclosing for obtaining a-particles, and neither physical nor chemical change ever occur during its time of use.

1-1-3 Solubility in Water and Body Fluids

a. Solubility in Water

Three pieces of 312.5µCi Am-241 foils having the same structures as the actual radioactive foil used in the detectors in question show activity leaching-out activity of max. 0.00045% (14.0 x 10^{-4} µCi) after five hours immersion in water at room temperature with 760mm Hg atmospheric pressure amounts to max. 0.00031% (9.6 x 10^{-4} µCi). Since the used dosage in each of detector is max. 0.91µCi, its leaching-out amount will be max. 4.1 PCi. This amount can be negligible. (See the attached Technical Data #1, Immersion test (b) and (c)).

b. Solubility in Body Fluids

The radioactive foil Am-241 1.1 µCi with the same structure as the foil used in each detector were immersed in N/10 hydrochloric solution for 4 hours at 98 deg F. In all tests less than 0.37%(4 x 10^{-3} µCi) of Am-241 was extracted. N/10 hydrocholic acid solution was selected for this test to closely simulate acid body fluids. (Test by Japan Isotope Association).

2.0 External Radiation Level

2-1 The external radiation level was measured with gamma ray at distance of 5cm and 25cm from the surface one detector, Model NID-58. The external gama radiation level was found to be extremely low and almost identical quantities in the back-ground.

Taking the ratio of dosage into account, the amount of external gama radiation of one detector was calculated as follows:

In the case of 5cm distance from the detector surface: 0.701 µrem/hr.

For distance of 25cm from the detector surface: 0.0025 µrem/hr.

2-2 The alpha particles of the foil are absorbed by the gold palladium of the front cover of the foil as well as by air, therefore, the distance the particles reach is about 5cm in the atmospheric air. Accordingly, no alpha particles can be detected at the distance of 5cm or 25cm from the surface of the detector.

3.0 Degree of Access of the Product to Human Being to the Product During Use

3-1 Possible access of human being to the radioactive foil of the detector is restricted only to cases when the detector is mechanically destroyed and radioactive foil is exposed. It is not likely for this to happen to ordinary people because the detector is handled and maintained for industrial and commercial buildings exclusively by professional experts.

As such, there exists no chance to come in contact with the foil directly. Although a person may intentionally have an access to the detector if he wishes, direct access to the detector, as described in the preceding paragraph, cannot be made because of its structural features. These feature are as follows:

a. The main portion of the outer surface of the detector is made of modified Polycarbonate plastic of high impact proof strength.

b. The radioactive foil is covered with three-fold covers:

1. Outer cover made of modified polycarbonate plastic, which can not be removed without special tools.
2. Outer chamber made of stainless steel
3. Gate plate made of stainless steel

3-2 As a rule, the detector is installed an 8 feet high ceiling of the room, which exclude people from reaching it.

3-3 The installation of the detector is made by a well-trained professional installer. First, the detector socket (containing no radioactive material foil) is installed. The wiring from the control panel are connected to the socket. The detector head is plugged into the detector socket during the final stage of installation. Therefore, the time required to install the detector is very short, and there exists no chance for ordinary people to be effected,especially, since the installation is to be done only by a professional installer. Furthermore, any detector found to defective during testing or maintenance or any other time is to be returned to Nittan without disassembling by installer or maintenance personnel.

4.0 Quantities

4-1 Annual quantity of the by-product material to be distributed:

4-1-1 Annual Sales Quantities: 20,000 pcs.

4-1-2 Radiation Activity Per One Detector: 0.9 μCi

4-1-3 Total annual amount of radioactive material: 18.20 mCi.

4-2 Number of units expected to be stocked at the warehouse.

4-2-1 At Nittan Corporation --------- 1,000 pcs.

4-2-2 At an installation site --------- 50 pcs. average.

4-3 Marketing and Sales Method

Marketing and sales of these detectors are to be done only through one or two authorized companies. Nittan Corporation provides a necessary technical assistance and supervision with respect to installation and maintenance.

Therefore, handling of the detector is to be done only by those person who are well trained and are capable of professional installation, thus, any access by ordinary people to the detector during its normal handling and distribution is completely excluded.

5.0 Expected Useful Life of Product

The expected useful life of the detector is about 15 years. The half life of the Am-241 employed in the smoke detector section is 458 years, therefore, any sensitivity change of the foil is expected during this 15 year's of use.

However, it is appropriate to state that the useful life of the detector is 15 years when taking into consideration the probable dust accumulation on the smoke entering slits which may affect the performance of the detector.

SECTION III

1.0 Prototype test method

1-1 The surface of the DETECTOR is wiped by a filter paper and the alpha-ray quantity, which sticks to the paper filter, is measured by a gas flow counter.

1-2 Endurance test of the DETECTOR

1-2-1 In order to ascertain its safety when exposed to high temperatures, the DETECTOR is put in the thermostatic chamber at 50 deg C with normal moisture for 30 days.

1-2-2 SO2 gas is selected as an intensive corrosive gas in the air, and in order to ascertain the Detectors safety and corrosive resistance, the DETECTOR is subjected to the gas corrosion test under the atmospheric condition of 45 deg C, and about 100% relative humidity. The corrosive gas is produced in the following way: 500ml of thiosulfuric acid soda having density 40g/l is put into a 5-liter decicator and then 10ml of 0.156N sulfuric acid is poured into it twice a day so that SO2 gas is produced. The DETECTOR is exposed to this SO2 gas for 4 days.

1-2-3 In order to ascertain safety against impact, an impact force of 50g is imposed on the installed DETECTOR continuously 5 times.

1-2-4 In order to ascertain safety against vibration, a vibration of 1,000 cycles/mim. with a total amplitude of 4mm is applied for one hour.

Before and after each test above (1-2-1 through 1-2-4) wipe test such as outlined in 1-1 is conducted.

1-3-1 Various kinds of test were conducted on each foil, having the same shape and construction (each activity is 312.5uCi), at R.C.C. in England. The test results are reported in the attached technical data #1, which comprises the following items.

1. Wipe test
2. Heat test at (a) 760 deg C and (b) 815 deg C
3. Immersion test
   - (a) Wipe test
   - (b) Water leaching as measured through the immersion test in water at room temperature for 5 hours long.
   - (c) Water leaching test in boiling water for one hour.
   - (d)+(e) Measurement of leaching out in case of methyl- ketone, acetone, trichloroethane and etc.
4.
   - (a) Impact test
   - (b) Drop test

1-3-2 In order to ascertain the validity of safety features under worst conditions of 160μCi foil with same shape and construction various tests were conducted at R.C.C. as shown in the attached Technical Data #2, comprised the following:

Corrosion testing

Samples of foils were exposed to various corrosive gases, to which the DETECTOR will probably be exposed to it when installed in building such as factories.

1. SO2 test
2. HCl test
3. Ammonia test

Heating tests in consideration of fire

1. Heat test at 800 deg C for 10 min.
2. Heat test at 1200 deg C for 1 hour.

2.0 Prototype test results

2-1 The wipe test result of the DETECTOR surface showed the same figure as that of background.

2-2 The wipe test result of the DETECTOR before and after the endurance test showed the same figure as that of background.

2-3-1 1) The wipe test result showed 1.42×10^{-4} μCi maximum, which correspond to 0.000045% and can be considered as 0%.
2) The heat test resulted in almost same amount of leaching amount as in 2-3-1.
3) The immersion test results showed a maximum leaching of 0.00045%. For solvents such as acetone, the leaching amount was found to be about 0.001%.
4) The impact as well as drop tests showed only 0.000029% leaching, which can be considered as zero.

2-3-2 The heat tests, which were set up for worst condition in the case of fire, showed leakage of 0.1%. Applying this figure to 0.7μCi foil, we get 7×10^{-4} μCi.

3.0 Quality Control Procedure

3-1 Tests of Am-241 foils.

3-1-1 The production control tests of the foil conducted at the manufacturer R.C.C.

(a) Visual inspection.

All production is inspected visually for surface damage of the active area. Careful inspection with a low power microscope is carried out on samples from each production run.

(b) An autoradiography examination is carried out on all production foils by placing them in contact with single weight bromide paper for a predetermined time before exposed film is developed and fixed. Distribution of activity and dimensions are carefully examined.

(c) Dust sampling using a continuous airflow sample is performed in the vicinity of the manufacturing equipment during all production. Foil storage areas are similarly monitored.

(d) Five samples of 2.5cm length are taken from each 50cm production batch and subjected to the tests described in the attached Technical Data #1, namely (1) Wipe test, (2) Heat and thermal shock test and (3) Immersion test to ensure uniform integrity of product.

3-1-2 Next, the source foils are cut by the Japan Isotope Association to the appropriate activity for use with the detectors and are cleaned with water. Then, after making it sure that the leaching amount does not exceed the limit of 0.005uCi by wipe test, the activity is measured.

3-1-3 Only the those foils, which have passed the above-mentioned tests at R.C.C. and the Japan Isotope Association, and whose sealing has moreover been proved sufficient, are supplied to Nittan Company, Ltd.

3-2 Nittan Company, Limited conducts the following tests to the Am-241 foils, which are already clamped on the anode plate of the DETECTOR by the RI-holder.

3-2-1 All of the AM-241 foils are examined visually to ascertain whether there exists any defect o~ stain on their surface. (100% inspection)

3-2-2 The wipe test is conducted by wiping Am-241 foil with filter paper and examing for any leaching. The standard allowable amount found through the wipe test is set up for maximum 0.005 μCi.

This wipe test is conducted based on the statistical sampling plan as per the item 3-2-3. The measuring apparatus is a 2r proportional counter consisting of a scaler (Model TDC5: Japan Radio Corp.) and a radioactive ray detector (Model FC-IE. Japan Radio Corp.).

3-2-3

Lot Size	Sample Size	Number of defective pieces allowed in sample
500 - 624	7	0
625 - 799	8	0
800 - 999	10	0
1000 - 1249	11	0
1250 - 1574	13	0
1575 - 1999	15	0
2000 - 2499	17	0
2500 - 3000	20	0

Nittan receives, are lots of 500 - 3,000 at a time, for which the severe test standard of JIS Z9015, namely AQL=0.4, is applied. From each lot, according to 3-2-3 list, the required number of samples are extracted randomly and these samples are tested in compliance with the standard.

If no samples are rejected among those samples tasted, products belonging to the same lot number are accepted.

If even one piece in the tested samples is found as defective, all products with the same lot number are not to be accepted, and every piece of foil in the same lot is to be individually tested on the same standard.

The foils which are accepted are used in DETECTORs, while the defective ones are not used and are disposed of in the proper way. This test method can eliminate the probability that a defective foil would be used in the DETECTOR.

3-3 The Americium-241 foil is cramped on the anode plate by the RI-holder which is fixed to the anode plate by spot-welding. (Please refer to the Fig. 2 of SECTION V). Since the strength of the spot-welding is greater than the pull force of the RI-holder, the foil, RI-holder and the anode plate are considered to be one rigid body.

The anode plate has the dimension of 12mm diameter, 1.5mm of thickness and its screw part is 4mm diameter and 5.7mm length. This anode plate is firmly screwed to the center pole by special tool and is tied together with the shield case through the anode supporter. Even if the anode plate should be removed from the center pole, it will not come out from the opening of intermediate electrode (gate plate), but remains inside of the reference chamber (inner ionization chamber).

3-4 All finished products are subjected to a 100% of visual inspection to ascertain the proper clamping of the foil to the anode plate. Even if this total check fails to find a defect, the next inspection covers every detector, as described under item 3-5 (inspection of the finished detector) will back it up.

For an example, if the foil were to be removed from the anode plate (this does not happen in actuality), this defect could be easily found through DETECTOR operation tests, because without the foil the DETECTOR will not operate (in the smoke operation test of 3-5-2 and electrical sensitivity test of 3-5-3). Before shipment every DETECTOR is individually inspected in steps of three 3 stages:

* Visual inspection of source foil
* Inspection through operation in the smoke test
* Inspection of electrical sensitivity operation

Thus, any defect, such as loosening of the source foils, is completely eliminated.

3-5 The final inspection is done to every DETECTOR.

3-5-1 Visual test:

To check if the DETECTOR is assembled in the proper way.

3-5-2 Smoke operation test:

To determine whether the DETECTOR responds properly to the smoke concentration of a predetermined density.

3-5-3 Electrical sensitivity test:

To ascertain the test of 3-5-2 electrically.

3-5-4 Temperature and Humidity cycle test:

To ascertain the stability of the DETECTOR.

Through this final inspection, it is confirmed that the assembly as per SECTION II has been executed properly and only the DETECTORs which have passed this final inspection are to be shipped as final products.

SECTION IV ESTIMATION OF RADIATION DOSE AND DOSE COMMITMENT

1.0 Explanation and reason of the does commitment compliance to 32:27a of the NRC regulations.

1-1 Normal Use

The gama radiation dose of the detector is less than 0.025µrem/hr at the 25cm distance from the surface of the detector as shown in SECTION III. For effective detection of any fire breakout, one unit of detector is usually installed on a ceiling surface, each unit covering 100 square meters. Since the height of a ceiling is generally considered to be 8 feet (2.4m), it is impossible for an ordinary person occupying the room to reach the detector under ordinary daily circumstance.

Assuming that the occupant carry out his daily life for a period of one year at 25cm from the surface of the detector, he would likely receive an external radiation dose of only 2.2 (mrem/year) according to the following calculation:

$$0.025(\mu rem/hr) \times 24(hr/day) \times 365(day/year) = 0.22(mrem/year)$$

Furthermore, assuming that the occupant living directly under the detector and the distance between the detector and the occupant is to be 1 meter, then he would likely to receive an external radiation dose of 1.57×10^{-3} (urem/hr) according to the following calculation:

$$0.025(\mu rem/hr) \times \left(\frac{25cm}{100cm}\right)^2 = 1.57 \times 10^{-3} \ (\mu rem)$$

Assuming he would remain in this position for a period of 50 weeks, 8 hrs/day and 5 days/week, then he would likely receive an external radiation dose of only 3.14urem/year which is calculated as follows:

$$1.57 \times 10^{-3}(\mu rem/hr) \times 8(hrs/day) \times 5(days/wk) \times 50 = 3.14(\mu rem/yr)$$

From the above, under normal condition of use, it is impossible for anyone to receive an external dose of 5 mrem/year. Accordingly, the dose commitment of the detector satisfies to column I of §32-28.

