A New Matrix Atlas

Consolidating the Work of
Paul Hayden Duensing
and Others

(A Work In Process)

Edited by
Dr. David M. MacMillan
Mineral Point, Wisconsin
2022

Revision 11, 2022-08-25.

This document is published by CircuitousRoot, the private type foundry and press of the editor. The current electronic version of this document, its source files, and the DXF and SVG files for its drawings, are online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/literature/practices/index.html

The editor may be reached by e-mail at dmm@Lemur.com or by postal mail at:
2526 Wearne Road, Mineral Point, Wisconsin 53565, USA.
He prefers not to receive telephone calls.

Preface

The slim booklet entitled *Matlas* (for "Matrix Atlas"), written and compiled by the late Paul Hayden Duensing, was for its time the essential reference in the amateur and revivalist typefounding community for technical details about typecasting matrices.

But Duensing's *Matlas* was never issued in a final version or as an actual book. It was a series of typescripts which evolved over the years. That evolution was not necessarily cumulative; each version contains information not present in the other versions. Moreover, although Duensing was a careful scholar, errors exist in all versions. (For example, the value cited as the depth of drive for Ludlow matrices is incorrect.) Sadly, Duensing did not live to complete a final version.

A need still exists, therefore, for a compendium of all of the matrix information in *Matlas*, corrected when necessary and augmented when possible with data from other sources. This is an attempt to produce such a work.

Any work such as this is necessarily detailed, because it must include all of the special cases and exceptions. After all, what good would be an Atlas of the world which left out certain regions because they contained too many countries? But in ordinary practice much of this detail may be ignored – the basics are pretty simple. All of the notes and references may be ignored as well. They're present because it is important not only to know things but to know *how* and *why* we know things.

This compendium draws upon and collates the work of many people - Duensing in particular, but others as well. However, all of the errors in this volume are of course my own. (If something is in error here it is so because I made a mistake in transcribing a source, or because I made a mistake in interpreting information, or because I failed to verify received data against actual experience or measurement, or because I made a mistake in my own measurement or understanding.) I would appreciate greatly all comments, corrections, and additions.

Note: Items enclosed in {braces} are references to the Bibliography. This convention is nonstandard, but quite useful.[1]

1 I find (parentheses) confusing when used for this purpose. [brackets] are reserved for indicating editorial content. <angles> are used in too many text formatting systems today. {braces} are all that is left.

To my late wife, Rollande

Acknowledgments

Until the fall of 2008, I'd never even seen a piece of type and didn't know what a matrix was. My debts to the typecasting and letterpress printing communities are boundless, and this list cannot,and does not, identify them all.

Pride of place must go to the late Paul Hayden Duensing, for his groundbreaking work in his original *Matlas*, and to Ginger Duensing for her permission to use that work. I greatly regret that I was never able to meet Duensing. My thanks go out also to Richard L. Hopkins for many things, including preserving and making available much of Duensing's work.

My debt to Schuyler (Sky) Shipley, proprietor of Skyline Type Foundry(https://www.skylinetype.com), is also impossible to overstate. I learned typecasting in my apprenticeship at his foundry.

Paul Aken also deserves special mention for making available to me many unique items of matrix and typecasting technological history.

The following people, listed alphabetically, contributed comments, corrections, suggestions, and new material to this work: Rich Hopkins (Hill & Dale Private Press and Type Foundry, and founder of the American Typecasting Fellowship), Bob Magill (Sterling Type Foundry), Kevin Martin (Papertrail Handmade Paper and Book Arts, https://www.papertrail.ca), and the late Gregory Jackson Walters.

The many faults which remain in this *New Matrix Atlas* should be attributed to me.

Table of Contents

1 Introduction

1.1 Purpose

Paul Hayden Duensing wrote that the purpose of his *Matlas* was

> "to examine the various kinds of type matrices a contemporary typefounder is likely to encounter today and to describe their differences and similarities with a view to how they may be cast as single types for hand composition."[2]

This *New Matrix Atlas* has the same purpose, although I will not hesitate to investigate matrices that a contemporary typefounder is *not* likely to encounter.

Duensing then notes that

> "Basic to this consideration are five factors which govern the success of casting from a given matrix. These are: depth of drive, mold height, metal quality, temperature and speed of casting."[3]

1.2 Aspects of the Matrix

But Duensing's list includes both factors integral to the matrix (e.g., depth of drive) and typecasting procedures independent of the matrix (e.g., temperature). I would suggest instead the following list of aspects of the matrix itself which may be described and quantified:

1. Depth of Drive
2. Mold Height (Type Height – Depth of Drive = Mold Height)
3. Head Bearing (and in some cases Foot Bearing)
4. Side Bearing
5. Geometry of the matrix
6. Dimensions of the matrix

To these matrix-centric factors, the person or organization designing the type and the type founder casting it must also add the three aspects of type alignment:

2 {*Matlas* 1986} and {*Matlas* 1988}. Citations in {brackets} refer to items in the Bibliography.
3 {*Matlas* 1988}

1. Vertical alignment
2. Lateral (that is, horizontal) alignment
3. Set width.

What follows in this Introduction is a set of discussions of these aspects of matrices and type in greater detail.

1.2.1 Head Bearing and Side Bearing

Head Bearing and Side Bearing are characteristics of the matrix (not of types). They are the relationships between the edges of the matrix and the edges of the body of the type as it would be cast from the matrix in perfect default alignment. They are not visible on the matrix (except insofar as a used matrix may show the shadow of the cast type body from heat discoloration), but are a part of the matrix's definition.

The Head Bearing is the offset from the top edge of the matrix to the theoretical top of the body of the type. The Side Bearing is that from side of the matrix to the corresponding theoretical edge of the body of the type. Head Bearing and Side Bearing are dimensions which are established in advance for each particular kind of matrix. They are a part of matrix engineering, not type design.

1.2.2 Lining and Fitting

The type itself has a relationship between the printing face of the type and the edges of its body. (In most cases, the printing face is smaller than the body, but in type with kerns it may be larger.) It is the responsibility of the type designer(s) and matrix maker(s) to establish the three relationships necessary to position a type's printing face as desired on a its body:

1. The vertical alignment of the printing face on the body.
2. The lateral alignment of the printing face on the body.
3. The set (set width) of the body.

(The height of the body is taken as fixed.) The establishment of these three dimensions is a part of type design, not matrix engineering. Establishing the vertical alignment may be termed "lining," and establishing the set width and lateral alignment may be termed "fitting."

The lining and fitting of type is a matter of judgment. (Important elements of type, such as "baseline," are not physical features of type but are interpretations imposed on the type by the designer and, in practice, the type caster.) Unlike Head Bearing and Side Bearing, they are not absolute and may change.

Examples of the re-lining or re-fitting of existing types include:

- When existing types were re-lined and re-fitted from pre-point bodies to point system bodies after 1886.
- When existing types were re-lined for uniform lining systems, first by the Inland Type Foundry from at least 1894[4] and later, by 1906, by ATF (for their American Line).
- When 19th century types of unknown lining and fitting were reissued through electroformed matrices in the "antique" type revival of the mid-20th century.
- When existing matrices are cast today at narrower set widths than specified on the matrix. (Tastes in set and the letterspacing of type have changed, and type cast to the set widths which were stamped on the matrices in the early 20th century may appear too wide in the early 21st.)
- When existing matrices are cast to individually adjusted vertical alignments which do not necessarily match those of the lining standard for the matrix font. This happens often.

In principle, the lining and fitting of type is done by the type designer and matrix maker, and can be ignored by the type caster. For machine composition this must be the case, as the machine operator cannot manually intervene for individual types. But in casting single types, the type caster must always check these three lining and fitting factors, and frequently must adjust them.

In addition, type casting machines such as the Thompson have precise but relative adjustments for vertical and lateral alignment, rather than accurate adjustments to an external standard. Thus each time the machine is set up to cast from a particular matrix font the operator must vertically align the matrix. Even if a lining standard exists for the matrix font, the operator exercises his or her judgment as to what vertical alignment on the machine matches the lining standard. For situations where no lining standard exists,

4 "This Is Not Pi" [Advertisement]. *The Inland Printer.* Vol. 13, No. 2 (May, 1894): p. 194.

and for the lateral alignment of each sort, the type caster's judgment in the end controls the alignment.

1.2.3 The Matrix and the Type

The following two illustrations attempt to put together these ideas of matrix bearings and type alignment.

The first illustration shows what you actually see on the matrix, the type cast from it, and the page printed from this type. On the matrix, ignoring numbers and codes stamped on it, all you see are the casting cavity and the external geometric shape of the matrix. The head and side bearings are not visible, as they are not physical features of the matrix as an object. On the type, all you see are the sides of the type body and the printing face of the type (ignoring things such as the beard and other nonprinting features). The vertical alignment and lateral alignment are not physical features of the type (though the set width is). On the printed page, all you see is the image made from the printing surface of the type. No matrix bearings or type alignments appear visually on the page, even though they locate the printed image on the page. Type as a physical thing in metal or ink has no features such as a baseline; they are brought to it by the interpretation of the type-maker.

So here's what you see:

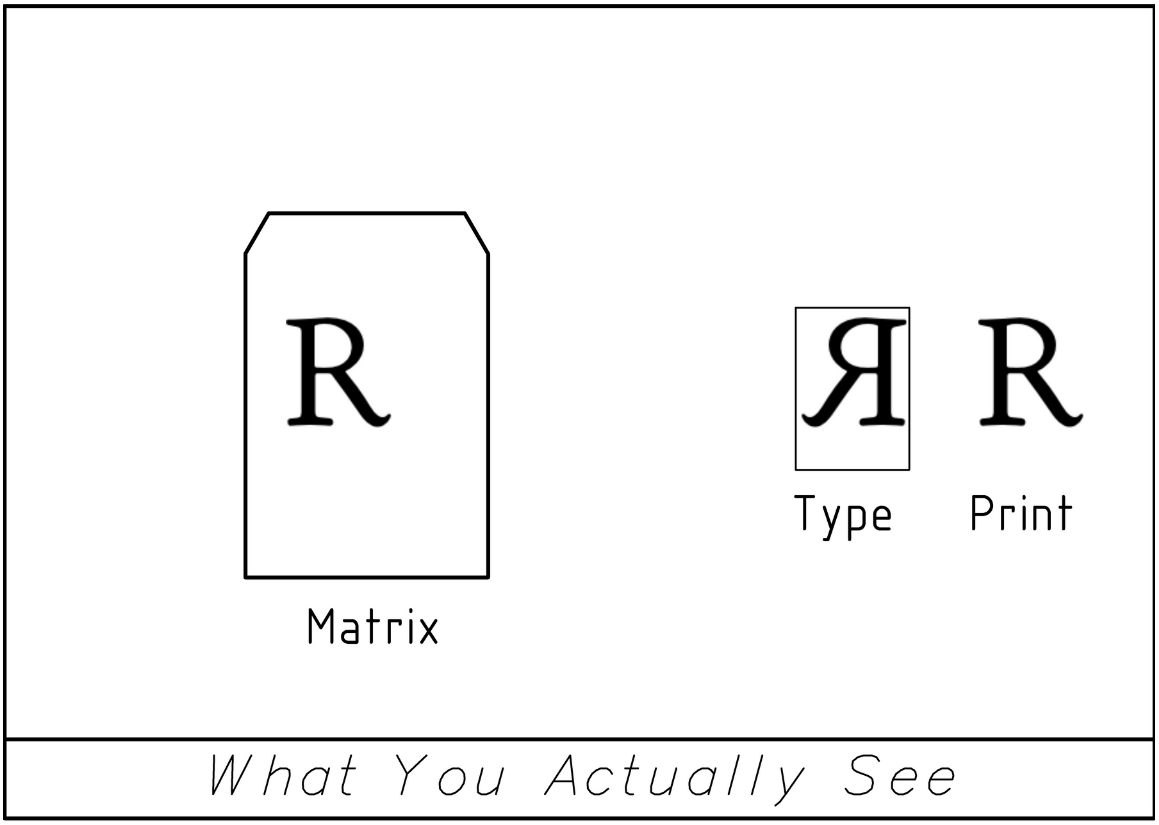


Figure 1: What You Actually See: Matrix, Type, and Paper

But here's what you actually do:

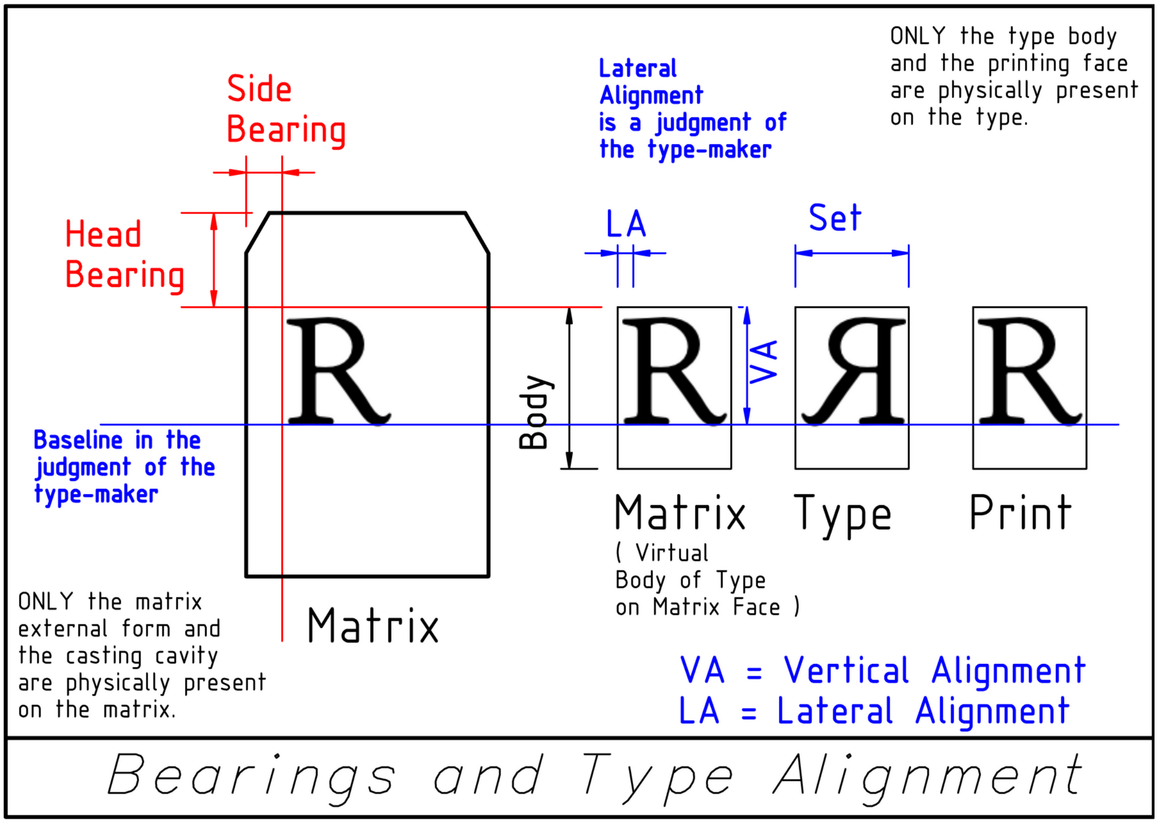


Figure 2: What Creates It: Matrix Bearings and Type Alignment

1.3 Common Matrix Drives and Mold Depths

Of the various dimensions of type, Duensing writes:

> "Foremost is the depth of drive of the matrix being coupled with a mold which will yield the desired type height."[5]

The term "depth of drive" comes, of course, from the original method of manufacturing a matrix using a punch. It is used regardless of the method of manufacture of the matrix (punched, engraved, or electroformed), and designates the distance between the surface of the matrix which bears against the mold and the bottom of the casting cavity of the matrix.[6]

1.3.1 Matrix Drives

For convenience, here is a table of the matrix depths of drive commonly (and sometimes less commonly) found in American type casting practice:

5 {*Matlas* 1986} and {*Matlas* 1988}.

6 This definition accommodates the unusually deep "drive" of Ludlow matrices, which is the sum of the actual depth the punch is driven in plus the milled cavity intended to form the crossbar of the 'T' of the Ludlow slug.

	US Type Height	Matrix Drive	Nominal Mold Height[7]
Stereotype/Electrotype	0.918	0.155 [8]	0.763[9]
Ludlow	0.918	0.153	0.765
ATF B-4 (NY/Conner), 120 pt and up[10]	0.9180	0.1251	0.7929
ATF B-4 (NY/Conner), 48-108 pt	0.9180	0.1241	0.7939
ATF B-3 (NY/Conner), 30-42 pt	0.9180	0.0968	0.8212
ATF STL-3 (Central or St. L.), 36-72 pt	0.9180	0.0844	0.8336
ATF B-2 (NY/Conner),14-24 pt	0.9180	0.0758	0.8522
English Linotype	0.918	0.075	0.843
Lanston Giant Caster >= 42 pt	0.918	0.065	0.853
English Monotype Super Caster	0.918	0.065	0.853
Nuernberger-Rettig, native	0.918	0.065	0.853
English Monotype Display > 36 pt	0.918	0.065	0.853
ATF STL-2 (Central or St. L.), 14-30 pt	0.9180	0.0535	0.8645
Lanston Monotype Display (14-36 pt)	0.918	0.050	0.868
Lanston Monotype Thompson	0.918	0.050	0.868
English Monotype Display <= 36 pt	0.918	0.050	0.868
English Monotype Comp. (except 4 ½ pt)	0.918	0.050	0.868
Mergenthaler Linotype & compatible	0.918	0.043	0.875 (7/8”)
Thompson Thompson, Compositype	0.918	0.043	0.875 (7/8”)
ATF B-1 (NY/Conner), 6-12 pt	0.9180	0.0420	0.8760
ATF STL-1A (Central or St. L.), 6-12pt	0.9180	0.0309	0.8871
Lanston Monotype Composition	0.918	0.030	0.888
English Monotype 4 ½ pt Composition	0.918	0.030	0.888

Table 1: Common Matrix Drives and Mold Depths

7 This is a calculated, theoretically perfect mold height assuming no shrinkage. See the section below for notes on real mold depths which take shrinkage into accont.

8 {Lanston Giant 12pg}, p. 8.

9 Of course, for stereotypes/electrotypes this is not really a “mold height” but a base height.

10 ATF data from {Rehak 1993}, p. 183.

1.3.2 A Note on Mold Depths and Typemetal Shrinkage

One of the most enduring fallacies in the history of type is that typemetal expands upon solidification. We have known from laboratory work since the early 20th century that this is false. Typemetal as an alloy, and each of its constituents individually (lead, antimony, tin), all contract upon solidification. Yet I have heard this myth repeated as a fact in the early 21st century, and it can be seen in at least one 21st century college textbook.[11] See the Appendix "Belief in the Expansion of Typemetal" for a historical survey of this myth.

In more practical terms, what remains for the typefounder is the question of how much typemetal shrinks in solidification, and what compensation must therefore be made in the mold dimensions. (So far as I can tell, no compensation was ever made in matrix dimensions.) It appears that there are two views here, which I have not yet reconciled with practice.

On the one hand we have a value of approximately 2 percent shrinkage upon solidification as accepted in the metallurgical literature. This is cited by Hiers (1939), without source.[12] Gonser and Winkler (1849) do give a source, the research of Matsuyama in 1928.[13] Thompson (1930) also credits Matsuyama[14], and cites the 2 percent value as one for lead-tin-antimony alloys containing "from 12 to 16 percent antimony.". I have not yet tracked down Matsuyama's original article, although at least two copies exist in the US. It would appear that this 1928 research is the whole of the metallurgical research in this area (a fact which is surprising given the economic importance of typemetal throughout much of the 20th century). The data for the contraction of type metal reported in Gonser and Winkler are:

11 {Sivasankar 2008}, p. 41.
12 {ASM 1939 /Hiers}, p. 1549.
13 {ASM 1948 / Gonser & Winkler}, p. 958.
14 {Thompson 1930}, p. 1093.

	Pb	Sn	Sb	Contraction, percent
Electrotype	92	4	4	2.6
Stereotype[15]	83.7	4	11.3	2.0
Linotype	79	5	16	2.0
Monotype	76	3	16	2.0
Lead	100	-	-	3.4
Tin	-	100	-	2.8
Antimony	-	-	100	1.4[16]

Table 2: Contractions of the Constituent Elements of Typemetal

These values should be treated as what they are: specific experimental values. In particular, the values for Linotype and Monotype alloys do not necessarily match practice, and no alloys are presented for the higher-tin and higher-antimony type metals. Note also that the properties of alloys cannot be extrapolated from their constituent elements[17], so it would be unwise to make inferences from the values of pure Pb, Sn, and Sb.

Other sources cite a value an order of magnitude smaller: about 0.3 percent.

Kevin Martin notes that in reality "mold cavities are all slightly deeper and larger … by about 0.3% … to account for the shrinkage of the type as it cools after hardening." He further cites an increase in mold height of about 0.003.[18]

The ATF/Dale Guild data used here is, as given in {Rehak 1993}, actually mold data, not matrix data. As presented in Rehak it specifies an over-height mold with an expected shrinkage. (Example: B4 48-108pt mold depth height is called out as 0.9216, with an expected shrinkage of 0.0032. 0.9216 – 0.0032 = 0.9184.) This example corresponds generally with Martin's, but disagree with the metallurgical literature.

The ATF/Dale Guild shrinkage factors cited in {Rehak 1993} are primarily 0.0032 " (inches, not percentages) for mold height for Barth machines (0.0042" for 120pt and up),

15 "Specimen contained 0.5% Copper" (Gonser & Winkler's note)
16 Value not from Matsuyama, but from an unnamed article by H. Endo in the J. Inst. Metals, 30, 121 (1923).
17 The classic example is table salt, which is made of the poison gas chlorine together with sodium (which can explode if you drop it in water).
18 {Martin 2015-01-23}

but range from 0.0018” to 0.0027” for pivotal casters. In all cases, however, these values are nearly an order of magnitude less than the 2% expected from the metallurgical literature.

At present, I do not have sufficient practical experience to attempt to resolve this difference.

2 Conventions for Company Names

Identifying companies and their products gracefully and accurately can be difficult in this field. The companies originating the two dominant systems of machine composition both licensed their products to legally separate foreign corporations (with different names). At times their engineering practices were closely aligned; at times they were not. This means that just saying "Linotype" or "Monotype" is often ambiguous and can be seriously misleading.

Here are a few more or less random remarks on these names and the conventions of the present document.

2.1 Linotype

The original Linotype company in the United States was, by beginning of serious production in Brooklyn in the 1890s, called the Mergenthaler Linotype Company.[19] It licensed an English subsidiary, which began (in complicated circumstances) in 1889 as The Linotype Company, Ltd.[20] and which in 1903 merged with The Machinery Trust Ltd. to become Linotype and Machinery, Ltd.[21]

The German Linotype firm, which at times was independent but at other times was under the control of the American firm (I am unaware of any history which has sorted this all out) was founded in 1896 as The Mergenthaler Setzmaschinenfabrik GmbH (Berlin). [22] There were also licensed Italian and French Linotype firms.

Since the English firm never used the word "Mergenthaler" in its name, and since the audience of this *New Matrix Atlas* is primarily anglophone, the term "Mergenthaler" when used here without further qualification will mean the American firm.

2.2 Monotype

The original Monotype firm in the United States was called the Lanston Monotype Machine Company from a very early date.[23]The English firm, which was always a separate

19 The pre-history of this firm under various names, from the 1870s, is extremely complex and some of its details remain unknown.
20 {Kahan 1999}: 161.
21 {MOSI 2001}.
22 {Kahan 1999}: 223.
23 The original Lanston Type Machine Company of 1886 was reorganized in 1902 to become the Lanston

company[24], was formed in 1897 as The Lanston Monotype Corporation Limited. It became The Monotype Corporation Limited in 1931.[25] In principle, the name "Lanston" might therefore be applied to either. However, the finest years of the English firm began in the 1930s and it is most commonly remembered today as simply The Monotype Corporation Limited.

So when not citing the full corporate name[26] I will adopt the convention here of reserving the term "Lanston" for the products of the American firm.

Monotype Machine Company. This was well before it brought a viable machine to market. See (Hopkins 2012): 123 and {Slinn *et al.* 2014}: 324.

24 At least until it acquired the remaining intellectual property of the American firm after its demise.

25 See {Slinn et al. 2014}: 24, 77.

26 Or the abbreviation "LMMC."

3 Lanston Monotype (i.e., American) Composition

3.1 Lanston Standard Composition (Cellular)

3.1.1 History

The history of the Lanston Monotype composition matrix (also called a "cellular" matrix[27]) is covered in some detail in Rich Hopkins' book *Tolbert Lanston and the Monotype* {Hopkins 2012}, pp. 101-102 & 199. His illustrations, which include a rare original style matrix, are invaluable. Hopkins notes that the matrix in its initial form was introduced in 1897. Originally, it had a depth of drive of 0.050 inches and employed steel rods penetrating the matrices to hold them in relative position. These matrices were 0.2" x 0.2" in their face dimensions. In around 1904, Lanston Monotype changed to a new matrix design.[28] They retained the 0.2" x 0.2" dimensions, but changed the depth-of-drive to 0.030 inches and changed the method of holding the matrices to a set of steel "combs." This change allowed a larger centering pin.[29] Hopkins has noted that a deliberate attempt was made to recall all earlier matrices, and very few survive.[30]

The standard 0.2 x 0.2 inch Monotype composition matrix was intended to accommodate type bodies up to 12 points ({Lanston MMI}: §4).

This present section covers only Lanston Monotype standard composition (cellular) matrices as they appear post-1904. It does not cover the rare 1897-style matrices, Lanston large composition matrices, English Monotype composition matrices in any form, or Monotype display matrices in any form. It assumes that the matrices are being cast on a Monotype Composition Caster (vs. a Super Caster or a Thompson, for instance). It also assumes that the casting machine is in its regular adjustment.

27 Monotype explained that the combs which hold the matrix in place in the matrix case form, for each matrix, a cell in which it has some degree of freedom of movement. {Lanston 1916}: 8-9. This explanation would limit the use of the term "cellular" to Lanston (vs. English) matrices; I do not know if in practice this was the case.

28 Hopkins cites documentation from 1910, "The Cellular Matrix," which was included in a 1913 Lanston Monotype specimen book. This document, in turn, says that the changeover to the new matrix style was done "six years earlier."

29 The English Monotype firm retained the rod, but added side bars of a different form. They also retained the original 0.050 inch depth of drive.

30 Rich has told me this in conversation. I think that he published this information as well, but I cannot now find the source.

3.1.2 Depth of Drive

The depth of drive for Lanston Monotype (i.e. American) composition matrices is 0.030 inches.

