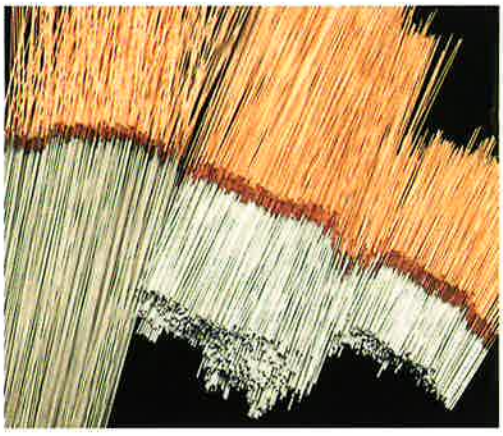
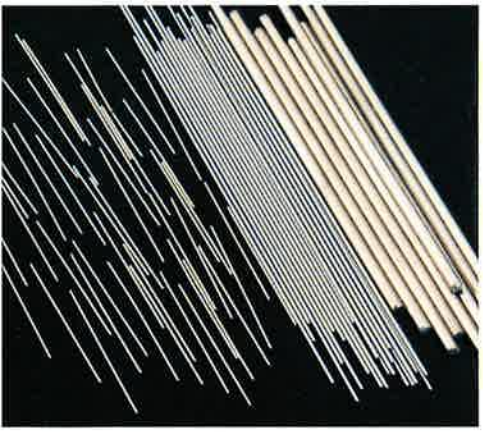
Lead Wires

Specialized Lead Wires Filling Larger Role In Lamp Design



The most common varieties of leads produced by GE are combinations of nickel, Dumet and copper alloys.



One part leads or "straights" are the least complex of the leads we supply.

Selecting the correct lead wire for a lamp is critical to its performance, service life and ultimate cost.

The availability of sophisticated wire-to-wire welding procedures and an unending variety of clad and bare wire alloys has given today's engineers a great deal of flexibility in meeting these requirements.

A lead may be as simple as a single strand of wire or as complex as three different wires welded end-to-end. Materials may range from ordinary copper to platinum clad molybdenum.

The lead wire's primary purpose is to conduct electrical current or a signal through the vacuum seal in the glass envelope. A second lead wire carries the signal or current out.

By combining different materials in the lead wire assembly, other tasks can be accommodated. These include mechanical support for the filament, electrical resistance, vibration damping or circuit breaking.

A wide variety of lead wire designs, too many to enumerate here, are available from GE Lighting Components in Cleveland, Ohio. Every lamp product has its own particular lead wire configuration.

Changing Technology

The technology is growing and changing almost daily. Our ability to weld diverse materials permits us to select the best wire for each part of the lead. New wire combinations have been developed to meet special needs and such processes as dip forming are available to create metal composites which can satisfy several design demands at once.

Typically, in the construction of a multipart lead, a high temperature material is utilized for the lamp envelope environment, a metal that matches the expansion of the glass is used in the seal area, and a high conductivity wire is selected for the outer lead.

Types Of Lead Wires

Whether they are a single wire or a three part assembly, lead wires consist of three basic sections: the external or "outer" section connected to the power source; the seal or "press" section that is imbedded in the glass, and the "inner" section that connects to and often supports the filament.

GE produces literally billions of lead wires each year for its own requirements and dozens of other lamp makers around the world.

Here, briefly, are some of the more common types that GE produces on a regular basis.

One-Part Leads

One part leads are the simplest types because they have no weld knot. Materials can be nickel, Dumet, or others. They are generally referred to as "straights."

Two-Part Leads

Two-part leads are two wires joined by a single weld. One of the wires does double duty as both the inner and seal section, or the outer and seal section. Nickel and Dumet are the most common materials used. Applications include neon glow lamps and some types of fluorescent tubes.

Three-Part Leads

Three-part leads are the most common of the welded leads manufactured by GE. They consist of three wires joined by two welds, forming the inner section, the press section and the outer section.

Head lamps and signal lamps for automobiles are almost always a nickel inner, Dumet seal, and copper outer section.

Fluorescent lamps usually have Cumet (CCFe) or copper outer leads, a Dumet seal section and nickel or nickel iron inner section.

In hard glass lamps, the seal section may be tungsten or molybdenum and the inner section nickel, stranded nickel or stranded nickel copper.

Most other three part leads consist of a copper outer, Dumet seal and an inner section of nickel, copper or copper nickel. Some come with a fuse section made of Monel®[1] or nickel clad Dumet.

Hook leads, in which the inner portion has a formed hook at the end, are described in the next section.

Molybdenum foil leads, in which a molybdenum foil tab is used for the press section, are described on page 5.

Other leads include:

Formed leads, with the inner or outer section formed with one or more bends, are normally made to specific customer requirements.