1-2 Normal Disposal

The maintenance of the detectors is carried out by well trained professional installers who are strictly instructed to return any defective detectors to Nittan Corp., and this is also indicated on the labels of the detector. Nittan Corp. conducts necessary periodical training professional installers who are to be engaged in installation and maintenance in conjunction with authorized companies.

1-3 Normal Handling

It is reasonable to assume that the most of the normal handling of the detector is done during installation of the unit. The heads and the sockets are packaged separately. The most time consuming task during the installation is the mounting of the socket to the ceiling which requires two screws and wiring connection with control panel. After these tasks, the head can be mounted on the socket by simply twisting it clock-wise. The time required to install the detector head is considered to be less than one minute per detector.

Since the radioactive foil employed in the detector is located 30mm inward from the surface the detector, the external radiation dose at 25cm from the surface is found to be 2.18 μrem/hr according to the following calculation:

$$\left(\frac{28}{3}\right)^2 \times 0.025\ \mu rem/hr = 2.18\ \mu rem/hr$$

Assuming that a maximum of 20 detectors are to be installed at a construction site, the time required to install these detectors will be 4 days and the number of installation jobs be 50 a year, then the external radiation dose is found to be 36.4urem/year according to the following calculation:

$$\frac{2.18\ \mu rem/hr}{60\ min/hr} \times 1\ (min/pc) \times 20\ (pcs/job\ site) \times 50\ (jobs/year) = 36.4\ \mu rem/year$$

This satisfies the value stipulated in the column I of §32-28.

1-4 Estimate of External Radiation Dose During Maintenance

To ensure a proper operation of a fire alarm system, routine periodical maintenance is required by professionally trained maintenance personnel. Principally the following are required:

a. Routine Check
b. Operation test
c. Functional test

a) The routine check shall be a visual inspection of the outer appearance of the detector installed on a ceiling. The primary purpose of this inspection is to find any apparent damage and dust accumulation which may affect smoke entrance into the detector. The external dose to the maintenance personal is found to be 0.78urem/yr as calculated below.

We have assumed that the time required to complete a routine check to be 5 minutes, the distance from the detector during this check to be 1 meter directly under the detectors and the number of the detector to be inspected by this person to be 6,000 pcs per year.

$$\left(\frac{25}{100}\right)^2 \times 0.025\ (\mu rem/hr) \times \frac{5}{60}\ (hr)$$

$$\times\ 6000\ (pcs/yr) = 0.78\ \mu rem/year$$

b) The operational test shall be made at least every three months. In this test, each detector shall be tested with actual smoke using the Nittan Smoke Tester which consists of smoke generator and an extension rod to reach the detector installed on ceiling. During this test, each detector must confirm its operation within 1 minute of introduction of smoke to the detector.

The external radiation which maintenance personnel would likely receive during this test is found to be 0.117µrem/yr with the following assumption and calculation. It is assumed that the time required to complete one operational test to be one and one-half minutes, the person engaged in testing is directly 1 meter below the detector and the number of detectors to be tested by this person in one year is 3,000 pcs.

$$\left(\frac{25}{100}\right)^2 \times 0.025\ (\mu rem/hr) \times \frac{1.5}{60}\ (hr)$$

$$\times\ 3000\ (pcs/yr) = 0.117\ \mu rem/year$$

c) The functional test shall be made at least every 6 months. The purpose of this test is to measure the sensitivity of the detector using The Nittan Delta V Tester. The tester is a monitoring device and has the capability of electrically sending gradual smoke buildup similar to that of an actual fire breakout electrically to smoke detector. The sensitivity of detector can be measured by simply plugging the detector into the socket on the tester and, pressing the test button. It only takes one minute.

During the functional test, it should be confirmed that the measurement taken during this test be within the ranges indicated on the label. If the measurement is not within the specified ranges on the label, the unit should be returned to Nittan Corporation without disassembly.

The external radiation dose which the maintenace person would likely to receive during this functional test is found to be 182 µrem/yr according to the following assumption and calculation.

It is assumed that the handling time required to complete one functional test be 5 minutes, the external radiation dose on the surface of the detector be 2.18 urem/hr from 1.3 of SECTION V and the number of the detectors to be handled in year by this person be 1,000 in total.

2.18 (μrem/hr) x 5 (hr/pc) x 1,000 (pcs/yr) = 182 μrem/yr

From the above, it is concluded that the total external radiation dose which the person would likely receive as a result of performing jobs of a), b), and c) amounts to 183μrem/yr. Therefore, the person for maintenance never receives 5 mrem/yr of the external radiation dose. This satisfies the value in the column I of §32:28.

1-5 Warehouse Storage

The external radiation dose from the detector presumably accumulated at one location during distribution is found to be less than 5mrem per year even under the extremely worst assumed condition according to the following calculation, the value of which satisfies that of table 1 of 32-28.

Five detectors are packed into a cardboard box. The dimension of this this box is 100mm x 130mm x 565mm. Ten of cardboard boxes packed into a large shipping box having dimensions of 280mm x 520mm x 580mm.

The external radiation dose on the surfaces of the cardbord box containing 50 detectors was measured using Low Energy Gamma Ray Survey Meter (Model ICS-501, Arrow Co., Ltd.). The measurements showed that only the bottom surface of the box registered 1 urem/hr activity.

Based on this measurement, we calculated the activities of 1,000 pcs, which is most like to be accumulated at the warehouse of Nittan Corp. at any one time. 20 boxes each containing 50 units are to stacked up as 2 boxes in direction of width, 5 boxes in direction of length, and 2 boxes in direction of height. For a calculation of the maximum external radiation dose for this storage arrangement, we assumed that the external radiation dose will be concentrated at the center of the bottom suface of the pile. The maximum external radiation does is found to be 1.8 μrem/hr according to the following calcuation:

$$\frac{5^2}{52^2} \times 1\ \mu rem/hr \times (1000/5) = 1.8\ \mu rem/hr$$

The maximum external radiation dose for a person, who is engaged in working in this warehouse 8 hours a day, 5 days a week, and 50 weeks a year, is found to be 3.12 mrem/yr according to the following calculation.

1.8 (μrem/hr) x 50 (weeks/yr) x 5 (days/week)
x 8 (hours/day) = 3.6 mrem/yr

This value satisfies Column I of §32:28.

Since it is not likely that the person is to remain on the surface of the shipping boxes at all time during his working hours, the actual external radiation dose the person likely receives is less than 3.0 mrem/year.

2.0 Internal Radiation Dose Commitment Under Normal Condition

Internal radiation dose commitment is cause either by taking the radioactive foil through mouth or inhaling it.

2-1 Orally

Taking the foil into human body orally may happen only when the outer chamber is taken off, the gate plate is removed and moreover 2 spot-welding parts of RI-holder are destroyed. Only after this may the foil be removed and brought to the mouth. Such a series of phenomena never takes place.

2-2 Inhalation

The internal radiation dose commitment through inhalation can be considered in case of the fire, and during the handling process of detectors or under installed conditions it is absolutely impossible.

3.0 External Radiation Dose Commitment Under Severe Condition

3-1 Direct External Radiation Dose from Foil

As described in 2-1, this never happens in actuallity. However, assuming the foil would be removed by an accident and people would approach it, then the external dose integrated in 50 years is found to be 13.3 mrem/50 years which is very small and are safe in comparison with that of the value specified in Column II of §32:28 as indicated in the calculation below.

We make an assumption that a person be exposed continuously for 50 years at distance of 28cm from the foil. Since the foil is located about 30mm inward from the surface of the detector, the external radiation dose at the 28cm distance from the foil can be calculated below by taking into consideration the doseage in the case of 25cm distance from the detector surface.

$$\left(\frac{28}{25}\right)^2 \times 0.025 \text{ (urem/hr)} = 0.314 \text{ urem/hr}$$

Accordingly, the external dose of 50 years will be:

$$0.314 \text{ (urem/hr)} \times 24 \text{ (hr/day)} \times 365 \text{ (days/year)} \times$$

$$\int_0^{50} e^{-\frac{0.693}{433}t}\, dt = 13.3 \text{ mrem/50 years}$$

4.0 Internal Dose Commitment Under Severe Condition

4-1 Internal Dose Commitment by Inhalation in Case of Fire

4-1-1 Warehouse Fire

The worst case of the dose commitment, we will consider would be if a fire break out a warehouse where 1,000 units of the detectors were stocked. According to the attached technical data #2, 0.1% of the leakage of radioactive foil was detected in the heating test assuming fire conditions. This total quantity can be assumed to be particle which may be possibly inhaled.

To calculate internal dose commitment of a person who remains in a fire condition for 5 minutes, it is assumed that the air volume of a standard whorehouse is 200,000 ft^3 (5.6×10^9 cc) with no air exchange taking place. We calculated the internal dose amount which an occupant would receive in 5 minutes at time of fire as follow.

According to the recommendation of ICRP " Report of Committee II on Allowable Dose Amount of Radioactive Radiation in Human Body(1959), the most critical organ for inhalation of insoluble radioactive dust particles can be considered to the be lung and the rate fa, at which the inhaled particles reach the critical organ, is $0.12.10^7$ cc/8hrs according to the same ICRP report. Therefore, in 5 minutes the person would inhale 1.05×10^5 cc of air as calculated below:

$$\frac{10^7 \text{ cc}}{8 \text{ hr}} \times \frac{5}{60} \text{ hr} = 1.05 \times 10^5$$

In case of storing 1,000 units of detectors each with radioactive material of 0.7μCi on an average, the following calculation is made:

$$\text{Dose} = \frac{(0.7 \times 1000)\ \mu\text{Ci} \times (1 \times 10^{-3})}{(5.6 \times 10^{3})\ \text{cc}} \times (1.05 \times 10^{5})\ \text{cc}$$

$$\times\ 0.12 \times \frac{2.2 \times 10^{6}\ \text{dis}}{\text{min} - \mu\text{Ci}} \cdot \frac{5.7\ \text{MeV}}{\text{dis}}$$

$$\times \frac{(1.6 \times 10^{-6})\ \text{ergs}}{1000\ \text{g}}\ \text{MeV} \quad \frac{\text{g.Rad}}{10^{2}\ \text{ergs}} \cdot \frac{10\ \text{rem}}{\text{Rad}}$$

(Weight of Lung)

$$\times \frac{(5.26 \times 10^{5})\ \text{min}}{\text{years}} \times \int_{0}^{50} e^{-\frac{0.693}{150}t}\ dt$$

$$= 0.08\ \text{rem/50 years}$$

The situation just described above nerve actually takes place : however, even in such a case, the dose commitment satisfies the value specified in Column II of §32:28.

4-1-2 Building fire in which the detector are installed.

Assuming that the ceiling height of a standard size building be 8 ft. (2.4m), one unit covers 100m^2 of floor area, considering that there is no air exchange and a person remain in the fire for 5 minutes, then the dose commitment integrated 50 years would be 2.5 rem/50 years as shown in the calculation below:

$$\text{Dose} = \frac{(0.91\mu\text{Ci}) \quad (1 \times 10^{-3})}{(100 \times 10^{4} \times 2.4 \times 10^{2})\text{cc}} (1.05 \times 10^{5})\text{cc}$$

$$\times\ 0.12 \times \frac{2.2 \times 10^{6}\ \text{dis}}{\text{min} - \mu\text{Ci}} \cdot \frac{(5.7)\text{MeV}}{\text{dis}} \cdot \frac{1}{(1000)\text{g}}$$

$$\times \frac{(1.6 \times 10^{-6})\ \text{ergs}}{\text{MeV}} \cdot \frac{\text{g.Rad}}{10^{2}\ \text{ergs}} \cdot \frac{10\ \text{rem}}{\text{Rad}}$$

$$\times \frac{(5.26 \times 10^{5})\ \text{min}}{\text{years}} \times \int_{0}^{50} e^{-\frac{0.693}{150}t}\ dt$$

$$= 2.5\ \text{rem/50 years}$$

Therefore, the value satisfies the that of value of Column II of §32:28.

4-2 Internal dose commitment due to taking foil into human body in aworst case of scenario worst accident.

As already mentioned, the installation of the detectors is carried out by only well-trained professional installers. Therefore, the detectors can not be easily destroyed or disassembled so that radioactive foil could be swalled.

Under normal conditions of use, one may attempt to gain direct access to the radioactive foil by removing the detector head from the socket with intention of destroying or tampering with it. However, the detectors are monitored by a control panel so that any removal of the detector head send a trouble signal to the control panel. In this case, the control panel will send out a trouble signal by means of audible or visual alarms throughout the building.

This enables a supervisor of the building to prevent any theft or tempering of the detectors. It is a preventive measure. Furthermore, in case of removal of the outer chamber located inside of the outer cover, the detector must be remove from the socket which result in a reaction similar to that stated above.

As such, it is almost impossible for anyone to swallow the foil of the detectors that have such preventive measures.

Nevertheless, we assumed that some one swalled the foil and calculated the resulting dose commitment exposed in 50 years to be 11 mrem/50 yrs which is negligible low in comparison with the value specified in the Column II of §32:28.

The maximum activity of the radiation foil in the detector is 0.91 µCi/pc. The foil swalled trough mouth leaks into the gastric juice in the stomach. This leak can be considered as leak amount to N/10 HCL liquid according to SECTION III, and it is 0.37%. We assume all of the leaked radioactive material would be dissolved into body fluids. According to the above-mentioned ICRP report, the rate of transferring from intestine to blood is 10^{-4}.

Furthermore, according to the said ICRP data the rate f2 between the deposit amount in bones and the amount deposited in the whole body is 0.9.

