NRC FORM 313
(1-84)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB 3150-0120
Expires: 5-31-87

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

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

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OF WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

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

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

- [ ] A. NEW LICENSE
- [X] B. AMENDMENT TO LICENSE NUMBER 21-19874-01
- [ ] C. RENEWAL OF LICENSE NUMBER ______

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

Armson, Inc.
25304 Farmington Road
P.O. Box 2130
Farmington Hills, MI 48018

Region 3

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

25304 Farmington Road, Farmington Hills, MI 48018
and
37716 Hills Tech Drive, Farmington Hills, MI 48018 — New site

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION: Glyn A.J. Bindon

TELEPHONE NUMBER: 313 + 478-2577

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.
Possession - add C14 for R & D, increase H3

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES

8710060245 860214
REG3 LIC30
21-19874-01 PDR

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY 3K
AMOUNT ENCLOSED $ 60.00

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE—CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
Glyn A.J. Bindon	Glyn A.J. Bindon	President	7-27-85

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS

- [ ] <$250K
- [ ] $250K–500K
- [ ] $500K–750K
- [ ] $750K–1M
- [ ] $1M–3.5M
- [ ] $3.5M–7M
- [ ] $7M–10M
- [ ] >$10M

b. NUMBER OF EMPLOYEES *(Total for entire facility excluding outside contractors)*

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION *(Dollar and/or staff hours)* ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? *(NRC regulations permit it to protect confidential commercial or financial—proprietary—information furnished to the agency in confidence)*

- [ ] YES
- [ ] NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
Amd	Aug-20th	3538 3B	Aug-1 N/S for -020 Aug-1 for S&D *30 eb fee due - see 11/15/85 ltr.	G Jacobson

AMOUNT RECEIVED	CHECK NUMBER	DATE
$3380 (120†)	4778/4817 (#60 for fee)	8/26/85

PRIVACY ACT STATEMENT ON THE REVERSE

$340 5975 (deposited 5/87) Transferred 9/9/87 from 1/23/87 renewal request. Control 320042 - Jan 87 - 20th (ltr)

Continuation of NRC Form 313

Item 5, Radioactive material

a. Element and Mass Number: Carbon 14
b. Chemical and Physical form: Solid metal carbonate
c. Maximum amount which will be possessed at any one time:
Sealed sources manufactured by M B Microtec A.G. as described in patent description in Part D page 10 to 14, no single source in excess of 200 microcuries, 500 millicuries maximum.

Item 6, Purpose for which licensed material will be used:
Development of new gunsights with longer life illumination. Evaluate suitability for possible general or specific licenses.

Item 7 to 11 are listed in Part D.

Our understanding is that we are currently permitted to possess a maximum of 800 curies of Tritium as used in the Armson O.E.G. gunsight, and 100 curies of any GTLS made by M B Microtec. Upon approval of the requested quantities in part A and part B of this application, the tritium possession maximum would increase 150 and 360 curies of tritium for a combined total of 1,410 curies.

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Page 3

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Glyn A.J. Bindon

TELEPHONE NUMBER
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9. FACILITIES AND EQUIPMENT.

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12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
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AMOUNT ENCLOSED $ 60.00

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Glyn A.J. Bindon	Glyn A.J. Bindon	President	7-27-85

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FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY

AMOUNT RECEIVED	CHECK NUMBER		DATE

PRIVACY ACT STATEMENT ON THE REVERSE

Continuation of NRC Form 313

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This section contains information applicable to all parts of this application

Form 313 items:
Item 7, Individual responsible for radiation safety program and their training and experience:

Glyn A.J. Bindon operates as the radiation protection officer. He is a graduate of Parks College of St. Louis University with a Bachelor of Science Degree in Aeronautical Engineering. He worked on the main rocket engines of the Lunar Module of the Apollo Space program. This provided four years of experience with the very toxic chemical used for propulsion. He also has operated in the capacity of radiation protection officer at Armson, Inc. for over four years.

Mr. Bindon has received guidance from Dr. Henry Griffin, Ph.D. and Dr. Richard Copeland during their association with ERG. Although these men are not now associated with ERG, their services are available to Armson, Inc. on an as required consulting basis. Copies of their professional resumes are attached as pages 15 to 18 of Part D.

Item 8, Training for individuals working in or frequenting restricted areas:

All employees of Armson, Inc. are familiar with the need for care in handling and storage of the nuclear materials which are the subject of this application. As part of the training program for the present program which involves the handling of GTLS' as they are assembled into the telescopes and iron sights, personnel have made visits to other nuclear facilities.

Glyn A.J. Bindon has visited the M B Microtec A.G. facilities 3 times. Each visit has averaged 2 days and has included training in the handling of the tritium materials. He has also made one visit to the nuclear facilities of NRD in Grand Island, NY. Armson, Inc., has been on the NRC mailing list for several years. This provides information in the nuclear industry. Mr. Bindon reads the NPRM's and other materials available in order to be up to date industry problems and solutions. Mr. bindon has also toured the optical assembly facilities of Swarovski Optik in Tirol, Austria; Kern & Co., in Aarau, Switzerland and of course Armson Sales (Pty) Ltd., in New Germany, South Africa: all places where tritium illuminated optical gunsights are assembled.

Other employees who will be involved are also exposed to all opportunities to become better trained.

Carolyn R. Bindon has a Bachelor of Arts degree in Classics from Houghton College in 1960. She has been familiar with the operations at Armson, Inc. for the entire experience with tritium illuminated gunsights. She has also visited both M B Microtec A.G. and NRD nuclear facilities.

