

Typecasting Matrix Metallurgy

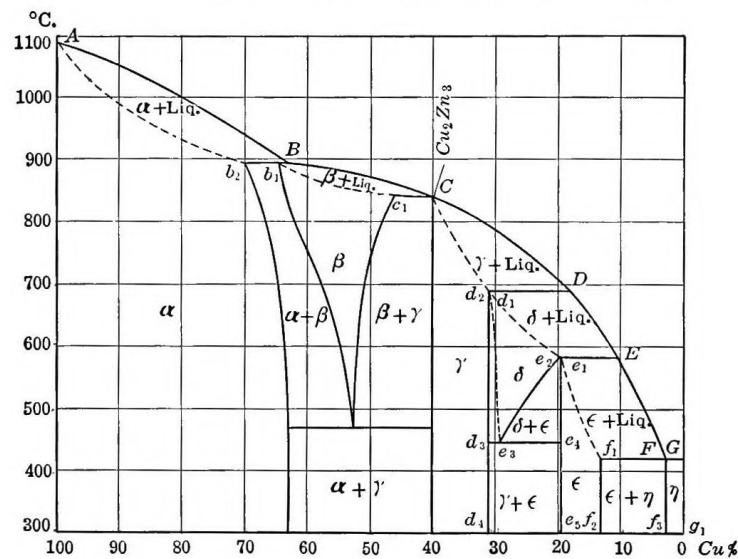
A Survey of the Evidence

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CircuitousRoot

2026

Acknowledgments

In addition to the contributors noted on the title page, thanks are due to the late Theo Rehak (Dale Guild Type Foundry) for preserving several of the documents which appear here.

Title Page Image

The image on the title page is Figure 21 from Hofman's *Metallurgy of Copper* {Hofman 1914}: 28. It is the phase-diagram for copper-zinc alloys (that is, for various kinds of brass). Please note that its information is well over a century old. For practical work, you should consult a modern source for our current understanding of the phases of Cu-Zn alloys. This illustration is from the Cornell University digitization of this work and is in the public domain.

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1• Introduction

The composition of the metal alloys used historically in making typecasting matrices is of course a topic of considerable interest to modern matrix makers. (It seems to be less interesting to historians of type, which is curious considering the great interest they have in the historical metallurgy of typemetal.) For all that this is the case, we have very little reliable data. This small booklet attempts to present every piece of actual evidence that we now know.

The evidence available to us comes in three general categories, treated here in declining order of reliability:

- Actual metallurgical analysis of samples
- Surviving engineering and production documents
- Marketing claims (all of which are highly suspect)

The modern matrix maker should bear several things in mind when interpreting this information.

Firstly, and perhaps most importantly, historical matrix makers worked within the limitations of their eras. They used what were the best materials available to them (or at least what they *thought* were the best materials, which isn't quite the same thing). This does not mean that they used the best materials now possible. For example, Lanston Monotype Machine Company punched aluminum matrices were made from an alloy known then as "duralumin." They used it because it was the first high-strength aluminum alloy (and even then a somewhat legendary material, due to its use in aviation). This alloy (or, more accurately, this class of alloys), while still represented in the modern alloy designations, is now but one of many aluminum alloys with properties which might be desirable to the matrix maker. We do not yet know whether any of the more modern alloys might be better. This would be worth investigating, not only to make better matrices but also because these older alloys are now often more difficult to acquire in small quantities.

Secondly, the properties of metals and their alloys often depend highly upon their processing. Work hardening and heat treating are the most important processes here. So for example a matrix which has been punched will have its casting cavity work-hardened considerably by the punching operation, while a matrix engraved from the same alloy will not. The two might behave and stand up in casting entirely differently. Heat treating is especially important with aluminum alloys; it can change their characteristics considerably. In particular, the "duralumin" alloys and their successors do not deliver their advantages unless they are heat treated.

Thirdly, historical matrix makers worked within the understanding of the commercial metallurgy of their time. Assaying was more expensive then, and it isn't clear to me that the alloys specified in older engineering drawings meticulously included all of the very minor components that show up in something like a modern XRF assay. Also, the alloy designations we work with today were developed primarily in the World War II and post-war era. There is little *a priori* reason to expect that modern alloy designations will match earlier practices exactly. It is the nature of specifications and standards to expand over time. So for example many modern definitions of traditional copper alloys now include a maximum for trace amounts of iron. Earlier manufacturers and earlier specifications didn't bother with this. The absence of a trace amount of iron in an earlier source does not in itself mean that it does not match a modern alloy specification.

Publication Note

All of this material will be incorporated into the second edition of *A New Matrix Atlas*, which is in process. It just seemed like a reasonable (and reasonably small) sub-project to collect it here first.

I would welcome corrections to the present document. It exists in a difficult writing environment where on the one hand there is too little evidence yet on the other hand there are so many numbers and special terms that confusion can become my default state.

I would also, especially, welcome any new information. If you have a relevant surviving document from any matrix manufacturer, or if you have done metallurgical analyses of matrices, please share this information. Every data point is good to have. I would be happy to incorporate such material into future revisions.

2• Nomenclature

2.1• “Chalfant”/Flat/Display Matrices

Most practical typesetters in North America would recognize the date “Nov. 24, 1908” immediately. It was stamped on the back of every Lanston Monotype display matrix for the Type-&-Rule caster. Fewer will be familiar with the name of William E. Chalfant, yet he is no less important. It was his patent, issued on November 24, 1908 and assigned to the Lanston Monotype Machine Company (LMMC), which defined the standard for this matrix — with its distinctive beveled corner cuts {US 904,510 Chalfant 1908}.

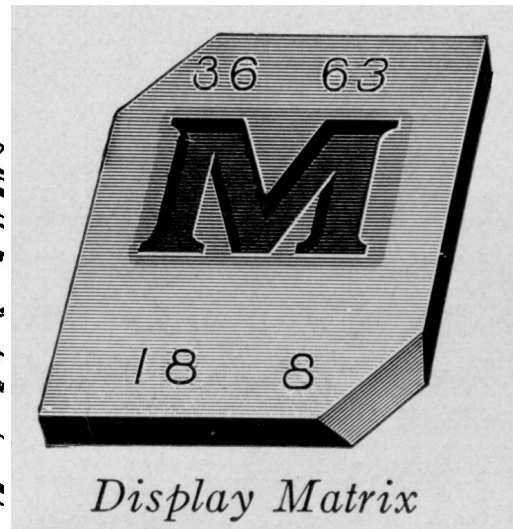
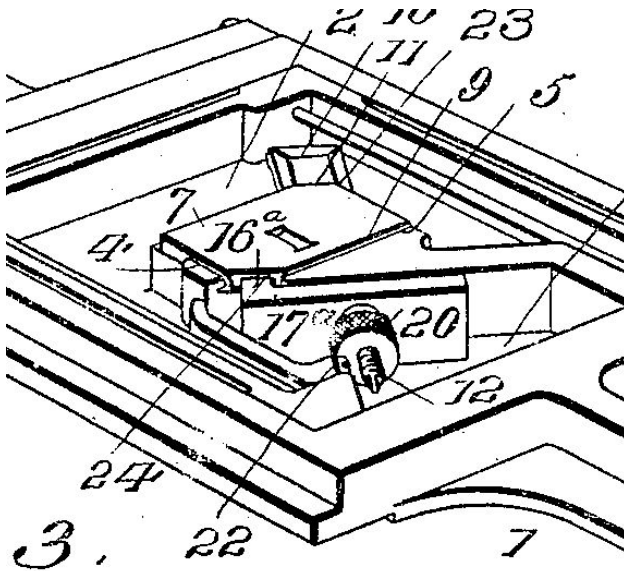


Figure 2.1: Chalfant / 904,510 (Nov. 24, 1908)¹

Figure 2.2: Lanston “Display Matrix”

This matter comes up because the Lanston Monotype Machine Company never settled on a proper name for this kind of matrix.² Most practical typefounders will call it a “flat mat,” or an “electro mat” (when electroformed), or an “aluminum flat mat” (when punched aluminum), or a “Lanston display mat,” or some other name based on the attributes of the matrix. But the LMMC made other kinds of mats which were flat, display, and/or aluminum. And while they never made any other style of electro mats, they did make brass mats in this style which were driven (punched), not electroformed. Other makers also made completely different kinds

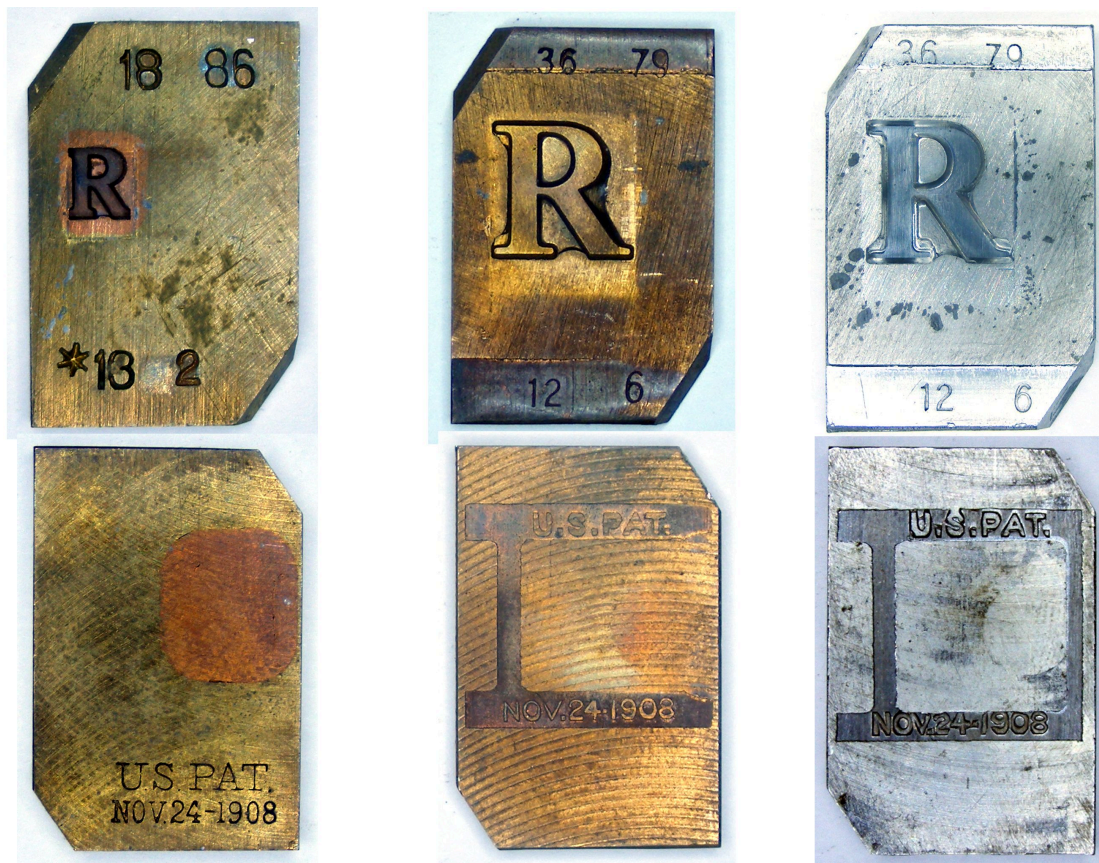
¹(Left) Cropped from Fig. 1 of Chalfant’s patent, {US 904,510 Chalfant 1908}. USPTO digitization. Public domain. (Right) From a 1930s era Lanston Monotype Machine Company specimen book, {LMMC 1930s MTF1}. This is from the section entitled “Monotype Matrix Information for the Use and Convenience of Monotype Owners and Operators.” Scanned by me from my copy. Public domain.

