ADAMS Template: SECY-067

DOCUMENT DATE: 12/07/1965

TITLE: PRM-030-020 - - SELF LUMINOUS SCREW

CASE REFERENCE: PRM-030-020

KEY WORD: RULEMAKING COMMENTS

Document Sensitivity: Non-sensitive - SUNSI Review Complete

JUN 13 1968

PRM 30-20

Luminous Products Corporation
379 Albany Street
Boston, Massachusetts 02118

Attention: Mr. Felix R. Baleo
Technical Director

Gentlemen:

Enclosed for your information is a notice of proposed rule making to revise the Commission's regulations, 10 CFR Parts 30 and 32.

The proposed revisions would:

(a) establish a class exemption for self-luminous products containing tritium, krypton 85 and promethium 147 when such products have been manufactured, imported, or transferred pursuant to a specific license issued to a manufacturer by the Commission for distribution for use under the exemption; and

(b) establish requirements and criteria for the issuance of specific licenses authorizing manufacture, import or distribution of self-luminous products containing such byproduct material for possession and use under the exemption and requirements for reports of transfers of byproduct material under the license.

If this rule is adopted, the framework would be established within the regulations whereby specific licenses could be issued for exempt distribution of the products specified in your petition for rule making (PRM 30-20). It would be necessary that such products meet the conditions of sections 32.22, 32.23, and 32.24 of the proposed amendments.

JUN 1 8 1968

The notice of proposed rule making is being transmitted to the Office of the Federal Register. The notice will allow a period of 60 days for public comment after publication in the Federal Register. Any comments you may wish to offer will receive careful consideration.

Sincerely yours,

Original signed by
Forrest Western

Forrest Western, Director
Division of Radiation Protection
Standards

Enclosure:
Notice of Proposed Rule Making

Distribution:
Formal File
Supplemental File
Secretariat w/cy for
Public Document Room
Attn: Stan Robinson
Product Standards Branch, RPS

RPS:PAB	RPS:PSB	RPS:DDIR	RPS:DIR
MEFitzPatrick:mfs			
GLHutton	RFBarker	LRRogers	FWestern
/ /68	/ /68	/ /68	/ /68

PRM 30-20

MAY 9 1966

Luminous Products Corporation
575 Albany Street
Boston, Massachusetts 02118

Attention: Mr. Felix R. Baleo
Technical Director

Gentlemen:

Thank you for your letter of April 15, 1966, with the results of the tests to which you have subjected certain of your molded plastic sources.

These results appear to be in good agreement with the information you provided at the time of your recent visit to Bethesda.

Sincerely yours,

Original signed by
Forrest Western

Forrest Western, Director
Division of Safety Standards

Distribution
Formal
Supplemental
Public Document Room
Secretariat

DSS	DSS	DSS
JNehemias:sf	RJCatlin	FWestern

DOCKET NUMBER
PETITION RULE PRM 30-
Self-luminous Screws

PRM 30-20

TEL 426-7311 | AREA CODE 617

LUMINOUS

LUMINOUS PRODUCTS CORPORATION 575 ALBANY STREET, BOSTON, MASSACHUSETTS 02118

April 15, 1966

DOCKETED USAEC APR 18 1966 SECRETARY DOCKET CLERK

DOCKETED USAEC MAY 3 1966 Office of the Secretary Public Proceedings Branch

Dr. Forrest Western
Director, Division of Safety Standards
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Sir:

In further support of our petition for rule making, PRM-30, the following supplemental information, demonstrating that the proposed self-luminous screws, prepared by our molded plastic technique, possess an unusual degree of safety, is submitted.

The activated phosphor in these molded plastic sources is suspended in 80 - 90% of a clear, inert, non-radioactive plastic, resulting in a rigid source in which nearly all the radioactive phosphor particles are totally embedded in the clear plastic medium. The possibility of chipping, flaking, cracking, peeling, or dusting commonly associated with self-luminous painted surfaces is entirely eliminated.

To demonstrate the extreme inertness and insolubility of these molded plastics, sources were prepared at different activity levels and soaked in 100 ml of a variety of solutions for extended periods of time. Aliquots of the soaking media were removed periodically and counted. These results are tabulated on the attached sheet.

It should be emphasized that these tested sources were not protected or coated in any manner prior to the immersion tests. The proposed use requests the exemption of 5 millicuries of tritium per unit in which these sources are further incorporated into a sturdy metal housing and securely crimped behind a clear plastic window so that the self-luminous source itself may be removed from the housing only with extreme difficulty.

Thank you for your consideration.

Sincerely yours,

LUMINOUS PRODUCTS CORPORATION

Felix R. DeLeo
Technical Director

Attachment

ERD:ich

DOCKET NUMBER
PETITION RULE PRM 30-20
Self-luminous Screw

Dr. Forrest Western

Attachment

April 15, 1966

Total mcs. H^3 In Source	Soaking Medium	Length of Soak (hrs.)	Microcuries H^3 in Medium	Percentage of Total Soaked Off
59	0.1 N HCl	24	14	0.024
45	0.1 N HCl	24	13	0.031
59	0.1 N HCl	24	14	0.024
35	H_2O	24	15	0.043
		144	95	0.27
		312	135	0.39
35	H_2O	24	18	0.052
		144	98	0.28
		312	145	0.42
38	3% NaCl	24	28	0.074
		168	123	0.32
40	3% NaCl	24	31	0.077
		168	115	0.29
42	3% $NaHCO_3$	24	28	0.067
		168	123	0.30
42	3% $NaHCO_3$	24	28	0.067
		168	127	0.30
38	3% HOAc	24	34	0.09
		168	121	0.32
38	3% HOAc	24	30	0.078
		168	114	0.30
37	3% Lactic Acid	24	38	0.10
		168	146	0.40
37	3% Lactic Acid	24	29	0.078
		168	114	0.31
39	20% Sucrose	24	23	0.059
		168	110	0.28
42	20% Sucrose	24	8	0.019
		168	104	0.25

Felix R. DeLeo

Felix R. DeLeo, Technical Director

FRD:jcb

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

PRM 30-20

Luminous Products Corporation
575 Albany Street
Boston, Massachusetts 02118

Attention: Mr. Felix R. Deleo
Technical Director

Gentlemen:

Reference is made to your petition for rule making PRM 30-20, requesting certain amendments of the Commission's regulation "Rules of General Applicability to Licensing of Byproduct Material", 10 CFR 30.

The petition describes the tritium-activated self-luminous screws you wish exempted from Commission licensing requirements and, in broad, general terms, the kinds of products in which you envisage their use. It appears that, if the petition were granted in its present form, the self-luminous screws would be available to the public as off-the-shelf items. Also, the screws would be incorporated by manufacturers in a variety of products intended for use by the general public (consumer products).

In accordance with the provisions of the statement published in the Federal Register 3462, 1965 "Use of Byproduct Material and Source Material in Products Intended for Use by General Public (Consumer Products)", a copy of which is attached, Commission policy currently provides that exemptions from licensing requirements for consumer products will be made on a case-by-case basis.

As you know, the statement lists criteria used by the Commission in making a determination that a proposed exemption would be in the national interest. In relation to your petition, Criterion No. 4 appears to be especially significant. Up to this time the Commission has only exempted from regulatory control items in which the byproduct material was incorporated in a product such that conditions of use could be predicted with considerable confidence.

FEB 1 8 1966

More specifically, the Commission has favored conditions under which the byproduct material could not be diverted to unintended and undesirable uses without adversely affecting a valuable product.

In view of the possibility that the Commission will find that the proposed exemption does not meet its criteria, you may wish to amend your petition to request exemption of specific products of such a nature that the radioactive material is unlikely to be diverted to undesirable uses. If you were to so amend your petition, it would be necessary to describe each of the products in which byproduct material would be incorporated.

If you do not wish to amend your petition, you may wish to provide additional information in an effort to demonstrate that the apparent ease with which the byproduct material in the proposed self-luminous screws could be diverted to undesirable uses would be compensated by unusual degrees of utility and safety.