Stephen G. Bindon is a senior at the University of Michigan in their Bachelor of Science program in Chemical Engineering. In addition to his training in engineering, he has worked for 3 years for Armson, Inc., and has been intimately involved with the development program for the devices now presented for licensing for exempt distribution. He has visited the University of Michigan

copy

Regis 3

Nuclear Chemistry laboratories, and witnessed the entire test program at ERG which is reported on pages 3 and 4 of this section.

Item 9, Facilities and Equipment

The present facilities, located at 25304 Farmington Road have been supplemented with new industrial facilities at 37716 Hills Tech Drive. A layout of the new facility is shown on page 9 of Part D. This sheet also shows more detail on the equipment.

Item 10, Radiation Safety Program

Armson, Inc. will maintain an on going program similar to that described in item 8 above.

Item 11, Waste Management:

Armson, Inc. will store old reticle assemblies which are removed from gunsights. These will be stored in a safe place until 1000 are collected or 10 years, whichever occurs first. These will then be properly packaged and sent to a commercial waste disposal facility. Inserts can also be removed and replaced by this method.

Environmental Research Group
Nuclear Studies Department

Wipe Procedure - Tritium

1. Dampen 1/4 section of Whatman #40 filter with D.I. H_2O.
2. Wipe sample surface thoroughly.
3. Place filter in centrifuge tube along with 1 1/2 ml of D.I. H_2O.
4. Shake capped tube for 24 hours.
5. Remove 1 ml of H_2O from tube, add 10 ml L.S.C. and count along with standards (1 ml standard ^3H water solution) and blanks (blank filter extracted with 1 1/2 ml D.I. water - count 1 ml + cocktail)
6. Report results as:

$$\text{nCi in sample} = \frac{(\text{cts smp} - \text{cts blk})}{\text{cts std}} \left(\frac{\text{nCi in std}}{0.667}\right)$$

(detection limit for Armson project is 5 nCi)

erg
ENVIRONMENTAL RESEARCH GROUP, INC.
117 N. FIRST ST.
ANN ARBOR, MI 48104 (313) 662-3104

ANALYTICAL REPORT

Project: A3082

Report Date: 06/06/85

Results by Sample

Prepared for:
ARMSON, INCORPORATED
PO BOX 2130
FARMINGONT HILLS, MI 48018
Attention: GLYN A.J. BINDON

Client P O.: LETTER
Report #: 119
Samples Rec'd: 05-31-85

Approved: Thomas J. Cullen Jr.
Refer Questions to
CAROLYN NOACK

**
Residual Samples Will Be Held
For Two Weeks
**

Client ID	1) 1.5X-5X-32 MARLIN .444	2) 1.5X-5X-32 WEATHERBY 460	3) 2X-7X-40 WINCHESTER 70 30	4) 2X-7X-40RF COLT AR-15 .223	5) 1X18 KERN/MB MICROTEC REFLEX	6) 3X-9X-56 BROWNING .300WM
ERG Sample Number	05/130788	05/130789	05/130790	05/130791	05/130792	05/130793
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter						
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

Client ID	7) 6X42 SWAROVSKI ZFM-T	8) 4X40 REM. MODEL 4 30-06	9) 4X KERN ZF 4X24	10) 6X56 STEYR SSG-P2 .308	11) 4X40 .308 NOMA MAGNA BOLT	11a) 1 DROP, 1M, ON GUN
ERG Sample Number	05/130794	05/130795	05/130796	05/130797	05/130798	05/130799
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter						
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

Client ID	11b) 20 DROPS, 1M, ON GUN	11c) 2 DROPS, 2M, ON GUN	11d) 20 MORE DROPS, 1M, OFF GUN	21) COLT ACE .22 PISTOL	22) S&W MODEL 65 .357 MAG	23) S&W MODEL 28 .357 MAG
ERG Sample Number	05/130800	05/130801	05/130802	05/130803	05/130804	05/130805
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter						
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

Client ID	24) S&W MODEL 586 .357 MAG	25) RUGER REDHAWK .44 MAG	26) COLT GOLDCUP .45 ACP	27) COLT OFFICE-RS MODEL .45 ACP	28) BROWNING HI POWER 9mm	29) SIG-SAUER P226 9mm
ERG Sample Number	05/130806	05/130807	05/130808	05/130809	05/130810	05/130811
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter						
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

CONTINUED

erg

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

Client ID	30) BARETTA 92SB 9mm	31) STEYER GB 9mm	32) HK P-7 9mm	33) EIBAR 32 (20 DROPS ON GUN	34) COLT AR-15 FRONT POST ONLY	35) H&K FRONT POST ASSEMBLY (2
ERG Sample Number	05/130812	05/130813	05/130814	05/130815	05/130816	05/130817
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter						
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

Client ID	36) DW FRONT POST (20 DROPS O	37) COLT PYTHON FRONT POST ONLY	38) S&W PARTRIDGE FRONT POST (2	39) H&K REAR SIGHT ASSEMBLY (	43) EIBAR 32 (2 DROPS ON GUN, 2M	44) COLT AR-15 FRONT POST
ERG Sample Number	05/130818	05/130819	05/130820	05/130821	05/130822	05/130823
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter						
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

Client ID	45) H&K FRONT POST (2 DROPS, 2	46) DW FRONT POST ON GUN (2 D	47) COLT PYTHON FRONT POST ONLY	48) S&W PARTRIDGE FRONT POST AS	49) H&K REAR SIGHT (2 DROPS,
ERG Sample Number	05/130824	05/130825	05/130826	05/130827	05/130828
Matrix	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE	WIPE SAMPLE
Parameter					
TRITIUM IN WIPE SAMPLE pCi/wipe	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi	<5 nCi/wi

Project Comments:

MAXIUM ALLOWED CONTAMINATION LIMIT IS 5.0 NANOCURIES.