²In general, Lanston is a technical writer’s nightmare. They had the finest system of part symboling the world has ever seen, yet in their marketing literature they could never agree on what anything was called. There are situations where they use nearly half a dozen different names for the same machine within a single document.

of flat, electro, display, etc. mats. Attributes are a poor way to identify something and none of these names are even close to being unambiguous

These matrices are defined by their size and geometry, especially the distinctive beveled corner cuts on diagonally opposite corners. These, which allow the matrix to be held in a machine never designed for them, are the essence of Chalfant's patent.

I am going to take the foolhardy risk of introducing new terminology here (as if we didn't already have enough names!) and will call all matrices of this form "Chalfant" style mats, regardless of their material, production method, or intended use. This has the advantage of being unambiguous. Also, given the importance of these matrices to North American typesetting, it seems appropriate that William Chalfant should finally receive some recognition.



Brass, Electroformed

Brass, Punched

Aluminum, Punched

Figure 2.3: Three Kinds of Chalfant Matrices, Showing the Patent Date³

³Photographs by DMM.

2.2• Modern Copper and Aluminum Alloy Designations

The “CDA” is the Copper Development Association. This is the North American copper industry’s trade association. It has established comprehensive standard alloy designations. Generally, when you see a three-digit number for a copper alloy (e.g., 360) that will be a CDA number. CDA alloy numbers are actually five digits, but the final two digits are usually “00” and often omitted. ‘C’ for “copper” is used as a prefix. So C360 is the same as C36000. Sometimes, but not always, one or more common industry marketing names may be associated with an alloy. So for example CDA 360 is “free-machining brass.”

In North America, aluminum alloys are designated by four-digit codes (usually) arranged in various series by their major properties. So for example the old “duralumin” is a part of the 2000 series of aluminum-copper alloys. Alloys may have various suffixes appended to them, primarily to represent their state of processing. So for example the common 6061 alloy is usually supplied for general machining purposes in the 6061-T6 or -T651 state (indicating things such as its heat treating). These designations are overseen by The Aluminum Association. For an extensive article on these designations, see:

https://en.wikipedia.org/wiki/Aluminium_alloy

2.3• “Commercial Bronze”

Common or commercial names are often interesting and historically informative, but rarely useful. At times, they are deliberately misleading. So for example “commercial bronze” is not a bronze at all, but rather a brass. This term didn’t arise because the foundry masters didn’t know what they were making, it was used because they knew what would sell. Bronze is high-status, brass is low-status.

In the 6th edition (1968, revised 1975) of their *Standards Handbook* for wrought copper alloys, {CDA 1975}, the CDA gives the following definitions:

Commercial Bronze, 90% (Copper Alloy No. **220**) — An alloy containing nominally 90% copper and 10% zinc, generally available in flat products, wire, rod and tube. The alloy is not technically a bronze, but because of long usage the term “Commercial Bronze” has been used. (p. 6)

Leaded Commercial Bronze, 90% (Copper Alloy No. **314**) — An alloy containing nominally 89% copper, 1.75% lead and 9.25% zinc generally available in rod, shapes and bar, and used extensively for hardware. The alloy is not technically a bronze, but because of long usage the term “Leaded Commercial Bronze” has been used. Hardware Bronze is a term formerly used to designate any one of a broad range of similar alloys; this term is not recommended. (p. 7)

2.4• “Leaded Bronze”

TO DO: Count the number of modern CDA alloys which could be “leaded bronze.” Within this, count the number of which are really brass.

Preliminary results (not re-checked):

There is no CDA alloy which is called just “bronze” or “leaded bronze.”

At least nine CDA alloys classified as “bronze” are called “brass.”

At least four CDA alloys classified as “brass” are called “bronze,” including C22000, C31400, and C31600.

There are also “tin brasses,” which contain little or no zinc (e.g., C50800, C53200). The CDA classifies these and at least five other alloys called brass as “bronze.”

It might be possible to bring some clarity to this, but it might also be that the least confusing thing to do is to abandon the term “bronze” entirely. It is best left to archaeologists of the Bronze Age, who only have to deal with tin bronze vs. arsenical bronze.

3• Metallurgical Analyses

The modern metallurgical analysis of actual matrices (or matrix blanks) is the best possible evidence, but even it must be taken with caution.

Limitations of Scope

Firstly, each analysis is true for only the single matrix analyzed. Alloys may have changed over time for several reasons. There may have been engineering changes in the matrix makers' specifications. There may have been changes in the alloys available. The actual alloys supplied may have varied from one supplier to another, or even between production batches of a single supplier.

Limitations of Method

Secondly, the methods of analysis used are now extremely accurate but also very limited.

The most commonly used method, XRF (X-Ray Fluorescence), works by exposing the material to an X-ray beam, which excites the atoms of the sample, and measuring their emitted radiation. It is limited to analyzing only a thin layer at the surface. As such it may be inaccurate for the matrix as a whole if the matrix is not uniform. XRF also has limitations in detecting lighter elements. This can be a major issue when analyzing aluminum alloys. Not only is aluminum itself a light element, but one of its important alloying elements, magnesium, is also light. (In the results here, the XRF analysis did not detect magnesium where it was almost certainly present.) This can also be a limitation in analyzing steel (which is highly dependent upon small amounts of the light element carbon).

Another method which has been used in one case for typemetal analysis (but not yet, to the best of my knowledge, for matrix analysis) is PIXE (Particle-induced X-ray emission). This focuses a more powerful, but narrower, beam of radiation on the sample. It can provide a deeper level of penetration, but it is limited in the area it covers. It is very accurate within this small area, but its results are representative of the entire sample only if the sample is homogenous.¹

A third method is the use of a mass spectrometer. This would seem to me to be the most accurate of the modern methods, but I am not aware of any use of it to analyze typographical materials of any kind.

The old-fashioned methods of analysis using laboratory chemistry could potentially produce results more representative of the sample as a whole, but I'm not sure that these methods are even used today.

This last point also implies that the methods used for analyzing the alloys as they were

¹This is a significant problem in using it for typemetal analysis, because most typemetal alloys other than the ternary eutectic alloy (which, not coincidentally, is also Linotype alloy) are extremely nonuniform mixtures at a micro-scale.

produced often many decades ago differed greatly from the methods that we would tend to use today.

Finally, of course, in some cases the method of analysis is unknown. This can be the case when the analysis was done by a commercial laboratory.

Limitations of State

Thirdly, alloy analysis tells you nothing about the state of processing of the metal (e.g., work hardening, heat treatment). For some alloys, these processing steps are at least as important as the specification of the alloy itself.

The presentation here will be alphabetical by manufacturer's name

3.1• Sources for these Analyses

MT-DMM

In 2013, the engineer and typecaster Mark Turpin ran samples of various typecasting-related items through the commercial-grade XRF machine at his place of employment (on his own time, with permission of his management). I supplied the sample items. Results cited here which are marked “MT-DMM” are from this study.

TA-ER

These are analyses of new old stock Monotype Corporation (UK) composition matrix blanks done by Ed Rayher (Swamp Press). The blanks themselves were preserved by the former Type Archive and acquired by Patrick Goossens (Project Letter-kunde) during its closure. Patrick kindly gave us samples of these.

3.2• ATF Barth Matrices

American Type Founders Company, Barth Automatic Typecasting Machine engraved matrix, 8 point Bernhard Gothic. [MT-DMM].

	Element	%
Bulk material:	Cu	60.61
	Zn	37.15
	Pb	2.13
	Ni	0.05

	Element	%
Front Surface	Cu	44.86
	Zn	28.96
	Pb	23.48
	Ni	2.7

Turpin observed that the front is definitely plated, but that the plating is so thin that the XRF machine just “sees” the brass base material through it and reports only a small percentage for the nickel of the plating. The value for lead on the front surface also appears disproportionately high (it is much higher than what would be found in a leaded brass). I would attribute this to typemetal contamination on the surface of the matrix.

The front surface values therefore do not represent a true material but rather are a composite of an essentially pure nickel layer plus lead contamination from typemetal on top of the bulk material (which is a leaded brass).

Note: This is an orphan matrix, acquired by me in 2011 from the pipe organ builder Stanton Peters, who in turn got it from his business partner the late Henry Weiland (an organ builder and noted collector of type machinery). I do not have the entire matrix font.

Note on Electroformed Barth Matrices

Contrary to popular understanding, ATF produced Barth matrices electroformed from original matrices through a relatively late date.² I own the matrix font for 60 point Series 476 Goudy Handtooled Italic and can confirm that it was electroformed. I have not yet had this metallurgically analyzed, but the electrodeposited eye would be 100% copper while the rest is clearly a brass.

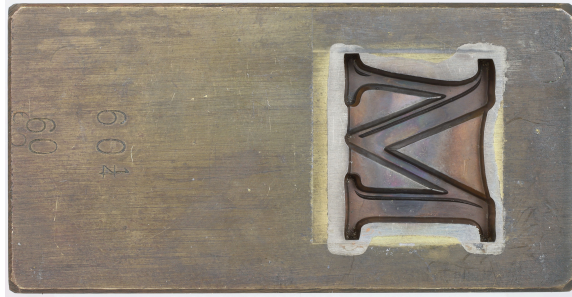


Figure 3.1: ATF 476 Goudy Handtooled Italic, 60pt Matrix, 'M'³

²They may have produced these to the very end in special cases. Theo Rehak told me that the matrices for casting curved face types for wire marking were never machine cut.

³Photograph by DMM.

3.3• Linotype-Compatible Matrices

3.3.1• Intertype (US) Matrices

Intertype 8pt 2348, Century Schoolbook with Italic and Small Caps [MT-DMM].

Element	%
Cu	61.20
Zn	37.80
Pb	0.88

Intertype 9pt 2754, Century Schoolbook with Italic and Small Caps [MT-DMM].

Element	%
Cu	61.64
Zn	37.22
Pb	1.03

3.3.2• Mergenthaler Linotype Matrices

(Note: The Mergenthaler Linotype Company was the US company. The UK company became Linotype & Machinery Ltd.)

Mergenthaler Linotype Co. 5 Δ 2, 5 point No. 10 with Gothic No. 4 [MT-DMM].

Element	%
Cu	63.67
Zn	35.46
Pb	0.81

Mergenthaler Linotype Co. 8 Δ 26, 8 point Century Expanded with Italic and Small Caps [MT-DMM].

Element	%
Cu	63.37
Zn	35.71
Pb	0.76
Fe	0.10

3.3.3• Simoncini Matrices

Simoncini 12 ∞ KN, Simplicitas (sort: 'h') [MT-DMM].

Element	%
Cu	64.66
Zn	35.22
Ni	0.04

3.3.4• Star Parts Matrices

Star Parts 9 ★ A319, Star News with Gothic [MT-DMM].

Element	%
Cu	60.08
Zn	34.47
Pb	1.32

3.4• Linotype-Compatible Spacing

Unmarked brass hairspace, 0.020" thick [MT-DMM].

Element	%
Cu	68.39
Zn	31.54

Unmarked copper hairspace, 0.010" thick [MT-DMM].

Element	%
Cu	100.00

Unmarked steel hairspace, 0.004" thick [MT-DMM].

Element	%
Fe	99.63
Mn	0.27
Cr	0.10
C	[unknown]

3.5• Linotype-Compatible Border Slides

Mergenthaler Linotype Co. Border Slide No. 2071, 6pt. Dash [MT-DMM].

