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NLI 114620

SOFT SOLDERS and SOLDER FLUXES

TYPES - USES
APPLICATION

MANUFACTURED BY
NATIONAL LEAD COMPANY

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Introduction

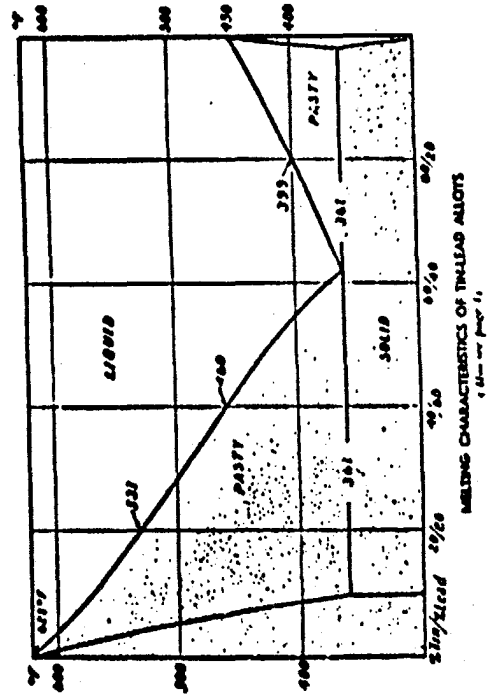
In the average mind, solder occupies no high pinnacle. It is just another article of commerce.

Yet, if by some stroke of magic, all the solder in the world were suddenly to disappear, modern life as we know it would completely collapse. Transportation—planes, cars, ships—would stop. Swift communication by radio and telephone would be stilled. Electrical power, from giant dynamo to the smallest generator, would be no more. Even a major part of our food supply would be lost through the failure of mechanical refrigeration and the "leaking at the seams" of tin containers of all kinds—not to mention the many other common objects that would go out of order or fall apart such as gas meters, dairy equipment, metal band instruments and jewelry.

So solder is important. It has a particularly vital part in modern industrial progress as well as in many everyday things that contribute to our way of living.

In this booklet the varied functions of solder are discussed and a special attempt made to show how they are well met by the versatility and comprehensiveness of the National Lead Company line of soft solders.

Your inquiry about any of these solders or a request for advice and help on a specific solder problem is always welcomed. Simply address the office nearest you. (See page 32.)



MELTING CHARACTERISTICS OF TIN-LEAD ALLOYS
(See see page 1)

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National Lead Company

CHAPTER ONE

Story of Solder

What it is

Solder is one of Nature's enigmas. Here is a combination of metals—usually lead and tin—possessing properties foreign to the parent metals themselves. If you tried to join the seams of a tin can, for example, by using just pure tin you would melt the tin coating off the can. Because, of course, a tin can is really a steel can with a very thin tin coating. If you tried to use lead alone, it would be still worse for it takes 170 degrees (Fahrenheit) more heat to melt lead than tin.

Yet these two metals, combined as they are in solder, actually melt at a much lower temperature than either lead or tin. Thus solder makes it possible to join metals at a comparatively low heat and with no risk of damage.

This peculiar result of the marriage of the two metals has been known for many centuries. There are plenty of evidences of solder's use in ancient times and the Romans are generally credited with the introduction of soft solder. In fact, the word is derived from the Latin and the historian Pliny describes one of their mixtures, "Argentarium," consisting of equal parts lead and tin—the "half and half" of modern times. Actually, until the introduction of machine soldering, there seems to have been little fundamental change in the operation from Roman days until now.

Of course, there have been great strides in the improvement of the purity of solders. Better and more accurate refining processes make it possible to produce solder today that is not only reliable in its mixture but completely free from the impurities that interfere with the proper functioning of a solder.

The soft solders are almost always alloys of tin and lead although other combinations can be used, such as lead, tin and silver, for example. While a low melting point is the real reason for the wide use of soft solders, it is an equally important fact that they readily adhere to other metal surfaces.

In order to meet varied conditions of use there are many different compositions of the alloy, from those with very little lead to others in which the tin has been practically eliminated or even replaced.

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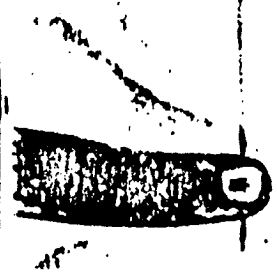


MELTING DATA ON TIN-LEAD ALLOYS

Also see chart on page 2

COMPOSITION		MELTING POINTS				FREEZING RANGE	
		Solidus		Liquidus			
Per Percent	Lead Percent	°F	°C	°F	°C	°F	°C
0	100	621	327	621	327	0	0
2.5	97.5	574*	301*	606	319	32	18
5.0	95.0	518*	270*	594	312	76	42
7.5	92.5	450*	232*	541	305	131	73
10.0	90.0	361*	183*	570	299	209	116
12.5	87.5	361*	183*	559	293	198	110
15.0	85.0	361*	183*	550	288	189	105
17.5	82.5	361*	183*	540	282	179	99
20.0	80.0	361	183	531	277	170	94
22.5	77.5	361	183	520	271	159	88
25.0	75.0	361	183	511	266	150	83
27.5	72.5	361	183	500	260	139	77
30.0	70.0	361	183	491	255	130	72
32.5	67.5	361	183	474	251	123	68
35.0	65.0	361	183	477	247	116	64
37.5	62.5	361	183	469	243	108	60
40.0	60.0	361	183	460	238	99	55
42.5	57.5	361	183	451	233	90	50
45.0	55.0	361	183	441	227	80	44
47.5	52.5	361	183	432	222	71	39
50.0	50.0	361	183	421	216	60	33
52.5	47.5	361	183	410	210	49	27
55.0	45.0	361	183	399	204	38	21
57.5	42.5	361	183	387	197	26	14
60.0	40.0	361	183	374	190	13	7
62.0	38.0	361	183	361	183	0	0
62.5	37.5	361	183	363	184	2	1
65.0	35.0	361	183	367	186	6	3
67.5	32.5	361	183	372	189	11	6
70.0	30.0	361	183	378	192	17	9
72.5	27.5	361	183	383	195	22	12
75.0	25.0	361	183	387	197	26	14
77.5	22.5	361	183	394	201	33	18
80.0	20.0	361	183	399	204	38	21
82.5	17.5	361	183	405	207	44	24
85.0	15.0	361	183	410	210	49	27
87.5	12.5	361	183	417	214	56	31
90.0	10.0	361	183	423	217	62	34
92.5	7.5	361	183	428	220	67	37
95.0	5.0	361	183	435	224	74	41
97.5	2.5	361	183	442	228	81	45
100.0	0	450	232	450	232	0	0

*[illegible]

Most solder compositions, upon the application of heat, pass from the solid state through a semi-solid or pasty condition and finally to the completely liquid or free-flowing state. The sole exception to this behavior is an alloy containing 62% tin. At 183° C. (361° F.) this mixture changes sharply from solid to liquid. There is no intermediate state.