Under these conditions, the internal dose commitment for bones for 50 years is calculated as below.

$$\text{Dose} = (0.91)\mu\text{Ci} \times 0.37 \times 10^{-2} \times 10^{-4} \times 0.9$$

$$\times \frac{(2.2 \times 10^{6})\text{dis}}{\text{min} \quad \mu\text{Ci}} \times \frac{28.3\text{MeV}}{\text{dis}} \times \frac{1}{7000\text{g}}$$

(Weight of Bone)

$$\times \frac{(1.6 \times 10^{-6})\text{erg}}{\text{MeV}} \times \frac{\text{g.Rad}}{10 \text{ ergs}} \cdot \frac{10\text{rem}}{\text{Rad}}$$

$$\times \frac{(1.6 \times 10^{-6}) \text{ ergs}}{\text{MeV}} \times \frac{\text{g.Rad}}{10^{2} \text{ ergs}} \cdot \frac{10 \text{ rem}}{\text{Rad}}$$

$$\times \frac{(5.26 \times 10^{5}) \text{ min}}{\text{years}} \times \int_{0}^{50} e^{-\frac{0.693}{458}t} \, dt$$

$$= 11.0 \text{ rem/50 years}$$

4-3 Those value calculated in 4-1 and 4-2 are figures on the assumption of such accidents which never happen in actuality.

Even under those severe conditions, the values do not exceed those values specified in Column II of §32:28. Namely the radioactive foil and its application method in the detector is completely safe and reliable.

SECTION V DRAWINGS AND TECHNICAL DATA

This section contains the followings:

Fig. 1	Construction of Assembled Detector
Fig. 2	RI Foil Assembly Drawing
Fig. 3A	Label Drawing: NID-58
Fig. 3B	Label Drawing: NID-68AS
Fig. 3C	Label Drawing: NID-68AS-1
Fig. 3D	Caution Label
Fig. 4	RI Foil Construction

Technical Data 1, 2 (RI Test Data)

OIB2 (P/N: PU90-2000-1 & PU90-41000-1)

TABLE OF CONTENTS

SECTION 1

1.0 Description

The Ionization Combustion Detector, Model 0IB2 detects product of combustion in an early stage of fire and sends a fire signal to the control panel which gives a fire alarm by operation alarm sounders and visible indicators.

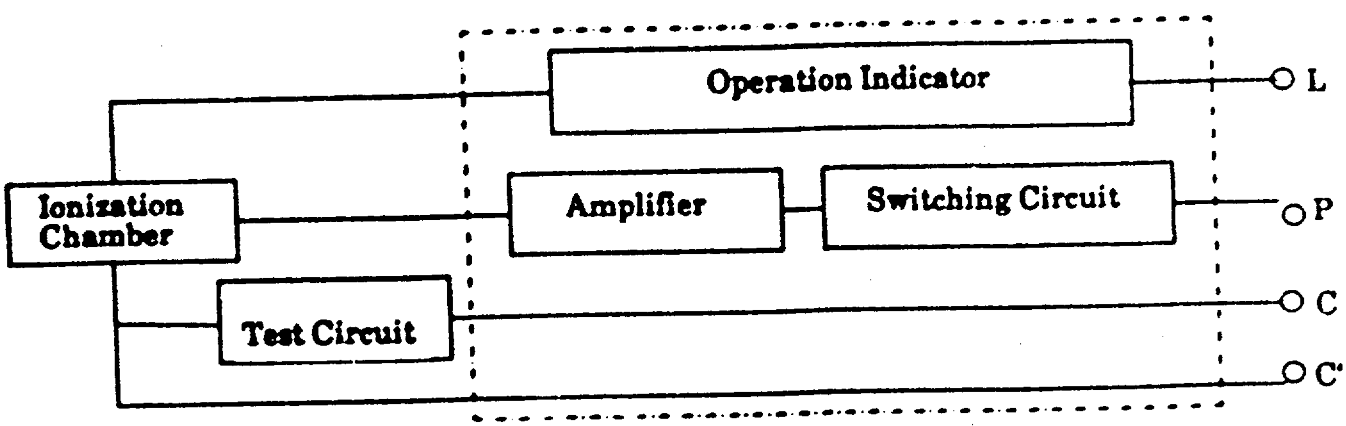
1.1 General Structure of the Detector

The detector consists of a detector head and a socket as a complete unit. The detector head consists of some major parts, namely an outer cover, ionization chamber parts including a radioactive source, a printed circuit board with all electric parts and a body. The Outer Cover and the Body which cover all internal parts are made of the polycarbonate plastic which is UL-listed as flame resistant grade, 94 v-o.

The socket made of polycarbonate plastic has external terminals to be connected to a control panel.

1.2 Structure Details

The schematic diagram of the detector is shown as below.



1-2-1 Ionization Chamber

As shown in the assembly drawing fig.1 of section II, three electrodes (the Outer Chamber, the Gate Plate and the Anode Plate) make a formation of two ionization chambers (the Reference Chamber and the Measuring Chamber), which are ionized in common by one piece of the radioactive source (Am-241, 0.7μCi) fixed on the Anode Plate.

which is fixed directly on the center of the Body. The Gate Plate is supported by the supporter made from high insulation resin "Polycarbonate" which is fixed on the Body. The Outer Chamber is directly fixed on the Shield plate by tapping screw. Combustion product entering these chambers reduces the ionization current and changes the voltage across the measuring chamber by the change of impedance balance between both chambers. This voltage change correlated to the density of the combusiton product sent to the Signal Desposition Circuit as a smoke signal. Several openings are provided in the Outer Chamber for the smoke entrance and the Outer Cover having many slits serves as a mechanical buffer to eliminate influence of wind. Furthermore the stainless steel mesh provided between the Outer Cover and the Outer Chamber protects insect and dust which may cause a fault operation of the detector. This mesh works also as a protector against a static electricity and electric noises generated by external devices.

1-2-2 Signal Disposition Circuit

The smoke signal from the ionization chambers is amplified in the Amplifier, and when the density of the combustion product reaches the predetermined level, the Switching Circuit is triggered and the Operation Indicator is lit. A fire signal is given through the terminal P. The Voltage between the external terminals L and C is kept to operational voltage range.

2.0 Intended Use

This detector is used in a fire alarm system by combination with a control panel or as one part of self combined alarm device which contains sounder and signal transmitter.

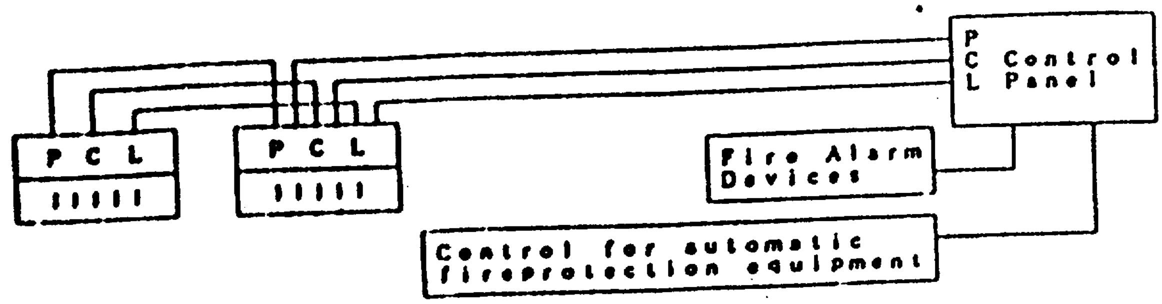


Fig A

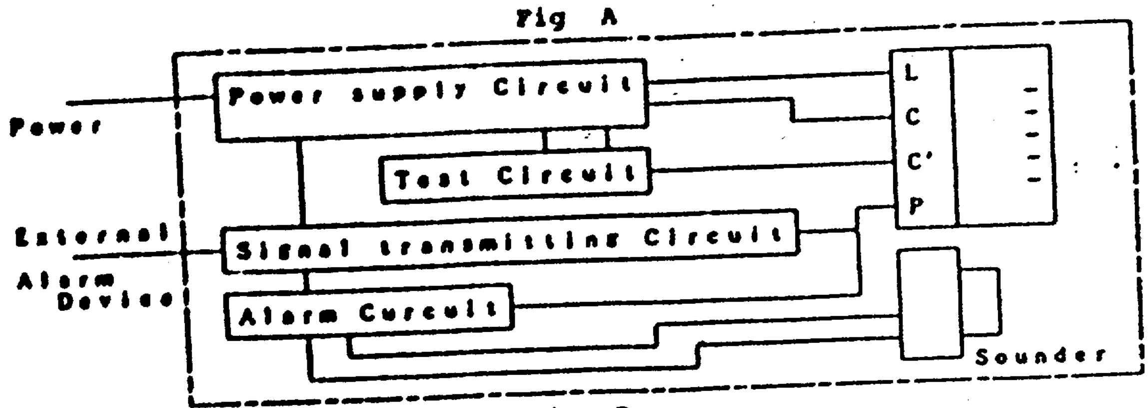


Fig B

Fig A shows fire alarm and control system using this detector. The power from the control panel is supplied to the detector through L and C lines, and the line P is used as a signal line by forming a closed circuit with the line C when the detector is operated. Fig B shows an example of the circuit diagram for self combined alarm device.

2-1 condition of Use

2-1-1 Under normal condition

When the necessary electric power for a normal operation of the detector is supplied from the control panel or the power supply circuit in Fig B and no combustion product exists in the ionization chambers, only very small quiescent current of the detector flows through the detector lines. Under this condition the control panel or the self combined alarm device indicates "Normal Condition".

2-1-2 Under fire condition

When combustion product enters into the ionization chambers of the detector, the signal voltage(smoke signal)corresponding to the density of the smoke is given to the amplifying circuit. When this voltage exceeds the threshold value, the amplified signal is transfered to the switching Circuit which turns to "ON" condition. The operation indicator in the detector is lit by the current through the terminal L and C and fire signal is given through a closed circuit between termnal P and C to the control panel or the alarm circuit in the self combined alarm device.

2-2 Protection against tampering and removal of the detector

This detector provides lock-up feature to prevent from any removal caused by vibration and etc. When this detctor is installed with surface mounting adaptor, a special tool is required for removing detector head from its socket.
In the case of attempting to destroy the detector mounted in its socket, that is to say, breaking the Outer Cover and the Outer Chamber, it causes no ionization current in the measuring chamber and results in the same condition as fire, when the control panel gives an alarm.

3.0 Radioactive Source Assembly

The radioactive source Am 241 employed in the detector is a silver based foil with a gold -palladium alloy cover and is held between the Anode plate and the RI-Holder, which made of stainless steel and are fixed together by means of curling.
The Anode Plate is covered with the Gate Plate supported on the Gate Supporter, which is furthermore covered with the Outer Chamber. All of these parts are covered with the Outer Cover. The Anode Plate is directly fixed to the Body. The Gate Supporter is fixed through the Shield Plate to the Body. The Outer Chamber, the Shield Case and the Outer Cover are fixed all together to the Body. The Gate Plate, the Outer Chamber and the shield plate are made of stainless steel, while the Outer Cover, the Gate supporter and the Body are made of UL-listed polycarbonate classified as a self-extinguishing group O. As explained above, the radioactive source is covered with threefold covers made of strong material against mechanical stress and high temperature and is located in the inner-most part of the detector, thus, an extremely high safety feature is provided.

SECTION II

1.0 General

1.1 The model 01B2 detector is equipped with one piece of Americium-241 foil as the radioactive source.

This radioactive foil is manufactured by the Radio-chemical Center(R.C.C.) in England, is sent to Japan Isotope Association where the foil is cut into an appropriate size for the use in the model 01B2 detector. Each cut foil is washed cleanly with water and is subjected to a wipe test to make sure its leakage does not exceed the standard level (0.005μ Ci). The dose is measured. The manufacturing process is shown in the attached technical data 1.

Manufacturing process

The radionuclide, as americium oxide, is contained uniformly distributed and sintered in the matrix of pure fine gold at temeratures in excess of 800°C. It is further contained between a backing of pure fine silver and a front covering of gold palladium alloy (94% gold, 6% palladium) by hot forging. The metal layers now continuously welded are extended in area by means of a power rolling mill to give the required active and overall foil areas.

1-1-1 Type and Quantity of By-product Material

By- product Material	:	Am-241
Activity	:	Typical 0.7μCi, Max. 0.91μCi
Base Metal	:	Silver
Active Layer	:	AmO 2 + Fine Gold
facing Covering	:	Gold Palladium Alloy
Total Thickness	:	0.15mm - 0.20mm
Code No	:	AMMO-423

1-1-2 Chemical and Physical Form

The radioactive source Am-241 used in the model 01B2 is an oxide (Am02), insoluble in water and stable to chemicals. This radioactive source is a sealed source sandwiched between two metals of pure fine silver and gold palladium alloy. This sealing method is considered to be the most effective and safest means of capsule enclosing in order to obtain -particles, and neither physical nor chemical changes ever happen during its time of use.

1-1-3 Solubility in Water and Body Fluids

a. Solubility in Water

Three pieces of 312.5 Ci Am-241 foils having the same structure as the actual radioactive foil used in the model 0IB2 show activity leaking-out of max. 0.00045% (14.0 x 10^{-4} μ Ci) after five hours immersion in water at room temprature. On the other hand, the activity leakingout after immersing in boiling water for one hour at 760mm Hg amounts to max.

0.00031% (9.6 x 10^{-4} μ Ci). Since the used dosage in 0IB2 is max. 0.91 μCi its leaking-out amount can be max. 4.1 PCi. This amount can be negligible. (See the attached technical date 1, Immersion test (b) (c) .)

b. solubility in Body Fluids

The radioactive foil Am-241 1.1 μCi of the same structure as the foil employed in 0IB2 were immersed in N/10 hydrochloric and solution for 4hours at 98 F. In all tests less than 0.37% (4 x 10^{-3} μ Ci) Am-241 extracted. N/10 hydrochloric acid solution was selected for this test to simulate most closely the acid body fluids. (Test at Japan Isotope Association)

2.0 External Radiation Level

2-1 The external radiation level was measured by gammaray at distance of 5cm from the surface of the model 0IB2 detector. The gamma external radiation level was found to be extremely low and actually it amounts to near nearly same quantity as that of the back ground in case of 0IB2 foil. Taking the ratio of dosage into account the gamma external radiation amount of one 0IB2 detector was calculated as follows.

