



ELECTROLUMINESCENT (EL) SUSPENSIONS

GENERAL ELECTRIC COMPANY
ELECTROLUMINESCENT PRODUCTS

General Electric offers a complete line of electroluminescent (EL) materials designed for specific EL lamp applications. Our product line of EL phosphor suspensions or phosphor component-mix kits (for suspension formulation) is composed of green, blue or yellow phosphors—or combinations—to derive specific color coordinates and brightness under specified lamp operating parameters. In addition to the phosphor suspensions, a barium titanate (barrier layer) suspension and an indium oxide (top conductor) suspension are also offered.

The electroluminescent phosphors are uniformly dispersed in an appropriate binder and plasticizer along with a combination of solvents to provide excellent coating characteristics. The suspension components are formulated to achieve specific lamp performance characteristics, namely:

- optimum maintenance (half-life)
- decreased susceptibility to moisture ingress/degradation
- reduced current density
- diminished susceptibility to arcing (higher over voltage before arc out)
- improved color stability (particularly white colors)
- increased, as well as controlled, brightness
- higher allowable operating temperatures without lamp degradation

EL BARIUM TITANATE SUSPENSION

The barium titanate suspension is coated directly onto the aluminum foil and acts as a reflector and dielectric barrier layer. It may be applied by a doctor blade process or reverse roll coating process and is typically coated with a dried coating thickness of 30 to 35 μm . At this coating thickness, a kilogram of barium titanate suspension will produce approximately 40 square feet of coating.

The EL barium titanate suspension is supplied as a very fine particle size (1-2 μm) material with a typical viscosity of approximately 4200 centipoises. It is recommended that the barium titanate suspension be mixed by rolling or tumbling the suspension container prior to use to assure homogeneity of the suspension.

EL Product Designation	Order Number
Barium Titanate 117-3-7	70010

EL PHOSPHOR SUSPENSION

The EL phosphor suspension is coated onto the dried barium titanate layer and serves as the light generator in the finished EL lamp. It may be applied by a doctor blading process and is typically coated with a dried coating thickness of 45 to 55 μm . At this coating thickness, a kilogram of phosphor suspension will produce approximately 50 square feet of coating.

The EL phosphor suspensions are supplied as average particle size material of 20 to 30 μm , with a typical viscosity of 3700 centipoises. The suspension may be formulated to higher or lower viscosity values to accommodate specific coating parameters. The suspensions possess an off-white body color, greenish to slightly tan, depending on the phosphor/phosphors employed. It is recommended that the phosphor suspensions be kept mixed during storage by rolling or tumbling the suspension containers to avert settling-out of the phosphor particles. Settling-out of the phosphor particles for prolonged time periods may result in difficulty in getting the phosphor particles homogeneously dispersed upon ultimate resuspension. General Electric, therefore, offers a phosphor component-mix kit (described below) to obviate this potential problem.

The phosphor suspensions are each designed to give specific lamp performance characteristics under given excitation conditions in combination with a pre-defined coating thickness. Following are the offered phosphor suspensions (and corresponding phosphor component-mix kits) along with the analogous order code numbers and typical (lamp) performance characteristics. The performance characteristics shown are initial values obtained after a four hour seasoning (burn-in) period.

EL PHOSPHOR SUSPENSION (cont'd.)

EL Product Designation	Order Number	Typical Performance Characteristics
Standard Green 117-3-1 or as mix kit 117-4-1	70001 70023	At 120V/400 Hz: Brightness—>22 footlamberts CIE X—.220 ± .040 CIE Y—.510 ± .040 Current Density— <2.0 ma/in ² Over Voltage Arc Out—> 800 volts At 220V/400 Hz*: Brightness—>60 footlamberts Current Density—<3.0 ma/in ²
Bright Green 117-3-9 or as mix kit 117-4-9	70003 70028	At 120V/400 Hz: Brightness—>30 footlamberts CIE X—.220 ± .040 CIE Y—.540 ± .040 Current Density—<2.5 ma/in ² Over Voltage Arc Out—>800 volts At 120V/60 Hz*: Brightness—>5 footlamberts Current Density—<0.5 ma/in ² At 220V/400 Hz*: Brightness—>70 footlamberts Current Density—<3.5 ma/in ²
Special Green 117-3-11 or as mix kit 117-4-11	70012 70030	At 220V/400 Hz: Brightness—>50 footlamberts CIE X—.200 ± .040 CIE Y—.510 ± .040 Current Density—<2.5 ma/in ² Over Voltage Arc Out—>800 volts
High Frequency Green 117-3-10 or as mix kit 117-4-10	70004 70029	At 120V/400 Hz: Brightness—>25 footlamberts CIE X—.190 ± .040 CIE Y—.460 ± .040 Current Density—<2.0 ma/in ² Over Voltage Arc Out—>800 volts
Std. Auto White 117-3-2 or as mix kit 117-4-2	70007 70032	At 120V/400 Hz: Brightness—>8, <10 footlamberts CIE X—.320 ± .030 CIE Y—.360 ± .030 Current Density—<2.0 ma/in ² Over Voltage Arc Out—>800 volts
Bright Auto White 117-3-18 or as mix kit 117-4-18	70014 70022	At 120V/400 Hz: Brightness—>10 footlamberts CIE X—.320 ± .030 CIE Y—.360 ± .030 Current Density—<2.0 ma/in ² Over Voltage Arc Out—>800 volts At 180V/800 Hz*: Brightness—>25 footlamberts
Standard White 117-3-4 or as mix kit 117-4-4	70006 70025	At 120V/400 Hz: Brightness—>8 footlamberts CIE X—.290 ± .030 CIE Y—.310 ± .030 Current Density—<2.0 ma/in ² Over Voltage Arc Out—>800 volts
Bright Standard White 117-3-21 or as mix kit 117-4-21	70020 70031	At 120V/400 Hz: Brightness—>10 footlamberts CIE X—.280 ± .030 CIE Y—.350 ± .030 Current Density—<2.5 ma/in ² Over Voltage Arc Out—>800 volts