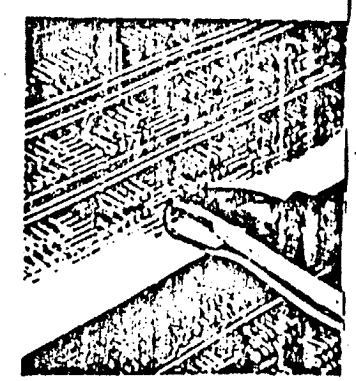
Eutectic Mixture

This latter mixture is known as the eutectic, which means free flowing and is the lowest melting point of the two metals. This intimate mixture of the tin and lead actually occurs in varying degree in nearly all the commercial combinations of solder alloys. In any solder containing up to 62% tin the solid metal formed during the freezing range is nearly all lead. As a consequence the liquid part grows richer and richer in tin until it finally reaches the eutectic temperature at which precise point the liquid solidifies and the solder is set.

As is shown by the diagram on page 2, the more lead in a tin-lead solder, the longer the interval between liquid and solid state. This is why a wiping solder must necessarily be a higher lead content solder whereas solders with over 40% tin are useful for other purposes.

When the tin content exceeds 62%, the solidification process is much the same except here the first crystals to form are almost pure tin instead of lead. The tin content of the liquid part then reduces until the eutectic is reached. It is clearly indicated by the diagram that the pasty range of the higher tin solders is not nearly so great as that of the higher lead mixtures.

National Lead Company's long experience in making solders for all the many and varied fields has resulted not only in a complete line of standard purpose solders but also in many specialty items. There is no soldering requirement that we are not equipped to meet accurately and efficiently. And this includes the type of alloy as well as the size and form in which it is furnished.



Soldering a strap bar on a crossbar switch in a telephone exchange.

Courtesy Bell Telephone Laboratories

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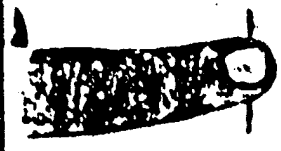
Where Solder is Used



Automotive. Anyone who has driven an automobile with a leaky or partially dry radiator knows how important this part of a car is. In every one of these radiators solder plays the vital part of holding the elements together. A radiator of average size will contain as much as seven or eight pounds of solder so the tot l amount of solder used for this purpose is very high indeed.

There are many different types of automobile radiators, such as tubular, honeycomb, flat tube and fin or Harrison. All of them, however, are built up from many small units and these units of varying sizes and shapes, according to the particular method being used, are held together by solder. In some cases the solder is applied in a bath and in others the machine method is employed.

The top and bottom tanks of the radiator as well as the various hose fixtures and the filling cap are likewise held fast by solder.

Another important use of solder in the automotive field, not so much for mechanical efficiency as for appearance, is for body work. As yet it has not proved practical to construct an automobile body so that it is seamless. While many former joints have been eliminated, such as in the stamping of an entire roof, there are still surface imperfections. To fill these in so that when the car is painted not a trace remains, body solder is employed. This is a special mixture that works easily and forms a tough strong surface.



Dipping an automobile radiator core in a solder bath to seal ends of tubes.

There is also a big use of this same solder in automotive repair, where dents and holes in bodies or fenders can be filled in and concealed.



Body soldering with torch and insert with spray gun

Electrical. It is no exaggeration to say that our modern electrical development in all fields communication, transportation, industry and the home is dependent to a surprising degree upon the use of solder. Only with this versatile product could all the necessary connections be made electrically sound and durable.

As an example of what solder means in this field, take the present day automatic telephone exchange. One serving a total of only ten thousand stations requires over eight million soldered connections. Just one telephone call can involve as many as four thousand soldered connections. Then, too, in radio both broadcasting and receiving soldered connections are numbered in the millions.

Of course, all electrical motors and generators, no matter what the use or the size, involve soldered connections. There is no other practical way of making them.

Solder, in the form of wiping solder, also functions in the joining up of the thousands of miles of lead covered electrical cables in this country. After the wires are joined and soldered, they are again covered and protected by a lead sleeve with a "wiped joint" of solder.

Can Manufacture. The manufacture of tin plate containers has become one of our big industries. They are turned out by the million in all shapes and sizes and in their making solder plays a most important part.

The side seams of cans would soon loosen and leak if not securely held and sealed with solder. In many cases the bottoms as well as the tops of cans are also soldered in place. Then, with those to be vacuum sealed, the final barrier to keep the can airtight is a drop of solder on the hole through which the air is extracted.

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CHAPTER TWO

Soldering

Proper Conditions

fuel used to heat it can affect the quality and working properties of the finished product.

Solder made up by the user from scraps is a dubious product because of the practical certainty that foreign matter has crept in. Dirt, copper particles, iron or steel filings are just some of the impurities that can cause trouble.

It is well for the solder user to remember that the quality of a solder is directly related to the reputation of the maker. The fact that National Lead Company has been making and selling

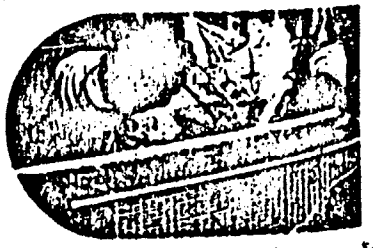


Ripping a telephone cable splice.

reliable, high quality solder for half a century is reason enough for the confidence of our many customers. It is likewise better assurance than anything we might say that, in National Lead solders, every user can be sure of getting that best requirement of a good job—a pure, controlled made solder.

