Data Sheet

Product Data Sheet 7215-B
September, 1995

GE Lighting Components

Tungsten Lamp Filament Wire

Type 218 tungsten wire has been the industry standard for incandescent lamp filaments for the last 75 years.

Nothing has come along to challenge its superiority. It burns brightly on command, cycle after cycle, providing long hours of illumination at a very low cost.

GE Development

GE Lighting developed Grade 218 tungsten wire and continues to be a major producer of the material. For filament applications, we produce sizes from 0.72 to 20.00 mils (0.018 to 0.508 mm) diameter in a weight range of 1.00 to 777.08 mg per 200 mm.

Although it is lightly doped to achieve specific metallurgical properties, Type 218 wire is essentially pure at 99.95 + weight percent tungsten.

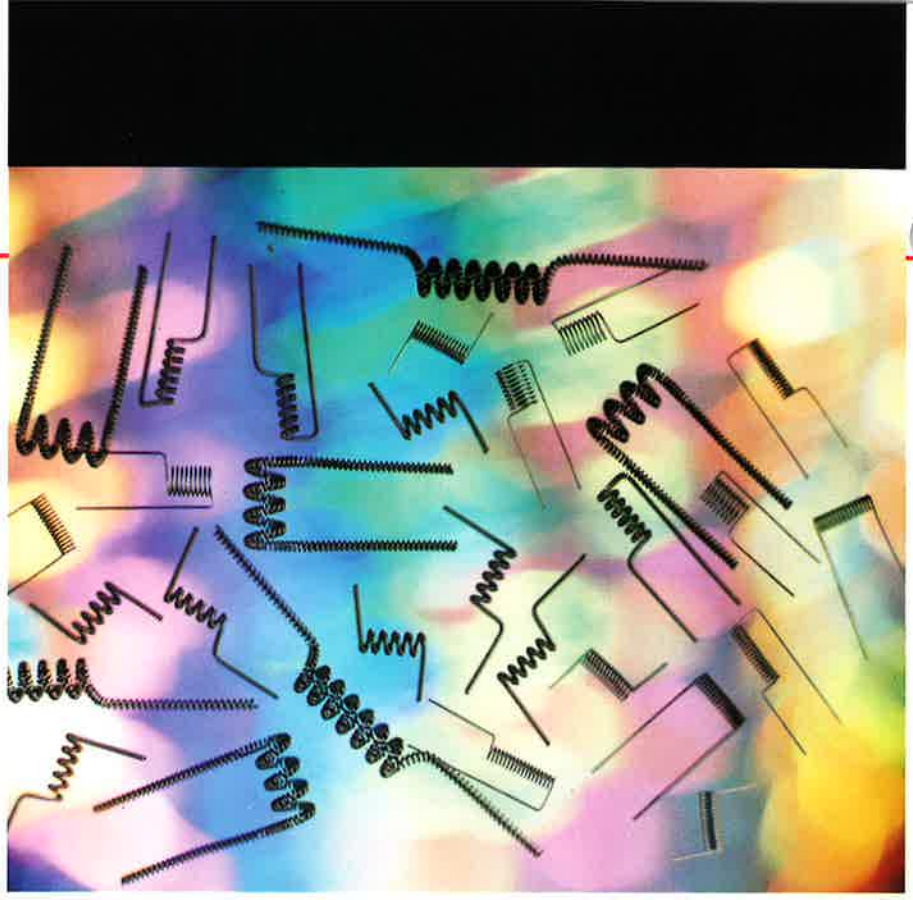
A Refractory Metal

Its most outstanding attribute is its microstructure after recrystallization. Proper "flashing" of the wire produces a large, elongated and interlocking grain structure which promotes high temperature strength and excellent non-sag qualities. The wire also performs well in extremely difficult forming applications, especially if a low level of heat is applied to the point of coiling or forming.

Tungsten is one of the refractory metals, a family of materials which exhibit very high strength at elevated temperatures. With a melting point of 3417 °C, tungsten is stronger than any other metal over 1900 °C, and retains usable strength at 3000 °C, making it unique and irreplaceable in many applications.

The material combines low vapor pressures at elevated temperatures, excellent room temperature strength, good electrical and thermal conductivity, high elastic modulus and hardness, and inertness to chemical reaction with many materials.

Lamp filaments are made in a variety of sizes and shapes to meet today's lighting requirements.



Although tungsten is sometimes considered difficult to fabricate, technology developed by GE makes it possible to produce ultra thin wire with sufficient ductility for filament coiling operations.