3.1.3 Side Bearing, Set & Horizontal Alignment

The side bearing (distance from the side of the matrix to a side of the type body) is established on the right and is 0.021 inches. (The corresponding distance on the left varies depending upon the set of the type.)

Note that because the side bearing is on the right side (whereas Compositype / Thompson / Lanston display matrices use a left side bearing) the casting position of a Lanston composition matrix is therefore "upside-down" (relative to regular display matrix conventions) when they are cast on the Thompson Type-Caster.

The set of the type cast is determined by an elaborate arrangement which is at the heart of the Monotype system. This is well covered in the instructional material of the two Monotype firms and by some third party literature. It is independent of matrix considerations[31] and will not be covered here.

The horizontal alignment of the face within the set width of the body is determined by the design department when fitting the type's design in matrix manufacturing. While it is subject to some physical limitations (e.g., the necessary width of the beards) it is largely a matter of aesthetics rather than matrix engineering. It will not be covered here.

31 Other than overall limits imposed by matrix size, of course.

3.1.4 Head/Foot Bearings & Vertical Alignment

The vertical alignment (that is, the lining) of Lanston Monotype composition matrices is actually quite straightforward and does not differ in principle[32] from that of any other matrix manufacturer or type foundry that employs some systematic method of lining (such as American Type Founders, for example). However, the explanation of this vertical alignment in the Lanston literature is one of the most extraordinary (and extraordinarily confusing) pieces of technical writing that I have ever encountered.

Put most simply:

1. The nick side of the type is toward the matrix foot side and the anti-nick side toward the matrix head side.
2. All Lanston Monotype composition faces[33] are located on the matrix with a common baseline which is 0.145 inches from the head-side of the matrix. Here I will refer to this baseline as defined on the matrix as the "**matrix-line**."[34]
3. The top bearing (distance from the matrix head to the anti-nick side of the type body) is 0.020 for 12 point bodies. The top bearing increases at a rate of 0.010 inches per each decrease in point-size of the type body. So the head bearing for 10 point type is 0.020 + (2 * 0.010) = 0.040. The head bearing for 8 point type is 0.060. For 6 point it is 0.080. Etc. All other vertical alignment values may be computed from these two simple pieces of information: head bearing and matrix-line.

Lanston Monotype uses the term "**type-line**" to mean "the location of the type face's baseline, as measured from the anti-nick side of the type."[35] Defining type-line in this way is useful when casting. If you wish to inspect a cast type for correctness of alignment, you simply put the type into a lining gauge with its nick up (as it should be) and place a steel lining standard next to it. You can then visually check the alignment of

32 Though, of course, the actual numbers are different. Lanston Monotype composition will not line with, say, ATF's "American Line" type.

33 Except for certain exceptions. See the section on "Exceptions," below.

34 Duensing calls this baseline as defined on the matrix the "matrix alignment" to distinguish it from the baseline defined on the type (the "type-line," discussed below). The term "matrix-line" is not attested in the literature (I'm just making it up here) but it seems useful when talking about both baseline as defined on the matrix ("matrix-line") and baseline as defined on the type ("type-line.")

35 This is my wording here, not Lanston Monotype's.

(your judgment of) the baseline of the type against this lining standard. Here is an illustration from the 1916 edition of *The Monotype System* showing this setup. (Note that in this illustration the solid metal triangular ("knife-edge") bar which shows the lining is represented as transparent so as better to show the operation.

Figure 3: Lanston Monotype Lining Gauge in Use

This use of a common baseline which is defined in the matrix design geometry means that all[36] Lanston Monotype composition faces will run with each other in the same matrix case. However, I presume[37] that potentially undesirable kerning may occur if there is not room for a larger face when a mold for a smaller body is in use. In *The Monotype System*, Lanston Monotype claims "infinite combination of Monotype faces," but emphasizes mixing body sizes while using a mold for the largest of the sizes mixed. For casting larger faces on smaller bodies, see "Varying the Type-line" (§282/pp.126-127 in 1912, §279/p. 108 in 1916)).

36 Again, except for exceptions.

37 I qualify this because I have not yet done it with my own hands.

3.1.4.1 Duensing's Drawing of Vertical Alignment for Lanston Composition

Here is an extract from a drawing from {*Matlas* 1988}: Fig. 11 which illustrates the right side bearing and what I'm calling here the "matrix-line" (that is, the common baseline alignment).

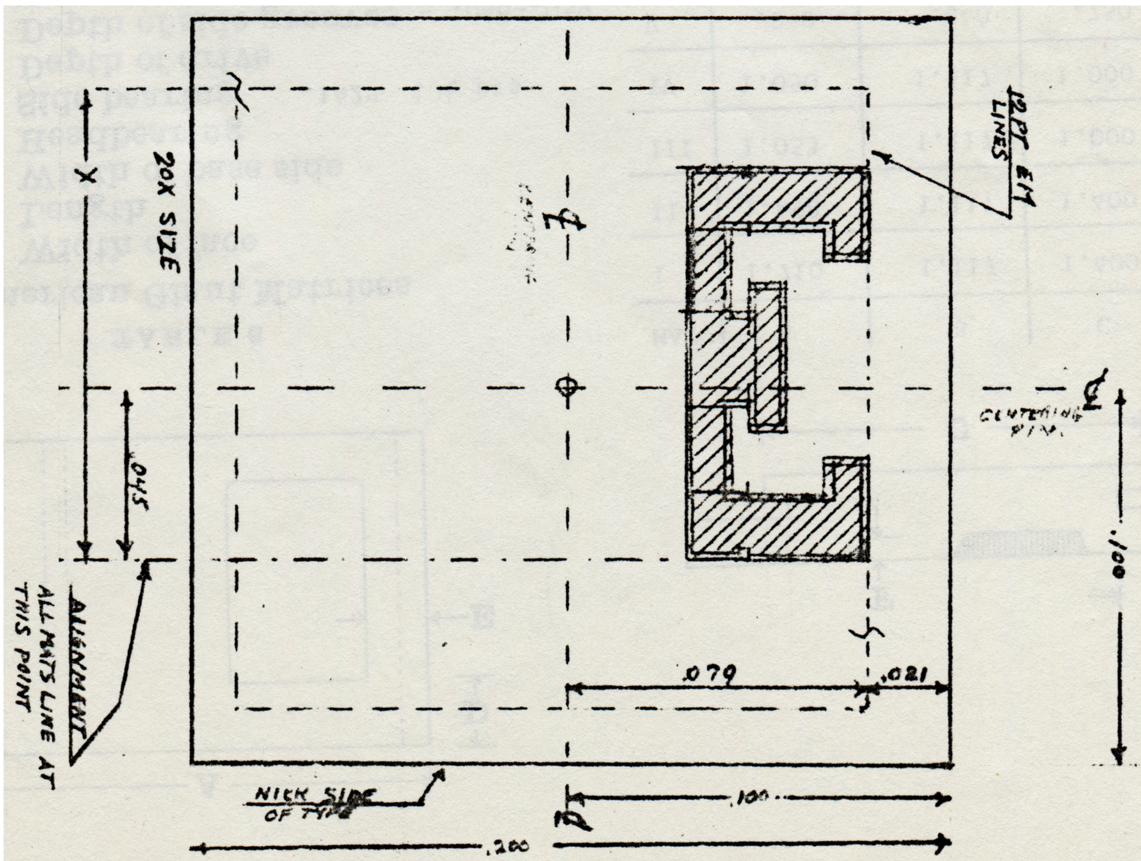


Figure 4: Lanston Cellular Vertical Alignment Drawing (Duensing)

It shows the matrix size (0.2" x 0.2"), the right side bearing (0.021") and the matrix-line (0.100 + 0.045 = 0.145). The dashed square within the matrix (called out as "12PT EM LINES") represents the body of a 12 point set, 12 point body type against the matrix. The doubled lines on the 'E' represent (qualitatively, not numerically) the width of the beard.

3.1.4.2 Duensing's Data for Vertical Alignment for Lanston Composition

Duensing gives a table showing "type-line," head bearing and foot bearing in {*Matlas*

1988}. I do not know his sources; he may have determined these values empirically. Here are his values. (I've added a computed value for the unnamed distance from the baseline to the nick-side of the type.) Duensing gives values only for 6, 8, 10 and 12 point bodies, but once you spot the regularity in the head bearings values for other body sizes would be easy to compute.

Body Size (points = inches)	Head Bearing (inches)	Type-line (anti-nick side to baseline) (inches)	(baseline to nick side) (inches)	Foot bearing (inches)
6 = 0.0829	0.080	0.0650	0.0180	0.0370
8 = 0.1106	0.060	0.0850	0.0257	0.0293
10 = 0.1383	0.040	0.1050	0.0333	0.0217
12 = 0.1659	0.020	0.1250	0.0410	0.0140

Table 3: Lanston Cellular Vertical Alignment Data (Duensing)

Type designers might with interest note that because the head bearings increase (or decrease, depending on which direction you're going) at a constant rate in decimal inches while the type bodies increase/decrease at a constant rate in American Printer's Points (1 point is 0.013833... inches, for Lanston Monotype), the relative position of the baseline on the type body is not constant. So, for example, with 6 point type the ratio between type-line and body size is (0.0650 / 0.0828) = 0.784, for 12 point type it is (0.1250 / 0.1659) = 0.0753.

3.1.4.3 A New Drawing of Vertical Alignment for Lanston Composition

Here is the situation for 6 point type bodies, represented graphically. The overall height of the bar represents the 0.2 inch height of the matrix. (The width of the bar is arbitrary; we're concerned only with vertical alignment here.) The black areas at the top and bottom of the bar are the head and foot bearings: matrix head to type anti-nick side above (0.080" here) and type nick-side to matrix foot below (0.0370" here). The two grey areas between them, taken together, show the nick-to-anti-nick dimension of the type (its body height[38], here 6 points or 0.08298") The distance on the type body above the baseline is the "type-line" (0.0650" here). The distance below the baseline was not given a name by Lanston, probably because it isn't referred to in the casting process (it is 0.0180" here).

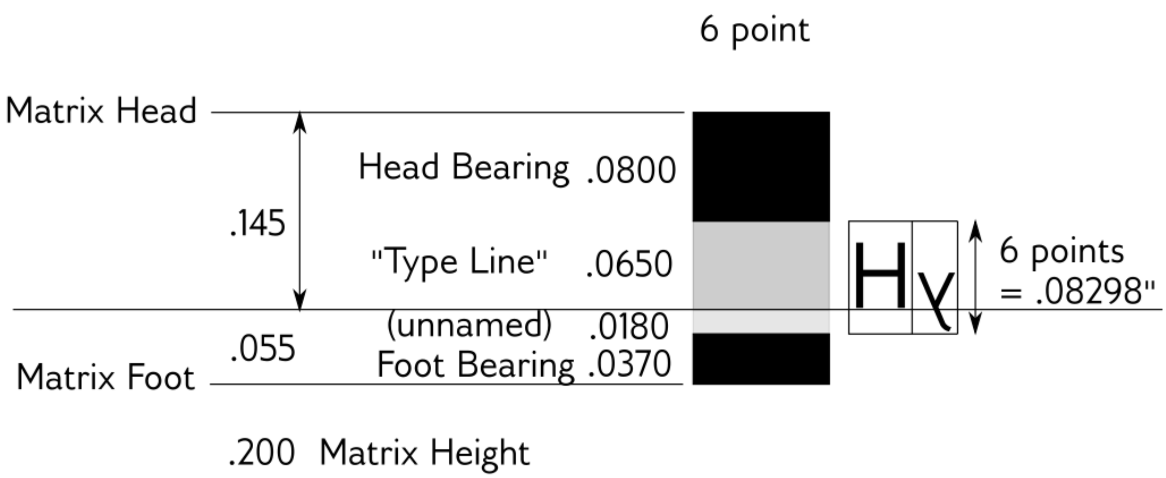


Figure 5: Lanston Cellular Vertical Alignment, Schematically, at 6 pt (DMM)

If you repeat this diagram for every type body size, you see a simple progression of vertical alignments which looks very similar to that of any regular type foundry.

38 This is the height of the type as you look at its face. "Height" can be a confusing term, though, because this height has no relation to the type's height-to-paper.

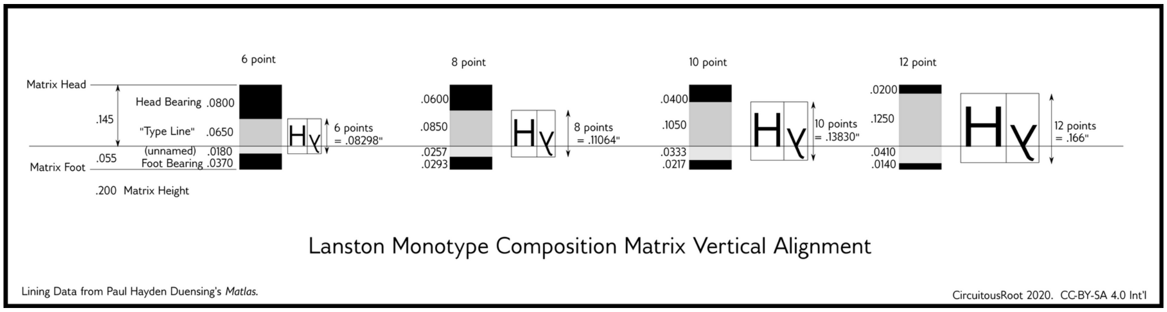


Figure 6: Lanston Cellular Vertical Alignment, Schematically, 6 to 12 pt (DMM)

3.1.5 Lanston Monotype's Explanation of Type-line

This all seems straightforward (and it is). But there is nothing so logical that it cannot be made confusing by well intentioned efforts to make it appear simpler.

In *The Monotype System*[39], Lanston Monotype tries to make their system sound different from that of

> "the so-called 'Standard Line Type' of the type-foundries, which requires the compositor to cut up leads when setting together two different point-size faces." (p. 108)

But this advantage is the case simply because the Monotype, like the Linotype,[40] can cast a smaller face on a larger body. This is enabled by the use of a single baseline at a fixed offset from the matrix head, but it is not otherwise inherent in Monotype's "type-line."

Lanston Monotype explains their "type-line" in this way:

> **The Type-line for Monotype Faces**, that is, the distance from the bottom of the serifs of the cap H to the top of the type opposite the nick, is the size of the body expressed in points, but written as a decimal to the hundredths place, *plus* .005". For example, the ten-point type-line is .10 + .005" = .105", the twelve-point type-line is .12 + .005" = .125", the five-and-one-half-point type-line is .05 1/2 (or .055) + 0.005" - .060". {Lanston 1916}: 108.

This is one of the strangest pieces of technical writing I have ever seen. It is not engineering; it is numerology. It asks you to take a value in points (example: 12 points,

39 {Lanston 1912}: 126 and {Lanston 1916}: 108. Page references here are to the 1916 edition.
40 Or a typefounder, but not in "real time" in the composing room.

which is 0.1659 inches) as a number and magically change the units of that number to hundredths of decimal inches (thus, 0.12 inches). Then you add an unexplained constant (0.005”). The result of this is a physical measurement on the type (0.125”)

To the best of my knowledge, no documentation survives in which the person(s) originating this lining system explained their motives, so what follows here is speculation. But it seems pretty clear that they decided to set the head bearing first, in simple decimal inch increments (0.2, 0.4, 0.6, 0.8). If you then select a single baseline on the matrix for all body sizes, all of the other numbers fall into place. If by chance or intent you select your baseline so that at one of the sizes the resulting “type-line” distance has almost the same numbers in it as the body size (e.g., .125 for 12 point has “12” in it) then the numerological trick described in *The Monotype System* works because you’re adding/subtracting decimal inches in the head bearing from decimal numbers of points (not the actual size of the points). But it works by accident. If, for example, for aesthetic reasons Lanston had chosen a type-line of 0.119 for 12 point (which would have been perfectly reasonable), this numerological trick would have failed (it probably never would have suggested itself).

This trick has one use: it gives a quick way to remember which lining standard to use for each body size.

But it is not meaningful either for the design of typefaces or the engineering of matrices. Lanston standard composition type-line is defined by head bearing and a fixed baseline, not by pretending that point sizes are hundredths of decimal inches.

3.1.6 Exceptions (Lanston Cellular)

Type is guaranteed to break just about any system you throw at it, so of course there are exceptions.

3.1.6.1 Lanston Special Matrix Line

Some faces are too tall for the standard alignment and cast with a baseline 0.005" than the standard. *The Monotype System* describes the procedures used for checking the alignment of these faces. (At the time, at least, they didn't supply a line standard for these faces but instead supplied a spacer ("liner") which allowed the use of regular line standards. However, Rich Hopkins has observed that in over 50 years of Monotype typecasting he has never seen such a "liner.[41]) See {Lanston 1912}: §287, p. 129 and {Lanston 1916}: §283, p. 110. This alignment is called "low line" in the glossary of *The Monotype System*. It is called "special matrix line" in "Monotype Matrix Information" {Lanston MMI}: §31.

The only face cited by both these sources is series 56J, Ionic (further, *The Monotype System* cites it only in 6 point). This series is shown in mid-century Lanston catalogs. But McGrew indicates that its number later was reassigned to "Gothic, Lining, #525."

3.1.6.2 Lanston Title Line

"Title line faces fill the type body and are lined at the bottom." {Lanston MMI}: §32. This source does not identify any title line faces (note that just having "Title" in the face's name does not necessarily make it a title line face).

41 Personal communication, 2020-10-06.

3.1.6.3 Lanston Lining Faces[42] / Plate Gothics[43]:

These are cap-only faces, but they are not titling faces. They were provided in multiple face sizes for each body size. They are designed so that each size, regardless of body size, lines with every other size of the face *when cast on their designated body*. This is subtly different from Monotype's standard lining, which achieves constant baselines between different type body sizes by casting on a single size of body.

For example, with a regular face you could run 6 point and 12 point together in the same matrix case (on a 12 point mold) and the baselines of both sizes would line up. But if you cast the 6 point on a 6 point mold the "type-line" of 6 point would be 0.0650 and its (unnamed) distance below the type-line is 0.0180. For the 12 point (on a 12 point mold, of course) these values would be 0.1250 and 0.0410. So a section of composition cast as 6 point on a 6 point body would *not* line with a separately cast section of composition cast 12 on 12 (their baselines would be 0.0180 and 0.0410 above the nick sides of the types, respectively).

For a specific comparison, consider any of the variations of Hess Stationers Gothic (series 84 (Light), 82 (Medium) or 85 (Bold)). Each of these series was cut in:

- Four face sizes at 6 point (Nos. 1 - 4), for composition
- Three face sizes at 12 point (Nos. 1 - 3), for composition
- Two face sizes at 18 point (Nos. 1, 2), for hand setting
- Two face sizes at 24 point (Nos. 1, 2), for hand setting.

Each point size used the same line standard (type-line), regardless of face size: 0.0710 for 6 point, 0.1540 for 12 point, 0.2370 for 18 point, and 0.3200 for 24 point.

42 The term "lining" as used here is quite confusing unless you've had hands-on experience with plate gothics or similar faces. It was a common term in the industry and not specific to Monotype. It was applied to faces such as the plate gothics which were commonly used to set things such as business cards and stationery. These faces were supplied in more sizes than there were available type bodies (thus, X pt No. 1, 2, etc.) and all of these face sizes had to be freely combinable in the same line of text without messing about with leading to make their baselines line up. So every size of the series was made to line with every other size (the distance from the baseline to the nick side of the type was always the same, regardless of body and face size), but this lining necessarily differed from whatever lining the foundry used for its other series of types.

43 If you have come to type through 21st Century graphic design, the term "gothic" may be a source of confusion as well. It is the traditional anglophone printer's and typefounder's term for the style of face which is now more commonly called "sans serif." The term has nothing to do with blackletter styles such as Fraktur. The two terms, "gothic" and "sans serif," are interchangeable synonyms, but when the face was called a "gothic" originally, it seems right to me to retain the terminology of its makers.

Working through the type dimensions, we get:

Body Size (points = inches)	- type-line	baseline to nick side
6 pt = 0.0830 in.	- 0.0710	0.0120
12 pt = 0.1660 in.	- 0.1540	0.0120
18 pt = 0.2490 in.	- 0.2370	0.0120
24 pt = 0.3320 in.	- 0.3200	0.0120

Because the baseline to nick side distance is constant at 0.0120, every body and face size of Hess Stationers Gothic will line with every other size of the same, in both hand and machine composition. They will not, however, line with "regular" Monotype faces in machine composition. Neither will Hess Stationers Gothic line with other lining faces such as Light Copperplate Gothic (series 340) or Lining Gothic (series 350[44]). There was some common lining between various lining faces / plate gothics, but in general each series has to be considered on its own.

{Matlas 1986} also cites "Scripts, Old English, etc." as examples of lining faces, but I have not yet been able to determine which faces Duensing meant.

3.1.6.4 Lanston H9 Long Descenders

Several Lanston series could be supplied with long descenders ("traditional length descenders"). {Lanston TLD} shows 14 such faces. Matrices with these descenders were identified with the symbol "H9". When used, these were cast on bodies at least one point larger than nominal (e.g., a 6 point face would cast on a 7 point or greater body). {Lanston TLD} gives a table for the line standards to be used in these cases:

Nominal Body on Actual Body (points)	Line Standard for long descenders (inches)
6 on 7	0.065
7 on 8	0.075
8 on 9	0.085
9 on 10	0.095
10 on 11	0.1050
11 on 12	0.1200

44 McGrew calls this "Lining Gothic #7 Modified."

12 on 14	0.1383

Note that for faces up to 11 points these long descender mats were supplied as regular 0.2" x 0.2" mats. But at 12 point (to cast on 14 point bodies) they were supplied as 0.2" x 0.4" mats. These required the use of a special mold. The English Monotype implementation of this feature involved even more sophisticated matrix engineering and also required special molds. For more on this see the Appendix on "Monotype Mixed Matrix Size Composition."

3.1.7 Errors and Contradictions

Unfortunately, various editions of *Matlas* contained both outright errors and also data incompatible with the version reported above. These need to be mentioned.

In {*Matlas* 1988} and {*Matlas* 2008} there is an inconsistency. In the text and in the drawings the value for the "matrix alignment" of the baseline is given as 0.145 inches (as above). But in Table 1, just above the first of these references, it is given as 0.164 inches. This value of 0.164 would seem to be an error.

In {*Matlas* 1988}, Duensing calls out the "matrix alignment" of the baseline as 0.145 inches (as above), but converts this to 10 1/4 points. This is not correct. 10 1/4 Lanston points is 0.141792 inches.[45]

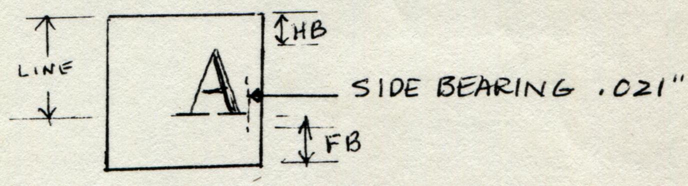
In the {*Matlas* 1986} (but not in {*Matlas* 1988}), Duensing reports data attributed by him both to the experienced typefounder John Carroll and to Baltotype. The most important difference in these values (vs. those given above) is that the "LINE" is not constant. It varies inconsistently from 0.1450" to 0.1490". It seems unlikely that this is correct, given the need for a single line in order for faces for different bodies to run together. Also note that in this table "FB" does not mean Foot Bearing. Instead, it is the value from the baseline to the matrix foot. According to the drawing which accompanies this table, FB + LINE should add up to the matrix height, but it does not.

45 Rounding to the millionths place, which ought to be good enough even for Bancroft.

Here's the table from {*Matlas* 1986}:

American comp mats in theory can nearly all be run together and the types cast will all align. The exceptions to this are, of course, lining fonts such as the four sizes of 6 or 12 pt. Copperplate Gothics, Scripts, Old English, etc. As the table compiled by the late John Carroll (Table 1) shows, the alignment is not always automatic or exact.

TABLE 1



POINT	HB	FB	LINE
6	.0840"	.036"	.1490"
8	.0618"	.0305"	.1468"
10	.0400"	.0231"	.1450"
12	.0207"	.0145"	.1457"

From Baltotype

Figure 7: Carroll / Baltotype Lining Information (Duensing)

3.1.8 Geometry and Dimensions

Here are two extracts from Fig. 11 of {*Matlas* 1988} which show the dimensions of a Lanston cellular matrix.