In the case of 5cm distance from the detector surface:

0.245 μ rem/hr.

In the case of 25cm distance from the detector surface:

0.015 μ rem/hr.

2-2 The alpha particles of the foil are absorbed by gold palladium of the fornt cover of the foil as well as by air, therefore, the reaching distance of the particles is about 5cm in the atmospheric air. Accordingly, no alpha particle can be detected at the distance of 5cm or 25cm from the detector surface of OIB2.,

3.0 Degree of Access of Human Beings to the Product During use

3-1 Possible access of human beings to the radioactive foil of OIB2 is restricted only when the detector is mechanically destroyed and the radioactive foil is exposed. Such a case is not likely to happen for oridnary people because the detector is handled, installed and maintained exclusively by professional experts. Therefore there exists no chance to touch the foil directly. Although a person may have an access to the detector intentionally if he wishes, a direct access to the foil, as described in the preceeding paragraph, is very hard because of its structural features. These features are as follows:

a The main portion of the outer surface of the detector is made of modified Polycarbonate plastics of high impact proof strength.

b The radioactive foil is covered with threefold covers:

1 Outer Cover made of modified Polycarbonate plastics, which can not be removed without special tool.

2 Outer Chamber made of Stainless steel

3 Gate Plate made of Stainless steel

c The detecter can not be removed from its socket without special tool.

3-2 The installation of the detector is made by a well-trained professional installer. At the first step, the detector socket(containing no radioactive foil)is installed in connection with the detector lines coming from the control planel, and then, the detector head is put and locked in the detector socket.

Therefore, the time required to install the detector is verty short, and there exists no chance of affecting ordinary people at all, since the installation is to be done only by a professional installer.

Furthermore, any defective detector found during the test or maintenance or anything else is to be returned to the manufacturer without disassembling by installers or maintenance people.

4.0 Quantities

4-1 Annual quantity of the detector containing the by-product material to be distributed:

- 4-1-1 Annual Sales Quantities; 5,000 pieces
- 4-1-2 Radiation Activity per One Detector; 0.9μCi max.
- 4-1-3 Total annual amount of radioactive materiai, 4.55 mCi

4-2 Number of units expected to be stocked at the warehouse.

- 4-2-1 At Nittan Corporation ——— Max. 500 pcs.
- 4-2-2 At an installation site ——5pcs. in average

4-3 Marketing and Sales Method

Marketing and sales of the model 0IB2 are handled bv Nittan Corporation who is also responsible to give a full technical supervision with respect to installation as well as to withdraw of anv defective units.

Therefore, the handling of the detector is to be done onlv those persons who are well trained and are capable of professional installation, thus, any access of an ordinarv person to the detector during its normal handling and distribution is completelv excluded.

5.0 Expected Useful life of product

The expected useful life of the detector product is about 15 years. The half life of the Am-241 employed in the smoke detection section is 458 years, therefore any sensitivity change of the detector due to decreasing of radioactivity of the foil is not expected during 15 year's of use at all.

However, it is appropriate to state that the useful life of the detector is 15 years considering the probable dust accumulation on the smoke entering slits which may affect the performance of the detector.

SECTION III

1.0 Prototvpe test method

1-1 The surface of the DETECTOR is wiped by filter paper and the ray quantity, which sticks to the paper filter, is measured by the qasflow-counter.

1-2 Endurance test of the DETECTOR.

1-2-1 In order to ascertain its safety when exposed to high temperature, the DETECTOR is put in the thermostatic chamber at 50°C with nomal moisture for 30 days.

1-2-2 So gas is selected as an intensively corrosive gas in the air and in order to ascertain its safety for corrosive resistance the DETECTOR is exposed in the atmospheric condition of 45°C, about 100% moisture. The corrosive gas is produced in the following way: 500 ml of thiosulfuric acid soda having density 40g/l is put into a 5L desiccator and then 10 ml of 0.156N sulfuric scid is poured into it twice a day so that So gas is produced. The DETECTOR is exposed to this So gas for 4 days.

1-2-3 In order to ascertain safety against impact, an impact force of 50g is imposed on the installed DETECTOR continuously 5 times.

1-2-4 In order to ascertain safety against vibration, a vibration of 1,000 cycles/min with 4mm total amplitude is applied for one hour.

Before and after each test of 1-2-1 to 1-2-4 above mentioned a wipe test as in 1-1 is conducted.

1-3-1 Various kinds of test were conducted on each foil, having the same shape and construction (each activity is 312.5 Ci) at R.C.C. in England. The test results are reported in the attached technical dada No.1, which comprises the following items.

1. Wipe test

2.Heat test at (a) 760°C and (b) 815°C

3. Immersion tests

(a) Wipe test

(b) Measurement of water leaching by the immersion test in water at room temperature for 5 hours long

(c) Water leacking test in boiling water for one hour

(d) and (e) Measurement of leaching out in case of methyl-ethyl-ketone, acetone, trichloroethane etc.

4. (a) Impact test

(b) Drop test

1-3-2 In order to ascertain the safety features of 160μCi foil with same shape and construction under the worst conditions various technical data No.2, which comprises the following items.

Corrosion testing

Samples of foils were exposed to various corrosive gases, which the DETECTOR will probably suffer when installed in such building as factory.

1. SO_2 test
2. HCl test
3. Ammonia test

Heating tests in consideration of fire

1. Heat test at 800°C for 10 minutes
2. Heat test at 1,200°C for 1 hour

2.0 Prototype test results

2-1 The wipe test result of the DETECTOR surface showed the same figure as that of back ground.

2-2 The wipe test result of the DETECTOR before and after the DETECTOR'S endurance test showed the same figure as that of back ground.

2-3 (1) The wipe test result showed 1.42×10^{-4} μCi at the maximum, which corresponds to 0.000045% and can be considered as 0%

(2) The heat test resulted in the nearly same leaching amount as 2-3 (1)

(3) The immersion test result showed the maximum leaching of 0.00045%. Against solvents souch as acetone the leaching amount of about 0.001% was found.

(4) The impact as well as drop tests showed only 0.000029% leaching, which can be judged as zero.

(5) The heat tests, which were set up under the worst conditions in consideration of fire, showed leakage of 0.1%.
Applying this figure to 0.3μCi foil, we get 7×10^{-4} μCi.

3.0 Quality Control Procedure

3-1 Tests of Am-241 foils.

3-1-1 At first the foils passed the production control tests conducted at the manufacturer R.C.C

(a) Visual inspection. All production is inspected visually for surface damage in the active area. Careful inspection with a low power microscope is carried out on samples form each production run.

(b) An autoradiograph is carried out on all production foils by placing them in contact with single weight bromide paper for a predetermined time before exposed film is developed and fixed. Distribution of activity and dimension are carefully examined.

(c) Dust sampling using a continuous airflow sampler is performed in the vicinity of the manufacturing equipment during all production. Foil storage areas are similarly monitored.

(d) Five samples of 2.5cm length are taken from each 50m production batch and subjected to the tests described in the attached technical data No.1, namely 1. Wipe test, 2. Heat and thermal shock test, and 3. Immersion test to ensure uniform integrity of product.

3-1-2 In the next place, the source foils are cut by Japan Isotope Association at the appropriate activity and are cleaned by water. Then, the activity is measured after making it sure that the leaking amount dose not exceed the limit of 0.005μ Ci by wipe test.

3-1-3 Only the source foils, which have passed the above-mentioned tests at R.C.C. and Japan Isotope Association and moreover whose sealing has been proved sufficient, are supplied to the manufacturer of this detector

3-2 Nittan Company, LTD conducts the following tests to the Am-241 foils, which are already fixed on the anode plate of 0IB2 detector.

3-2-1 To examine all of the Am-241 foils visually if there exists any defect or stain on their surface.(To check quantity)

3-2-2 To conduct wipe test by wiping Am-241 foil with filter paper and by examining any leaking. The standard allowable amount be the wipe test is set up at maximum 0.005μCi.

This wipe test is conducted based on the statistical sampling plan as per the item 3-2-3. Measuring apparatus is a 2 proportional counter consisting of a scaler (Model TDCS : Japan Radio Corp.) and a radioactive rays detector (FC-IE : Japan Radio Corp.)

3-2-3

Lot size	Sample size	Number of defective pieces allowed in sample
500- 624	7	0
625- 799	8	0
800- 999	10	0
1,000-1,249	11	0
1,250-1,574	13	0
1,575-1,999	15	0
2,000-2,499	17	0
2,500-3,000	20	0

The lot size, which Nittan Corporation receives, are 500-3,000, for which the severe test standard JIS Z9015, namelv AOL=0.4, is applied. From each lot, according to the 3-2-3 list,the samples of required numbers are extracted and these samples are tested in compliance whith the standard.

If no rejected sample is found in the tested samples, all lot numbers belonging to these samples are acceptable.

If even one piece in the tested samples is found as defected, all lot numbers belonging to these samples are unaccepted, and every piece of foil in the same lot is to be individually tested on the same standard

The foils, which are accepted, are applied to DETECTORS, while the defected ones are not used and are disposed of in the proper way. This test method can eliminate any probability that a defect foil may be applied to the DETECTOR.

3-3 The Americium-241 foil is fixed on the Anode Plate by curing. (Please refer the Fig. 2 in Section V)

The Anode Plate has the dimensions of 12.7mm diamter, 2.0mm thickness and its screw part is 3mm dia. and 4.0mm length. This Anode Plate is firmlv screwed to the center of the Bodv by special tool. Even if the Anode Plate should be removed from the center, it will not come out from the opening of of the intermediate electrode (Gate Plate), but remains inside of the reference chamber (inner ionization chamber).

3-4 All of the finished products are subjected to 100% of visual inspection to ascertain the proper fixing of the foil on the anode plate. Even if this total check would fail to find a defect, the next covering every detector, described under item 3-5 (inspection of the finished detector) can follow up.

For example, even if the foil should removed from the anode plate (this does not happen actually), this defect can be found byDETECTORtests, namely: the DETECTORdoes not operate properly when the tests (items 3-5-2 and 3-5-3: Operation by smoke, and Electrical sensitivity check) are conducted. Accordingly, before shipment, every DETECTORis individually inspected through three stages;

Visual inspection of source foils
Inspection by smoke operation
Inspection of electrical sensitvity

Thus, any defect such as loosening of source foils, is completely eliminated.

3-5 The final inspections are done to every DETECTOR.

3-5-1 Visual test: To check if the DETECTOR is assembled in proper way.
3-5-2 Smoke operation test: To check if the DETECTOR gives a right reaction to the smoke of predetermined density.
3-5-3 Electrical sensitivity test: To ascertain the test of 3-5-2 electrically.
3-5-4 Temperature and moisture cycle test: To ascertain stability of the DETECTOR.

Through this final inspection it is confirmed if the assembley as per Section V has been executed in the right way and the DETECTORS which have passed this final inspection only are to be shipped as final products.

SECTION IV 1.0 Estimation of Radiation Dose and Dose Commitment

Explanation and reason why the dose commitment complies to the articcle 32:27 a of the NRC regulations.

1.1 Normal Use

The gamma radiation dose of the model 0IB2 detector is less than 0.015 μrem/hr at the 25cm distance from the surface of the detector as shown in Section II. Under the following conditions, the estimation of the extermal radiation dose which occupant in Lavatory receives in any one year is as follows.

Conditions ;

1. distance from occupant to ceiling on which the detector installed ; 25cm
2. Occupancy : 5 times/day
3. Occupation time ; 30 minutes/time

The external radiation dose per year is

0.015(μrem/hr) x ½ (hr/time) x 5(times/day)=13.7μrem/year

From the above result, under normal condition of use it is impossible for anybody to receive 5mrem/year of the dose. Accordingly the dose commitment of the detector 0IB2 satisfies the column I of 32-28

1-2 Normal Disposal

Since the maintenace of the model 0IB2 smoke detector is made only by well trained professional installers and they are strictly instructed to return any defective detector, if found, to the address indicated on the labels, every defective detector shall be returned to the sole Distributor, Nittan Corporation, without fail.

Nittan Corporation conducts necessary periodical training to those of professional installers who are to be engaged in installation or maintenance.

1-3 Normal Handling

As stated above, the model 0IB2 detector can be separated into two parts of the socket, and the head containing the radioactive source.

In case of the detector's installation the authorized installer connects the detector lines from the controlpanel or the self combined alarm device with the socket, which is fixed on the ceiling by two screws. After fixing the wiring as well as the socket the head is locked in the socket.

The external radiation dose which likely be received by the installer is calculated as below.

The time required to install the detector is considered less than one minute per one detector as the detector head is relatively easily mounted on the detector socket.

The measured value of the radiation dose on the surface of the detecter is 3.5μrem/h. Therefore, assuming that the maximum 100 detectors be installed in one construction site, and the numbers of the installation jobs be 50 in one year, then the external radiation dose is found to be 291.7μrem/year according to the following calculation.

$$\frac{3.5\ \text{rem/hr}}{60\text{min/hr}} \times 1(\text{min/pcs}) \times 100\ (\text{pcs/job site})$$

$$\times\ 50(\text{jobs/year}) = 291.7\mu\text{rem/year.}$$

This satisfies the value stipulated in the column I of 32-28.

1-4 Estimate of External Radiation Dose During Maintenance

To ensure proper operation of a fire alarm system employing the model 01B2, in principle the following periodical tests will be made by the authorized maintenance person.

a) operational test
b) Functional test

a)The operational test shall be made at least every three months, In this test, each detector installed on ceilling shall be operated by introducing actual smoke into the detector with the specified Smoke Tester which consists of smoke generation section with the rod attached to reach the detector on ceiling. In this test, then it shall be confirmed if each tested detector shall operate properly with in 1 minute.
The external radiation dose which the maintenance person would likely receive is found to be 0.375μrem/year according to the following calculation. It is assumed that the time required to complete one operational test be one and a half minute, the person engaged in testing stay 25cm directly under the detector to be tested by this person in one year be 1,000 pieces.

$$0.015(\mu\text{rem/year}) \times \frac{1.5}{60}\ (\text{hr/pcs}) \times 1{,}000(\text{psc/year}) = 0.374\mu\text{rem/year.}$$

b)In principle, the functional test shall be made at least every 6 months. The purpose of the test is to measure the sensitivity of the detector with the use of Delta V Tester. The Delta V Tester is a monitoring device which can simulate electrically similar condition as gradual smoke entering into the detector in order to measure the sensitivity of the detector (V'). The sensitivity of the detector can be measured by plugging the detector head into the socket of delta V Tester, which can be done very easily and requires only one minute.