Note Results indicated by '#' are in mg/Kg instead of mg/L
FR = See field report for result
NA = Not applicable to test requested
ND = Nondetected, detection limit in ()
SD = Sample damaged

SR = See attached report for result
< = Positive result but at unquantifiable concentration below inicated level
- = Test not requested for this sample

mb-microtec ag
CH-3172 Niederwangen/Bern
Freiburgstrasse 624
Telefon National 031 34 11 25
International + 4131 34 11 25
Telex 32 829 merbe

TEST AND INSPECTION REPORT

Tests below were performed on luminous inserts per enclosed drawings T 4367, T 4495, T 4496 and T 4520. The inserts contain gaseous tritium light sources (GTLS) manufactured by mb-microtec ag, Niederwangen, Switzerland.

The sources are registered with the US Nuclear Regulatory Commission (US NRC) under the Registry No: NR-446-S-102-S (Model 400/1) of September 27, 1984.

Tritium activities are:

T 4367	=	6 mCi T
T 4495	=	13 mCi T
T 4496	=	18 mCi T
T 4520	=	28 mCi T

The tests are specified in "American National Standard N540-1975, Classification of Radioactive Self-Luminous Light Sources". Test level 4 as described below applies:

1. Discolouration (N540, 7.2.)

   12 hours exposure to specified lamp. No discolouration or other effects to occur.

2. Temperature (N540, 7.3.)

   Storing in air at -55° and $+80^{\circ}$
   Standard cooling and heating equipment.

   Visual inspection not to reveal any evidence of failure.

3. Thermal shock (N540, 7.4.)

   Transfer from 80° to -55° environment. Equipment as in 2.

   Visual inspection not to reveal any evidence of failure.

4. Pressure, reduced (N540, 7.5.)

   Exposure to 87 mm Hg abs. Bell jar with vacuum pump.

   Visual inspection not to reveal any evidence of failure.

5. Impact (N540, 7.6.)

   Free fall to steel plate, 1m 20 times
   2m twice

   Visual inspection not to reveal any evidence of failure.

mb-microtec ag
CH-3172 Niederwangen/Bern
Freiburgstrasse 624
Telefon National 031 34 11 25
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6. Vibration (N540, 7.7.)

For 60 minutes in frequency range 10 to 55 Hz.

Attachment of test samples to moving coil (less membrane) of dynamic loudspeaker, which is powered by wobbler and followed by 100 W amplifier.

Visual inspection not to reveal any evidence of failure.

7. Immersion (N540, 7.8.)

Baths at 0°C and 80°C, cycled.

Radioactivity in hot plus cold bath water not to exceed 50nCi tritium .

8. Final Pass/Fail Test (N540, 8)

On test samples having passed tests 1 through 7 above.

8.1. Visual inspection for failure or degradation.

8.2. brightness loss less than 20%

8.3. loss of radioactivity less than 50nCi T per source for 24 hrs water soak.

RESULTS

Test 1. Discolouration:

Source test performed successfully per condition in US NRC certificate of registration Nr-446-S-102-S

Test 2. Temperature:

Tested: 5 inserts each type (20 total)

Results: all passed

Test 3. Temperature shock:

Tested: 5 inserts each type (20 total)

Results: all passed

mb-microtec ag
CH-3172 Niederwangen/Bern
Freiburgstrasse 624
Telefon National 031 34 11 25
International + 4131 34 11 25
Telex 32 829 merbe

Test 4. Pressure (reduced):

Tested: 5 inserts each type (20 total)

Results: all passed

Test 5. Impact:

Tested: 5 inserts each type (20 total)

Results: all passed

Test 6. Vibration:

Tested: 5 inserts each type (20 total)

Results: all passed

Test 7. Immersion:

Tested: 5 inserts each type (20 total)

Results: Assay of radioactivity in bath water by liquid scintillation counting (Beckman Scintillation Spectrometer):

Each type: < 1nCi T per 5 inserts.

(counts over 1 minute within the statistical error the same as for blank bath water)

All passed

Test 8. Final Pass/Fail:

Tested: 5 inserts each type

Results: Visual inspection: all passed

Brightness loss: 1.5% max.

Loss of radioactivity:
5 inserts each type soaked together total 4 soak tests

Results: Assay for radioactivity in 24 hour soak water as per Test 7.