First the casting face:

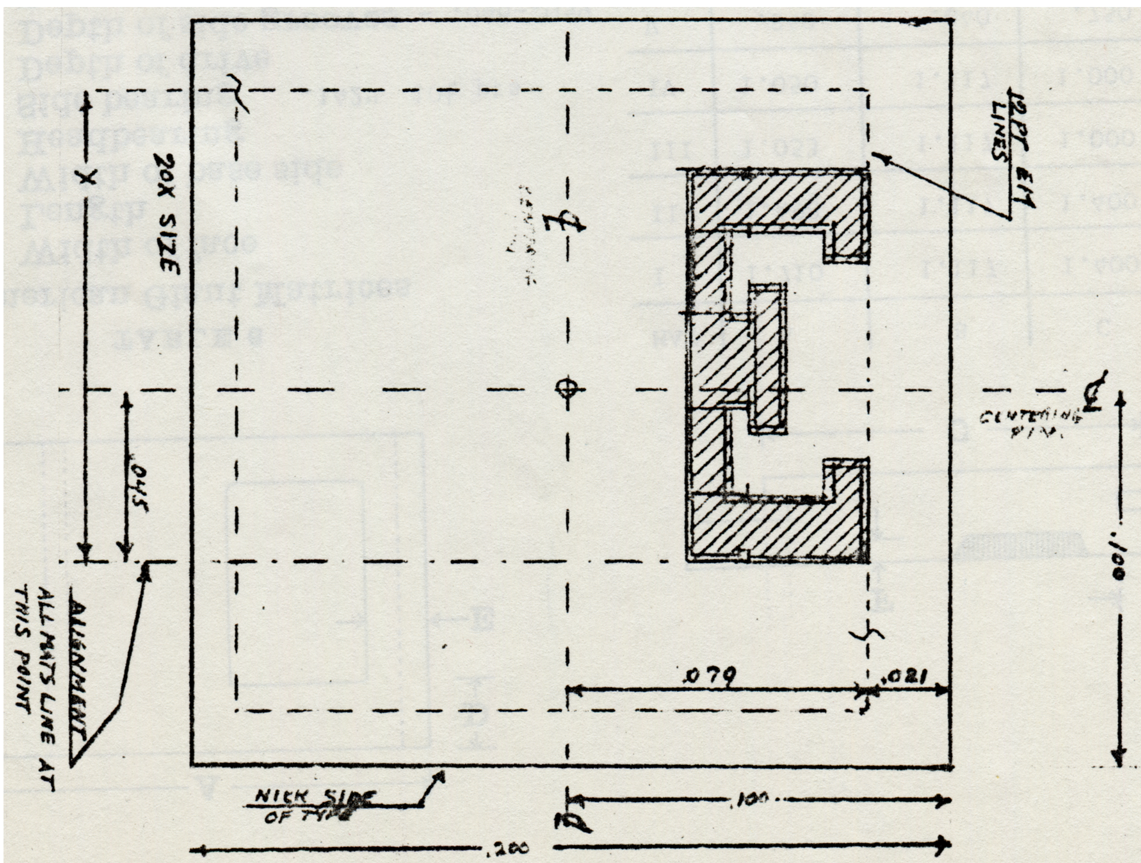


Figure 8: Lanston Cellular Matrix Face Dimensions, Drawing (Duensing)

And here the body:

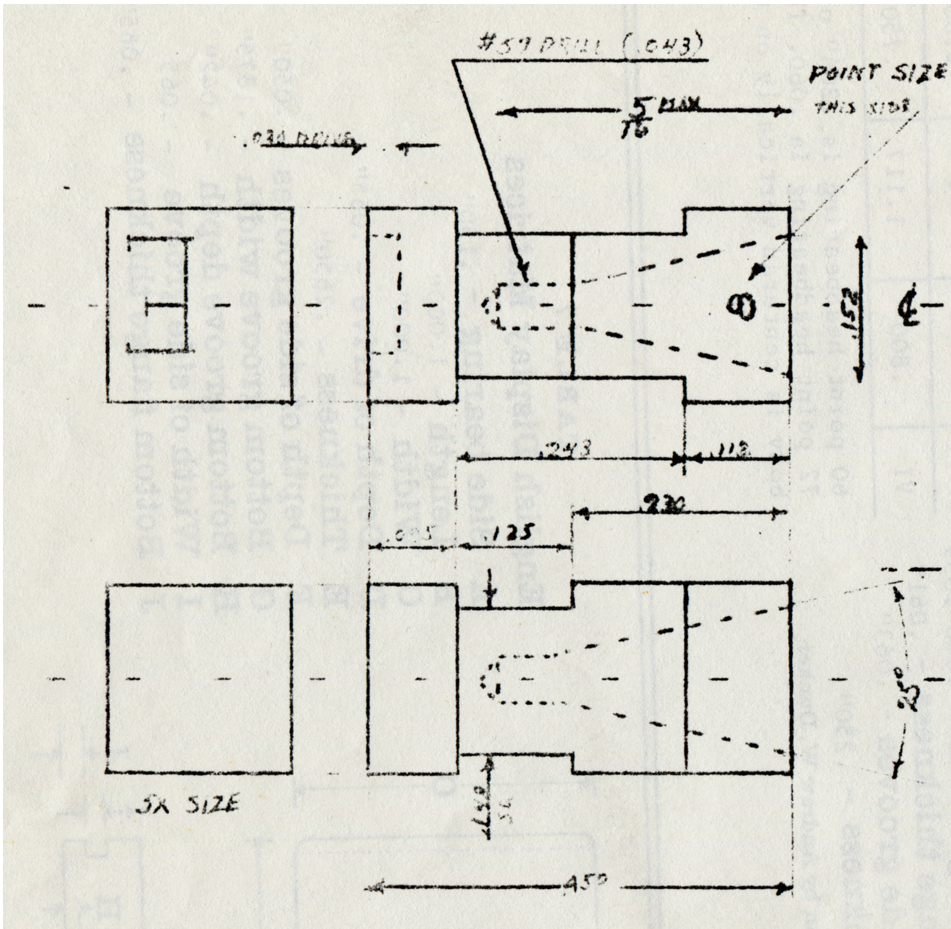


Figure 9: Lanston Cellular Matrix Body Dimensions, Drawing (Duensing)

3.1.9 Cellular Matrix Symbol Locations

Lanston cellular matrices were stamped with identifying alphanumeric symbols on two sides. With the character to be cast is in the normal reading position, the side to the left was the "point side," containing the body size in points and optionally other information, and the side to the bottom ("nearest the reader") is the "series side," containing the type series number and optionally other information. Here is the illustration used by Lanston:[46]

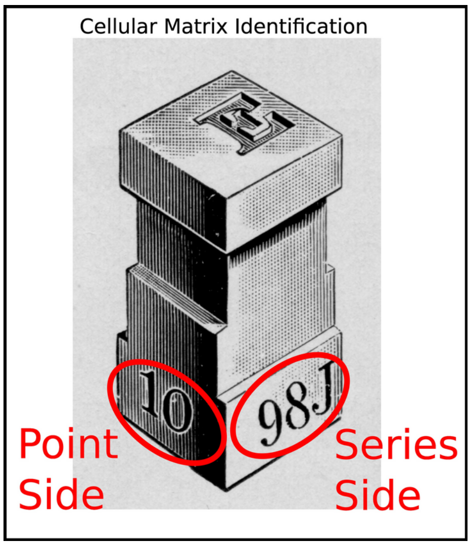


Figure 10: Lanston Cellular Matrix Sides, Identified for the Symbols they Carry

In addition to the self-explanatory point (body) size, several kinds of symbols appear in these locations:

- Series Side, Classification Symbols
- Series Side, Unit Value Symbols

46 From {Lanston MMI}, p. 7

- Series Side, Miscellaneous Identifying Symbols
- Point Side, Set-Sizes
- Point Side, Miscellaneous Identifying Symbols
- Dash Symbols
- Single and Piece Fraction Symbols
- Ruled Form Matrices for Composition
- Classified Sign Matrices, System For

3.1.10 Cellular Matrix, Series Side, Classification Symbols

For cellular matrices, Lanston Monotype used a single-letter suffix after the series number to indicate the "classification" of the typeface. The suffixes were:[47] [48]

Typeface Classification Symbols Used After the Series Number	
A	Modern Roman
B	Modern Roman small caps
C	Modern Italic
D	Modern Italic small caps
E	Old Style Roman
F	Old Style Roman small caps
G	Old Style Italic
H	Old Style Italic small caps
J	Boldface Roman
K	Boldface Italic
L	Typewriter, Mailing Lists, etc.
M	Foreign faces

Table 4: Lanston Monotype Classification Symbols Used after the Series Number

47 From {Lanston MMI}, p. 7.

48 {Lanston MMI} distinguishes the set of post-series letters A-H/J-M as "classification" symbols and N/P/Q/R/S/T/X/Y (to be discussed later) as "miscellaneous" symbols. {Matlas 1988} concatenates a subset of them into a single run of symbols A-C/E-H/J/K/M/N/X. Here I've decided to keep them in separate tables as Lanston did.

The series number indicated the series generally. Thus, the specimen book page for series No. 8 (Modern Roman) shown in several sizes simply said "No. 8".

Each matrix was stamped with the series number and a single classification letter. So for example the "98J" in the illustration above indicates that this matrix is of series No. 98, which is Cloister Black, and that in particular it is the Boldface Roman variation of Cloister Black.[49]

These suffixes may appear confusing to the 21st century typefounder, because they mix two kinds of information that we now think of as distinct.

Sometimes letters simply give helpful information about the general style of the typeface (Modern vs. Old Style, for example). So "61E" indicates series 36 (which is Hess' "Cochin") and classification 'E' (that this face is an Old Style Roman). A "61A" could not exist in principle because Cochin is an Old Style face while 'A' designates Modern faces.[50]

At other times the letters indicate what we would now consider to be variations within a single typeface (Italic vs. Roman or Small Caps, for example). So "61G" indicates Cochin (Old Style) Italic.

The system is incomplete in that it is not possible to specify all combinations (there is no way to classify explicitly a Modern Boldface Roman vs. an Old Style Boldface Roman, for example). It is not, however, as inconsistent as it would appear today. It was developed in the first decade of the 20th century, when modern ideas of what a "typeface" is had not yet settled down, and when the first commercially successful "families" of types were just beginning to appear. These classifying letters represent, in my opinion, an older approach to thinking about type – before the modern concept of a typeface with variations was firmly established.[51]

---

49 These distinctions are sometimes obvious, but this system is most useful when they are not. By way of contrast, the English Monotype face numbering system for composition does not include these suffixes. Rich Hopkins has observed that it can be extremely difficult to distinguish, say, an English Monotype series 270 (Bembo) roman comma from an italic comma in 8 point. With the Lanston system, the difference would have been indicated on the mat by the suffix. {Personal communication from RLH, 2020-10-14}

50 Kevin Martin notes, further, that some composition faces were available *only* as J and K, even though they were not explicitly "bold" faces (example: Franklin Gothic, Series 107). {Martin 2015-01-23}

51 For a polemical discussion of this, see {CR CC}.

3.1.11 Cellular Matrix, Series Side, Unit Value Symbols

[TO DO: a – s, from {Lanston MMI}, p. 7]

3.1.12 Cellular Matrix, Series Side, Miscellaneous Identifying Symbols

Miscellaneous Symbols Used After the Series Number	
N	A border or ornament
P	A sign
Q	A logotype (but not a ligature such as 'fi', 'fl', etc.)
R	A dash or leader
S	A bracket, parenthesis, brace, or piece brace
X	An unclassified character
Y	A brace

Table 5: Lanston Monotype Miscellaneous Symbols Used After the Series Number

Miscellaneous Symbols Used Before the Series Number	
T	Cross Rule

Table 6: Lanston Monotype Miscellaneous Symbols Used Before the Series Number

3.1.13 Cellular Matrix, Point Side, Set-Sizes

[TO DO: Z – M, from {Lanston MMI}, p. 7]

3.1.14 Cellular Matrix, Point Side, Miscellaneous Identifying Symbols

{Lanston MMI}, p. 7, defines meanings for symbols “Miscellaneous” symbols appearing after the point size. The symbols defined are A – G and H1 - H9.

Duensing, in all editions of *Matlas*, defines meanings for “Codes for Modified Characters,” without indicating where they appear. The symbols defined are H1 – H9, plus H12, H13, H22, H32, and H61.

Here is a composite table showing all of these symbols. If two definitions exist, separated by a slash, the one before is Duensing's and the one after is Lanston Monotype's.

Miscellaneous 'A' – 'G' Symbols Used After the Point Size	
A	Accent
B	Superior cap or figure
C	Superior lower case
D	Inferior cap or figures
E	Inferior lower case
F	Modern figures or Old Style Hanging Figures
G	Old Style lining figures

Table 7: Lanston Monotype Miscellaneous A-G Symbols Used After the Point Size

Miscellaneous 'H' Symbols Used After the Point Size	
H1	Shortened characters / Shortened descender
H12	Shortened descenders and condensed
H13	Shortened descenders and extended
H2	Condensed on a narrower body / more condensed than normal
H22	Condensed on a narrower body
H3	Extended on a wider body / more extended than normal
H32	Extended on a wider body
H4	Full face on body pointways[52]
H5	Shortened ascenders
H6	Central on body pointways
H61	Central on body and safe on a smaller body
H7	Low alignment / Low line
H8	High line / High line
H9	Means a multitude of things, including long descenders and re-designed characters / Redesigned

Table 8: Lanston Monotype Miscellaneous 'H' Symbols Used After the Point Size

Note: Some of these symbols (especially H4 and H9) were used with the same meanings by Lanston Monotype in describing their display matrices. For more on this, see the "Display Matrix Alphanumeric Codes" section of the chapter on Lanston Monotype Display Matrices, below.

3.1.15 Cellular Matrix Dash Symbols

[TO DO, system from {Lanston MMI}, p. 7]

52 I *think*, but have not confirmed, that this means a titling face.

3.1.16 Cellular Matrix Single and Piece Fraction Symbols

[TO DO, system and letters (J, K) from {Lanston MMI}, p. 7]

3.1.17 Ruled Form Matrices for Composition

[TO DO, system from {Lanston MMI}, p. 7]

[Note as distinct from Ruled Form System from display matrices, q.v.]

3.1.18 Classified Sign Matrices, System Form

[TO DO – synthesize from “Classified and Miscellaneous SIGNS for Monotype Machine Typesetting” from the loose-leaf specimen book.]

[Note: this system draws upon the Set-Size and Unit Value tables]

3.2 Lanston Large Composition

[TO DO]

4 Lanston Monotype Display

4.1 Kinds of Lanston (American) Display Matrices

The Lanston Monotype Machine Company made three overall styles of matrices for casting single types for hand composition:

- Display matrices intended for the Type-&-Rule Caster, for type body sizes up to 36 points. These are flat rectangular matrices with two distinctive beveled corner cuts.
- Display matrices for the Thompson Type-Caster for 42 and 48 point type body sizes only. These are flat rectangular matrices without corner cuts.
- Display matrices for the Giant Caster, for type body sizes up to 72 points.[53] These are thicker square or rectangular matrices with side grooves.

The present section will cover the first of these. The others will be discussed later.

4.2 Lanston Display for the Type-&-Rule Caster

4.2.1 Overview

The matrices manufactured by the Lanston Monotype Machine Company for use in their Type-&-Rule Caster[54] became the mainstay of independent typefounding in the 20th century, and are still in use today. While the Type-&-Rule caster could cast from 4 point to 36 point,[55] display matrices were used only for the 12 to 36 point bodies. (The low end

53 The largest body accommodated in normal orientation was 72 points, but the set could be larger and types could be cast sideways to an effective body height up to the limit of the set. Hopkins, in {ATFNL 32} (reprinted in {Matlas 2008}) shows a Giant Caster matrix intended to cast a 108 point character sideways.

54 The name of this machine is particularly troublesome. Lanston Monotype employed several different names for it – sometimes in the same document! It began as a display casting attachment for the ordinary composition caster. After the introduction of the fusion-casting capability it could cast strip material as well (if so equipped). In later use, Lanston seems to have settled on “Type-&-Rule Caster,” even when the machine was not equipped for casting strip material. With a suitable kit of parts, one could convert a Composition Caster into a Type-&-Rule Caster and *vice versa*. It is often informally called an “Orphan Annie.” The origin of this nickname is not known. The story still circulates that it is because of an “OA” prefix to the serial numbers, but Richard L. Hopkins has been unable to substantiate this by finding such a serial number. See {Hopkins 2012}, p. 205.

55 See the Lanston Monotype eight-page brochure "Monotype Type-&-Rule Caster", reprinted in {CR

of this range overlaps the high end of the composition matrix range.)

These were flat matrices with beveled cuts on diagonally opposite corners. Initially, and for decades after, they were electroformed. Early Lanston literature explicitly calls them "electro" matrices. A handwritten note by Duensing in his copy of {*Matlas* 1986} says "1950s most still electroed". Later they were punched in both brass and (more commonly) aluminum. In addition to their use on the Type-&-Rule Caster, with appropriate mold and matrix equipment they may also be cast on the Thompson Type-Caster, the Giant Caster, the Super Caster, and the Nuernberger-Rettig.

Here's the standard illustration of it that Lanston used for decades.[56]

`

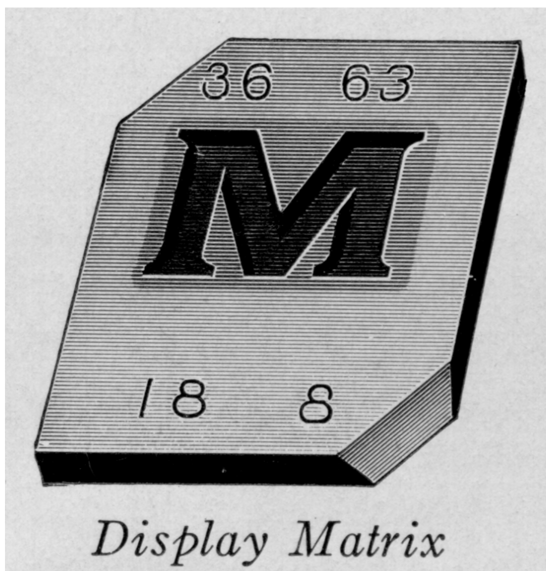


Figure 11: Lanston Monotype Display Matrix (to 36 pt)

TR } (Sales Literature section).

56 This illustration appeared as a photograph in {Lanston 1912}, but by {Lanston 1916} was redone as a line engraving. The version here is from {Lanston MMI} and probably dates from the 1930s or 1940s.

4.2.2 For the Hasty

Understanding the Lanston display matrix in detail and with some aspiration to accuracy turns out to be surprisingly difficult – a lengthy task beyond the patience of some. Here, then, is a quick simplified view of the matter. The caveat is that each gain in brevity is a loss in truth.

Size: 1 1/8 in. long x ¾ in. wide x 0.094 in. thick.

Shape: Diagonal corner cuts top left and bottom right at a 30 to 35 degree angle to the long axis, beveled 60 degrees, sized to fit Lanston Monotype X41A Matrix Holder.

Depth of Drive: 0.050 in.

Side Bearing: 8 points (0.1107 in.) at all body sizes.

Head Bearings:

Body Size (in points)	Head Bearing (in points)
12	32
14	30
18	26
24	32
30	26
36	20

Table 9: Lanston Monotype Display Matrix Head Bearings

4.2.3 Prehistory

The display casting attachment for the Lanston Monotype caster was announced in 1903.[57] The patent for this was {US 883,378}, issued to John Sellers Bancroft and Mauritz C. Indahl and assigned to the Lanston Monotype Machine Company. It was filed December 1, 1904, but not actually issued until March 31, 1908.

However, the Bancroft/Indahl patent specifies a rectangular matrix without corner cuts. The distinctive Lanston Monotype display matrix with its corner-cuts on diagonally opposite corners was patented by William Elmer Chalfant in {US 904,510}. This was filed on October 12, 1907, but not issued until November 24, 1908. This issue date is stamped on the back of most Lanston Monotype display matrices. (This date has no other significance, and does not indicate a date of manufacture. It appears on matrices clearly made after the patent expired.) I do not know what form of matrix was employed by the very early display casting attachments in the 1903-1907 timeframe.

But while the Chalfant patent established the matrix geometry, it employed a matrix holder which substituted for the entire die case. A holder of this style is illustrated in the original 1912 edition of *The Monotype System* ({Lanston 1912}, p. 174). The now more familiar removable "Sorts Matrix Holder Slide"[58] [59] was not described until a 1915/1916 patent by John Sellars Bancroft and Mauritz C. Indahl {US 1,193,345}. This style of holder is shown in the 1916 second edition of *The Monotype System* ({Lanston 1916}, p. 160). This change in holder design has no bearing[60] on the matrix design.

For a further discussion of this, with reprints of the patents, see {CR TR Mats}.

4.2.4 Sizes

The five most common body sizes for display matrices are: 14, 18, 24, 30, and 36.

Physical bodies down to 12 point could be cast on the Type-&-Rule Caster. Some faces smaller than this, issued on display matrices, were designed to be cast on 12 point bodies. For example, series No. 166, Heavy Copperplate Gothic Extended, was issued in

57 In a four page insert following p. 328, by Wood & Nathan Co., the "sole selling agent" for the Lanston Monotype Machine Company. *The Inland Printer.* Vol. 32, No. 3 (December, 1903). Reprinted in {CR Lanston 1903}.
58 So called in {Lanston 1916}, p. 160, for example.
59 More formally the X41A Matrix Holder (for Display Matrices) group. {Lanston 1941}, p. 6.
60 Pun intended, of course.

8 point and 10 point sizes for casting 8-on-12 and 10-on-12.

Other sizes were also offered, including: 16, 20, 21, and 22 point.[61]

Lining faces were sometimes issued in multiple face sizes per body size. For example, series No. 85, Hess Stationers Gothic Bold, was issued in three sizes at 18 point (No. 1, 2, and 3).[62]

4.2.5 Depth of Drive

All Lanston Monotype (that is, American) display matrices have a depth of drive of 0.050 inches.

4.2.6 Side Bearing

Duensing writes:

> All American Monotype Display Mats have uniform side-bearings of 8 points or .1107"

With a point of 0.013,8, eight points would be is 0.110,4 inches. It would seem, however, that Duensing was being more accurate. If he employed the 1886 Type Founders' Association point to six decimal places (0.013,835), eight points is 0.11068. If he employed the ATF point of published in 1902 (0.013,87), eight points is 0.110,696. If he employed the Monotype point of 0.013,833, eight points is 0.110,664. Each of these values rounds to 0.110,7.[63] (For a more detailed discussion of the value of the American printers' point, see the Appendix "What's the Point?" at the end of this present work.)

4.2.7 Head Bearings

Later versions of *Matlas*[64] give the following values, in points, for head bearings for

61 See {Lanston 1955}. Series 790 Stymie Bold was issued in 21 point display matrices; see {Lanston Stymie 21}

62 Curiously, while it was only *issued* in a single size at 24 point, that size was No. 2.

63 Tthe value that Duensing published under his own typefoundry letterhead in {*Matlas* 1986} and repeated in {*Matlas* 1988} was taken to only five places (0.013,83). This produces a value for 8 points of 0.110,64, which rounds to 0.110,6, not 0.110,7.

64 {*Matlas* 1988} and {*Matlas* 2008}, but not {*Matlas* 1986}

Lanston Display matrices. Schuyler R. Shipley has confirmed[65] that these are correct in his experience.

Body Size (in points)	Head Bearing (in points)
12	32
14	30
18	26
24	32
30	26
36	20

Table 10: Lanston Monotype Display Matrix Head Bearings

For an explanation of why the progression of head bearing values is not uniform, see the next section.

I do not yet know the head bearings for the less common sizes (16, 20, 21, and 22 point).

The 1986 version of Matlas had a more complex table which included a "Balto & Mono" section which appears to conflict with the "Mono. Std." information reprinted above. For a discussion of this, see the Appendix: Uncertain Information: Duensing's "Balto & Mono" Table.

4.2.8 Foot Bearings and Mold Styles

Matlas also gives "foot bearing" information for Lanston Display matrices.[66] This is a curious dimension, for two reasons.

First, it is not necessary, either for making or casting from a matrix. The matrix bears upon its holder on its left and top sides *only*. The side bearing (to the left) and head bearing (to the top) fully define the position of the type body relative to the matrix edges and the matrix holder.

Second, it has long been recognized that you cannot control both a chain of

65 In a telephone conversation, December 2014.

66 All editions also give Thompson foot bearing information within the Lanston Display section. The 1986 edition also gives Baltotype foot bearing information, again within the Lanston Display section.

dimensions along a line and an overall dimension of the same line.[67] Thus, if a matrix has a defined overall length (head to foot), and if that overall length is composed of a head bearing, a body size, and a foot bearing, you cannot simultaneously dimension and tolerance all four of these values. Something's got to give. Since the foot bearing is an unnecessary dimension, if it is included at all it should be made clear that it is a nominal or (in drafting terms) “reference” dimension.

However, the foot bearing is useful in understanding why the sequence of head bearing values does not decrease uniformly as body siz e increases.

The Type-&-Rule casters uses two different styles of mold to accommodate the range of bodies it cast. Duensing calls these “T-Molds” and “U-Molds.” More formally, Lanston called them Style 1T and Style 1U Sorts Casting Molds (and their successors).[68] The “T-Mold” is for 12, 14, and 18 point bodies. The “U-Mold” is for 24, 30, and 36 point bodies.

Each of these two styles of mold was designed to use a constant “foot bearing” for all of the body sizes was made for, and a different head bearing for each body size. The foot bearing for the T-Mold is 36 points; for the U-Mold it is 24 points. This arrangement becomes relatively clear when presented in a drawing:

67 For an early, and more general, description of this, see {Buckingham 1921}, p. 48.

68 See {Lanston 1T/1U 1918} and {Lanston 2T/2U 1949} I do not yet know if later versions were introduced. Aside: Do not conflate Monotype sorts casting molds such as the T and U molds with Monotype composition molds such as the 2E, 3E, etc.

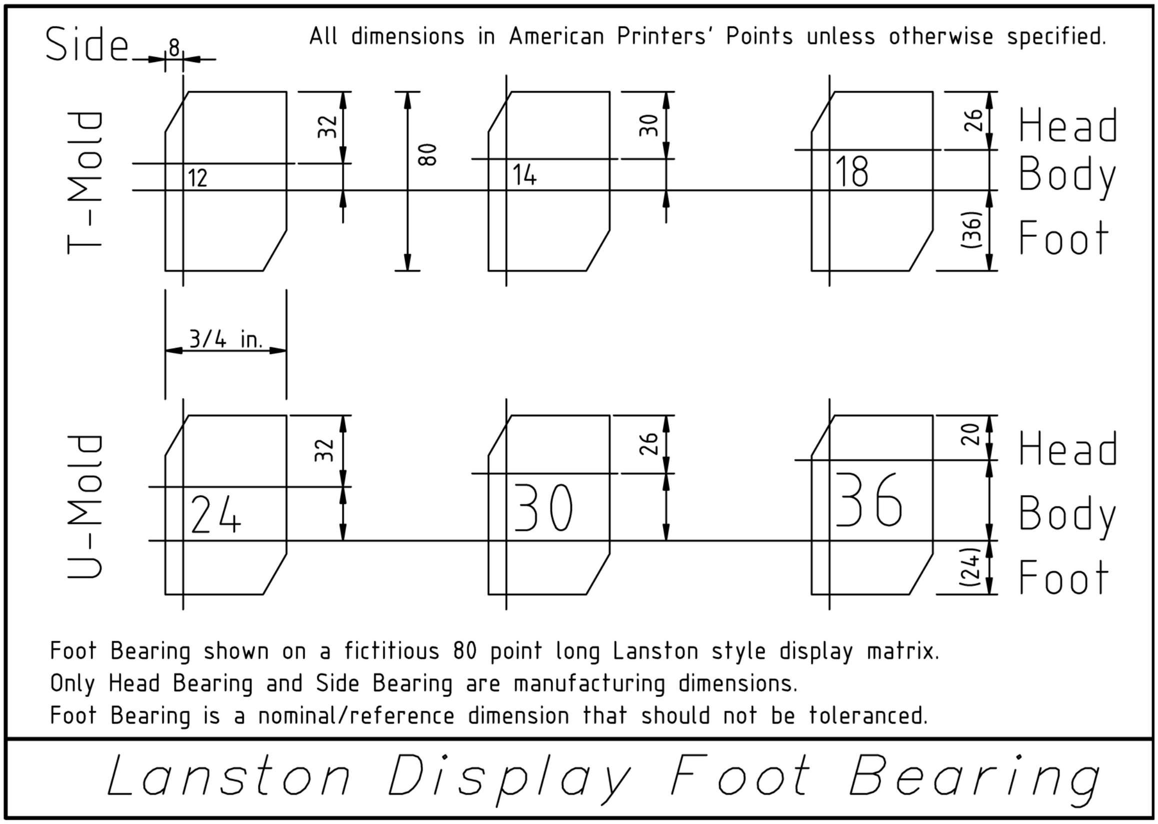


Figure 12: Lanston Display Matrix Foot Bearings (12 to 36 pt)

The only problem with this is that we do not in fact know the intended length of a Lanston Monotype display matrix (see the next section for a discussion of the problems). Whatever their length “really” is, it probably isn't 80 points..

