

Edwin J. Ingram, Lt. Col.  
Director for Special Weapons  
Department of the Army  
Seneca Army Depot  
Romulus, New York 14541

November 6, 1968

Dear Sir:

RE: "Hi-Lo" Switch Plates #1442078-2

We have reviewed the captioned item, your inquiry dated November 1, 1968, and Bendix Kansas City Division Invoice #233304.

Each of the "Hi-Lo" Switch Plates contains approximately 40 millicuries of a tritiated phosphor mixed with an adhesive binder to hold the phosphor together and to the aluminum plate. After the material is applied to the plate it is overcoated with a clear plastic resin and cured. It is required that an amount of tritiated phosphor (approximately 40 millicuries) be applied to the plate to provide a luminosity of 20 micro-lamberts.

Tritium is a very weak (.018 MEV) emitter of beta radiation and is not penetrating. The thin overcoating of plastic stops most of the beta radiation, which is the only type of radiation emitted from tritium.

External beta radiation levels at the surface of the switch plate are almost non-existent, and bonding the tritiated phosphor with adhesive and subsequent overcoating the same prevents the material from coming loose which could cause slight radioactive contamination. In the event small pieces of the tritiated phosphor could fall off because

Edwin J. Egan, Lt. Col.  
Roselius, New York 10541  
Page 2  
November 6, 1968

of damage, it does not present a significant radiation hazard.  
We will attempt to provide any other information you may request  
on the "Hi-Lo" Switch Plates.

Yours truly,

  
Health and Safety

  
Enclosures (4)

cc:  2/523  
 2/540  
 2/500





DEPARTMENT OF THE ARMY  
SENECA ARMY DEPOT  
ROMULUS, NEW YORK, 14541

IN REPLY  
REFER TO

AMXSE-N

1 NOV 1968

The Bendix Corporation  
Kansas City Division  
Kansas City, Missouri 64141

Gentlemen:

This activity has in stock thirty (30) "Hi-Lo" switch identification plates received from your division. Part number and shipping data are shown on the attached copy of the shipping and receiving document.

The label on each of these items shows a content of 40 microcuries Tritium Isotope and is dated 1-18-67. As readings of less than .1 milliroentgen/hour were obtained using radiac instrument AN/PDR 27-J, we feel that the labels may be incorrect as to the quantity of radioactive material contained in each item. Since special controls are required on items exceeding one (1) microcurie radioactive material content we wish to ascertain if the data for these items are correct.

Sincerely yours,

EDWIN J. INGRAM  
LTC, OrdC  
Director for Special Weapons

1 Incl  
As stated

~~\_\_\_\_\_~~ D/658  
~~\_\_\_\_\_~~

AMXSE-N

1 NOV 1968

The Bendix Corporation  
Kansas City Division  
Kansas City, Missouri 64141

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Sincerely yours,



EDWIN J. INGRAM  
LTC, OPAC  
Director for Special Weapons

1 Incl  
As stated

*Activated Phosphor*  
*near 400 millicuries*  
CF 1831  
149207P SA 237304 D 267  
~~\_\_\_\_\_~~ D 844-2



INVOICE



P.O. BOX 1189 KANSAS CITY, MISSOURI 64141

No. 233304

L-40

DATE:

SHIPPED TO

SENECA ARMY

KCAO

SOLD TO

CUSTOMER ORDER NO. HD102905745203	
PACKING LIST NO.	SHIP VIA REA
F.O.B.	BILL OF LADING AD572553
WEIGHT 2	DATE SHIPPED 6 26 67
NO. OF PACKAGES 1 CTN	AUTHORIZED BY [REDACTED]

YOUR PART NO.	OUR PART NO.	DESCRIPTION	QUANTITY	UNIT PRICE	EXTENSION
224692 00	1442078 2	PLATE IDENT	30		
FSN 1115 949 5034					
REF; A5245K 6229 2954					
NO "A" COST MATL.					
		( 22 0 1H )			

Shipping

[REDACTED]