Each type per soak test (and per insert) < 1nCi T

All passed

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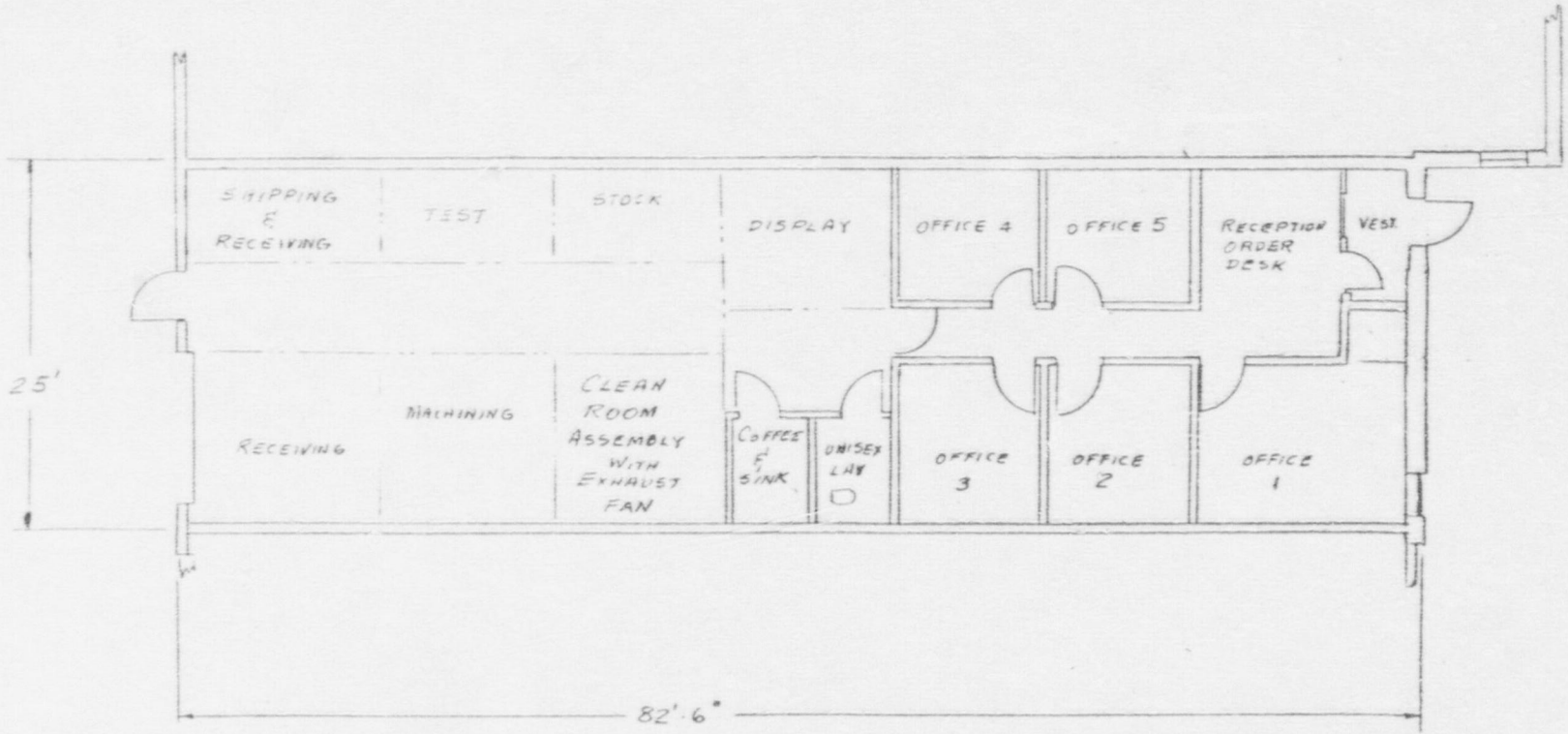
Telex 32 829 merbe

RESULTS SUMMARY

Inserts T 4367, T 4495, T 4496, T 4520 meet Test Level 4 requirements per ANSI N540 and are classified as TIGC1444444.

Certified: Date: April 2, 1985

Head QC:



All nuclear assembly work will be done in the clean room area. Filtered air is used to control cleanliness for the optical systems. Some air will be exhausted. The entire area is 16 ft high, giving a large internal volume compared to the magnitude of the nuclear storage. Completed assemblies are placed in the stock area. A small storage shelf will be located near the exhast fan at the 12 ft level. The main stock of lamps and inserts not in process will be kept here. A record count of stock will be kept. Any breakages will be logged. No other special equipment is planned other than the use of tritium wipes by ERG as used in the development program.

2050 sq. ft. of 37716 Hills Tech Drive

ARMSON, INC. P. O. BOX 2139 FARMINGTON HILLS MICHIGAN 48018	FLOORPLAN - OFFICE & FACTORY			
	INCHES (mm) SB 7-12-85	Scale: 1/8" = 1'	Dwg. No. 1433	

Rev. 7-26-85

United States Patent [19]

Thuler

[11] **4,020,203**

[45] **Apr. 26, 1977**

[54] **LUMINOUS MARKING IN AN INDENTATION OF AN OBJECT**

[76] Inventor: **Oscar Thuler**, Freiburgstrasse 624, 3172 Niederwangen, Berne, Switzerland

[22] Filed: **Mar. 27, 1975**

[21] Appl. No.: **562,516**

[30] **Foreign Application Priority Data**

May 22, 1974 Switzerland 7056/74
June 15, 1973 Switzerland 8751/73

[52] **U.S. Cl.** ..... **428/35**; 428/67; 428/417; 428/428; 427/66; 252/301.6 S

[51] **Int. Cl.**[2] **B32B 3/08**; B32B 3/10; C09K 11/00; H05B 33/00

[58] **Field of Search** ..... 427/66; 428/917, 35, 428/67, 45, 131, 417, 428; 252/301.1, 301.2 R, 301.3 R, 301.6 S

[56] **References Cited**

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3,908,055	9/1975	Susuki et al.	428/67

Primary Examiner—Philip Dier
Attorney, Agent, or Firm—Blum, Moscovitz, Friedman & Kaplan

[57] **ABSTRACT**

A luminous mark on an object is provided by a phosphor and a source of nuclear radiation in an indentation of the object, the materials being held in place by a transparent cover closing said indentation.

