REPORT ON THE MANUFACTURING AND IDENTIFICATION OF PCB-FILLED FLUORESCENT LAMP BALLASTS

Commercial Chemicals Branch
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1 TERMS OF REFERENCE

Preamble

The Commercial Chemicals Branch of the Environmental Protection Service is responsible for enforcing the Environmental Contaminants Act and the regulations developed under the Act. Additionally, it is responsible for protecting human health and the environment from chemical substances that are used in commerce. In order to determine the use of fluorescent lamp ballasts and to easily and readily identify specific PCB-filled products and to determine whether they pose a direct and significant threat to human health or the environment, a study was conducted using the following terms of reference:

i) identify domestic and foreign manufacturers who have used PCBs in the manufacture of ballast capacitors for use in fluorescent lighting.
ii) determine methods for the identification of ballast capacitors that contain PCBs.
iii) determine manufacturing techniques of each different type of ballast.
iv) determine the quantity of PCBs used in each type of ballast capacitor.
v) determine whether ballast capacitors could leak or rupture, and the frequency of such faults.

2 PROBLEM

There has been growing concern over the fact that PCBs were widely used in lamp ballast resistors. Inquiries from government agencies (federal, provincial and municipal), industry and the public have greatly increased with the growing general knowledge that PCBs are in such wide-spread use. Inevitably, the inquiries include questions on: the potential for PCB leakage from ballast resistors; the risk of heating and exploding; how can a person identify a ballast that contains PCBs; and, of course, the potential risk to human health. It is primarily for these reasons that Environment Canada decided to conduct a study into the procedures for identifying ballasts containing PCB-filled capacitors, determining the domestic and foreign manufacturers who have used PCBs in ballasts, and determining the quantity of PCBs in use in ballasts and any potential problems. This study will not address the risk to human health, or the potential risk, in the use of PCB-ballasts.

Ballast resistors that this study addresses are those that are used primarily with fluorescent lighting.

3 BALLAST RESISTORS (OPERATION)

Ballast Resistors are mounted on the light fixture between the fluorescent tubes and are shielded with a metal protector device which reduces heat radiation (see Photograph No. 1). As current passing through the ballast increases, the ballast has the property of increasing in resistance. Similarly, the ballast will decrease in resistance as the current passing through it decreases. The ballast is designed to maintain a constant current through it, despite variations in applied voltage or changes in the rest of the circuit. It acts, therefore, as a variable load on the system, differing from "load resistors" which have a constant resistance.

The required ballast action is obtained by using resistive material that increases in resistance as temperature increases. Any increase in the current passing through the ballast causes an increase in the temperature which then results in an increase in resistance and reduces the current.

Ballast resistors are used to compensate for any variations in the line voltage or to compensate for negative volt-ampere characteristics of other devices, such as fluorescent lamps and other vapour lamps.

Ballasts permit the economical dimming and flashing of rapid-start lamps, providing a range of applications and control that was not possible with previous fluorescent lamp types. These rapid-start lamps are commonly used in flashing signs, and in residential and commercial lighting where continuously variable illumination levels are desired.

4 CONSTRUCTION OF BALLAST RESISTORS

Typical ballast resistors contain a reactor (a core and coil assembly), a thermal protector and a capacitor (see Photograph No. 2). The housing of the ballast is a heavy steel measuring, in the case of the ballast in Photograph No. 2, exactly 216 mm (not counting the mounting brackets) in length, and exactly 58 mm in width. The reactor measures approximately 102 mm x 58 mm x 38 mm deep. The capacitor measures approximately 51 mm x 51 mm x 19 mm (see Photograph No. 3). It is the capacitor that could contain PCBs. During the manufacture of the ballast, the core and coil assembly are mounted inside the ballast housing and are connected to the capacitor. The coloured, interconnecting wires are designed primarily for ease in installing the ballast. The entire airspace inside the ballast and around the reactor and the capacitor is then filled with an asphalt mixed with a very fine silica powder. This asphalt compound acts as a heat transfer medium as well as a protective coating against moisture for the electrical parts and as a medium for reducing the sound emitted from the core and coil assembly.