**INTERDEPARTMENTAL MEMO**

**DATE:** May 27, 1965

**TO:** Memo for File

**SUBJECT:** MC 1831 CABLE ASSEMBLY (HI-LO PLATES, TRITIATED PHOSPHOR)

On this date attended a meeting with [REDACTED], [REDACTED], [REDACTED], and another materials engineer. The following areas were discussed:

1. Sandia Livermore is to forward some switch plates and we will check them for contamination levels and give them to [REDACTED] who will in turn forward them to [REDACTED].
2. [REDACTED] will attempt to develop a means to cover the plates either by application of an epoxy, polyurethane, or other material. He will also try to bond a transparent film or plate over the letters to contain the loose contamination.
3. Industrial Hygiene will check with MRI to determine if they have equipment to measure the luminosity from the plates that is supposed to be 30 micro-lamberts. Industrial Hygiene will advise Materials Engineering if MRI can or cannot perform this evaluation. This evaluation will be performed prior to Materials Engineering coating the plates and subsequently to determine if they still meet the desired specification. *AND ADVISE [REDACTED]*
4. [REDACTED] will contact Bendix, Scintilla Division to assure their license is adequate to handle this material as required for the switch plates.
5. After Materials Engineering develops a means to coat the plates, if possible, [REDACTED] will make a trip to U. S. Radium at Morristown, Pennsylvania to determine why the loose contamination on the plates, especially the back side, and make arrangements to have U. S. Radium coat the plates as has been found satisfactory by BKC Materials Engineering.
6. The drawing on these plates has no call-out indicating the degree of permissible contamination on the plates, or what the tritiated phosphor will be covered with, and how thick. This will be added to drawing later after Materials Engineering completes their evaluations and makes recommendations.



**INTERDEPARTMENTAL MEMO**

**DATE:** April 16, 1964  
**TO:** Memo for File  
**SUBJECT:** TRITIATED PHOSPHOR

Was contacted by [REDACTED], Purchasing Department, relative to MC 1465, which is a dial. [REDACTED] stated that he had talked to [REDACTED] and they were in need of expediting the production of these dials.

[REDACTED] stated that the cure cycle of seven days poses a significant delay in the delivery of production MC 1465's. The MC 1465 housing and dial receive a coat of tritiated phosphor at United States Radium, Bloomsburg, New Jersey, and the tritiated phosphor is coated with a non-soluble protective coating material, cured for seven days, and then shipped to Sargent and Greenlease Company in New York where they are assembled into a combination lock and subsequently shipped to Bendix.

Each housing contains 10 microcuries of tritium and each dial contains 25 microcuries of tritium.

At the present time they would like to ship 70 housings and 70 dials from United States Radium prior to the seven days cure period. The seven days cure period is called out by the Atomic Energy Commission in the license given to United States Radium to use tritiated phosphor and apply it on dials. As a result, J. P. Wright, KCAO AEC, was contacted to see if he could expedite these 70 dials and housings via AEC Materials and Licensing Division to see if they could be shipped prior to the seven days cure period to meet production schedules.

J. R. Rudy, KCAO AEC, was also advised of this problem as he called and was evidently assigned to handle the problem by [REDACTED]





*Dist. & File  
File copy*

July 1, 1965

~~\_\_\_\_\_~~ D/212

HI-LO SWITCH PLATES



The Hi-Lo Switch Plates for use on the MC 1931 cable assembly contain a tritiated phosphor compound in the engraved letter area so the letters can be observed in the dark. The tritiated phosphor consists of radioactive tritium that is present as a tritiated organic compound mixed with zinc sulphide and an adhesive placed into the recessed letter areas in the plate. A protective coating is then applied over the letters to seal the material in the recessed areas.

Tritium gives off only very weak beta radiation that is no problem external to the body. Each of these plates contains a total of approximately 40 millicuries of the tritiated phosphor which is such a small quantity as to present no significant health problem in handling the plates. The plates are marked with radiation labels in that we requested they be identified in this manner to provide better controls.