Stranded leads have a portion of their length, usually the outer section, made from an assembly of twisted wires. Used in high intensity discharge lamps and other applications where flexible connections are required, they generally consist of a number of smaller wires wound around a central core wire.

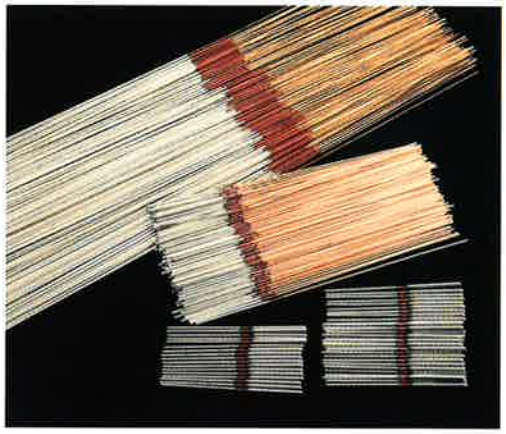
[1] *Trademark, INCO Family of Companies*

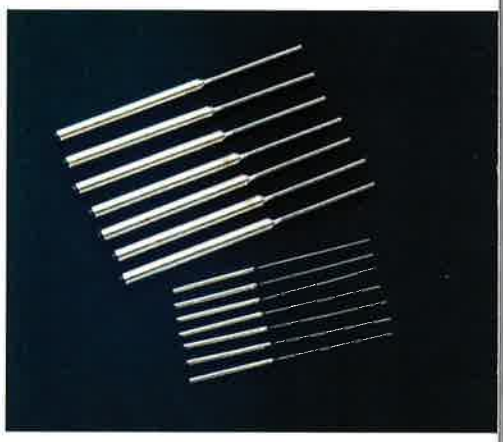
Most lamp leads produced by GE have a Dumet press section, but the other sections vary widely. Shown in the photo, top right, are nickel inner, Everdur outer; iron inner, copper outer, and nickel/nickel.

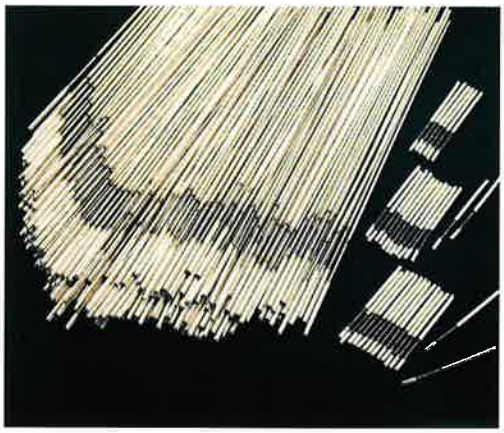
Two-part leads, center photo, are used in glow lamps and fluorescent tubes.

Nickel-iron-cobalt alloy is another widely used material for the press section (bottom photo). It can be combined with any number of nickel based, copper based or other alloys.

Stranded leads, above left, offer greater flexibility than a single wire.







In some cases, stranded wire is produced without a core. If desired, cut lengths can be fused at one end to prevent fraying and the other end can be covered with a nickel sleeve to increase weldability.

Pointed leads have the end of the outer section rounded to serve as a pin for socket insertion. They are commonly used in cathode ray tubes and receiving tubes. Pins are produced to standard specifications on special pin rolling equipment and can be supplied in a large variety of diameters, lengths and materials.

Fused leads are welded assemblies in which one part, usually the outer, has been designed to act as a fuse.

Tube leads are made by flattening a straight round wire and then drawing the flattened portion through a circular die forming a tube.

Flat end leads are made from a straight round wire and flattened on one or both ends.

Round leads are usually formed of large diameter wire and act as current carrying supports in larger lamps.

Channel leads are made from a metal strip which is formed into a U-shaped cross section and bent according to specifications. They are used in lamps having a mogul bi-post base.

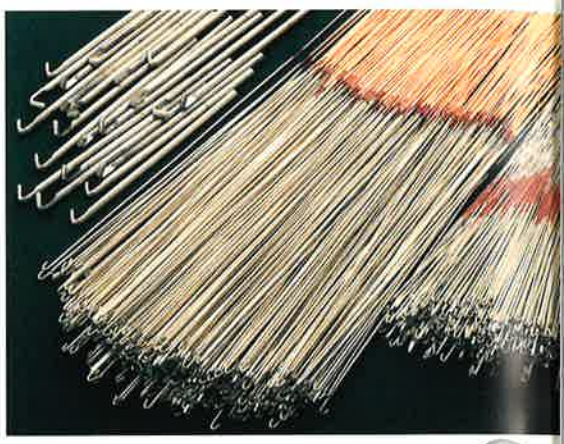
Hook Leads

In the normal lamp-making process, the tungsten filament is clamped or crimped in place by folding the top of the lead wire over the filament. But for some types of lamps, a preformed hook is preferred. On these leads, the end of the inner portion has been flattened or sheared and then formed into a hook.

