When the term solder is used without being qualified what is usually meant is an alloy of tin and lead with or without small addition of other metals.

The tin content may vary from 1 °o up to nearly 100% and is always the first number in the designation. Thus 60/40 is 60% tin and 40% lead.

The choice of the alloy required is governed by the nature of the work to be soldered and the conditions under which the finished product has to perform.

The choice of the form in which the solder is purchased is governed by the nature of the soldering operation.

The choice of the flux is governed by the nature of the metals to be soldered.

SPECIFICATIONS:

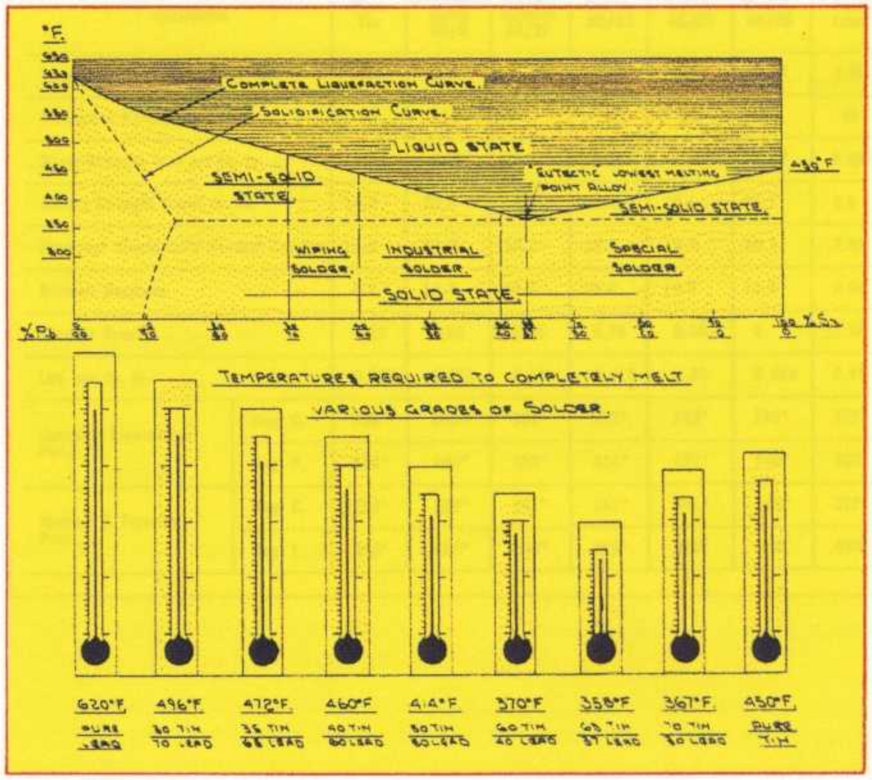
Canada Metal solders are certified to be the highest quality obtainable, the standard solders being made to the Federal Specification OQ-S-571, shown below.

CANADA METAL SOLDER

Table 1. -Chemical-composition requirements of solder'