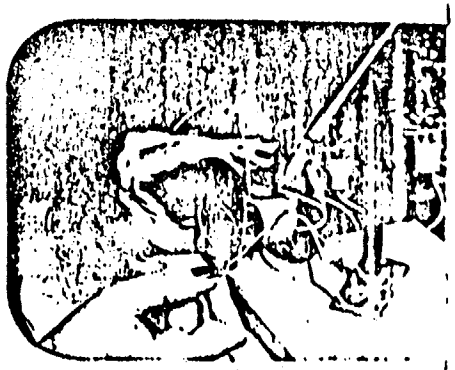
Time Required

The time element is also important. The best joints are those where the solder is kept in a molten state just long enough to wet the surfaces but not so long that objectionable alloying with the surface can take place. The alloy so formed may result in brittleness. The time of heat application should be kept always down to the minimum, both for economy in production and to promote sound joints.



Torch soldering operation on automobile fuel reservoir.

Cleaning Soldering Irrons



Soldering metal element leads in an overall temperature indicator.

Methods in Use

There are several ways in which solder can be applied. The one used in each particular case is generally determined from the standpoint of ease, efficiency and the production of the correct type of joint. Those in common use are as follows:

Iron or Bit. This is the oldest method and still widely used. The "iron", which is usually copper, may be of almost any size or weight. Sometimes, aluminum faced with copper is used to reduce the weight. It can be the externally heated kind or will be heated by a gas flame or electrical heating element. The important thing is to use an iron large enough and with sufficient heat capacity to keep the work at proper temperature while the soldering is being done, without overheating the iron.

Torch. This is a somewhat more rapid process of soldering than the use of an iron. But it can only be used where heating of parts adjacent to the joint is permissible. Torch soldering may be done by hand or it may be semi-automatic where the work is mechanically conveyed through the flame at a rate to properly heat the parts and the solder then applied.

Spray. In this technique, solder in the form of wire is fed through a nozzle where it is melted by a gas flame and forcibly expelled by compressed air. The solder particles flatten on impact and adhere well to any roughened surface. This method does not produce very strong joints but is suitable for such work as filling in automobile bodies and fenders.

Wiping. This is the method used in the joining of lead pipe as well as cable sheathings. It is entirely a hand operation where

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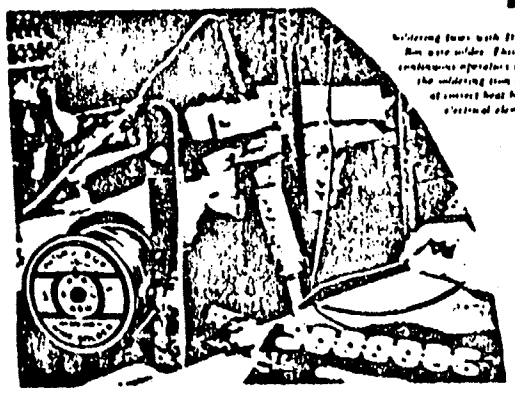
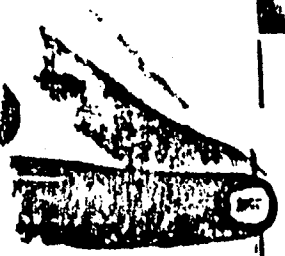


Soldering tubes with Dutch Box wire solder. This is a continuous operation with the soldering iron kept at correct heat by an electrical element.



the paste or some molten solder is manipulated around the joint with a pad of cloth until a smooth, secure joint results. Wiping is sometimes used in auto body finishing and repair work.

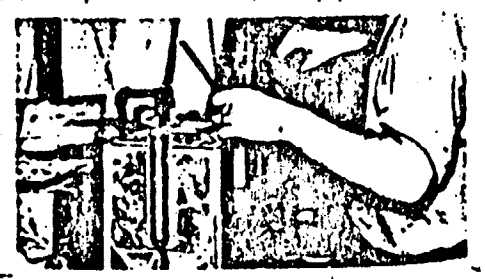
Bath. This is a time saving soldering method on many industrial products. Automobile radiators are perhaps the prime example of the use of a soldering bath. Usually automatic temperature control is a factor. Large baths are often required to insure constant heat at the proper working temperature. Small parts are sometimes centrifuged to remove excess solder after being dipped.

Sweating. In this method the heating of the articles causes the solder to run into the joints. It is particularly suited to the joining of large surfaces or where several parts have to be soldered at one time or where parts can be most conveniently assembled while cold. Sweating is also the process involved in the joining of the copper tubing and fittings used in some plumbing systems.

Induction and Electrical Resistance. Induction heating machines, wherein the object to be soldered is brought to the proper temperature by exposure to a field of high frequency current, are quite widely used in certain soldering operations. The solder and flux are applied and then the whole job heated. The induction method is particularly useful where several soldering operations are to be done simultaneously, as in a radio tube base.

One electrical resistance method is simply the passing of a high amperage through the object being soldered after application of flux and solder. The resultant heating completes the operation. Another form is a resistance element used to heat objects placed within it so that they can be soldered.

Automatic. Actually this is not an entirely different method of soldering because many of those previously described are utilized in all of the automatic systems. Fin rans, for example, have their side seams soldered in machinery employing the bath method. Bottoms and tops are also attached with an automatic version of the solder bath. And with vacuum sealed cans the iron is used. The sweating operation can be converted to automatic use by passing the articles through an oven or induction machine.



Soldering tap wires on a gas meter.

Strength of Soldered Joints

Under loads of short duration well soldered joints are usually as strong or even stronger than the tensile strength (quick time) of the solder employed. However, this strength may be greatly reduced where the load is of long duration.

As a specific illustration of this, the National Bureau of Standards has determined the following short and long time strengths of soldered joints on copper tube fittings. Sleeve couplings were sweated on with various solders and subjected to axial pull.

Solder Used			Maximum Allowable Mean Stress			
			Short Time	For Loaded Long Duration		
			at 65° F.	at 85° F.	at 250° F.	at 325° F.
Tin	Lead	Antimony	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	not tested
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	not tested

These findings may be considered as illustrative of the strength of good soldered joints in general. Of course, there are many times where strength is not too important. Other functions of solder such as hermetic sealing, or heat transfer, or the need for electrical conductivity, may be paramount. Also, when strength is the major requirement in a soldered joint it is often desirable, in addition to properly applying sufficient solder, to use such reinforcing devices as interlocking seams, crimping, riveting, bolting or hooking wires into lugs.