It would be best, then, to use “foot bearing” for Lanston display matrices as a way of understanding why the sequence of head bearing values is nonmonotonic, and then to forget about it.

4.2.9 Maximum Set Width

The maximum set width of type cast using Lanston Type-&-Rule Caster matrices is not yet clear.

In *The 'Monotype' Casting Machine* {Monotype UK 1952} TO DO: 48pt

4.2.10 Casting Lanston Display Matrices on English Moulds

English display matrices are designed such that when cast on an English Type-&-Rule Caster their type is centered over the jet (which is not the case with the constant foot bearing of the Lanston system). This means that when casting Lanston display matrices on English molds for English Type-&-Rule Casters special provisions must be made for this difference in vertical alignment.

Kevin Martin writes:

> The English display moulds all have the same alignment of the center of the type body, keeping the type centered over the jet for all sizes. There is a special holder 49A for Lanston mats used with English moulds which has a continuously adjustable cone hole position to allow proper alignment of the Lanston mats.[69]

4.2.11 Casting Display Faces as Titling on a Smaller Body

[NOT DONE: Investigate the use of inserts a41A18 - a41a27 in the X41A (Lanston) matrix holder for aligning matrices for casting them as titling faces on a smaller than intended body. There may also exist inserts 72S17/22/23 and 72S18/24/25 for a 72S matrix holder, but these are not well attested.[70]]

4.2.12 Planchet Issues

Given the ubiquity of the Lanston display matrix, it is surprising how difficult it is actually to define its external geometry and dimensions. The problem has to do with cutting corners, in both a literal and a figurative sense.

In the one case, these matrices are difficult to measure and define because they involve compound angle cuts to their corners. These would be relatively complicated to describe in a perfect world. When they must be re-derived from existing matrices which typically have banged-up corners (so that the point you're measuring doesn't actually exist in metal any more), the situation deteriorates.

In the other case, the mechanism of the Bancroft/Indahl 1915/1916 matrix holder design is robust and admits of considerable variation in matrix form. Lanston's

69 Personal communication, 2015-01-22.
70 Kevin Martin, personal communication 2015-01-22.

production engineers knew this, and took advantage of it. The result is that in certain basic dimensions (such as length) there is so much variation in surviving examples that is isn't really possible to say what the value should be.

4.2.13 Planchet Overall Length

It would appear, generally, that Lanston display matrices are 1 1/8 inches long (1.125 inches). Duensing cites this as one of his values, and matrices made to this length will work in both the Type-&-Rule caster and the Thompson.

But there is a variation of more than 0.01 in those matrices I have examined, with values up to at least 1.136 inches. Duensing uses two different values in the same sentence: 80 points (1.1068) and 1.125 inches.[71] Roy Rice used 81 points (1.1206 inches).[72] Moreover, in actual practice the bottom edge of some Lanston-manufactured display matrices is anything but straight – some are distinctly wavy. As such, they do not even have a defined length (or, rather, they have a length with such broad tolerances that ordinary careful workmanship would produce better results).

4.2.14 Planchet Overall Width

It would appear that the overall width is ¾ inch. Roy Rice used 0.75 inches.[73] It would probably be unwise to look to precision to three decimal places. Duensing in 1988 used 54 ¼ points (which is 0.7506), but converted this to 0.747 inches[74] [75] Examples measured to date range up to 0.759.

A matrix made to $0.75^{-0}_{+0.01}$ would, I believe, work in both the Type-&-Rule Caster and the Thompson. Actual tolerances are probably broader than this.

71 {*Matlas* 1988}, p. 4 and {*Matlas* 2008}, p. 4.
72 {Ride MDMD}
73 {Rice MDMD}
74 {*Matlas* 1988}, p. 3, and {*Matlas* 2008}, p. 3.
75 This would give a nonstandard point of 0.013769, which is not, I think, what Duensing intended. Rather, I think that the 0.747 is a holdover from {*Matlas* 1986}, p. 3, where he used a width of 54 points (which is 0.74709 inches).

4.2.15 The Three Styles of Lanston Display Matrices for the T&R Caster

As noted earlier, Lanston Monotype display matrices for the Type-&-Rule Caster were produced in three major variants: brass electroformed, brass punched, and aluminum punched.

Brass, Electroformed Brass, Punched Aluminum, Punched

Three Styles of Lanston Display Matrices

Figure 13: Three Lanston Monotype Display Matrices, Front and Back

The brass electroformed version, which is the oldest style, is nominally flat on the front and back. All Lanston matrices appear to have been stamped with the Chalfant patent date, regardless of their date of manufacture. Note however that it was (and is) common practice among amateur matrix makers to drill out unwanted Lanston matrices to make planchets for electroforming new matrices.

The right and, especially, the bottom edges of the brass electroformed matrices are frequently not straight, but this does not matter in matrix alignment.

Both styles of punched matrix bear the patent date on the back in relief within a channel.[76] Both punched styles have what appears at first to be a raised center section. Actually, this center section is the standard matrix thickness (0.094 inches, approx.). The two sides are of lesser thickness (approx. 0.090). The edges of this center section are often quite rough, and both front and back typically show quite distinct surface patterns from milling. This front-surface geometry is not relevant at all to the use of these matrices on the Type-&-Rule caster (which holds them by the corner chamfers) and is not relevant to their use on the Thompson (there is enough freedom of motion in the Matrix Holder that you don't even notice that you're gripping the matrix 0.004" below its front surface).

Note: The circular shadow visible on the back sides of the punched matrices shown is due to the X41A Matrix Holder on the Type-&-Rule Caster.

All four main sides of the brass electroformed matrices are relatively sharp, suggesting that they were cut. The left and right sides of the punched matrices (both brass and aluminum) are similarly sharp, but their top and bottom sides have a slight radius. This, together with vertical striations on these sides suggests that they may have been sheared or pressed on these edges. Here is a close-up photograph of the top left corner of a brass punched matrix:

76 I have at least one font of flat-backed aluminum punched mats, but they are under-height and appear to have been milled down.

Figure 14: Lanston Monotype Brass Punched Matrix Top Left Corner, Close-Up

This photograph shows clearly:

- The rounding of the upper edge of the top side (to the left in the photograph).
- The vertical striations on the top edge.
- The two levels of the surface.
- The coarse and indefinite nature of the transition between the two levels of the surface
- The fact that the exact corners of the bevel are by no means easy to define, up close, and typically are not physical features in metal.

4.2.16 The Corner Cuts

The distinctive beveled corner cuts on the Lanston display matrices are the most difficult feature on them to describe accurately. Fortunately, they are also the least important feature and probably also the feature which allows for the greatest variation. They are used *only* for holding the matrix into the matrix holder on the Type-&-Rule caster. They are not used at all when casting on other machines such as the Thompson.

To the best of my knowledge, original engineering specifications for these matrices do not survive. Reconstructing approximate specifications which will work is easy, given the wide tolerances allowed. Reconstructing *exact* specifications is nearly impossible, as the several points of the corner bevel that one would expect to measure are typically either rounded off or, on close examination, consist instead of complex geometries which are probably not part of the bevel itself.

It is perhaps best to try to understand the corner cuts in terms first of their function and then of at least one method probably used to produce them. This will, in turn, help to put measured drawings in perspective.

Here are two photographs of a brass electroformed display matrix in a Lanston X41A Matrix Holder. On the left, the holder is shown open, on the right it is shown closed on the matrix. The views are as you would see the holder when holding it in your hand (that is, the handle is beyond the bottom side of the photographs).

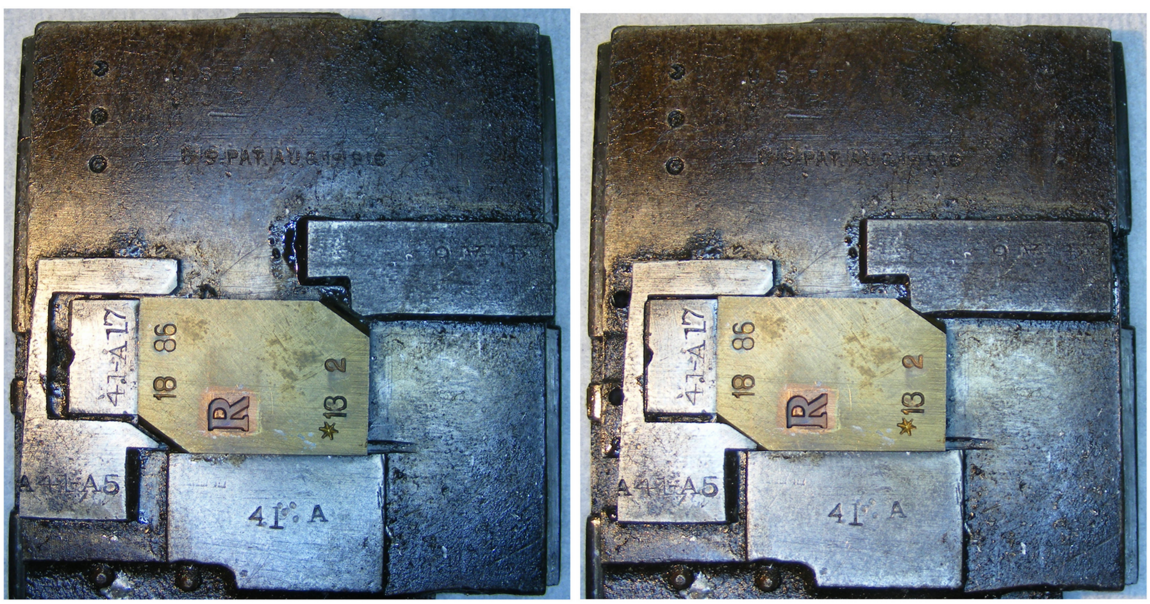


Figure 15: Lanston Display Matrix in X41A Matrix Holder, Open and Closed

The top side of the matrix banks against the fixed abutment 41A17 (on the left in the photograph), while the left side of the matrix banks against fixed abutment which is a part of 41A (on the bottom in the photograph).[77] The corner bevels play no part in positioning the matrix.

77 This abutment is not a separate part, but is cast and machined as an integral part of the 41A Matrix Holder's main casting.

In the left photograph, the two sliders which will clamp the matrix in are shown retracted.

In the right photograph above, and in the closer view below, the long rectangular slider 41A6 at the upper right of the photograph has moved leftward under spring pressure to push against the lower right bevel of the matrix. The C-shaped part a41A5 on the left has moved rightward and just a little bit downward. It both clamps down on the matrix's upper left corner bevel and pushes against the upper right side of the mat. (I presume that the spring pressure acting on it is less than that acting on 41A6.)

It's clear that these corner bevels will work even with quite a wide variation in their form.

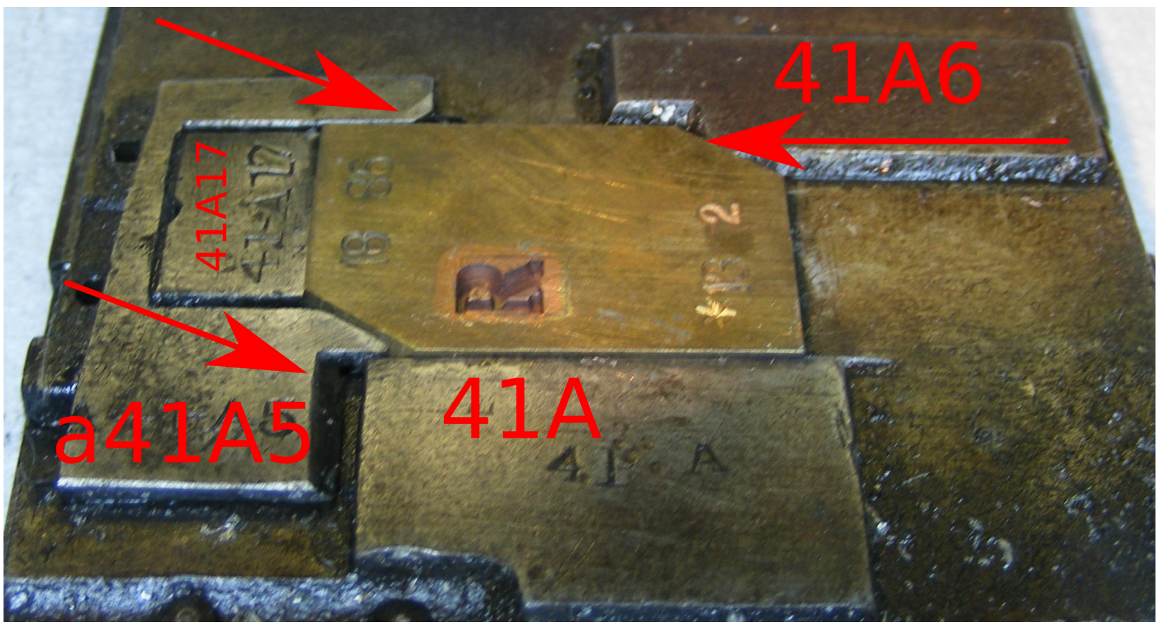


Figure 16: Lanston Display Matrix in X41A Matrix Holder, Parts and Motions

Now let's consider how such corner bevels might have been made. I have no idea how Lanston Monotype actually did it; to the best of my knowledge, the display matrix machinery has not survived.[78] But the equipment that Andrew Dunker used to machine his matrices has survived. It represents the way in which an expert machinist trained in the late 19th century would have approached the matter, and it is possible that Lanston Monotype employed a similar method on a larger scale.

78 I'd love to be wrong about this.

Dunker employed a metalworking shaper to machine his mats.[79] The vise he built for holding matrices for it is designed both for finishing the matrix surfaces and for making corner bevels (though I am not aware of any Dunker matrices with corner bevels). In the photograph below, it is shown as Dunker left it, with a matrix being held in its top part for surface finishing. Ignore this, and assume that it has been folded out of the way. Instead, look at the channel on the side. If you were to put a matrix planchet in it and clamp it down (probably using the socket-head screw to the right), and then were to pass a cutter horizontally over the top,[80] you would generate the corner bevel.

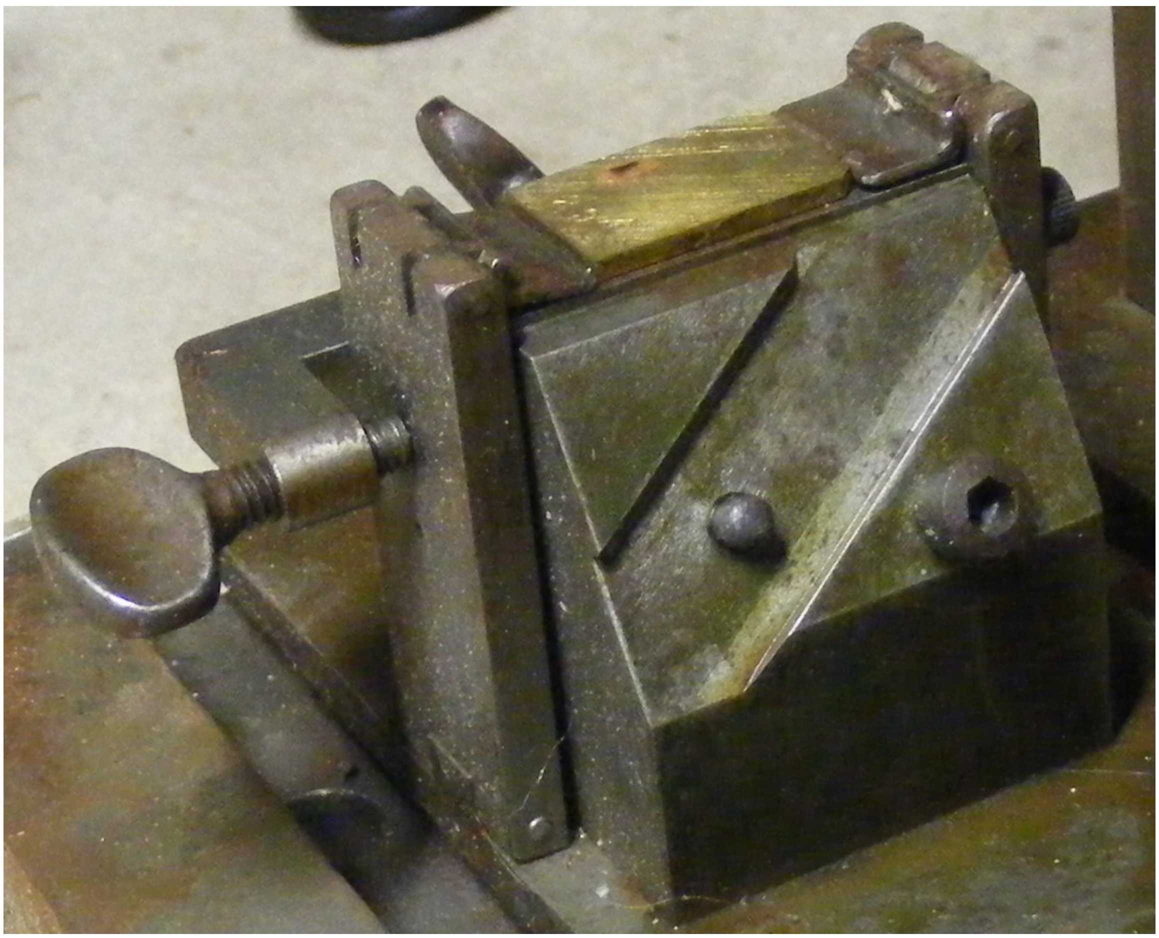


Figure 17: Andrew Dunker's Matrix Vise on His Metalworking Shaper

79 An E. N. Boynton traversing head shaper. For more information on it, see the section "Dunker Matrices for the Thompson," below.

80 Either the shaper's cutter as Dunker used it, or a conventional milling cutter.

From the point of view of specifying a matrix, the important thing here is that the depth and dimensions of the corner bevels depend on the length of the matrix, not on each other or on common datums. In modern engineering drawing practice, the natural thing to do would be to establish two datums (probably at the head and side bearing sides of the matrix) and then to define both corner bevels relative to these. Feed this into a CNC mill and you're done.

But to accurately draw the matrix as it would be fixtured and cut in Dunker's vise, you would instead specify the two angles (corner cut angle and bevel angle) and the overall length of the matrix. Here is a graphical comparison of the two methods, simplified to two dimensions (ignoring the bevel angle):

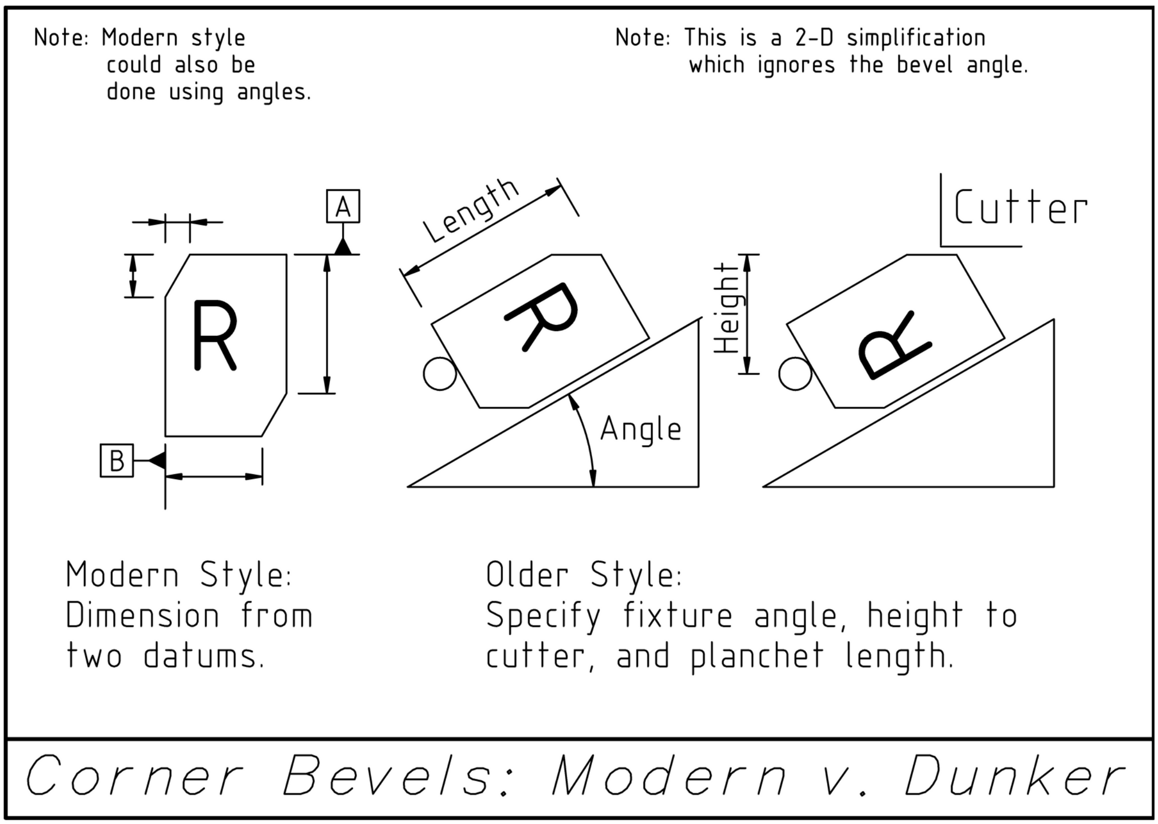


Figure 18: Modern (Quasi-GD&T) vs. Fixturing Methods for Lanston Corner Bevels

4.2.17 Measured Drawings

Evidence is always nice. Here are measured drawings of Lanston display matrices.

[TO DO: Only have one so far – do brass punched and an aluminum punched matrices.]

After several days of attempting to measure mats using height gages on surface plates, microscopes, etc. I realized that the best approach would be, instead, to capture an image at known size and work from it. Ordinary office flatbed scanners turn out to be remarkably accurate for work actually in contact with the glass.[81] A resolution of 1200 dpi is good enough for this work. I then imported the image into a 2-D CAD program capable of drawing proper lines and measuring dimensions.[82]

Here is a scanned image and measured drawing of the front and back of a brass electroformed Lanston display matrix.[83]

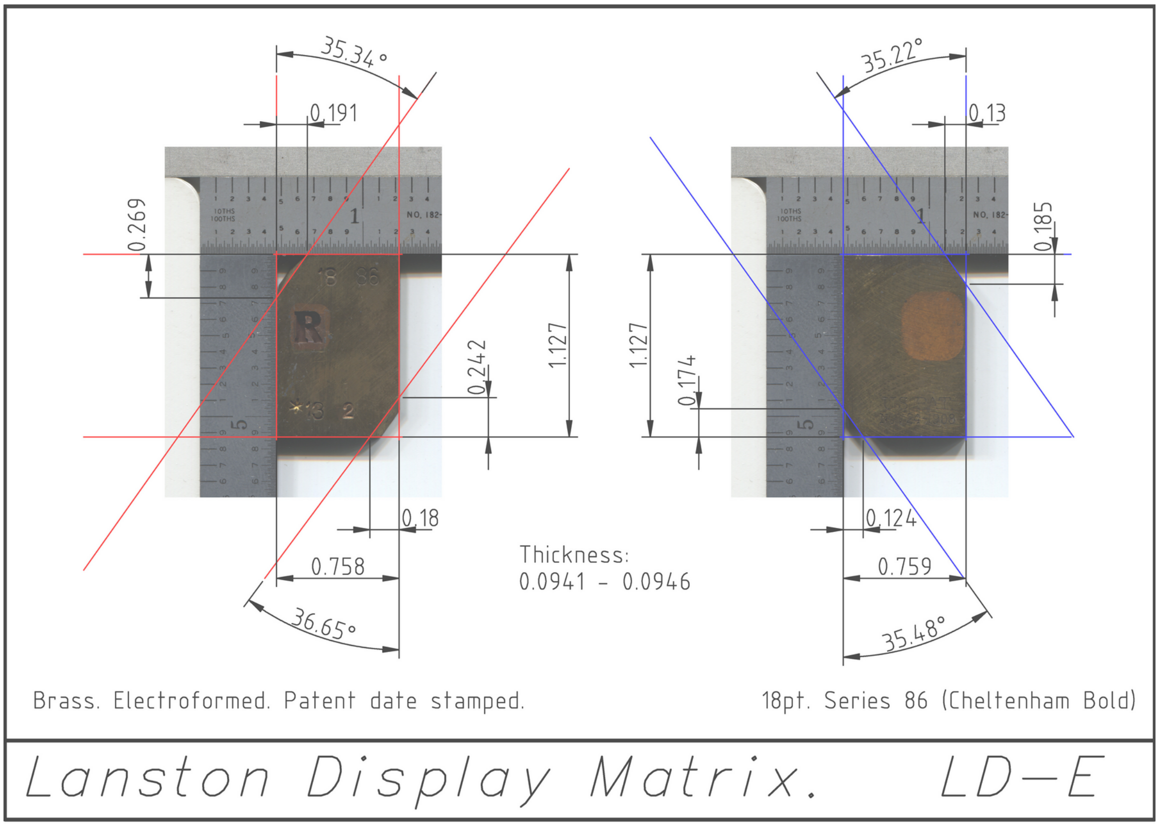


Figure 19: Lanston Brass Electroformed Display Matrix, Analyzed

81 They become inaccurate as measuring tools very quickly as you go above the glass.

82 I use LibreCAD, but any 2-D CAD program should work. Inkscape is not sufficient – it is very difficult to do an *accurate* drawing in it.

83 "LD-E" is simply an identifier for the sample: Lanston Display specimen E.

4.2.18 Display Matrix Markings; Reading Set Widths

Four numbers (and optionally an asterisk) appear on the non-casting portions of the front of a Lanston display matrix.

The upper left number is the body size of the type to be cast, in points. (But see the next section on “Display Matrix Additional Marking and Coding” for modifiers to this value.)

The upper right number is one of two things:

For regular matrix fonts of letters, figures, and points, this number is the Lanston Monotype series number of the face. Tables of Lanston Monotype series numbers are available online at {CR MDST} and in print in {McGrew 1993}. Note that American (Lanston) and English Monotype series numbers are unrelated.

For ornaments, this number is the ornament number. See the next section, “Display Matrix Additional Marking and Coding,” for an example of this.

