Type Metal for the Linotype

OF THE MANY variables which influence the quality of composition in a newspaper, book, or job shop, one of the most important is the type metal used. It is likewise important in the relationship between customer and salesman, because poor metal means machine trouble and customer complaints. Thus the metal question is the first to be checked when any problem arises with the quality of slugs, or sometimes in cases of damage to matrices.

Company Policy on Type Metals

THIS COMPANY is neutral as far as individual suppliers of type metal are concerned. We recommend that a reputable type metal manufacturer, who will supply a good quality metal capable of meeting the requirements for successful use in the Linotype, be patronized. A high grade metal, properly cared for, will run at a uniformly low, even temperature and produce solid slugs with sharp, clear faces, capable of holding up under long runs or molding pressure.

Type Metal Uses

THE MOST widely used type metals are for Linotype, electrotype, stereotype, Monotype, foundry type, and other variations of these basic uses. Since these various applications require that the type metal have certain specific properties, different alloys are made to meet these requirements.*

However, the basic elements of all type metal alloys are lead, antimony, and tin in various percentages. Also very small percentages of other elements such as copper, arsenic, zinc, aluminum, magnesium, bismuth, sulfur, and others may be present.

The Basic Type Metal Alloy

LEAD, which forms the basis (approximately 84% for Linotype metal) of all type metals, has a melting point of 621° F. and is extremely malleable and ductile. The addition of the other elements, principally tin and antimony, improves the strength, hardness, and other qualities which are necessary for type metal.

Tin, which flows readily under pressure and has a melting point of 450° F. is added to the lead (approximately 4.5% for Linotype metal) for the purpose of increasing the strength, hardness, and fluidity of the type metal.

Antimony (approximately 11.5% for Linotype metal), when added to lead, also increases the hardness of the type metal. The melting point of antimony is 1167° F. It has the good feature of imparting to the alloy, in some small measure, its unusual property of minimizing contraction of the type metal while solidifying. This makes for clear, sharp letters since the type metal fills every crevice of the matrix character before complete cooling and subsequent contraction occurs.

The combination of approximately 4% tin, 12% antimony and 84% lead produces an alloy which has a melting point of 476° F. This is known as an "eutectic" alloy, which means that the melting point of the alloy is the lowest possible with these components. Because this eutectic alloy has a single melting point and possesses excellent fluidity it is well suited for Linotype use. Its operating range is between 515° F. to 550° F.

Metal Standards

THE METAL formula (its proportions by weight of lead, tin, and antimony) is the most frequently used standard with reference to our customers' operations. Sometimes we encounter metal comparisons based on "the Brinell test." This refers to relative hardness of the metal. The test is made on the Brinell hardness machine, in which a ball of 10 millimeters diameter (0.393″), under a load of 500 kilograms (1,102 lbs.), is applied to a sample of metal for 1 minute. The hard steel ball makes an indentation in the sample of metal and the diameter of

*A special hard metal, made for use with special Linotype equipment for telephone directory composition, is described on page 4.

the "dimple" determines the hardness number under the Brinell system. A typical Linotype metal Brinell hardness is 22, of Monotype 26, and of foundry type 32.

Test or analysis, to show the metal formula, is usually made by a metal supplier. A few large printing plants have laboratory facilities for this procedure. The Brinell test is usually made in a general testing laboratory although larger manufacturers (such as Linotype) use the Brinell machine regularly to test various metals in use.

Impurities

Other elements, which are commonly introduced into type metal stocks by accident or carelessness in sufficient quantity to cause trouble, are copper, zinc, aluminum, magnesium, nickel and arsenic.

Since most printing establishments use zinc and copper engravings, copper-shelled electrotypes, and brass rules, with consequent routing and sawing, chips and dust along with loose chewing gum, candy, cigarette and tobacco "tinfoil" wrappers may find their way into the melting pot. Thus copper and zinc are the impurities most often found in type metal.

Copper in amounts over .05% and zinc in amounts over .001% cause excessive drossing. This results in a poor type face and hollow slugs. Copper in excess also causes wear and clogging of small orifices due to the hardness and high melting point of the copper-tin crystals which form.

Nickel in amounts over .01% causes the same trouble as excessive copper.

