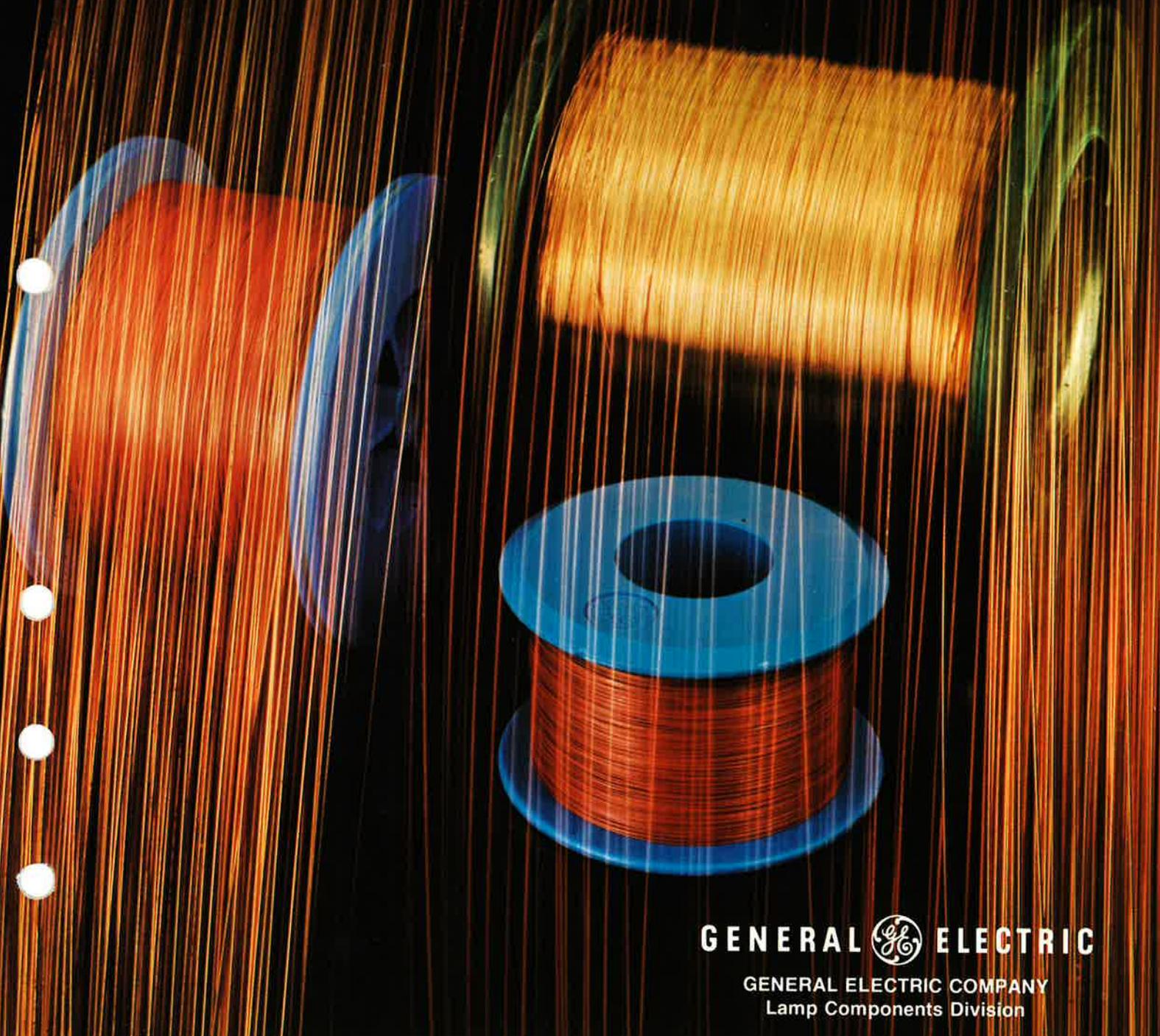




Dumet and Cumet Wire



GENERAL  ELECTRIC

GENERAL ELECTRIC COMPANY
Lamp Components Division

Dumet

Dumet is a clad wire consisting of a copper sheath metallurgically bonded to a nickel-iron core for sealing with glass in the manufacture of lamps and electronic components. This combination achieves very specific engineering properties such as:

- A thermal expansion rate which is a close match with soft glass.
- Electrical resistivity desirable in a wide range of lamp and electronic applications.
- A high melting point.
- Good corrosion resistance.