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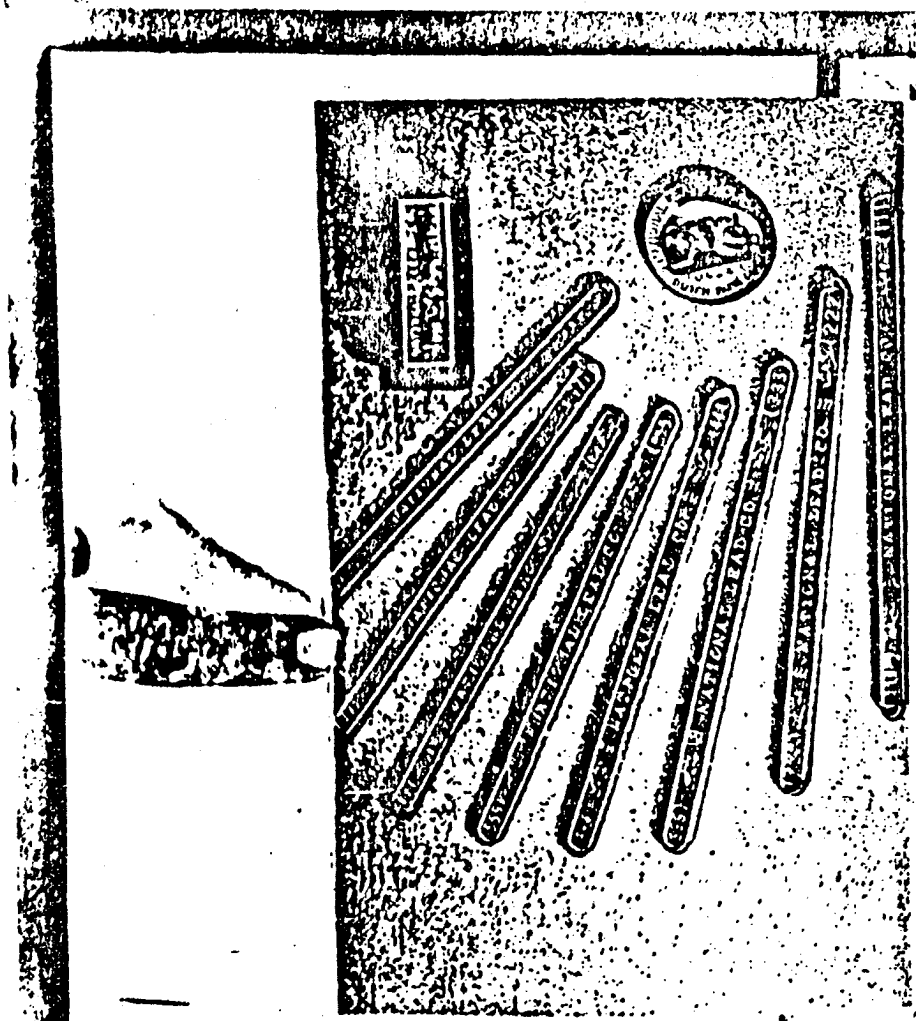

CHAPTER THREE

National Lead Solders

"The Dutch Boy Line"

BAR SOLDER

Numbered Bar and Ingot

Dutch Boy bar solder is available in eight different mixtures - each designated by a number and with characteristics that fit it for particular types of work. All, however, are rigidly standardized as to composition and are fully qualified to bear the Dutch Boy trademark - the mark of quality.

111. This is the highest tin content solder sold under the Dutch Boy trademark. It is guaranteed to be made of pig tin and refined lead and tin mixed in equal parts (50% tin and 50% lead). Dutch Boy 111 is bright, strong and completely free from impurities. It flows easily, keeps fluid at practicable working temperatures, promotes rapid tinning, covers well and has high adhesion. There is no cracking on set and the joint has high fracture resistance. Widely used for all metal fabrication, both mass production and job shop.

Bissell Hardness No. 12.5 - Density 0.05
Liquidus 420° F. — Pasty Range 60°

222. A smooth, free flowing solder with slightly less tin than 111. Suitable for use wherever a bright, strong solder is wanted.

Bissell Hardness No. 12.5 - Density 0.02
Liquidus 482° F. — Pasty Range 72°

333. This is an ideal composition for the general run of galvanized iron and sheet metal work, roofing, leaders, gutters and cornices. It is free flowing.

Bissell Hardness No. 12.2 — Density 0.04
Liquidus 441° F. — Pasty Range 70°

444. This grade of solder is sometimes called "strictly half and half" in the trade although actually it contains more lead than tin. 111 being the real half and half. Its pasty range makes it useful for heavy wanted work and it is also used for inter mixture with the higher tin grades.

Bissell Hardness No. 12.1 — Density 0.08
Liquidus 415° F. — Pasty Range 72°

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555. Particularly adapted for plumbing work where a bright, shiny job is desired. This solder is also suitable for other uses even where an iron is used.

Brasell Hardness No. 127 Density 9.11
Liquidus 440° F.—Paste Range 45°

666. This is a most reliable and economical solder for electrical products, heat exchangers, can manufacturing and commercial shop work. Tins and wets copper, tin and terne plate readily forms good penetrations and makes durable joints not subject to "showering" on generator armatures, operating under normal temperature ranges. It is also a first class dipping solder.

Brasell Hardness No. 154 Density 9.19
Liquidus 430° F.—Paste Range 97°
IS RANSHED STOCKS IN 1/2 AND 50 LB. INGOTS

777. This solder has an unusually large percentage of tin for a wiping solder. When used for this purpose it can be reduced slightly with more lead.

Brasell Hardness No. 115 Density 9.21
Liquidus 356° F.—Paste Range 67°
IS RANSHED STOCKS IN 1/2 AND 50 LB. INGOTS

888. This is a select plumber's wiping solder, always uniform, with wide paste range and good running properties. It wipes a joint that will not sweat, has butter like consistency with no coarseness or graininess. Also ideal for cable splicing.