The quantity of PCBs that is used in a ballast capacitor used for two four-foot fluorescent lamps is 37 grams, or 26.5 ml. The two four-foot fluorescent lamp assembly is the most common office application, accounting for an estimated 95% of all fluorescent lamp uses. Much of the PCBs in the capacitor is absorbed by several layers of paper. Canadian General Electric states that, in the highly unlikely event of a rupture through the ballast case, the asphalt compound and the capacitor can, no more than perhaps one half of the PCBs can actually escape.

At the other end of the scale, the greatest amount of PCBs in a ballast capacitor would be in a fixture operating a 1500 Metal Halide lamp, a type that is not utilized indoors, and certainly not in an office environment. This type of ballast capacitor could contain about 185 ml of PCBs; again, however, much of this amount is absorbed in the paper layers.

4.1 Potential Leakages

In view of the elaborate physical containment of the material in the ballast and the low normal operating temperatures, there is little likelihood of PCBs escaping into the air. Fixture safety specifications from C.S.A. require that the ballast case temperatures not exceed 90°C under normal operation. Furthermore, the thermal protector (see Photograph No. 2) within the ballast de-energizes the circuit when the hottest internal temperature exceeds 105°C (some ballasts are designed to de-energize at

120°C). At this temperature, a small amount of asphalt compound may soften and leak out. It is this small amount of leakage of the asphalt compound that is generally mistaken for a PCB leakage.

5 BALLAST RESISTOR MANUFACTURERS

The following domestic and foreign manufacturers of fluorescent lamp ballast resistors account for by far the largest sources of ballast resistors in use in Canada:

a) Aerovox Incorporated
Amherst, Nova Scotia
(902) 667-3886 Ext. 34

b) Aerovox Incorporated
New Bedford, Mass.
( ) 994-9661

c) Allanson Manufacturing Co. Ltd.
33 Cranfield Road
Toronto, Ontario
M4B 3H2
(416) 755-1991

d) Canadian General Electric
940 Lansdowne Avenue
Toronto, Ontario
M6H 3Z4
(416) 530-5419

e) Phillip Electronics Ltd.*
Scarborough, Ontario
(416) 292-5161

f) Sola (USA)
1717 Busse Road
Elk Grove Village
Illinois, USA
(312) 439-2800

g) Sola Canada
377 Evans Avenue
Toronto, Ontario
M8Z 1K8
(416) 252-6465

h) Universal Manufacturing Co.
Paterson, New Jersey
(201) 684-1400

5.1 Acknowledgements

All of the companies listed have been extremely helpful in providing the necessary information for identifying ballast resistors by code and date of manufacture.

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* Phillips purchases ballast capacitors from Aerovox but uses a distinct identification code (see Section 6)

Canadian General Electric was exceptionally helpful; in addition to providing identification characteristics and technical information on the manufacture and use of ballast resistors, CGE provided Environment Canada with the ballast housing and "guts" which were used to make it easier to explain the manufacturing and to identify the individual ballast components.

6 IDENTIFICATION OF BALLAST RESISTORS

Each manufacturer of ballast resistors uses a distinct code for identifying the type of ballast, its dielectric fluid and its date of manufacture.

6.1 Aerovox Ballast

A ballast manufactured by Aerovox will have an identification code on the label attached to the ballast housing. If the ballast was manufactured in Canada, the code will identify the ballast as "AE". If it was manufactured in the United States, the code will identify it as "AH".

The company code, either "AE" or "AH", will then be followed by a numerical code identifying the year and week of fabrication.

a) **Examples**

i) AE 8252

This code on the ballast label identifies this ballast as having been manufactured in Canada in the last week of December (52) in 1982(82).

ii) AH 7808

This would identify a ballast resistor manufactured in the United States in the last week of February (08) in 1978(78).

The above two examples provide basic data on the country in which the ballast was manufactured and the date of manufacture. Since Aerovox changed to a non-PCB dielectric fluid in June 1978, the above codes could be quite critical in helping to identify the exact date of manufacture. In the event the date of manufacture is illegible, there is another source of information (a catalogue code) that can be used to determine whether the ballast capacitor contains PCBs.

The catalogue code is stamped on the ballast housing. The following is an example of an Aerovox catalogue;

P 193 FC

The first unit would be either "P", "Z" "H" or "N", which identifies the material of the capacitor plate.