Your letter of December 7, 1965, states that similar self-luminous screws have been prepared by the thousands for licensed users for many years without incident. A more explicit discussion of such experience might be helpful.

We shall be glad to discuss this matter with you or your representative in our office should you consider that this would be helpful.

Sincerely yours,

Original signed by
Forrest Western

Forrest Western, Director
Division of Safety Standards

Attachment:
"Use of Byproduct Material and Source Material in Products Intended for Use by General Public (Consumer Products)"

DOCKET NUMBER
PETITION RULE PRM 30-20

Self-luminous Screw

JAN 12 1966

Luminous Products Corporation
575 Albany Street
Boston, Massachusetts 02118

Attention: Mr. Felix R. Dolce
Technical Director

Gentlemen:

Your letter of December 7, 1965, to the Chief, Isotopes Branch, is considered a petition for rule making as provided for by 10 CFR Part 2.802 of the Commission's regulations. The petition has been docketed to recognize the request for changes in the regulations in 10 CFR Part 30, "Licensing of Byproduct Material," and assigned Docket No. PRM-30-20. Further correspondence pertaining to this petition should reference this docket number.

As staff review progresses on this petition, it may be necessary to request additional information.

Sincerely yours,

Original signed by
Forrest Western

Forrest Western, Director
Division of Safety Standards

Distribution:
Formal
Supplemental
Public Document Room
Stan Robinson, Secy
OGC
F. Western
G. Hutton

DOCKETED
USAEC
JAN 13 1966
OFFICE OF THE SECRETARY
PUBLIC PROCEEDINGS
BRANCH

SS:ASDIR	SS:DIR	OGC
GHHutton:jm	FWestern	RShapar
1 /66	//66	/ /66

PETITION RULE PRM 30-20

TEL 426-7311 | AREA CODE 617

Self-luminous Screw

LPC LUMINOUS

LUMINOUS PRODUCTS CORPORATION 575 ALBANY STREET, BOSTON, MASSACHUSETTS 02118

PRM 30-2

December 7, 1965

DOCKETED USAEC JAN 12 1966

DOCKETED USAEC JAN 13 1966 OFFICE OF THE SECRETARY PUBLIC PROCEEDINGS BRANCH ers

Chief, Isotopes Branch
Division of Licensing and Regulation
United States Atomic Energy Commission
Washington 25, D.C.

Dear Sir:

Under the provisions of Federal Register 3462, 1965 "Use of Byproduct Material and Source Material in Products Intended for Use by General Public (Consumer Products)" exemption is requested of the possession and use of a tritium-activated, self-luminous, screw from the licensing requirements for by-product and source material of the Atomic Energy Act of 1954, as amended; and of the Commission's regulations, "Licensing of Byproduct Material" 10 CFR Part 30 and Licensing of Source Material, 10 CFR Part 40.

A lot of 15 prototype sources as described in the accompanying print was prepared and the sources subjected to the following series of tests.

Test 1. - Accelerated Weathering

5 of the test sources, 1 to 5 inclusive, were cleaned, wipe tested, and subjected to 100 hours of accelerated weathering in a Type D1-TS Atlas Weather-ometer in accordance with Federal Test Method Standard Number 141, Method 6151. At the conclusion of the 100 hours the sources were again wipe tested.

Source Number	Net dpm before weathering	Net dpm after 100 hrs
1	2290	1120
2	220	1550
3	1380	1060
4	-	1230
5	1450	1030

All counting in this test and subsequent tests was done in a Tri-Carb Liquid Scintillation Spectrometer.

Visual examination of the test sources after weathering revealed no detectable change in physical appearance. No trace of water was observed in the source cavity.

Test 2. - Radiological soak test

5 sources, designated 6 - 10 inclusive, were separately submerged in 100 ml of water for continuous soak testing. Aliquots of the soaking water were removed for assay periodically and the results tabulated below.

Source Number	Total activity in 100 ml H_2O-microcuries H^3 48 Hrs	96 Hrs	7 Days
6	-	-	0.008
7	-	0.023	0.015
8	-	0.009	0.013
9	-	0.018	0.004
10	-	-	-

Each of the test sources has 5 millicuries of tritium. It should be noted that in the least favorable case less than 0.0005% of the total activty was observed in the aqueous phase after 96 hours of continuous soaking.

Test 3. - Shock

Test was performed as specified in Par. 6·3·1 NBS Handbook 66, 28 May 1958. Ten sources, 1 - 5 and 11 - 15, were placed in a capped metal pipe three feet long. The pipe was rotated about its mid-point at such a speed that the sources approximated a free fall from one end to the other. The test was repeated for 100 falls. The sources were individually wipe tested. Six areas of the pipe interior were also wipe tested after removal of the sources.

Source Number	Net dpm - total wipe After shock test
1	200
2	130
3	170
4	60
5	40
11	190
12	630
13	380
14	-
15	210
Pipe Interior Position A	-
Pipe Interior Position B	540
Pipe Interior Position C	-
Pipe Interior Position D	-
Pipe Interior Position E	-
Pipe Interior Position F	2410

As a result of this test the sources show surface scratching and denting of the front plastic and the metal case. Ultra-violet examination of the interior of the test pipe and of the sources after

caps of the pipe or on the exterior surfaces of the sources.

Test 4. - Vibration

Sources 1 to 5 and 11 to 15 were next attached to a Vibration Fatigue Testing Machine and vibrated at 26 cycles per second and a vibration acceleration of twice the acceleration of gravity for one hour. The sources were wipe tested and examined under ultra-violet light after the test. No evidence of chipping, flaking or cracking of the luminous source was detected.

Source Number	Net dpm on total wipe after vibration test
1	2040
2	1060
3	1670
4	1500
5	2100
11	1870
12	1760
13	1690
14	1990
15	1130

Tritium for the proposed use is incorporated into a recently developed self-luminous molding plastic from which the sources are made upon the application of heat and pressure. Our experience has demonstrated that molded self-luminous sources are far superior to sources prepared from self-luminous paints. Wipe tests and soak tests are reduced by large factors. Chipping, flaking cracking and peeling, associated with painted deposits, are entirely eliminated.

Similar self-luminous screws have been prepared by the thousands for licensed users for many years without incident.