Brasell Hardness No. 135 Density 9.33
Liquidus 459° F.—Paste Range 91°
IS RANSHED STOCKS IN 1/2 POUND INGOTS

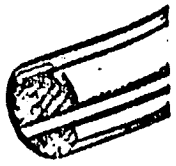
DUTCH BOY WIRE SOLDER

Solid Wire Solder

As the term implies, wire solder is simply regular solder extruded or drawn to form wire. It is made in almost as many tin-lead formulas as is bar or ingot solder, and in diameters ranging from 32 to 0000 B and S gage. Dutch Boy wire solder is supplied wound on 1, 5, 10, 25 and 50 lb. spools. Wire solder is used in many types of work, principally where numerous gauged small pre-fluxed parts are involved and where a straight line produc-tion method can be set up.

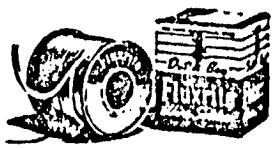
Dutch Boy Fluxrite

This is an entirely different type of wire solder and flux combination. Instead of the conventional hollow wire with a flux core, Fluxrite has the flux enclosed in four channels near the surface of the wire (see diagram).



This arrangement has the most important advantage of putting the flux on the work first as it should be for the best and most efficient soldering. The wire hits the iron or other source of heat, the flux is released to cover the work and then the solder melts to complete the joint.

With this unique wire solder it is also possible to assure complete continuity of flux with no skip spots. Users can be certain that every fractional length contains flux in the correct amount.



Fluxrite contains a rosin flux and comes in a variety of compositions and diameters to suit most specifications. Also can be furnished in the form of rings or other special shapes to fit specific jobs. Ideal for all types of electrical, telephone and radio work. It has been very successfully used in soldering operations involving induction heating, showing distinct advantages over the conventional cored wire solder. Another field for which it is particularly adapted is in soldering bi-metaling copper and brass parts where the Fluxrite is preplaced in proper position.

Dutch Boy Flux Core Solder

This is hollow solder wire filled with flux. The acid types are suitable for all general work where wire solder is called for while rosin core solder is especially designed for making trouble-free joints on electrical, telephone and radio work.

Both types are stocked in three diameters—1/8", 9/32", and 1/16"—on 1, 5, 10, 25 and 50 pound spools. However, any other

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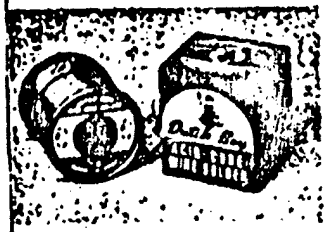
diameters from 3/32" to 1/64", as well as special gages, can be furnished on order and supplied without delay.

National Lead Company is also widely experienced in the manufacture of wire solder with a great number of special fluxes, of many different degrees of strength. These include not only pure grade rosin and the standard zinc chloride acid flux but special rosin combinations for use under low temperature requirements, or on parts excessively oxidized. Also noncorrosive, quick acting fluxes harmless to plated metal as well as liquid acid and solid acid and steam compounds for use on lead.





We are well equipped, therefore, to supply any special requirements in a wire core solder, both in size and type of wire and in the most suitable flux for the purpose.

SPECIFICATION SOLDERS

National Lead Company long has been looked upon as a source of supply for so-called "spec solders." Large solder users whose needs are pretty rigidly restricted so but one or two types of solder frequently develop their own specifications for a solder that precisely fits the job in hand. These specifications are turned over to National Lead's solder specialists who produce the alloy that conforms exactly to the stated requirements.

Other large consumers prefer to use solder that meets the published specifications of certain organizations or the Federal Government. Both the Society of Automotive Engineers (SAE) and the American Society for Testing Materials (ASTM) issue soft solder specifications.

Due to the peculiarly advantageous position of National Lead Company in the metals and alloy field, its resources, its highly specialized research facilities, its "know how," if you please, the production of specification solders has become a major factor in this branch of the Company's business. The "spec solder" buyer may rest assured that he has only to give us the applicable specification and we will follow it accurately.

SOFT SOLDER SPECIFICATIONS

Alloy Grade		% Tin (Stated)	% Lead (Nominal)	% Antimony			Melting Range			
AAR	ASTM			Min.	Desired	Max.	Solidus °F	°C	Liquidus °F	°C
	70A	70	30			0.12	361	183	378	192
	70B	70	30			0.50				
	60A	60	40			0.12	361	183	374	190
	60B	60	40			0.50				
	50A	50	50			0.12	361	183	421	216
	50B	50	50			0.50				
	45A	45	55			0.12	361	183	441	227
1A	45B	45	55			0.50	361	183	414	212
1B		45	57	1.5		2.00	361	183	405	208
	40A	40	60			0.12	361	183	460	238
2A	40B	40	60			0.50	361	183	460	238
	40C	40	58	1.8	2.0	2.4	365	185	448	231
2B		38	62	1.5		2.0	361	183	450	232
	35A	35	65			0.25	361	183	477	247
	35B	35	65			0.50				
	35C	35	63.2	1.6	1.8	2.0	365	185	470	243
	30A	30	70			0.25	361	183	491	255
3A	30B	30	70			0.50	361	183	494	257
	30C	30	68.4	1.4	1.6	1.8	364	183	482	250
3B		28	72	1.5		2.0	361	183	454	251
	25A	25	75			0.25	361	183	511	266
4A	25B	25	75			0.50	361	183	511	266
4B		25	75	1.25		1.75	361	183	502	261
	25C	25	73.7	1.1	1.3	1.5	364	184	504	263
5A	20B	20	80			0.50	361	183	531	277
5B		20	80	1.25		1.75	361	183	518	270
	20C	20	79	0.8	1.0	1.02	363	184	517	270
6A	15B	15	85			0.50	361	183	550	288
6B		15	85			2.75	361	183	557	280
	10B	10	90			0.50	514	268	570	299
	5A	5*	95			0.12	574	301	594	312
	5B	5*	95			0.50	554	290	588	309
	2A	2*	98			0.12	603	318	610	321
	2B	2*	98			0.50	581	305	603	317
	2.5S*	*	97.5			0.40	579	304	579	304
	1.5S**	1*	97.5			0.40	588	309	588	309

