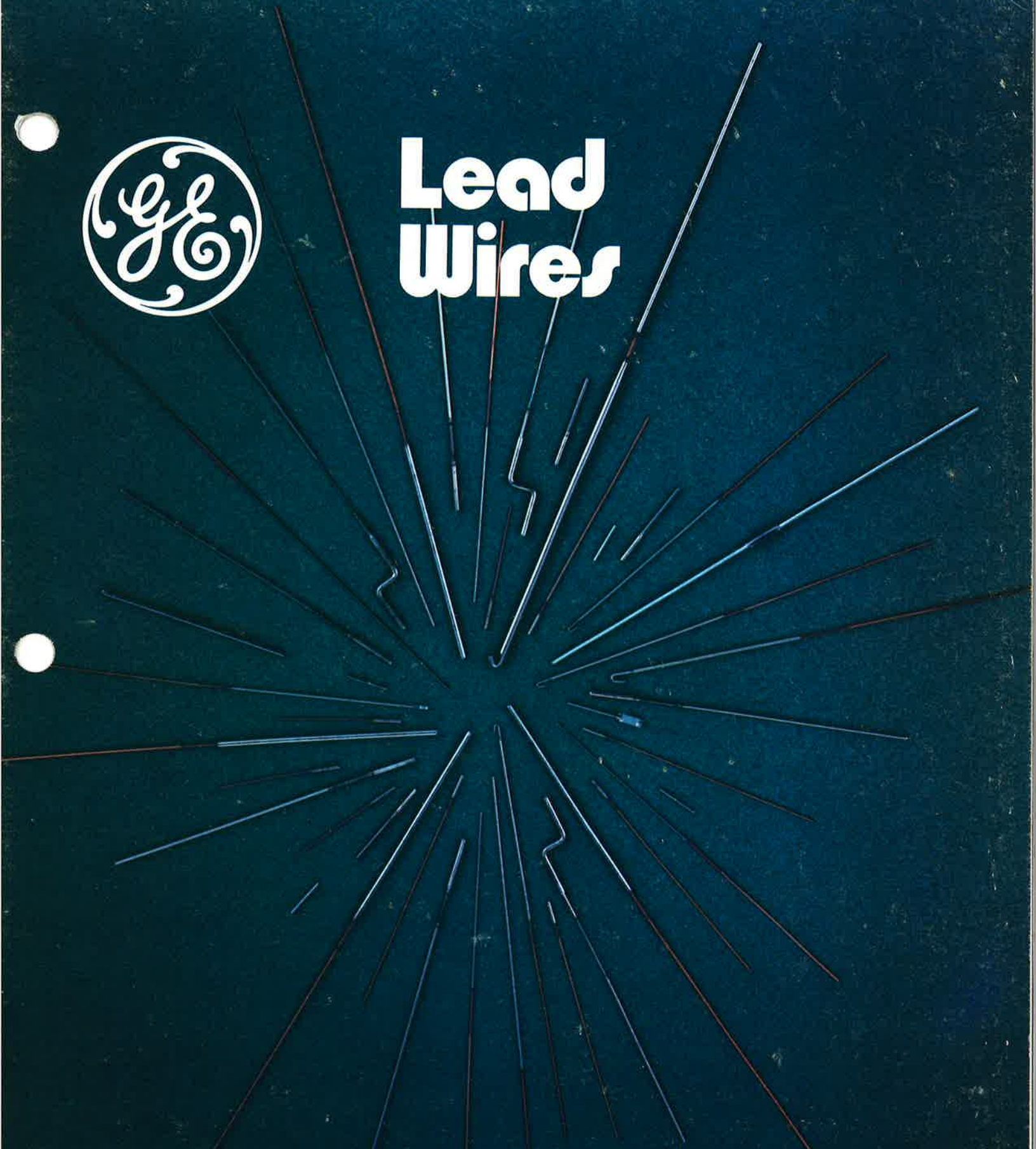
Lead Wires



GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY
Lamp Components & Technical Products Division

Lamp & Electronic Lead Wires

Quality lead-in wires are essential in the production of electric lamps, neon signs, electronic tubes, semiconductor products and many other electronic devices.

In a lamp, the lead wires perform such functions as supporting the filament or other internal elements, conducting current into the lamp from the base, and providing a hermetic seal with the glass envelope.

On baseless lamps, the lead wires may provide direct connection to the socket or power supply. Where required for certain lamp types, a fusible element may be incorporated in the lead.