V or U Shapes

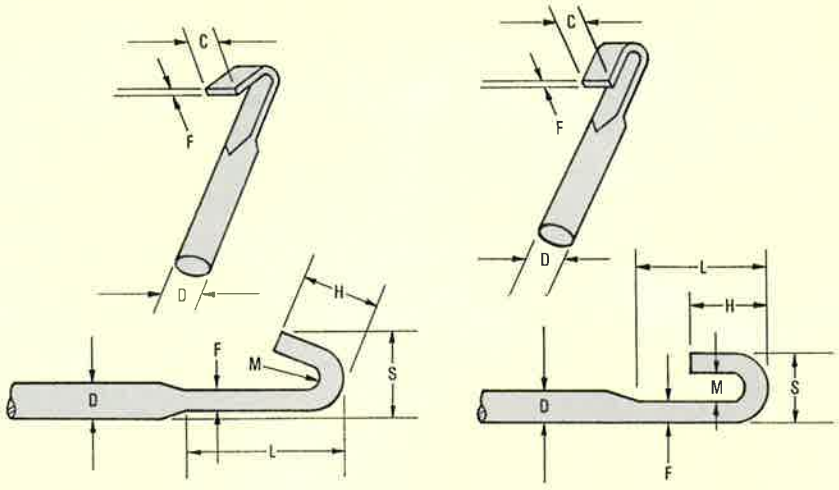
Hook leads may consist of a single wire formed at one end or two, three or more dissimilar wires welded together with a hook formed at one end. They are classified by the shape of the hook as either Regular (V shaped) or Parallel (U shaped) hook leads. In addition, some larger sizes may have corrugated surfaces.

GE produces a complete line of hook leads. Data on typical length, diameter straightness and weld knot tolerances are available.



Leads with a formed hook are ready for fast and easy assembly to the lamp stem.

Hook Lead Dimensions



In ordering hook leads, either "V" for the V shape (left) or "U" for the parallel shape (right) should be specified. (V shaped will be supplied if no distinction is made.) The letter symbols in the diagrams refer to the following dimensions:

C – flat width
D – wire diameter
F – flatness
H – hook length
L – leg length
M – mandrel diameter
S – hook spread

Molybdenum Foil Leads

When leads are to be sealed in quartz, etched molybdenum foil tabs are usually used for the press section.

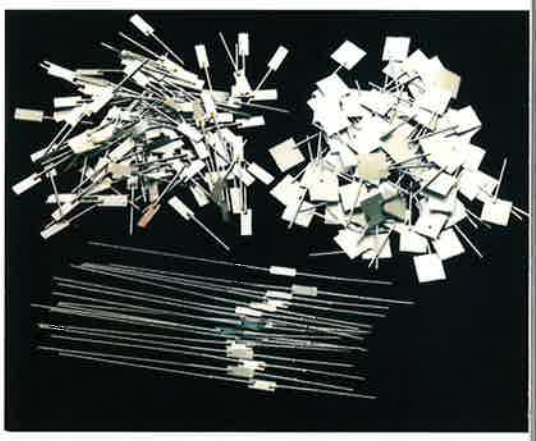
Molybdenum can provide a good hermetic seal because it matches quartz's coefficient of thermal expansion and can withstand high pinching temperatures. The tab shape is preferred over a wire because it minimizes the stresses generated by the wide swings in temperature.

The molybdenum foil is etched to an approximate lenticular cross-section to minimize the formation of leak channels along the edge of the coil.

The typical etched foil lead is usually made of GE Type 218 tungsten or Type KW molybdenum wire with a platinum clad molybdenum weld tab to facilitate joining to the inner lead. Welds for these leads are strong and reliable.

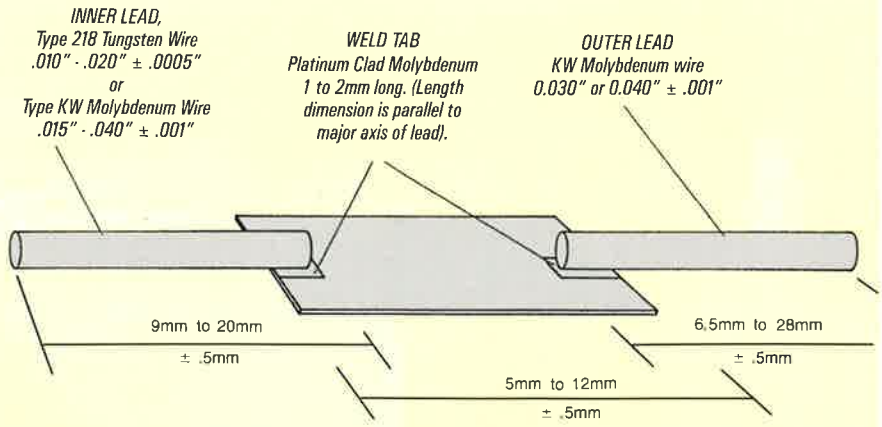
Applications include high temperature mercury arc lamps, tungsten-halogen cycle lamps, infrared heat lamps, and certain electronic and instrumentation applications.