Dumet is generally specified as either **Lamp Grade** or **Semiconductor Slug Grade**.

Lamp Grade Dumet is commonly ordered in the diameter range of 10 to 30 mils and, as its name implies, is used in lamp applications as the sealing mate-

rial with the glass envelope. Lamp Grade Dumet is normally ordered with either a borated or nickel-plated surface depending on the application.

Semiconductor Slug Grade Dumet comes in standard diameters ranging from 30 to 68 mils, but diameters up to 125 mils are available upon special request. This grade of Dumet is commonly ordered with either a leach-resistant borated surface coating, or an oxidized surface and is used as the sealing material in two-part electronic leads for capacitors, diodes and other discrete devices.

Because of the growing number of special requirements in both the lamp and electronic industries, a wide range of wire diameters and surface finishes is available in both lamp and semiconductor slug grade Dumet.

Cumet

Like Dumet, Cumet is a clad wire that exhibits a special combination of properties. The product is made by metallurgically bonding a copper sheath to a low-carbon steel core. Controlling cladding thickness and the circular cross section of the steel core wire are important design factors which affect the performance of Cumet.

Cumet combines the good electrical conductivity of copper and the strength of steel. The pigtail portion of two-part leads for capacitors, rectifiers, diodes and other electronic devices are major applications for Cumet. The wire is also used for formed wire parts for electronic components, and in lead wires for electronic tubes and incandescent lamps.

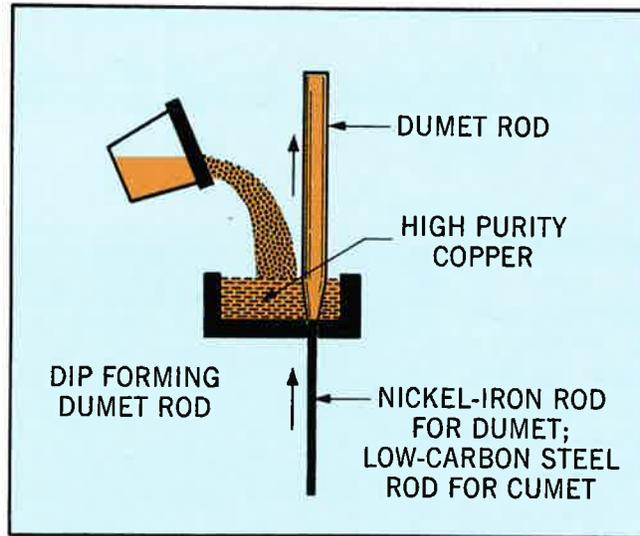
Cumet is available from GE with a nominal 40% conductivity. The material exhibits weldability characteristics that are well suited to cross-wire welding.

The most common wire diameter for pigtail applications is 20 mils; however, other diameters are available upon request. Cumet's steel core permits the use of magnetic sorting and handling equipment in the manufacture of pins, lead wires and other small pieces.

Manufacturing

In the dip-forming process used to create Dumet and Cumet, the core material is fed from a continuous coil and passes through a bath of low oxygen, high-purity copper. The copper sheath freezes on the core rod like melted tallow on a candle, forming a metallurgical bond. Coating thickness is controlled by the speed at which the core rod is traveling through the molten bath and the core temperature.

Close control is exercised in the handling and manufacture of these products. This is especially true for Dumet, where maintaining the proper coefficient of expansion, minimizing composition variables and providing a controlled cladding thickness are all important in providing good sealing characteristics.