The units (numbers) in the second, third and fourth positions identify the size of the capacitor in the ballast.

The fifth and most diagnostic slot has either "G", "R" or "F". An "F" in the fifth position identifies the ballast capacitor as <u>containing PCBs</u>. A "G" or an "R" is a

non-PCB capacitor. The sixth and final unit will be a letter between "A to R" which identifies the particular brand of dielectric liquid.

6.2 Allanson Ballast

Ballast resistors required for HID lighting manufactured by Allanson Manufacturing are identified with a two letter code signifying the year and the month of manufacture. The code will be stamped on the end of the ballast housing where the hole mounts are located. An example of a code would be:

D N

The "D" represents the month of manufacture i.e. April. The "N" represents the year of manufacture; in this particular example, it is 1983. The year code is interpreted by commencing with the letter "A" which represents the year "1969"; consequently, "N" represents 1983. Another example could be:

L J

In this example, the ballast was manufactured in December in the year 1978.

Allanson switched from PCBs to a non-PCB (DOP) fluid in 1980. If the catalogue identification is readily available on the ballast housing, the PCB or non-PCB status could be determined. For example, any catalogue code using the prefix "N" is a non-PCB ballast. If a code does not have an "N" prefix, the ballast capacitor contains PCBs.

6.3 Canadian General Electric

The name plate on a typical ballast resistor manufactured by Canadian General Electric will have the following information:

17 A 28 7 E (see Photograph No. 4)

It is the final letter in this code that will designate whether the ballast capacitor contains PCBs. See Photograph No. 4 for an example of a CGE ballast identification label. If the final letter is an "E", the ballast capacitor does not contain PCBs. It is clearly a non-PCB filled capacitor.

On the other hand, if the final letter is "T" (see Photograph No. 5) the ballast capacitor may contain PCBs. It is unfortunate that the identification cannot be more clear at this point; however, the problem results from the fact that Canadian General Electric used a "T" to identify ballast capacitors manufactured up until shortly after they switched in June 1977 to using a non-PCB dielectric fluid. Since the switch to the

identifying "E" did not occur at the same time as the changeover to a non-PCB fluid, the "T" does not conclusively designate the ballast as a PCB-ballast capacitor. The designation of "E" does, however, clearly identify the unit as non-PCB.

If the code ends in a "T", then there is reason to "suspect", but suspect strongly, that the unit contains PCBs. With units that are identified with a "T", there is only one conclusive way of determining whether the unit does in fact contain PCBs. On the reverse side of the ballast housing, CGE stamps a date code. A NOTE OF PRECAUTION: DO NOT ATTEMPT TO REMOVE AN ENERGIZED BALLAST FROM ITS MOUNT IN THE EVACUATED TUBE IN THE FLUORESCENT LAMP FIXTURE. Under no circumstances should an inexperienced person attempt to remove a ballast unless the electrical current is switched off and locked or protected to ensure that the current cannot be re-activated while removing the ballast.

In a situation where a person has access to an unmounted ballast, the manufacturing date code can easily be read on the ballast housing. For example, see Photograph No. 6 which clearly shows the following code:

2811

This code is to be read by reversing the first two numbers. In other words, this code clearly designates this ballast as being manufactured in the year 1982(28) and in the month of November (11).

Another example of the manufacturing date code could be:

1805

This code would identify the manufacturing date as 1981(18) during the month of May (05).

6.4 Phillips Electronics

Ballasts manufactured by Phillips Electronics are identified with a four number manufacturing date code. For example, ballasts may be marked as follows:

1433

The first digit indicates the year of manufacture. In this case, 1981(1). The next two digits indicate the week of manufacture; this ballast would have been manufactured in the 43rd week of 1981. The final digit designates the day of manufacture - Wednesday (3).

Phillips discontinued using PCBs in late 1978; consequently, any ballast identified as being manufactured after early 1979 will be a non-PCB unit.

In the case of High Intensity Discharge (HID) lighting, all ballasts are clearly marked as "NON-PCB" or "PCB".