GE offers a number of engineering options with its etched foil leads. For instance, for some applications we flatten the outer lead (0.015″ - 0.018″ thick for 0.030″ diameter wire or 0.022″ - 0.025″ for 0.040″ diameter wire) at the welded end. For other uses, nickel wire or a wire of another compatible material can be butt welded to the end of the outer or inner lead if desired. GE also offers a number of alternative dimensions and configurations of etched foil leads.



Etched foil leads (above) are welded assemblies used as lead wires in many types of hard glass or quartz encapsulated devices (below).

Standard Sizes And Tolerances



Typical size and tolerance limitations of molybdenum foil leads. The outer and/or inner leads may be offset from the center line of the foil tab if desired.

Table I

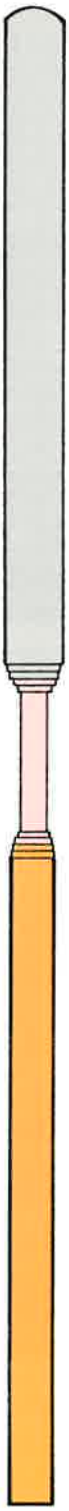
Physical Properties of Glass Sealing and Lead Wire Materials

	Glass Sealing Materials												
	Copper		Dumet	Dumet II	42 Ni	Gas-Free 42% Ni	42 - 6 Ni Cr.	46 Ni	52 Ni.	27 Cr	® Kovar	W	Mo
	OFC	0.02P											
Analysis: Carbon			0.10 Max	0.06 Max	0.10	0.05	0.10	0.10	0.10	0.15	0.02		
Manganese			0.75 - 1.25	0.50 Max	0.50	0.50	0.50	0.50	0.50	0.60	0.30		
Silicon			0.25 Max	0.35 Max	0.25	0.25	0.25	0.25	0.25	0.40	0.20		
Chromium			0.20 Max	0.25 Max	–	–	5.75	–	–	28.00	–		
Nickel			41.00 - 43.00	46.50 - 48.00	42	42	42.5	46	51	0.50	29		
Copper	99.95	99.90 P	0.15 Max	0.15 Max	–	– Ti 0.4	–	– Ti 0.4	–	–	– Co 17		
Other		0.02	Fe, residuals	Fe, residuals	Bal. Fe	Bal. Fe	Bal. Fe	Bal. Fe	Bal. Fe	Bal. Fe	Bal. Fe		
Density: grams/cc	8.94	8.94	8.26 - 8.32	8.26 - 8.32	8.12	8.12	8.12	8.17	8.30	7.60	8.36	19.3	10.2
lbs. per cu. in.	0.323	0.323	0.298 - 0.301	0.298 - 0.301	0.293	0.293	0.293	0.295	0.300	0.274	0.302	0.697	0.369
Thermal Conductivity 20 - 100 °C													
Cal/cm/sec/cm²/ °C	0.948	0.8	0.2 - 0.3	ND	0.025	0.025	0.029	0.028	0.032	0.054	0.04	0.31	0.34
Btu/in/hr/sq. ft/ °F	2750	2320	–	–	74	74	84	81	93	158	116	900	1000
Electrical Resistivity (20 °C)													
Microhm – cm	1.71	2.03	7.3 - 12.0	7.0 - 15.0	72	72	95	46	43	63	49	5.5	5.2
Ohm per cir. mil ft.	10.3	12.2	44 - 72	42 - 90	430	430	570	275	258	380	294	33	31
Elec. Cond. % IACS	101	85	24 - 14	25 - 12	2.3	2.3	1.8	3.6	3.9	2.8	3.4	31	33
Curie Temperature °C	–	–	380	380	380	380	295	460	530	610	435	–	–
Melting Temperature °C	1083	1083	–	–	1425	1425	1425	1425	1425	1425	1450	3410	2610
°F	1981	1981	–	–	2597	2597	2597	2597	2597	2597	2642	6170	4730
Specific Heat cal/gr.	0.092	0.092	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.14	0.11	0.033	0.066
Thermal Expansion in/in/ °C x 10^7													
25 - 100 °C	168	168	50 - 65[1]	76 - 85[1]	50.1	43.4	65.5	71.0	99.5	94.6	58.6	45	51
25 - 200 °C	172	172	80 - 100[2]	96 - 105[2]	47.1	44.1	70.8	73.7	101.0	100.5	52.0	46	
25 - 300 °C	177	177			47.6	46.1	82.6	75.0	101.0	105.3	51.3	46	
25 - 350 °C	178	178			50.5		90.4	74.4	100.0	107.0	48.9	46	
25 - 400 °C	181	181			62.5	64.1	100.0	74.3	100.0	107.8	50.6	46	
25 - 500 °C	183	183			83.2	85.6	115.0	86.8	102.1	111.2	61.5	46	57
25 - 600 °C	188	188			99.0	100.1	125.8	100.2	110.0	112.6	78.0		
Mechanical Properties (Annealed)													
Ultimate Str. (1000psi)	35	35	100 Max	100 Max	82	80	80	82	80	85	75	490	120
Yield Str. (1000psi)			80 Max	80 Max	34	34	40	34	40	55	50	360	110
% Elong. (2 ")			10 Min	10 Min	30	30	30	27	35	25	30	8	30
Rockwell Hardness			–	–	B76	B76	B80	B76	B83	B85	B68	C45	B88
Elastic Modulus (10^6psi)	16	16	–	–	21.5	21.0	23	23	24	30	20	50	47