Like most materials, tungsten develops additional strength as it is worked into smaller diameters. Successive draws create the fibrous grain structure needed for ductility in coiling and other fabrication processes. As the wire is drawn, the ductile-to-brittle transition temperature is progressively suppressed to values well below room temperature. Because tungsten wire is processed below its recrystallization temperature, it work hardens and must be softened by stress- relieving anneals to allow further processing to smaller diameters.

Manufacturing

To provide 99.95% purity in the finished product, only contaminant-free starting materials are used in the production of tungsten wire. Purity levels are maintained throughout manufacturing, from the powder metallurgy process through the wire drawing operations. The wire is produced to +/–3% size tolerance by weight.

Frequent quality audits of process temperatures, reduction drafts and lineal speeds are performed to maintain uniformity of dimensions and properties. Product traceability throughout GE's process establishes a reliable wire pedigree.

Two Options

Type 218 tungsten wire is available from GE with either a "black" (B) or "cleaned and straightened" (CS) surface condition.

The black (B) wire, suitable for most lamp applications, has a graphite coating over a layer of surface oxide.

For those who prefer a wire which has been electrochemically cleaned and straightened, we produce a CS wire that shows no visible evidence of drawing lubricant residues, oxides, or other foreign matter such as dirt or oil when viewed without magnification.

Size Range Determination

Filament applications require very close control of wire dimensions.

Diameters above 0.51 mm (20 mils) can be measured with standard micrometers. But for most filament wire applications, these methods of direct measurement cannot approach the degree of precision required. Therefore, an indirect method called rating is used. A precise 200 mm length of wire is cut and weighed on an accurate electronic balance. The weight of the sample is recorded in milligrams to two decimal places.

Rating and Weighing

Rating and weighing of tungsten wire is performed by experienced personnel specifically trained for this precision operation. Constant checks are made to maintain accuracy of the system. Balances used are the most accurate and dependable types available. They are always calibrated at the nearest point to the wire size being weighed, and the working calibration weights are frequently checked against standards traceable to the National Bureau of Standards. Each balance is used only for a small portion of the total size range.

Cutting blocks are designed and calibrated to cut precisely to a 200 millimeter length.

Table I - Size/Weight Relationship

Diameter (d) = $K\sqrt{mg/200\ mm}$
$mg/200\ mm = C \times d^2$

Units	K	C
Microns	18.223	3011.18×10^{-6}
mm	.018223	3011.18
mils	.71745	1.9427

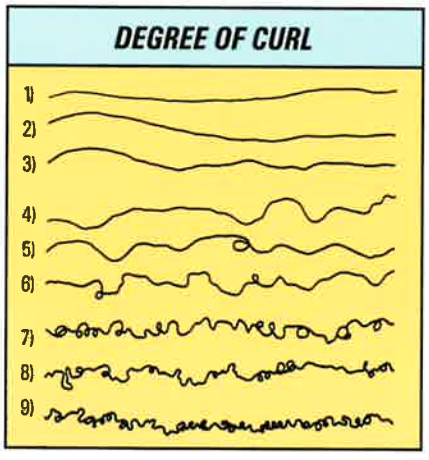
Straightness

Straightness is determined by the amount of camber exhibited by the wire. For tungsten wire, camber is expressed as the maximum deviation of the wire from a straight line over a fixed span.

Black (B) wire has no implied curl designation. Cleaned and straightened (CS) wire will have a curl rating of 6 maximum or a camber of 32 mm maximum/ 200 mm, depending on size. See chart below.

Table II - Wire Straightness

Size Range	Maximum Curl or Camber/ Wire Length
1.0 - 10.00 mg	6 maximum curl
10 mg or greater	32 mm/200 mm camber



Labels

All labels will include at least the following information:

1 Number of meters.

2 In and out rating (mg/200 mm) for wire below 20 mil and size in mils for wire 20 mil and above.

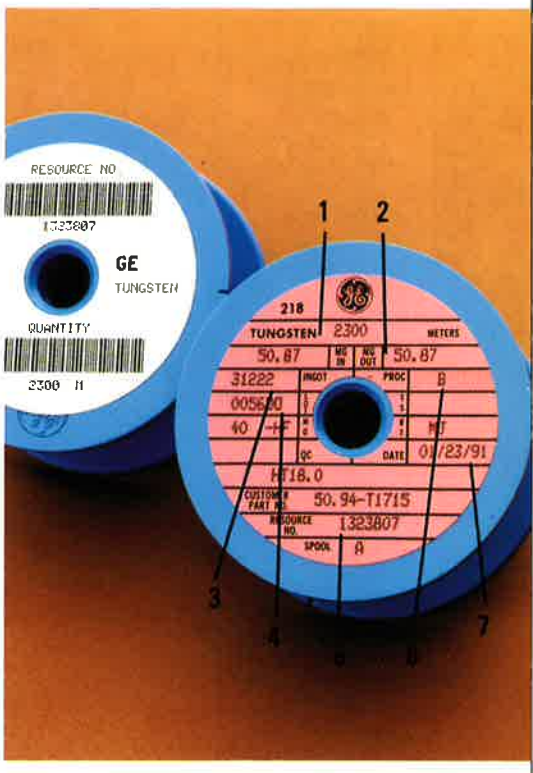
3 Ingot number.

4 Lot number.

5 GE resource (reference) number.

6 GE process code (B or CS).

7 Manufacturing date.



Computer generated labels (right) have the wire processing information that confirms the finished wire specifications. Bar coding (left) is used to speed order processing and maintain good inventory control.

Shipping Containers & Coils

GE 218 tungsten wire is packaged for shipping on either self-contained coils or wound on standard spools or bands. The material is shipped in one continuous length per container or coil, as indicated in the table below. Any deposit charge made for shipping containers is refunded when containers are returned prepaid and in good condition.

A Unique Resource

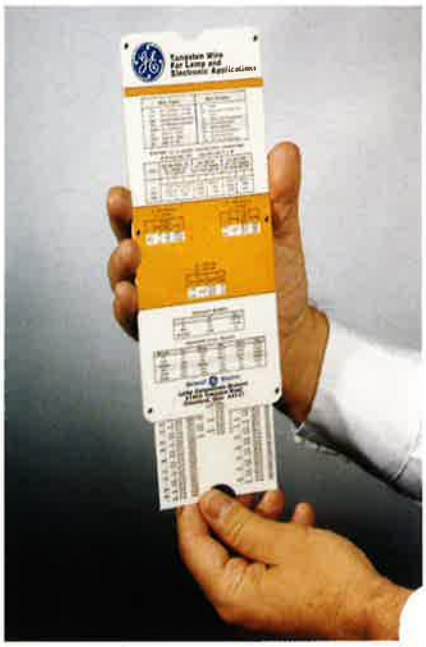
Tungsten wire is one of several lamp related products available through GE Lighting Components. In wire alone, we produce Dumet, Cumet, molybdenum, platinum clad molybdenum, and lead wire assemblies.

We also manufacture lamp bases, glass in the form of bulb blanks, tubing and pressed ware; Lucalox® ceramic, luminescent phosphors and inorganic chemicals.

For more information on 218 tungsten wire or any of our other lamp components or materials, contact your regional sales representative or our offices at Nela Park in Cleveland, Ohio.

To Order

To order tungsten wire, contact your local sales representative, or the Nela Park office in Cleveland, Ohio.



The GE conversion slide chart pictured here provides data on wire types and finishes, diameter to weight ratios, and other information. It is available from GE in English, Japanese, German and Spanish, with data in both English and metric values.

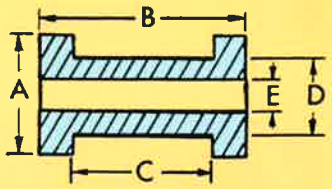


TABLE III

Minimum Order Value: $500 per line item

	Name	Material	Approx. Weight In Grams	CONTAINER DIMENSIONS Units	Flange Diameter (A)	Width (B)	Traverse (C)	Barrel (D)	Hole (E)	Mg Per 200 mm	Approx. Container Capacity (grams)
	Small Plastic Spool	ABS	22	mm	53.98	26.16	19.81	37.16	10.29	1.0 - 60.0 Black Wire and 1.0 - 50.0 Clean Wire	250
				in.	2.125	1.030	.780	1.463	.405		
	Large Plastic Spool	ABS	63	mm	63.50	35.00	28.55	41.22	10.29		500
				in.	2.500	1.378	1.124	1.623	.405		
	Blue Special Band	Lexan®	73	mm	119.86	27.00	20.63	105.18	96.04	20.0 - 150.0 Clean Wire	650
				in.	4.719	1.063	.813	4.141	3.781		
	Orange Regular Band	Lexan®	100	mm	126.21	33.34	25.40	108.36	98.43	41.0 - 777.0 Black or Clean	1050
				in.	4.969	1.313	1.000	4.266	3.875		

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