The two bottom numbers (and optional asterisk) indicate the wedge positions for the Type-&-Rule Caster when using this matrix. The left number gives the setting of the 47S Normal Wedge, the right number gives the setting of the 46S Justification Wedge, and the asterisk, if present, indicates that the 60S Abutment-Screw Packing Piece must also be in position.[84]

These numbers can also be interpreted as the intended set width of the character. This can be useful when casting the matrix on machines other than the Type-&-Rule Caster (such as the Thompson Type-Caster). The left number (the Normal Wedge number) indicates the number of whole points in the set. The right number (the Justification Wedge number) indicates the number of additional eights of a point. If the asterisk is present, then the sum of these two numbers is the set width. So for example if these numbers are 16 and 6, then the set width is 16 + (6 * 1/8) = 16 ¾ points. If the asterisk is *not* present, then add 17 points to the result. Thus if the numbers are “*16 2” the set width is 17 + 16 + ¼ points, or 33 ¼ points.

Here is this information visually:

84 See for example {Lanston 1916}, p. 164.

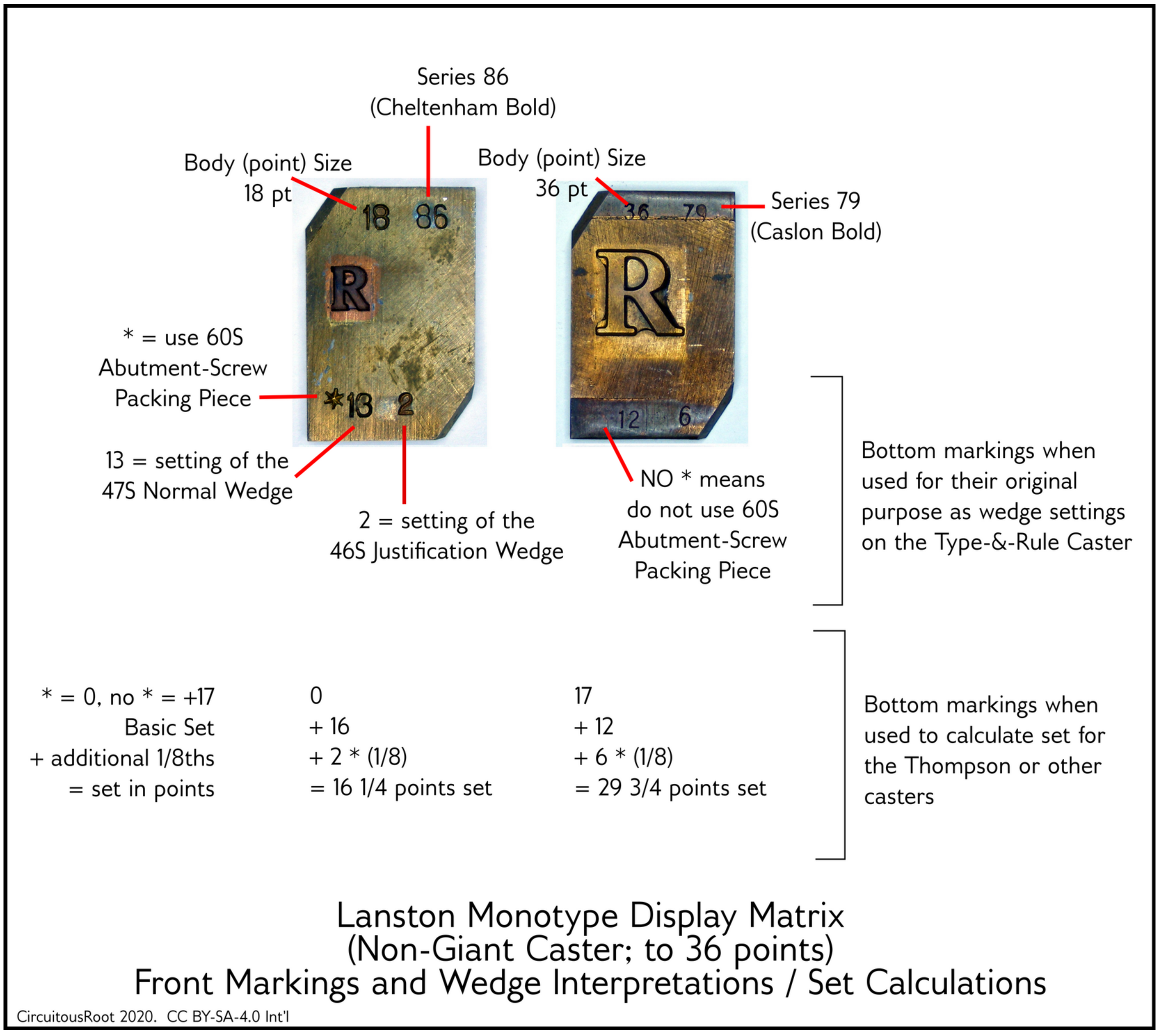


Figure 20: Reading a Lanston Display Matrix

It is important to remember that these set markings are not intended to specify the set. They're wedge settings for a particular machine (the Type-&-Rule Caster) from which it happens that set may be calculated. This is of practical importance for sets over 36 points (17 + 18 + 8/8 = 36). For these sizes the set is given in whole points only, because the machine's wedges are at their maximum setting and the operator, to achieve these sets, must adjust manually the Mold Blade Abutment Screw to widen the set.[85]

85 My thanks to Kevin Martin for this information (which goes far beyond my own experience at the Monotype). Personal communication, 2015-01-22.

4.2.19 Display Matrix Additional Marking and Coding

The principal numbers or symbols physically stamped on Lanston display matrices are those described earlier (point size, series number, the two wedge setting numbers, sometimes an asterisk, and the Chalfant patent date on the back). At times, though, other information may be either stamped on the matrix or used in its identifying literature. Some of these markings are to some degree systematic; others are *ad hoc*.

4.2.19.1 Coding Adopted from Cellular Matrix Usage

Lanston Monotype employed some of the alphanumeric symbols normally used for cellular matrices to describe display matrix fonts. So for example in the *Handy Index of 'Monotype' Rental Matrices*,[86] series No. 345 (Copperplate Gothic Bold) was offered in both 18 point and 18H4 point, the latter being "full face on body," which is to say titling.

These are the symbols for which I have seen evidence: B, F/G, H4, H9.

Symbols from Cellular Classification Symbols, Used After the Series Number	
B	Small Caps [Cellular: Modern Roman Small Caps]

Table 11: Lanston Display Codes from Cellular, after Series Number

Note on B: In Cellular usage, 'B' is "Modern Roman Small Caps," but in display matrix usage it just means "small caps." For example, see series No. 248, Garamont, which was issued in 14B and 18B "Small Capitals for Hand Composition. Garamont is certainly not a Modern face.

Symbols from Cellular Classification Symbols, Used After the Point Size	
F	Modern Figures or Old Style Hanging Figures
G	Old Style Lining Figures

Table 12: Lanston Display Codes from Cellular, after Point Size

Note on F & G: Interpreting 'F' requires a knowledge of the style of the face. If the face is a modern face (one which would have been classified with an A, B, C, or D suffix in composition) then an 'F' after the series number on a display mat indicates that it is a lining figure. If the face is an old style face (one which would have been classified with an E, F, G, or H suffix in composition) then an 'F' here indicates it is a hanging figure. But, to complicate matters, in this case an additional 'G' may be present to indicate old

86 {Lanston 1955}

style.[87] I'm not yet certain if a 'G' could appear on its own.

Here is an example of a figure '0' (zero) from 30 point series 330 (Sans Serif Bold). [88] This is a modern face, so the 'F' after the point size indicates that this is a figure and that it is a lining figure.

Figure 21: Lanston Display Matrix Marked as Lining Figure

But not all figures were designed as part of any particular face. For example, Kevin Martin notes that:

> there are also figures not associated with any particular face which have markings which appear to refer to a face, but do not. So in 10-point, 10F-21E is hanging figures for Binny OS (#21), 10G-21E is lining figures for the same (and there are -21G for corresponding italics), but there are also figures designated just 10F-21 which have nothing to do with the Binny.[89]

87 Kevin Martin, personal communication, 2015-01-22.
88 Photograph courtesy of Kevin Martin.
89 Personal communication, 2015-01-22.

'H' Symbols from Cellular, Used After the Point Size	
H4	Full face on body pointways[90]
H9	“Means a multitude of things, including long descenders and re-designed characters”[91]

Table 13: Lanston Display Alphanumeric Codes, 'H'

Here are examples of both, for 36 point Lanston series 140 (Modern Gothic Condensed / Tourist Gothic, roman).[92]

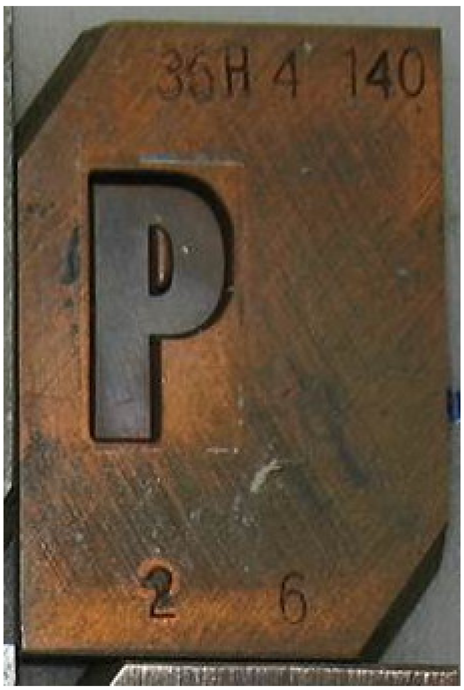


Figure 23: Lanston H4 for Display

Figure 22: Lanston H9 for Display

However, Martin notes that in display sizes, at times, a suffix ‘S’ to the series number was used instead of these H4/H9 codes.[93] (See below for more on the use of this ‘S’.)

90 Examples in {Lanston 1955}
91 The description here is Duensing's. I don't actually have evidence of this yet from the Lanston literature.
92 Photographs courtesy of Kevin Martin.
93 Personal communication, 2015-01-22.

4.2.19.2 Coding NOT Adopted from Cellular Matrix Usage

At least one code is used on display matrices after the series number which might seem at first to have been adopted from cellular matrix usage, but was not.

This is a suffix ‘S’ after the series number. Its meaning in cellular matrices is “A bracket, parenthesis, brace, or brace piece.” Kevin Martin, in supplying the example below, indicates that in display mats this ‘S’ was normally used for swash characters but could, as in the example, be used for any alternate design. Here is a matrix for 24 pt Lanston series 330 (Sans Serif Bold), alternate lowercase ‘a’:

Figure 24: Lanston Series 330, 'S' suffix for alternate character

Kevin has also indicated that at times this ‘S’ for alternate marking was also used to indicate H4/H9 alternate characters (see the section above for more on this).

4.2.19.3 *Coding for Ornament Matrices*

Lanston ornaments were coded by their own series numbers, with optional modifiers. These ornament series numbers were independent of the regular typeface series numbers and could duplicate each other. I think that in case of confusion you just had to figure it out.

According to a probably 1930s vintage Lanston specimen book, Display Matrices for casting on the Monotype Type-&-Rule Caster[94], Thompson Type-Caster or Giant Caster[95] were marked with the ornament series number without any suffix.

Cellular ornament matrices were indicated with the ornament series number and a suffix ‘N’.

This specimen book indicates that:

> A, B, C, or D after the series number indicates different positions of the same design; right and left of the same design, or the individual matrices which make up a two- or three-color combination design.

and

> M shown after the point size indicates a Monotype Material Making Machine continuous strip border.

This specimen also says:

> *a* after point size indicates the design is available for casting in multiple on a single type up to a maximum of 36-point set width for 6-point designs, 24-point set width for 8-point designs, 30-point set width for 10-point, and 36-point set width for 12 point.
>
> I do not yet understand the meaning of this.
>
> What this specimen book does not indicate is the coding (and matrix marking) used for ornamental matrix series where multiple face sizes were cut at a single body size. Kevin Martin has supplied an example of this from his collection. It is ornamental Matrix Series No. 873, in 14 point. At this body

94 The specimen book says “Monotype Type Caster,” but as they’re talking about casting display matrices, it must be equipped to make it the machine later called the Type-&-Rule Caster.

95 There is an ambiguity here: They’re clearly talking about flat mats for the T&R/Thompson, which can be cast on the Giant Caster with the proper equipment. But they’re silent about the coding for these ornament series on Giant Caster mats.

size there were two face sizes: No. 1 and No. 2. The example below left shows ornament 873, 14 pt No. 2 as coded on the matrix; the '2' after the point size indicates that it is the second face size. The specimen book shows this as "No. 2" (below, right[96]):

Figure 25: Lanston Ornament 873, 14pt No. 2

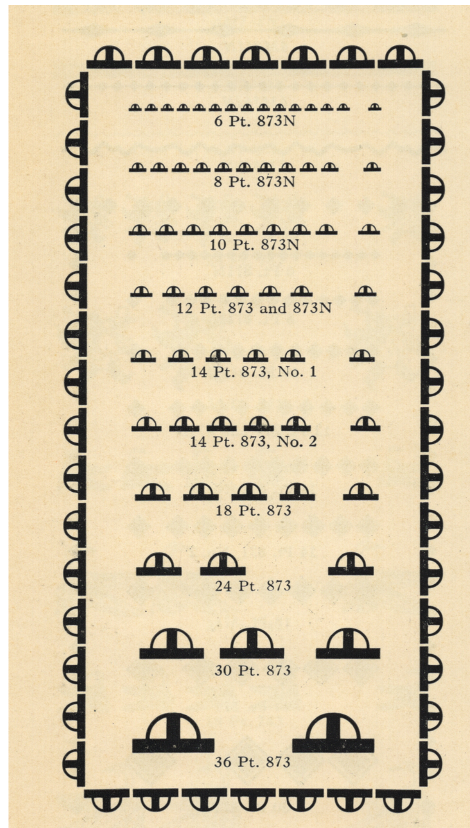


Figure 26: Lanston Ornament Series 873

4.2.19.4 Coding for Symbols

[TO DO]

4.2.19.5 Cap & lc Markings

It's hard to tell the difference between (say) a gothic cap 'I' and lowercase 'l'. Identifications of Caps vs. lc may be stamped on the matrix. Here is an example of two

96 Scanned by the editor.

mats for 36 point Lanston series 140 (Modern Gothic Condensed / Tourist Gothic), one of which is marked ‘C’ for Capital and the other ‘lc’ for lowercase. Note that their set widths also differ.

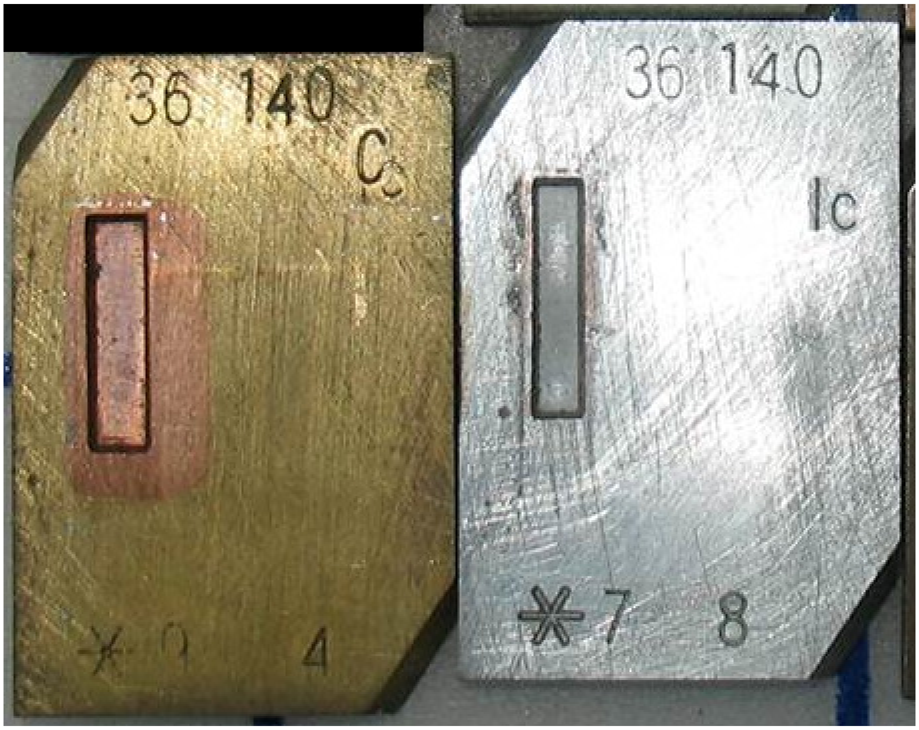


Figure 27: Cap. vs lc, in 36 pt Lanston series 140

4.2.20 Display Matrix Series Numbers vs. 'K'

In cellular matrix fonts, Lanston's practice was to indicate an italic font by using the “Classification” letter suffixes after the series number. Thus in cellular sizes No. 86 (Cheltenham Bold) was 86J for roman and 86K for italic.

In display and Giant Caster sizes, Lanston did not use these suffixes in this way. Instead, the roman or basic variant just carried the series number (thus, for example, 24 point No. 86, Cheltenham Bold) and the italic variant had a series number with the digit '1' appended (thus, 24 point No. 861, Cheltenham Bold Italic).

It was, however, the informal practice of some foundries to label their boxes of display matrices with the 'K' suffix to indicate italic (thus: “14 thru 36 86K”).

There are about a dozen exceptions to the “add 1 for italic” formula, some of which seem to have a historical basis, others of which seem simply arbitrary. For a discussion of them see {CR Composite Lanston Specimen}.

4.2.21 Other (Conflicting) Data

Other information about Lanston display matrices which would appear to conflict with that given here has been published and/or distributed. It doesn't do just to dismiss it, because it comes from serious sources and clearly they were looking at *something*. For discussions of these, see the Appendices:

- Uncertain Information: Duensing's "Balto & Mono" Table
- Uncertain Information: Rice's Chart

4.3 Lanston Display (42 & 48 Point, for the Thompson)

4.3.1 History/Explanation

These matrices have not received much coverage in the literature.

Richard L. Hopkins illustrated one of them in his photographic survey of "Display Matrices for Individual Castings." This appeared first in the *American Typecasting Fellowship Newsletter*[97] and was later incorporated by him in his 2008 edition of Matlas.[98]

The 1955 Lanston rental index notes that "Matrices are available … including 42 and 48 point Display matrices for use on the Thompson Caster. (0.050 drive)"[99] This is useful because it gives an official specification for the depth of drive.

Duensing, in {Matlas 1986}, p. 3, includes 42 and 48 point "Thompson" head and foot bearings in the "Balto & Mono" section of his "American Mono Display" table.

These matrices were intended for the Monotype-Thompson Type-Caster. They cannot be cast on the Type-&-Rule caster. While their size would be within the capacity of both the Giant Caster and the Super Caster, I do not know whether mold and matrix equipment was made for those machines to cast these matrices.

97 {ATFNL 32}
98 {*Matlas* 2008}
99 {Lanston 1955}, p. 1.

4.3.2 Depth of Drive

As mentioned above, {Lanston 1955}, p. 1, asserts that the depth of drive for these matrices is 0.050 inches.

4.3.3 Side Bearing

[TO DO]

4.3.4 Head and Foot Bearings

Duensing's “American Mono Display” table in {Matlas 1986} gives information which is probably about these matrices. However, this information raises questions, and he did not include it in later editions. He has the following (all values in points):

		Balto & Mono		
		Head	Foot	
Thompson	42	18	20	NG use
	48	18	12	large mat

Table 14: Lanston Thompson >36pt Head & Foot Bearings

The problem here is twofold:

First, Duensing says that these are “NG” - which I presume means “no good”.

Second, the 42 point line sums to 80 points, while the 48 point line sums to 78 points. These values, whatever they might be, should be equal.

4.3.5 Markings and Identification

[TO DO]

4.3.6 Geometry and Dimensions

[UNKNOWN TO ME]

4.4 Lanston “Giant Caster” Matrices

[TO DO]

5 Lanston Monotype Rule Casting

5.1 About Lanston vs. Elrod Stripcasting

It is my observation that even experienced typecasters (sometimes *especially* experienced typecasters) have a tremendous difficulty in comprehending the difference bewteen stripcasting as done on various Monotype machines and stripcasting as done on the Elrod.[100] The two are entirely different in their first principles.

5.1.1 Monotype (Knight) Fusion Casting

The Monotype process, based on Amos L. Knight's US patent 1,222,415 (filed 1914-10-03) is a "fusion casting" process which is in turn a modification of traditional die casting. All regular machine typecasting is die casting: molten metal is forced into a finite-volume mold under pressure. Indeed, Bruce's pivotal type caster was the first commercially successful die casting machine of any kind.

In the Monotype/Knight process, a longish, thin piece of type (representing a section of a strip or border) is first cast. This is a conventional die-casting process; the mold is of fixed, finite volume. This piece of type is partially ejected so that its trailing edge now forms one side of the mold. Then while the trailing edge is still soft, a second piece of type is cast into this mold. It fuses with the first piece. This is in turn ejected and the process repeats. This process is the fusion-casting of individual types so that they fuse together to form a continuous strip.

The Monotype/Knight fusion-casting process has the advantage that because single, stationary types are being cast these types can carry upon them any design desired. This permits the casting of decorative borders, for example.

This process has the disadvantage, however, that because it is a die casting process the types (which become rule/borders) cast will suffer from some casting porosity. All type has some degree of casting porosity, no matter how well cast.

5.1.2 Elrod Continuous Casting

The method devised by Benjamin S. Elrod, and patented in his US patent 1,438,951

100 And, after its patents expired, a few derivative machines such as the Universal.

(filed 1917-05-04) is fundamentally different. In Elrod's method, a pot of molten typemetal has in its side a "mold" which is not a finite chamber: it is a tube, open at both ends. This mold is cooled in its middle. Liquid metal enters it on one side and, as it passes through the mold, solidifies - emerging as a solid strip on the outside.

In practice this method requires a few additional components: a starter strip to get things going, a puller mechanism to keep things moving, a pump inside the pot to keep up a sufficient flow of metal, and oil lubrication injected into the mold cavity to keep things sliding.

Observers may be confused, when viewing this process, because for practical reasons the puller mechanism used with the Elrod Strip Caster is a reciprocating mechanism and as a result a pattern of marks appears on the side of the type. This is unimportant; the puller could be continuous, and indeed in Benjamin Elrod's first test it *was* continuous (he simply pulled on the strip with pliers).

The Elrod process has the significant advantage that the entire solidification process takes place within the bath of metal. At no point is there an opportunity for air to enter as solidification occurs. Properly cast Elrod rule is therefore completely free of casting porosity.

The Elrod process has the disadvantage that, as a true continuous process, it is not possible to cast designs into sections of the product.[101] It can only be used to cast rule which has simple, linear patterns (and of course base and spacing material).

5.1.3 What Will Be Covered Here

The Elrod does not have matrices, only molds. It is therefore not considered in this "matrix atlas." The Monotype/Knight process, however, does use matrices. All American and English Monotype strip casting, regardless of the machine, is Knight fusion-casting.

5.2 Lanston Rule Matrices

[TO DO]

101 The later Universal Strip-Caster had a mechanism to emboss designs onto the cast product by means of rollers. This machine was not a commercial success.

6 English Monotype

QUESTION: Was the English composition matrix ever called a “cellular” matrix, or was that usage reserved for Lanston composition matrices (because of the cellular nature of the combs securing American matrices within the matrix case)?

6.1 English Standard Composition

[TO DO]

6.2 English Small Composition (4 1/2 pt)

[TO DO]

6.3 English Display

The display matrices produced by the English Monotype company were much more substantial than those produced by Lanston. Their manufacture is in part documented in {*MR* 40.3} and {*Making Sure* 2}. They were punched, not electroformed. Richard L. Hopkins indicates that they were "made of copper encased in a very fine coating of chrome," but that "very old English display matrices were not chrome plated." ({*Matlas* 2008}, p. 6)

They came in two sizes: 1 inch square and 1 1/4 inch square. The specifications for the external dimensions, with tolerances, for the 1 inch square English Display matrices for use from 42 to 60 point type survive in the English Monotype drawing D3437, dated Feb. 6, 1929. This was reprinted by Duensing in {*Matlas* 1986}. See also the illustration below and Drawing No. CR-22 in the Appendices for dimensioned drawings based upon this information.

6.3.1 Depth of Drive

The depth of drive is .065. English Monotype drawing D3437, gives the "REJECT SIZES" for depth of drive as $\begin{matrix}.0652\\.0645\end{matrix}$. My interpretation of this is that if the depth was .0652 or deeper, or if the depth was .0645 or shallower, the matrix would be rejected.[102]

102 On Drawing D3437 as reprinted in {*Matlas* 1986} the word "REJECT" is crossed out and the word "LIMIT" is substituted, implying that matrices at exactly 0.0645 and 0.0652 would be accepted. This is not a Monotype engineering revision to this drawing, however, but merely a later interpretation by someone who possessed this copy of this drawing. It cannot be accepted as Monotype practice.

6.3.2 Head and Side Bearings

The head and side bearings of English Display matrices are presently incompletely known to me.

In {*Matlas* 1986} the only reference to English Display matrices is English Monotype drawing D3437 (1929). It gives a dimension which *might* be the side bearing, but for its value only calls out “J50 STANDARD”. It does not indiate head bearing(s).

In {*Matlas* 1988} Duensing prepared a drawing of an English Display matrix, with values. These values seem to be the nominal/basic values from D3437, with the addition of a value for the Side Bearing: .150”. There is no indication of head bearing.

In{*Matlas*, the 2008}, editor by Richard L. Hopkins adds a drawing by Duensing (which didn't actually appear in any known *Matlas* during Duensing's life) which gives some dimensions for English Display matrices, including head and side bearings. But these dimensions are questionable. The dimensions given for the thickness of the matrix (0.250) and the width of the slot on the bottom (.210) do not agree with those given in the English Monotype drawing D3437 of 1929 (which gives $\genfrac{}{}{0pt}{}{.2650}{.2647}$ and $\genfrac{}{}{0pt}{}{.1875}{.1880}$, respectively), or in Duensing's own {*Matlas* 1988}. Moreover, the head bearing Duensing does give, 0.275, cannot be correct for at least the 42-60 point size of the matrix (because 60 points is 0.834”, and 0.834 + 0.275 = 1.109”, which is larger than the matrix). Pending further information, the side bearing remains unverified and the head bearing or bearings remain unknown.

English Display	Head Bearing	Side Bearing
< 42 point	unknown	0.150 [unverified]
42 to 60 point	unknown	0.150 [unverified]
> 60 point	unknown	0.150 [unverified]

Table 15: English Display Head and Side Bearings

6.3.3 External Dimensions

The following illustration contains external dimension information derived from English Monotype drawing D3437 of 1929 as reprinted in {*Matlas* 1986}. For a version in the style of an engineering drawing, see drawing CR-22 in the Appendices.