Element	%
Cu	64.25
Zn	35.40
Pb	0.30

3.6• Ludlow Typograph Matrices

(European readers should be aware that this is the “Ludlow” machine, which was officially called the “Ludlow Typograph.” The composing caster called a “Typograph” as manufactured in Europe was the Rogers Typograph, an entirely different machine.)

Ludlow Typograph Co. Series 28-M (lines 1-5-11), 6 point Tempo Medium [MT-DMM].

Element	%
Cu	56.94
Zn	40.71
Pb	2.28

3.7• Ludlow Typograph Spacing

Unmarked (probably Ludlow Typograph Co.) 6 point Ludlow space. [MT-DMM].

Element	%
Cu	61.64
Zn	36.71
Pb	1.47
Fe	0.06

Unmarked (probably Ludlow Typograph Co.) Ludlow hairspace (thickness not measured) [MT-DMM].

Element	%
Cu	60.15
Zn	38.52
Pb	1.26

3.8• Monotype (UK) Composition Matrix Blanks

Monotype Corporation Ltd., “bright” brass blanks for composition matrices [TA-ER].

Element	%	Error
Cu	88.54	± 0.373
Zn	7.03	± 0.098
Sn	3.76	± 0.113
Pb	0.670	± 0.060

Monotype Corporation Ltd., “dark” brass blanks for composition matrices [TA-ER].

Element	%	Error
Cu	90.73	± 0.341
Zn	8.84	± 0.098
Pb	0.432	± 0.046

Note: The “light” and the “dark” matrix blanks came from two separate bins of blanks, but to the best of my knowledge they were not otherwise distinguished from each other. The light blanks had suffered less surface tarnishing than the dark ones over the several decades since they were manufactured.

3.9• Monotype (UK) Display (Super Caster) Matrices

Monotype Corporation display (Super Caster) matrix, Series 692 Univers Bold Expanded. [MT-DMM].

Element	%
Cu	73.49
Zn	11.98
Cr	13.84

Caution: Do not quote this composition as the composition of a Super Caster matrix. This is probably chrome-plated brass (Cu-Zn, with a thin layer of pure Cr on the surface) rather than some strange Cu-Zn-Cr alloy. The metallurgical analysis here confirms that the underlying matrix material is a brass (Cu-Zn alloy), and as such is useful, but it does not tell us the composition of that brass.

3.10• Monotype (US) Cellular Matrices

Lanston Monotype Machine Company “cellular” composition matrix, markings not recorded. [MT-DMM].

Element	%
Cu	82.86
Zn	10.86
Pb	5.58

This does not correspond closely to any alloy listed by the Copper Development Association. It is, though, definitely a brass (not a bronze).

3.11• Monotype (US) Chalfant Electro Matrices

Lanston Monotype Machine Company “Chalfant” style electro display matrix, Series 86 Cheltenham Bold, 18 point. [MT-DMM].

Brass portion:	Element	%
	Cu	62.17
	Zn	35.38
	Pb	2.35
	Ni	0.04

Electroformed “eye”:	Element	%
	Cu	100.00

3.12• Monotype (US) Chalfant Aluminum Matrices

Lanston Monotype Machine Company “Chalfant” style punched aluminum display matrix, Series 86 Cheltenham Bold, 18 point. [MT-DMM].

Element	%
L.E.	94.85
Cu	4.16
Fe	0.54
Mn	0.50
Pb	0.05

Note: The XRF machine reported the 94.85% constituent as just a “light element.” Most of this is certainly aluminum, of course, but it could also include the magnesium one would expect to be present in the alloys that Monotype was using. The alloys specified by Monotype over the years for aluminum matrices have had between 0.35 and 0.60 percent magnesium.

4• Engineering Documents

4.1• Sources for these Documents

That we have any surviving engineering documentation at all is a not-so-minor miracle. Thanks are due to the late Theo Rehak (Dale Guild Type Foundry) and to Patrick Goossens (Project Letter-kunde) for their heroic efforts in preserving what little remains.

LMMC-ATF-LK:

Documents marked “LMMC-ATF-LK” were created by the Lanston Monotype Machine Company (LMMC), either as an independent firm or as later owned first by the U. S. Banknote Corporation and then by American Type Founders (ATF, which itself was owned at this time by White Consolidated Industries). During the brief period in which ATF owned the Lanston company, these documents were sold, along with pantograph engraving and other equipment, to a scrap dealer in New Jersey. They were acquired from that dealer by Project Letter-kunde in the 2010s and are preserved there.

LMMC-DG-LK:

Documents marked “LMMC-DG-LK” were created by the Lanston Monotype Machine Company or its two successor incarnations (see above). In some fashion which he never told us about, they were acquired by Theo Rehak for the Dale Guild Type Foundry. They were acquired by Project Letter-kunde when it purchased the materials of the former Dale Guild Type Foundry and are preserved there.

4.2.2• Alloy 316 “Leaded Commercial Bronze” (1971)

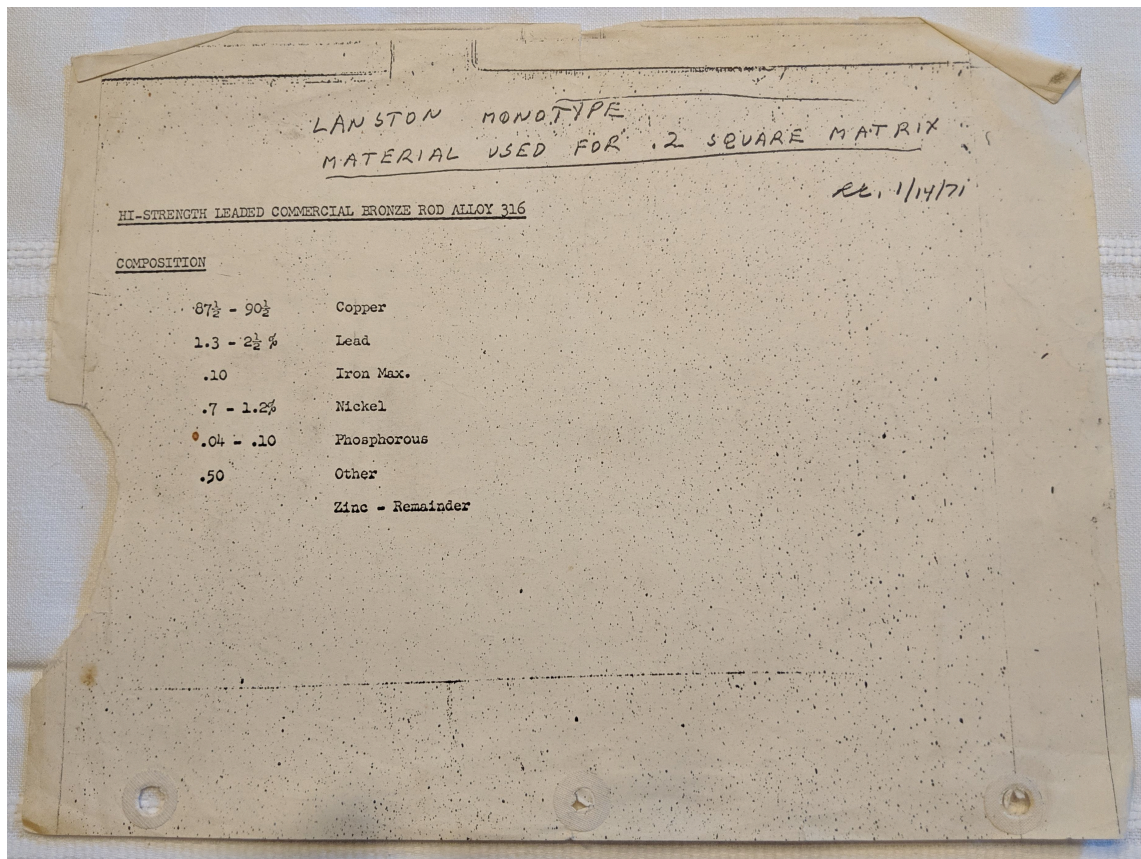


Figure 4.2: LMMC Material for .2 Square Matrix (1971)²

This document is the only unambiguous specification for the alloy of a Monotype (US) cellular matrix that we have. This is “leaded commercial bronze,” alloy 316 (which is Copper Development Association C31600 today). While this is called “bronze,” and while that name has been retained through long tradition, it is a brass. No one writing formally within the copper industry seems quite willing to admit it, but “commercial bronze” has been a deliberately deceptive trade name from the beginning.

It should be noted, however, that this is a very late document. The formerly distinguished Lanston Monotype Machine Company of Philadelphia was a shadow of itself by this date (and no longer in Philadelphia). It had been acquired first by the U. S. Banknote Corporation and then, in early 1970, sold to American Type Founders. This document dates from the period of ATF ownership.³ See {Hopkins 2012}, pp. 148–152. It is therefore reasonable to ask whether or not this late specification represents LMMC practices in its prime.

²LMMC-DG-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

³In 1975, ATF sold the former Monotype matrix business to Hartzell Machine Works.

4.3• Monotype (US) Cellular Spacing Matrices

4.3.1• “Tool Steel” Spacing and Low Quad Matrices

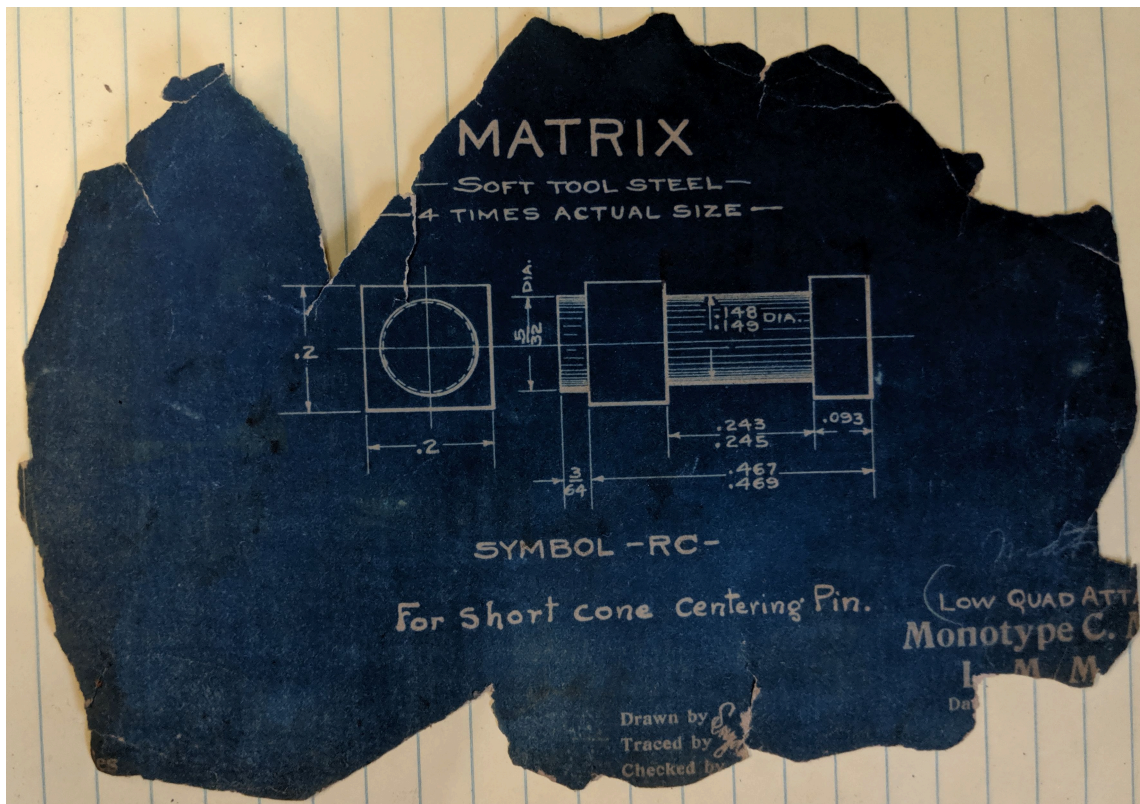


Figure 4.3: LMMC Drawing, Low Quad Attachment Matrix⁴

This fragment of a drawing, and the one on the next page, specify “soft tool steel” and “tool steel.” The specification of “tool steel” isn’t particularly helpful, as there are many kinds of tool steels.