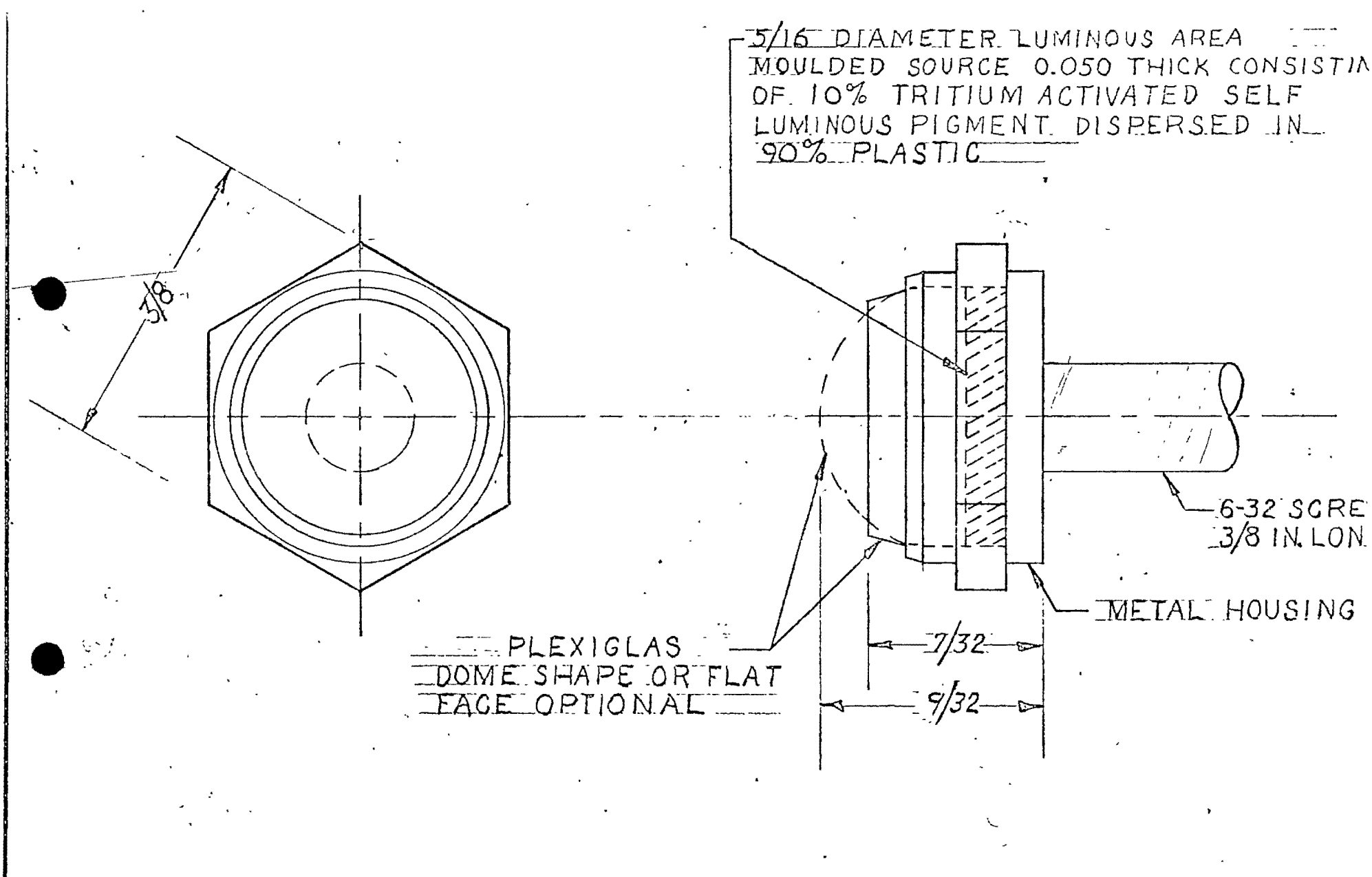
Marking the approximate position of light switches, electrical outlets, door bells, house numbers, dangerously protruding beams, stairs, posts or articles of furniture are a few benefits that may accrue to the public.

It is proposed that a maximum of 5 millicuries of tritium in the form of a self-luminous molded plastic be allowed for each device. Since such a device in normal use would be well removed from the person, the quantity of radioactivity is small and in an unusually safe physical form, the self-luminous source itself is well contained and may be removed from the housing only with extreme difficulty and force, and the external radiation is negligible, we feel that our material in the proposed form possesses an unusual degree of safety, and that the exemption of 5 millicuries of tritium in the described device, will not constitute an unreasonable risk to the common defense and security or to the health and safety of the public.

Respectfully submitted,

LUMINOUS PRODUCTS CORPORATION

E. D. Y. L.



MATERIAL SPECIFICATIONS	FRACTIONAL	DECIMAL	ANGULAR
	±	±	±

LUMINOUS PRODUCTS CORP
BOSTON, MASS.

DRAWN	EWG
CHECKED	

REV.	DATE	SCALE
	12-3-65	6-1

DO NOT SCALE DRAWING

NAME: RADIOACTIVE LUMINOUS BUTTON

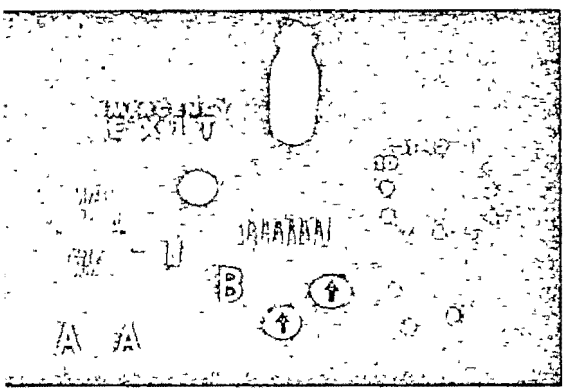
DRAWING NO: 100-1-7

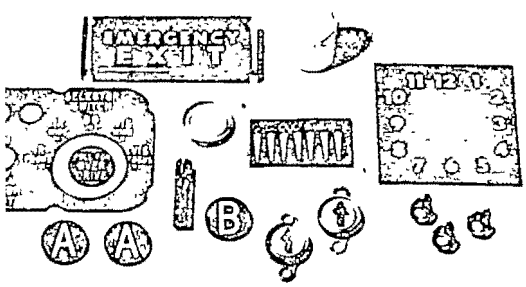
MOLDED SELF-LUMINOUS COMPONENTS

low cost

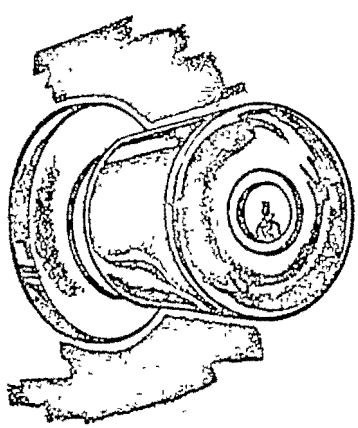
mass produced

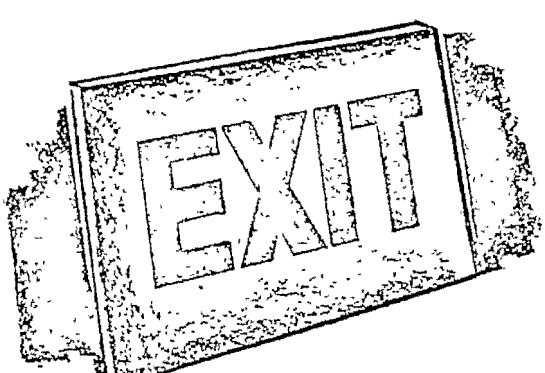
MOLDED SELF-LUMINOUS





Shown above are typical examples of molded, screened and painted self-luminous products made by Luminous Products Corp.





Until recently virtually all self-luminous products have been produced by brush or silk-screen application of self-luminous paints. These techniques are tedious and costly. In addition, the items produced are subject to chipping, flaking, cracking, and peeling. Luminous Products Corp. has now developed a unique, self-luminous plastic molding powder which permits the preparation of self-luminous components by injection molding. The radioactive phosphor particles are embedded in a clear plastic matrix which can be injection molded to produce a light, compact, rugged source. Both tritium and promethium-147 have been successfully incorporated into molded self-luminous components.

Injection molding is particularly suited to production of *large numbers of specific end items* such as chain pulls, lock illuminator sources, dark room markers, switch plate sources, and self-luminous automobile shift quadrants. Silk-screen printing or the application of decals directly to the lightweight self-luminous molded plaques offer great versatility in the preparation of a variety of signs. The elimination of handpainting or silk-screening of radioactive luminous paints permits substantial cost savings.

Molded sources have higher brightnesses, longer luminous life, and markedly improved soak and wipe test characteristics than equivalent sources prepared from self-luminous paints.

RADIOACTIVE SELF-LUMINOUS SUBSTANCES

Radioactive self-luminous substances are materials which emit light continuously. They consist of an intimate mixture of radioactive isotopes and phosphorescent crystals. The radioisotopes supply a continuous source of energy to the phosphorescent crystals which transform the radioactive energy into visible light.

The main advantages of self-luminous compounds are that they require no external power supply and can be incorporated into small rugged components which have a useful luminous lifetime years in length. Prior to World War II, radium (a naturally-occurring radioactive element which emits alpha, beta, and gamma radiation) was universally used in self-luminous substances. Since World War II, a great variety of artificial radioactive elements have become available. Two of these, tritium and promethium-147, have shown marked superiority over radium.