We have evaluated several of these plates and they should present no health problem in handling the same. In addition to this we are in the process of having U. S. Radium (vendor) place a double coating of protective material over the tritiated phosphor to provide a more substantial protective layer.

Attached for your reference and files is information on these tritiated luminescent materials. We will be glad to provide any assistance you may deem necessary in the handling of these Hi-Lo Switch Plates.

~~\_\_\_\_\_~~

~~\_\_\_\_\_~~

Atts. AEC No. C-124 "AEC to Permit Use of Tritium on Luminescent Compounds"  
"Advantages of Tritium Luminescent Devices"



*File*

May 28, 1965

**[REDACTED]** Dept. 841

**TRITIUM FILLED SELF-LUMINOUS SWITCH PLATE FOR ASSEMBLY CP-1831**

Scintilla is due to ship the next lot of CP-1831 Assemblies the early part of June. We need an answer as to how to handle the switch plate. The switch plate specified contains radioactive contamination of a level higher than our vendor is licensed to handle. We at Bendix Kansas City are also faced with a handling problem due to the level of contamination.

It is our understanding that you and Scintilla are aware of the problem and that several avenues are being investigated.

We are enclosing letters from Bendix Scintilla and United States Radium Corporation which explain the problem, possible solution, and need for either a decision, possibly a stop work order.

Request you advise **[REDACTED]** (Ext. **[REDACTED]**) by Tuesday, June 1, 1965, of your proposal to the situation.


**[REDACTED]**  
**[REDACTED]**

**[REDACTED]**  
cc: **[REDACTED]** 11/263  
**[REDACTED]** 11/822  
**[REDACTED]** 11/247 ✓  
**[REDACTED]** 11/510

THE *Bendix* CORPORATION

SCINTILLA DIVISION • SIDNEY, NEW YORK 13838

May 26, 1965

  
The Bendix Corporation  
Kansas City Division  
Box 1159  
Kansas City, Missouri 64141

Subject: 1441895-2 Cable Assembly

Reference: BKO P.O. B275595A


The matter of radioactive contamination of the identification plate specified for the subject cable was discussed during the visit of your TMS Team last week. We were assured at that time that a decision would be forthcoming to resolve this problem. Three possibilities are apparent:

1. Delete requirement for identification plate
2. Specify improved plate eliminating objections
3. Specify plate lacking radioactive elements

On May 18 our supplier, U.S. Radium Corporation, wrote commenting on the problem in some detail. A copy of this letter is attached to assist you in considering the situation. In the meantime, we will need formal permission to ship cables against your referenced purchase order less the identification plate, Scintilla part number 10-373299.

Your prompt attention will be appreciated.

  
Cabling & Special Products

cc:   
Sandia-Livermore



MANUFACTURERS OF  
LUMINOUS DIALS  
NEUTRON SOURCES  
RADIATION SOURCES  
RADIOACTIVE SPECIALTIES  
RADIOACTIVE LIGHT SOURCES  
NAME PLATES  
ETCHED AND LITHOGRAPHED  
LUMINOUS COMPOUNDS  
"IONOTRON"  
STATIC ELIMINATORS  
"RADELIN"  
X-RAY SCREENS  
TELEVISION PHOSPHORS  
"LACRON" PANELS  
"HELECON"  
LUMINESCENT PIGMENTS

TELEPHONE JEFFERSON 9-4000

UNITED STATES RADIUM CORPORATION

P. O. Box 246

MORRISTOWN, NEW JERSEY

May 18, 1965

PLANTS AND LABORATORIES  
BLOOMSBURG, PA.  
BERNARDSVILLE, N. J.  
WHIPPIANY, N. J.  
NO. HOLLYWOOD, CALIF.

EUROPEAN SUBSIDIARY:  
UNITED STATES RADIUM  
CORPORATION EUROPE  
GENEVA, SWITZERLAND

CANADIAN SUBSIDIARY:  
RADELIN LTD. TORONTO

CABLE ADDRESS  
RADELIN-MORRISTOWN, N. J.