The specification of “soft” on the drawing above is useful, though. This indicates not that the alloy itself was somehow a softer steel but that the hardenable tool steel was used in an un-hardened (soft) condition.

⁴LMMC-DG-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.



Figure 4.4: LMMC Drawing, Low Quad Matrices for Special 18pt. Composition⁵

⁵LMMC-DG-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

4.3.2• Drawing 18340, “Leaded Bronze”

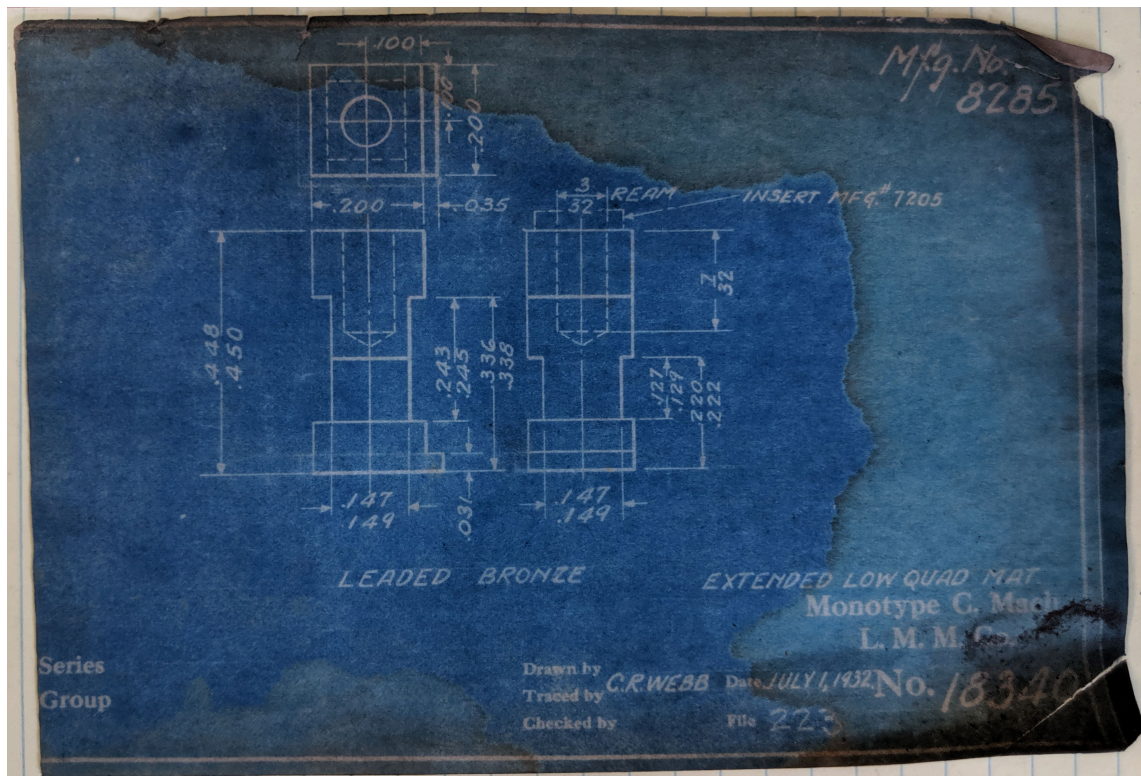


Figure 4.5: LMMC Drawing 18340 (1932) Extended Low Quad Mat⁶

See section 4.2.1, “Drawing 16880, “Leaded Bronze,”” on page 18, earlier, for a discussion of why the specification of “leaded bronze” is at best not useful and at worst probably deceptive.

⁶LMMC-ATF-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

4.4• Monotype (US) Electro Display Matrices



Figure 4.6: LMMC Manufacturing Number 8192⁷

The Lanston Monotype Machine Company production system designated items which were produced by them as stock or for input into other processes by “manufacturing numbers.” So for instance the input material for brass electro matrices wasn’t raw brass stock from a supplier but, instead, Lanston Monotype “Mfg. No.” 8192 or 8193 (these were two different sizes; there were special electro mats for larger sizes). These Manufacturing Number items, in turn, had one or more operations (and therefore operations sheets) associated with them for their processing.

One sheet each for both of the Manufacturing Numbers for electro display matrix blanks, 8192 and 8193, survive. (There was probably only one operation for each: “Cut off to length”.) Unfortunately, the sheet for 8193, reproduced above, is in extremely poor condition. It is possible, however, to make out the material: Half Hard Brass.

⁷LMMC-ATF-LK. Photograph by DMM from the Project Letterkunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

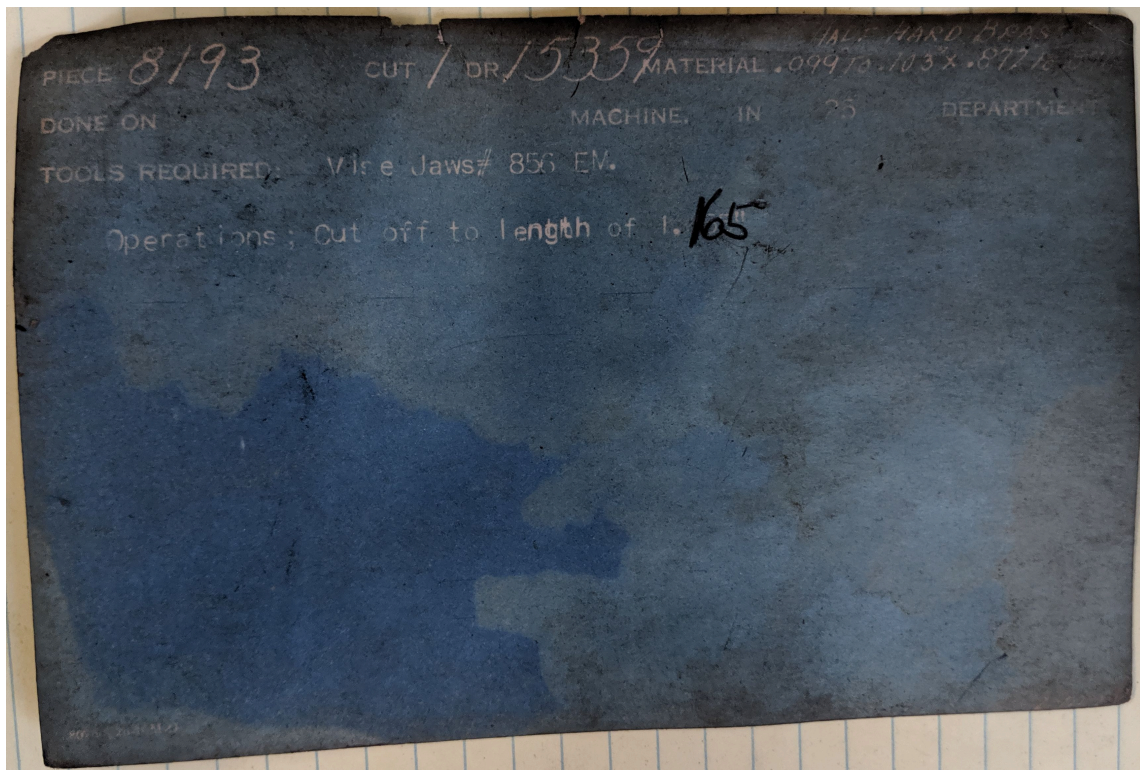


Figure 4.7: LMMC Manufacturing Number 8193⁸

A single sheet for manufacturing number 8193 survives, in better condition. (Again, there was probably only one such sheet, as the only operation was to cut the stock to length.) The sheet itself is undated, but the shop floor blueprint is stamped “FEB 16 ’28” on its back. It specifies “Half Hard Brass” as the alloy.

The term “half hard brass” is not really sufficient for either engineering or procurement. It could mean any number of very different alloys. As such, it is of very limited use in re-engineering Lanston matrices. It is, however, probably sufficient for shop floor use in cutting stock to length.

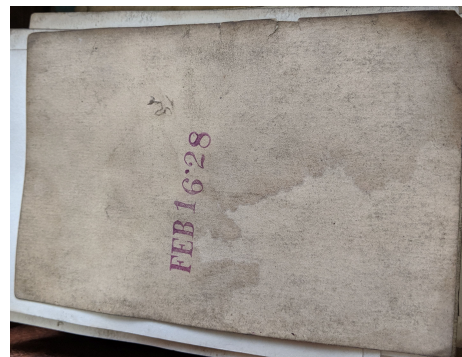


Figure 4.8: LMMC 8193, Verso

⁸LMMC-ATF-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

4.5• Monotype (US) Punched Aluminum Matrices

I will combine all Lanston Monotype Machine Company (LMMC) aluminum matrix documentary evidence (that is, both Giant Caster matrices and Chalfant matrices) into a single section here. This is not without its risk.

On the basis of evidence presently known, it seems that the selection of the alloy was common between the two, and there is evidence that in late production, at least, both were using the same alloy. This makes sense, as all LMMC aluminum matrices were punched, not engraved. No consideration needed to be made for materials suitable for one process vs. the other.

On the other hand, it is clear that there were differences in processing between the two kinds of matrices. This is true in the physical punching process; one need only compare the back of a thin Chalfant aluminum matrix to the thicker Giant Caster matrices to see this. The pattern on the back of the Chalfant-style punched matrix is a result of (or was designed for) the punching process (and is identical to the pattern on the back of punched brass Chalfant-style matrices). Whether, or how, these differences extended to things such as heat treating is not yet known.

4.5.1• Duralumin Background

The history of the successive aluminum alloys used by the LMMC is rooted in the history of the family of aluminum alloys once known as “duralumin.”

The origins of duralumin and related high-strength aluminum alloys are very complicated and not always well documented. Understanding this subject requires a background not just in metallurgy but in patent law, antitrust law, and the emergence of both military and industrial research laboratories. Simplifying this to the context of matrix production, the important technical points to take away are, firstly, that “duralumin” is not a single alloy but rather a trade name which soon became loosely applied to a great range of alloys, and, secondly, that the effectiveness of all of these alloys depends as much on their heat treatment after cold working as it does on the alloy itself. A specification of “duralumin” tells you almost nothing and using it without heat treatment after punching gains you nothing.

The production of aluminum in volume began in the late 1880s; it had been difficult to isolate and quite expensive before then. By the first years of the 20th century there were efforts, especially in Germany, to develop high-strength alloys. In 1903 Alfred Wilm, in Germany, began work on aluminum alloys containing magnesium⁹ which responded well to heat treatment. This

⁹It is interesting to look back at Wilm’s original explanation, because it concentrates on magnesium as the critical alloying element. In his 1911 article, he proposes an analogy. Just as in iron small additions of a light element, carbon, have a disproportionate effect upon the strength of the material (turning iron into steel), so also small additions of the light metal magnesium turn aluminum into a high-strength alloy. I do not know how well his analogy stands up to modern metallurgical thought.

was a breakthrough. A few years later he was granted a patent for this,¹⁰ by which time production had started under the trade name “duralumin”¹¹ at the Dürener Metallwerken AG.¹² By 1911 production had spread to England, Austria, and Hungary.¹³

These were the first high-strength aluminum alloys. They achieved considerable success, especially in aviation, and perhaps some notoriety because the Zeppelins which bombed London in the First World War were constructed of duralumin.