SUGGESTED APPLICATION

MILITARY AND SPACE

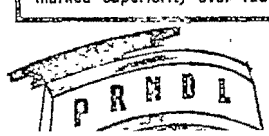
- ☐ SWITCH MARKERS
- ☐ PERSONNEL MARKERS
- ☐ GUN SIGHTS
- ☐ LEVEL GAUGES
- ☐ VEHICLE MARKERS
- ☐ INSTRUMENT PANELS

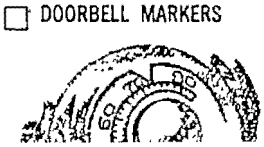
INDUSTRIAL

- ☐ EXIT SIGNS
- ☐ DARKROOM MARKERS
- ☐ DIRECTION POINTERS
- ☐ SWITCH MARKERS
- ☐ EMERGENCY BUTTONS

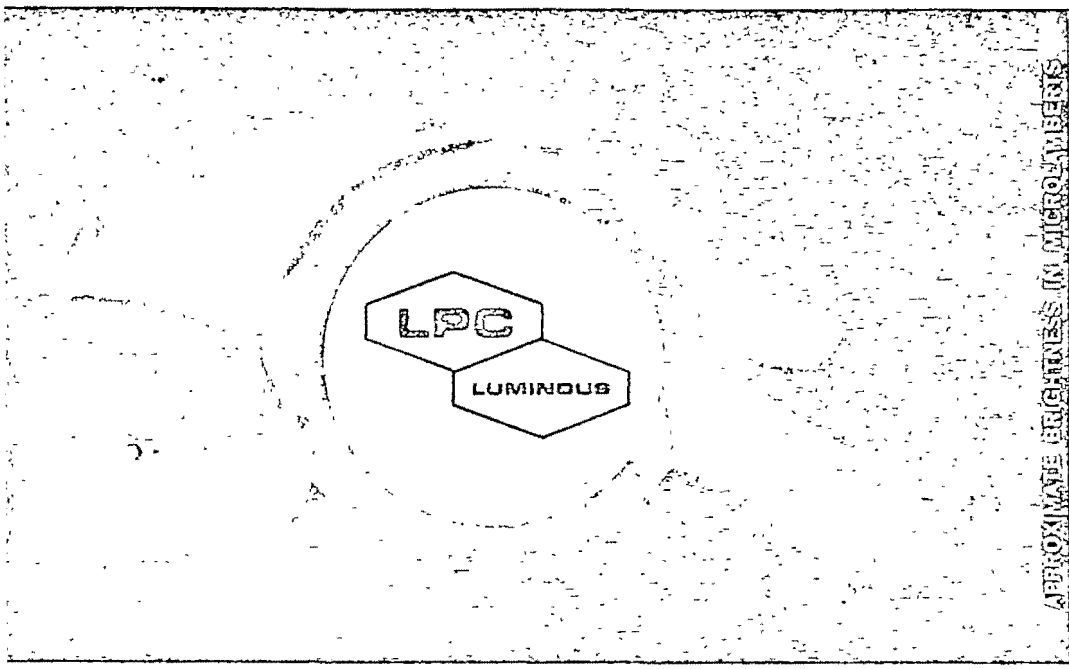
CIVILIAN

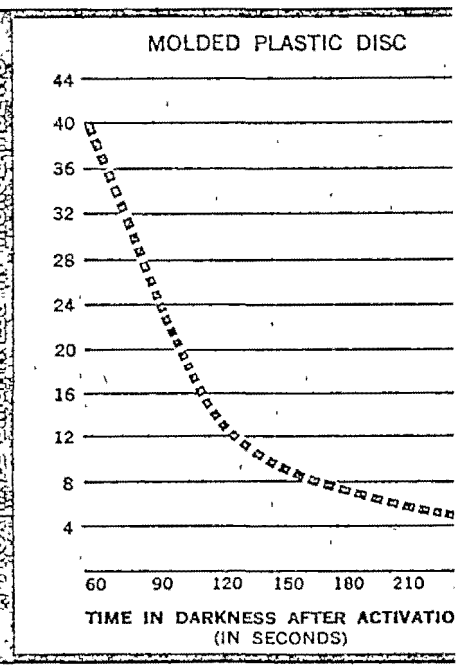
- ☐ TIMEPIECES (U.S. AEC APPROVED)
- ☐ SCREW HEADS
- ☐ AUTOMOBILE LOCK ILLUMINATORS (U.S. AEC APPROVED)
- ☐ HOUSEHOLD LOCK ILLUMINATORS
- ☐ THERMOSTAT DIALS
- ☐ EMERGENCY BUTTONS FOR ELEVATORS, TELEPHONES, ETC.
- ☐ LIGHT SWITCH MARKERS
- ☐ FUSE BOX LOCATORS
- ☐ DOORBELL MARKERS



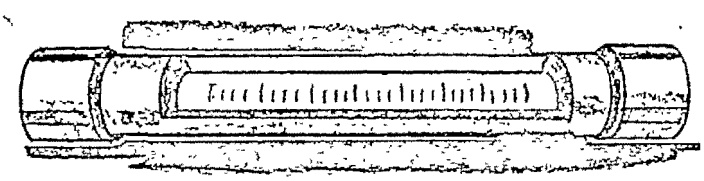


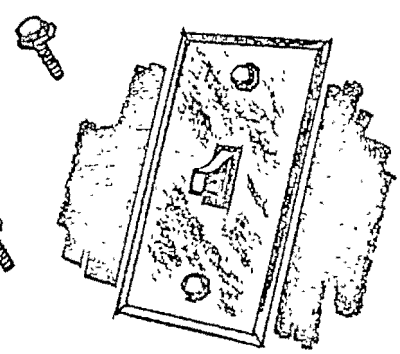
...MPONENTS ... *a new concept in self-luminosity*





escription: The attached disc is an example of a molded luminous plaque. The printing was pplied by silk screen stenciling. **Instructions:** U.S. AEC regulations prohibit the use of radioctive materials in this demonstration disc. Therefore, the disc must be energized by exposure o direct sunlight or a bright light for at least 15 seconds. After exposure to light, transfer the disc nmediately to a completely darkened area. A specific brightness can be visualized by consulting ie chart and determining the appropriate waiting time. For example, the brightness of the disc ill be approximately 14 microlamberts 120 seconds after removing the disc to a dark area followng direct exposure to light.



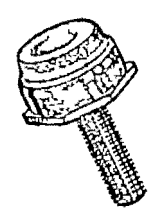


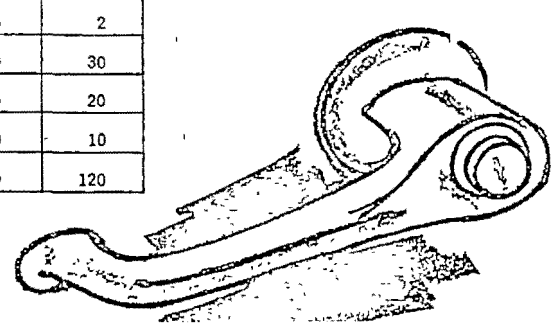
ADDITIONAL INFORMATION

olors: All maximum brightnesses estimated for arious application procedures are based on mission in the green spectral range (~5200A). Maximum attainable brightnesses with red or blue emitting phosphors are only about one-tenth of the brightness obtainable with green-emitting phosphors.

COMPARISON OF PRINCIPAL ISOTOPES FOR SELF-LUMINOUS PRODUCTS

ISOTOPE	ISOTOPE HALF-LIFE (YEARS)	MAXIMUM ENERGY OF EMISSION (MEV)		SURFACE RADIATION	FORM	MAXIMUM PRACTICAL SURFACE BRIGHTNESS (IN MICROLAMBERTS) WAVE LENGTH		
		BETA	GAMMA			BLUE 4100Å	GREEN 5200Å	RED 6300Å
TRITIUM (H^3)	12.5Y	0.018	NONE	NEGLIGIBLE	MOLDED PLASTIC	15	50	5
					PAINTED SURFACE	5	25	2
					GAS-FILLED SOURCE	150	1000	30
'ROMETHIUM — 147	2.6Y	0.22	NONE	LOW	MOLDED PLASTIC	50	200	20
					PAINTED SURFACE	20	150	10
KRYPTON — 85	10.76Y	0.67	0.54	SIGNIFICANT	GAS-FILLED SOURCE	600	2000	120





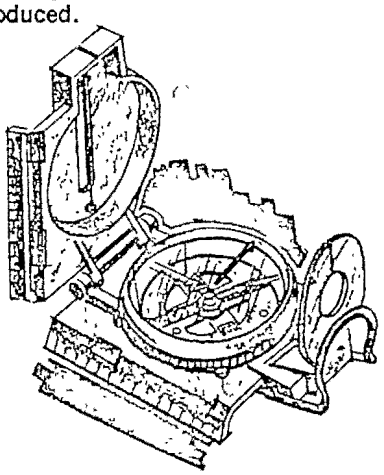
OTHER TECHNIQUES

There are certain applications not suited to injection molding of self-luminous components. For such applications, available techniques include:

Painting: Self-luminous paints are prepared from an intimate mix of phosphors and radioisotopes with binders and thinners. These paints can be applied by either silk-screen process or brush techniques. Typical applications are clock, watch, or instrument dials, watch hands, and compass bowls. These paints may also be used to fill or backfill engravings in plastic.