Composition	Tin	Lead	Antimony	Bismuth, max.	Silver	Copper, max.	Iron, max.	Zinc, max.	Aluminum, max.	Arsenic, max.	Cadmium, max.	Total of all others, max.	Melting range[2]	
													Solidus	Liquidus
Sn70	69.5 to 71.5	Remainder	0.20 to .50	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	380
Sn63	62.5 to 63.5	Remainder	0.10 to .25	0.10 to .25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	360
Sn62	61.5 to 62.5	Remainder	0.20 to .50	0.25	1.75 to 2.25	0.08	0.02	0.005	0.005	—	—	0.080	350	372
Sn60	59.5 to 61.5	Remainder	0.20 to .50	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	375
Sn50	49.5 to 51.5	Remainder	0.20 to .50	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	420
Sn40	39.5 to 41.5	Remainder	0.20 to .50	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	460
Sn35	34.5 to 36.5	Remainder	1.60 to 2.00	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	475
Sn30	29.5 to 31.5	Remainder	1.40 to 1.80	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	490
Sn20	19.5 to 21.5	Remainder	0.80 to 1.20	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	360	530
Sn10	9.00 to 11.00	Remainder	0.20, max.	0.03	1.70 to 2.40	0.08	—	0.005	0.005	—	—	0.10	514	570
Sn5	4.5 to 5.5	Remainder	0.50, max.	0.25	—	0.08	0.02	0.005	0.005	—	—	0.080	518	594
Sb5	94.0, min.	0.20, max.	4.00 to 6.00	—	—	0.08	0.08	0.030	0.030	—	0.030	0.030	450	464
Pb90	—	Remainder	11.00 to 13.00	0.25	—	0.08	0.02	0.005	0.005	0.600	—	0.080	476	478
Ag1.5	0.75 to 1.25	Remainder	0.40, max.	0.25	1.3 to 1.7	0.3	0.02	0.005	0.005	—	—	0.080	588	588
Ag2.5	0.25, max.	Remainder	0.40, max.	0.25	2.30 to 2.70	0.30	0.02	0.005	0.005	—	—	0.030	580	580
Ag5.5	0.25, max.	Remainder	0.40, max.	0.25	5.00 to 6.00	0.30	0.02	0.005	0.005	—	—	0.030	579	689

'indicated in percent by weight.
2Indicated in degrees F, approximately. and for information only.



Melting Point Diagram Lead-Tin Solder

The above diagram illustrates in a graphic way the peculiar and interesting facts set forth in the table of melting points- For example, between the area of complete liquefaction and area of solidity there is always (in the case of alloys) an intermediate area of mixed liquid and solid, except at one point, namely, that representing the alloy of 63°.b tin and 37°.•'0 lead- At this point the liquid area touches the solid area- No matter which way we go from this point, i.e., no matter whether we increase our tin content or decrease it-we find that complete liquefaction requires a higher temperature. At one other point the solid area meets the liquid area, but it is at the melting point of 100 percent lead - not an alloy-

The melting points on this sheet and the physical characteristics on the next sheet will only apply to solders made from pure virgin materials- Solders made from scrap contain zinc, aluminum, copper, arsenic or antimony, as impurities- These will affect the melting point to some degree, the physicals to a greater extent and the fluidity most of all.

MELTING POINTS OF LEAD-TIN ALLOYS

Composition		Melting Points			
LEAD Per-cent	71N Per-cent	Cam lets Liquefaction		cation Point	
			[illegible]		
100.0	0-0	327	620	327	620
97.5	2-5	320	608	299	570
95.0	5.0	314	597	272	522
90.0	10.0	302	576	224	435
85.0	15-0	290	554	181	358
80.0	20-0	280	536	181	358
75.0	25-0	268	514	181	358
70.0	30-0	257	496	181	358
65.0	35.0	247	477	181	358
60.0	40.0	238	460	181	358
55.0	45-0	225	437	181	358
50.0	50.0	212	414	181	358
45.0	55-0	200	392	181	358

Composition		Melting Points			
LEAD cent	TIN Per cent	Liquefaction Complete Point		Solid& cation Point	
		°C	°F	°C	"F
40.0	60.0	188	370	181	358
37.0	63.0	181	358	181	358
35.0	65.0	182	360	181	358
30-0	70.0	186	367	181	358
25-0	75-0	192	378	181	358
20.0	80-0	199	390	181	358
15.0	85.0	205	403	181	358
10.0	90.0	213	415	181	358
5-0	95-0	222	432	181	358
0.0	100.0	232	450	232	450
Sb 5-0	95.0	240	460	232	450