VIA SPECIAL DELIVERY

The Bendix Corporation  
Scintilla Division  
Sidney, New York 13838

Re: Purchase Order 273609 and 278479

Subject: Tritium Filled Self-Luminous Plate

Dear [REDACTED]:

This will confirm and supplement our recent telephone conversation relative to the problem encountered in your testing of the tritium illuminated plate 10-373299 as covered under the referenced orders. We understand the problem arises due to the determination of removable activity and measurable radiation at the treated surfaces of plates as delivered to you on order 273609. It is apparently your feeling that the part is unacceptable if one must tolerate the appearance of such activity during usage, and I had thus suggested a suitable processing method which can be expected to eliminate the difficulty.

In referring to the parts already treated and supplied, note that this is essentially an engraved and filled unit in which a solid tritium coated phosphor in heavy paste form is deposited into the engraved recesses. After drying, this material is overcoated with several layers of a resin which serves as a partially effective seal against the wiping off of active material from the deposited tritium compound. This overcoating process does in fact serve to retain the activity initially, even though the seal is by no means absolute. It may be interesting to you to have specific data relative to our own wipe testing prior to shipment, since these results will give you at least a slight indication of the type of thing which we expect will occur on any such tritium filled parts.

We performed a seven day aging and wipe testing series on these plates, as is customary for most of our processed radioactive parts. Since the level of removable activity after overcoating is quite low initially, we tested in multiple lots, using a single wiping swab to obtain a total result from a great many pieces. Thus, we split the full 27 piece lot into two groups of 10 pieces each and one group of 7 pieces. These groups are listed below, with total removable activity from each group as determined

(Cont.)

UNITED STATES RADIUM CORPORATION

Scintilla Div. - Bendix Corp.

Page 2

Attn: XXXXXXXXXX  
5/18/65

in a wipe test March 10, as well as in a final wipe test March 17.

	<u>Total Removable Activity of Group (Wipe Test 3/10/65)</u>	<u>Total Removable Activity of Group (Wipe Test 3/17/65)</u>
Group A - 10 pcs.	Background	1500 cpm above background
Group B - 10 pcs.	Background	300 cpm " "
Group C - 7 pcs.	400 cpm above background	3500 cpm " "

NOTE: - In interpreting the above in terms of the actual quantity of active material determined to be present in the wiping swab, our present measurement relationships are based on the assumption that 5500 counts per minute is equivalent to .005" microcurie.

You will observe that even the largest determined value of 3500 counts per minute as obtained from the seven piece group, still shows an inconsequential average of only 500 cpm for each plate in the group. Even so, the above series already is indicative of the diffusion and exchange phenomena which I had suggested could give rise to higher levels of removable activity as the treated parts go through a longer aging period. It would be quite impossible to guess at the amount of removable activity which might become apparent within any given period. This could obviously be determined only through actual testing.

One can anticipate however, that a wipe test taken on each of the parts several months from the date of manufacture, could remove activity amounting to at least a few thousand counts per minute. This can be objectionable to many of those individuals in the field interested in health physics aspects and radiological control, even though tritium is looked upon as one of the least hazardous of the radioactive materials currently in use.

As I had proposed, there is one positive method of relieving this type of difficulty. This can be achieved through modification of design of the plate, so that we can accommodate a sealed tubular glass light source internally within the part. The primary light source would still be based on the use of tritium, but it would then be present as the gas hermetically sealed within a glass tube which will retain the element. The inner wall of

(Cont.)



Attn: [REDACTED]  
5/18/65

the tube would be coated with a phosphor which is then excited by bombardment of the tritium beta particle to emit light. Such tubular light sources have become the basis for a very great deal of our activity in the self-illumination of various types of panels, dials, etc. Several such devices are shown in the accompanying Isolite Bulletin 30.35.

Such devices are now being prepared quite routinely, with complete freedom from leakage and removable surface contamination. As further points of superiority, the surface brightness at detail points of the panel or dial can be several times as high as that available through a tritiated phosphor fill, while the rate of luminescent decay is much lower. In this latter connection, note that the half-life of luminescence in the sealed gas type of source is approximately seven or eight years, as contrasted with perhaps two to three years with the tritiated phosphor fill.