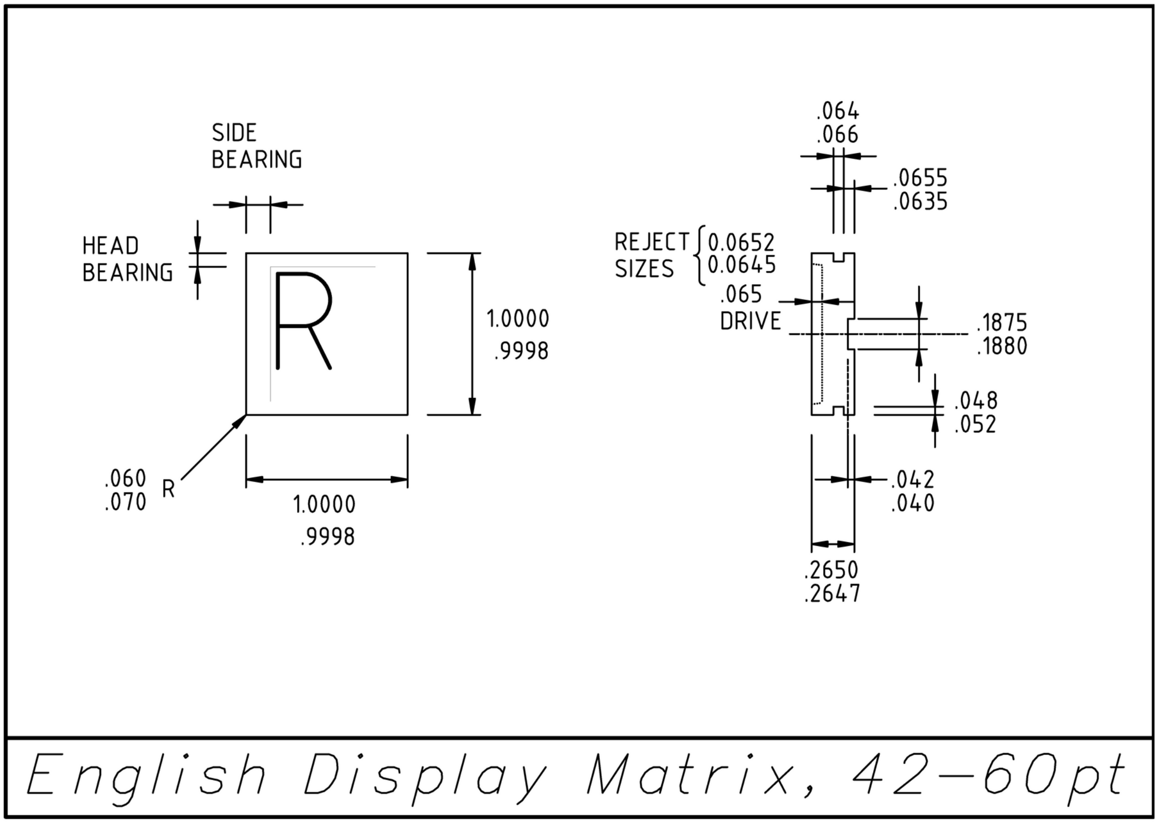


Figure 28: English Display Matrix Dimensions, 42-60 point

6.3.4 Dimensioning Practices

A note about drawing style and tolerancing/gaging practices may be in order. Monotype drawing D3437 of 1929 was not prepared in conformity to the then-new British Standard 308:1927 *Engineering Drawing Office Practice*. (For example, it omits the leading '0' on dimensions under 1 inch; BS308:1927 called for this '0'.) However, it does represent the state of the art in dimensioning and gaging practices for 1929. In every case but that of the "REJECT SIZES," the dimension specified as the upper dimension in a pair is that of the part at what was then called the "Maximum Metal Condition" (MMC). This concept of maximum (and minimum) material conditions remains a core idea in 21st century "geometric dimensioning and tolerancing," but while it is stated as a set of procedures in modern textbooks, we have lost sight of the underlying reasons for it which developed out of manufacturing and gaging needs. *These are relevant to the maker of a new matrix.*

The idea was that it is a desirable practice to manufacture a part to its Maximum Metal Condition (thus: the largest acceptable shaft and the smallest acceptable hole). This gave the greatest allowance for wear, and was also the condition in which you could most easily rework the part if necessary (e.g., turning down the shaft, reaming out the hole). This manufacturing practice was reflected in engineering drawings by a particular method of expressing tolerances. Rather than expressing tolerances bilaterally (plus-or-minus), tolerances were expressed <u>unilaterally from the MMC</u>.

For example, rather than specifying an external size of $.9999 \pm .0001$ (a bilateral tolerance), the external dimensions on this drawing were specified as $\begin{matrix}1.0000\\.9998\end{matrix}$ (a unilateral tolerance), with the *assumption* that the upper number specified the MMC.[103] [104]

In the case of a hole, slot, radius, or other "negative" feature, the smaller number represents the MMC. So for example the width of the bottom slot was specified as $\begin{matrix}.1875\\.1880\end{matrix}$ In this case the MMC (the upper number) is smaller; it is also the desired slot width (.1875 is 3/16 inch - many decimal dimensions in older engineering practice work

103 This style of writing the dimensions as a pair of limit dimensions, one above the other, is in itself ambiguous with regard to material condition.We know from {Abbott 1953}, p. 30, that in British practice "a *convention* in common use requires that the uppermost dimension of the pair should always give the *maximum metal size*." This convention was made official in {BS308:1953}. Modern practice (in the US at least) distinguishes "limit dimensioning" from unilateral tolerancing. In limit dimensioning in current practice there is no longer any assumption of material condition, as there was in earlier British practice. But with unilateral tolerancing the Maximum Material Condition can now be made explicit as a 0 tolerance. So the "limit dimension" style dimensioning of this matrix, given as $\begin{matrix}1.0000\\.9998\end{matrix}$ with an assumption that the upper number was the MMC, becomes the unilaterally toleranced dimension: $1.0000\begin{matrix}0\\-.0002\end{matrix}$. See {ASME Y14.5-2009}, p. 25.

104 See {CR DT} for a discussion of the history of this topic. It gets complicated.

out to decimalized fractional inches).

However, it should be noted that there are probably some cases on this drawing where the limit dimensioning actually represents bilateral tolerancing. For example, the depth of the side slot was specified as $\begin{matrix}.048\\.052\end{matrix}$. While the upper number (0.48) is the MMC, it is likely that the desired slot depth was actually 0.05. (It is just a slot for retaining the matrix in its holder; nothing registers against its internal side.) So this dimension probably means $.050^{+.002}_{-.002}$ rather than $.048^{+.004}_{0}$. We do not, however, at this time have any solid evidence either way (beyond assuming a preference for simpler numbers).

An apparent exception to this MMC practice occurs in the specification of the two REJECT SIZES for depth of drive: $\begin{matrix}.0652\\.0645\end{matrix}$ The upper number represents a deeper drive, and thus the Least Material Condition (LMC), not the MMC. This makes sense, however, when you consider the manufacturing origins of the concept of MMC and LMC (something not addressed in modern textbooks). The upper number represents not so much the MMC *per se* as it does the desired manufacturing outcome. In the case of an 0.065 drive matrix, ideally you want this to be 0.065 exactly. Monotype allowed a very slight tolerance for a deeper drive (< .0002) and a greater tolerance for a shallower drive (< .0005), but clearly the desirable outcome was a matrix as close to 0.065 as possible (that is, closer to the upper number).

6.3.5 Matrix Planchet Manufacturing

So how does this rather arcane account of former engineering drawing practices affect the matrix maker today? If you're just making a single matrix, it does not. A newly made matrix which gages or measures within the limit dimensions specified on D3437 without any other considerations will be interchangeable with any other matrix made to these same specifications.

The difference comes when you wish to do either (or both) of two things: (1) to tune your manufacturing process so that it reflects the understanding of interchangeable manufacture that The Monotype Corporation Ltd. had in the 1920s, and/or (2) to convert the toleranced dimensions of D3437 into an unambiguous specification in 21st century engineering drawing practices - this would allow even a computer controlled milling machine to understand the original manufacturing goals.

In doing this, the following points emerge:

1. It is not correct simply to treat the limit dimensions of D3437 as limit dimensions without consideration of material conditions (as described by {ASME Y14.5-2009}, for example).

2. It is in general not correct to translate these limit dimensions into bilaterally toleranced dimensions. (The exception is the depth of the side groove, which probably is in intent a bilaterally toleranced dimension.)

3. It is in general correct to translate these limit dimensions into unilaterally toleranced dimensions from a MMC which was expressed by the top number in the D3437 limit dimension. (The exception, again, is the depth of the side groove.)

4. In the case of the "REJECT SIZES," it is probably correct to translate these into an unequal bilaterally toleranced dimension. The only difficulty is that standards such as Y14.5-2009 do not include the concept of "less than" or "greater than" (but not equal to) in tolerances. So a slightly nonstandard expression such as this must suffice: $.0650\begin{matrix} <+.0002 \\ >-.0005 \end{matrix}$. A geometric dimensioning and tolerancing "BASIC" dimension with a tolerance in an associated frame would also work.

6.4 Super Caster

Unlike the Lanston Monotype Machine Company's "Giant Caster," the English Monotype "Super Caster" does not take its own special form of matrix. Rather, it is the intended machine for English Monotype display matrices. With suitable matrix and mold equipment, it can also cast from matrices of other kinds.

7 Other Type Caster Manufacturers

The Thompson comes first here, because it has been the workhorse of the independent typefounding industry since its introduction in 1907. But it is worth noting that the Compositype came first. Moreover, Compositype was co-founded by John E. Hanrahan, who formerly had been the principal type designer of the John Ryan Type Foundry (Baltimore).[105] The National Compositype Company developed an extensive matrix library, the acquisition of which after its demise was the subject of a strongly worded fight in the press between the Universal Type-Making Machine Company (the successors to Nuernberger-Rettig) and the Thompson Type-Making Company.[106]

The manufacturers considere here are:

- Thompson
- Compositype
- Nuernberger-Rettig

105 See {Annenberg 1994}, p. 222.

106 See various advertisements placed by both firms in The Inland Printer in April and May of 1914. These are reprinted in {CR Thompson} and {CR NR}.

7.1 Thompson Type Machine Company

With appropriate mold and matrix equipment, the Thompson Type-Caster can cast from any style of matrix in sizes up to 48 point. The section here concerns specifically the style of flat matrix introduced by the Thompson Type-Machine Company (TTMC) for their caster. Duensing gives data for three variations: small and large "old Thompson" matrices (that is, matrices made by the TTMC) and "Monotype Thompson" matrices made by the Lanston Monotype Machine Company (presumably after their acquisition of the TTMC in 1929).

See also the section later in this present volume on Independent Matrix Makers (for whom the Thompson was an obvious target machine), and especially the section there on Andrew Dunker's matrices for the Thompson. Dunker's precise reverse-engineering of a Thompson-compatible matrix may be a better place for the aspiring matrix maker to start than the Thompson data here.

7.1.1 Depth of Drive

The design of the first version of the matrix equipment for the Thompson Type-Caster,[107] appears to have been intended for casting from Linotype matrices.[108] [109] In consequence, when the Thompson Type-Machine Company introduced matrices of their own format (at an exact date which is not known), they retained the standard Mergenthaler Linotype depth of drive: 0.043". (This is in fact a quite logical number for American type: 0.918 - 0.043 = 0.875, which is 7/8.)

7.1.2 Head and Side Bearings

In all editions of *Matlas*, Duensing gives the side bearing of both sizes of Thompson matrix as a uniform 8 points.

---

107 The early machines employed a method of "set blocks" for establishing the set width of the type. Later machines employed the "Micrometer Set Adjusting Device." While the name of this Device makes it sound as if it was simply an attachment, it actually represented a complete, and not backward-compatible, re-engineering of the matrix equipment for the machine.

108 The initial announcements of the machine to the trade said, more specifically: "The most striking feature of the Thompson Typecaster is the matrix it employs - the ordinary Linotype matrix - although it is built to cast type from any other matrix desired - Monotype, Compositype or foundry matrix." {IP 39.2 p.250}

109 Given the initial focus of the Thompson on Linotype matrices, it would be interesting to learn whether the TTMC adopted the ATF point of 0.0139 or the Mergenthaler Linotype point of 0.014.

7.1.3 Head Bearings in the 1986 Edition of *Matlas*)

The values given by Duensing for the head bearing(s) are more complex. In at least one case they also involve a foot bearing. More importantly, the information in various editions of *Matlas* is contradictory, both between versions and within editions. Moreover, it is not entirely clear in some cases if he is referring to Thompson-style or Monotype display style matrices.

I'll start with the earliest information, which is that in {*Matlas* 1986}. Thompson head bearing information occurs in three places in it.

(A) Head Bearing for the Old Thompson small ("narrow") matrices.

This is on p. 5 of {*Matlas* 1986}. This table does not appear in later versions of *Matlas*. It is elaborate and internally consistent, but it contradicts information both in other parts of the 1986 edition and in later editions of *Matlas*.

For the head bearings of the small "Old Thompson" matrices (he calls them "narrow" here), Duensing presents a drawing and a table of values. In the drawing, the small Thompson style matrix is shown with a constant foot bearing of 24 points. The table gives a set of variable head bearings for various body sizes. In each case the sum of the head bearing, the body size, and the foot bearing is 81 points. This works out to 1.1259" (which is only 0.001 over the nominal matrix length of 1.125 inches).

Body size in points	Head bearing in points	Comment (Duensing's)
6	51	
8	49	
10	47	
12	45	
14	43	
18	39	
24	33	
30	27	
36	21	
42	15	“will not clear mold”
48	9	“will not clear mold”

Table 16: Head Bearings for Old Thompson Small Matrices {Matlas 1988}

If in fact the 42 and 48 point head bearings result in matrices whose body position cannot be raised up to meet the casting cavity of the mold (which is how I interpret Duensing's comment), then one wonders if these values were determined from the equation or from actual matrices.

In {*Matlas* 1986}, in the Thompson section, Duensing says nothing about the head bearings of the large Old Thompson matrices.

However, in (*Matlas* 1986) in the “American Mono Display” section, Duensing presents Thompson information in two parts of a table. This table says that it shows head and foot bearings for Monotype display matrices (not Thompson matrices). Nevertheless, it gives “Thompson” information.

In the section of the table marked “Balto & Mono”, he gives head and foot bearings for Monotype “T” Molds (sorts casting molds for the Type-&-Rule caster for 12pt, 14pt, and 18pt) and U-Molds (sorts casting molds for 24pt, 30pt, and 36pt). This information is clearly for Lanston display matrices. However, in the same section of the table he also gives two lines of data marked “Thompson”. Here is this section of this table:

	Balto & Mono			
		Head	Foot	
T-Mold	12	32	36	
	14	29	37	
	18	25	37	
U-Mold	24	31	25	
	30	25	25	
	36	19	25	
Thompson	42	18	20	NG use
	48	18	12	large mat

Table 17: "Balto & Mono" Head and Foot Bearing Data from {Matlas 1986}

For all of the T-Mold and U-Mold entries the sum of the body size, the head bearing, and the foot bearing are all 80 points, which is the size Duensing gives for the length of a Monotype display matrix in the diagram accompanying this table.

The first "Thompson" line also sums to 80 points, but the second sums to 78 points. As I would interpret "NG" to mean "No Good," I'm not sure why these two lines appear in this section of the table at all. They were dropped from this table in later editions.

In the section of this same table marked "Thompson" there are values for head and foot bearings for some kind of matrix – but it isn't clear what kind. If you interpret the table literally, they must be for Lanston Monotype display matrices as used on the Thompson. If you accept the numbers in the table as correct, then they cannot be for "Old Thompson" small matrices, as these numbers have a fixed head bearing where Duensing on p. 5 gives a variable head bearing for Thompson small mats. My current interpretation of this table (though I suspect that I am wrong) is that it contains values for "Old Thompson" large matrices. Here is this section of this table:

Thompson		
	Head	Foot
12	18	50
14	18	48
18	18	44
24	18	38
30	18	32
36	18	26

Table 18: Pre-Monotype Thompson Large Head and Foot Bearings, from {Matlas 1986}

In each case, the sum of the constant head bearing (18 points), the body size, and the variable foot bearing is 80 points. This fits the value Duensing gives in the drawing accompanying this table for the length of a Lanston Monotype display matrix. Unfortunately, it does not match either of the length values that he gives on p. 5 for Thompson-style matrices. (80 points is 1.104 inches. On p. 5 he gives the length of the small Thompson-style matrix as 1.125 inches and the large as 1.190 inches.)

Summary of the 1986 data:

1. The table on p. 5 gives variable head bearings and constant foot bearings for "narrow" (= small) Thompson-style matrices.
2. The two lines for 42pt and 48pt "Thompson" in the "Balto & Mono" part of the American Mono Diplay table on p. 3 should probably be discarded.
3. The part of the table on p. 3 (in the American Mono Display section) may specify constant head bearing data for large Thompson-style matrices. If it does, though, it does not match the length dimension of either size of Thompson-style matrix.

7.1.4 Head Bearings in the 1988 (and 2008) Editions of *Matlas*

The primary difficulty with Thompson-style matrix information in later editions of *Matlas* is that the table of (variable) head bearing and (constant) foot bearings for the small ("narrow") Thompson-style matrices, on p. 5 of the 1986 edition, is entirely missing. Later editions just have a simplified table which specifies a constant foot bearing for “Old Thompson Small” matrices of 24 points, with no head bearing.

Here is the head and side bearing information from Table 5 (on p. 5) of {Matlas 1988} (the table also gives other information on external dimensions and Baltotype and Iwata Bokei practice; this is not relevant here):

	Head Bearing	Foot Bearing	Comment
Old Thompson Small	-	24 pt	{*Matlas* 1988}
Old Thompson Large	18 pt	not applicable	{*Matlas* 1988} {*Matlas* 1986}
Monotype Thompson	18 pt	not applicable	{*Matlas* 1988}

Table 19: Head (and Foot) Bearings for Thompson Matrices from {Matlas 1988}

The same table is reprinted verbatim in {*Matlas* 2008}.

In the “U.S. Lanston Mono Display” section of {*Matlas* 1988}, Duensing presents a reformatted and slightly reduced version of the table which appeared in the “American Mono Display” section of the 1986 edition. He now labels the “T-Mold” and “U-Mold” data as “MONOTYPE STANDARD”, and he drops the 42-point and 48-point “Thompson” lines. This is unproblematic: this information is for Monotype display matrices, not Thompson-style matrices.

However, the third section of the 1986 table, “Thompson”, is in 1988 converted into a separate table marked “THOMPSON STANDARD.” The values in it remain the same. Each line still sums to 80 points, which is the length Duensing associates with the Lanston display matrix, not any Thompson-style matrix.

7.1.5 Head Bearings in Matlas, Summary

The information presented in the various editions of Matlas for Thompson matrices:

1. Has internal contraditions
2. Does not clearly distinguish Monotype display and Thompson style matrices
3. Omits important information in later editions

It is difficult to rely upon information with these issues, and it might be best to discard it and start from scratch.

7.1.6 On Foot Bearings

Most (all?) matrices are located in their holders by two surfaces, typically one at the head of the matrix and one at the side. So it is only necessary to specify two offsets from the sides of the matrix which bear on these locating surfaces in order to determine the intended position of the type body against the matrix: the head bearing and the side bearing, typically.

Yet in several cases Duensing also presents a foot bearing. There are three issues with this. First, this dimension is quite obviously redundant. The external size of the matrix is known, and the head bearing plus the body size plus the foot bearing must equal the matrix length. Second, this dimension is also less critical. So long as the matrix fits in its holder, the length of the "foot bearing" may vary without affecting the alignment of the matrix. Third, specifying this dimension is at odds with the basic principles of dimensioning for interchangeable manufacture established in the early 20th century: you cannot specify both a stack of dimensions and its overall length in real manufacturing situations where mathematically perfect parts are impossible.[110]

Nevertheless, foot bearings were important in the opinion of at least two of the generation of independent matrix makers working in the 1980s. In addition to Duensing in *Matlas*, Roy Rice prepared an entire chart of Lanston display matrix dimensions specifying head bearings, body sizes, and foot bearings.[111]

7.1.7 External Dimensions

Duensing writes "These mats were made in two sizes and may be identified by their having two chamfered corners at the head." In {*Matlas* 1986} (and duplicated in {*Matlas* 2008}), he presented the following information about Thompson matrices. Dimensions in inches .

110 See for example {Buckingham 1921}, p. 48, where this principle becomes the first law of dimensioning. It has remained a core idea in engineering drawing ever since.

111 This was distributed at least on a limited basis. A copy exists in Duensing's papers. It is not yet online.

	Length	Width	Thickness
Old Thompson Small	1.125	.750	.094 - .099
Old Thompson Large	1.190	.875	.085 - .086
Monotype Thompson	1.181	.875	.119

Table 20: Thompson Matrix External Dimensions from {Matlas 1988}

However, in the earlier {Matlas 1986} he presented slightly conflicting data.

	Length	Width	Thickness	Source
Thompson Narrow	1.125	.750	[see below]	TABLE 6, on p. 5
Old Thompson	1.185	.875	.093	TABLE 5, on p. 4
Thompson Wide	1.190	.875	[see below]	TABLE 6, on p. 5
Monotype Thompson	1.186	.875	.119	TABLE 5, on p. 4

Table 21: Thompson Matrix External Dimensions from {Matlas 1988}

In TABLE 6 (p. 5), he gives thickness values which appear to apply to both matrix sizes, and which are further interesting because they're expressed in terms of nominal points, but which don't always match the thickness values cited above:

	Thickness range	Nominal thickness in points
Both sizes of TTMC matrices	.094 - .099	7
“some old ones”	.085 - .086	6

Table 22: Thompson Matrix Thicknesses in Inches and Points, from {Matlas 1986}

This information becomes even more problematic when one calculates the actual values of these two point dimensions in inches. Given a point of 0.0139”, 7 points is 0.0973”,which is comfortably within the range cited. But 6 points is 0.0834, which is well below the range cited.

It is worth noting that within reasonable limits the thickness of a flat matrix on a Thompson is not a critical value.

7.1.8 Geometry of Thompson Matrices

[TO DO: Drawing illustrating the Thompson matrices.]

Note: The drawings of Thompson matrices in *Matlas* show relatively large un-beveled corner-cuts at both top corners. But the Thompson matrices presently in my possession (which are in original Thompson Type-Machine Company boxes) have very small corner-cuts. Schuyler Shipley, proprietor of Skyline Type Foundry, has examined a dozen Thompson matrices from his extensive collection. He reports that the size of the corner cuts varies widely, from "barely even there" to "as big as 1/8 inch."[112] The corner cuts on the Thompson matrix play no part in its use on any type casting machine.

112 In an e-mail to the editor, 2015-01-11.

7.2 Compositype

7.2.1 History

[TO DO: Update wrt my Compositype history article - esp. the real name (it was never called the Compositype)]

The Compositype was the first of several type casting machines which emerged around the turn of the 20th century in response to the notion that every printer should be his own typefounder. It was not successful in the market as a casting machine, but it is notable for its influence on early 20th century matrix production. This influence came about not only because it was the first, but also because one of the founders of the National Compositype Company was John E. Hanrahan, formerly the principal type designer of the John Ryan Type Foundry (Baltimore) and with ATF from 1892 to the start of Compositype in 1899.[113]

A 1909 article in The Inland Printer noted that "the [Compositype] company had practically exhausted its resources in 1907, and its factory in Baltimore has not been in operation for the past few years."[114]

In 1914, an interesting dispute was conducted in the trade press by the Universal Type-Making Machine Company (successors to Nuernberger-Rettig) and the Thompson Type-Machine Company. By way of background, both companies not only sold matrices but rented them. In April 1914, Universal (N-R) announced that they had purchased "the entire matrix equipment" of the National Compositype Company. Simultaneously, Thompson announced that they had purchased "an entire Compositype matrix library" and that in doing so they had "secured this line of matrices." Further, Thompson proposed to loan these matrices to Thompson owners for free.[115]

It is clear from an examination of Thompson Type-Machine Company specimens that many of the Thompson series numbers bear a strong relation to Compositype series numbers, but the exact nature of this has not yet been worked out.

At some point around 1918/1920, the Universal and the Thompson companies became

113 {Annenberg 1994}, p. 222.
114 {McCue 1909, Part 2}
115 The advertising history of this dispute may be read in the "Advertisements and Trade Notes" sections of {CR Thompson} and {CR N-R}.

one, and in 1929 the Lanston Monotype Machine Company purchased the Thompson Type Machine Company.

7.2.2 Depth of Drive

[TO DO]

7.2.3 Geometry and Dimensions

[TO DO. They're very much like early Thompson matrices.]

7.3 Nuernberger-Rettig

The Nuernberger-Rettig was basically a pivotal type caster adapted with a more sophisticated drive mechanism for intended use by printers. It also featured a mold which differed from the ordinary pivotal mold by casting a jet which would break off above the feet of the type.[116] This allowed it to cast type which did not require the foot to be plowed.

The N-R company later became the Universal Type-Making Machine Company and the caster was renamed the Universal Type-Making Machine.

With appropriate mold and matrix equipment, the N-R could be configured to cast ordinary Lanston Monotype display matrices, as well as its own matrices.

7.3.1 Depth of Drive

Duensing lists the depth of drive of the native Nuernberger-Rettig matrix as 0.065 inches in all versions of *Matlas*.

116 Not all Nuernberger-Rettig molds had this feature, however. The N-R molds that I have examined from the two ex-Sterling Type Foundry N-Rs were a mix of the special N-R molds and ordinary pivotal caster molds.

7.3.2 Geometry and Dimensions

[TO DO]

8 Independent Matrix Makers

Many independent companies and individuals made matrices in the 20th century. For the most part, technical information about their practices has been lost.

In the case of companies such as Baltotype, the information which was recorded in Duensing's *Matlas* has to do with overall dimensions and head/side bearings.

In the special case of the matrices made by Andrew Dunker for the Thompson Type Caster, however, the surviving information is particularly interesting. Dunker presented (and Duensing published, in *Matlas*), a reasonably functional reverse-engineering of a simple matrix form which was satisfactory for use with the Thompson. Because of its simplicity (no corner cuts) and because he gave toleranced dimensions, his work may be the best starting place for someone wishing to make new matrices for the Thompson.