During the functional test, it shall be confirmed if the measured operating sensitivity (V') be within that of the range indicated on the label. If the measured sensitivity is not within this range, it shall be returned to Nittan Corporation without disassembling it.

The external radiation dose which the maintenance personal would likely receive during the functional test is found to be 29μrem/year according to the following assumptions and calculation.

It is assumed that the handling time required to complete one function test be 5 minutes, the external radiation dose on the surface of the detector be 3.5 rem/hr from the measured result and the number of the detectors to be handle in one year by this person be 1,000 pieces in totsal.

$$3.5\,(\mu rem/hr) \times \frac{5}{60}\,(hr/hcs) \times 1{,}000(pcs/year) = 29\mu rem/year$$

From the above, it is concluded that the total external radiation dose which the person would likely receive as a result of performing Jobs of a), b) amounts to 292 rem/year. Therefore, the person for maintenance never receives 5 mrem/year of the external radiation dose. This satisfies the value in the column I of §32:28.

1-5 Warehouse Storage

The external radiation dose from the model 0IB2 detector presumably accumulated at one location during their distribution is found to be less than 5 mrem per year even under the extremely worst assumed condition according to the following calculation, the value of which satisfies the value of table I of §32-28.

10 detectors are packed into a cardboard box, which has the dimentions of 5.5cm height, 9.5cm width and 22cm length.

The external radiation dose on the surface of this cardboard box containing 10 detectors was measured by the gamma ray survey-meter.
As a result of measurement, the maximum extermal radiation dose on the surface of the cardboard box was found to be 7μrem/h.

In view of convenience of transportation or storage, the shipping box (46cm x 30cm x 30cm) accommodates 30 cardboard boxes. In that case, each cardboard box was located to diminish the total external radiation dose, that is, the location of cardboard box was arranged so as that the surfaces of maximum radiation dose face each other. In this case, the external radiation dose of shipping box was nearly negligible, 0.1μrem/h.
The maximum external radiation dose of a person, who is engaged in working in this warehouse for a year at the rate of 8 hours a day, 5 days a week and 50 weeks a year, is found to be 0.2 mrem/year according to the following calculation:

$0.1(\mu rem/hr) \times 50(weeks/year) \times 5(days/week) \times 8(hours/day)$

$= 0.2$ mrem/year

This value satisfies Column I of §32:28

2.0 Internal Radiation Dose Commitment Under Normal Condition

Internal radiation dose commitment is caused either by taking the radioactive foil through mouth or by inhaling it.

2-1 Taking through mouth.

Taking the foil into human body through mouth may happen only when the outer chamber is taken off, the gate plate is removed and moreover parts of the RI-Holder are destroyed. And thereafter the removed foil is to be brought into mouth. Such a series of phenomena never takes place.

2-2 Inhaltion

The internal radiation dose commitment through inhalation can be considered only in case of fire, and under handling process of detectors or under installed condition it is absolutely impossible.

3.0 External Radiation Dose Commitment Under Severe condition

3-1 Direct External Radiation Dose from Foil

As described in 2-1,this never happens practically. However, assuming the foil would be removed by any accident and people would approach it, then the external dose integrated in 50 years is found to be 6.9 mrem/50 years which is absolutely small and safe in comparison with that value specified in Column II of §32:28 as the below-mentioned calculation indicates.

We take an assumption that a person be exposed continuously for 50 years at the distance of 25cm from the foil. Since the foil is located about 15mm from the detector surface, the external radiation dose at the 25cm distance from the foil can be calculated as below takng into consideration the dose in case of 25cm distance form the detector surface.

$$\left(\frac{26.5}{25}\right)^2 \times 0.015\,(\mu rem/hr) = 0.0612\,\mu rem/hr.$$

Accordingly the external dose exposed in 50 years will be :

$$0.0162(\mu rem/hr) \times 24(hr/day) \times 365(days/year)$$

$$\int_0^{50} e^{-\frac{0.693\,t}{458}}\,dt = 6.9 \text{ mrem/50 yeares}$$

4.0 Internal radiation Dose Commitment Under severe Condition

4-1 Internal Radiation Dose Commitment by inhalation in case of warehouse fire.

As the worst case we consider the dose commitment when a fire breaks out in the warehouse where 500 units of the detectors are stocked.

According to the attached technical data 2, 0.1% at the heating test assuming a fire, All of this quantity can be assumed as particles to be possibly inhaled. To calculate internal radiation dose commitment of a person who remains in a fire condition for 5 min., it is assumed that the air volume of a standard warehouse is 200,000 ft (5.6×10^9 cc) and air shall not be exchanged. We calculate the internal radiation dose amount which an occupant would receive for 5 minutes at fire.

According to the recommendation of ICRP "Reprot of Committee II on Allowable Dose Amount of Radioactive Radiation in Human Body (1959)", the most critical organ for inhalation of insoluble radioactive dust particles can be considered to be lung and the rate fa, at which the inhaled particles reach the critical organ, is 0.12. The air amount to be inhaled by this person is 10^7 cc/8hrs according to the same ICRP report. Therefore in 5 minutes the person would inhale 1.05×10^5 cc of air as below calculation:

$$\frac{10^7 cc}{8\,hr} \times \frac{5}{60}\,hr = 1.05 \times 10^5\,cc$$

In case of storing 500 units of detectors with each radioactive material of $0.7\mu Ci$ on average, the following calculation is made:

$$\text{Dose} = \frac{(0.7 \times 500)\,\mu\text{Ci} \; (1 \times 10^{-5})}{(5.6 \times 10^{4})\,\text{cc}}$$

$$\times (1.05 \times 10^{5})\,\text{cc}$$

$$\times 0.12 \times \frac{2.2 \times 10^{6}\ \text{dis}}{\text{min} - \mu\text{Ci}} \times \frac{5.7\ \text{MeV}}{\text{dis}}$$

$$\times \frac{(1.6 \times 10^{-6})\,\text{ergs}}{1{,}000\ \text{g}}\ \text{MeV} \cdot \frac{\text{g.Rad}}{10^{2}\ \text{ergs}}$$

$$\cdot \frac{10\ \text{rem}}{\text{RAD}} \cdot \frac{(5.26 \times 10^{5})\ \text{min}}{\text{year}} \times$$

$$\int_{0}^{50} e^{-\frac{0.693}{458} t}\, dt = 0.041\ \text{rem/50 years}$$

The situation just described above never takes place actually; however, even in such a case, the dose commitment satisfies the value specified in Colun II of §32:28

4-2 Internal radiation dose commitment due to taking foil into human body at the worst accident.

As already described, the installation of the model 01B2smoke detectors is carried out by well-educated professional installers.

Therefore, the detectors cannot be sofar destroyed or disassembled so that the radioactive foil could be swallowed.

Under normal condition of use, one may attempt to again direct access to the radioactive foil by removing the detector head from the socket with an intention of destroving or tampering it. However, the model 01B2 is connected electrically with a control panel to form a fire alarm system and if the detector head should be removed from its socket a trouble signal shall be sent to the control panel.
Upon receiving such a signal from the detector, the control panel sends out the trouble signals by means of audible and/or visible alarms.

As such, the detector is provided completely with a preventive measure against theft and tampering and, therefore, it is absolutely not possible that any one would swallow the foil.

Never-the less, assuming the case of swallowing the foil, we get the calculation result of the dose commitment exposed in 50 years as 11.0 mrem/50 years which is negligible low in comparison with the value specified in the Column II of §32:28.

The max. activity of the radiation foil in the model 01B2 detector is 0.91μCi/pcs. The foil swallowed through mouth leaks to gastric juice in the stomach.

This leak can be considered as a leak amount to N/10 HCL liquid according to Section II, and it is 0.37%. We assume all of leaked radioactive material would be dissolved into body fluids. According to the above-mentioned ICRP report, the rate of transferring from intestine to blood is 10^{-4}.

Furthermore, according to the said ICRP data the rate f2 between the deposited amount in bones and the amount deposited in the whole body is 0.9 .

Under these conditions, the internal dose commitment for bones for 50 years is calculated as below.

$$\text{Dose} = (0.91)\ \text{Ci} \times 0.37 \times 10^{-2} \times 10^{-4} \times 0.9$$

$$\times \frac{(2.2 \times 10^{-6})\text{dis}}{\text{min}\,\mu\text{Ci}} \cdot \frac{28.3\ \text{Mev}}{\text{dis}} \times \frac{1}{\underset{\text{(weight of bones)}}{7000}}$$

$$\times \frac{(1.6 \times 10^{-6})\text{erg}}{\text{Mev}} \times \frac{\text{g.Rad}}{10\ \text{ergs}} \cdot \frac{10\text{rem}}{\text{Rad}}$$

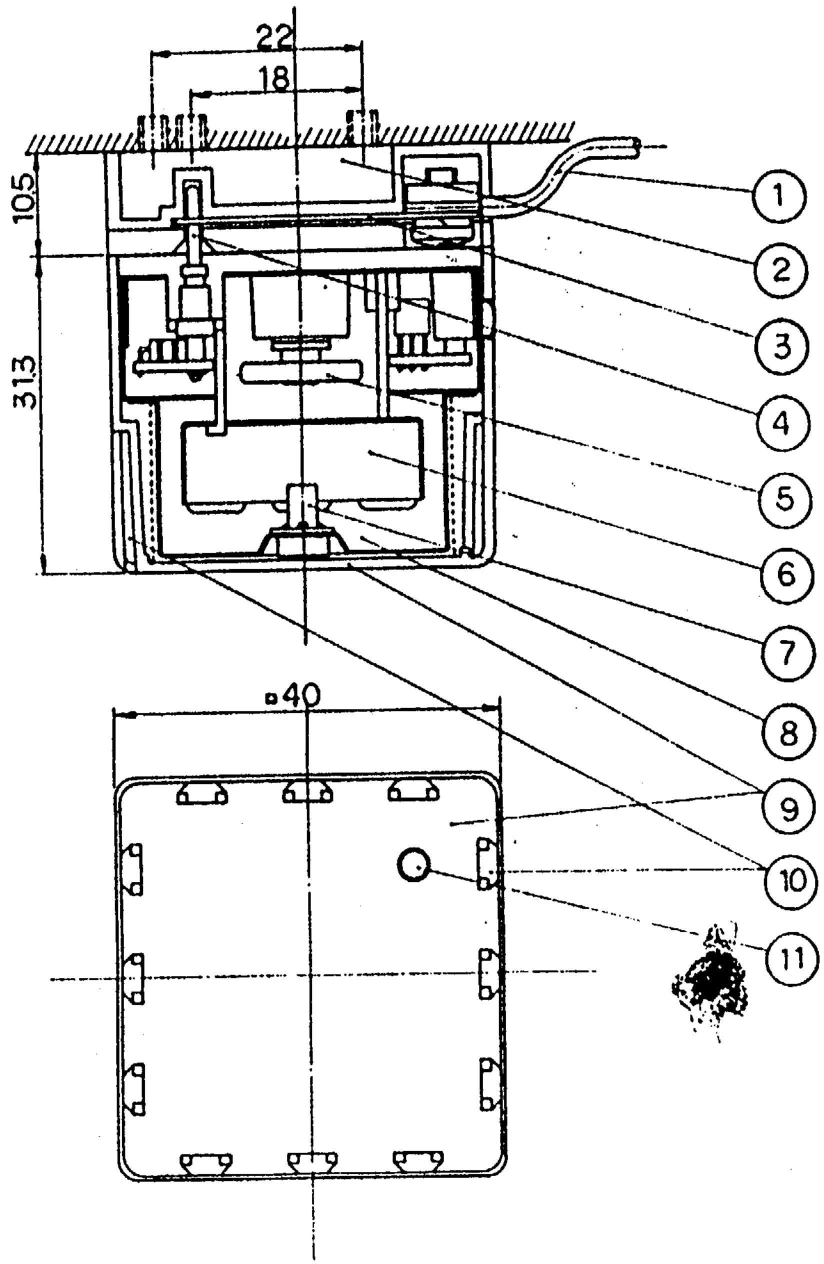
$$\times \frac{(5.26 \times 10^{5})\text{min}}{\text{year}} \times \int_{0}^{50} e^{-\frac{0.693}{458}t}\, dt$$

$$= 11.0\ \text{mrem/50 year}$$

4-3 Those values calculated in 4-1 and 4-2 are figures on assumption of such accidents, which never happen in actuality.

Even under those severe conditions, the value do not exceed those values specified in Column II of §32:28.