Note: Sb=Antimony

63/37

PHYSICAL PROPERTIES OF SOLDER

MATERIAL		Tin	streamline		50/50	Cert'd. 45/511	Cert'd. 40/60	Pun Lead
Tensile Strength Tons per sq. in.		0.94	2.65	3.43	2.80	2.65	2.76	0.89
Elongation Percent on 4 ins.		55	38	31	42	45	35	39
Sheer Strength Tons per sq. in.		1.28	2.68	2.77	2.56	2.33	2.23	0.896
Impact Strength (Izod) ft.-lbs.		14.2	20.4	14.7	15.4	15.1	13.7	5.6
Electrical Conductivity Percent Copper		13.9	10.9	12.2	10.8	10.5	10.1	7.91
Brinnall Hardness		4.1	13.4	16.7	15.0	15.4	15.8	3.00
Specific Gravity		7.29	7.01	8.35	8.75	8.88	9.	11.37
Lbs. per cu. in.		0.262	0.252	0.301	0.315	0.32	0.324	0.41
Complete Liquidation Point	Deg. C.	232°	240°	181°	212'	225'	238°	327'
	Deg. F.	450°	460°	358'	414'	437'	460°	620°
Melting b Freezing Point	Deg. C.	232°	232°	181'	181'	181°	181°	327'
	Deg. F.	450°	450°	356°	3118°	358'	358'	620'

FORMS AND PACKAGES:

Canada Metal Solders are available in the following forms.

Ingots of 10 lbs., 20 lbs. and 50 lbs. each
Bars of 1/4 lb., 1/2 lb., 3/4 lb., 1 lb. and 1 1/4 lb. in 50 lb. boxes.
Solid Wire in any gauge heavier than .032" on 1 lb., 5 lb., 10 lb., 25 lb. and 50 lb. spools.
Cored Wire-same as solid wire.
Ribbon - up to 4" wide, from .010 up in thickness.
Preforms - shapes, strips, pellets, rings.
Powder -- 100, - 200.- 325 mesh - 100 lb. containers.
Paint - Corrosive and Volatile flux types - 1 lb., 5 lb. and 25 lb. containers.

Uses: When ordering solder it is desirable to state the use to which the solder will be put as different end uses necessitate different manufacturing processing.

STANDARD SOLDERS AND TYPICAL USES

TIN/LEAD

63/37 This is the euctectic alloy and is used where low operating temperatures, optimum flow, and clean, bright solder joints are required. Flow soldering of printed circuits is a typical use.

60/40 In the same class as the above but less expensive. Used extensively in radio, television, telephone, electronic and electrical industries generally.

50/50 Probably the most popular all purpose high grade solder, used on copper and brass, especially on plumbing and electrical work.

45/55 A general purpose solder suitable for radiator repair work and sheet metal applications, particularly galvanized iron.

40/60 The alloy is on the borderline between general purpose solders and the wiping group. May be used in place of 45/55 where the solder is used as a filler metal. It is also a high grade wiping solder with good tinning properties.

WIPING SOLDERS:

Cable wiping is the highest tin content of the regular wiping solders, and is recommended where mechanical strength is of first importance such as cable joints.

Easy wiping is designed to meet the average general purpose work as it has good mechanical properties combined with easy working characteristics.

30/70 A smooth, easy to work solder with a good plastic range, therefore, suitable both for plumbers wiping and auto body solder.

BODY SOLDERS:

This group is fairly broad with the tin content as low as $2\frac{1}{2}$ % and as high as 30%, depending on the customers individual requirements.
All Canada Metal Body Solders are processed to ensure the maximum plasticity and workability.

SPECIAL PURPOSE SOLDERS:

A widening field in the use of solders has resulted in the development of "soft" solders using metals other than tin and lead, sometimes in combination with the tin and lead or sometimes with one or the other.

95/5 is a tin/antimony solder used where good strength or fatigue properties are required. Where the solder is used under higher than normal temperatures or stresses. Or where a lead free solder is needed because of the danger of an undesirable lead pick up.
Hot water lines on copper pipe, Aerosal cans and sap buckets are samples.

#588 are high temperature lead base solders for use where the conventional
#530 tin/lead would melt or become seriously weakened.
#35 One field is in electric motors, generator and starters.

SPECIAL SOLDERS FOR SPECIAL PURPOSES OR TO CUSTOMERS SPECIFICATIONS ARE MADE WITH EQUAL CARE AND ATTENTION TO QUALITY.

Stainless steel solder — As their names would indicate are special solders
Aluminum solder — designed to solder these specific materials.