Semiconductor Slug Grade Dumet

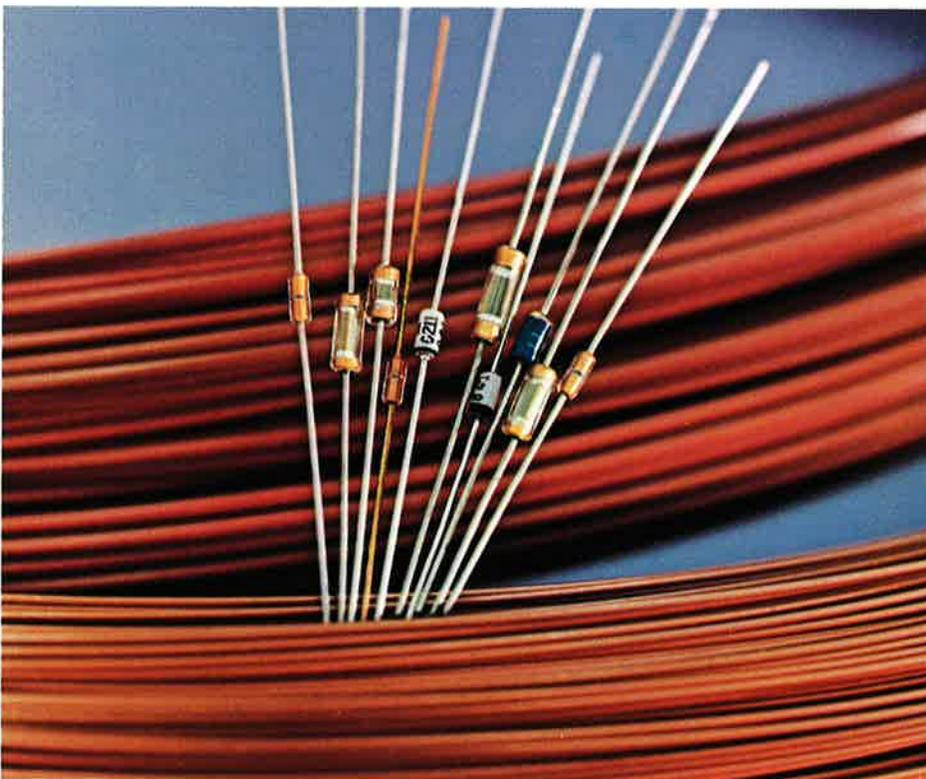
The major application of Dumet in the size range of 30 to 68 mils diameter is in two-piece slug leads for discrete

electronic devices such as diodes and capacitors. Semiconductor Slug Grade Dumet is available from General Electric with special tensile and color properties tailored to meet the needs of the electronic industry.

During manufacture of two-piece slug leads, deformation of the Dumet slug can occur. General Electric has the capability to provide a high tensile Dumet which resists deformation during processing, resulting in a more circular Dumet slug.

For critical glass sealing applications, such as capacitor lead wires, a dark colored Dumet, which normally indicates a high oxide thickness, is usually required for hermetic glass sealing. For this type of application the high tensile properties of the Dumet will be sacrificed to attain the needed oxide thickness.

To determine the tensile and color properties that best meet a specific application, we suggest that you contact General Electric for engineering assistance; refer to page 8 of this brochure for details.