6.5 Sola Ballasts

Sola uses a three letter series followed by a three number sequence to identify the dielectric fluid used in the ballast capacitor. Any ballast that is identified with an "ACA" lettering series contains PCBs. Any ballast that is identified with an "ACB" series is a non-PCB capacitor.

In other words:

ACA 393 (or any three numbers) is a PCB capacitor.
ACB 468 (or any three numbers) is a non-PCB capacitor.

6.6 Universal Manufacturing

Ballast resistors manufactured by Universal Manufacturing are clearly identified with a date code as well as a stamp designating the ballast capacitor as a PCB unit or a non-PCB unit. Although Universal switched to using a non-PCB dielectricfluid in 1978, the date is insignificant in that the ballast label will clearly identify the unit as a PCB or a non-PCB capacitor.

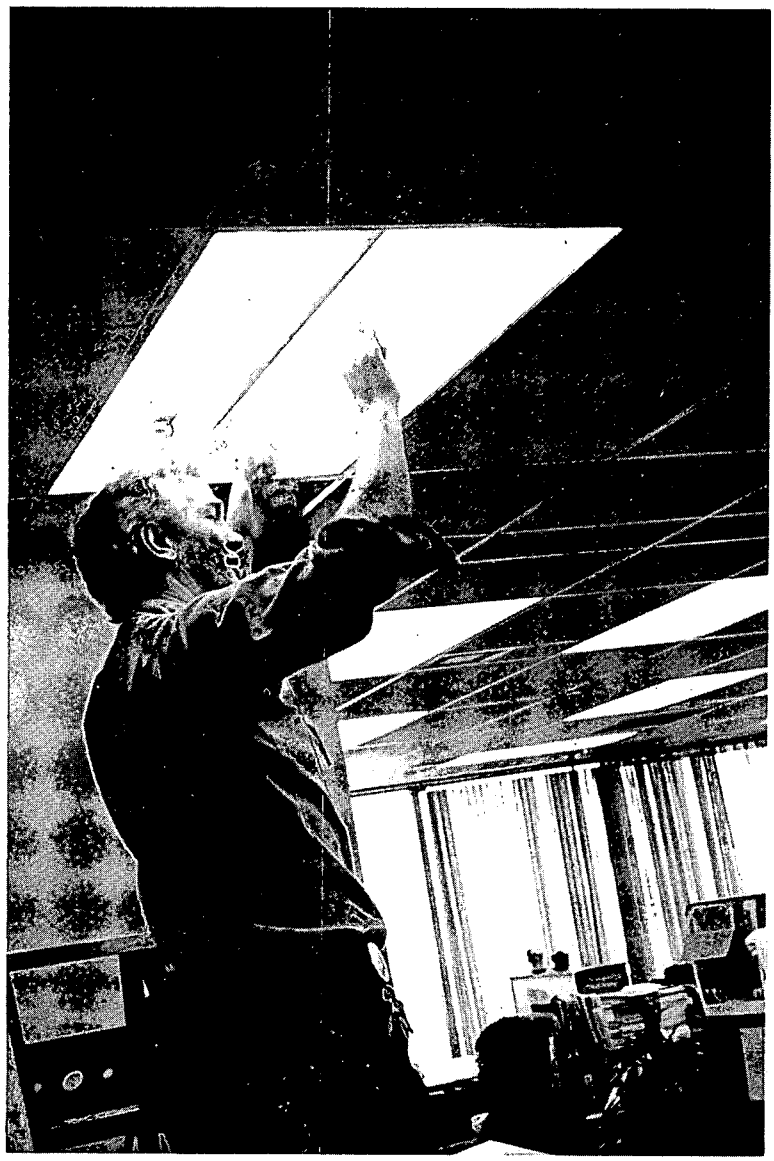


PHOTO NO. 1a FLUORESCENT LAMP UNIT

The inside fluorescent tubes on both sides of evacuated tube have been removed for easy access

PHOTO NO. 1b EVACUATED TUBE

Evacuated tube has been removed exposing lamp ballasts.