* NOTE: The color coordinates will vary slightly with changes in voltage and/or frequency. The current density will vary significantly and in proportion to changes in other voltage or frequency.

EL PHOSPHOR SUSPENSION (cont'd.)

EL Product Designation	Order Number	Typical Performance Characteristics
Standard Blue 117-3-5	70008	At 120V/400 Hz: Brightness—>10 footlamberts CIE X—.180 ± .030 CIE Y—.280 ± .030 Current Density—<2.0 ma/in ² Over Voltage Arc Out—± 800 volts
or as mix kit 117-4-5	70026	
Standard Yellow 117-3-6	70009	At 120V/400 Hz: Brightness—>7 footlamberts CIE X—.530 ± .030 CIE Y—.460 ± .030 Current Density—<2.5 ma/in ² Over Voltage Arc Out—>800 volts
or as mix kit 117-4-6	70027	

EL PHOSPHOR COMPONENT-MIX KITS

Phosphor component-mix kits have been designed to give the same coating characteristics as the corresponding pre-mixed phosphor suspensions. The mix kit (designated 117-4-XX) is composed of two basic parts: (1) a predetermined quantity of dry phosphor powder to be combined and mixed with (2) a predetermined quantity of binder solution. A third portion of the mix kit consists of solvent solution to be used if/as needed to compensate for solvent loss during mixing, thereby resulting in the desired viscosity of the mixed suspension. The dry powder portion is added to the binder solution (while mixing) to give the same suspension characteristics as the GE pre-mixed suspension (117-3-XX series). Once the suspension is mixed, it is recommended that the phosphor suspension be kept mixed during storage by rolling or tumbling the containers to avert settling-out of the phosphor particles. A tank or other suitable container along with a mechanical mixer are required by the customer to utilize the phosphor component-mix kit.

The phosphor suspension derived from the component-mix kit (117-4-XX series) results in the same lamp characteristics as the corresponding (117-3-XX series) pre-mixed suspension.

EL INDIUM OXIDE SUSPENSION

The EL indium oxide suspension is screen printed onto the dried phosphor layer to give a dried coating thickness of approximately 5 μm. The indium oxide functions as the top conductor in the finished EL lamps. A standard 5 μm coating of indium oxide will typically result in 65-75 percent light transmission.

The indium oxide suspension is supplied as a very fine particle size (2-3 μm) material with a typical viscosity range of 1500-2000 centipoises. It is recommended that the indium oxide suspension be mixed by rolling or tumbling the suspension container prior to use to assure homogeneity of the suspension.

Two indium oxide suspensions are offered. The standard indium oxide (117-3-16) suspension is formulated with 100 indium oxide powder. The modified indium oxide is formulated with indium oxide in combination with a low concentration of tin oxide to improve conductivity. The modified indium oxide is particularly beneficial in larger lamp types where the center of the lamp is relatively far from the edge silver bus bar. The modified indium oxide is therefore designed to obviate "dark centers" in larger type lamps.

El Product Designation	Order Number
Indium Oxide 117-3-16	70011
Modified Indium Oxide 117-3-22	70021

COATING: SOLVENT REMOVAL

The solvent removal process may be carried out either in a continuous or batch process. If a continuous process is employed, the heat profile of the oven chamber must be related to the coating speed, air flow and heater type. The only absolute term is the maximum temperature at which the coating should be heated (approximately 230°C max.). For these purposes, the oven chamber temperatures are measured approximately one inch above the surface of the coating rather than the coating itself. The temperature profile must take into account the lower boiling solvents, thus the initial heating zone should be lower. If the solvent removal is too rapid, an uneven coating may result. The drying time in the oven will depend on the thickness of the coating, and the length of the oven chamber. The dried coating thickness is typically 30-35 μm for the barium titanate layer and 45-55 μm for the phosphor layer. Thus the drying time may vary from one to several minutes. The oven must be exhausted to expedite removal of the volatilized solvents. Either convection or radiant energy may be employed in the drying.