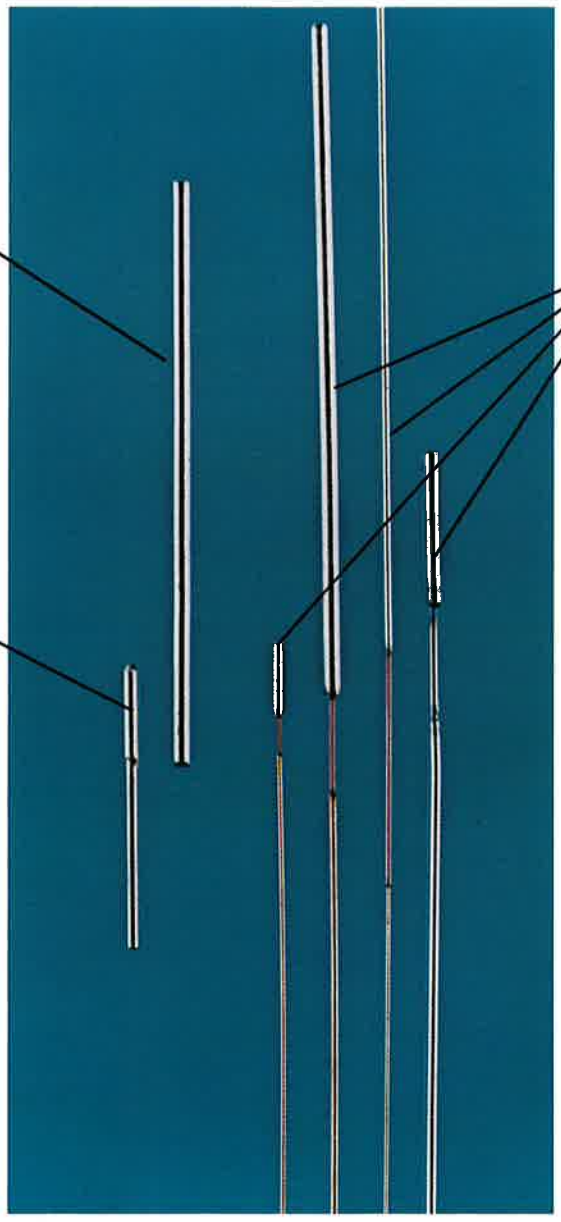
For most lead wire applications, no one single material can perform each of the necessary functions efficiently. Therefore, the typical lamp lead is usually made of two, three, or more wire segments of dissimilar materials welded together in series. General Electric produces a complete line of these welded lamp leads.

Lead Wire Products

STRAIGHTS AND CONVENTIONAL WELDED LEADS

ONE-PART LEADS
are single wires extending from the lamp base to the filament without an intermediate welded joint. They are generally referred to as "straights."

TWO-PART LEADS
consist of two wires joined by a weld. One part serves as both press and outer section combined, or as press and inner section combined.



THREE-PART LEADS
are the most common of the conventional welded leads manufactured by General Electric Company. They consist of three wires joined by two welds, forming the inner section, the press section and the outer section.

FOUR OR FIVE-PART LEADS
(not shown) consist of four or five wires joined by three or four welds respectively. Generally one of the midsections is the press section. The remaining components serve as inner and outer sections as required, and one may be designed to act as a fuse element.

Lead Wire Products (Continued)

SPECIAL PURPOSE LEADS

HOOK LEADS
can be a single wire or multiple wires welded together. The hook is formed at the end of the inner section and serves as a clamp for the lamp filament. For the method of measuring hook spread and hook length, see Page 10. For descriptions of special annealing treatments, see Page 12.

FORMED LEADS
are typically three-part leads with the inner or outer section formed with one or more bends. These are normally made to specific customer requirements.

STRANDED LEADS
have a portion of the lead, usually the outer section, made from stranded (twisted) wire. They are used in high intensity discharge lamps and other applications where flexible connections are required. In general, the stranded wire consists of a single center strand or core with a number of smaller outer wires wound around the core. 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.

ETCHED FOIL LEADS
are welded assemblies with an etched molybdenum foil as the press section. They are used in hard glass or quartz-sealing applications for high temperature applications. For details, see Page 8.

POINTED LEADS
have the end of the outer section rounded to serve as a pin for socket insertion. They are commonly used in lead wires for 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.

In addition to the lead wire configurations shown at the left, General Electric manufactures fused leads and hand-welded leads.

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

HAND-WELDED LEADS
are made to meet a number of special conditions. These include very small runs, material combinations that are difficult to weld such as tungsten to stranded wire, specialty items not readily adapted to automatic operations, and four-part, five-part, or larger lead combinations.

Terminology of Lamp Leads

The INNER SECTION
extends from the stem press into the inner portion of the lamp. Its purpose is to conduct current and support the filament and other internal elements.

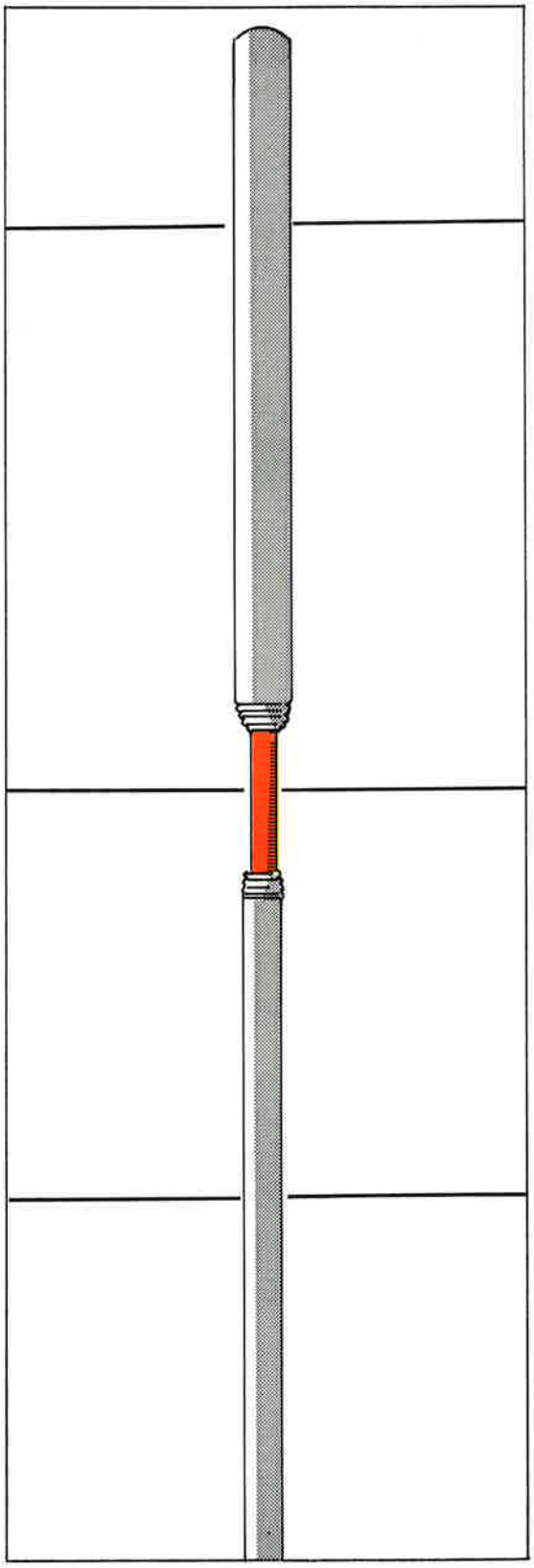
The inner section can be made from a wide variety of metals. Some of the standard materials used are: copper, Cumet (copperclad steel), 200 nickel, 205 degassified nickel, molybdenum, tungsten, nickel-plated iron, nickel-plated copper, chrome copper alloy, nickel-plated chrome copper alloy, zirconium copper alloy, and nickel-plated zirconium copper alloy.