Arsenic is generally present in type metals in amounts from .01% to .15%. Research indicates that it may be beneficial in these amounts because it is said to refine the grain structure, increase hardness, and improve ductility of the alloy. But excess arsenic may damage matrices.

Other elements in addition to these named above may be present naturally and as long as their percentage is held within certain limits they cause no trouble. In most cases the influence of these elements is to increase the drossing rate.

Dross

Dross is the substance which remains on the surface of type metal after it has become molten. There are two kinds of dross—that which comes from oxidation of the components of the metal, notably tin; and another form which stays suspended in the molten metal, undissolved, at ordinary working temperatures.

The dross which is a result of oxidation forms on the surface of the metal and has a dark or yellowish coloring. It is comparatively drier and more powdery than the other type of dross. Since tin oxidizes more readily than lead or antimony the oxide dross contains a higher proportion of tin than the original metal.

The dross which is suspended in the type metal before melting as a fine dispersion of non-soluble metals or compounds separates to the surface as a pasty or wet scum.

In general the greatest loss in metal due to drossing occurs in the remelting process rather than when in the Linotype pot. When in the Linotype pot there is only a small surface of the type metal exposed to the air thus cutting down oxidation and pot heating temperatures are not high enough to be conducive to excessive drossing.

The higher the temperature of type metal, the longer it is kept at this temperature and the more it is agitated, causing oxidation, the more dross is produced.

Remelting

An important part in producing a slug with a clear, sharp face is the techniques and treatment of the type metal in the remelting process. Too often this remelting is done in a haphazard manner by personnel who do not realize the importance of this operation.

The proper temperature for the remelting of Linotype metal is 600° F. to 650° F. All foreign matter should be carefully removed from the used-type metal before insertion in the remelting pot. When the metal is molten the surface should be lightly skimmed to remove any foreign matter that might possibly have been overlooked when the used-type metal was placed in the remelting pot.

When heating has continued long enough at the 600°–650° F. temperature to thoroughly melt the used-type metal, the skimmings from the casting pots may be added if they are known to contain no impurities.

The metal in the remelting pot should be thoroughly but gently stirred for three or four minutes so that the free metal in the lumps of dross can be separated from the oxides.

It will probably be necessary to use a good commercial flux to "dry up" the dross which is on the top of the metal. The flux usually contains a chloride (often ammonium chloride—sal ammoniac) which dissolves the oxide films. This permits the trapped metal in the dross to rejoin the melt thus saving on tin, antimony, and lead losses. Flux *should never be used* in the melting pot of the Linotype machine.

The flux is spread thinly over the entire surface of the dross and carefully mixed with it until the dross becomes dry and has a powdery appearance. The dry dross should then be carefully skimmed off and weighed to determine the amount of correction or toning metal to be added, or for credit allowance, on new type metal.

This correction metal is alloyed with a higher percentage of tin and antimony than the original type metal. The correction metal replaces the tin and antimony lost due to oxidation and drossing in the casting and remelting of the type metal. Usually a pound of correction metal is added for each pound of the dross that is removed.

It is stirred quietly into the remelting pot and the whole melt should be allowed to settle for a half hour or so. Then any dross which has formed should be carefully removed without the use of flux. The metal should then be poured into water-cooled molds, since quick chilling results in a better crystalline structure of the metal, improving its subsequent working qualities when it reaches the Linotype metal pot.

Our customers must realize (and the experienced plant executives do) that their type metal should be analyzed at regular intervals. As previously mentioned, most metal suppliers have facilities to render such testing service at little or no charge.

A Warning Against Excess Flux

SERIOUS PROBLEMS in our customers' plants have occasionally arisen, involving matrices completely ruined through the crushing of their sidewalls by bits of adhering type metal. After several such instances had puzzled servicemen and factory experts it finally was proved that excess flux, used in remelting the type metal (and in one plant also used around the molds and mouthpiece on the Linotype), was the cause of all the difficulty. The explanation has a simple chemical basis though that was not discovered until a number of cases of trouble had been encountered.