[1] *Axial at 25 - 400°C μ/μ/°C x 10^{-7}*
[2] *Radial at 25 - 400°C μ/μ/°C x 10^{-7}*

Metal Alloy Lead Wires						Clad Materials (Also see Dumet)	
Nickel 200	Nickel 205 (Nickel "S")	Nickel 211	Monel[3] 400	Inco-nel[3] 600	70 - 30 Brass	40% CCFe	30% CCFe
0.06 0.25 0.05 99.5 0.05	0.03 0.20 0.05 99.5 0.05 Ti 0.04 Mg 0.04	0.10 4.75 0.05 95.0	0.12 0.90 0.15 66 31.5	0.04 0.20 16 76 Fe 7.20	 70 Bal. Zn	 35 Fe Core	 23 Fe Core
8.89 0.321	8.89 0.321	8.72 0.315	8.84 0.319	8.41 0.304	8.53 0.308	8.23 0.294	8.15 0.284
  0.15 435	 0.15 435	 0.12 350	 0.062 180	 0.036 104	 0.29 845	 0.46 1330	 0.38 1100
9.5 57 18	9.5 57 18	18.3 110 9	48.2 290 3.6	98.1 590 1.7	6.16 37 28	4.4 26.4 40	5.9 35.3 30
360 1455 2651 0.13	360 1455 2651 0.13	352 1427 2600 0.13	43/60 1349 2460 0.102	– 125 1427 2600 0.109	– 954 1750 0.09	770 0.10	770 0.1[illegible]
  133 139 144 146 148 172	 133 139 144 146 148 172	 133 139 144 146 148 153	 140 145 150 155 160 165	 115	 199	 	
  70 25 45 B62 30	 70 25 45 B62 30	 30	 85 40 40 B68 26	 100 45 40 B74 31	 50 – 60 – 16	 24	 24

[3]*Trademark, INCO Family of Companies*



The Three Sections

Inner Section

In addition to its ability to conduct electrical current, the inner lead wire must have welding compatibility with the press section and often provide some structural support for a filament.

Inner sections are usually straight wires, but some are made with preformed hooks or flats to accommodate specific design functions, such as supporting components. Cleanliness is frequently a concern for inner lead materials as evolution of gases inside the envelope is undesirable. Nickel plating is frequently specified in order to prevent oxidation of the lead.

Candidate materials include oxygen-free copper, Cumet, (a copper-clad steel, CCFe), zirconium copper, dispersion strengthened copper (DSC), chrome copper, 200 nickel, 205 degassified nickel, 211 gassy or gas-free nickel, nickel plated copper, chrome copper alloy, nickel plated iron, molybdenum or tungsten. Inner lead surfaces exposed to lamp atmosphere should be OFHC copper only. Temper specified for those materials range from full hard to soft, depending on the application.

The inner section extends from the stem press into the lamp. Length is measured from the end of the press section, including the weld knot.

Press Section

This part of the lead is hermetically sealed into the glass or encapsulating material. To maintain the seal for the life of the component, it is necessary to select a material with a coefficient of thermal expansion that matches the glass.

By far the most common material for these applications is Dumet, a copper clad nickel-iron. It is made expressly to seal with soft glasses such as soda lime and lead glasses used in many lamp, capacitor and diode applications. The material also provides good electrical resistivity, a high melting point, and good corrosion resistance.