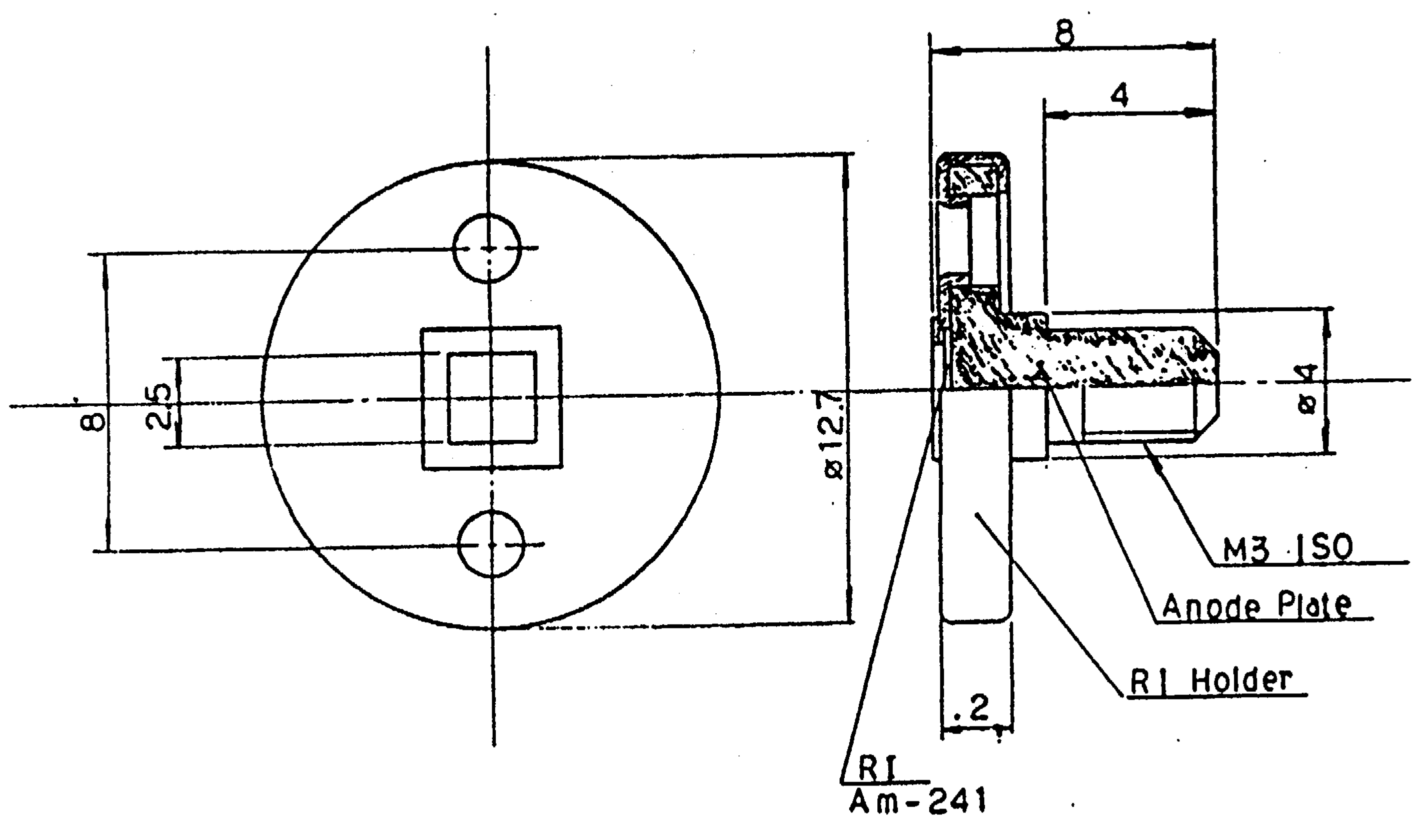
Namely the radioactive foil and its application method in the detector is completely safe and reliable.



Index No.	Description
1	External Wire
2	Socket
3	External Terminal
4	Contact Pin
5	Anode Plate
6	Gate Plate
7	Cathode Pin
8	Outer Chamber
9	Outer Cover
10	Smoke Inlet
11	Indicator

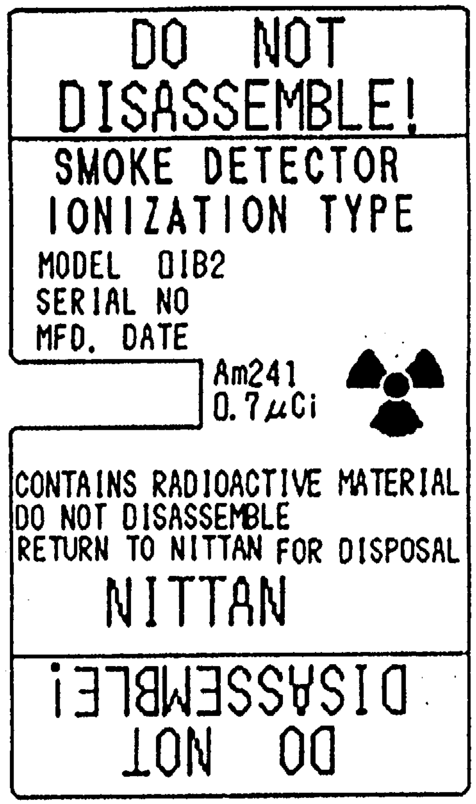
NITTAN

Construction Drawing
for 0IB2



NITTAN

CHECKED	DRAWN
SCALE /	DATE 10. 1. 1989
DIMENSIONS ARE IN mm	3RD ANGLE PROJECTION
TITLE Assembly Drawing of OIB2 RI Source	
MODEL NO.	
DRAWING NO.	



NITTAN

CHECKED	DRAWN
SCALE /	DATE 10. 1. 1989
DIMENSIONS ARE IN mm	3RD ANGLE PROJECTION
TITLE Label of OIB2	
MODEL NO	
DRAWING NO	

NOT TO BE [illegible]

Gold/Pd Allo
Gold Plated

Oct. 1967

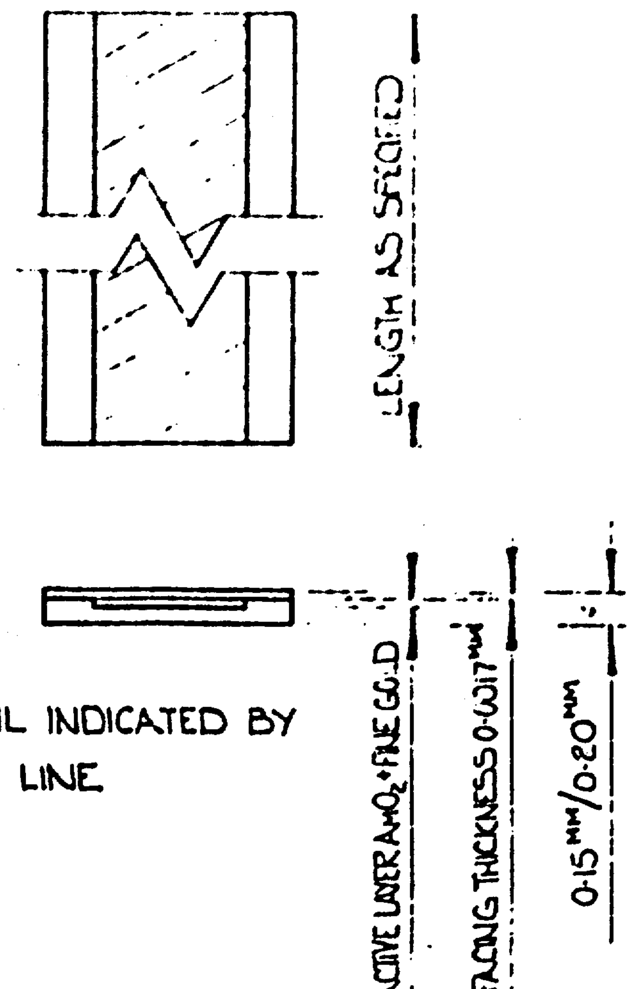
Technical Data - 1

<u>Tests carried out on Americium-241 alpha particle emitting foil manufactured by the Radiochemical Centre</u>

USED ON

DRG No. ARC 8522/S

THIRD ANGLE PROJECTION



BACK OF FOIL INDICATED BY GOLD LINE

NOT FOR PUBLICATION
THE INFORMATION ON THIS DRAWING IS NOT TO BE COMMUNICATED EITHER DIRECTLY OR INDIRECTLY TO THE PRESS OR TO ANY PERSON NOT AUTHORISED TO RECEIVE IT.

TYPE	OVERALL WIDTH	ACTIVE WIDTH	LINEAR ACTIVITY	FACE COVERING	BASE
Q274	20 MM $^{+0.5}_{-0.5}$	3 MM $^{+0.5}_{-0.5}$	15 μCi/CM	GOLD/PALLADIUM ALLOY	SILVER
Q423	20 MM $^{+0.5}_{-0.5}$	12·5 MM $^{+0.5}_{-0.5}$	10 μCi/CM	GOLD/PALLADIUM ALLOY	SILVER

JOB No.

PROJECT No.

MATERIAL & SPEC

FINISH

SURFACE TEXTURE
√ UNLESS STATED

REMOVE ALL BURRS

DRAWN H.E.L.

TCD.

CHKD.

APPD.

DIMS. IN M.M.

SCALE N.T.S.

TOLERANCES — UNLESS STATED

ISSUE	DATE	D.O.I./MOD
A	14·5·71	

THE RADIOCHEMICAL CENTRE
AMERSHAM BUCKS

CONTRACTOR

TITLE
Americium 241 Alpha Emitting Foil

DRG. No. ARC 8522/S

Tests carried out on Americium-241 alpha particle emitting foil manufactured by the Radiochemical Centre

Type of foil

Americium-241 foil, 100 µc/cm^2

active width	0.5 inches
total width	20 mm
length of samples	25 mm each

Manufacturing process

The radionuclide, as americium oxide, is contained uniformly distributed and sintered in the matrix of pure fine gold at temperatures in excess of 800°C. It is further contained between a backing of pure fine silver and a front covering of gold or gold palladium alloy (94% gold, 6% palladium) by hot forging. The metal layers now continuously welded are extended in area by means of a power rolling mill to give the required active and overall foil areas.

Wipe test based on British Standard 3513: 1962

All wipe tests carried out using 1 inch diameter discs of Whatman No. 1 filter paper moistened with Ethyl Alcohol, and allowed to dry before measurement. Wipe tests are carried out in every case on the active face and back of the foil and the two cut edges. Pressure of filter paper on foil 40-50 grams. Each disc is placed in a glass vial which is filled with a dioxane/toluene based liquid scintillant, and counted in a Nuclear Chicago Mk. 1 liquid scintillation counter. This counter has a dual photomultiplier detector assembly, designed for high efficiency counting of low energy β-emitters like ^{14}C and ^{3}H. In this system the α particles from americium-241 record with 100% efficiency from sources in solution in the scintillant. The counter has been calibrated for americium-241 dried on to filter paper discs, and for these, detection efficiency of about 90% is determined. Results corrected for this efficiency, and reported as microcuries americium-241.

Foil Type	Gold/palladium alloy (94% Au, 6% Pd) covering over active layer		
Sample Number	1	2	3
1. Wipe test on samples after manufacture	1.42×10^{-4}	1.39×10^{-4}	$0.45 \times 10^{-}$
2. Heat and thermal shock tests			
(a) Wipe test before heating	1.42×10^{-4}	1.39×10^{-4}	$0.45 \times 10^{-}$
Wipe test after heating to 760°C	0.65×10^{-4}	0.46×10^{-4}	$1.53 \times 10^{-}$
Wipe test after immersion in liquid nitrogen (-195.84°C)	0.69×10^{-4}	0.51×10^{-4}	$0.95 \times 10^{-}$
(b) Wipe test before heating	0.52×10^{-4}	0.17×10^{-4}	$0.54 \times 10^{-}$
Wipe test after heating to 815°C	0.15×10^{-4}	0.47×10^{-4}	$0.05 \times 10^{-}$
Wipe test after immersion in liquid nitrogen (-195.84°C)	0.55×10^{-4}	NIL	$0.49 \times 10^{-}$

Foil Type — [illegible]

[illegible]

Sample Number	1	2	3
3. Immersion tests.			
(a) Wipe tests as Test 1 on three control samples	1.42×10^{-4}	1.39×10^{-4}	0.45×10^{-4}
(b) After 5 hours immersion in water at room temperature			
i) Wipe test before immersion	NIL	1.86×10^{-4}	1.03×10^{-4}
ii) Activity leached out	9.3×10^{-4}	14.0×10^{-4}	8.5×10^{-4}
iii) Wipe test after immersion	0.65×10^{-4}	1.0×10^{-4}	1.0×10^{-4}
(c) After 1 hrs immersion in boiling water. Temp 98°C at 740 mm Hg			
i) Wipe test before immersion	0.03×10^{-4}	0.83×10^{-4}	2.63×10^{-4}
ii) Activity leached out	4.85×10^{-4}	3.03×10^{-4}	9.6×10^{-4}
iii) Wipe test after immersion	1.1×10^{-4}	1.4×10^{-4}	2.9×10^{-4}
(d) After 5 hrs immersion in methyl-ethyl ketone.			
i) Wipe test before immersion	2.79×10^{-4}	0.8×10^{-4}	1.57×10^{-4}
ii) Activity leached out	0.26×10^{-4}	1.73×10^{-4}	0.58×10^{-4}
iii) Wipe test after immersion	0.5×10^{-4}	0.39×10^{-4}	1.02×10^{-4}
(e) In this test, solutions were measured to determine the americium-241 extracted during immersion.			
Acetone i) after 24 hrs	33×10^{-4}	31×10^{-4}	32×10^{-4}
ii) after 48 hrs	NIL	16×10^{-4}	NIL
iii) after 72 hrs	5.2×10^{-4}	2.1×10^{-4}	3.9×10^{-4}
iv) after 168 hrs	8.1×10^{-4}	4.3×10^{-4}	5.4×10^{-4}
Trichloroethane i) after 24 hrs	33×10^{-4}	33×10^{-4}	23×10^{-4}
ii) after 48 hrs	NIL	NIL	NIL
iii) after 72 hrs	NIL	4.7×10^{-4}	0.9×10^{-4}
iv) after 168 hrs	5.4×10^{-4}	4.1×10^{-4}	9.0×10^{-4}

Foil Type		[illegible]		
Sample Number		1	2	3
Perchloroethane	i) after 24 hrs	23×10^{-4}	35×10^{-4}	$3[illegible] \times 10^{-4}$
	ii) after 48 hrs	NIL	NIL	NIL
	iii) after 72 hrs	2.5×10^{-4}	4.4×10^{-4}	3.7×10^{-4}
	iv) after 163 hrs	6.7×10^{-4}	5.6×10^{-4}	7.2×10^{-4}

4. i) Impact Test:

Steel ball diameter 12.7 mm, weight 8.3 gm, dropped through vertical height in free fall 1 metre. After initial wipe test on foil, the ball was dropped five times on to the face of 3 samples. Foils mounted on solid brass base.