Temper ranges from soft to full hard—depending on the application.

Inner sections are manufactured straight or with hooks. Hook leads are flattened at the end and formed into plain or corrugated hooks.

The PRESS SECTION,
the portion contained within the stem press or lead seal, is designed to provide a hermetic seal with the glass. The coefficient of expansion of the material selected must closely match that of the stem glass and, therefore, depends on the type of glass used. By far the most common material is Dumet wire. Tungsten, molybdenum and nickel-iron-cobalt alloy wire are also used, as is etched molybdenum foil.

The OUTER SECTION
extends from the stem press to the base of the lamp or connects directly into a socket. It conducts current from the base or socket to the other lead portions. Metals for this portion may be copper, nickel-plated copper, Cumet (copperclad steel), manganese nickel, nickel-plated iron, Everdur, or other materials.



Length Measurement Criteria

INNER SECTION
The length is measured from the end of the press section to the end of the inner section. It includes the weld knot at the end of the press section.

PRESS SECTION
The length of the stem press is the exposed or non-melted portion of the section; that is, it excludes the weld knots. The purpose of this rule is to measure only the portion available for making an effective seal.

OUTER SECTION
The length is measured from the end of the press section to the end of the outer section. It includes the weld knot at the end of the press section.

FOUR AND FIVE-PART LEADS
Sections adjacent to the press section include the weld knots of the press section. All other measurements are made to the center of the weld knot, or to the end of the lead if not welded.

Guide to Physical Properties of Glass Sealing

	Glass Sealing Materials														
	Copper		Dumet	42 Ni	Gas-Free 42% Ni	42-6 Ni Cr.	46 Ni	52 Ni.	27 Cr.	® Kovar	W	Mo	Nickel 200	Nickel 205 (Nickel "S")	Nickel 211
	OFC	0.02P													
Analysis: Carbon				0.10	0.05	0.10	0.10	0.10	0.15	0.02			0.06	0.03	0.10
Manganese				0.50	0.50	0.50	0.50	0.50	0.60	0.30			0.25	0.20	4.75
Silicon			*Copper Clad 42% Nickel Iron See GE Spec. DS 8311-01*	0.25	0.25	0.25	0.25	0.25	0.40	0.20			0.05	0.05	0.05
Chromium				—	—	5.75	—	—	28.00	—					
Nickel				42	42	42.5	46	51	0.50	29			99.5	99.5	95.0
Copper	99.95	99.90 P		—	—	—	—	—	—	—			0.05	0.05 Ti 0.02	
					Ti 0.4		Tl 0.4			Co 17					
Other		0.02		Bal.Fe	Bal.Fe	Bal.Fe	Bal.Fe	Bal.Fe	Bal.Fe	Bal.Fe				Mg 0.04	
Density: grams/cc	8.94	8.94	8.26 to 8.32	8.12	8.12	8.12	8.17	8.30	7.60	8.36	19.3	10.2	8.89	8.89	8.72
lbs. per cu. in.	0.323	0.323	0.298—0.301	0.293	0.293	0.293	0.295	0.300	0.274	0.302	0.697	0.369	0.321	0.321	0.315
Thermal Conductivity 20-100°C															
Cal/cm/sec/cm²/°C	0.948	0.8	0.2-0.3	0.025	0.025	0.029	0.028	0.032	0.054	0.04	0.31	0.34	0.15	0.15	0.12
Btu/in/hr/sq. ft/°F	2750	2320	580-870	74	74	84	81	93	158	116	900	1000	435	435	350
Electrical Resistivity (20°C)															
Microhm—cm	1.71	2.03	7.3 to 12.0	72	72	95	46	43	63	49	5.5	5.2	9.5	9.5	18.3
Ohm per cir. mil ft.	10.3	12.2	44 to 72	430	430	570	275	258	380	294	33	31	57	57	110
Elec. Cond. % IACS	101	85	23 to 14	2.3	2.3	1.8	3.6	3.9	2.8	3.4	31	33	18	18	9
Curie Temperature °C	—	—	380	380	380	295	460	530	610	435	—	—	360	360	352
Melting Temperature °C	1083	1083	— —	1425	1425	1425	1425	1425	1425	1450	3410	2610	1455	1455	1427
°F	1981	1981	— —	2597	2597	2597	2597	2597	2597	2642	6170	4730	2651	2651	2600
Specific Heat cal/gr.	0.092	0.092	0.11	0.12	0.12	0.12	0.12	0.12	0.14	0.11	0.033	0.066	0.13	0.13	0.13
Thermal Expansion in/in/°Cx10⁷			Radial												
25-100°C	168	168	60 to 80	50.1	43.4	65.5	71.0	99.5	94.6	58.6	45	51	133	133	133
25-200°C	172	172		47.1	44.1	70.8	73.7	101.0	100.5	52.0	46		139	139	139
25-300°C	177	177	60 to 80	47.6	46.1	82.6	75.0	101.0	105.3	51.3	46		144	144	144
25-350°C	178	178	65 to 85	50.5		90.4	74.4	100.0	107.0	48.9	46		146	146	146
25-400°C	181	181	80 to 100	62.5	64.1	100.0	74.3	100.0	107.8	50.6	46		148	148	148
25-500°C	183	183	100 to 140	83.2	85.6	115.0	86.8	102.1	111.2	61.5	46	57	172	172	153
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	74	82	80	80	82	80	85	75	490	120	70	70	
Yield Str. (1000psi)			50	34	34	40	34	40	55	50	360	110	25	25	
% Elong. (2")			30	30	30	30	27	35	25	30	8	30	45	45	
Rockwell Hardness				B76	B76	B80	B76	B83	B85	B68	C45	B88	B62	B62	
Elastic Modulus (10⁶ psi)	16	16		21.5	21.0	23	23	24	30	20	50	47	30	30	30