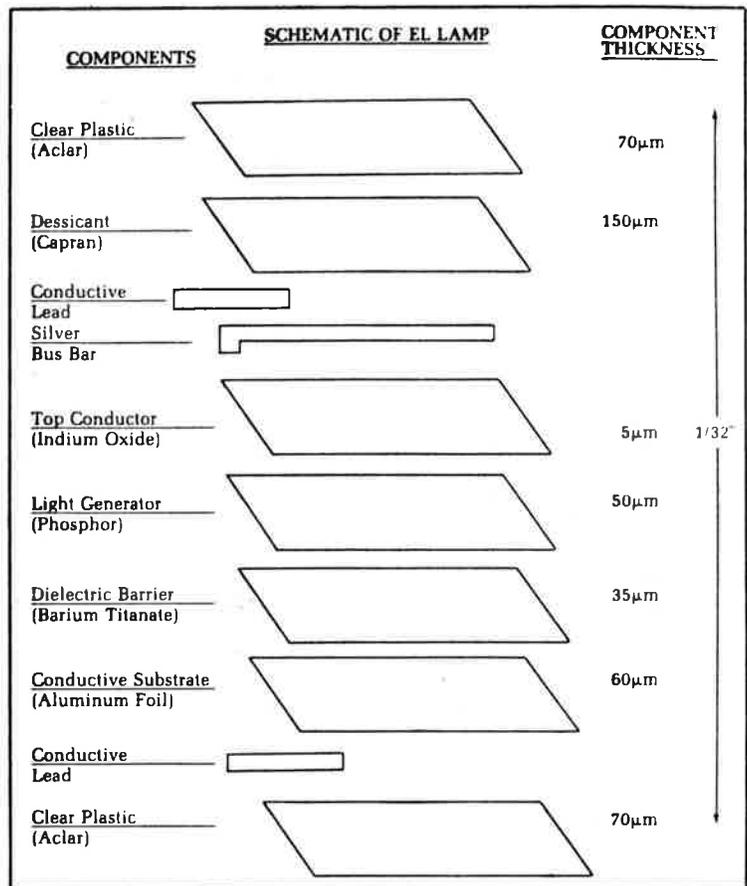
If a batch process is used with a conventional convection oven, the coating may be air dried for 10-15 minutes and then cured at 100-110°C for approximately 10 minutes in the oven.

TOXICITY

The toxicological properties of electroluminescent suspensions have not been completely defined. General Electric Company, therefore, suggests they be handled in such a manner as to avoid dust inhalation, ingestion and skin or eye contact. Some components of these materials are FLAMMABLE LIQUIDS and necessary precautions should be taken. Part or all of these materials may also have been reported for inventory under the Toxic Substances Control Act (PL-94-469).

GENERAL PROCESS OF EL LAMP FABRICATION

1. Coat conductive substrate (aluminum foil) with barium titanate suspension.
2. Remove solvent by oven curing.
3. Coat phosphor suspension onto dried barium titanate layer.
4. Remove solvent by oven curing.
5. Screen print indium oxide onto dried phosphor layer.
6. Remove solvent by oven curing (110°C).
7. Screen print silver ink onto the dried indium oxide layer edge, forming a bus bar stripe near the edge of the coated indium oxide.
8. Remove solvent by oven drying (110°C).
9. Cut the material into the shape(s) of the designed lamp(s).
10. Heat the Capran dessicant sheet(s) in an oven at 110°C to remove moisture.
11. Assemble the lamp components (bottom to top) as follows:
 - a. Aclar
 - b. Coated foil with indium oxide facing up
 - c. Copper ribbon leads—bottom lead under foil and top lead on silver bus bar
 - d. Preheated Capran
 - e. Aclar
12. Tack (attach) the lamp together by heating the plastic over the leads and at intermittent intervals along the lamp edges by means of an electrical heating gun.
13. "Bake-out" the assembled lamp(s) in an oven at 110°C for approximately one hour.
14. Laminate the lamp assembly via a laminating press using temperature and pressure.



AVAILABILITY

Phosphor suspensions (as well as phosphor component-mix kits) are available in batch size quantities of approximately 34 kilograms. The barium titanate suspensions are available in batch quantities of approximately 85 kilograms. The indium oxide suspensions are available in batch quantities of 10 or 20 kilograms. These EL suspensions (or phosphor component-mix kits) are available in production quantities with normal lead times of 2 to 3 weeks or less.

ORDERING

To order electroluminescent suspensions, contact your Sales Operation representative or:

Domestic

General Electric Company
 Chemical Products Plant
 1099 Ivanhoe Road
 Cleveland, Ohio 44110
 Phone: (216) 266-4611

International

General Electric Company
 Lamp Components & Technical Products Division
 International Sales
 21800 Tungsten Road
 Cleveland, Ohio 44117 U.S.A
 Telex: 985569 (GECOLCS EUCD)
 Phone: (216) 266-3295

General Electric's Lamp Components & Technical Products Division is the source for tungsten, molybdenum, glass, fused quartz, Lucalox® ceramic, phosphors, chemicals, Dumet and Cumet wire, leads, bases and other components used by the lamp, electronic, cemented carbide and other industries. Technical and engineering assistance is available on all products.