Gas Filled Sources: When brightnesses must be in excess of those obtainable by molding or painting, gas-filled sources can be considered. Gas filled sources employing tritium are prepared in a manner similar to the common fluorescent light bulb. The inner surface of a glass envelope is coated with phosphor and, after subsequent drying and baking, tritium gas is introduced and sealed into the cavity. The stronger beta energy available from krypton-85 permits the preparation of higher brightness gas filled sources.

Gas activated sources in the green spectral range have been prepared as bright as 2000 microlamberts for krypton-85 or 1000 microlamberts for tritium. By proper selection of the phosphor, it is possible to vary the color of the light produced.



All gas-filled, self-luminous sources are hermetically sealed and packaged in metal cases with plastic windows. The radiation level at the surface of tritium gas-filled sources is negligible. However, the gamma component of the krypton-85 isotope presents shielding problems and significant surface radiation.

TECHNICAL COMPETENCE

Luminous Products Corporation, a subsidiary of New England Nuclear Corp., has been engaged exclusively in the research, development, manufacture, and application of radioisotope activated self-luminous materials and sources since its formation in 1959. Under the registered trade name "Lumichron", self-luminous products manufactured at LPC have been employed for numerous applications. The competence of LPC's technical staff has been demonstrated by the successful completion of important government contracts for a variety of self-luminous materials. Among these was the first large scale government procurement of tritium activated self-luminous military compasses. Under a U.S. Army contract, LPC developed self-luminous light sources totally embedded in clear plastic for use as personnel and vehicle markers. A number of sources have been provided for the space effort.

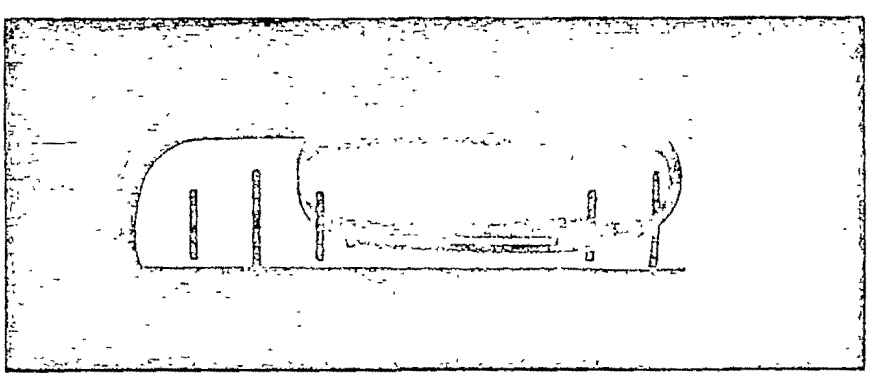
SOME LIMITATIONS

Although there are numerous feasible and practical applications for self-luminous substances, there are many more applications which are technically and/or economically unpractical or prohibited by law.

For instance, thousands of curies of tritium would be required to produce a light source equivalent to the average two battery flashlight.

Economic limitations are illustrated by the cost of producing the luminous area. Self-luminous materials of 20 microlamberts brightness are generally $1.50 per square inch for tritium activated materials, and $0.20 per square inch for promethium-147.

In addition, statutary limitations imposed by the U.S. AEC prohibit the use of self-luminous components for frivolous applications such as infants toys, fish lures, cuff links, etc.



LUMINOUS LEVEL VIAL

AEC LICENSING REGULATIONS

U.S.A.: Individual organizations wishing to employ self-luminous products must obtain a license from the U.S. Atomic Energy Commission. Luminous Products Corp., will assist prospective licensees in the preparation of the necessary forms.

Export Sales: Most export sales of self-luminous products are made without the necessity of a license from the U.S. Atomic Energy Commission. Prospective purchasers should, however, consult with local authorities about regulations governing the use of radioactive products in their countries.

LPC LUMINOUS

LUMINOUS PRODUCTS CORPORATION

575 ALBANY STREET, BOSTON, MASSACHUSETTS 02118

caps of the pipe or on the exterior surfaces of the sources.

Test 4. - Vibration

Sources 1 to 5 and 11 to 15 were next attached to a Vibration Fatigue Testing Machine and vibrated at 26 cycles per second and a vibration acceleration of twice the acceleration of gravity for one hour. The sources were wipe tested and examined under ultra-violet light after the test. No evidence of chipping, flaking or cracking of the luminous source was detected.

Source Number	Net dpm on total wipe after vibration test
1	2040
2	1060
3	1670
4	1500
5	2100
11	1870
12	1760
13	1690
14	1990
15	1130

Tritium for the proposed use is incorporated into a recently developed self-luminous molding plastic from which the sources are made upon the application of heat and pressure. Our experience has demonstrated that molded self-luminous sources are far superior to sources prepared from self-luminous paints. Wipe tests and soak tests are reduced by large factors. Chipping, flaking cracking and peeling, associated with painted deposits, are entirely eliminated.

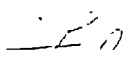
Similar self-luminous screws have been prepared by the thousands for licensed users for many years without incident.