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SPECIAL SOLDERS

Name	Use	Where Used
SEGMENT	In diameters desired from 32 to 0000 B & S gage and can be any length.	Where a definitely controlled amount of solder or wire form is to be purchased.
BAR	Bar practicable width and thickness requested.	Commonly used where parts to be joined are purchased each a batch and the solder then applied.
TRIANGULAR BAR	Usually from 12" long each 1/2", 1 1/4" and 1/4" wide. Also special sizes.	Specialized type of work where it is an advantage to use solder with a sharp edge or point.
SHOT	Are desired number of drops to the ounce or pound.	On work where a definite quantity of solder is to be purchased and the triangular shape is desired.
TRIMMER'S BAR	12" to 18" long, 1/2" to 1", wide, 1/4" thick.	For soldering seams in certain kinds of can work.
METER BAR	12" long, 1/2" to 1/4" wide and 1/4" to 1/8" thick.	Widely used for the seam soldering of gas meters.
CAPPING BAR	12" long and 1/2" square	Sometimes used for cappers in metal of drops or segments.
SLAB	Various sizes but those in commercial use are 20" x 2" x 1" and 18" x 9" x 1". Weight 15 to 20 lbs.	For solder baths.
PANTACLE	Low melt mixtures of tin and lead in various grades through 50, but as 000 numbers in the square with special directions and quotes on same.	For fine delicate work.
SHEET	Up to 24" x 96" and in thicknesses from .010" to 1/8". Used as in shape for use in solder gaskets in special assemblies.	Usually for purposes on work that is to be soldered in massing.

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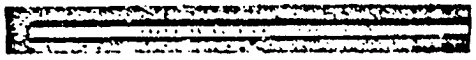
Body Solder

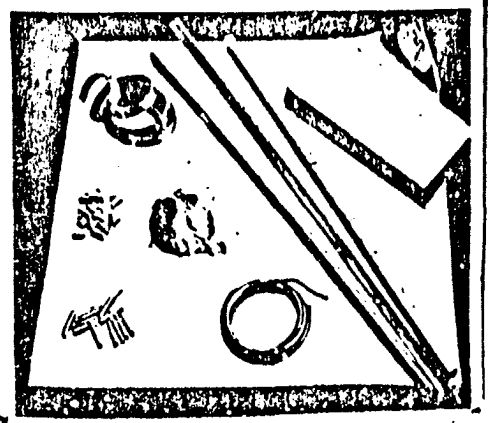
Auto body solder made by National Lead Company has just the right working qualities for the job. It will not run. Can be shaped and smoothed easily with a paddle yet works readily into narrow cracks or seams. Fills shallow dents solidly and quickly, sands to a feather edge.



This solder is unusually smooth flowing. Made from the purest metals it is completely free from hard spots, coarseness or grittiness; requires less grinding or filing. With a wide pasty range, it stays workable. No "time out" for reheating.

The final finish is solid, strong, smooth—no pinholes or porous spots—just right for the lacquer coat.

Auto body solder is furnished in extruded 1 or 2 ounce bars, 3/8" square, packed in 25 pound cartons. Also supplied in 1 1/2 pound bars in 50, 100 or 250 pound boxes or in extruded 1/4 round wire form, cut in 13" strips for use in solder spray guns. These wire strips are packed in 25 pound cartons.



Dutch Boy Tinning Compound

In portioning work of many kinds, such as body repair work, plumber's brass goods and bearing shells this liquid-free combination of finely pulverized solder and flux saves time and labor. Merely bring the area to be tinned to soldering temperature, apply the compound with steel wool and heat with the torch. The ingredients in the compound do the rest. A completely cleaned and tinned area is ready to take and hold the solder. In the tinning of bearing shells Dutch Boy Tinning Compound produces quickly and simply a nicely tinned surface that bonds perfectly with shell and bearing metal.

Supplied in 1 pound cans, 12 to the carton.





Fusible Alloys

Under this classification are usually included solders or alloys with particularly low melting points, approaching or even lower than the boiling point of water.

These compositions have a very useful function in places where ordinary solder could not be used. One of these important uses is in automatic safety devices which operate when a certain predetermined temperature is reached.

Perhaps the most common and best known of such safety devices is the widely used automatic sprinkler system for controlling and extinguishing fires at their very start. It consists of a network of water pipes suspended from the ceiling with sprinkler heads or valves at regular intervals. These openings are kept in a closed position by a low melting point solder. Any unusual heat or flame will melt this solder, releasing the valve and spraying the surrounding area with water or other extinguishing material.

Fusible solder is likewise the operating factor in other safety devices such as the ringing of automatic fire alarms, the operation of electrical alarms, the protection of oil burner installations by causing valves to shut off the fuel supply in case of fire. Also, various electrical equipment such as motors and heaters are protected from burning out by fusible alloy fuse links that break the current if a dangerous temperature is approached.

Another important function of low melting point solders is for work on materials or objects easily damaged by heat, such as wax impregnated radio condensers. This type is also used to seal glass equipment where a vacuum tight joint is needed or for joining metal with glass or other vitreous materials.

There are other uses for low melting point alloys not related to soldering such as for molds or foundry patterns, for filling thin walled tubes so they can be bent and for short run forming dies.

National Lead Company furnishes fusible alloys or low melting point solders in any desired composition. A few of the more widely used alloys are shown in the accompanying table.



Sprinkler head controlled by fusible alloy. Arrow points to soldered joint.

COMPOSITION AND MELTING TEMPERATURES FOR SOME LOW-MELTING EUTECTIC ALLOYS

Melting Point °C	Melting Point °F	Bismuth	Lead	Tin	Cadmium	Others
47	117	44.7	22.6	8.3	5.3	19.1 In
70	158	50.0	26.7	13.3	10.0	.....
91.5	197	51.6	40.2		8.2	.....
95	203	52.5	32.0	15.5		.....
102.5	217	54.0	.....	26.0	20.0	.....
124	255	55.5	44.5	.....	.....	.....
133	271	56.0	.....	40.0	.....	4.0 Zn
139.5	283	55.0	.....	42.0	.....	.....
142	288	.....	30.6	51.2	18.2	.....
144	291	50.0	.....	.....	40.0	.....
177	351	.....	.....	67.8	32.2	.....
183	362	.....	38.1	61.9	.....	.....
199	390	.....	.....	91.0	.....	9.0 Zn
221.5	430	.....	.....	96.5	.....	3.5 Ag
236	457	.....	79.7	.....	17.7	2.6 Sb
242	466	.....	88.6	.....	.....	11.2 Sb

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Stainless Steel Solder

This solder has exceptional tinning and wetting characteristics and low fusion temperature to avoid buckling of sheet metal. Makes strongest possible joint. Supplied in wire form or in 8 ounce and 1½ pound bars.