15 Claims, 4 Drawing Figures

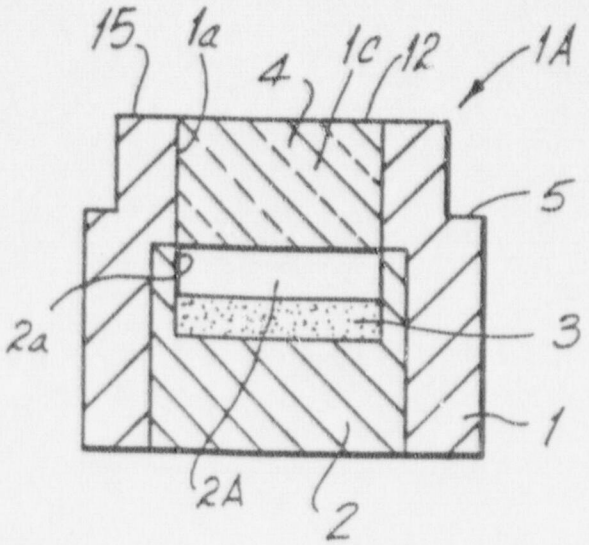


FIG. 1

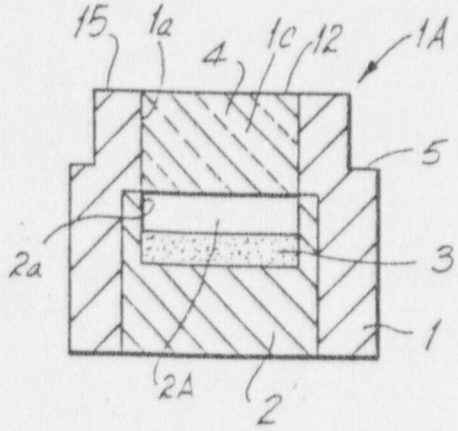
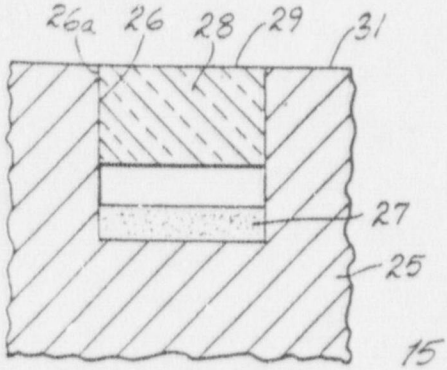


FIG. 4



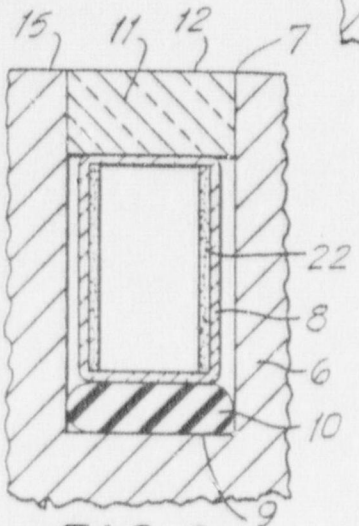


FIG. 2

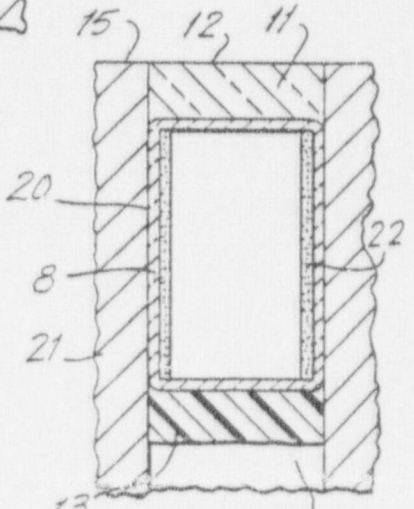


FIG. 3

LUMINOUS MARKING IN AN INDENTATION OF AN OBJECT

BACKGROUND OF THE INVENTION

In conventional luminous marking techniques, a metal or plastic segment of an object to be marked is provided with a small indentation or is countersunk. Into an indentation is placed a small quantity of a phosphorescent material and a source of nuclear radiation. In order to meet requirements imposed by the law, a protective cover must be provided to prevent direct contact with the radioactive material. A standard practice has been to use a plastic material as the cover. Also, it has been conventional to make the indentation containing the radioactive material sufficiently deep so that the exterior of the cover lies at a lower level than the surface of the surrounding object. Because the indentation and the cover are generally of small diameter, say about 2 mm, direct contact with the cover is not apt to occur. However, it has been found that if the object having one or more lumin markings is handled roughly or is used outdoors as is the case with a weapon, or if the object is exposed to abrasive materials, then a plastic cover may be damaged.

A more serious problem arises from the fact that the temperature coefficient of expansion of plastics is much larger than that of metals. Consequently, if the object is subjected to large changes in temperature as may be the case with a weapon which is fired many times in quick succession, then the plastic cover may fail to maintain effective closure over the indentation, eventually permitting escape of nuclear radiation.

SUMMARY OF THE INVENTION

Where an object to be provided with a luminous marking has an indentation therein, a phosphor and a source of nuclear radiation are placed in the indentation and the mouth of the indentation is sealed with an artificial sapphire of appropriate shape and size, the outer surface of the sapphire cover being essentially flush with the surface of the object.

In another embodiment the phosphor is in a sealed glass capsule which also contains a source of nuclear radiation. The capsule is seated on a resilient material such as rubber and the mouth of the indentation is again sealed with a sapphire so dimensioned that its outer surface is essentially flush with the surface of the object and its inner surface bears on the glass capsule.

Preferred luminescent materials are zinc sulfide, cadmium sulfide and mixtures thereof. Preferred sources of nuclear radiation are metal carbonates containing C^{14} and, where a glass capsule is used, tritium. Krypton may also be used as the source of nuclear radiation in a glass capsule.

Accordingly, an object of the present invention is a luminous marking on an object where the luminescence is provided by a phosphor and a source of nuclear radiation in an indentation or an aperture in the object, protection against contamination by the nuclear material being provided by a sapphire.