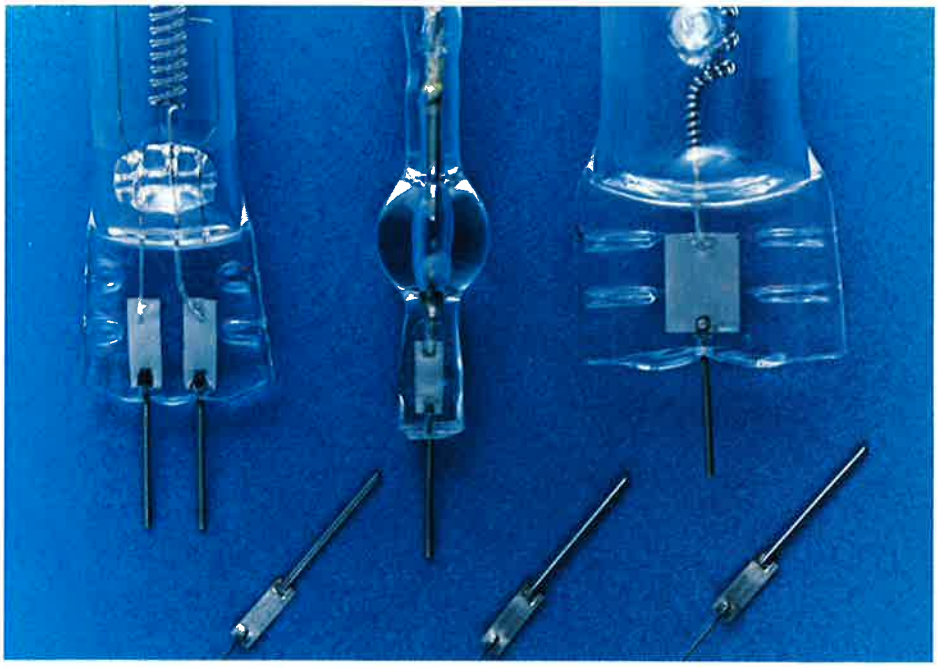
& Lead Wire Materials

Metal Alloy Lead Wires								Clad Materials (Also see Dumet)			Pure Metals (Also see W and Mo glass sealing materials)						
AISI Type 302	AISI Type 316	AISI Type 430	400 Monel	600 Inco-nel	Ad-vance ®	CDA 752	70-30 Brass	Kul-grid ®	40% CCFe	30% CCFe	Au	Ag	Al	Pt	Ta	Fe	Ti
0.15Max	0.08Max	0.12Max	0.12	0.04													
2.00Max	2.00Max	1.00Max	0.90	0.20		0.50Max											
1.00Max	1.00Max	1.00Max	0.15														
17-19	16-18	14-18		16													
8-10	10-14	0.50Max	66	76	43	18		27									
	—		31.5		Bal.	65	70		35	23							
	Mo 2-3			Fe 7.20		Bal.Zn	Bal.Zn	Cu Core	Fe Core	Fe Core							
7.9	7.9	7.7	8.84	8.41	8.9	8.73	8.53	8.89	8.23	8.15	19.3	10.5	2.69	21.45	16.6	7.87	4.51
0.285	0.285	0.278	0.319	0.304	0.322	0.316	0.308	0.321	0.294	0.294	0.698	0.379	0.097	0.775	0.600	0.284	0.163
0.04	0.04	0.05	0.062	0.036	0.051	0.08	0.29		0.46	0.38	0.71	1.00	0.57	0.165	0.13	0.18	0.43
116	116	145	180	104	148	232	845		1330	1100	2050	2900	1650	480	380	520	1250
72	74	60	48.2	98.1	49	28.7	6.16	2.3	4.4	5.9	2.19	1.629	2.65	9.83	12.45	9.71	7.0
433	445	361	290	590	294	173	37	14	26.4	35.3	13	9.8	16	59	75	58	42
2.3	2.3	2.9	3.6	1.7	3.5	6	28	70	40	30	78	105	65	16	14	18	25
		610	43/60	-125	—	—	—		770	770	—	—	—	—	—	770	—
1421	1399	1510	1349	1427	1210	1110	954				1063	960	660	1769	3000	1536	1668
2590	2550	2750	2460	2600	2210	2030	1750				1945	1760	1220	3217	5425	2797	3035
0.12	0.12	0.11	0.102	0.109	0.094	0.09	0.09		0.10	0.10	0.031	0.056	0.225	0.031	0.034	0.11	0.124
166	166	101	140	115	149						142	196	239	91	65	122	88
			145										243			129	91
171	175	110	150			160	199						253				
			155													138	94
180	180	120	160		163						152	206		96	66		
			165										287			145	97
90	85	75	85	100	60	60	50				20	22	13	40	55	40	
37	35	45	40	45		30	—					8	5	12		20	
55	55	30	40	40		40	60				45	48	40	30	30	45	
B82	B80	B82	B68	B74		—	—										
29	29	29	26	31	18	18	16		24	24	11.6	11	9	21.3	27	30	16.8