Pecos Solder

This low tin solder is a specially formulated alloy that has met with wide acceptance because it has working qualities comparable with solders of a much higher tin content.

Pecos is fast tinning and fast wetting. While it has a higher liquidus point than a solder rich in tin, it applies more readily than the usual low tin solder. This minimizes oxidation and fouling of soldering irons.

Pecos solder is furnished in both bar and wire form.

Silver Content Solders

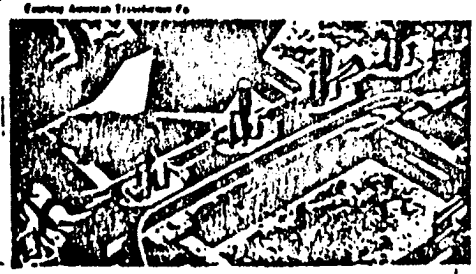
National Lead Company has developed several solders of a tin-lead silver combination. The addition of silver in carefully regulated proportions gives these solders certain qualities that make them ideal for many specialized uses. They have met with enthusiastic reception by important solder users.

These special solders are not to be confused with the wartime solders where silver was used to replace tin and which were sometimes difficult to handle and uncertain in their actions. All of the National Lead solders have been well tested in practice and will be found thoroughly reliable and easy to use.

Information about silver content solder that will meet your particular requirements will be gladly furnished upon request.

Soldering by the induction heating method. The assembled parts with solder preplaced go on conveyor belt at right, then pass between induction heating elements (center) where the soldering operation takes place in a matter of seconds. Completed unit is at extreme left.

Courtesy American Transformer Co.



CHAPTER FOUR

Fluxes

Purposes of Flux

While flux is purely an adjunct to soldering and forms no part of the completed joint, it is fully as important as the solder itself. Without the proper flux and its careful use, an unsatisfactory solder joint is sure to result.

The functions of a flux are three in number. First, it removes oxide or other surface film from the work after, of course, the parts have been made physically clean. Second, it promotes heat transfer and forms a protective layer over the joint during the soldering operation to exclude air and prevent oxidation before the solder freezes. Third, it reduces the interfacial tension between the solder and the metal being soldered so the solder can rapidly "wet" the surface. In addition to doing these essential things, a flux should be easy to apply and economical to use. It should leave no corrosive residue to attack the joint and give off no fumes which are injurious to the operator.

General Types

There is no such thing as an all-purpose flux or one that will work properly under all conditions and on every type of work. The flux should be chosen for the work in hand and there are many kinds from which to choose.

In general all fluxes can be grouped under one of three classes: corrosive, neutral or non-corrosive.

Corrosive Fluxes. Fluxes in this grouping are known also as acid or salt type fluxes. These include the chlorides of zinc, ammonium, calcium, magnesium, aluminum and other metals. Chloride fluxes, of which zinc chloride is the most common, are very fast working and highly efficient in removing oxide. Oxidized metals of almost any type may be readily soldered when a chloride flux is employed.

The principal disadvantage of this type of flux lies in the residue, which actively absorbs moisture. Unless removed by careful washing this will result in corrosion of the base metal. This residue is also electrically conductive which rules out the use of chloride fluxes in almost all electrical work.

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Neutral Fluxes. Fluxes of this class, while not chemically neutral, are of the mild type. Their use is confined chiefly to easily soldered metals such as clean brass, copper, lead and tin plate. Stearic acid is typical of the neutral fluxes. A familiar form is the "plumber's candle" for wiping joints on lead pipe and cable sheathing.

The residue from neutral fluxes is generally not objectionable and therefore it is seldom necessary to remove it after soldering.

Non-corrosive Fluxes. This group is typified by rosin, by far the most widely used. There are other agents available and in use but so far none has approached the popularity of rosin.

The prime advantage of this flux is the character of the residue, which being non-corrosive and non-conductive, makes the flux ideal for many types of work where cleaning is impracticable. Most electrical work requires non-corrosive flux.

Fluxes in the rosin group are relatively weak in their fluxing action, however, and for this reason their use is limited to easily soldered base metals, such as are found in tin plate containers and most radio and electrical parts. Pretinning is a distinct aid.

Nalco Fluxes



National Lead Company, as a result of long experience and familiarity with the practical applications of solder, has developed a number of fluxes which are being marketed under the Nalco name. These cover a wide range of uses so that within the following group the average solder user will find a flux to efficiently meet his requirements, whatever they may be.

FLUX No. 1

Soldering Fluid. This is an acid free but corrosive type flux for use on copper, brass, steel, tin and terne plate. It is a general purpose flux for plumbing, refrigerating, air conditioning, metal caskets, auto bodies and work where residue can be removed.

FLUX No. 2

Tinner's Flux. Compounded essentially for galvanized iron work, this is an extremely active liquid flux that will remove the zinc coating beneath the solder and thus prevent brittle joints.

FLUX No. 3

Stainless Steel Flux. This is a liquid flux for use on stainless steel which results in neat, sound joints with a minimum of harmful fumes. It is also very active.

FLUX No. 4

Dipping and Coating Flux. As the name suggests, this strong, acid-free fluid flux is especially designed for the hot dip coating of parts in solder. The water content is low to minimize spattering.

FLUX No. 5

Sweat Tube Fitting Flux. This liquid flux was developed for soldering sweat copper tube or pipe fittings (sometimes called streamline) where it is essential for the solder to penetrate into the joints by capillary attraction. The flux promotes rapid flow of the solder, including even low tin and silver lead solders, and greatly aids the joining operation.

It is also useful for other types of work on copper, brass or steel where rapid action and high penetration are necessary.

FLUX No. 6

Liquid Rosin Flux. A completely non-corrosive rosin flux in a volatile solvent, it provides a reliable, fast acting flux for all general work where the liquid form is more convenient and efficient.