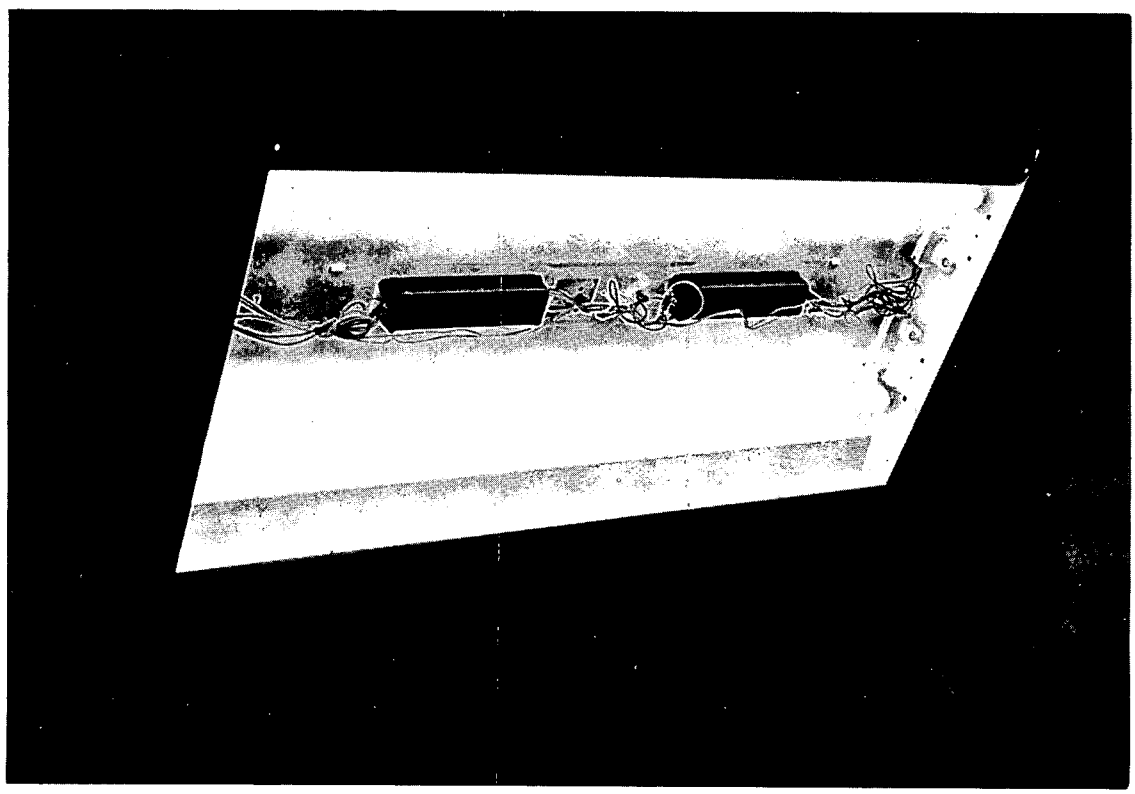
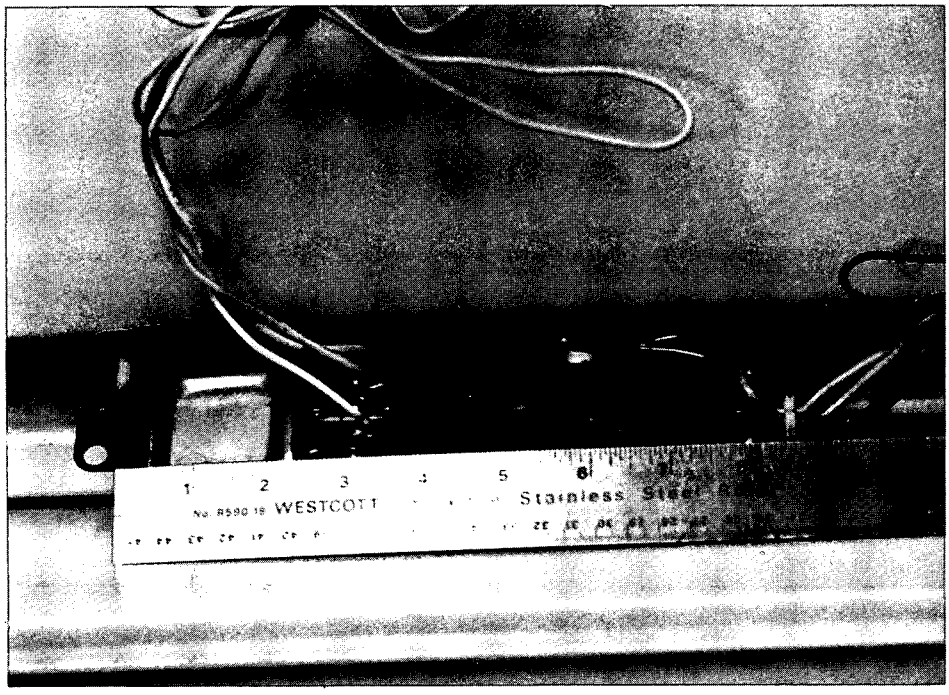