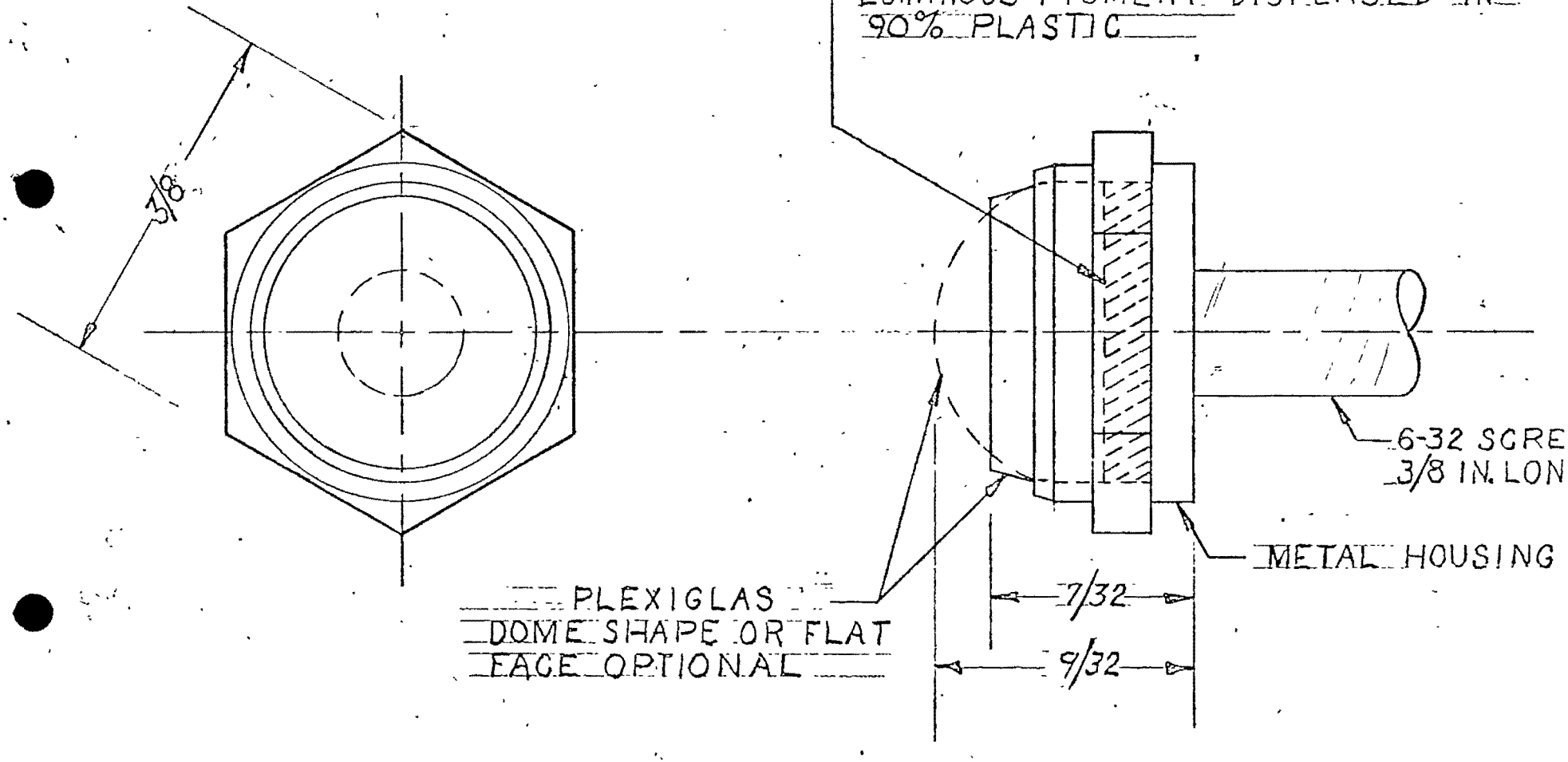
Marking the approximate position of light switches, electrical outlets, door bells, house numbers, dangerously protruding beams, stairs, posts or articles of furniture are a few benefits that may accrue to the public.

It is proposed that a maximum of 5 millicuries of tritium in the form of a self-luminous molded plastic be allowed for each device. Since such a device in normal use would be well removed from the person, the quantity of radioactivity is small and in an unusually safe physical form, the self-luminous source itself is well contained and may be removed from the housing only with extreme difficulty and force, and the external radiation is negligible, we feel that our material in the proposed form possesses an unusual degree of safety, and that the exemption of 5 millicuries of tritium in the described device, will not constitute an unreasonable risk to the common defense and security or to the health and safety of the public.

Respectfully submitted,

LUMINOUS PRODUCTS CORPORATION





MATERIAL SPECIFICATIONS	FRACTIONAL	DECIMAL	ANGULAR
	±	±	±

LUMINOUS PRODUCTS CORP
BOSTON, MASS.

		REV.	DATE	SCALE
DRAWN	Ewg		12-3-65	6-1
CHECKED			DO NOT SCALE DRAWING	
APP'D				

NAME: RADIOACTIVE LUMINOUS BUTTON

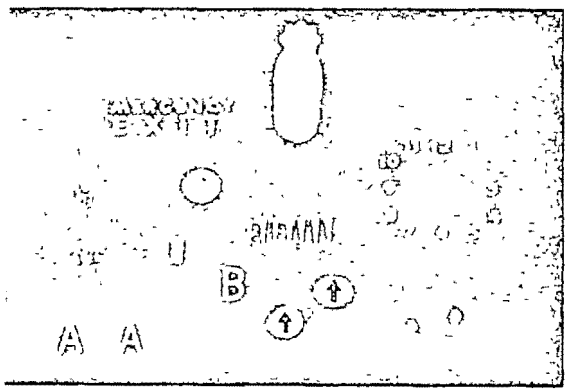
DRAWING NO. 100-1-7

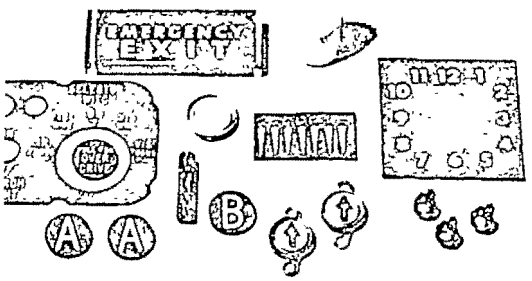
MOLDED SELF-LUMINOUS COMPONENTS

low cost

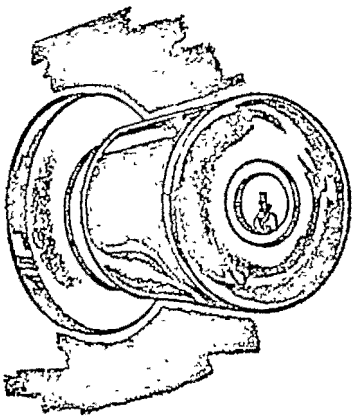
mass produced

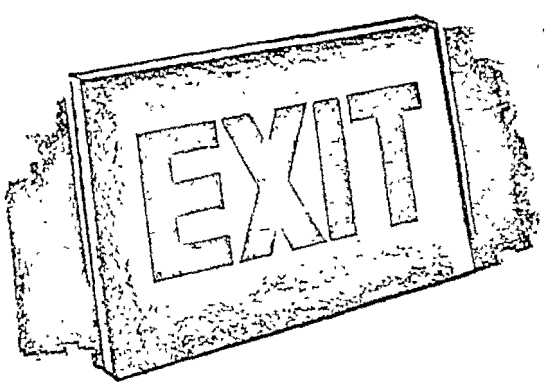
MOLDED SELF-LUMINOUS





Shown above are typical examples of molded, screened and painted self-luminous products made by Luminous Products Corp.





Until recently virtually all self-luminous products have been produced by brush or silk-screen application of self-luminous paints. These techniques are tedious and costly. In addition, the items produced are subject to chipping, flaking, cracking, and peeling. Luminous Products Corp. has now developed a unique, self-luminous plastic molding powder which permits the preparation of self-luminous components by injection molding. The radioactive phosphor particles are embedded in a clear plastic matrix which can be injection molded to produce a light, compact, rugged source. Both tritium and promethium-147 have been successfully incorporated into molded self-luminous components.

Injection molding is particularly suited to production of *large numbers of specific end items* such as chain pulls, lock illuminator sources, dark room markers, switch plate sources, and self-luminous automobile shift quadrants. Silk-screen printing or the application of decals directly to the lightweight self-luminous molded plaques offer great versatility in the preparation of a variety of signs. The elimination of handpainting or silk-screening of radioactive luminous paints permits substantial cost savings.

Molded sources have higher brightnesses, longer luminous life, and markedly improved soak and wipe test characteristics than equivalent sources prepared from self-luminous paints.

RADIOACTIVE SELF-LUMINOUS SUBSTANCES

Radioactive self-luminous substances are materials which emit light continuously. They consist of an intimate mixture of radioactive isotopes and phosphorescent crystals. The radioisotopes supply a continuous source of energy to the phosphorescent crystals which transform the radioactive energy into visible light.

The main advantages of self-luminous compounds are that they require no external power supply and can be incorporated into small rugged components which have a useful luminous lifetime years in length. Prior to World War II, radium (a naturally-occurring radioactive element which emits alpha, beta, and gamma radiation) was universally used in self-luminous substances. Since World War II, a great variety of artificial radioactive elements have become available. Two of these, tritium and promethium-147, have shown marked superiority over radium.