For hard glass applications, tungsten, molybdenum, nickel iron and nickel-iron cobalt alloys are used in the press section.

When leads are to be sealed in quartz, an etched molybdenum foil tab may be used because it has a better coefficient of thermal expansion match and can withstand high pinching temperatures.

The length of the press section is measured so that it excludes the weld knot. This provides a measurement that indicates the exact length available for making the seal.

Outer Section

The external section is the least sophisticated part of the assembly and hence cost plays a large part in material selection. Copper, copper-clad iron, nickel-plated copper, or nickel-plated iron are normally used with special alloys such as manganese nickel and Everdur as candidates for special applications.

On outer leads, a section that functions as a fuse may be added to prevent short circuits or surges from causing failures within the sealed lamp or tube. In most four or five part leads, one of the parts is usually a fuse.

The outer section extends from the stem press to the base of the lamp and connects directly into a socket. Its length is measured from the end of the press section and includes the weld knot.

All sections joined to the press section include the weld knots in their measured length. All other measurements are made to the center of the weld knot, or to the end of the lead, if not welded.

Manufacturing and Quality Control

Lead wire assemblies are manufactured in a modern, well equipped facility that is entirely devoted to this specialized product line. Wire is drawn to precise dimensions on wire mills designed and built to GE's specifications, annealed to achieve the properties required, cut and welded on high speed production equipment and carefully inspected to make certain all specifications are being met.

Because of the tiny sizes we deal with, in-process quality control is in effect at every operation. The dimensions of redressed wire dies are checked on several instruments before the tooling is released to the production floor, and the production equipment is checked continually to make certain it is functioning within set parameters.

Wires are cropped, matched end-to-end, and welded in a high speed operation that produces up to 300 two and three part leads per minute.

The weld area is visually inspected on every batch of leads coming off the welder.

Wire is kept under tension through annealing so its speed can be carefully controlled. This enables operators to achieve more exact properties in the final product.

Annealing Treatments

Anneal Type	Description

#1 ENTIRE LEAD ANNEAL – Entire leads involving nickel and copper are annealed at a temperature suitable for annealing copper, but below the annealing point for nickel. After annealing, the leads are put through a straightening process to recondition leads which become distorted during the anneal.

#1A ENTIRE LEAD ANNEAL – This is the same process as #1 anneal, except the final straightening operation is omitted.

#2 HOOK ANNEAL – This process anneals only the hook on finished leads.

#3 OUTER LEAD ANNEAL – The outer and press leads are annealed as a unit before being welded to the inner lead. This applies only to handmade leads.

#4 INNER LEAD ANNEAL – The inner lead is given a special anneal before being welded to the press and outer lead parts. This applies only to handmade leads.

#6 SPECIAL ANNEAL – Any annealing treatment desired, which is not covered by any of the foregoing, should be accompanied by a detailed explanation on the order.

#7 ENTIRE LEAD ANNEAL – The entire lead is annealed similar to the #1A anneal, except at a higher temperature suitable for annealing nickel. This temperature is above the melting point for copper. Therefore, this anneal is unsuitable for a complete lead having copper parts.

#9 ENTIRE LEAD ANNEAL – The entire lead is annealed similar to the #1 and #1A anneals, except for the longer time suitable for annealing nickel in large diameters.

When annealed lead wires are required, they should be designated by the symbol for the annealing treatment desired, followed by "Ann." For example: 3511 (Ni(S) Hk Corr – 164D-2584CU – #2 Ann.

For a three-part lead, when the inner and outer leads require different anneals, the inner lead anneal is listed first, followed by the outer lead anneal. For example: 8090 Ni(S) Hk–372D–5085Cu(NP) #4 & #3 Ann.

The annealing treatments apply to any type of lead wire.

Hardness Designation

Materials used in our leads may be specified in different tempers. Listed are current hardness symbols and their description.

These designations follow the material symbol, for example: 2068Crcu(Hd) (NP) or 25116Ni(S) (¼ Hd).

Table II – Hardness Designation

Symbol	Description	Nominal % Reduction In Area
(¼ Hd)	One-Quarter Hard	21
(½ Hd)	One-Half Hard	37
(¾ Hd)	Three-Quarters Hard	50
(Hd)	Full-Hard or Hard	60

Standard Tolerances

The following specifications and tolerances are GE standards for lamp leads. For best possible service and price, they should be used whenever possible.

Inquiries about specifications for special leads (or standard leads within special specifications) should be directed to GE Lighting Components (see page 12).