FLUX No. 7

E 3 A Flux. This flux is a solid rosin base material which leaves a hard, dry residue that is guaranteed non-corrosive. It meets the Navy Bureau of Ships specification for a non-corrosive flux.

FLUX No. 8

OPS-1A Flux. This solid flux, of the neutral type, is especially adapted for soldering on brass although it works equally well on copper, tin and terne plate. Should be used with adequate ventilation because of its somewhat unpleasant odor, due to its special composition.

FLUX No. 9

Acid Type Paste Flux. This is an unique and powerful product which leaves a completely water soluble residue. It can be used on most clean metals except stainless steel and aluminum. Washing quickly removes all residue. This paste can be applied in any position and solder will flow only as far as the flux extends.

FLUX No. 10

Rosin Paste Flux. This is not to be confused with the average non-corrosive paste containing considerable zinc ammonium chloride. It is a pure rosin product and can be used safely on any type work, no matter how delicate. Like the other Nalco rosin fluxes it will pass the most exacting tests for non-corrosive and electrically non-conductive residue.

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FLUX No. 11

Acid Solder Paint. This is a solder and flux combination, mixed with a special water gel, ready for application. Simply paint it on the work, apply heat and a bright tinned surface results.

Nalco Acid Solder Paint stays in suspension, is always ready to use and will cling to even a vertical surface. It stays on the spot to be soldered. No preheating is required.

It is a great timesaver and convenience in such operations as the banking of electrotypes, tinning bearing shells, auto body work and pertinuous parts prior to sweat joining.

FLUX No. 12

Resin Solder Paint. In this product the user has the advantage of both solder and flux. A dose of resin paint accomplishes two jobs in one operation. Only heat is needed to complete the job. Especially helpful to the electrician, both because of its convenience and its absolute non-corrosive quality. Also useful for small sweating jobs on copper, tin plate and easily soldered metals.

FLUX No. 13



Soldering Paste. Nalco No. 13 is the most active of the petrolatum base pastes now on the market. This type of flux is generally termed non-corrosive based mainly on the protective film of petrolatum which covers the joint after soldering.

This paste is useful for a wide variety of jobs on all metals, except aluminum and stainless steel.

FLUX No. 14

No. 14. A radically different type of flux, Nalco No. 14 is as active as a good quality corrosive type yet it leaves a non-corrosive, non-conductive residue. The heat of the soldering operation causes the liquid flux to decompose leaving only a very small amount of residue. Properly used, in the correct quantity to assure nearly complete decomposition, Nalco No. 14 can be used on practically any job where the non-corrosive properties of a resin flux are hereinbefore required.

It contains no zinc or ammonium chlorides or free hydrochloric acid. It is not satisfactory for use on tarnished stainless steel, Inconel and aluminum. It does work on zinc but here it generates a corrosive residue product which must be washed off.

FLUX No. 16

Soldering Gel. This flux has the same general application as Nalco No. 11 except it is in gel form instead of liquid.

FLUX No. 17

Solder Paste. This is a compounded solder and flux combination ready for application. The flux portion is of petrolatum base similar to Nalco No. 13 flux. The solder portion stays in suspension and only one operation is required to complete the entire soldering job.

FLUX No. 18

Liquid Resin. This flux is similar to Nalco No. 6 except that it is compounded with alcohol. It is a completely non-corrosive flux.

FLUX No. 19

Special Solder Paint. This is a solder paint formulated to combine finely divided solder with Nalco No. 11 flux and designed to do the soldering work in one operation instead of two.

FLUX No. 20

Special Soldering Flux. A special liquid soldering flux, free of ammonium chlorides. Intended for use on jobs where the presence of ammonium chloride is objectionable.

FLUX No. 21

Aluminum Soldering Flux. A liquid flux especially compounded for use in soldering aluminum parts.

FLUX No. 22

Special Soldering Fluid. This is a special flux prepared for use where Nalco No. 1 is not sufficiently active for the job in hand.

FLUX No. 23

Special Liquid Resin. A special non-corrosive flux activated for maximum speed and efficiency.

Nalco Fluxes Nos. 1, 2, 3, 4, 5, 6, 7, 8, 11, 13, 16, 18, 20, 22 and 23 are packaged in pint, quart, gallon, 5-gallon and 55-gallon containers. Nos. 9, 10, 11, 12, 17 and 19 come in ½, 1, 5, 50 and 100 lb. containers. No. 21 is put up in 1 oz. and 1 lb. packages. No. 14 comes in 2 oz., 1 oz. tins, and in 1, 5, 10, 50 and 100 lb. containers.

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APPROXIMATE DATA ON THE PHYSICAL PROPERTIES OF DUTCH BOY SOLDERS

	111	222	333	444	555	666	777	888
Ultimate Tensile Strength lbs sq. in.	6450	6600	6400	6600	6700	7000	7000	7000
Elongation %	90	90	90	90	90	80	75	70
Shear Strength lbs sq. in.	5600	5700	5500	5625	5525	5450	5375	5275
Brinell Hardness	12 3	12 3	12 2	12 7	12 7	13 4	13 3	13 3
Spec. Gravity	8 85	8 92	9 04	9 02	9 11	9 19	9 24	9 33
Solidus:								
Fahr	361	361	363	363	363	363	363	361
Cent	183	183	184	184	184	184	184	183
Liquidus:								
Fahr	421	432	441	435	448	450	450	453
Cent	216	222	227	224	231	232	232	234
Freezing Range								
Fahr	60	71	78	72	85	87	87	92
Cent	35	39	43	40	47	48	48	51

PHYSICAL PROPERTIES OF SOME TIN-LEAD SOLDERS

Per Cent Tin (lbs lb-in-oz)	15	20	25	30	35	40	50	62
Electrical Conductivity % of conductivity of copper, for cast solder	8 8	9 1	9 4	9 8	10 1	10 5	11 3	12 4
Tensile Strength lbs sq. in.	4700	5410	5770	6140	6230	6320	6450	6700
Elongation % in 2 in.	19	15	18	20	40	57	93	83
Shear Strength lbs sq. in.	4470	4740	5310	5500	5590	5680	5870	6060
Charpy Impact ft. lbs.	8 7	12 2	13 4	17 7	18 6	19 0	15 9	14 2
Brinell Hardness	9 5	12 8	12 6	12 4	11 9	11 4	12 3	13

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