SUGGESTED APPLICATIONS

MILITARY AND SPACE

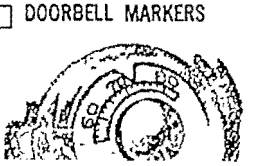
- ☐ SWITCH MARKERS
- ☐ PERSONNEL MARKERS
- ☐ GUN SIGHTS
- ☐ LEVEL GAUGES
- ☐ VEHICLE MARKERS
- ☐ INSTRUMENT PANELS

INDUSTRIAL

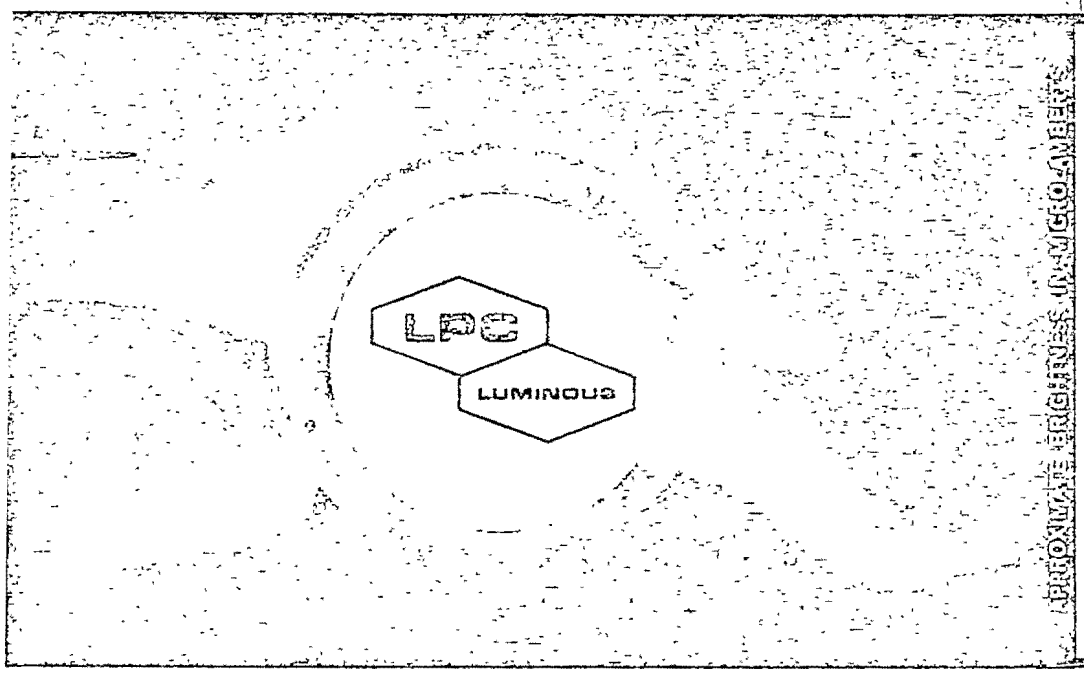
- ☐ EXIT SIGNS
- ☐ DARKROOM MARKERS
- ☐ DIRECTION POINTERS
- ☐ SWITCH MARKERS
- ☐ EMERGENCY BUTTONS

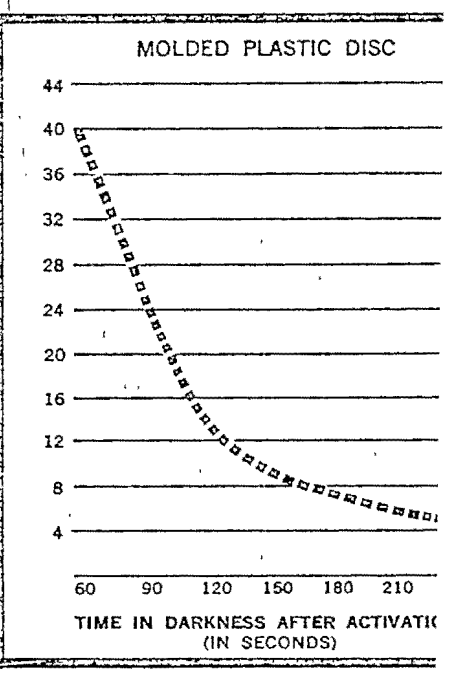
CIVILIAN

- ☐ TIMEPIECES (U.S. AEC APPROVED)
- ☐ SCREW HEADS
- ☐ AUTOMOBILE LOCK ILLUMINATORS (U.S. AEC APPROVED)
- ☐ HOUSEHOLD LOCK ILLUMINATORS
- ☐ THERMOSTAT DIALS
- ☐ EMERGENCY BUTTONS FOR ELEVATORS, TELEPHONES, ETC.
- ☐ LIGHT SWITCH MARKERS
- ☐ FUSE BOX LOCATORS
- ☐ DOORBELL MARKERS

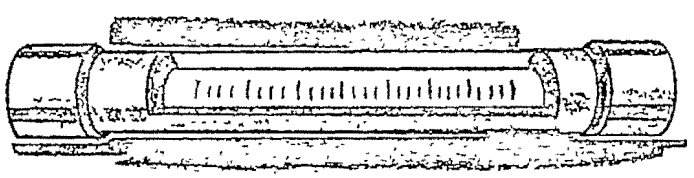


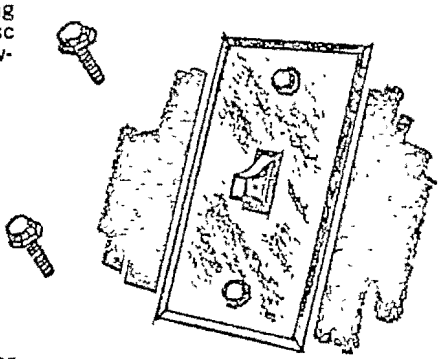
)MPONENTS ... *a new concept in self-luminosity*





Description: The attached disc is an example of a molded luminous plaque. The printing was applied by silk screen stenciling. Instructions: U.S. AEC regulations prohibit the use of radioactive materials in this demonstration disc. Therefore, the disc must be energized by exposure to direct sunlight or a bright light for at least 15 seconds. After exposure to light, transfer the disc immediately to a completely darkened area. A specific brightness can be visualized by consulting the chart and determining the appropriate waiting time. For example, the brightness of the disc will be approximately 14 microlamberts 120 seconds after removing the disc to a dark area following direct exposure to light.



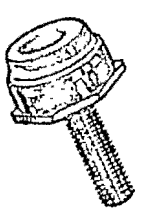


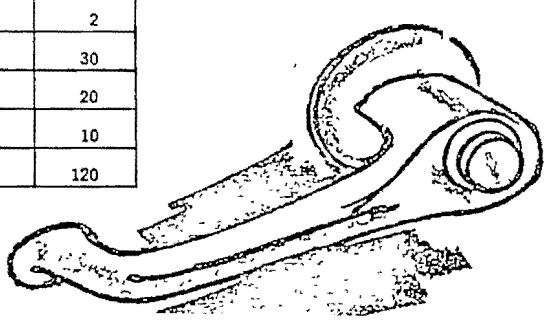
ADDITIONAL INFORMATION

Colors: All maximum brightnesses estimated for various application procedures are based on emission in the green spectral range (~5200A). Maximum attainable brightnesses with red or blue emitting phosphors are only about one-tenth of the brightness obtainable with green-emitting phosphors.

COMPARISON OF PRINCIPAL ISOTOPES FOR SELF-LUMINOUS PRODUCTS

ISOTOPE	ISOTOPE HALF-LIFE (YEARS)	MAXIMUM ENERGY OF EMISSION (MEV)		SURFACE RADIATION	FORM	MAXIMUM PRACTICAL SURFACE BRIGHTNESS (IN MICROLAMBERTS) WAVE LENGTH		
		BETA	GAMMA			BLUE 4100Å	GREEN 5200Å	RED 6300Å
TRITIUM (H^3)	12.5Y	0.018	NONE	NEGLIGIBLE	MOLDED PLASTIC	15	50	5
					PAINTED SURFACE	5	25	2
					GAS-FILLED SOURCE	150	1000	30
PROMETHIUM — 147	2.6Y	0.22	NONE	LOW	MOLDED PLASTIC	50	200	20
					PAINTED SURFACE	20	150	10
KRYPTON — 85	10.76Y	0.67	0 54	SIGNIFICANT	GAS-FILLED SOURCE	600	2000	120





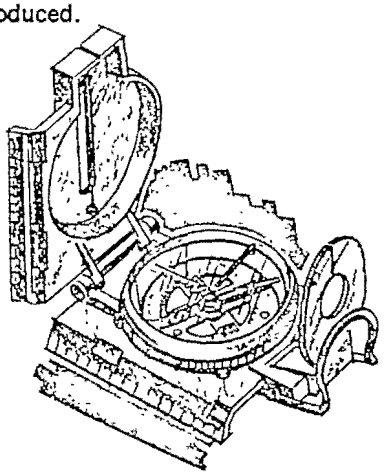
OTHER TECHNIQUES

There are certain applications not suited to injection molding of self-luminous components. For such applications, available techniques include:

Painting: Self-luminous paints are prepared from an intimate mix of phosphors and radioisotopes with binders and thinners. These paints can be applied by either silk-screen process or brush techniques. Typical applications are clock, watch, or instrument dials, watch hands, and compass bowls. These paints may also be used to fill or backfill engravings in plastic.