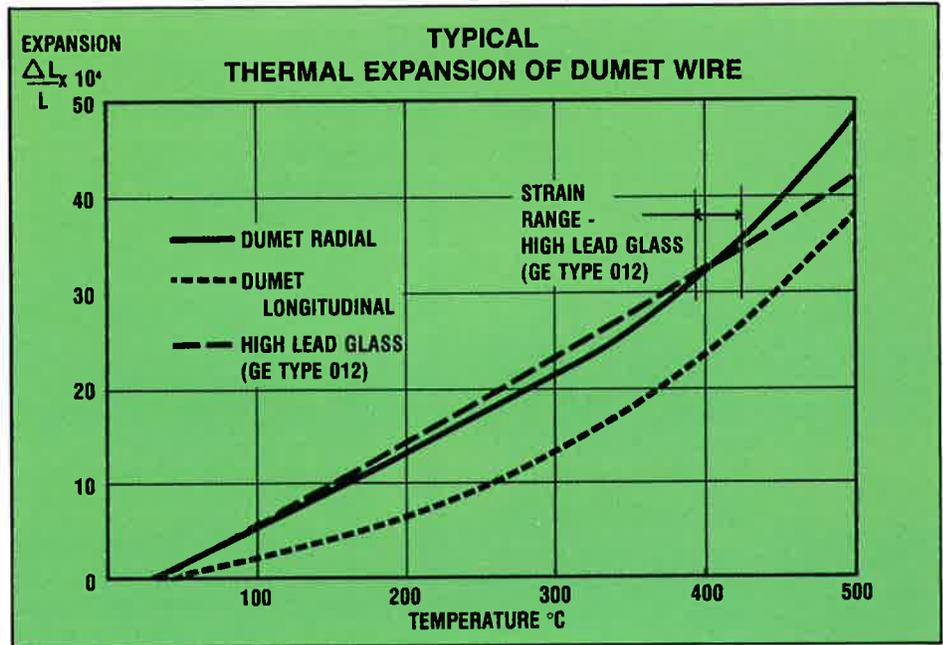
Properties of Dumet and Cumet

THERMAL EXPANSION

Dumet is a lead wire material with good conductivity and a radial coefficient of thermal expansion closely matching that of soft glass. The wire is capable of forming a hermetic seal with high and low lead glasses and lime glass.

Figure 1 compares the expansion of Dumet with high lead glass. Because Dumet is a composite material, its axial and radial thermal expansions are different. For this reason, the length of the seal which can be obtained depends on the diameter of the Dumet used and is a function of the ability of the thin copper sheath to yield and distribute the strains. Figure 2 illustrates this relationship.

Figure 1

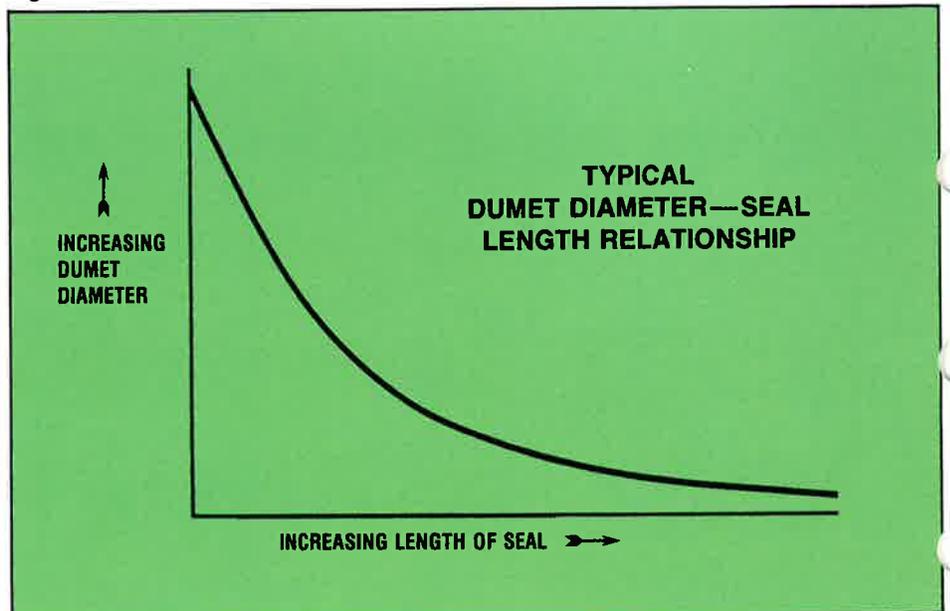


WELDABILITY

GE Dumet can be welded to a wide range of ferrous, non-ferrous, and refractory metals and alloys.

In resistance cross-wire welding of Dumet, the weld generally exhibits a forged structure with a narrow heat-affected zone and a minimum of expulsion. Under proper weld conditions, the nickel-iron core will form a metallurgical bond at the interface with the other metal.

Figure 2



TYPICAL PROPERTIES OF DUMET AND CUMET

Chemical Composition of Core by Weight %	DUMET	CUMET	
		C-1006 40% IACS	C-1018 40% IACS
Nickel	41.00-43.00		
Cobalt	0.50 Max.		
Manganese	0.75-1.25	0.25-0.40	0.60-0.90
Carbon	0.10 Max.	0.08 Max.	0.15-0.20
Silicon	0.25 Max.		
Chromium	0.20 Max.	0.05 Max.	0.05 Max.
Sulfur	0.015 Max.		
Copper	0.15 Max.		
Phosphorous	0.02 Max.	0.04 Max.	0.04 Max.
Molybdenum	0.15 Max.		
Aluminum		Present	Present
Titanium	0.08 Max.		
Iron & Residuals	Remainder	Remainder	Remainder