Another object of the present invention is a luminous marking in an object where a sapphire is mounted in an indentation or aperture so that its exterior surface is essentially flush with the surface of the object.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a sectional view of an embodiment of the invention wherein a sapphire provides protection against contact with or exposure to a radioactive material positioned within a sleeve;

FIG. 2 is a sectional view of an embodiment of the invention wherein a radioactive material and a phosphor are enclosed in a glass capsule seated in an indentation in an object to be marked;

FIG. 3 is a sectional view of an embodiment in which a glass capsule is held in place in an aperture in an object between a transparent sapphire cover and a seal of cast and hardened organic resin;

FIG. 4 is a sectional view of an embodiment wherein a radioactive material and a phosphor are positioned in an indentation in an object to be marked, said indentation being sealed by a transparent sapphire cover flush with the cover of said object.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment of the invention shown in FIG. 1 is particularly suitable for use in relatively shallow objects where it is desired to make specific points or regions conspicuous. Thus, said embodiment would be useful for indicating conspicuously a point upon a dial beyond which the indicator, such as a needle, should not travel, excursion beyond said point being taken as an indication that the device being monitored by the meter including the luminously-marked dial and the needle has exceeded the range of safe operation.

The construction of the embodiment of FIG. 1 is simple and inexpensive. The sleeve, generally indicated by the reference numeral 1A, includes annular member 1 which can be of any suitable metal but preferred, are brass, nickel-silver and corrosion-resistant aluminum alloys.

Plug 2, preferably of the same metal as member 1, is positioned within aperture 1C of member 1 and has a pocket 2A therein in which are placed a phosphor and a solid source of nuclear radiation 3. Suitable phosphors are zinc sulphide, cadmium sulphide and mixtures thereof. Suitable sources of nuclear radiation, also to be termed activators, are metal carbonates containing C^{14}. Examples are the sodium, lithium, potassium, barium and calcium carbonates. Barium carbonate is particularly satisfactory due to its low solubility in water. The luminous composition formed of the phosphor and the activator are held in the pocket of plug 2 by a binding agent. Generally the luminous composition is held in place by a binder consisting of a transparent organic synthetic resin such as polyvinyl alcohol, styrene or methyl-methacrylate. Preferably interior walls 1a and 2a should be reflecting, either specularly or diffusely.

It is necessary that the luminous source be protected from entry of moisture, and particularly of entry of acid since an acid of any appreciable strength would displace the carbonate ion, thereby destroying the activa-

tor. For this purpose transparent cover 4 of artificial sapphire is inserted into the mouth of the aperture 1c in member 1. Sapphire cover 4 makes an interference fit with wall 1a in member 1 and should be positioned so that the outer surface 12 of sapphire cover 4 is essentially flush with the adjacent surface 15 of member 1. Preferably member 1 is annular, as aforenoted, and the indentations therein are also annular, i.e., cylindrical. Sapphire cover 4 is therefore also cylindrical. The diameter of cover 4 should be about 2mm and said cover is disc-shaped.

Sleeve 1A holding plug 2 and cover 4 is designed for insertion into an aperture in an object (not shown). Shoulder 5 may be used during the positioning of the assembly in the object.

Activation by means of C^{14} is particularly suitable for the purposes of the present invention due to the fact that it is a source of pure beta-radiation having a maximum energy of 155 KeV and a half-life of 5570 years.

It is clear that a sapphire crystal cover will withstand essentially all chemical and mechanical effects as well as high temperature and temperature changes. In addition, the fact that the sapphire crystal is so small, namely, about 2 mm., results in resistance of the crystal to rotation or other displacement. Moreover, when the outer surface 12 of crystal 4 and the adjacent surface 15 of member 1 and the surface of the object are flush, then cleaning of the crystal surface presents no problem. The inorganic crystal cover in interference fit with the mouth of the indentation gives complete protection against escape of the carbon activator from the device. So far as absorption of the beta-radiation is concerned, a sapphire crystal cover is several orders of magnitude more effective than plastic which is frequently used. This is due in part to the considerably higher specific gravity of the inorganic material which for a sapphire crystal is about 400 mg/cm² per millimeter of thickness compared to about 50 mg/cm² for the usual plastic cover which is about 0.5 mm thick. The higher absorption of sapphire than plastic in the region of interest is due to the fact that the absorption of radiation is proportional to the fifth power of the atomic number of the absorbing material. The principal atomic numbers in plastics are 6 for carbon and 1 for hydrogen whereas for sapphire they are 13 for aluminum and 8 for oxygen.

It is not necessary to provide a special case-like insert to obtain luminous markings in accordance with the present invention. The preferred method is to use an indentation, that is countersinking, made directly in a surface of the object which is to be marked luminously. A dot of luminescent material can then be placed in this indentation and covered by a sapphire crystal using an interference fit. This technique is especially suitable for instruments, as aforenoted, especially where they are unlit and are to be used in the dark. Thus, they can be used on a meter, night-glasses, a telescope, etc. They can also be used in the form of dotted marks to provide a focusing point. Such a construction is shown in FIG. 4 in which object 25 has an indentation 26 therein, with luminescent composition 27 positioned in said indentation. The indentation 26 is sealed with a transparent sapphire crystal cover 28 making an interference fit with wall 26a of indentation 26. Again, surface 29 of the crystal 28 is flush with surface 31 of the object 25.