PHOTO NO. 1c LAMP BALLASTS



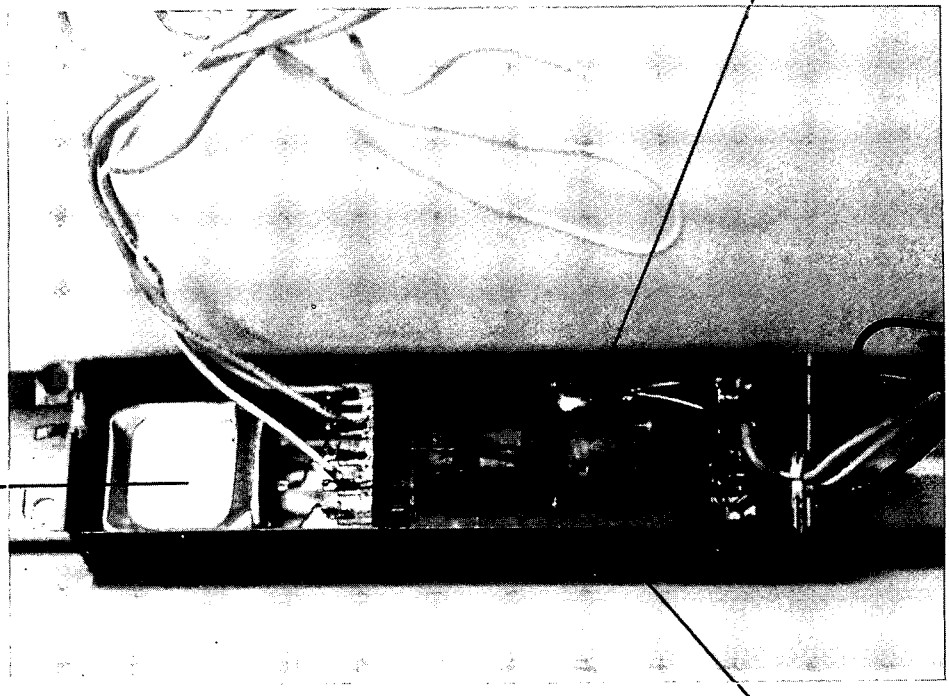


PHOTO NO. 2 COMPONENTS OF LAMP BALLAST

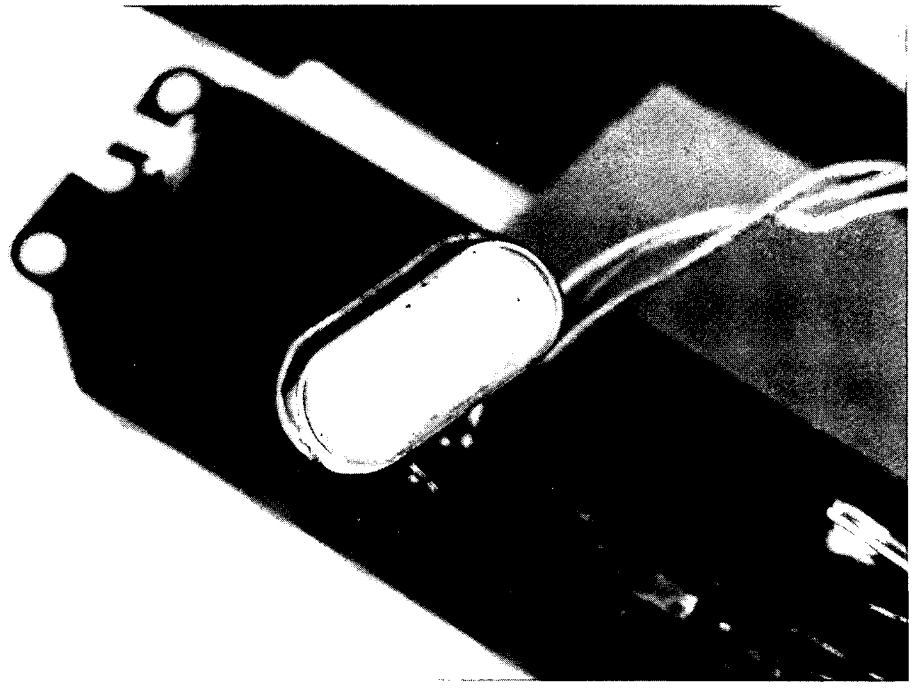


PHOTO NO. 3 BALLAST CAPACITOR

Capacitor has been dislodged from its normal position to illustrate its size. This is an