Table III – Typical Diameter and Length Tolerances

Machine-Made 2 or 3-Part Leads				
Lead Section	**Wire Diameter (Mils)**	**Length (mm)**	**Diameter Tolerance (Mils)**	**Length Tolerance (mm)**
Inner Section	10 to 30	Any	±1.0	±0.50
	31 to 60		±2.0	±0.75
	61 to 100		±3.0	±0.75
Press Section	10 to 20	9 or less	±0.3	±0.25
	10 to 20	Over 9	±0.3	±0.50
	21 to 32	9 or less	±0.5	±0.25
	21 to 32	Over 9	±0.5	±0.50
Outer Section (Non Fuse)	9 to 20	Any	± 1.0	±0.50
	21 to 60		± 2.0	±0.75
Outer Section (Fuse)	8 to 10	Any	±0.20 - 0.30	±0.50
	11 to 16		±0.25 - 0.35	±0.50
	17 to 20		±0.00 - 0.50	±0.50

NOTE: For 1-part leads the diameter tolerance for press sections given above will apply.
Tolerance for total length is ±.50 mm.
For 2-part leads the length tolerance for the press lead is ± 1.0 mm.

Straightness Tolerances

The inner leads are regularly tested for straightness and freedom from burrs. Samples tested are required to drop by their own weight to within 3mm of the weld knot through a cylindrical hole gauge described in Table IV.

Symbols For Materials

Table V lists the materials and symbols that are used in GE's lead wire product designations.

Materials are annealed unless other temper is indicated.

(NP) Indicates Nickel Plated Material — a number following it, the % plate by weight.

(S) Indicates Degassified Material

HK Indicates a Hook Lead

Ptd. Indicates a Pointed Outer Lead

Weld Knot Data

GE's lead wire manufacturing process is designed to maintain tight specifications on weld knot size and strength. The size of the knot is controlled so that the leads can be fed through automatic equipment. Sample leads from actual production runs are checked regularly for size and strength.

Table IV – Straightness Tolerances

Lead Wire Size	DIMENSIONS OF GAUGE	
	Length	Inside Diameter of Hole
50 Mils or smaller 51 Mils and larger	2 inches 2 inches	5 Mils greater than wire diameter 7 Mils greater than wire diameter

Table V – Material Symbols

Symbol	Material Description	Symbol	Material Description
Al	Aluminum	Mo	Molybdenum
CCFe	Copper Clad Iron (Cumet)	Mo(KV)	Molybdenum
CCFe(30)	Copper Clad Iron 30% Conductivity	Ni	Nickel 200, Gassy
CCFe(40)	Copper Clad Iron 40% Conductivity	Ni(S)	Nickel 205, Degassified
CrCu	Chrome Copper	NiD	Nickel 211, Gassy
Cu	Copper, Oxygen Free	NiD(S)	Nickel 211, Degassified
Cu(NP)	Copper, Nickel Plated	Pt	Platinum
D	Dumet	Ti	Titanium
Ev	Everdur (Silicon Bronze)	W	Tungsten
Fe	Iron (Low Carbon Steel)	ZrCu	Zirconium Copper
Fe(NP)	Iron Nickel Plated	#52 Alloy	50% Ni - Bal. Fe
Kovar	Kovar (Nickel -Iron - Cobalt Alloy)		

Table VI – Typical Weld Knot Sizes

Material	If Diameter Of Press is — (Mils)	Weld Knot Dimension— Diameter of Larger Wire Plus
Dumet	8 to 16 16 to 40	13 Mils* **
Tungsten, Ni/Fe/Co Alloy, or Molybdenum	8 to 40 41 to 50 51 to 60 Above 60	20 Mils 30 Mils 35 Mils (Varies with materials used)

* Where any pure copper, nickel-plated copper or copper alloy wire is involved, the addition is 18 mils.

** For Dumet wire larger than 16 mils, the weld knot diameter will vary, depending on both physical and chemical properties of the two materials involved.

Writing Lead Wire Specifications

In designating lead wire configurations, the sections are listed in sequence, beginning with the inner section and ending with the outer section. Each part is described by giving the following information in the order shown:

1) Diameter in mils (first two digits) or millimeters

2) Finished length in millimeters (second two digits)

3) Material symbol – see list of materials and their symbols on Page 10

4) Finish and special treatments, if any

5) Kind of form of inner or outer lead, such as straight (no designation), hook, or pointed.

6) Annealing treatment, if any (see Page 9)

Typical examples are:

2538Ni (S) A Hk-1612D-2047Cu

Inner Section –
- Diameter: 25 mils (.025 inches, 0.64 mm)
- Length: 38 millimeters
- Material: Nickel 205, Degassified
- Form: Hook. Refer to Hook Lead data on page 4.

