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To: VSRT Group
From: Alan E.E. Rogers
Subject: Tests of compact fluorescent lamp as microwave sources

In the 1950's and 1960s radio astronomers often used gas discharge tubes mounted inside the receiver waveguide to calibrate the radiometer. In simple terms, the gas discharge results in a plasma of electrons which is optically thick to microwaves. The noise temperature output is equal to the electron temperature which is typically around 10,000 K. The modern energy saving bulb, currently available in the supermarkets is a high intensity discharge (HID) in mercury-vapor. The lamps are all made in China and probably are pretty similar from one brand to another. The most common brand is GE and the discharge tubes are either helical or loop up and down. Wattage ranges from 15 to 30 (equivalent light output to about 50-100 w incandescent). The electronics in the base produces a high starting voltage (most likely around 1 kv) generated from a frequency (derived from a transistor oscillator) in the range of 50 to 90 KHz. The high frequency is used to reduce the 120 Hz flicker. There are two problems associated with the use of these lamps for VSRT tests, demonstrations and experiments:

- 1] There is often a 50-90 KHz modulation of the microwave output which can be confused with the modulation produced in the detector by interferometric fringes.
- 2] There is often a variation in the microwave output with a period in the range 10-20 seconds.

Both of these problems appear to be a minimum in the large lamps. The GE Biax electronic 27 W 120 VAC 60 Hz 400 ma FLE27QBX/2/SW gave the best results. I measured a brightness temperature of about 5000 K for this lamp. The tubes appear to be optically thin at 12 GHz so the maximum output occurs when the tubes pointed towards the antenna.



This bulb saves \$43.80 in energy costs.

Equivalent Soft White Bulb Life

Equivalent Soft White Bulb Life	Long Life Plus	Energy Saver	Incandescent
1700	1890	27	750
1700	1890	27	750
1700	1890	27	750
1700	1890	27	750

To learn energy costs, find the kWh rate on your utility bill and use the calculator below. For example, if the kWh rate is 17¢, this bulb saves \$43.80 in energy costs over the life of the bulb.

Long Life Plus

Fits Most Fixtures



PC: 4987
DISC:
ELEDZKZSNWCD
SACQZ71CN
Res: 4400609

CAUTION

Right of electric shock. Do not open. - Use indoors only. - Do not open - no user serviceable parts inside. - Not intended for use with emergency exit fixtures or lights, electronic timers, lamp may shatter and cause injury or property damage if broken. - Remove and install by grasping only plastic portion of the lamp.

Electricity cost savings*

Hour Rate	6¢	8¢	10¢	12¢
27 watt	26	35	44	53

- Long Life means less bulb changes
- Flicker-free
- Soft white light



Soft White 100 Energy Saving Bulb*

Manufactured for:
GE Lighting
General Electric Company
Nela Park, Cleveland, OH 44112
www.GELighting.com

LISTED 6C-19

Made in China

For more information on GE Energy saving lighting products, call 1-800-875-4343.

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Mercury

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FLUORESCENT LIGHTS AND MERCURY

Mercury is an essential ingredient for most energy-efficient lamps. Fluorescent lamps and high intensity discharge (HID) lamps are the two most common types of lamps that utilize mercury. Fluorescent lamps provide lighting for most schools, office buildings and stores. HID lamps, which include mercury-vapor, metal halide and high-pressure sodium lamps, are used for street lights, floodlights and industrial lighting. A typical fluorescent lamp is composed of a phosphor-coated glass tube with electrodes located at either end. The tube contains mercury, of which only a very small amount is in vapor form. When a voltage is applied, the electrodes energize the mercury vapor, causing it to emit ultraviolet (UV) energy. The phosphor coating absorbs the UV energy, causing the phosphor to fluoresce and emit visible light. Without the mercury vapor to produce UV energy, there would be no light. A four-foot fluorescent lamp has an average rated life of at least 20,000 hours. To achieve this long life, lamps must contain a specific quantity of mercury. The amount of mercury required is very small, typically measured in milligrams, and varies by lamp type, date of manufacture, manufacturing plant and manufacturer.



[General Information](#)
[Regulations](#)
[Information Sheets](#)

[Fluorescent Lamp Recycling](#)
[Lamp Alternatives/Low-Mercury Lamps](#)

Listed below are fact sheets, Web sites, brochures and articles on fluorescent lamps. The links will appear in a new browser window.

• General Information on Fluorescent Lamps

Full Title: [Disposal of Fluorescent Light Tubes, High Intensity Discharge Lamps and Fluorescent Lamp Ballasts](#)

Full Work Author: PRO-ACT

Abstract: Fluorescent light tubes and lamp ballasts, and high intensity discharge (HID) lamps are found throughout our environment in residences, office buildings, commercial and industrial buildings, streets, and parking lots. Their disposal can create waste which are often classified as hazardous. The purpose of this fact sheet is to provide information on the components which make the waste hazardous and on appropriate waste disposal procedures.

Full Title: [Mercury in Fluorescent Lamps](#)

Full Work Author: Massachusetts Department of Environmental Protection

Abstract: This Web site covers a very brief synopsis of mercury in fluorescent lamps. It explains why mercury is toxic, what to do with used fluorescent lamps, and links to some of the recycling services of fluorescent lamps in the New England area.

• Regulations Affecting Fluorescent Lamps

Full Title: [Safe and Environmentally Sound Management of Mercury-Containing Lamps](#)