aerovox capacitor mounted in a Canadian General Electric ballast and clearly stamped "No PCBs".

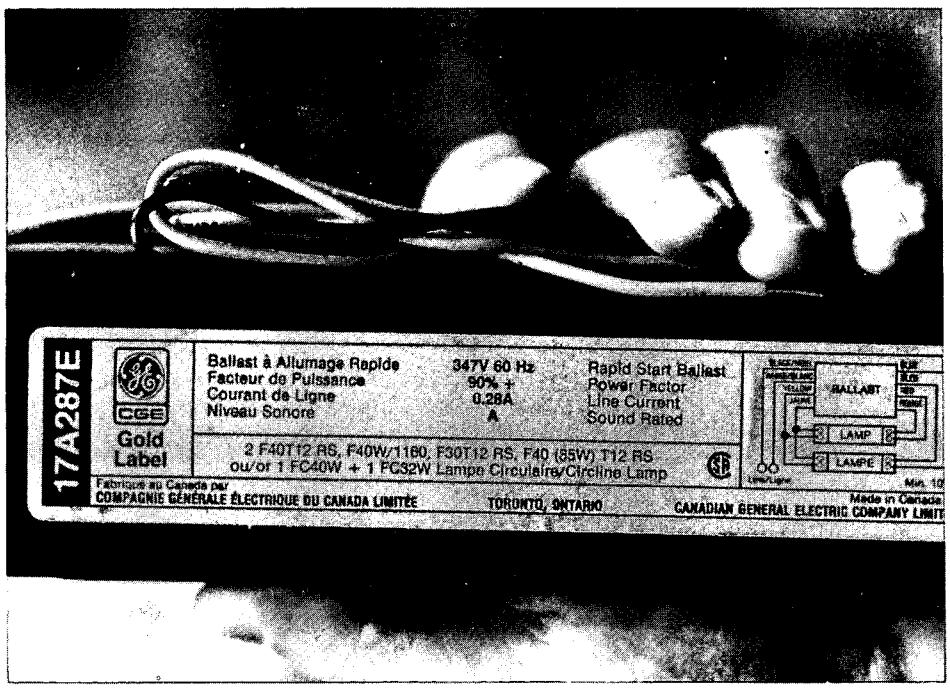


PHOTO NO. 4 CGE LAMP BALLAST

The "E" at the end of the manufacturer's code, "17A287E", clearly identifies this CGE ballast as a non-PCB unit