Initial wipe test	1.04×10^{-4}	NIL	$2.38 \times 10^{-}$
Wipe test after 1st impact on foil face	0.91×10^{-4}	0.66×10^{-4}	$0.11 \times 10^{-}$
Wipe test after 2nd impact on foil face	0.37×10^{-4}	0.03×10^{-4}	$0.41 \times 10^{-}$
Wipe test after 3rd impact on foil face	0.03×10^{-4}	0.18×10^{-4}	$0.49 \times 10^{-}$
Wipe test after 4th impact on foil face	0.25×10^{-4}	0.45×10^{-4}	$0.65 \times 10^{-}$
Wipe test after 5th impact on foil face	0.30×10^{-4}	0.60×10^{-4}	$0.47 \times 10^{-}$

Visual inspection showed that all samples had mechanical damage in the form of indentations about 5 mm diameter and 2 mm deep. No evidence of covering metal breakdown.

ii) Drop Test:

Foil samples mounted centrally in aluminium alloy case, 34.2 mm x 24.95 mm x 7.7 mm). The case was dropped five times with each sample through a vertic height of 1 metre in free fall on to a solid brass base.

Initial wipe test	1.24×10^{-4}	0.13×10^{-4}	$0.07 \times 10^{-}$
Wipe test after 1st drop	0.51×10^{-4}	0.44×10^{-4}	$1.03 \times 10^{-}$
Wipe test after 2nd drop	0.03×10^{-4}	0.36×10^{-4}	1.2×10^{-1}
Wipe test after 3rd drop	0.71×10^{-4}	0.67×10^{-4}	1.2×10^{-1}
Wipe test after 4th drop	0.03×10^{-4}	0.21×10^{-4}	1.1×10^{-1}
Wipe test after 5th drop	0.57×10^{-4}	0.59×10^{-4}	$0.13 \times 10^{-}$

Foil Type	Pure fine gold coverage over active layer		
Sample Number	4	5	6
1. Wipe test on samples after manufacture	0.59×10^{-4}	0.57×10^{-4}	0.42×10^{-4}
2. Heat and thermal shock tests			
(a) Wipe test before heating	0.59×10^{-4}	0.57×10^{-4}	0.42×10^{-4}
Wipe test after heating to 760°C	1.4×10^{-4}	0.4×10^{-4}	0.02×10^{-4}
Wipe test after immersion in liquid nitrogen (-195.84°C)	0.56×10^{-4}	0.64×10^{-4}	0.4×10^{-4}
(b) Wipe test before heating	0.04×10^{-4}	0.97×10^{-4}	0.60×10^{-4}
Wipe test after heating to 815°C	0.58×10^{-4}	0.53×10^{-4}	1.24×10^{-4}
Wipe test after immersion in liquid nitrogen (-195.84°C)	0.3×10^{-4}	0.26×10^{-4}	0.86×10^{-4}
3. Immersion tests			
(a) Wipe tests as Test 1 on three control samples	0.59×10^{-4}	0.57×10^{-4}	0.42×10^{-4}
(b) After 5 hours immersion in water at room temperature			
i) Wipe test before immersion	0.49×10^{-4}	0.61×10^{-4}	4.0×10^{-4}
ii) Activity leached out	18.9×10^{-4}	14.2×10^{-4}	7.4×10^{-4}
iii) Wipe test after immersion	1.45×10^{-4}	1.52×10^{-4}	1.39×10^{-4}
(c) After 1 hrs immersion in boiling water. Temp 98°C at 740 mm Hg			
i) Wipe test before immersion	0.045×10^{-4}	1.53×10^{-4}	1.48×10^{-4}
ii) Activity leached out	10.1×10^{-4}	3.03×10^{-4}	7.8×10^{-4}
iii) Wipe test after immersion	0.65×10^{-4}	5.0×10^{-4}	1.77×10^{-4}
(d) After 5 hrs immersion in methyl-ethyl ketone			
i) Wipe test before immersion	2.16×10^{-4}	0.43×10^{-4}	0.31×10^{-4}
ii) Activity leached out	0.015×10^{-4}	0.25×10^{-4}	0.12×10^{-4}
iii) Wipe test after immersion	2.17×10^{-4}	4.69×10^{-4}	3.86×10^{-4}

Foil type	Pure fine gold covering over active layer		
Sample Number	4	5	6

(e) In this test solutions were measured to determine the americium-241 extracted during immersion.

Solvent	Time	4	5	6
Acetone	i) after 24 hrs	30×10^{-4}	4.5×10^{-4}	27×10^{-4}
	ii) after 48 hrs	NIL	NIL	NIL
	iii) after 72 hrs	5.7×10^{-4}	5.2×10^{-4}	3.7×10^{-4}
	iv) after 163 hrs	3.4×10^{-4}	5.8×10^{-4}	5.3×10^{-4}
Trichloroethane	i) after 24 hrs	27×10^{-4}	27×10^{-4}	26×10^{-4}
	ii) after 48 hrs	NIL	NIL	33×10^{-4}
	iii) after 72 hrs	0.52×10^{-4}	NIL	NIL
	iv) after 168 hrs	7.0×10^{-4}	4.95×10^{-4}	3.6×10^{-4}
Perchloroethane	i) after 24 hrs	5×10^{-4}	28×10^{-4}	29×10^{-4}
	ii) after 48 hrs	NIL	NIL	12×10^{-4}
	iii) after 72 hrs	3.7×10^{-4}	4.2×10^{-4}	3.6×10^{-4}
	iv) after 168 hrs	5.2×10^{-4}	10.0×10^{-4}	5.4×10^{-4}

4. i) Impact test:

Steel ball diameter 12.7 mm, weight 8.3 gm, dropped through vertical height in free fall 1 metre. After initial wipe test on foil, the ball was dropped five times on to the face of 3 samples. Foils mounted on solid brass base.

Test	4	5	6
Initial wipe test	0.63×10^{-4}	1.27×10^{-4}	0.56×10^{-4}
Wipe test after 1st impact on foil face	8.9×10^{-4}	0.56×10^{-4}	1.2×10^{-4}
Wipe test after 2nd impact on foil face	3.3×10^{-4}	0.50×10^{-4}	0.61×10^{-4}
Wipe test after 3rd impact on foil face	0.05×10^{-4}	0.20×10^{-4}	0.54×10^{-4}
Wipe test after 4th impact on foil face	0.01×10^{-4}	0.20×10^{-4}	0.60×10^{-4}
Wipe test after 5th impact on foil face	0.79×10^{-4}	0.57×10^{-4}	0.22×10^{-4}

Visual inspection showed that all samples had mechanical damage in the form of indentations about 5 mm diameter and 2 mm deep. No evidence of covering metal breakdown.

Foil type	Pure fine gold covering over active layer		
Sample Number	4	5	6

4. ii) Drop test:

Foil samples mounted centrally in aluminium alloy case, 34.2 mm x 24.95 mm x 7.7 mm. The case was dropped five times with each sample through a vertical height of 1 metre in free fall on to a solid brass base.

	4	5	6
Initial wipe test	19.3×10^{-4}	7.9×10^{-4}	$0.65 \times 10^{-}$
Wipe test after 1st drop	9.1×10^{-4}	0.64×10^{-4}	$0.60 \times 10^{-}$
Wipe test after 2nd drop	5.0×10^{-4}	0.21×10^{-4}	$0.60 \times 10^{-}$
Wipe test after 3rd drop	7.0×10^{-4}	0.10×10^{-4}	1.0×10^{-4}
Wipe test after 4th drop	6.8×10^{-4}	0.42×10^{-4}	$0.57 \times 10^{-}$
Wipe test after 5th drop	1.53×10^{-4}	2.7×10^{-4}	$0.05 \times 10^{-}$

5. Abrasion Test / Repeated Wipe Test

Two foils samples, one with gold front covering and one with gold/palladium alloy front covering, were subjected to repeated wipe tests. Each wipe test recorded was carried out as described earlier under "Wipe Test", excepting that it was repeated five times with the same filter paper and on the whole alpha emitting surface only. Total activity removed from sample with gold front covering 4.48×10^{-3} µc in 122 wipe tests (five wipes each). Total activity removed from sample with gold/palladium alloy front covering 5.63×10^{-3} µc in 122 wipe tests (five wipes each).

The graph shows total activity removed; the increasing percentage being achieved by the addition of each wiped amount. No detectable activity was found on the last 20 wipe tests, representing 100 wipes across the surface of the foil for the sample with the gold front covering and $\sim 2.25 \times 10^{-4}$ µc for the sample with the gold/palladium alloy front covering.

The total activity removed by 610 wipes is $\sim \dfrac{1}{6 \times 10^{4}}$ of the total activity of samples in each test.

Production Control

(a) Visual inspection. All production is inspected visually for surface damage in the active area. Careful inspection with a low power microscope is carried out on samples from each production run.

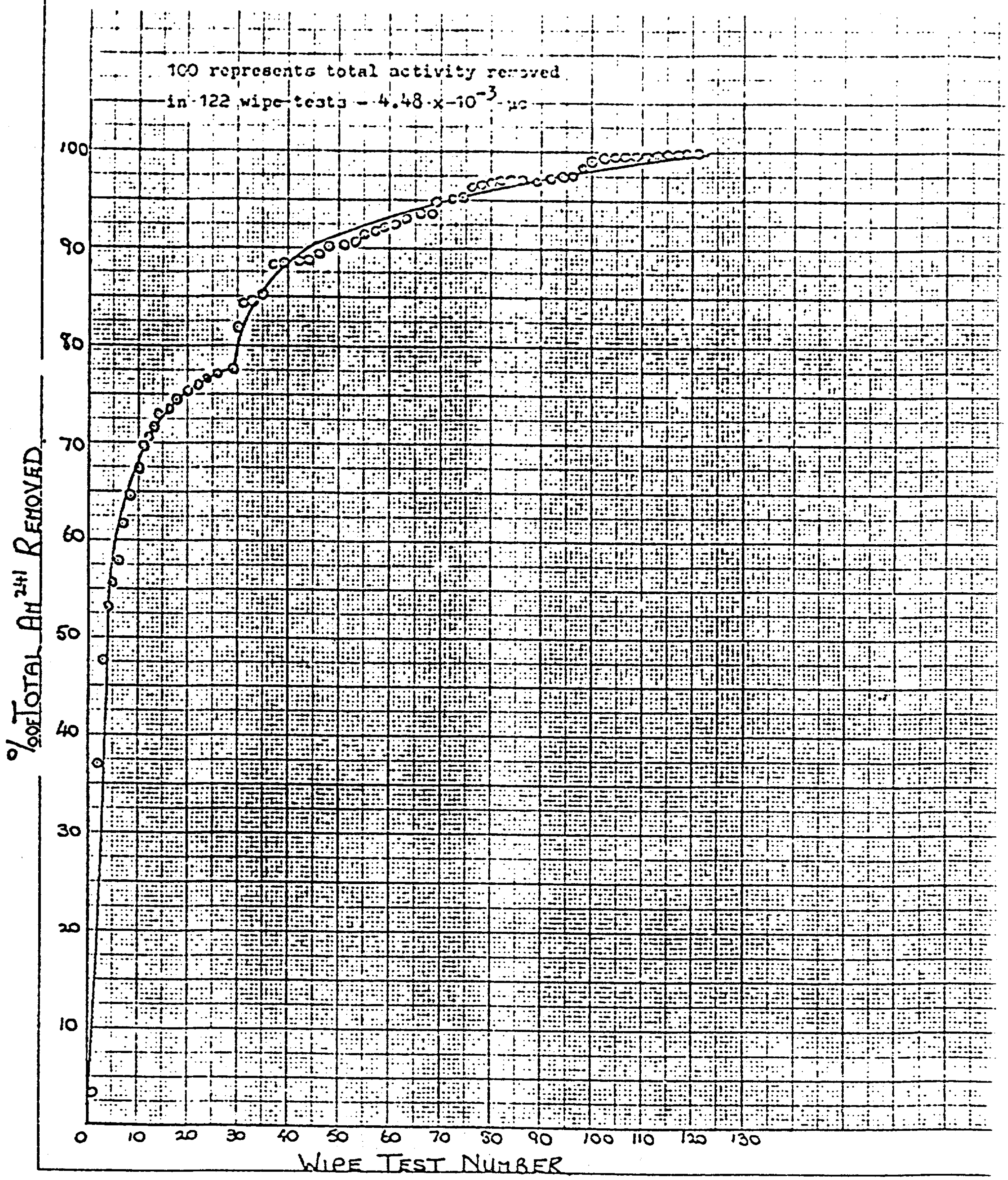
(b) An autoradiograph is carried out on all production foils by placing them in contact with single weight bromide paper for a pre-determined time before exposed film is developed and fixed. Distribution of activity and dimensions are carefully examined.

(c) Dust sampling using a continuous airflow sampler is performed in the vicinity of the manufacturing equipment during all production. Foil storage areas are similarly monitored.