8.1 Dunker Matrices for the Thompson

The late Andrew W. Dunker of Michigan was a highly skilled machinist who produced over the years a series of matrix fonts for the Thompson Type-Caster. For the most part these were revivals of "antique" typefaces no longer available (though in one special case, the typefaced "Homespun," he produced a very unusual original design). I have had the pleasure of casting from Dunker's matrices at Skyline Type Foundry, and can attest that they are of high quality and utterly remarkable construction. For the "antique" revivals, Dunker electroformed his matrices. The normal technique for electroforming, as practiced since Starr's patent in 1845, involves creating a blank matrix (or "planchet"), typically of brass, with a hole in it into which the casting cavity of the matrix is electroformed in copper. After electroforming, relatively little work is needed to finish the matrix to size. Dunker did not do this, however. Instead, he electroformed the entire matrix in copper in the solid and then machined this down to size.[117]

---

117 He used a metalworking shaper (a machine unrelated to the now more common woodworking shaper). The shaper he used was an E. N. Boynton shaper, the pattern for the main casting of which was made before 1879 (the year that the E. N. Boynton company became the Boynton & Plummer company). It is of an unusual style which Boynton called "Traverse Head," but which is more commonly known today as "traveling head." This machine survives. The metalworking shaper is a reciprocating machine tool which produces a characteristic pattern of *straight* tooling marks on the workpiece. These marks appear as a fine pattern of straight lines on the Dunker matrices, and in turn they are cast into the shoulders of the types cast from Dunker matrices (making type cast from these matrices easily identifiable as such).

In the 1988 16-page edition of *Matlas*, Duensing reprinted a dimensioned sketch by Dunker showing his regular and large-size electroformed matrices. (This sketch does not appear in {*Matlas* 2008}, even though most of the 2008 edition is based on the 1988 edition.) Here are two illustrations reproducing the information from that sketch (for a version of both done in the style of an engineering drawing, see Crawing No. CR-23 in the Appendices.)

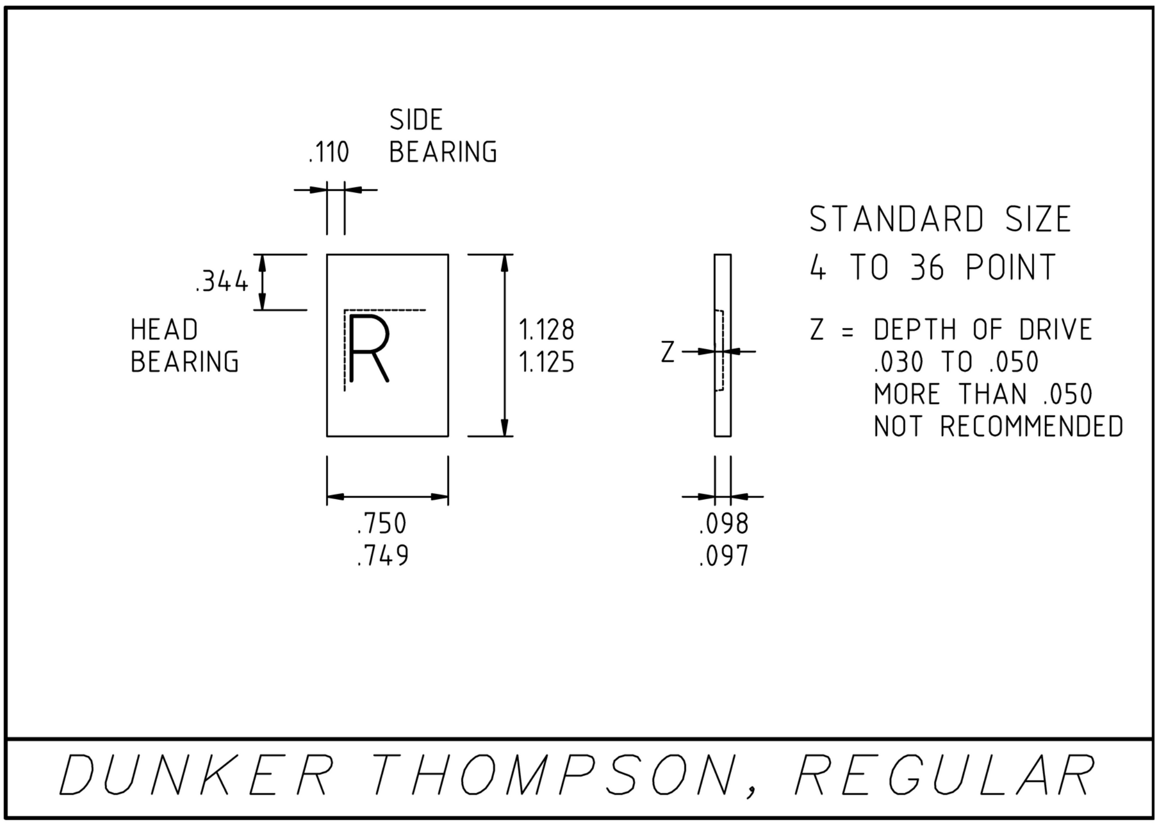


Figure 29: Thompson Matrix by Andrew W. Dunker, Regular Size {Matlas 1988}

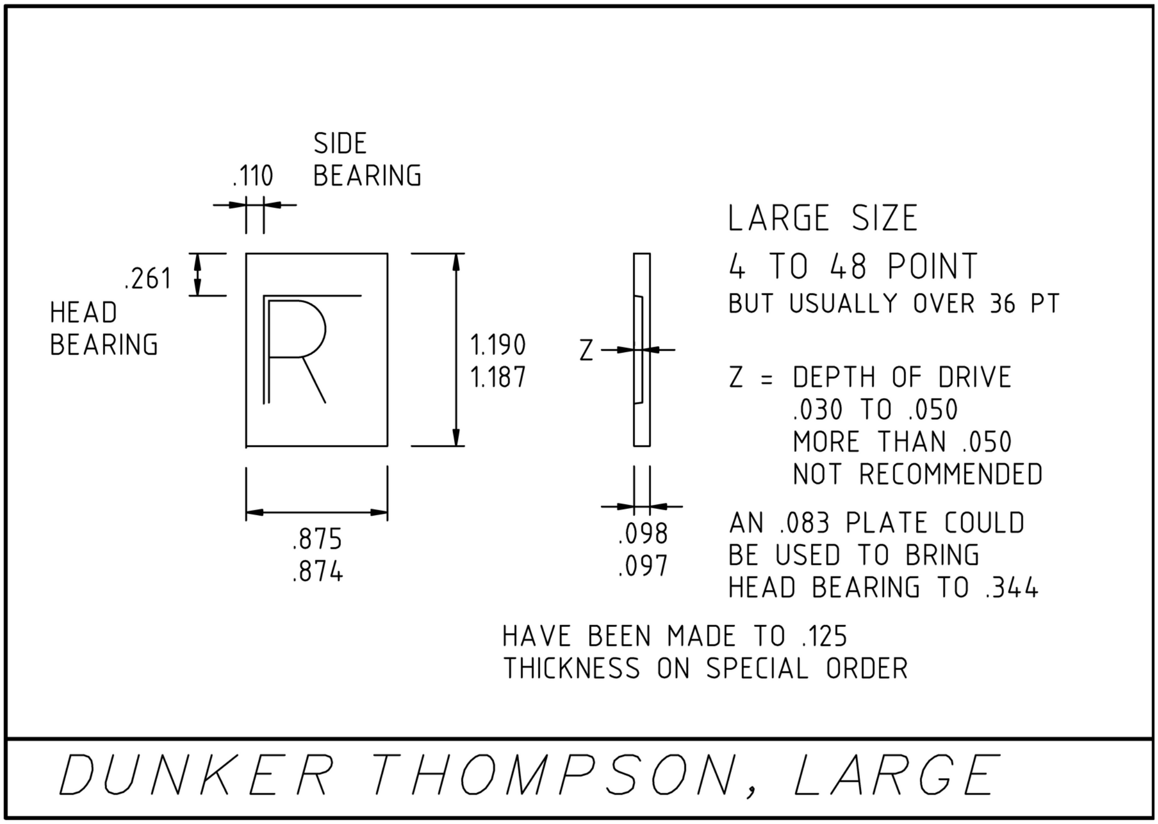


Figure 30: Thompson Matrix by Andrew W. Dunker, Large Size {Matlas 1988}

Typically, Dunker made his matrices to an .043 depth of drive, because his thompson was equipped with a mold for this depth. However, a complete census of known Dunker matrices and their dimensions and drives has not been done.

8.2 Baltotype (for the Thompson)

In {*Matlas* 1986} and {*Matlas* 1988}, Dunsing presented the following information about Baltotype matrices for the Thomson Type-Caster. Dimensions in inches (or points if indicated).

	Head Bearing	Side Bearing	Length	Width	Thickness
Baltotype	18 pt	8 pt	1.181	.815 (varies)	.098 (varies)

Table 23: Baltotype Matrix Data

Duensing's illustration accompanying this information was of a standard Thompson style matrix with two corner chamfers at the top. No further dimensions were supplied.

8.3 Baltotype (for the Type-&-Rule Caster?)

In the Lanston Monotype Display Matrix section (not the Thompson section) of {*Matlas* 1986}, one section of the table of head and foot bearings is labeled "Balto & Mono". However, the values that it gives do *not* seem to be correct for Lanston Monotype Display matrices. (Moreover, in the same table, there is a section labeled "Mono. Std." which does give correct Lanston values.) These do not seem to be values for matrices for the Thompson, because

- they conflict with the values given above which are explicitly identified as Baltotype for the Thompson,
- There is a separate Thompson sectio in this 1986 table, and
- The "Balto & Mono" section of the table is further labeled with "T-Mold" and "U-Mold" identifiers, which are Type-&-Rule Caster mold designations.

These values, which may be for Baltotype matrices for the Type-&-Rule Caster, are:

	[Body Size (points)	Head Bearing (points)	Foot Bearing (points)
T-Mold	12	32	36
	14	29	37
	18	25	37
U-Mold	24	31	25
	30	26	25
	36	19	25

Table 24: "Balto & Mono" Head and Foot Bearings, T-Mold and U-Mold, from {Matlas 1986}

For an explanation of “foot bearing,” and why it cannot be taken as anything more than a reference value, see the discussion of “Foot Bearing and Molds” in the Lanston Monotype Display Matrix section earlier.

For a more complete discussion of this table in {Matlas 1986}, see the Appendix “Uncertain Information: Duensing's 1986 Table.”

8.4 Iwata Bokei (for the Thompson)

In {*Matlas* 1986} and {*Matlas* 1988}, Dunsing presented the following information about Iwata Bokei matrices for the Thomson Type-Caster. Dimensions in inches (or points if indicated).

	Head Bearing	Side Bearing	Length	Width	Thickness
Iwata Bokei	18 pt	8 pt	1.125	.875	.125

Table 25: Baltotype Matrix Data

Duensing's illustration accompanying this information was of a standard Thompson style matrix with two corner chamfers at the top. No further dimensions were supplied.

I know nothing else about Iwata Bokei.

9 Composing Linecasters

Matrices designed for both composing linecasters (such as the Linotype) and noncomposing linecasters (such as the Ludlow Typograph) may be used by the typefounder. They all have characteristics which derive from the needs of linecasting which must still be taken into account when they are used to cast single types.

The most significant of these is their side bearing, which is zero because linecasting matrices must fit directly against each other so that the line to be cast can be composed.[118]

9.1 Mergenthaler Linotype

[TO DO]

9.2 English Linotype

[TO DO]

9.3 Intertype (American & English)

[TO DO]

9.4 Other Linotype Compatible

9.4.1 Matrotype

9.4.2 Simoncini

9.4.3 Star Parts

9.4.4 Soviet Linotype Derivatives

9.4.5 PRC Linotype Derivatives

118 As an exception to this, some Ludlow matrices were made such that they cast lengthwise on the Ludlow slug, not in composition. These have non-zero side bearings.

10 Noncomposing Linecasters

10.1 Ludlow Typograph

Ludlow matrices were manufactured in three widths (7/8”, 1 1/4”, and 1 1/2”) and three “slants” (roman (upright), standard italic (17 degree slant), and a 40-degree slant italic[119]) . No complete information exists as to which faces were cut on which matrix widths. Sometimes this is indicated by notes in the specimen books, sometimes it is not. Most Ludlow matrices were punched, but the very large sizes typically were engraved.[120] Any number of special third-party matrices were also engraved, especially for use in casting slugs for use in making rubber stamps.[121]

Type bodies larger than 96 point (the largest which would fit in ordinary orientation on a 1 1/2” matrix) were positioned horizontally on the matrix so as to cast longitudinally on the slug, usually one matrix at a time. (The largest Ludlow face offered was 240 point 3-BEC Ludlow Bodoni Campanile Advertising Figures.[122]) In addition, advertising figures in sizes starting at 72 point were also sometimes made to cast longitudinally on the slug.[123]

For more information on these, see the subsection below on Ludlow Matrix Sizes, Styles, and Dimensions.

Matrices intended for the Ludlow Typograph can be cast on the following typecasting equipment:

- The Thompson, 7/8” width matrices only, up to 48 point.
- [Can they be cast on the Giant Caster?]
- [Can they be cast on the Super Caster?]

---

119 The 40-degree italic was used only for 48-MIC Flair and 51-MIC Formal Script.

120 There were exceptions, however. For example, a set of Ludlow punches for advertising figures at some size over 144 points in an as yet unidentified plain gothic survive, as well as a set of matrices punched i*n aluminum* from them, on 1 ¼ inch mats, to cast lengthwise on the slug.

121 There are also a number of less common matrices attested, including aluminum matrices (in 7/8″ and 1 ¼″ at least), electroformed matrices (in 7/8″), and some which appear to be solid copper.

122 See, inter alia, {*Ludlow Typefaces* D}, p. 102, and {Ludlow LS47}, “Typeface Family No. 3,” p. F-3-3.

123 For detailed information on Ludlow matrix offerings, see *Confidential Information for Ludlow Salesmen*, a copy of which is reprinted online at {Ludlow LS47}. In particular, see section FP (“Ludlow Matrix Font Price List,” dated 10-22-62) for a complete list of sizes offered, and section F (“Fonts”) for sticks required (thus matrix sizes) for advertising figures from 72 to 240 point.

If the correct mold and matrix equipment is used, it is not necessary to alter Ludlow matrices for use on typecasting machines. I have, however, a font of Ludlow matrices which has been milled down so as to reduce its depth of drive, presumably to allow it to be used with non-Ludlow-mold equipment on the Thompson.

10.1.1 Ludlow Depth of Drive

All editions of *Matlas* are in error when they state that the depth of drive of Ludlow Typograph matrices is 0.168" and that Ludlow mold depth is 0.750. The actual depth of drive for the Ludlow is 0.153", giving a mold depth of 0.765. The correct Ludlow depth of drive is confirmed in the Ludlow Typograph Company technical bulletin "Uneven Ludlow Slug Height" by "EPF" (Edward P. Forman), which gives the Ludlow blank slug height as 0.765.[124] I've also confirmed this myself by measuring an actual well-cast Ludlow slug in my shop.

10.1.2 The "Thompson Space Mold" and Ludlow Matrices

Neither is it true that you can cast Ludlow matrices on the Thompson using a "Thompson space mold," as stated in *Matlas*. Schuyler Shipley, proprietor of Skyline Type Foundry, points out that while the numbers *almost* match, the geometry of the mold and the matrix holder will not produce the intended result and may damage the Thompson.

There is no "Thompson space mold" as such. High spacing may be cast on any Thompson mold using a blank matrix. Low spacing may be cast on the Thompson using a standard 0.868 mold for 0.050 Lanston Monotype matrices, adapted for casting spacing by the replacement of the 42TC33 Mold Front Wall Space Plate and the use of low space 44TC21 Type Body Pieces and 42TC77 Low Quad and Space Matrices. This will result in spacing material that is 0.763" high, which is very close to the 0.765 Ludlow blank slug height. However, this height is due to the Thompson low space matrix projecting 0.105 *into* the mold. The mold itself is still 0.868. Using a Ludlow matrix with this mold would (a) result in a type height of 0.868 + 0.153 = 1.021, and (b) require that the X30TC Matrix Carrier Cam Lever be adjusted 1.021 – 0.918 = 0.103" further out than normal. It is possible that this would exceed the limits of the machine and break the lever.[125]

124 This Ludlow bulletin has been reprinted in {Parrish FSN}, p. 111.

125 Neither Skyline Type Foundry nor the CircuitousRoot Type Foundry have actually tried this, because it would risk breaking the lever and would not produce a useful result even if it worked.

10.1.3 Ludlow Head and Side Bearings

For all Ludlow matrices designed to cast in the ordinary direction on the slug, the side bearing is zero. (For matrices to cast lengthwise on the slug, see below.)

The head bearing of Ludlow matrices is unusually complex. Four situations need to be considered:

- "Regular" faces
- Lining faces
- Titling face + size combinations
- Matrices to cast lengthwise on the slug

10.1.4 Head Bearings for Regular Faces

The type bodies of "regular" Ludlow faces bodies are centered on the longitudinal centerline of the Ludlow slug. (Further, the matrices themselves are also centered on the centerline of the mold cavity / slug body.[126]) This means that for these faces the head bearing is different for each body size. Here are a couple of illustrations of this from the Ludlow company's literature.[127]

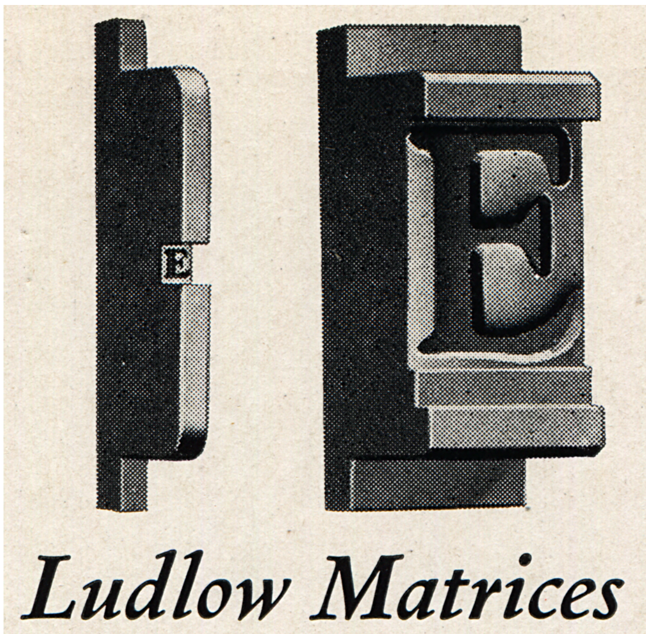


Figure 31: Typical Ludlow Matrices

126 I am indebted to Kylian Wrzesinski for the verification of this. I could have measured it myself, but Ky had already measured the relationship between the Ludlow mold cavity and the Ludlow stick sides (and thus Ludlow matrices) quite carefully during the engineering of a custom Ludlow matrix stick for casting Linotype matrices.

127 These were scanned from the undated brochure which apparently introduced the Model L Ludlow Typograph, but they were used frequently in later Ludlow literature. {Ludlow L1}

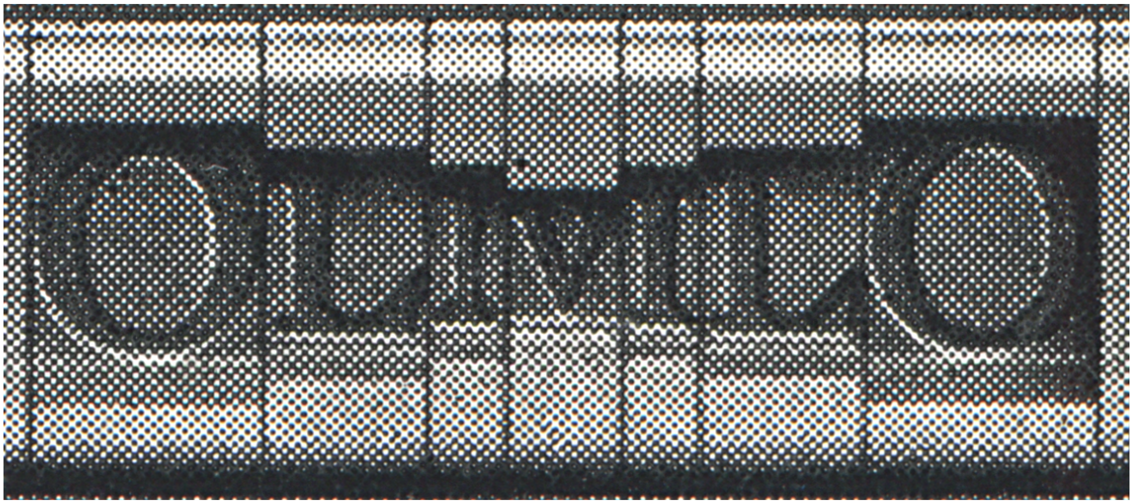


Figure 32: Ludlow Vertical Alignment for Non-lining Faces

[TO DO: Photograph equivalent images from real matrices, to replace these halftones.]

The head bearing for "regular" Ludlow matrices may be computed as:

$$\frac{\text{matrix size}}{2} - \frac{\text{body size}}{2} \quad .$$

For example, a 24 point size of a regular Ludlow face would be punched on a 7/8" matrix. ((7/8) / 2) – ((24 * 0.0138) / 2) = 0.271,9" head bearing.

10.1.5 Head Bearings for Lining Faces

Unlike regular Ludlow faces, "lining" faces such as the Ludlow Lining Plate Gothics align at the bottom of the letter, regardless of size. All of these faces are capital-only (but not titling). Here is the principle as illustrated in a Ludlow specimen book:[128]

128 {*Ludlow Typefaces* D}, p. 162.

Figure 33: Ludlow Vertical Alignment for Lining Faces

[TO DO: I suspect that the largest size of the face centers on the stick, but I need to actually pull some matrices to check this.]

[TO DO: I further assume that the alignment for the other sizes could be calculated by subtracting the difference in sizes; verify this.]

The problem is made more difficult because the various nominal body sizes for lining faces typically were cut not in a single size but in up to four subsizes. In one case only do we have documentation about these subsizes. (The specimen books observe that 6 point Ludlow Lining Plate Gothic No. 1 sets solid on a 4 point slug.) [TO DO / QUESTION: How to handle this?]

10.1.6 Head Bearings for Titling Face + Size Combinations

So far I have found only a very few cases in this category (of non-lining, titling faces which cast in the regular manner, not lengthwise on the slug):[129] [130]

- 6-BCT Ludlow Gothic Bold Condensed Title. This face was cut *only* in 60, 72, and 84 point sizes on 1 ¼ inch matrices and in the 96 point size on 1 ½ inch matrices. [131]

129 To complicate matters, sometimes "Title" in the specimen books really does mean titling in the conventional sense. Although I haven't examined matrices for them (only specimens and {Ludlow LS47}), I'm pretty sure that the following Advertising Figures, marked as "(Title)" and casting in regular orientation on the slug, are on driven on bodies of their specified size as regular titling faces:
- Ludlow 6-B Medium Gothic Condensed Advertising Figures, 84pt & 96pt.
- Ludlow 28-H Tempo Heavy Advertising Figures, 84pt & 96pt

130 I haven't yet found a showing (and don't have the matrices) for 6-EC Gothic Extra Condensed Advertising Figures in 60,72, 84, and 96 point. They are listed as casting in regular orientation in {Ludlow LS47}

131 6-BCT 60, 72, and 84 is shown in {Ludlow Typefaces D}, p. 128. I have not yet found a showing of the

- 3-BEC Ludlow Bodoni Campanile (but not 3-BEC Bodoni Campanile Advertising Figures). In the 84 and 96 point sizes this was cut as a "Cap Font" on 1 ¼" matrices.[132]
- 6-FEC Ludlow Franklin Gothic Extra Condensed ("Caps, figures and points only"), which in the 84 and 96 point sizes was driven in 1 ¼ inch matrices.[133]

The complication with these Ludlow titling faces is that Ludlow did not follow the conventions of typefounders.

In typefounding practice, a "titling" face is not just the collection of all of the capital sorts out of a regular font, but rather is an all-caps face sized (and aligned) to take up the entire body of the type. So for example in the illustration below,[134] the 72 point titling face has all-capital sorts whose printing faces are nearly 72 points in height, while the 72 point regular (uppercase and lowercase) face has capitals whose printing faces are much less than 72 points.

In conventional typefounding, it is sometimes, *but not necessarily*, possible to make a titling face at one body size (say, 72 point) by taking the matrices for the capitals from a larger body size (say, 84 or 96) and casting them full-face on the the body. In the illustration below, this more-or-less worked by using 72 and 96 point sizes of the lettering available in my CAD program.

96 point size, but all four sizes are listed in the "Typeface Family No. 6" section of {Ludlow LS47}, p. F-6-2, dated October 22, 1962.

132 See "Typeface Family No. 3" in {Ludlow LS47}, p. F-3-3. The 96 point size is shown in {*Ludlow Typefaces* D}, p. 96; some editions of the softcover/comb-bound *Some Ludlow Typefaces* show the 84 point size.

133 See {Ludlow Typefaces D} (or other specimen books) and {Ludlow LS47}, p. F-6-4.

134 These illustrations are rather crudely done with the lettering available on my 2-D CAD program, not with real type.

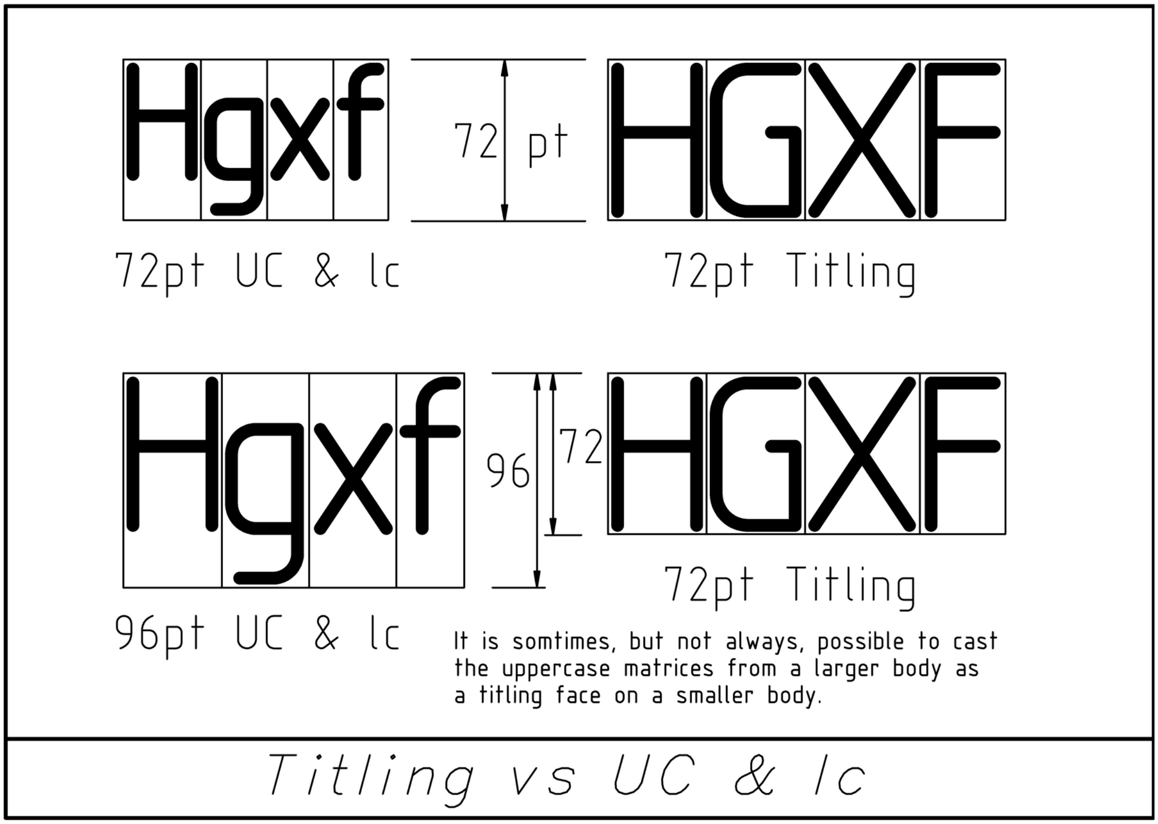


Figure 34: Conventional Typefounding Practice for Titling vs. UC & lc Faces

But Ludlow practice was to do their "Caps, figures and points" titling faces as if they were simply larger sizes of regular faces which were supplied in "caps, figures and points only," and their body sizes are called out as such. Yet they were cut as titling faces full on the matrix, not as regular faces with room for descenders. So for example 96 point Ludlow 6-FEC Franklin Gothic Extra Condensed was driven on 1 ¼ inch matrices[135] The printing face of this type is about 74 points,[136] which fits comfortably on a matrix of this size. Yet the body size is still called out by Ludlow as 96 points (1.324,8 inches), which is too large to fit on a 1 ¼ inch matrix.