Regaiv is really not a solder but is applied like solder to recoat areas of galvanized iron where the zinc has been burned off In welding, etc.

CORED SOLDERS:

All the conventional solders can be supplied in cored form with a variety of fluxes to choose from.
The Resin flux standard is #72 with either 2 or 3% flux, they would be numbered # 722 or # 723 as the case may be.
The standard Acid Core has 2% flux of a zinc chloride type.
The #92 Core Is a volatile Acid type and is specified with the flux percentage the same as the resin core, i.e. # 922, #923, etc.
Stearine Core is supplied for soldering terne plate or lead.

SOLDERING SUGGESTIONS

Certain fundamentals must be observed if a satisfactory soldering job is to be obtained.

First and foremost, the work to be soldered must be clean. Second, the work must be hot enough to melt the solder Third, the proper flux must be used. Fourth, the proper solder must be used.

Fluxes are designed to remove light films of oxide from the metal, to form a protective coating over the area to be soldered so a new film will not form, and to remove the interfacial tension between the solder and the metal being soldered so the solder can "wet" the surface. It is impossible to solder most oxidized surfaces with a tin/lead solder.

Fluxes are not designed to remove paint, lacquers, dirt, grease and oil. In fact even freshly washed hands have enough natural grease on them to affect the quality of a soldered joint. Therefore, parts that are cleaned and ready for soldering should not be touched with bare hands and all foreign matter should be removed either mechanically or chemically from the work before attempting to solder.

The number and variety of fluxes on the market is quite large but most of them fall into four main categories. These are the resin type, the Chloride Type, the volatile acid type and the stearic acid type.

The resin type in its pure state is the only one that can be called truly non corrosive, and is used in electronic work where not the slightest trace of corrosive material in the residue can be tolerated. To this type is frequently added activators to promote the fluxing action. The quantity used is so small that for most electrical, radio and T.V. work the corrosive factor is negligible and these fluxes are quite satisfactory. All the resin types can only be used on easy to solder materials such as copper and tin plate - the use of an open flame should be avoided. The Chloride types are usually spoken of as acid fluxes although not all of them contain free acids. The fluxing agents in them are usually derived from the action of an acid on a metal, thus zinc chloride, which is a good flux, is made by the action of Hydrochloric acid on zinc.

All of this group will absorb moisture from the air and in the damp condition are all corrosive. All the heating you can give them will not change this condition. Advantage is taken of this fact in that these fluxes will stand the heat of a direct flame.

The resin and stearic acid types will stand a certain amount of direct flame but should not be heated to the point of charring. If these fluxes are overheated a carbon deposit is left, which will make soldering impossible.

The volatile acid type cannot stand a direct flame. It can be used on cold work which is then dipped in hot solder, or applied either directly or in cored form to work which is at the soldering temperature. The volatile acid types are among the more recently developed and are being used where a strong fluxing action is needed but an inert residue is desired. With these fluxes (which are truly acid) the acid is broken down by the heat of soldering and goes off in the form of a gas leaving a small amount of residue which for all practical purposes is non corrosive.

While all fluxes should only be used in well ventilated areas, this is most important with the volatile acid types.

The Stearic acid types are used mainly on lead and lead alloys such as lead pipe, lead cable, sheet lead, lead traps and bends and terne plate. These fluxes are quite mild and relatively non corrosive.

Choice of solder depends on a number of factors such as material to be soldered, design of joint, strength of joint required, the temperature under which it will operate, the corrosive media in contact with the solder and possibly other unusual conditions so we can only generalize here.

The tin/lead solders can be supplied with a low or a high antimony content with the antimony going as high as 6% of the tin content. Additions of antimony improve the resistance of high tin solders to deterioration at low temperatures and also improves the joint strength when used with copper. It does not improve that on brass and actually lowers that on steel.

Antimony should not be present in any appreciable amount in solders which are to be used on galvanized iron as the zinc and antimony combine to form a brittle intermetalic compound which weakens the joint.