The production of something like duralumin in the United States began soon after the end of the war.¹⁴ The Aluminum Company of America (Alcoa) has always been the major player and a strong proponent of the originality of its own work. It had introduced its first duralumin-like alloy, 17S, by the early 1920s. What is important for the history of Monotype matrix making is that for about a decade during this period Alcoa had a competitor in the form of a division of the Baush Machine Tool Company.¹⁵ Baush used the name “duralumin” explicitly in their advertising material while Alcoa did not.¹⁶

Certainly some sales literature from Baush must survive, but other than advertisements in trade journals I have not yet discovered it. From third party sources, though, we can derive some information about their duralumin alloys. The 1930 edition of the *National Metals Handbook* says that “The two standard grades of Baush duralumin are distinguished by the letters A and B”¹⁷ The US [National] Bureau of Standards *Standards and Specifications for Metals and Metal Products* of 1933 confirms this and further notes that the condition of the metal as

¹⁰German patent 244,554 {DE 244,554 Wilm 1912}.

¹¹Sources are inconsistent about what constitutes a “duralumin.” By 1929 a NACA (predecessor to NASA) report gave this qualification: “The name “duralumin” is used here as referring to the class of heat treatable aluminum alloys in which the essential alloying elements are copper, magnesium, silicon and maganese, and not to the product of any particular manufacturer” {Rawdon 1929}, p 3. But not all of these elements have been included in all “duralumin” alloys, and indeed Wilm himself once reported on an alloy of aluminum with zinc (9.4%), copper (0.32%) and magnesium (0.39%) {Wilm 1913}, p. 101.

¹²Most sources claim that the name is derived from Dürener (or Düren, the town in which this plant was located) and “aluminium.” Hardouin Duparc questions this, however {Hardouin Duparc 2004}, §4. The association of “dur” with durability in English was probably just a happy accident for anglophone marketing departments.

¹³This information on the early history of the alloy was presented by Wilm in his first article on the subject. See {Wilm 1911}.

¹⁴I haven’t fully untangled this; details such as the date of introduction of particular alloys have been hard to pin down.

¹⁵The dates for the Metals Division of Baush were established in the “findings” portion of the major antitrust case brought by the United States against Alcoa in the late 1930s. (“United States v. Alcoa, 148 F.2d 416 (2d Cir. 1945)” <https://law.justia.com/cases/federal/appellate-courts/F2/148/416/1503668/>.) The finding was that “Baush Machine Tool Company, through its Metals Division, engaged in the manufacture and sale of duralumin and products manufactured therefrom during the period 1919–1931, although it made no substantial effort to obtain business after 1927.” See {US 1944}, p. 1703.

¹⁶See for example an advertisement by Baush in *Machinery* in 1921: {Baush 1921}.

¹⁷{ASST 1930}, p. 629.

supplied is specified by an additional letter: D for annealed, T for “quenched and aged at room temperature,” and H for the T material hard rolled.¹⁸ So for example the “Duralumin BD” specified by Lanston Monotype is simply Bausch duralumin alloy B, supplied in the annealed state.

¹⁸{ASST 1930}, p. 103.

4.5.2• LMMC Drawing 14703 and Alloy Specification

At this point, one of the most important surviving LMMC documents related to aluminum matrices become more intelligible.



Figure 4.9: LMMC Drawing 14703 (1926), [Aluminum] Matrix Material¹⁹

This is a manufacturing drawing, reproduced by the blueprint process for the shop floor. It would have been used as the basis for accepting or rejecting a shipment of material from a supplier. (It is different from the “Manufacturing Number” drawings which specify the Lanston processing of the material into the input for other Lanston manufacturing activities.)

The Lanston Monotype Machine Company introduced the Giant Caster in 1925 ({Hopkins 2012}: 79). The date of this drawing itself 1926-03-16, a year later. That it refers to material for Giant Caster matrices is clear from a note on the LMMC drawing 14459, “Sorts Matrices, Series Giant Caster,” which calls out this drawing 14703 explicitly (see section 4.5.3, below). However, the date that this blueprint for shop floor use was made is stamped on the

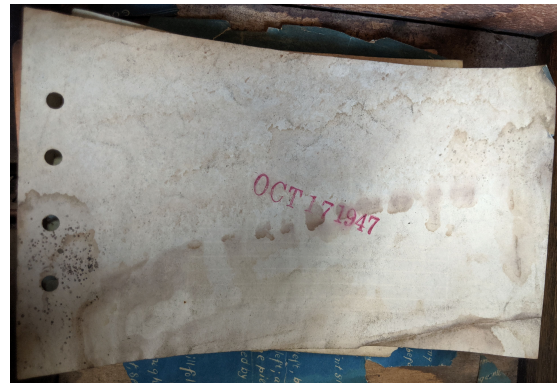


Figure 4.10: LMMC 14703, Verso

¹⁹LMMC-ATF-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

back: 1947-10-17 (indicating that its specifications were in use until at least that date).

This drawing specifies two matrix materials. They may have been used simultaneously, at least until Baush exited the materials business in 1931. Given the extent of Alcoa's near-monopoly on aluminum in this country, users considered alternative sources important.

The first of these is "Duralumin B.D." While I have not yet located original documentation from the Baush Machine Tool Company's Metals Division, we know from a third party source that they were the manufacturers of alloy "BD".²⁰

Rawdon's 1929 NACA report²¹ cites the composition of Bausch Duralumin BT, which is their alloy B supplied in the quenched and aged state. BD is the same alloy supplied in the annealed state. His composition for BT, therefore, is the same as that of BD (or, more generally, Baush Duralumin alloy B, regardless of condition):

Element	%
Al	remainder
Cu	3.9
Fe	0.51
Si	0.31
Mn	0.58
Mg	0.60
Cr	<0.02

The other material listed is "aluminum alloy 14-SO". Additionally, there is a note, A, which reads "Was 17SO Eaton 10-10-47". Here is closer view of that note:



Figure 4.11: LMMC Drawing 14703 (1926), Note A

Alloys 17S and 14S (17SO and 14SO in the annealed condition) were Alcoa materials. So as far as the Alcoa²² alloy, this drawing is telling us that as of alteration (A) of 1947-10-10, the aluminum matrix material was Alcoa alloy 14S in the 'O' (annealed) condition, and that prior to that (from at least 1926-03-16) the alloy was Alcoa 17SO.²³ This makes historical sense, because 17S was Alcoa's first duralumin-class alloy.

²⁰A 1929 report to NACA (the predecessor of NASA) contains a table of test results for alloys BD and 17SO. The notes to this table state that material BD was furnished by the Baush Machine Tool Company and that material 17SO was furnished by the Aluminum Company of America {Rawdon 1929}, Table III (pp. 25–26). This identification of B/BD/BT with Bausch is also confirmed by the *National Metals Handbook* (1930) and NBS (1933) publications cited earlier.

²¹{Rawdon 1929}, p. 22.

²²The use of "Alcoa" here is slightly anachronistic. The Aluminum Company of America began using that trademark in July of 1926.

²³"Eaton" is just the name of the person who made the note.

[illegible]

© ECN#701
7-9-56
B was 1450 Pierno 9-15-46
A was 1750 Entry 10-10-47

Note (B) reads “Was 14S0 Pierno 9-15-48”. This means that Lanston used 14-SO for less than a year, from 1947-10-10 (as specified in alteration note (A)) to 1948-09-15.²⁶ It then changed to something else.

30

the current four-digit classification system for wrought aluminum alloys on 1954-10-01²⁷ Unless the usage of a four-digit system in industry preceded this (something which is still open to investigation), then from 1948-09-15 to no earlier than 1954-10-01 Lanston must have been using an alloy which was at least called something other than 14-SO, but which was not yet called 2014-O. At present this is an unsolved puzzle.²⁸

Note © reads “ECN [probably: Engineering Change Number] #701 7-9-56”. Attached as it is to the material specification, which is now “ALUMINUM - ALLOY 2014-O”. This indicates that on 1956-07-09 Lanston changed from whatever they were using between 1948-09-15 and 1956-07-09 to 2014-O.

Ignoring the 1948–1956 puzzle, it is likely that this 1956 respecification introduced no real change. The 1954 wrought alloy designation system did not introduce new alloys but instead renamed and reclassified existing ones. So 14S simply became 2014 (and the old 17S became 2017).

²⁷See {AA 1954}.

²⁸One possible interpretation of the evidence here is that on 1948-09-15 LMMC switched to something very different from 14SO and then on 1956-07-09 switched back to 14SO under its new name, 2014-O. This does not seem at all likely. Yet on the other hand it was during this period that they changed their heat treating procedures for Giant Caster matrices sufficiently to require a change in matrix marking.

4.5.3• LMMC Drawing 14459 and Heat Treatment

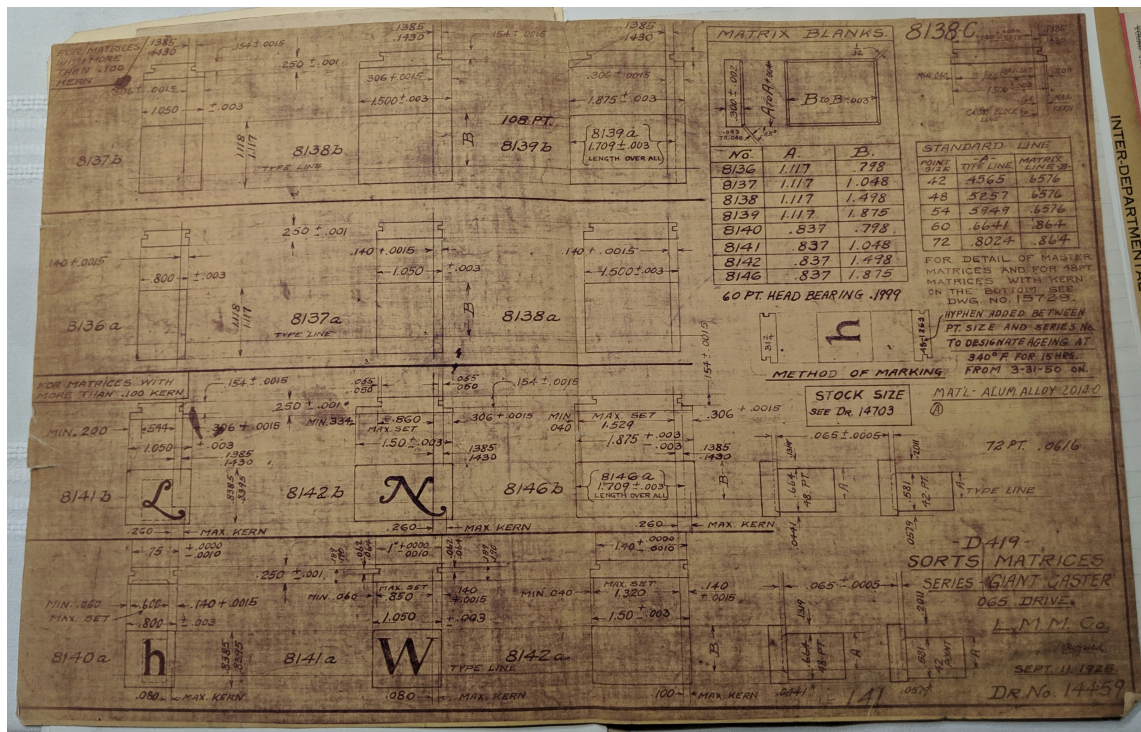


Figure 4.14: LMMC Drawing 14459 (1925), Giant Caster Sorts Matrices²⁹

This drawing defines the various forms of sorts matrices³⁰ for the Giant Caster. (Note to prospective Giant Caster matrix makers: This drawing as reproduced here is not really legible. It will be reproduced in fully legible form in *A New Matrix Atlas*, Second Edition (in preparation). If you really need it before I finish that, please contact me.)