Cladding Material

Copper, Min. Percent	99.90	99.90	99.90
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Cladding Weight %

Copper, Cladding	18-26, (22 Nom.)	34	36
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Cladding Thickness Ratio

Copper, Cladding Max:Min	2.0:1.0	2.0:1.0	2.0:1.0
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Physical Properties

Tensile Strength, KPSI	100 Max.	65	65
Yield Strength, KPSI	80 Max.	45-50	45-50
% Elongation	10 Min.	20	20

Thermal Properties

Coeff. Expansion, 25-400°C, $\mu/\mu/^\circ\text{C} \times 10^{-7}$	Axial	50-65	Not Determined	Not Determined
	Radial	80-100	Not Determined	Not Determined
Conductivity, 20-200°C Cal/cm/sec/cm ² /°C	0.2-0.3	0.46	0.46	

Electrical Properties

Resistivity: mΩ-cm	7.3-12.0	4.4	4.4
Circ. Mil-ohms/ft.	44-72	26.4	26.4
Conductivity %IACS	24-14	40	40

Density

lb/in ³	0.298-0.301	0.297	0.298
gm/cm ³	8.26 -8.32	8.23	8.26

Surface Coatings

BORATED DUMET

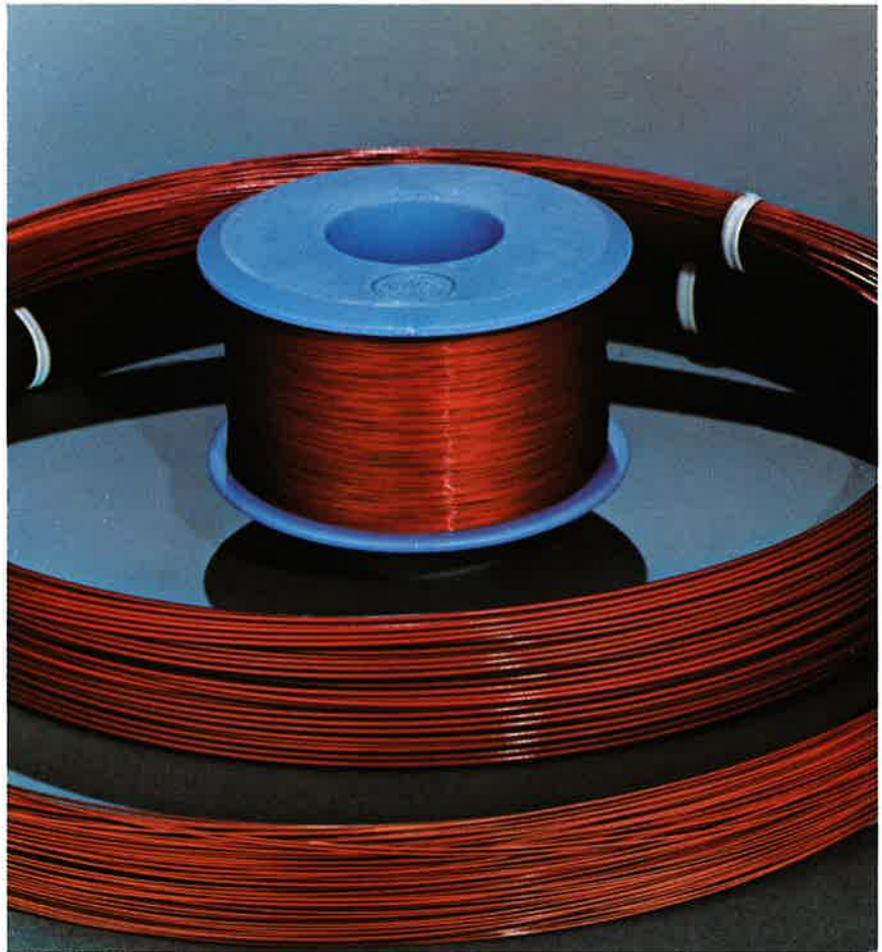
The borate coating, an anhydrous combination of fused sodium tetraborate (borax) and copper oxides, serves two functions:

- 1) The coating helps prevent excessive oxidation of the Dumet surface in the early "sealing fires" before being protected by the glass envelope.
- 2) It acts as a flux, accelerating the dissolution of the copper oxide in the surrounding glass envelope. This provides a "wetting action" which aids in sealing.