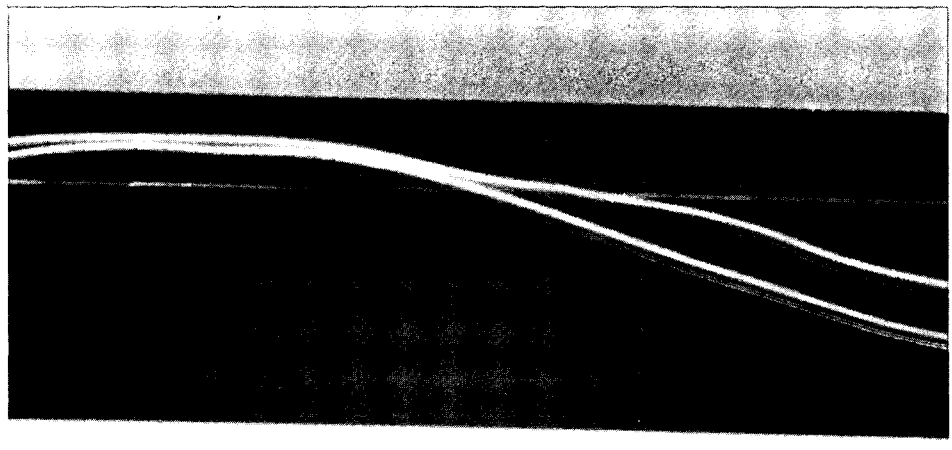


PHOTO NO. 5 CGE LAMP BALLAST

The "T" at the end of the manufacturer's code, "17A187T", identifies this ballast as a possible PCB ballast. The date code (see photo No. 6) must be checked to determine PCB or non-PCB status

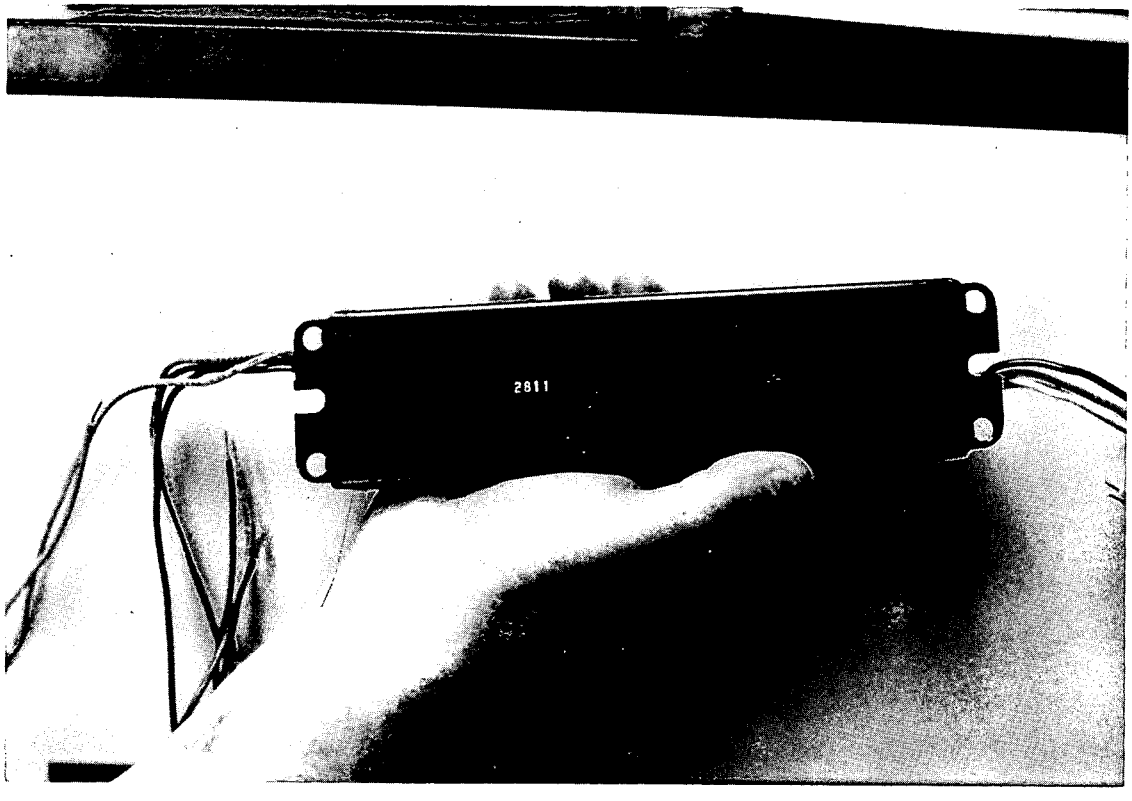


PHOTO NO. 6 MANUFACTURER'S DATE CODE

The first two digits on this date code must be reversed to determine the year of manufacture; consequently, this CGE ballast was manufactured in November (11) 1982 (28)