Flux, as a mixture containing sal ammoniac and rosin is quite similar chemically to the conventional soldering compound, used by tinsmiths to solder brass, tin, etc. Type metal is similar to solder, with its tin content. Matrices, of course, are brass. Under certain conditions, it has been found that *excess* flux will remain in the molten metal, causing a veritable soldering action. This makes the metal adhere to matrices, thus becoming the cause of crushed walls and resulting hairlines.

The exhaustive study of mysterious damage to matrices, which could not be accounted for by any conceivable mechanical condition, revealed in several cases that flux was the cause. In each instance it was an enthusiastic over-use of the flux, and in each case the damage began with *new* matrices. The new brass of the matrices had not acquired a surface discoloration or patina from use and oxidation. It was therefore in the bright, clean condition to which a tinsmith brings a piece of brass before he solders it. Thus the new matrices were affected by the soldering action of the flux-bearing type metal, while old matrices in the same plant (or even in the same font) were not affected. These troubles ceased when the use of flux was cut down to the proper percentage.

Successful Slug Production

1. Metal should be analyzed at periodic intervals.

   Correct alloy for Linotype metal is:

   Tin—4.5%.

   Antimony—11.5%.

   Lead—by difference, approx. 84%.

   Impurities not to exceed 0.10%.

2. Metal should be kept clean and free from impurities. Type metal only should be remelted. All foreign material such as mats, zinc cuts, copper, brass, saw-dust, paper, wood, tinfoil, etc., should be culled out.

3. Flux *should not be used* in the Linotype pot.

4. Run pot within proper temperature range—535° F. to 550° F.

5. Do not overheat metal beyond 650° F. in the remelting process.

6. Use proper mold cooling method (Thermo-Blo) when large slugs are cast at a fast rate.

7. Skim dross from metal in metal pot daily.

8. Keep mouthpiece holes and mouthpiece vents open.

9. Keep metal in the pot at the proper level—½″ below ring.

10. Clean pot pump plunger and the vent holes in the sides of the pot well. The pot throat should be cleaned at infrequent intervals.

11. Exercise care and proper techniques in the remelting operation. Avoid excess flux.

A Case History

THE IMPORTANCE of type metal in our customer relationships is vividly illustrated by a development in a plant whose purchasing agent thought he could economize by changing his metal supply. An eager metal salesman offered to beat the prevailing price on standard metal by a half-cent or so and the P. A. fell for it. This plant had hundreds of standing pages of legal data which were corrected at intervals by the insertion of newly-set slugs. Thus, when the cheap metal came into use, many of these pages had lines or paragraphs in the new metal added here and there. Then it was discovered that these new slugs became full of pit-holes when they were molded and literal hell broke loose. As sometimes happens, the plant superintendent was quite sure that his Linotypes were at fault. After the usual preliminary bouts with salesman and servicemen he demanded the immediate attention and action of the agency manager—likewise a Brooklyn executive, who happened to be in the city, was called into the fracas. Finally, careful analysis of the whole situation disclosed that the "cheap" metal was sub-standard and dirty. The customer's good will was ultimately restored but the episode cost a lot of frayed nerves. It's good insurance to emphasize good metal!

Hard Metal

THE TERM *Hard Metal,* in Linotype language, means a special alloy which was originated some years ago to provide extra hard, durable slugs in telephone directory composition. On larger phone books, directory publication procedures call for the frequent reprinting of a few books, from standing pages as corrected daily with new numbers, etc. Such handling of slugs cast in standard Linotype metal had produced rapid wear, necessitating resetting too often. Special hard metal has solved the problem but brought many problems to Linotype.

The formula for hard metal, as originated by Imperial Type Metal Co. (and later copied by others), was 14% tin, 24% antimony, .05% cadmium, .05% copper, and 61% lead. The operating temperature for such metal is 635° to 650° F., requiring adaptations of metal pot and other machine parts, including twin molds so that the excessive heat may be dissipated in part by alternate casting.

Through more than a decade of experience with the problems developed by hard metal (and all of them involving customer relationships with a number of larger plants), Linotype files contain a considerable accumulation of data. Any salesman who encounters the prospective use of hard metal as a new development in any customer's plant should immediately ask his agency for guidance, and with that request report the printing requirements to be met. The telephone companies have been cooperative with us from the start, though their insistence on this use of hard metal has been only a phase (and *not* of profit to us) in our service to Linotype users.