The lowest melting point solder in the straight tin/lead group is 63% tin, 37% lead at 358 deg. F. Lower melting points may be obtained by the addition of other metals. Incidentally, when speaking of solder, the tin content is always first-the above would be 63/37 as the tin content increases or decreases from 63% the melting point rises:

The strength of the solder itself is often used as a measure of the joint strength. This is not quite true as 60/40 solder is stronger than 50/50, but 50/50 will give a stronger joint under most conditions.

Aside from the workmanship, the other major factor in joint strength is the joint clearance. Five thousands of an inch is the optimum. Below three thousands, the joint may not fill out and above six or seven thousands, the capillary action loses its effect and furthermore there is unalloyed solder in the joint which is weaker than the solders which has alloyed with the parent metal.

There are many special solders and fluxes for special purposes available from The Canada Metal Company Limited. Most solders can be obtained in a number of forms, ingot for a bath used for dipping, cast or extruded bar for heavy work such as sheet metal, solid wire from very fine up to the size of the bar and cored solder similar to the solid wire except the solder has a flux core. The flux in the core may be acid, resin or volatile acid.

After the material to be soldered is cleaned, the flux should be applied and then the work brought up to soldering temperature. The heat may be applied in a number of ways. In the case of dip soldering, the cold material is merely dipped in molten solder after cleaning and fluxing and the heat obtained from the solder itself. Care should be taken to leave the work in the solder long enough to bring it up to the right temperature.

Another point to consider is the size of the melting pot. Since every time a dip is made, heat is removed, the pot should be of such a size as to allow for this drain of heat without dropping the pot temperature appreciably. If the pot is too small the tendency is to over heat the solder to try to put back quickly the heat equivalent of that drawn out in the soldering operation. Remember that the hotter the pot, the faster the solder will oxidize. A small amount of resin floating on top of the pot will tend to inhibit dross (oxide) formation.

For oven or induction heating applications preformed solder shapes are frequently used. These are manufactured to the exact shape and size required. Some are made from wire, others from flat strip, either with or without flux core.

Torch and bit soldering are perhaps the two commonest methods used.

he torch may be either propane, gasoline, natural ur manufactured gas but all should be handled in much the same way. Apply the heat as uniformly as possible to avoid local overheating except where a heavy piece is being soldered to a lighter part, then apply the heat mainly to the heavy section. If possible keep the direct heat off the actual surface to be soldered. If soldering in a confined area put a piece of asbestos cloth or board behind the work if the flame can go beyond it.

If a soldering iron is being used, the copper tip must be clean and properly tinned or it will not work. Should the tip be dirty it should be filed down to clean metal, heated, fluxed and tinned with solder.

Regardless of how this heat is applied, it should be left in contact with the work long enough to bring the point of soldering above the melting point of the solder. A cold joint may appear to be soldered when it really is not.

Where a chloride type flux has been used it is advisable to clean the flux residues from the work as it can cause corrosion. A word of caution here, some fluxes (pastes in particular) are advertised as non-corrosive but contain chlorides, so if the make up of the flux is unknown, the residue should be removed. Alcohol or Turpentine will dissolve most flux residues, and washing with a solution of washing soda will neutralize the chloride type residues.

SOLDERING INSTRUCTIONS

For use with: Copper, Brass, Zinc, Iron, Steel, Galvanized Iron, Tin Plate.

(1) Thoroughly clean parts to be soldered. (Paint, Insulating varnish, and dirt should be removed with a file or emery paper. Grease and oil should be washed off with water and a detergent.)

(2) Apply flux to areas to be soldered. (Use Resin or Neutral fluxes on electrical work, acid fluxes on iron, steel or galvanized iron. Acid flux residues should be washed or wiped off.)

(3) If soldering iron is being used, clean the tip with a file, flux and tin with solder.

(4) Heat parts to be soldered, areas to be soldered must be hot enough to melt the solder. Do not overheat resin or paste fluxes, if they are charred, they are destroyed and must be cleaned off.

If solder does not flow, either parts are not clean enough or the parts are not hot enough.

Note:
Aluminum, Die Casting Alloys and Stainless Steels require special fluxes and techniques.

Should any specific soldering problem arise, Canada Metal Company technical service department is at your disposal.