(d) Five samples of 2.5 cm length are taken from each 50 m production batch and subjected to the tests 1, 2 and 3 above to ensure uniform integrity of product

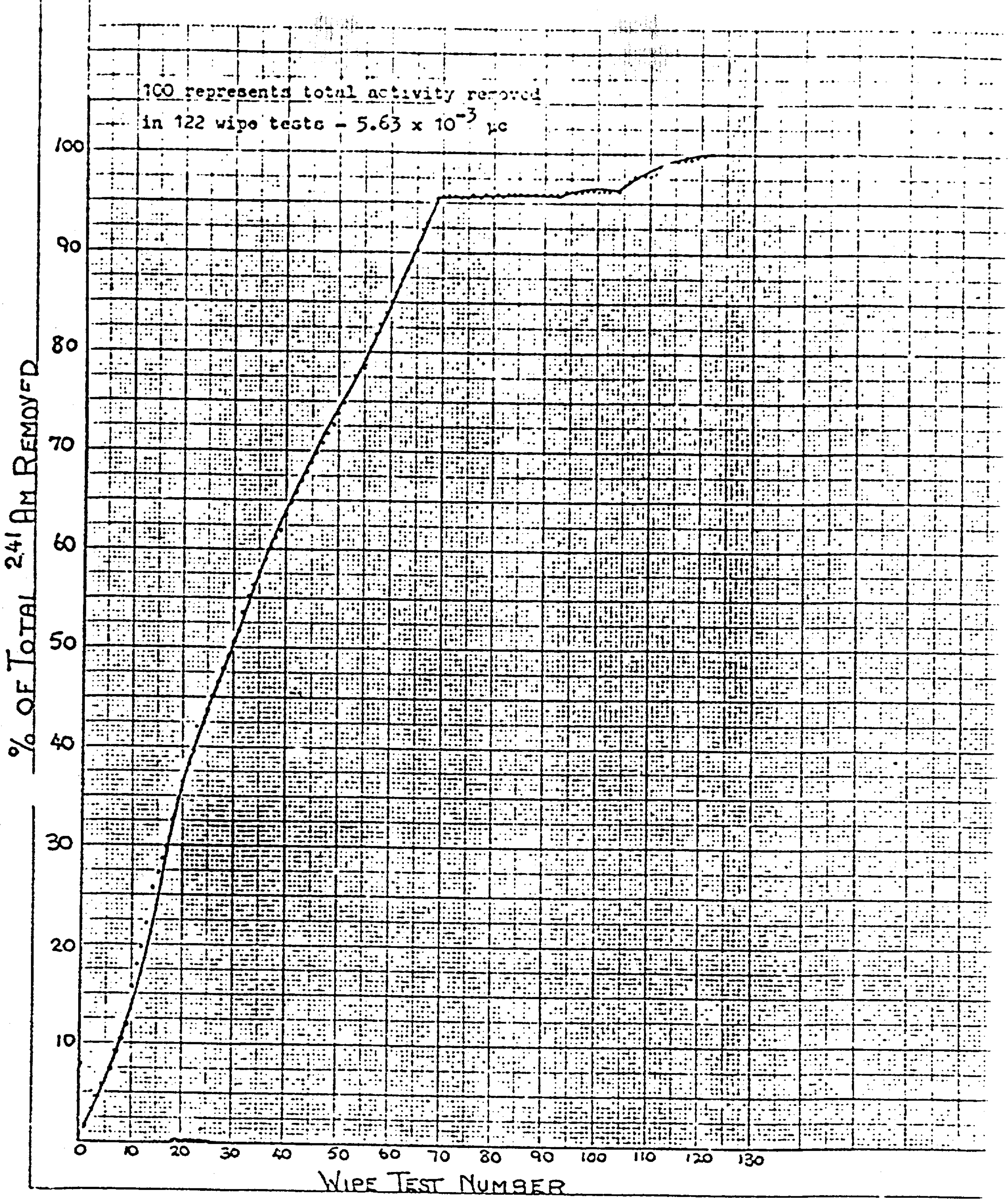
GOLD FACED F IL

Graph showing removable contamination by continuous wipe testing from ^{241}Am foil until wipe testing filter papers gave no detectable amount.



gold/palladium alloy 94% , 6% Pd)

Graph showing removable contamination by continuous wipe testing from ^{241}Am foil until wipe testing filter papers gave no detectable amount.



Testing of Americium-241 Alpha Foils

Test Samples

Samples of foil type [illegible] 2 1 cm long, active width 12.5 mm, overall width 20 mm, containing 100 µCi americium-241.

Initial Immersion Test: < 0.005 µCi extracted during 16 hours immersion test.

Wipe Test: < 0.005 µCi

CORROSION TESTING

Test 1. Sulphur dioxide test

Samples were exposed for 8 days to moist air containing 1% SO_2.
Immersion test - < 0.2 µCi extracted.
Wipe test - < 0.005 µCi.

2. Hydrogen chloride test

Samples were exposed for 16 days to dry air containing 1 mg HCl gas/litre.
Immersion test - < 0.005 µCi extracted.
Wipe test - < 0.002 µCi.

3. Ammonia test

Samples were exposed for 16 days to dry air containing 10 mg NH_3 gas/litre.
Immersion test - < 0.002 µCi extracted.
Wipe test - < 0.002 µCi.

HEATING TESTS

1. Samples were maintained at 600°C for 10 minutes and then rapidly cooled by immersion in water. This was carried out 50 times on each sample.
   Immersion test - < 0.005 µCi extracted.

2. Samples were maintained at 1200°C for one hour and then rapidly cooled by immersion in water.
   Immersion test - < 0.015 µCi extracted.
   Wipe test - < 0.2 µCi.

THORN Automated Systems

THORN Automated Systems Inc
Corporate Offices
835 Sharon Drive
Westlake, Ohio 44145
(216) 871-9900
FAX (216) 871-8320

AFFIDAVIT

I, E. Joseph Martini, Vice President Manufacturing Operations, on behalf of THORN Automated Systems, Inc. have read and understand all commitments made in the named supporting documents in Nittan Corporation's registration documents NR-481-D-101-E and NR-481-D-102-E and agree on behalf of THORN Automated Systems, Inc. to be legally bound by all statements and representations both express and implied made by Nittan Systems, Inc. in said registrations.

E. Joseph Martini

E. Joseph Martini

THORN Automated Systems, Inc.
Vice President Manufacturing Operations

State of Ohio
County of Cuyahoga

On the day of 13th March 1992 before me came E. Joseph Martini , of THORN Automated Systems, Inc. who executed the foregoing and acknowledged that he executed the same.

Mary Lee Aust

Notary - My Commission expires 12/14/92

featuring THORN Autocall life safety systems

ATTACHMENT A4

4

SECTION THREE

CONTENTS:

1. Copy of current license 34-23772-02E Amendment No. 02
2. Application
3. Attachment E1 – Copy of Registry for Amersham dated October 26, 1979
4. Attachment E2 – Amersham Data Sheet 11262
5. Attachment E3 – Detail drawings and bill of materials for 612I and 912I
6. Attachment E4 – Amersham Data Sheet 11247
7. Attachment E5 – Copies of point of sale labels
8. Attachment E6 – Loss Prevention Certification Board Test Reports
9. Attachment E7 – Copies of ISO 9001 Registrations
10. Attachment E8 – Procedures

021986

MATERIALS LICENSE

Amendment No. 02

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 39, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. Thorn Automated Systems, Inc.

2. 835 Sharon Drive
Westlake, Ohio 44145

In accordance with letter dated April 9, 1992

3. License number 34-23772-02E is amended in its entirety to read as follows:

4. Expiration date October 31, 1995

5. Docket or Reference No. 030-31616

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Americium 241	A. Foil sources in smoke detection devices (Amersham Model AMM1001H, Amersham USA AMM-1001)	A. (Not applicable See Condition 10)

9. Authorized Use

Pursuant to Section 32.26, 10 CFR Part 32, the licensee is authorized to distribute industrial type smoke detector devices as specified in Condition 10, to persons exempt from the requirements for a license pursuant to Section 30.20, 10 CFR Part 30, or equivalent provisions of the regulations of any Agreement State.

CONDITIONS

10. The following smoke detector devices may be distributed pursuant to this license provided the amount of Americium 241 contained in the device does not exceed the amounts specified in the following table:

Device Model	Maximum Quantity per Device
MF Series	1.0 microcurie
OIB (P/N PU90 2000-1 and P/N PU90 41000-1)	1.0 microcurie
NID 58	1.0 microcurie
NID 68 AS Series	1.0 microcurie

11. This license does not authorize possession or use of licensed material.

12. The licensee is only authorized to distribute from its facility located at 835 Sharon Drive, Westlake, Ohio.

NRC Form 374A
(5-84)

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number: 34-23772-02E

Docket or Reference number: 030-31616

Amendment No. 02

CONDITIONS

(continued)

13. The licensee shall file periodic reports as specified in Section 32.29(c), 10 CFR Part 32.

14. The licensee shall perform tests for leakage and/or contamination in accordance with procedures described in letter dated September 28, 1990. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, the detector lot shall not be transferred without additional evaluation, the manufacturer should be informed of the results and further sampling be performed in order to characterize the problem. Individual detectors shall not be transferred if further testing reveals the presence of 0.005 microcurie or more of removable contamination.

15. Except as specifically provided otherwise by this license, the licensee shall distribute licensed material described in Condition 10 of this license in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licenseee's application and correspondence are more restrictive than the regulations.

    A. Application dated March 14, 1990.

    B. Letters dated October 25, 1989; May 31, 1990; July 20, 1990; August 9, 1990; September 28, 1990; October 1, 1990; and October 2, 1990.

    C. Letters dated November 15, 1989; October 10, 1991; March 13, 1992; March 30, 1992; and April 1, 1992.

    D. Letter dated April 9, 1992.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

DATE: APR 15 1992

BY: [signature]

Michael A. Lamastra
Medical, Academic, and Commercial
Use Safety Branch
Division of Industrial and
Medical Nuclear Safety, NMSS
Washington, D.C. 20555

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE

(Corrected Copy)

NO.: NR136S174U **DATE:** October 26, 1979

SEALED SOURCE TYPE: Foil Source

MODEL: AMM1001, AMM1001H

MANUFACTURER/DISTRIBUTOR: Amersham Corporation
2636 S. Clearbrook Drive
Arlington Heights, IL 60005

MANUFACTURER/DISTRIBUTOR:

ISOTOPE: Americium-241 **MAXIMUM ACTIVITY:** 50 microcuries per square cm of foil

LEAK TEST FREQUENCY:

PRINCIPAL USE: Ion Generators, Smoke Detectors

CUSTOM SOURCE: ___ YES _X_ NO

ATTACHMENT E1

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE

NO.: NR136S174U **DATE:** October 26, 1979

SEALED SOURCE TYPE: Foil Source

DESCRIPTION:

The Model AMM 1001 sealed source consists of americium oxide uniformly distributed and sintered in a pure gold matrix which is further contained between a backing of gold coated pure silver and a front covering of either gold or gold-palladium alloy and fabricated by hot forging methods. The continuously welded metal layers are rolled so that the minimum thickness of the layers are:

gold-palladium alloy	0.0015 mm
americium oxide plus gold	0.0001 mm
gold	0.0001 mm
substrate	0.20 mm

Sub-division of the rolled foil is accomplished by cutting or punching into discs of 5 mm diameter or strips of say 2 mm x 10 mm diameter. At the activity loading specified above, there is no loose or wipable contamination above the wipe test limit of 0.005 microcuries.

The Model AMM 1001H mounted sealed source consists of a sized foil mounted in a "T" shaped standard holder constructed of tin plated brass. Lips of the source holder are rolled over the edge of the foil so the cut edges of the foil are not exposed. The larger diameter of the holder is approximately 5 mm and the length is approximately 6 mm. The useful life is 20 years.

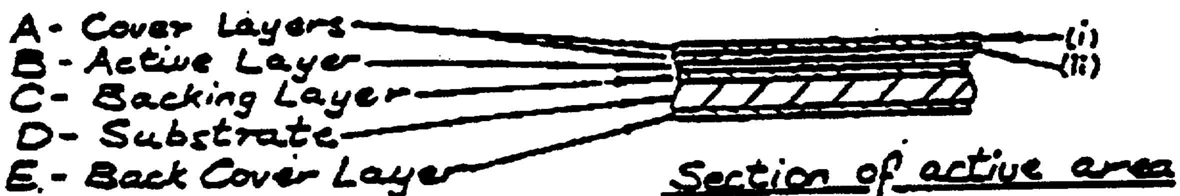
LABELING:

Neither the foils nor mounts are labeled. This evaluation does not describe possible A/S foil sources distributed under other model designations nor sources previously distributed under "AMM" designation.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE

SEALED SOURCE TYPE: Foil Source

DIAGRAM:



A - (i) Palladium ~ 0,002 mm
(ii) Gold ~ 0,0002 mm
B - Americium Oxide plus Gold ~ 0,002 mm
C - Gold ~ 0,001 mm
D - 0,20 - 0,25 mm
E - Gold - < 0,001 mm

PROTOTYPE TESTING:

Prototype Model AMM 1001 blanked sealed sources and Model AMM 1001H mounted sources have been tested to conditions described by USASI standard N5.10-1968 and respective classifications of C54545 and C44444 have been demonstrated. Results of wipe tests of the tested foils were acceptable to less than 0.005 microcuries. In addition, AMM 1001 samples have successfully passed "special form" testing conditions.

Model AMM 1001 foils have experienced the following additional tests:

1. Immersion in water of prototype foils for 3 weeks at room temperature: less than 0.001 microcurie per foil loaded at maximum activity was found in the water.

2. Immersion in 0.1 N hydrochloric acid for 24 hours at room temperature: less than 0.004 microcurie activity was leached out.

3. Foils were subjected to tests in moist air, dry air, sulfur dioxide fumes, hydrochloric acid fumes, ammonia vapor, to repetitive wipe tests (5000X) and welding tests: less than 0.005 microcurie wipable contamination was found. Shelf-life tests of foils with 50 microcuries/cm² loading show no deleterious aging effects after 6 years.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE

NO.: NR1365174U DATE: October 26, 1979

SEALED SOURCE TYPE: Foil Source

PROTOTYPE TESTING (CONT'D):

Foils and mounted foils have been subjected to ozone at 0.75 ppm for a period of 60 days and salt spray for 16 days without deleterious results.

QUALITY ASSURANCE AND CONTROL:

Not less than 10 percent of the Model AMM 1001H sources are checked by gamma counting to ensure that the activity in each foil is within specified limits. Each product is visually inspected to check that the rolled-over edge is satisfactory and that the alpha emitting surface is free from surface defects. Each source is wipe tested to an acceptance limit of 0.005 microcuries.

In addition to the above, each Model AMM 1001 foil is checked by alpha spectrometry to determine the adequacy of the gold cover.

REFERENCES:

Date October 26, 1979 Reviewed By /s/ Joseph M. Brown, Jr.

Date October 26, 1979 Concurrence /s/ Earl G. Wright

ISSUING AGENCY:

U.S. Nuclear Regulatory Commission