The embodiment of FIG. 2 is preferred because of the fact that the radioactive source is not exposed during preparation of the luminous markings. Object 6 which is to be fitted with a luminous marking has an indentation 7 therein in which is inserted a resilient material 10, preferably a soft rubber, which is seated at bottom 9 of the indentation in the object 6. Resting on resilient material 10 is a glass capsule 8 having a phosphor 22 held to its walls by a binder. The phosphor is preferably zinc sulphide but also may be cadmium sulphide or a mixture of the two sulphides. The capsule also contains a radioactive gas, preferably tritium, but also, may be krypton. Capsule 8 is preferably biased against resilient material 10 by crystal cover 11 mounted to be essentially flush with the surface of object 6. The object of such biasing is to increase the shock-resistance of the assembly. However, where shock and vibration will be absent, such biasing is unnecessary. Crystal cover 11 is a transparent artificial sapphire and is seated in object 6 in a press fit. The primary seal against escape of radiation is provided by the glass capsule and a secondary seal is provided by the press fit between the crystal and the mouth of the indentation. Glass capsule 8 fits slidingly within the indentation in object 6. The dimensions of the capsule can be very small, a preferred size being about 2 mm in outer diameter and 5 mm long. The result is that when viewed from any distance the marking appears to be a dot of slight or negligible depth.

In the embodiment of FIG. 3 object 21 has an indentation passing completely therethrough so that the indentation constitutes an aperture 21*a*. The glass capsule 8 may be sized to make a sliding fit with the interior wall 20 of the aperture and then may be held by a crystal cover 11 press-fitted to one end of the aperture and by a hardened casting material such as a silicone resin or an epoxy resin at the other end thereof. The outer surface 12 is flush with adjacent surface 15 to avoid entrapment of dirt. The enclosures consisting of the vall 20, crystal 11 and resin 13 provide excellent protection against breakage of the capsule and consequent escape of radioactive gas. Again, it is preferred that the interior surface 20 of object 21 be reflecting, in the interest of enhancing the brightness of the illumination provided by the marker.

Preferred binders for the phosphor 22 in the glass capsule are orthophosphoric acid and sodium and potassium silicate. These binders are inorganic and do not darken under the effect of the nuclear radiation.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description are efficiently attained and, since certain changes may be made in the above article without departing from the spirit and scope of the invention it is intended that all matter contained in the above description and shown in the accompanying Drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. Luminous marking on an object, said object having an indentation therein, comprising a phosphor in said indentation, a source of nuclear radiation in said indentation and an artificial, transparent sapphire crystal shaped to conform to the mouth of said indentation and to form a seal for confining said phosphor and source of nuclear radiation within said indentation and for preventing entry of corrosives or acids from the exterior,

the outer surface of said sapphire crystal being essentially flush with the outer surface of said object at said indentation.

2. The luminous marking as defined in claim 1, wherein said phosphor is an inorganic compound selected from the group consisting of ZnS, CdS and mixtures thereof.

3. The luminous marking as defined in claim 1, wherein said source of nuclear radiation is a metal carbonate containing C^{14}.

4. The luminous marking as defined in claim 1, wherein said metal carbonate is $BaCO_3$.

5. The luminous marking as defined in claim 1, wherein said crystal makes an interference fit with the mouth of said indentation.

6. The luminous marking as defined in claim 1, wherein said object is annular and at least the interior surface of said indentation in said object is of a material selected from the group consisting of nickel, silver and a corrosion-resistant aluminum alloy.

7. The luminous marking as defined in claim 5, wherein the interior of said indentation is reflective.

8. The luminous marking as defined in claim 1, further comprising a sealed glass capsule, said capsule containing said phosphor and said source of nuclear radiation, and an inorganic binder for holding said phosphor against the wall of said capsule, said capsule fitting within said indentation, and a resilient material between the bottom of said indentation and said capsule.

9. The luminous marking as defined in claim 8, wherein said source of nuclear radiation is selected from the group consisting of tritium and krypton.

10. The luminous marking as defined in claim 8, wherein said capsule is biased against said resilient material by said sapphire crystal.

11. The luminous marking as defined in claim 1, wherein said indentation is an aperture passing completely through said object, said transparent sapphire crystal sealing one end of said aperture, and further comprising a glass capsule enclosing said phosphor and source of nuclear radiation, and an organic resin positioned proximate the other end of said aperture for holding said capsule within said aperture.

12. The luminous marking as defined in claim 11, wherein said organic resin is selected from the group consisting of epoxy resin and silicone resin.

13. The luminous marking as defined in claim 11, wherein said phosphor is selected from the group consisting of ZnS, CdS and mixtures thereof.

14. The luminous marking as defined in claim 11, wherein said source of nuclear radiation is selected from the group consisting of tritium and krypton.

15. The luminous marking as defined in claim 1, wherein said indentation is cylindrical in cross-section and said sapphire is a disc.

* * * * *

PROFESSIONAL RESUME

NAME: Henry C. Griffin

EDUCATION: Ph.D., Nuclear Chemistry, M.I.T.

B.S, Chemistry, Physics & Mathematics, Davidson College

POSITION: Manager, Nuclear Studies Department

CAPABILITIES:

- Nuclear Chemistry
- Radiation Measurements
- Nuclear Systems
- Background Radiation Studies
- Computer Applications

EXPERIENCE:

Environmental Research Group, Inc.

Directs and supervises all of ERG's nuclear studies throughout the United States. Responsible for development of low level background measurement systems and computerization of ERG's nuclear chemistry facilities. Broad experience in fission chemistry and analytical analysis of plutonium isotopes.

Department of Chemistry, University of Michigan

Assistant Professor, 1964-70, Associate Professor, from 1970 on; Director of Freshman Studies, 1974-78.

Department of Nuclear Engineering, University of California (Berkeley)

Visiting research engineer (with S.G. Prussin) 1978-79.