Glass sealing is sensitive to a number of variables and success often depends on achieving a precise coating of borate on the Dumet wire. The characteristics of the coating are usually detected by the color—from pale copper to a dark, dusty red. An ASTM color chart, F 29, is used to quality-check the borated Dumet surface. GE can vary the manufacturing process to meet any color standard on the chart.

LEACH-RESISTANT BORATED DUMET

Leach-resistance (LR) is only available in borated Dumet.



OXIDIZED DUMET

The use of oxidized Dumet has increased in diode and capacitor slug applications where the glass sealing is done in a furnace. However, for flame sealing applications, leach resistant borated Dumet rather than oxidized Dumet is recommended. The color range of oxidized Dumet is similar to the color standards of borated Dumet, but not exact, and does not conform to ASTM color chart F 29.

UNBORATED DUMET

For special applications where a clean copper finish is desired, unborated Dumet can be used. Unborated Dumet is commonly used as a pigtail material for some electronic slug leads.

NICKEL-PLATED DUMET

A nickel-plated finish is used on Dumet for some applications to provide more protection from sealing fires and to reduce oxidation inside a sealed lamp envelope. Nickel-plated Dumet has the added advantage of not requiring a cleanup operation after stem-making.

Packaging



Dumet wire in the range of 10 to 30 mil diameters is shipped on either 5 or 10-pound spools contained in clear heat-sealed plastic bags with a desiccant. In the 30 to 125 mil range, Dumet is wound into 10-pound self-contained coils that are tied and shipped in sealed black plastic bags with a desiccant.



Cumet is available in 80 to 100-pound pail packs or on 30-pound spools. The pail packs are flat drums in which the wire is wound around a central core so that it can be continuously fed from the pail to automatic processing or assembly machinery.

Storage and Handling

Because Dumet's sealing ability can be impaired by improper storage and handling, GE recommends that certain procedures be followed in order to obtain the greatest value from this product.

The coating on borated Dumet is anhydrous and is susceptible to picking up moisture from the air. Too much moisture causes a white spotty appearance on the wire surface and is referred to as "blooming". Scattered bubbles in the glass seal can result from this condition. To minimize this problem, GE borated Dumet is packaged in a sealed plastic bag which includes a desiccant that helps maintain the required atmospheric condition during shipment. GE recommends that the customer observe the following procedures when handling Dumet:

Dumet should be kept in its sealed bag and stored in cabinets main-

tained at a relative humidity of less than 50%.

- Prolonged storage should be avoided and the oldest stock always used first.
- Dumet should be used within 30 days from the date of shipment to minimize the possibility of deterioration.
- The material should not be touched with bare hands and should be kept free from contact with grease and exposure to light. (The light will not affect sealing qualities, but may alter the identifying color of the wire.)
- Any mechanical damage to Dumet's surface should also be avoided since a broken surface may cause sealing problems.

CAUTION

Deterioration of the Dumet surface after delivery is not considered a defect in material or workmanship, nor a failure to conform to specifications.

GE recommends that the product be used within 30 days from the date of shipment in order to minimize the possibility of deterioration.

Engineering Assistance

Application engineering assistance is available by writing or calling:

General Electric Company
Lamp & Electronic Parts
Products Dept.
Marketing Section
1133 East 152nd Street
Cleveland, Ohio 44110
Phone: (216) 266-4348

GE recommends that you take advantage of this service if you are not thoroughly familiar with the properties of Dumet and Cumet.

Ordering Information

Send orders directly to:

Domestic

General Electric Company
Carolina Welds Plant
900 North George Street
Goldsboro, North Carolina 27530
Phone: (919) 734-5121

International

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

Europe

International General Electric Co.
of New York
Lamp Components Sales Operation
21a High Street East, Uppingham
Leicestershire LE15 9PY England
Phone: 057-282-3748
Telex: 34362 (GELCOS)

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

General Electric Company
Lamp Components Sales Operation
21800 Tungsten Road
Cleveland, Ohio 44117
(216) 266-2451
Telex: 985569

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