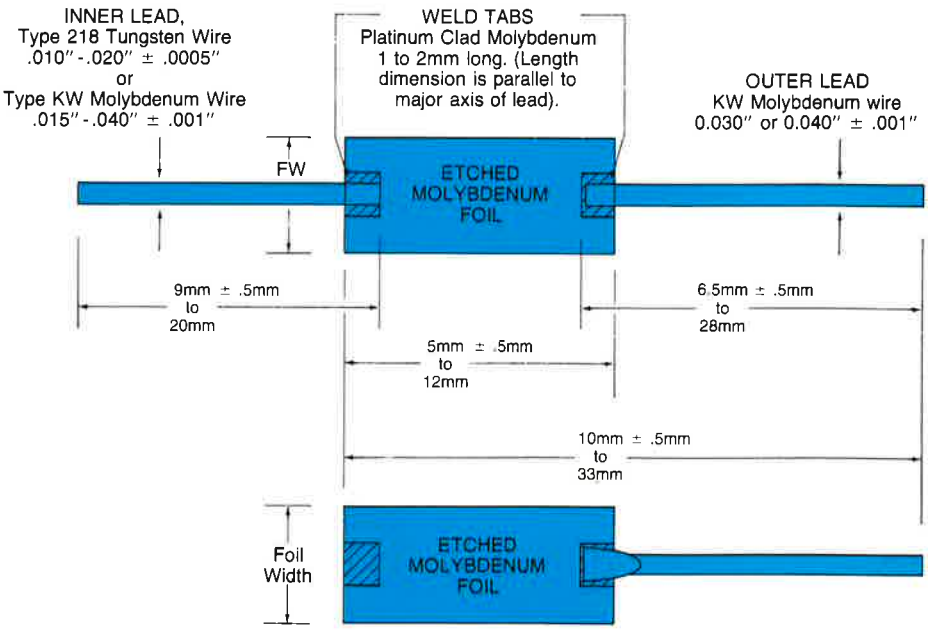
Etched Foil Leads

Etched molybdenum foil is used for leads because its physical properties are desirable in connection with hermetic sealing of certain types of lamps. The molybdenum foil is etched to an approximately lenticular cross-section for this application. This aids in minimizing the formation of leak channels along the edge of the foil. The typical etched foil lead shown in the photo and drawing on this page has an inner lead, usually made of GE Type 218 tungsten or Type KW molybdenum wire, and an outer lead, also made of KW molybdenum wire. A platinum clad molybdenum inner weld tab is required with an inner lead to facilitate joining of the lead and foil sections. Welds for these leads are strong and reliable.

General Electric Company 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. General Electric also offers a number of alternative dimensions and configurations of etched foil leads.



Etched foil leads are welded assemblies used as the lead wires in many types of hard glass or quartz encapsulated devices for high temperature applications. They provide the functions of internal and external electrical connection and mechanical support, plus a hermetic sealing capability for pinch seals. Applications include mercury arc lamps, tungsten-halogen cycle lamps, infrared heat lamps, and certain electronic and instrumentation applications.



STANDARD SIZES AND TOLERANCES—The illustration shows typical size and tolerance limitations. Note that outer and/or inner leads and weld tabs may be offset from center line of foil if desired.

ETCHED MOLY FOIL LEAD WIRE DIMENSIONS

Typical Foil Dimensions

Nominal Width	Foil Width Range	Foil Thickness Range (At Centerline)
2.4 mm	.090 - .100 in.	.0008-.0010 in.
3 mm	.117 - .130 in.	.0010-.0012 in.
4 mm	.157 - .172 in.	.0013-.0015 in.
5 mm	.191 - .210 in.	.0011-.0013 in.
8 mm	.275 - .330 in.	.0011-.0013 in.

Other foil thicknesses and widths are available.

Typical Platinum-Clad Weld Tab Sizes

Nominal Width	Tab Width Range	Thickness Range
0.8 mm	.030 - .034 in.	.0015-.0025 in.
1 mm	.038 - .042 in.	.001 -.002 in.
1.5 mm	.058 - .062 in.	.0018 -.0022 in.
2 mm	.078 - .082 in.	.0018-.0022 in.
3 mm	.118 - .122 in.	.0018-.0022 in.