Lawrence Livermore Laboratory; Nuclear Chemistry Division

Summer 1978.

Swiss Federal Reactor Institute, Wurlenlinger, Switzerland

Guest scientist (with H.R. von Gunten) 1971-72.

Argonne National Laboratory

Research associate, chemistry division, 1962-64 (with L.E. Glendenin), guest scientist, summers 1965, 1966, 1967, January-August 1968.

PUBLICATIONS: Over 40 publications from 1961 to the present dealing with all phases of nuclear chemistry and computerization of nuclear measurement systems.

AFFILIATIONS: American Chemical Society
American Physical Society
American Association for the Advancement of Science
Recognized in American Men & Women of Science
14 ed. 1979.

PROFESSIONAL RESUME

NAME: Richard A. Copeland

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Ph.D., Environmental Chemistry,
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B.S., Geology and Chemistry,
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POSITION: Vice Chairman of the Board of Directors
Nuclear Studies Manager

CAPABILITY:
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- o Management of Research and Development Programs
- o Environmental Impact Assessment
- o Unique Nuclear Chemistry Background for Nuclear Activation Analysis

EXPERIENCE: Environmental Research Group, Inc.

President and Senior Program Manager, problem identification and problem solving. Responsible for guiding the growth of ERG from its inception to one of the nation's leading environmental analytical firms. Currently responsible for developing the company's new product and service areas and directing the Nuclear Studies Program.

Specialist in environmental measurements, air, surface and subsurface processes, and problems associated with hazardous wastes.

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Ann Arbor, Michigan

Assistant Research Chemist responsible for major project to analyze the effect of atomic power plant effluent in the Great Lakes Region. Measuring, tracing and monitoring utility air quality.

Department of Earth & Planetary Science

Massachusetts Institute of Technology
Cambridge, Massachusetts

Served in a variety of teaching and research positions in the field of geochemistry.

RESUME
Richard A. Copeland
Page Two

PUBLICATIONS: Over 15 publications/presentations including three ERG special reports published in collaboration with other staff members and consultants. The latter constitute significant contributions to environmental research as conducted under his jurisdiction.

AFFILIATIONS: Director, Association of Environmental Laboratories
Sigma Xi
American Association for the Advancement of Science

Sending his Fax

[redacted] 2, 1986

Glyn A. J. Hinton
Armson, Inc.
P. O. Box 2130
Farmington Hills, Michigan 48018

Dear Mr. Hinton:

This refers to application dated July 27, 1985 requesting authorization to distribute gunsights containing tritium to persons exempt from the requirements for a license. Enclosed is License No. 21-19874-02E which has been amended in entirety to authorize distribution of three types of gunsights. Please note, we only authorized the distribution of iron-sights installed on weapons.

As we discussed on the telephone, we did not grant your request to distribute sights unmounted on a weapon. This would increase the likelihood of misuse of the site and thus increase the possible doses resulting from misuse of the product and/or accidental damage of the product. Your request would also increase the likelihood of exposure of non-users of the product who received no benefit from product use.

Please review this license and its conditions for correctness and to assure any changes in procedures required by the conditions are implemented.

Sincerely,

John W. N. Hickey
Material Licensing Branch
Division of Fuel Cycle and
Material Safety

Enclosure:
License No. 21-19874-02E

6[illegible]8248 1P.

FCML FCML
SLBaggett:ht JHickey
01/ /86 01/ /86

NRC Form 374
(5-84)

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

Amendment No. 01

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, 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. Armson, Inc. P. O. Box 2130 2. Farmington Hills, Michigan 48018	3. License number: In accordance with application dated July 27, 1985 21-19874-02E is amended in its entirety to read as follows: 4. Expiration date: January 31, 1989 5. Docket or Reference No.: 030-20771

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. Hydrogen-3	A. Sealed light sources (Saunders-Roe Model PRH 880/G/200 or MB Microtec A.G. Model 400 Series)	A. Not applicable (See condition 10.)

9. Authorized use

A. Pursuant to 10 CFR Section 32.22 the licensee is authorized to distribute sealed light sources in gunsight or scopes listed in condition 10 to persons exempt from the requirements for a license as defined by 10 CFR 30.19.

CONDITIONS

10. The licensee is authorized to distribute the following:

(1) Sealed light sources installed in optically magnifying scopes manufactured by Trijicon with a maximum activity of 75 millicuries.

(2) Sealed light sources installed in Occluded Eye Gunsights Model Armson O.E.G with a maximum activity of 160 millicuries.

(3) Sealed light sources installed in Iron Sight inserts manufactured by Trijicon and mounted on a weapon prior to distribution with a maximum activity of 30 millicuries per source and 90 millicuries per weapon.

8604070247 2pp

NRC Form 374A (5-84) U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE
SUPPLEMENTARY SHEET

PAGE 2 OF 2 PAGES

License number: 21-19874-02E

Docket or Reference number: 030-20771

Amendment No. 01

CONDITIONS

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

12. Each device distributed under this license shall be manufactured with materials and construction methods tested and labeled in accordance with the provisions of Section 32.22, 10 CFR Part 32, Section 30.19, 10 CFR Part 30 and all statements, representations and procedures contained in application dated July 27, 1983 and July 27, 1985; and letters dated November 9, 1983, November 18, 1983, January 3, 1984, November 15, 1985, January 8, 1986 and January 9, 1986.

JAN 23 1986

FOR THE U. S. NUCLEAR REGULATORY COMMISSION

DATE _____

BY _____
Material Licenisng Branch
Division of Fuel Cycle and
Material Safety
Washington, D. C. 20555

1/21/86

3