In order to give you a fairly specific proposal on which to base your thoughts, we have developed our basic ideas relative to a conversion of the design of the present plate part number 10-373299. Overall dimensions of the plate would remain the same exclusive of thickness, which would be necessarily increased to 3/16". Material of construction would be acrylic plastic. The part would be machined to provide the same superficial features as in the present plate. The HI-LO lettering would be of the same height and stroke as in the existing part. These would be left as transparent light-emitting areas on the surfaces with the olive drab finish as originally specified. Since daylight contrast between the letters and background may otherwise be poorer than desirable, we would plan on applying a series of small white dots along the transparent area of each letter. We find that this gives more satisfactory viewing results than is true of the other possible alternative of outlining each letter with a narrow white border.

A single tubular lighting element would be totally recessed and potted within the panel to achieve lighting of the legend. Although we can achieve the present brightness of the part, and obtain suitable uniformity of lighting while retaining present locations of the letters HI and LO, the lighting would be considerably improved through moving the lettering downward to leave an open area about 1/4" high at the top of the plate. With that area available for location of the light tube, brightness can be approximately doubled, and much better legibility should result.

We can supply a part fabricated and lighted in this way, at

(Cont.)

UNITED STATES RADIUM CORPORATION

Scintilla Div. - Bendix Corp.

Page 4

Attn: [REDACTED]  
5/18/65

the following prices.

100 pieces		\$14.05 each	
590	"	11.20	"
1000	"	10.25	"

Prices are f.o.b. Bloomsburg, Pennsylvania; delivery of a 590 piece lot as on the existing order, will require four weeks. New York State license is of course necessary to cover the appropriate tritium content. In connection with the licensing requirement, however, you may well be interested in noting that this is basically a type of device which is more easily subject to General License issuance of the AEC, than would be true of the tritiated phosphor filled part. General License coverage can of course be of significant advantage in those cases where an item with radioactive content must be distributed to a number of ultimate users. If not General Licensed, it becomes necessary for each ultimate user to obtain a specific license from the AEC or the appropriate Agreement State, to cover his possession of the isotope. This could become an important point for your consideration, depending on the intended distribution and use of the plate.

I believe that this will give you most of the information for your immediate consideration as far as a possible design change is concerned. Beyond this, note that we are still holding here without action, the 25 returned plates originally shipped on order 273609. We find no basis for your rejection of these plates, as far as the terms of the original transaction are concerned.

Also, with respect to the more recent purchase order number 272479, covering 590 of the same parts, we had initiated fabrication prior to return of the small lot, at which time we had held up further action. At that point however, we had already purchased and received the full lot of machined metal plates from our supplier, and the money already spent against this order is estimated as \$700 to \$800.

There is of course no further action being taken against either of the orders, and we shall await your further instructions in this respect.

Very truly yours,

UNITED STATES RADIUM CORPORATION

[REDACTED]  
Radioactive Products

cc: [REDACTED] (Scintil [REDACTED] v.)



February 8, 1963

[REDACTED] D/17

MC1465, INDUSTRIAL HYGIENE HANDLING PROCEDURE

The activated phosphor used on the dial of the MC1465 results in a negligible radiation exposure because its very low energy is almost completely absorbed within the luminescent paint.

A recent study by the AEC concluded that tritium phosphor could be exempted from licensing in its dial use since the tritium is chemically bound and cannot detach itself from the insoluble and non-volatile plastic matrix unless the plastic is destroyed by fire or other violent chemical reactions.

In view of the physical state of the subject phosphor, recent study devoted to its use and the assembly procedures performed by your personnel, no personal monitoring or protective clothing is indicated. Industrial Hygiene shall be notified in the event of any breakage or destruction of the plastic matrix.

Refer any questions on this matter to Industrial Hygiene at Ext [REDACTED]

[REDACTED]

[REDACTED]