The drawing was made originally on 1925-09-11 (in the same year that the Giant Caster was introduced) but this is a later revision. Unless it has been erased,³¹ the original revision did not specify the material. However, the reference to drawing 14703 (the drawing discussed in the previous section) would incorporate a material specification by reference.

²⁹LMMC-DG-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org "Copyright Undetermined" statement.

³⁰One might at first think that this terminology is redundant, as you cannot cast composition with a Giant Caster. But in addition to sorts, the Giant Caster could also cast borders and rule.

³¹This is a diazo whiteprint, so a well-done erasure on the original vellum, now lost, would not be visible.

At an undated revision level identified as (A) the material was specified as aluminum alloy 2014-O. This must have been at some point after 1954-10-01, when the Aluminum Association introduced the four-digit wrought aluminum alloy designation system.

What is of greater interest is an earlier, un-lettered but dated (1950-03-31), revision which indicates a change in the matrix marking. This change was to indicate matrices made with a different heat treating procedure. Fortunately, the note says something about this new procedure: “[artificial] ageing at 340° F. for 15 hours.”

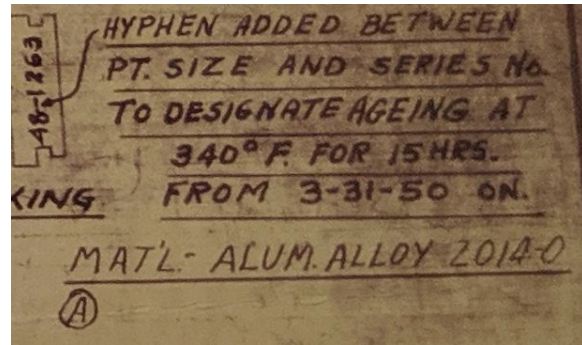


Figure 4.15: LMMC 14459, Detail

4.5.4• Mfg. No. 8194, Aluminum Chalfant Matrix Blanks

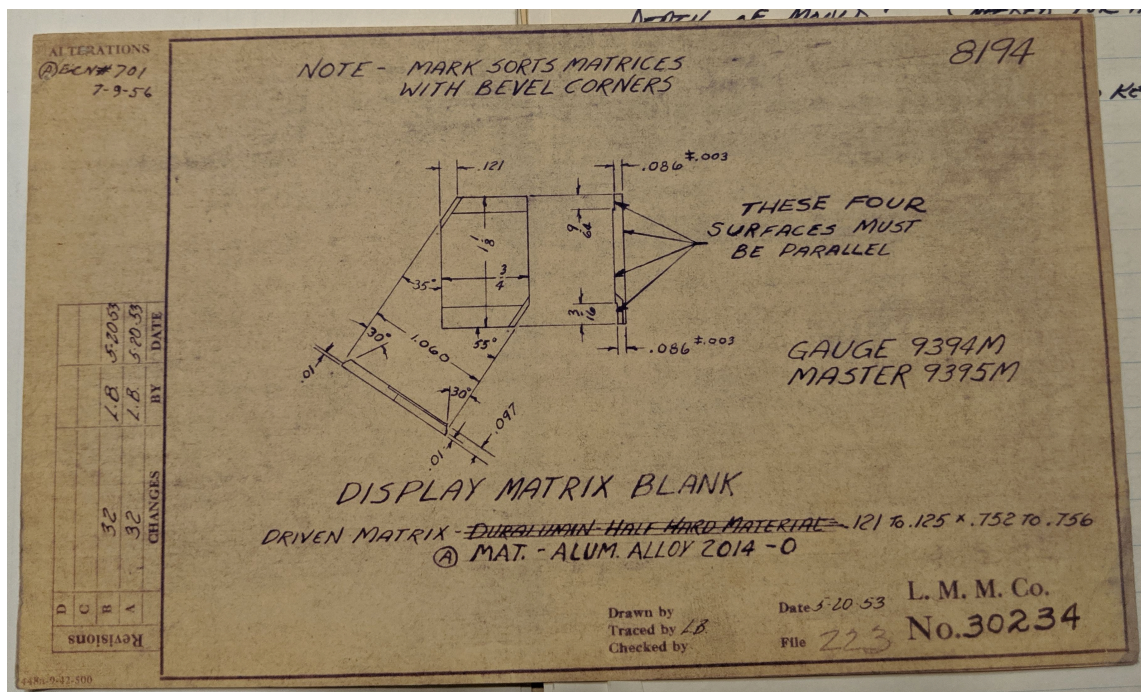


Figure 4.16: LMMC Drawing 30234 (1953), Display Matrix Blank³²

LMMC drawing 14703, discussed in section 4.5.2 earlier, specified the alloy and other criteria for accepting or rejecting aluminum stock from an outside vendor for Giant Caster matrices. It did *not* cover Chalfant-style matrices. These were probably the same material, but the other criteria for the acceptance of that material would have differed, so a different drawing would have been required. That drawing does not survive.

The drawing shown above, No. 30234, describes “Manufacturing Number” 8194, the LMMC-manufactured blank for a driven aluminum display matrix. It doesn’t describe how Lanston would make this blank, just what the blank should be when finished.

It is one of the most important surviving LMMC drawings because it gives full external dimensions for an aluminum Chalfant-style matrix.³³ It is also important because it gives the material used as of 1956, and a date for this change in specification. The drawing is at revision level B, dated 1953-05-20 (see the Revision block at its left).³⁴ It is, further, at Alteration level (A) for ECN [Engineering Change Number] #701, dated 1956-07-09 (see the Alterations note

³²LMMC-DG-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

³³These aren’t quite the same as those for an electro display Chalfant matrix. At 0.097” thick, the aluminum matrices are slightly thicker. We do not have surviving documentation concerning the thickness of brass *driven* Chalfant matrices.

³⁴Confusingly, LMMC was at this time simultaneously using lettered “revision” levels and circle-lettered “alteration” levels.

at its upper left). This is the same ECN and date as were present in drawing 14703, “Gray Matrix Material” for the Giant Caster, discussed earlier. Alteration (A) changed the material to aluminum alloy 2014-O.

Unfortunately, the earlier (now crossed-out) alloy specification in this drawing, “Duralumin Half Hard” is not particularly useful. As should be clear from the earlier discussion, just saying “duralumin” doesn’t really specify an alloy - just the intent to use a high-strength aluminum. Further “half hard” is not really a part of the terminology of aluminum alloys. The hardness or temper of aluminum is really too complex to be captured by this phrase. It is terminology more appropriate to copper-based alloys such as brass. Jewelers and clockmakers, for example, frequently specify “half hard” brass.

A full set of operations sheets for processing stock to create manufacturing number 8194 does not survive, but the first one (“Cut 1”) does. It is reproduced below. The specification of alloy on it (“Duralumin”) is not that useful, but its date is important: 1934-07-07. This is evidence that by that date Lanston was producing aluminum Chalfant-style matrices.

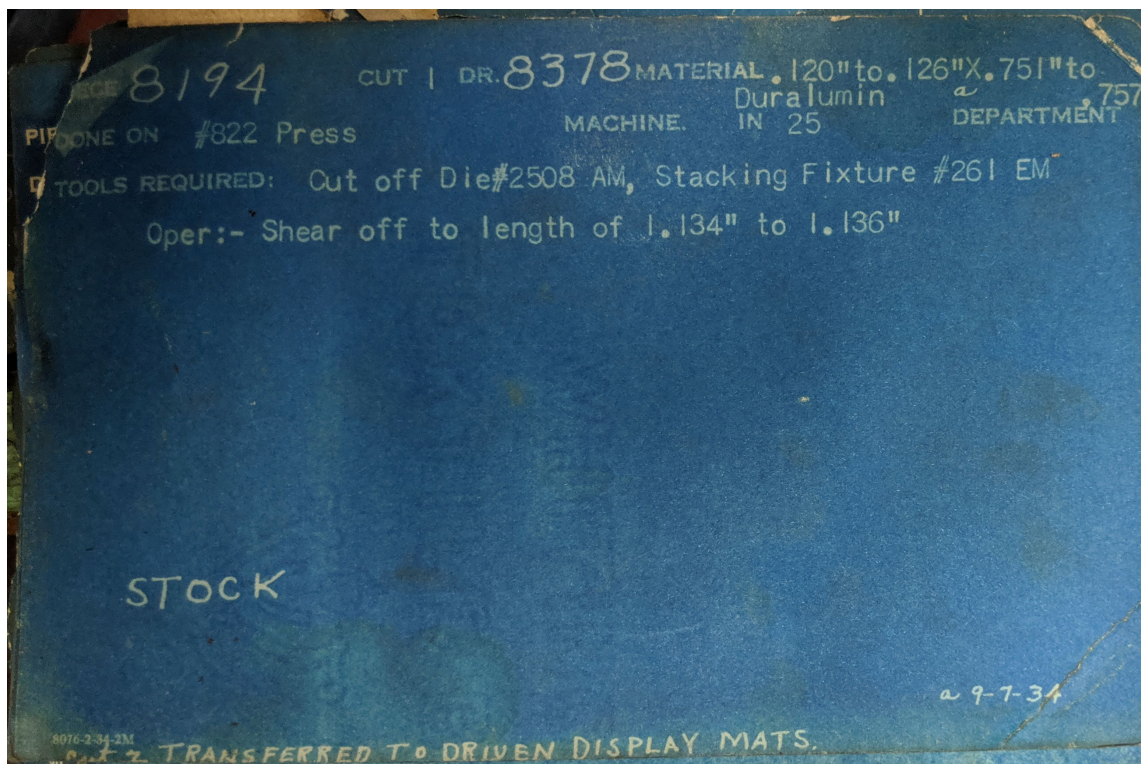


Figure 4.17: LMMC Manufacturing Number 8194, Cut 1³⁵

³⁵LMMC-ATF-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org “Copyright Undetermined” statement.

4.5.5• Summary of LMMC Aluminum Matrix Metallurgy

Cautiously, we know the following from these documents and other sources:

The Giant Caster was introduced in 1925.

We have no evidence concerning the composition of Giant Caster matrices in 1925 and the first quarter of 1926.

LMMC produced aluminum alloy matrices for the Giant Caster from at least 1926-03-16. This production may well have begun in 1925, when the Giant Caster was introduced.

LMMC produced aluminum alloy Chalfant-style matrices for the Type-&-Rule Caster and the Monotype-Thompson Type-Caster from at least 1934-09-07. This production may well have begun earlier, but we have no evidence concerning this.

The following is true for Giant Caster matrices:

From at least 1926-03-16 to 1947-10-17 either of two alloys were used. The first was Bausch Machine Tool Company alloy B in the annealed state: BD. (This would have become unavailable after 1931.) The second was Alcoa aluminum alloy 17S in the annealed state: 17SO. We have no evidence concerning the methods of heat treatment used at this time, but it is reasonable to assume that these matrices were heat treated (because these alloys do not provide their advantages without heat treatment).

From 1947-10-10 to 1948-09-15 the alloy used was Alcoa 14SO. (Bausch Duralumin BD remained in the LMMC specification, but it had been unavailable for some years at this time.)