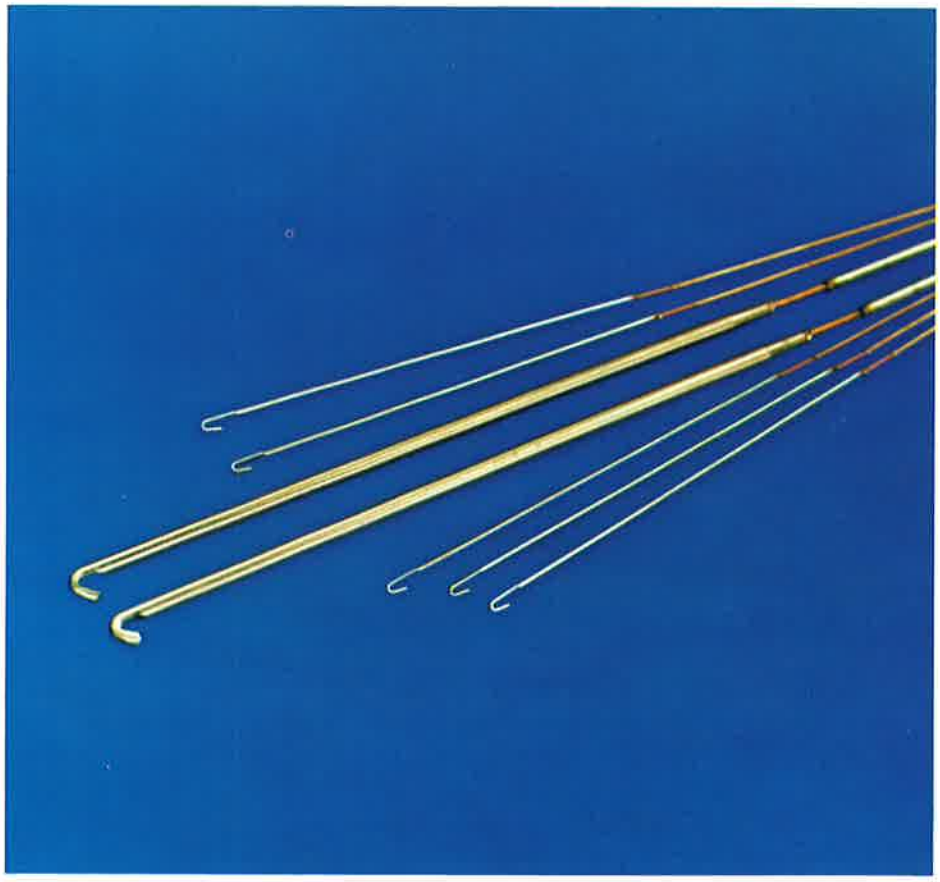
Other tab widths and thicknesses are available.

Hook Leads

In the normal lamp-making process, the tungsten filament is clamped or crimped in place by folding the top of a straight lead wire over the filament, but for some types of lamps a pre-formed hook is preferred. These leads are basically the same as straight lead wires except that the end of the inner portion has been flattened or sheared and then formed into a hook.

Hook leads may be a single wire formed at one end or may be composed of two, three, or more dissimilar materials welded together in series with a hook formed at one end. They are classified by the shape of the hook into Regular (V shaped) or Parallel (U shaped) hook leads. In addition, the larger size may have corrugated surfaces.

General Electric produces a complete line of hook leads. Data on typical length, diameter, straightness and weld knot tolerances shown on Pages 13 and 14 also applies to hook leads.

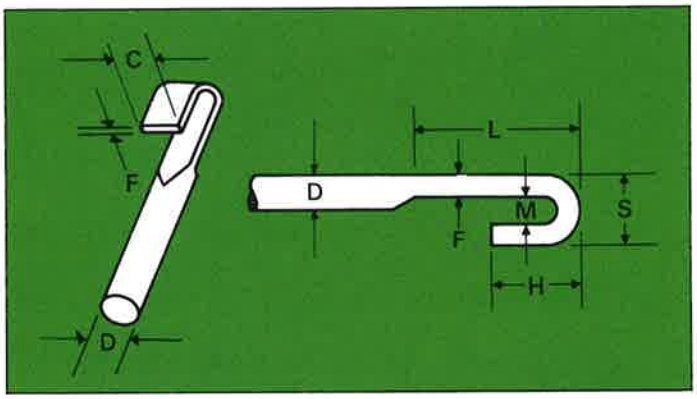


Typical Hook Lead Dimensions

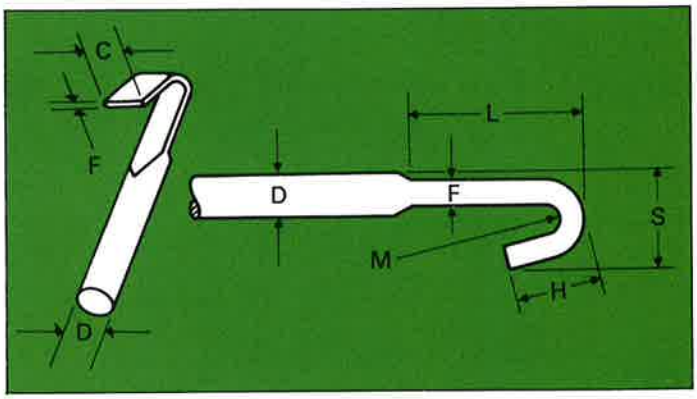
U HOOKS

V HOOKS

LETTER SYMBOLS IN THE ILLUSTRATIONS ARE KEYED TO THE COLUMN HEADINGS OF THE TABLES.



The illustration above shows the important dimensions considered in determining a parallel hook shape. Parallel hooks are made from round wire which is flattened and then formed. In ordering parallel hooks, the symbol "U" should be used in the hook designation; otherwise, the regular V type hook will be supplied. For example, a parallel hook lead, formed on .040 inch nickel S wire 90 mm long, would be designated as: 4090 Ni(S) U Hk.



The illustration above indicates the important dimensions considered in determining a V-hook shape. The table on the next page lists the standard sizes of V-hooks and gives typical hook dimensions for those sizes. Standard hooks are categorized by the wire diameter and a letter suffix. For example, in the table there are four standard V-hooks formed from .020 inch wire. They are listed as 20, 20A, 20B, and 20C. In standard lead wire nomenclature, a 20A hook, V-shaped, formed on a 20 mm long nickel lead would be designated as: 2020 Ni A Hk.