Press Section –
- Diameter: 16 mils (.016 inches, 0.41 mm)
- Length: 12 millimeters
- Material: Dumet

Outer Section –
- Diameter: 20 mils (.020 inches, 0.51 mm)
- Length: 47 millimeters
- Material: Copper, Oxygen-Free

EXAMPLE: 2013Ni-123D-1634Cu (Hd)

Inner Section –
- Diameter: 20 mils (.020 inches, 0.51 mm)
- Length: 13 millimeters
- Material: Nickel 200, Gassy

Press Section –
- Diameter: 12 mils (.012 inches, 0.30 mm)
- Length: 3 millimeters
- Material: Dumet

Outer Section –
- Diameter: 16 mils (.016 inches, 0.41 mm)
- Length: 34 millimeters
- Material: Copper, Oxygen-Free, Hard

EXAMPLE: 355Ni(S)-1631D

Inner Section –
- Diameter: 35 mils (.035 inches, 0.89 mm)
- Length: 5 millimeters
- Material: Nickel 205, Degassified

Press Section –
- Diameter: 16 mils (.016 inches, 0.41 mm)
- Length: 31 millimeters
- Material: Dumet

Ordering Data

New Product Request For Quote

Requested By:_____ Phone:_____ Fax:_____

Customer Lead Wire Product Specifications Requirements.

Customer:_____

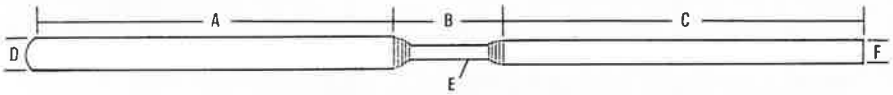
Date Of Request:_____

Customer Description:_____

Customer Drawing Number:_____ Issue Date:_____

Customer Specifications:

Inner Lead Section:	Press Section:	Outer Lead Section
A: Length_____MM	B: Length_____MM	C: Length_____MM
D: Diameter_____IN	E: Diameter_____IN	F: Diameter_____IN



Material:_____	Material:_____	Material:_____
Grade:_____	Grade:_____	Grade:_____
Percent Plate:_____	Color:_____	Percent Plate:_____
Temper:	Temper: Soft	Temper:
Soft_____	Soft Only	Soft_____
¼ HD_____		¼ HD_____
HD_____		HD_____
Bend Torque:_____GM/CM	Oxide Thickness:_____	Bend Torque:_____
Bend Angle:_____+/–	Percent Ni. Plate:_____	Bend Angle_____+/–
_____		_____
Cutoff Burr:_____		Cutoff Burr:_____
Weld Knot Max:_____		Weld Knot Max:_____

Straightness: _____ × _____ Gage.

Overall Straightness: _____ × _____ Gage.

Other Special Requirements:_____

_____

Customer Specifications And/Or Drawings Attached: Yes_____ No_____

Is The Chemistry Or Material Grade Defined: Yes_____ No_____

Certification Required: Yes_____ No_____

Special Notes: Inner leads with copper wire require OFHC copper.
Outer leads with copper wire can use ETP or OFHC copper.

The Lighting Market And Beyond

GE Lighting-Components is a source for literally hundreds of components and materials used in lamp and vacuum tube manufacturing.

In addition to lead wires and lead wire assemblies, we manufacture tungsten wire, tungsten lamp filaments, tungsten metallizing wire and coils, molybdenum wire, molybdenum lamp supports and molybdenum EDM wire; lamp bases and formed and fabricated parts.

We produce glass in the form of bulb blanks, tubing and pressed ware; Lucalox® ceramics, luminescent phosphors, inorganic chemicals, fluxes, inks and getters.

Many of these products and materials are also used in semiconductor processing, electronic packaging and testing, electrodischarge machining, manufacture of cutting tools, vacuum metallizing, and many other applications.

Some of these products may be available from our inventory, while others may be custom made to your specifications. Everything we produce is subject to stringent quality control procedures whether it is destined for our product line or yours.

Because of the unique character of many of these products, GE stands ready to provide product development or application engineering assistance to its customers.

For more information, contact your regional sales representative or one of the sales offices indicated below.

Ordering Information

Orders for lead wires can be handled through GE Lighting – Components' regional representatives, our headquarters in Cleveland, or directly with our manufacturing plant listed below.

GE Carolina Welds Plant
900 N. George St.
Goldsboro, NC 27530
Phone: (919) 731-5113
Fax: (919) 731-5146

Sales Offices

HEADQUARTERS

Domestic Sales

Nela Park
Cleveland, OH 44112
(216) 266-2451
FAX: (216) 266-3372

International Sales

Nela Park
Cleveland, OH 44112
(216) 266-3295
FAX: (216) 266-3702
Telex: 256616

EUROPE
G.E. Lighting
Components Marketing & Sales
Melton Road
Leicester LE4 7PD England
Tel: 0116 261 1754
Fax: 0116 261 1499

GE Lighting
Components

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