In 1948-09-15 the alloy was respecified, but we do not know what alloy was named. The actual composition of the alloy may or may not have changed.

On 1956-07-09, with LMMC Engineering Change Number #701, the Giant Caster matrix alloy was respecified again, this time with the Aluminum Association's new four-digit alloy designation system: 2014-O.

It is likely that in the period before LMMC Engineering Change Number #701 on 1956-07-09 the alloy used for Chalfant-style matrices was the same as that used for Giant Caster matrices, but we have no evidence concerning this. With that 1956 ECN, the Chalfant aluminum matrix alloy was respecified as 2014-O (the same as the Giant Caster matrix alloy).

We know nothing of the heat treatment of Giant Caster matrices before 1950-03-31. There must have been heat treatment, because these alloys are require heat treatment to fulfill their potential. Presumably it followed the alloy manufacturer's recommendations. From 1950-03-31, Giant Caster matrix heat treatment included "[artificial] ageing at 340° F. for 15 hours." All heat treatment would have been done after punching.

We know nothing about the heat treatment of Chalfant-style matrices, although what we know about Giant Caster matrices could serve as a reasonable guide.

Here is a summary of the alloys discussed. ‘B’ is Bausch Duralumin B, which the LMMC specified in its annealed state as “BD”. “17S” and “14S” are former designations for Alcoa alloys. These were specified by the LMMC in their ‘O’ (annealed) state: 17SO, 14SO. “2017” and “2014” are Aluminum Association designations, also specified in their ‘-O’ (annealed) state: 2014-O. Alloy 2024 (which was never used by Lanston) is also here because 2014 and 2017 can be difficult to source in small quantities. 2024 is the closest widely available alloy. (Note that alloy 2011, also widely available, is not close. It’s a simple Al-Cu alloy without magnesium (Mg) or manganese (Mn).)

These specifications ignore trace impurities that are sometimes cited (usually as maximum allowable values) by manufacturers. In all cases, aluminum plus impurities constitute the remainder.

If nothing else, this table demonstrates that “the same” alloys are not always the same. If this is important in your work, always request the mill test report to accompany any material you purchase. Manufacturers create a mill test report for each production batch and reputable industrial suppliers will provide it if asked.

	B ¹	17S ²	17S ³	2017 ⁴	2017 ⁵	14S ⁶	2014 ⁷	2014 ⁸	2024 ⁹	2024 ¹⁰
Cu	3.9	4.1	4.0	4.0	4.0	4.4	4.4	4.4	4.4	3.8–4.9
Fe	0.51	0.51	–	–	–	–	–	–	–	<0.05
Si	0.31	0.32	–	–	0.50	0.8	0.8	0.8	–	<0.05
Mn	0.58	0.51	0.5	0.5	0.7	0.75	0.8	0.8	0.6	0.3–0.9
Mg	0.60	0.61	0.5	0.5	0.6	0.35	0.4	0.50	1.5	1.2–1.8
Cr	<0.02	–	–	–	–	–	–	–	–	<0.01

Sources

- B¹ & 17S²: {Rawdon 1929}, p. 22. These values are from actual chemical analyses done by the Bureau of Standards, not from manufacturer or institutional specifications. Both were done of materials supplied in the heat treated state (BT, 17ST), but that would not have affected the composition.
- 17S³: {Alcoa 1935}, p. 56.
- 2017⁴: {ASM 1967}, p. 306. Curiously, {ASM 1961} gives no composition information for alloy 2017.
- 2017⁵: {AA 2003}, p. 1-12.
- 14S⁶: {Alcoa 1936}, p. 56.
- 2014⁷: {ASM 1961}, p. 937. This is the earliest edition after the adoption of the 4-digit wrought alloy designation system. The numbers in {ASM 1967}, p. 306, are almost the same, except that Si is 0.9 and Mg is 0.5.
- 2014⁸: {AA 2003}, p. 1-12.
- 2024⁹: {AA 2003}, p. 1-12.
- 2024¹⁰: OnlineMetals.com (ThyssenKrupp) advertised specification (not a mill report) at <https://www.onlinemetals.com/en/product-guide/alloy/2024>. Accessed 2026-07-30. This also lists maximums for zinc (0.25%) and titanium (0.15%).

4.6• Monotype (US) Border and Rule Matrices

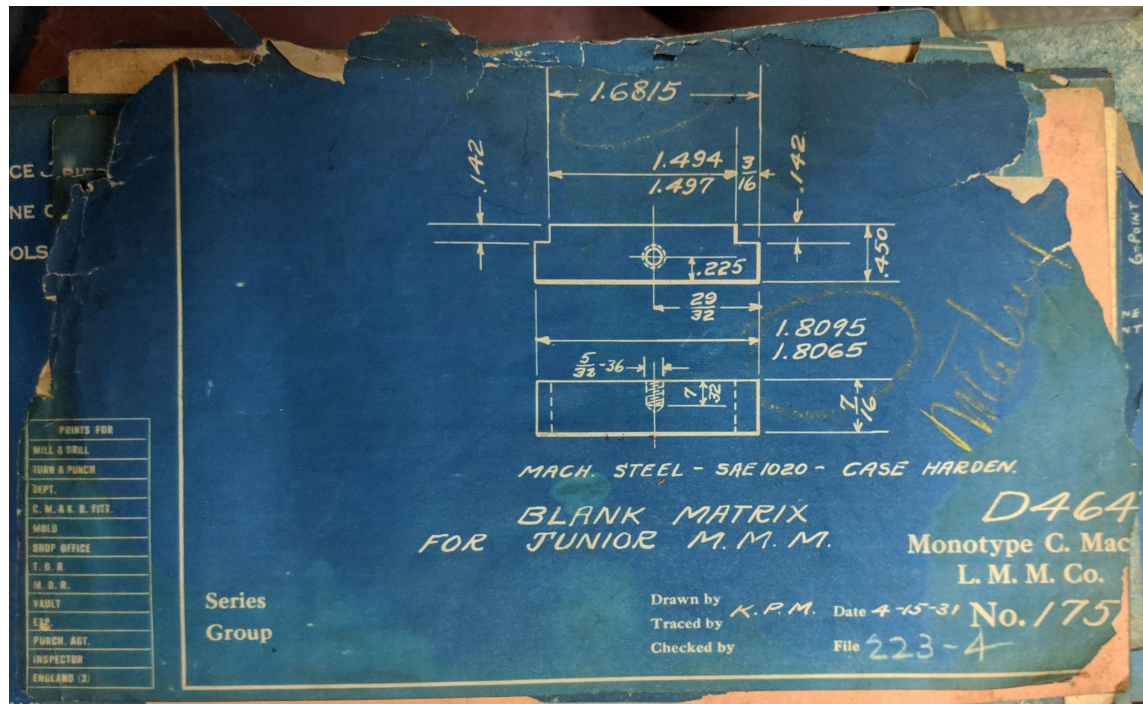


Figure 4.18: LMMC Drawing 175xx (1931), JrMMM Matrix Blank³⁶

No physical evidence of the Lanston Monotype Junior Material Making Machine survives. It failed so completely that Rich Hopkins, in his comprehensive book *Tolbert Lanston and the Monotype*, isn't quite sure that they made it at all. This and a very few other drawings preserved at Project Letter-kunde are valuable documentary evidence that at least they went through the entire engineering and production process. This is a shop floor blueprint.

From a metallurgical point of view, what is interesting is the specification of 1020 steel. This isn't a tool steel. It's just a very plain, simple steel within the general class of "mild steels": iron plus 20 "points" (that is, 0.20 percent) carbon, with no other alloying elements. 1020 steel is not itself hardenable, which is why case hardening (hardening by introducing extra carbon at the surface) is specified here.

Of course, any steel is going to be harder than the leaded brass used by Mergenthaler Linotype for their border slides.

Although we have no engineering drawings for them, Lanston Monotype border and rule matrices for their other machines were also steel, not brass.

³⁶LMMC-ATF-LK. Photograph by DMM from the Project Letter-kunde archives. Reproduced here through the courtesy of Patrick Goossens under a RightsStatements.org "Copyright Undetermined" statement.

5• Marketing Claims

Notwithstanding the claims of the two Monotype companies, cited below, and remembering that so called “commercial bronze” is not a bronze, there is at present no evidence that either company ever manufactured a composition matrix out of a true bronze.

5.1• Monotype (US) Cellular Matrices

From a very early date, the Lanston Monotype Machine Company (LMMC) made a point in their marketing and technical literature that their composition matrices were made of bronze rather than brass. It is easy to understand why they did this. Since, well, the Bronze Age bronze has always been a high-status material. Brass, while beloved of machinists and clockmakers, has often been seen as a low-status material. You make trinkets out of brass, and Linotype matrices.

The earliest reference that I have been able to find to LMMC matrices being bronze dates to the introduction of the updated “cellular” matrix in 1910. This is in an article in *The Fourth Estate*, “a newspaper for the makers of newspapers.” It appears just after a full-page advertisement for the cellular matrix and is little more than a repackaged press release. It describes the matrix material as “the toughest bronze, not brass, and being highly compressed. See {*The Fourth Estate* 1910}, pp. 5–6.

Cellular matrices are made of the toughest bronze, not brass, selected after experiments extending over several years, and, in their manufacture, every precaution is taken to compress this bronze to the last degree: The bars from which the matrices are made are rolled and re-rolled; when a matrix is driven, this bronze—not just at the character, but everywhere—is compressed still further by special presses which exert a pressure of one hundred and fifty thousand pounds to the square inch.

Figure 5.1: *Fourth Estate* (1910)

A few later references must suffice to make the point that this was a longstanding part of the LMMC argument for its superiority.

The first edition of *The Monotype System* says:

Each single Matrix is a separate unit of bronze (*not brass*) ... [italics original] (LMMC 1912}, p. 8)

In their 1916 specimen book, they make the point even more forcefully. (The version at right is reproduced from the 1922 edition of this book; it is identical to the 1916 version. The digitization of the 1922 edition by The Internet Archive is far higher quality than that of the 1916 edition by Google.) See {LMMC 1916}: 16.

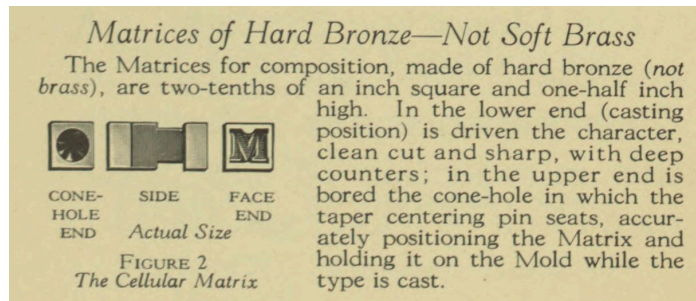


Figure 5.2: LMMC Specimen Book (1922)¹

The section of the 1930s era Lanston Monotype specimen book on “Monotype Matrix Information for the Use and Convenience of Monotype Owners and Operators” says that even blank matrices for quads and spaces are either steel or bronze (LMMC 1930s MTF1}, p. 2).

5.2• Monotype (UK) Composition Matrices

As early as 1908 (before the introduction of the “cellular” matrix in the USA), in his extended article for the Institution of Mechanical Engineers, Lucien A. Legros wrote that “The Lanston Monotype matrix ... is struck in the end of a small square block of bronze.” (See {Legros 1908a}: 1071. or {Legros 1908b}: 1071.) He doesn’t say which firm’s products he is referring to, but he was writing in England and the English firm (then the Lanston Monotype Corporation Ltd.²) was producing their own matrices by this time.