U-HOOK LEADS

DIMENSIONS GIVEN IN THE TABLE ARE IN MILS (THOUSANDTHS OF AN INCH)

(D) Wire Diameter	(F) Flat Thickness	(M) Mandrel Diameter	(L) Leg Length	(H) Hook Length	(S) Hook Spread	(C) Flat Width
16	8-10	15-17	150-185	75- 95	40- 44	20-23
16A	8-10	15-17	160-195	85-105	40- 44	20-23
18	9-11	17-19	150-185	75- 95	44- 48	26-29
20	10-12	17-19	150-185	75- 95	46- 50	27-30
20A	10-12	17-19	160-195	85-105	46- 50	27-30
25	14-16	22-24	150-185	75- 95	58- 64	35-38
25A	14-16	25-27	160-190	92-112	65- 70	35-38
30	16-18	25-27	150-185	85-110	68- 78	40-43
30A	16-18	25-27	160-195	95-120	68- 78	40-43
30B	16-18	38-42	160-195	95-120	85- 95	40-43
35	21-23	25-27	150-185	95-120	84- 90	43-47
35A	21-23	27-29	160-195	110-130	95-102	43-47
40	24-26	29-31	150-185	95-120	94-102	47-51
45	29-31	29-31	150-185	95-120	99-107	52-56
50	36-38	29-31	150-185	95-120	114-122	57-61

V-HOOK LEADS

DIMENSIONS GIVEN IN THE TABLE ARE IN MILS (THOUSANDTHS OF AN INCH)

(D) Wire Diameter	(F) Flat Thickness	(M) Mandrel Diameter	(L) Leg Length	(H) Hook Length	(S) Hook Spread	(C) Flat Width
			FLATTENED HOOKS			
10	5- 7	12-15	70- 80	55- 65	43- 48	15-17
10A	5- 7	18-22	125-135	85- 95	36- 41	15-17
12	6- 8	12-15	70- 80	55- 65	43- 48	15-18
12A	8-10	12-15	95-105	80- 90	55- 60	15-18
12B	8-10	18-22	125-135	85- 95	36- 41	15-18
14	8-10	12-15	95-105	80- 90	55- 60	17-20
16	9-11	16-19	64- 75	50- 60	40- 45	21-24
16A	9-11	12-15	95-105	80- 90	55- 60	21-24
18	11-13	16-19	65- 75	50- 60	52- 57	23-27
18A	11-13	12-15	95-105	80- 90	58- 63	23-27
18B	11-13	23-26	90-100	90-100	78- 83	23-27
18C	11-13	29-32	95-105	80- 90	78- 83	23-27
18D	12-14	33-36	140-150	120-130	78- 83	23-27
20	12-14	12-15	105-115	75- 85	70- 75	27-30
20A	12-14	12-15	105-115	75- 85	62- 68	27-30
20B	12-14	23-26	90-100	90-100	72- 78	27-30
20C	13-15	32-34	140-150	120-130	78- 83	27-30
25	15-17	23-26	105-115	90-100	77- 82	31-34
25A	14-16	31-33	90-100	90-100	78- 83	31-34
25B	14-16	41-43	90-100	90-100	90- 95	31-34
25C	15-17	31-33	140-150	120-130	77- 82	31-34
30	20-22	29-32	105-115	90-100	90- 95	35-40
30A	20-22	23-26	105-115	90-100	77- 82	35-40
30B	20-22	40-44	175-185	125-135	105-115	35-40
30C	19-21	19-22	105-115	75- 85	75- 81	36-38
30D	20-22	31-33	175-185	125-135	105-115	35-40
35	21-23	32-35	105-115	90-100	95-105	45-50
35A	21-23	33-36	225-235	160-170	125-135	45-50
35B	21-23	40-44	225-235	160-170	105-115	45-50
35D	21-23	25-28	110-120	100-110	85- 95	45-50
35E	21-23	42-46	225-235	160-170	105-115	45-50
40	23-25	25-30	105-115	90-100	95-105	54-60
40A	23-25	38-41	225-235	160-170	125-135	54-60
40B	23-25	48-51	225-235	160-170	140-150	54-60
40C	23-25	33-36	145-155	120-130	100-110	54-60
40D	23-25	48-51	225-235	160-170	130-140	54-60
40E	23-25	59-61	225-235	160-170	140-150	54-60
50	30-32	33-36	180-190	160-170	135-145	67-72
50A	29-31	59-61	180-190	170-180	140-150	67-72
50B	30-32	40-44	180-190	160-170	135-145	67-72
60B	39-41	40-42	245-265	235-245	155-165	77-83
			SHEARED HOOKS			
60	31-40	25-30	125-135	120-130	135-145	**
60A	31-40	44-46	155-165	120-130	150-160	**
*80	43-53	44-46	145-155	140-150	168-175	**
*80A	43-53	44-46	185-195	180-190	185-195	**
*80B	43-53	30-32	150-160	145-155	168-177	**
*80C	43-53	59-61	175-185	170-180	190-200	**
*80D	43-53	74-76	175-185	170-180	205-215	**
†100	60-70	25-30	155-165	150-160	185-195	**

*80 Mil Leads are swaged to 47-52 mils diameter at the press lead, and the weld knot does not exceed 60 mils.

†100 Mil Leads are swaged to 66-72 mils diameter at the press lead, and the weld knot does not exceed 80 mils.