Gas Filled Sources: When brightnesses must be in excess of those obtainable by molding or painting, gas-filled sources can be considered. Gas filled sources employing tritium are prepared in a manner similar to the common fluorescent light bulb. The inner surface of a glass envelope is coated with phosphor and, after subsequent drying and baking, tritium gas is introduced and sealed into the cavity. The stronger beta energy available from krypton-85 permits the preparation of higher brightness gas filled sources.

Gas activated sources in the green spectral range have been prepared as bright as 2000 microlamberts for krypton-85 or 1000 microlamberts for tritium. By proper selection of the phosphor, it is possible to vary the color of the light produced.



All gas-filled, self-luminous sources are hermetically sealed and packaged in metal cases with plastic windows. The radiation level at the surface of tritium gas-filled sources is negligible. However, the gamma component of the krypton-85 isotope presents shielding problems and significant surface radiation.

TECHNICAL COMPETENCE

Luminous Products Corporation, a subsidiary of New England Nuclear Corp., has been engaged exclusively in the research, development, manufacture, and application of radioisotope activated self-luminous materials and sources since its formation in 1959. Under the registered trade name "Lumichron", self-luminous products manufactured at LPC have been employed for numerous applications. The competence of LPC's technical staff has been demonstrated by the successful completion of important government contracts for a variety of self-luminous materials. Among these was the first large scale government procurement of tritium activated self-luminous military compasses. Under a U.S. Army contract, LPC developed self-luminous light sources totally embedded in clear plastic for use as personnel and vehicle markers. A number of sources have been provided for the space effort.

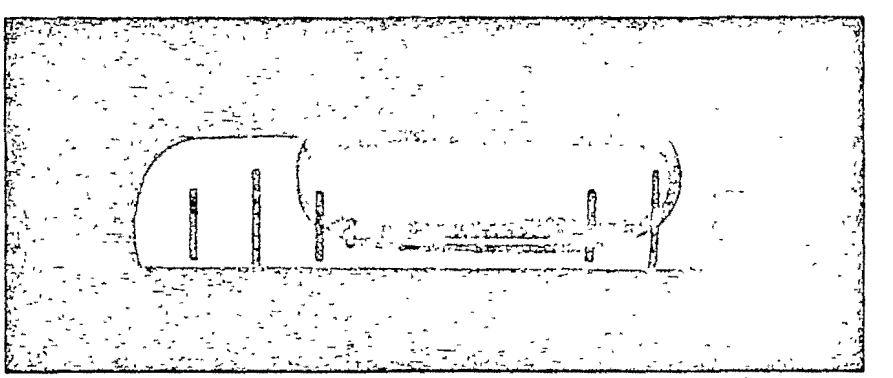
SOME LIMITATIONS

Although there are numerous feasible and practical applications for self-luminous substances, there are many more applications which are technically and/or economically unpractical or prohibited by law.

For instance, thousands of curies of tritium would be required to produce a light source equivalent to the average two battery flashlight.

Economic limitations are illustrated by the cost of producing the luminous area. Self-luminous materials of 20 microlamberts brightness are generally $1.50 per square inch for tritium activated materials, and $0.20 per square inch for promethium-147.

In addition, statutary limitations imposed by the U.S. AEC prohibit the use of self-luminous components for frivolous applications such as infants toys, fish lures, cuff links, etc.



LUMINOUS LEVEL VIAL

AEC LICENSING REGULATIONS

U.S.A.: Individual organizations wishing to employ self-luminous products must obtain a license from the U.S. Atomic Energy Commission. Luminous Products Corp., will assist prospective licensees in the preparation of the necessary forms.

Export Sales: Most export sales of self-luminous products are made without the necessity of a license from the U.S. Atomic Energy Commission. Prospective purchasers should, however, consult with local authorities about regulations governing the use of radioactive products in their countries.

LPC LUMINOUS

LUMINOUS PRODUCTS CORPORATION

575 ALBANY STREET, BOSTON, MASSACHUSETTS 02118

LPC LUMINOUS

TEL 426-7311 | AREA CODE 617

LUMINOUS PRODUCTS CORPORATION 575 ALBANY STREET, BOSTON, MASSACHUSETTS 02118

PRM 30-20

December 7, 1965

Chief, Isotopes Branch
Division of Licensing and Regulation
United States Atomic Energy Commission
Washington 25, D.C.

Dear Sir:

Under the provisions of Federal Register 3462, 1965 "Use of Byproduct Material and Source Material in Products Intended for Use by General Public (Consumer Products)" exemption is requested of the possession and use of a tritium-activated, self-luminous, screw from the licensing requirements for by-product and source material of the Atomic Energy Act of 1954, as amended; and of the Commission's regulations, "Licensing of Byproduct Material" 10 CFR Part 30 and Licensing of Source Material, 10 CFR Part 40.

A lot of 15 prototype sources as described in the accompanying print was prepared and the sources subjected to the following series of tests.

Test 1. - Accelerated Weathering

5 of the test sources, 1 to 5 inclusive, were cleaned, wipe tested, and subjected to 100 hours of accelerated weathering in a Type D1-TS Atlas Weather-ometer in accordance with Federal Test Method Standard Number 141, Method 6151. At the conclusion of the 100 hours the sources were again wipe tested.

Source Number	Net dpm before weathering	Net dpm after 100 hrs
1	2290	1120
2	220	1550
3	1380	1060
4	-	1230
5	1450	1030

All counting in this test and subsequent tests was done in a Tri-Carb Liquid Scintillation Spectrometer.

Visual examination of the test sources after weathering revealed no detectable change in physical appearance. No trace of water was observed in the source cavity.

Test 2. - Radiological soak test

5 sources, designated 6 - 10 inclusive, were separately submerged in 100 ml of water for continuous soak testing. Aliquots of the soaking water were removed for assay periodically and the results tabulated below.

Source Number	Total activity in 100 ml H_2O-microcuries H^3 48 Hrs	96 Hrs	7 Days
6	-	-	0.008
7	-	0.023	0.015
8	-	0.009	0.013
9	-	0.018	0.004
10	-	-	-

Each of the test sources has 5 millicuries of tritium. It should be noted that in the least favorable case less than 0.0005% of the total activty was observed in the aqueous phase after 96 hours of continuous soaking.

Test 3. - Shock

Test was performed as specified in Par. 6·3·1 NBS Handbook 66, 28 May 1958. Ten sources, 1 - 5 and 11 - 15, were placed in a capped metal pipe three feet long. The pipe was rotated about its mid-point at such a speed that the sources approximated a free fall from one end to the other. The test was repeated for 100 falls. The sources were individually wipe tested. Six areas of the pipe interior were also wipe tested after removal of the sources.

Source Number	Net dpm - total wipe After shock test
1	200
2	130
3	170
4	60
5	40
11	190
12	630
13	380
14	-
15	210
Pipe Interior Position A	-
Pipe Interior Position B	540
Pipe Interior Position C	-
Pipe Interior Position D	-
Pipe Interior Position E	-
Pipe Interior Position F	2410

As a result of this test the sources show surface scratching and denting of the front plastic and the metal case. Ultra-violet examination of the interior of the test pipe and of the sources after the test showed no luminous material on the interior walls or end