¹This is from the section “The Flexible Matrix System” in the 1922 edition of the *Monotype Specimen Book of Type Faces*. See {LMMC 1922}, p. 16. From the Internet Archive digitization of a University of California copy. Public domain.

²It bore this name from its founding on 1897-12-13 until 1931-05-21, when it became The Monotype Corporation Ltd. See {Slinn *et al.*}, p. 13 & p. 77.

6• Future Work

More Metallurgical Analyses

The most pressing need is for more metallurgical analyses of actual matrices. In most cases at present we have only a single sample (or none at all). From a statistician's point of view, a sample of one means nothing.

If you do this (with your own equipment, if you have it, or through a commercial service) it would be best to include as much information about the matrix as possible: matrix type, type series and size information, notes on condition, etc. A photograph of the matrix wouldn't hurt, either.

Additional Documents?

It is possible that further documentation survives. Anything which might be found would be a valuable addition to our knowledge.

The records of the English Montype firm, and of Stephenson, Blake, which were formerly with the Type Archive and are now with the Science Museum (London) have not yet been investigated in this regard.

Experimental Work

The matrix makers of the past used the best technologies available to them. An argument can be made that we should do the same. Moreover, the exact alloys available to them are not always available today, or can be difficult to acquire in smaller quantities. (Aluminum alloy 2014 is an example of the this. It is easy to find in thousand kilogram quantities, but hard to find as a single bar.)

For aluminum matrices in particular, it would be interesting to explore more modern alloys. One of the known problems with the 2000 series of alloys has been susceptibility to corrosion. It is no surprise that this is also a known problem of aluminum Monotype matrices. Alloys in the 7000 series¹ can be both stronger than those in the 2000 series and less prone to corrosion. 7075 is the strongest and perhaps most common, but it is prone to stress corrosion cracking. Alloy 7050 might be a better starting place.

Matrix making is alive and well, albeit on a much smaller scale than in the past. If you are making matrices in experimental alloys, your results would be very interesting. These don't have to be results of success — sometimes knowing what doesn't work is just as valuable.

I would be happy to include all additional information in future revisions of this work. In addition, please consider publishing your analysis, documents, and experimental work in the *American Typecasting Fellowship Newsletter* (<https://www.AmericanTypecastingFellowship.org>).

¹These alloys were developed in Japan in the 1930s and reverse-engineered in the US.

Bibliography

Bibliographic Style Issues

I am aware of issues/difficulties in the citation style. The style guides for bibliography and citation in the humanities have entered into a dark period where citations are expected to flow into the text so smoothly that it is difficult to follow the citation at all. This may suit aesthetics, but it is a discourtesy to the reader and an impediment to the researcher. The best remaining style guide is the *Chicago Manual of Style*, 17th edition (2017), with its (author date) style of citation.

However, the recommendations of *Chicago* 17th fail for many of the more complex references here. To circumvent this, I will use the CircuitousRoot house style.² This follows *Chicago* 17th as much as possible but differs in this way: Each citation will consist of a unique {entity date} pair. This pair will be repeated in the Bibliography at the start of each bibliographic entry and will serve to identify it. This has the advantages of unique numbered citations as found in the style guides of the more rigorous sciences while retaining the readability of traditional citations in the humanities.

The entry itself will follow a more traditional form which places the date at the end of the publication information.³



{Alcoa 1935} *Alcoa Aluminum and Its Alloys*. Pittsburgh, PA: Aluminum Company of America, 1935.

This has been digitized by the Building Technology Heritage Library from the Canadian Centre for Architecture copy and is available at the Internet Archive at:

https://archive.org/details/AlcoaAluminumAndItsAlloys_960/

{AA 1954} *The Aluminum Association Alloy Designation System for Wrought Aluminum*. [“Effective October 1, 1954”] NY: The Aluminum Association, 1954.

{AA 2003} *Aluminum Standards and Data*. [no location]: The Aluminum Association, 2003.

{ASM 1961} *Metals Handbook. Vol. 1 Properties and Selection of Metals*. 8th Edition. Metals Park, Ohio: American Society for Metals, 1961.

{ASM 1967} *Aluminum Vol. 1, Properties, Physical Metallurgy and Phase Diagrams*. Metals Park, Ohio: American Society for Metals, 1967.

{ASST 1930} *National Metals Handbook*. 1930 [2nd] Edition. Cleveland, OH: American Society for Steel Treating, 1930.

This has been digitized by Google from the Stanford University copy. Google Books ID:

zKFBAQAIAAJ .

{Baush 1921} “Duralumin.” [Full-page advertisement.] In *Machinery*. Vol. 27, No. 12 (August, 1921): 10.

²See *CR Bibliographic Style: A Justification and Explanation of The CircuitousRoot House Style for Bibliography and Citation* at <https://www.CircuitousRoot.com/PUTURLHERE>

³In *Chicago* 17th it is placed after the author and it is up to the reader to reconstruct the citation from this infix use.

This volume of *Machinery* has been digitized variously. The Hathi Trust has the Google digitization of the New York Public Library copy of the final part of this volume. See:

<https://babel.hathitrust.org/cgi/pt?id=nyp.33433109970156&seq=652&q> (Google Books ID: CmU-AQAAMAAJ). The Google Books ID for their digitization of the very incomplete University of Chicago copy is IQU0AQAAMAAJ.

{CDA 1975} *Standards Handbook: Wrought Copper and Copper Alloy Mill Products. Part 3 — Terminology*. Sixth Edition, 1968. Revised 1975. NY: Copper Development Association, Inc., 1975.

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<https://archive.org/details/copper-development-association-inc.-pdf-a/>

{CDA 1994} *Copper Casting Alloys*. [Publication 7014.] NY: Copper Development Association, and Des Plaines, IL: Non-Ferrous Founders' Society, 1994.

This document formerly was online at the Copper Development Association's website. It is no longer online, but an archived copy is available via the Wayback Machine of the Internet Archive at:

https://web.archive.org/web/20240917172402/https://www.copper.org/publications/pub_list/pdf/7014.pdf

{CDA 2025} *Application Datasheet: Standard Designation for Wrought Copper Alloys*. McLean, VA: Copper Development Association, 2025.

This document formerly was online at the Copper Development Association's website. I was able to access it through at least the 2025-06-06 edition. It is no longer online, but an archived copy of the 2023-05-31 edition is available via the Wayback Machine of the Internet Archive at:

<https://web.archive.org/web/20240124031120/https://www.copper.org/resources/properties/db/datasheets/all-alloys.pdf>

{DE 244,554 Wilm 1912} Imperial German Patent 244,544, "Verfahren zum Veredeln von magnesiumhaltigen Aluminiumlegierungen." [Process for refining magnesium-containing aluminum alloys.] Filed 1909-03-20. Issued 1912-03-09 to Alfred Wilm.

German patents are available via the European Patent Office's "Espacenet" service at:

<https://worldwide.espacenet.com/patent/search> In this case, search for "de 244554c" and go to the "Original Document" tab.

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{Hardouin Duparc 2004} Hardouin Duparc, Olivier B. M. "Alfred Wilm and the Beginnings of Duralumin." [This appears to have been published twice:] In *Revue de Métallurgie*. Vol. 101, No. 5 (May 2004), pp. 353-360. Also in *Zeitschrift für Metallkunde*. Vol. 96, No. 4 (2005): 398-404.

This article has been uploaded by its author to: https://www.researchgate.net/publication/45705177_Alfred_Wilm_and_the_beginnings_of_Duralumin

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{Hopkins 2012} Hopkins, Richard L. *Tolbert Lanston and the Monotype: The Origins of Digital Typesetting*. Tampa, FL: University of Tampa Press, 2012.

{Knerr 1922} Knerr, H. C. “Duralumin — A Digest of Information.” In *Transactions of [the] American Society for Steel Treating*. Vol. 3, No. 1 (October 1922): 13–42.

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https://archive.org/details/sim_american-society-for-metals-asm-transaction-s-quarterly_1922-10_3_1

{Legros 1908a} Legros, L[ucien] A[lphonse]. “Typecasting and Composing Machinery.” In *Proceedings [of the Institution of Mechanical Engineers]*. 1908, Parts 3–4: 1027–1179, discussion pp. 1180–1121, Plates 32–46 (Dec. 1908). Westminster, UK: By the Institution, 1908. [PD]

This has been digitized by Google from the Harvard University copy. Google ID: GNiOAAAAYAAJ.

This digitization is also available (possibly served with better images?) at the Hathi Trust at
<https://catalog.hathitrust.org/Record/100475635> (catalog record) and
<https://babel.hathitrust.org/cgi/pt?id=hvd.hb1f32&> (full view).

This also has been digitized by Google from the University of Michigan copy. Google ID: 7kNJAAAAMAAJ. However, this is a terrible digitization with nearly unusable plates. See {Legros 1908b} for a better version.

{Legros 1908b} Legros, L[ucien] A[lphonse]. “Typecasting and Composing Machinery.” Excerpted and reprinted from *Minutes of Proceedings of the Meeting of the Institution of Mechanical Engineers*. 1908-12-18. Westminster, UK: By the Institution, 1908. [PD]

This has been digitized by Google from the Harvard University copy. Google ID: GNiOAAAAYAAJ.

This is a better digitization than {Legros 1908a}. Should anyone with a serious interest need better scans of the plates, I do have a paper original.

{LMMC 1912} *The Monotype System*. Philadelphia, PA: Lanston Monotype Machine Co., 1912.

For digital versions of this in various editions, see the CircuitousRoot Notebook “The Monotype Composition Caster & Keyboard Technical Literature” at <https://www.circuitousroot.com/artifice/letters/press/comptype/monotype/literature/technical/index.html>

{LMMC 1916} *The Monotype Specimen Book of Type Facs*. Philadelphia, PA: Lanston Monotype Machine Company, 1922.

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{LMMC 1922} *The Monotype Specimen Book of Type Facs*. Philadelphia, PA: Lanston Monotype Machine Company, 1922.

This has been digitized by the Internet Archive from a University of California copy and is online at:
<https://archive.org/details/monotypespecimen00lansrich/>

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In the 1930s, the LMMC specimen book was issued as a collection of looseleaf fascicles in a post-style binder. No two copies are quite the same. In this instance, “MTF1” refers to my primary copy of this specimen book. I have digitized this, but it is at present only partially online, at: <https://www.CircuitousRoot.com/artifice/letters/press/comptype/monotype/typography/index.html>

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The full title of this journal is: *Metallurgie. Zeitschrift für die gesamte Hüttenkunde: Aufbereitung — Eisen- und Metallhüttenkunde — Metallographie*. [Metallurgy. Journal of the Entire Field of Extractive Metallurgy: Mineral Processing — Ferrous and Non-Ferrous Metallurgy — Metallography].

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Alloys in Military Technology, with Special Reference to Duralumin.] In *Kriegstechnische Zeitschrift*.
Vol. 16, No. 3 (1913): 97–106.

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Revision History

Rev. 3, 2026-08-03. Begun 2026-07-26. (This is the first public release; revisions 1 and 2 were drafts circulated only to colleagues.) I've been collecting this information since 2013, but it was Ed Rayher's analysis of the English Monotype composition matrix blanks which prompted the present compendium.

The layout of this document was done
using the X_YL^AT_EX derivative of
Prof. Knuth's T_EX digital layout system.

Digital Lettering Faces

Latin text: T_EX Gyre Schola.

Based on URW Century Schoolbook,
which in turn is based on
ATF's Century Schoolbook by M. F. Benton.

Latin display: Gillius ADF No. 2
from Arkandis Digital Foundry.

Based on Gill Sans.

Computer text: T_EX Gyre Cursor.

Based on URW Nimbus Mono L,
which has roots in Kettler's Courier.