**Most hooks formed from wire .060 inch and larger are sheared and formed without being flattened. For these sizes, the flat width is approximately the same as the wire diameter.

CORRUGATED HOOKS may be required for flattened leads 25 mils in diameter, or larger. The corrugations will be 5 mils deep on 10 mil centers. These leads should be designated Hk Corr (for example: 3050 Ni(S) Hk Corr).

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 larger diameters.

NOTE

When annealed lead wires are required, they should be designated by the symbol number 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-327D-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) (¼Hd).

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

Symbols for Materials

To identify the material commonly used in our parts, the following table lists materials and symbols that are used in our 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

Symbol	Material Description	Symbol	Material Description
Al	Aluminum	Mo	Molybdenum
CCFe	Copper Clad Iron (Cumet)	Mo(KW)	Molybdenum, High Heat Resistant
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
D	Dumet, Medium Borate	Pt	Platinum
D(L)	Dumet, Light Borate		
D(D)	Dumet, Dark Borate	Sn	Tin
D(U)	Dumet, Unborated	Ti	Titanium
Ev	Everdur (Silicon Bronze)	W	Tungsten
Fe	Iron (Low Carbon Steel)	ZrCu	Zirconium Copper
Kovar	Kovar (Nickel-Iron-Cobalt Alloy)	#52 Alloy	51% Ni - Bal.Fe
Rodar	Rodar (Nickel-Iron Cobalt Alloy)		

Weld Knot Data

General Electric Company'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.

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.

Standard Tolerances

The following specifications and tolerances are General Electric 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 with special specifications) should be directed to the Marketing Section, Glass & Metallurgical Products Department. (see "Engineering Assistance" on Page 16).

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 31 to 60 61 to 100	Any	± 1.0 ± 2.0 ± 3.0	± 0.50 ± 0.75 ± 0.75
Press Section	10 to 20 10 to 20 21 to 32 21 to 32	9 or less Over 9 9 or less Over 9	± 0.2 ± 0.2 ± 0.5 ± 0.5	± 0.25 ± 0.50 ± 0.25 ± 0.50
Outer Section (Non Fuse)	9 to 20 21 to 60	Any	± 1.0 ± 2.0	± 0.50 ± 0.75
Outer Section (Fuse)	8 to 10 11 to 16 17 to 20	Any	+ 0.20 − 0.30 + 0.25 − 0.35 + 0.00 − 0.50	± 0.50 ± 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.

Handmade 2 or 3-Part Leads				
Lead Section	**Wire Diameter (Mils)**	**Length (mm)**	**Diameter Tolerance (Mils)**	**Length Tolerance (mm)**
Inner Section	10 to 30 31 to 60 61 to 100	Any	± 1.0 ± 2.0 ± 3.0	± 0.75 ± 0.75 ± 0.75
Press Section	10 to 20 21 to 40	Any	± 0.2 ± 0.5	+ 1.0 − 0.5 + 1.0 − 0.5
Outer Section	9 to 20 21 to 60	Any	± 1.0 ± 2.0	± 1.0 ± 1.0

NOTE: In case stranded wire is used on outer section, the length tolerance is ± 2mm and diameter tolerance is ± 5 mils.

In case press section is of tungsten or molybdenum, the diameter tolerance is ± 1 mil.

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 as follows:

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

Writing Lead Wire Specifications

In designating lead wires that consist of more than one part, the parts 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)
2. Finished length in millimeters (second two digits)
3. Material symbol—See list of materials and their symbols on Page 13.
4. Finish and special treatments, if any.
5. Kind or form of inner or outer lead, such as straight (no designation), hook, or pointed.
6. Annealing treatment, if any (see Page 12).

TYPICAL EXAMPLES ARE:
2538Ni (S) A Hk-1612D-2047Cu

Inner Section— Diameter: 25 mils (.025 inches)
Length: 38 millimeters
Material: Nickel 205, Degassified
Form: Hook. Refer to Hook Lead Tables on p. 10 & 11 of "Lead Wires" catalog, covering 25 mil A Hook

Press Section— Diameter: 16 mils (.016 inches)
Length: 12 millimeters
Material: Dumet (Medium)

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

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

Inner Section— Diameter: 20 mils (.020 inches)
Length: 13 millimeters
Material: Nickel 200, Gassy

Press Section— Diameter: 12 mils (.012 inches)
Length: 3 millimeters
Material: Dumet (Light)

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

EXAMPLE: 355Ni(S)-1631D

Inner Section— Diameter: 35 mils (.035 inches)
Length: 5 millimeters
Material: Nickel 205, Degassified

Press Section— Diameter: 16 mils (.016 inches)
Length: 31 millimeters
Material: Dumet (Medium)

Engineering Assistance

While this general catalog lists our complete product offering on lamp and electronic leads, it does not reflect the full extent of our capabilities. For your special needs, we welcome the opportunity to work with you on an engineering basis, whether it involves a modification of one of our present designs or the development of a completely new lead. Call or write:

General Electric Company
Glass & Metallurgical
Products Dept.
Marketing Section
24400 Highland Road
Cleveland, Ohio 44143
Phone: (216) 266-3630

Ordering Information

For further information or to order lead wires, contact your Sales Operation representative, Sales headquarters, or the Carolina Welds Plant customer service representative.

General Electric Company
Lamp Components & Technical
Products Division
Sales Operation
21800 Tungsten Road
Cleveland, Ohio 44117

Phone:
Domestic —(216) 266-2451
International —(216) 266-3295

Telex: 985569 (GECOLCS EUCD)

General Electric Company
Carolina Welds Plant
P.O. Drawer 107
Goldsboro, North Carolina 27530

(919) 731-5118

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. For information, contact:

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