So to determine the head bearing of a Ludlow face at a size where it is offered in "Caps, figures and points only," you must first determine the actual body size of this titling face. This information was never published.[137] Then you can use this effective

135 According to its entryin various Ludlow specimen books.
136 As measured from a specimen book.
137 Attempting to derive this information from the next size down does not work. Thus 84 point Ludlow 6-

body size in the regular formula given earlier to determine the head bearing.

10.1.7 Matrices Cast Lengthwise on the Slug

Larger Ludlow matrices were engraved (or sometimes punched) in an orientation rotated by 90 degrees from normal, so that they would cast lengthwise on the slug. In the 84 and 96 point sizes, there was some overlap of orientation. Ludlow 6-B Medium Condensed Gothic in 84 and 96 point, for example, were driven in 1 ½ inch matrices and cast in the regular orientation,[138] while Ludlow 28-B Tempo Bold Advertising Figures from 84 to 144 point cast the long way on the slug.[139] [140] The largest size which would fit in normal orientation on the largest (1 ½") Ludlow matrix was 96 point (1.324,8").

Unlike matrices in regular orientation, which had to fit with each other in composition in the stick and therefore had a side bearing of zero, matrices made to cast lengthwise in the stick have nonzero side bearings.

[TO DO: I have no idea how to determine either the side or the head bearings in these cases.]

10.1.8 Ludlow Matrix Sizes, Styles, and Dimensions

[TO DO: measure and draw all three sizes and slants.]

FEC Frankling Gothic Extra Condensed (a "caps, figures and points only" size) does have a regular caps + lowercase size one size down (at 72 points). But the full cap height of the 84 point titling size is about 65 points (7 points less than 72). The full cap height of the 72 point size is about 56 points, and the overall height from the highest ascender to the lowest descender in the 72 point size is about 68 points (4 points less than 72). These face measurements do not suggest that 72 points is the real body size for the "84 point" titling size.

138 See "Typeface Family No. 6," p. F-6-2, in {Ludlow LS47}.

139 See many specimen books, including {*Ludlow Typeface* D}, p. 55.

140 It can get more complex. 96 point 3-BEC Ludlow Bodoni Campanile was driven as a (titling) "Cap Font" in regular orientation on 1 ¼" matrices (with a face height of about 76 points), while 96 point 3-BEC Ludlow Bodoni Campanile Advertising Figures were engraved, probably on 7/8" matrices to cast lengthwise on the slug (with a face height of about 90 points). The only way to distinguish the two aside from physical inspection was by their telegraph code words in ordering: "Luxes" vs. "Midst".

10.2 A-P-L

[TO DO]

10.3 Nebitype

[TO DO]

11 “Foundry” Style Matrices

11.1 ATF Data for Pivotal and Barth

[TO DO]

11.1.1 ATF “American Line” Lining Information

This information has been preserved in original American Type Founders’ internal specifications documents in the former Dale Guild collection now in the possession of Letterkunde Press, Antwerp, Belgium. Its publication is in process.

11.2 Inland Type Foundry (Lining Information)

This information has been preserved in original American Type Founders’ internal specifications documents in the former Dale Guild collection now in the possession of Letterkunde Press, Antwerp, Belgium. Its publication is in process.

11.3 Barnhart Brothers & Spindler (Lining Information

This information has been preserved in original American Type Founders’ internal specifications documents in the former Dale Guild collection now in the possession of Letterkunde Press, Antwerp, Belgium. Its publication is in process.

12 Hand Mold Matrices

[TO DO. Note that matrices for hand mold use will have a notch on the back, as opposed to the divot of otherwise similar pivotal type caster matrices.]

13 Other an Uncommon Machines

These are primarily of antiquarian interest. These matrices are unlikely to be encountered by the typefounder, and if they are they are approaching a degree of rarity which would suggest conservation rather than use.

[TO DO: Check Legros & Grant for more matrix styles]

13.1 Linotype Junior

[TO DO]

13.2 Linograph

[TO DO]

13.3 Monoline

13.4 Rogers Typograph (US)

[TO DO]

13.5 Rogers Typograph (Germany)

[TO DO]

13.6 Stringertype

[TO DO]

14 Appendices

14.1 Monotype Mixed Matrix Size Composition

14.1.1 Background: The Monotype Matrix Case

To understand why this rather involved bit of matrix and mold engineering was necessary, you have to understand how a cast occurs on a Monotype Composition Caster. The Monotype composition matrix case consists of a grid of matrices held together with some play between all of them. This allows the matrix to move slightly as it is seated firmly on the centering cone behind it. This, in turn, provides for accurate alignment relative to the mold. Because there is a little bit of space between each matrix in the matrix case, it is vitally important that only one single matrix completely covers the mold opening. If for some reason two adjacent matrices were to cover the mold opening, typemetal would be pumped into the space between them and the matrix case would instantly cease to operate properly.

In regular composition using only 0.2" x 0.2" matrices up to 12 point bodies, this is not a problem because the mold cavity will never be larger than the matrix (in the body-wise dimension; set is handled by different mechanisms). In "large composition" with 0.2" x 0.4" or 0.4" x 0.4" matrices at sizes from 14 point up to the maximum of 24 point this is also not a problem, because the larger matrices completely cover the mold opening (again, body-wise). Here this is shown schematically:

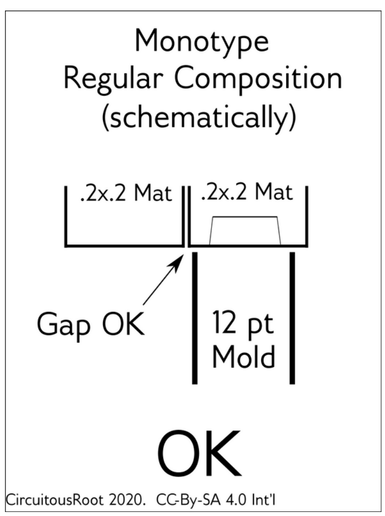


Figure 35: Monotype Composition (schematic)

14.1.2 Mixed-Matrix Problem

A problem occurs, however, when you want to do composition with 0.2” x 0.2” matrices plus other matrices which are larger. This situation occurs, for example, when implementing the “H9” long descenders (“traditional descenders”) at point sizes from 12 point (which with H9 long descenders was intended to be cast on a 14 point body). In Lanston’s implementation of this (which we’ll consider first; the English solution was more complex), the majority of the matrix font was supplied on regular 0.2” x 0.2” matrices while the H9/long descender mats were supplied as 0.2” (set-wise) x 0.4” (body-wise) matrices. The mold for this must be a 14 point mold, because the body is 14 point. This works fine for the H9 mats. But when you come to cast the regular 0.2” x 0.2” mats, the mold opening spans the bottom edge of the mat and extends to the mat below it in the case. This will not work.

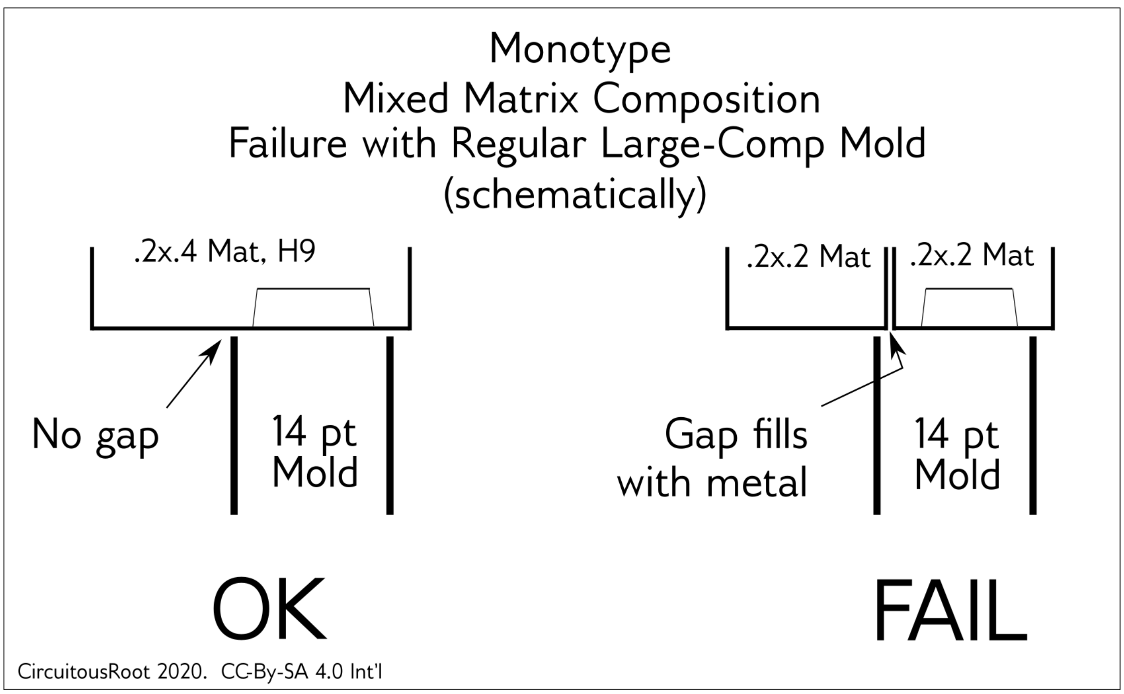


Figure 36: Monotype Mixed Matrix Composition Failure with Large Comp. Mold

14.1.3 Lanston's Solution

I have not yet located either an example or an explanation of the solution to this problem by the Lanston Monotype Machine Company. This next explanation, therefore, describes a *hypothetical* Lanston mold which solves this problem. (It is a simplification of the English Monotype solution to match Lanston's simpler matrix solution.)

If you make a 14 point body mold, the top of which slopes inward on the nick side so as to present a 12 point opening, then both 0.2" tall and 0.4" tall (body-wise) matrices will cast without problems. When casting 0.2" x 0.2" matrices, the 12 point opening allows the matrices to cast as usual, with a sloped shoulder on a 14 point body. When casting 0.2" x 0.4" matrices, the shoulder slopes as before, but the face is more than 12 points. A portion of the face will, therefore, hang unsupported over the shoulder in a kern-like feature.[141] Here is this situation as presented in a schematic diagram:[142]

I must emphasize that the diagram above is at present entirely hypothetical. I have not yet located a Lanston mold serving this purpose (or even identified one in a parts book). Neither do I know a name for it. The English equivalent (see below) is colloquially referred to as a "doghouse" mould because both shoulders slope. Perhaps this is a half-doghouse mold?

141 I do not know if either the Lanston or English Monotype firms had a name for this feature. One respected typecaster has, in correspondence, called it a kern (because it overhangs). Another equally respected typecaster has, again in correspondence, objected to its being called a kern (because it does not extend beyond the type body, and not all kerns are unsupported).

142 This is not a measured diagram of a mold, because as yet I have not located one.

14.1.4 English Monotype's Solution

The matrix aspect of Lanston's solution to this problem (supplying the H9/long descender matrices as 0.2" x 0.4" matrices) is wasteful of matrix case locations. These are at a premium, and losing an entire position when only a small portion of it will be used by the long descender is not an optimal solution.

The English Monotype firm solved this problem with much more complex matrix engineering and a mold with *two* sloped shoulders.[143] To illustrate this, here is an English 15x17 matrix case for 14 point Bembo.[144]

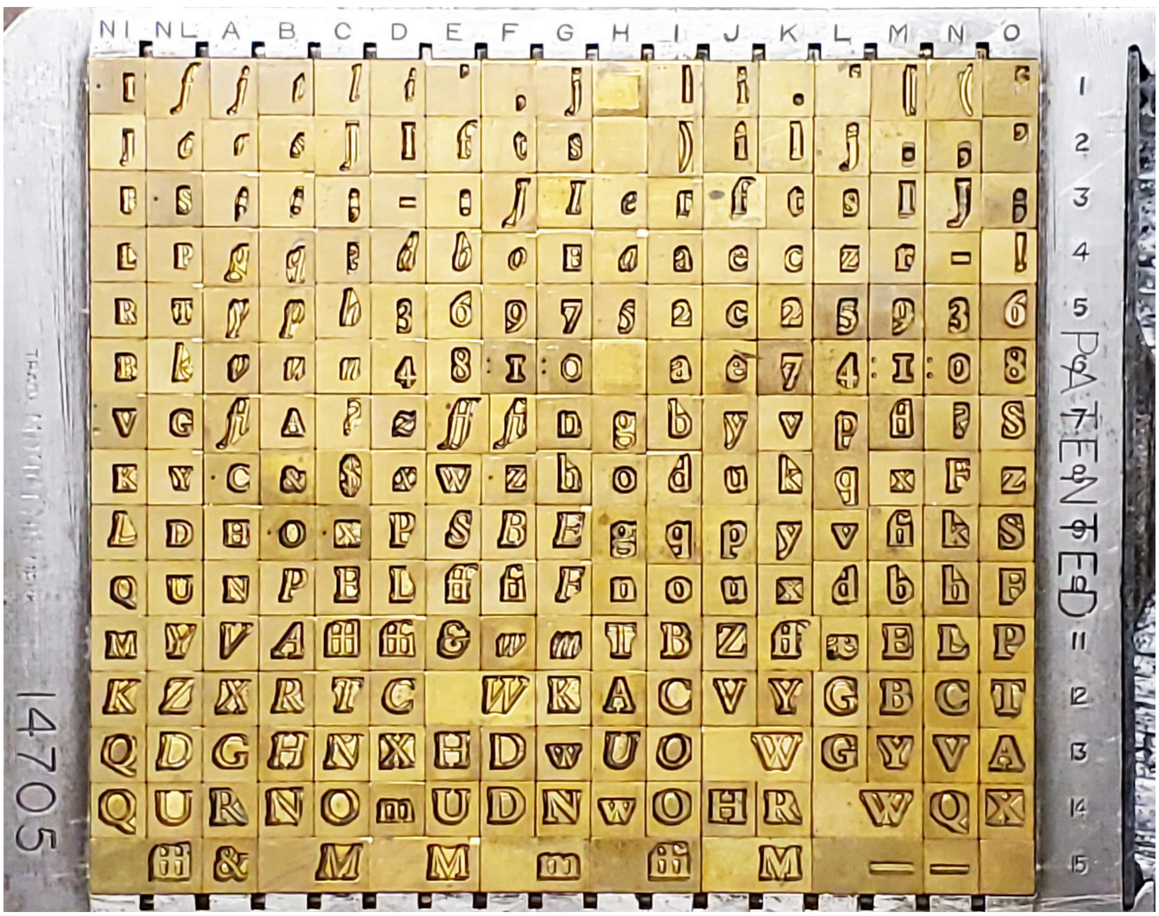


Figure 37: English Monotype 14 pt Bembo, 15x17 Matrix Case

143 Actually, the English mold allowed setwise expansion as well, so it had sloped shoulders on all four sides.

144 Photograph courtesy of Richard L. Hopkins.

From this matrix case here are close-up views showing three different situations.

Below left is an example of the body-wise (only) expansion of a matrix (together with the contraction of the adjacent matrix). Note the ‘fl’ matrix, which expands into the space below it, and the small caps ‘C’ matrix, which is shorter.

Figure 39: Body-wise expansion

Figure 38: Body-wise and set-wise expansion

Above right is an example of the expansion of a matrix in both dimensions (body-wise and set-wise). Note that the ‘ff’ matrix (which is the expanded one) requires smaller matrices both below it (lc ‘w’) and to its right (‘fi’).

Finally, here is an example of set-wise expansion (only), in the ‘ff’ matrix. (It also shows a cap ‘W’ supplied as an 0.4” x 0.2” matrix.)

Figure 40: Set-wise expansion and a double mat

Each of these expanded or contracted matrices has an ordinary (English) 0.2” x 0.2” matrix body beneath the surface. The expansion is provided by a ledge which juts out at the surface of the matrix. The surface of the matching contracted matrix is cut away to accomodate it. This allows the matrix case to hold these matrices as usual. This can be seen here in two views of an expanded matrix together with a contracted one (which happens in this case to be a blank):[145]

Figure 42: English overhanging and recessed mats

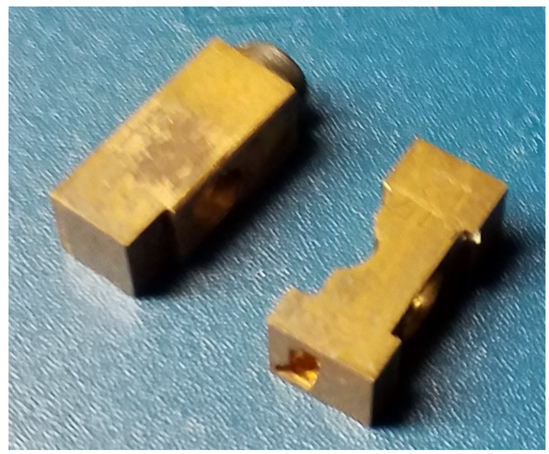


Figure 41: English overhanging and recessed mats, showing faces

It would appear from a visual observation of the photographs above that the cut-out for the “ledge” is deeper than the ledge. This is certainly necessary for the proper centering and lockup of both matrices.

Here’s a schematic view of a pair of matrices (showing two matrices with characters on them, not the blank mat in the two figures above) which shows how these work with the English Monotype multiple-sloped mold which (at least in the United States) is sometimes called a “doghouse” mold:

145 These matrices are not the Bembo mats seen in the earlier photographs. They’re 12 point, an I think they’re English series 617 (which is New Clarendon, in roman and italic). Photographs by the editor of matrices in the collection of Richard L. Hopkins.

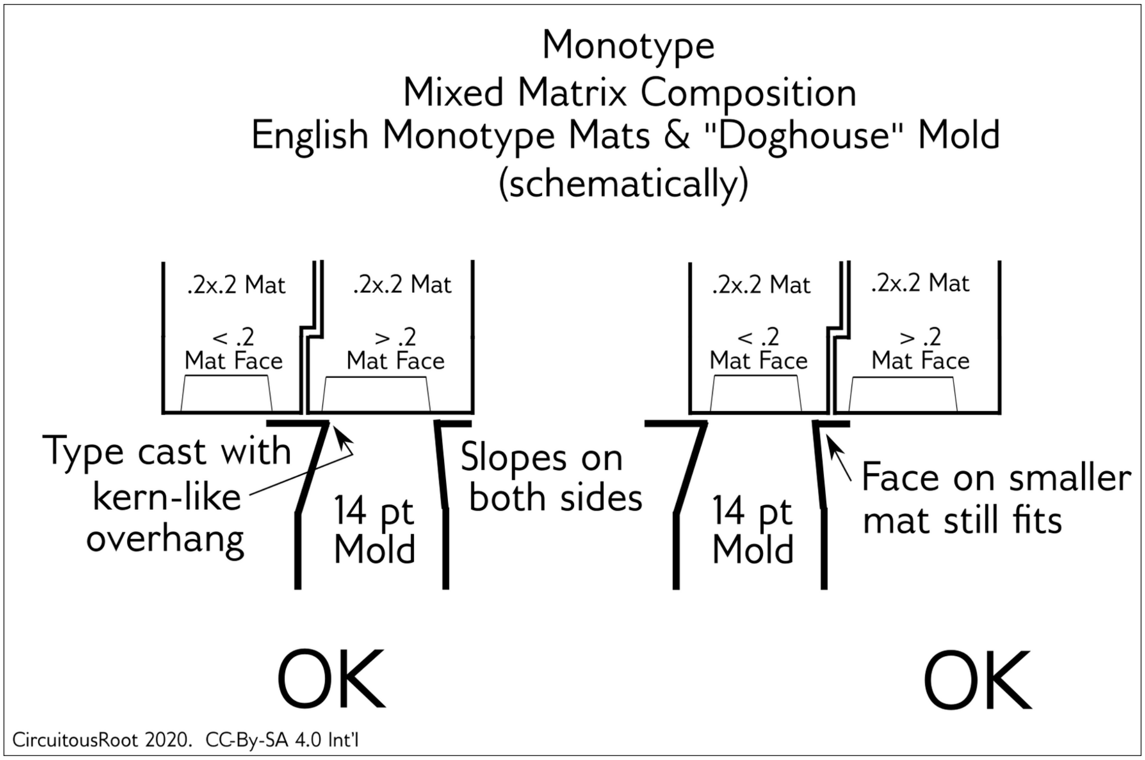


Figure 43: English Monotype overhanging matrices and "doghouse" mould

In both of these views, the mats are shown above, nesting together. The mold is shown below. These views serve equally well for illustrating body-wise overhang and set-wise overhang. The mold has sloped shoulders on both sides.

Let’s assume that this figure is showing a body-wise view, as was done with the Lanston mold earlier. In the left view, the sloped shoulder on the nick-side (left as shown) of the type allows the casting of the overhanging mat with a kern-like projection within a 14 point body. (I don’t have the proportions quite right in this drawing; it would overhang a bit more.) The right view shows that the sloping shoulder on the anti-nick side of the mold allows the cut-away mat to cast as well.

Here is a view of an actual mold of this kind, showing clearly these two shoulders. [146] Some American typecasters (at least; perhaps the English as well?) call this a “doghouse” mold because of its shape. I do not know its official English Monotype name or part

146 Photograph by Richard L. Hopkins.

symbol.

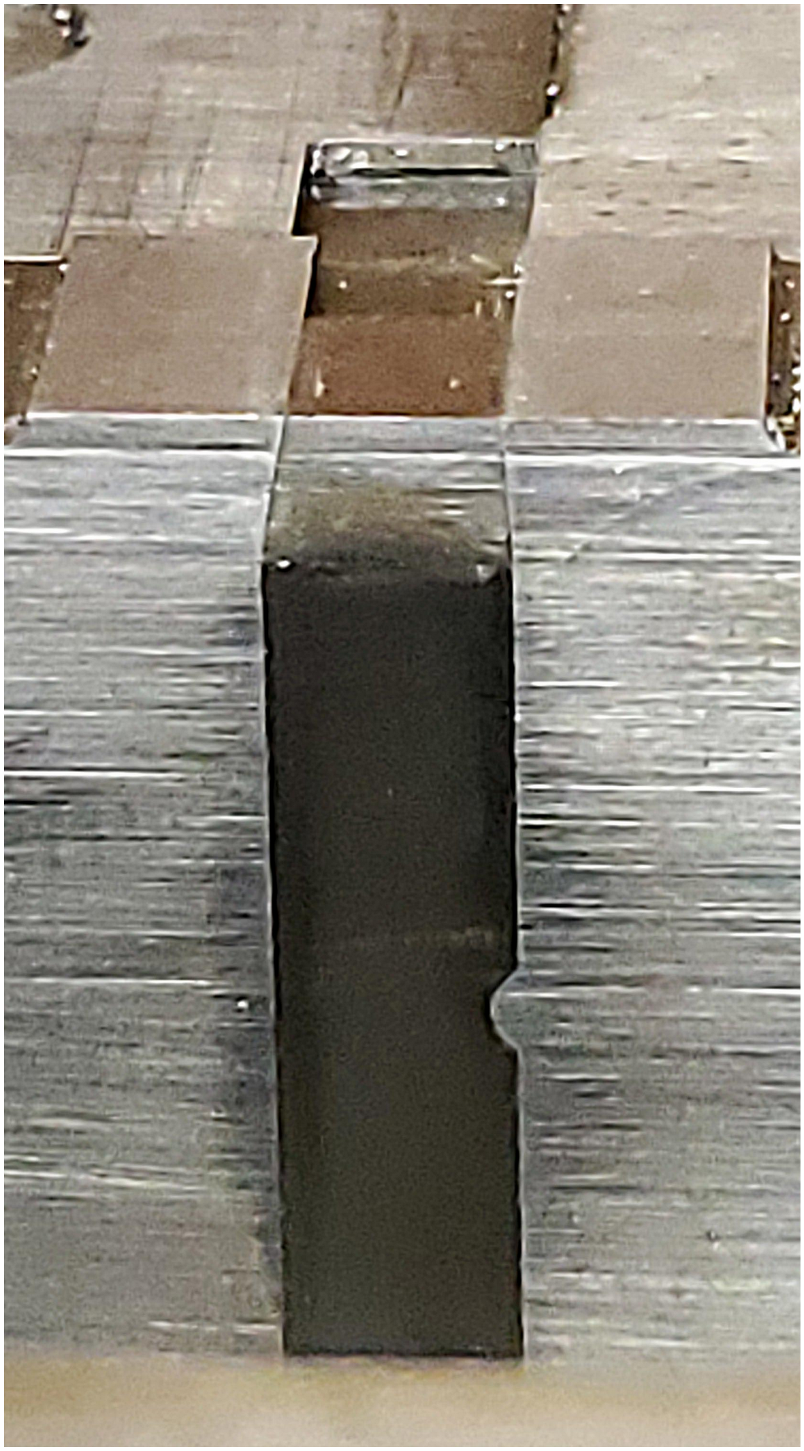


Figure 44: English Monotype "doghouse" mould for overhanging and cut-away matrices

Finally, here are two views of a type[147] cast with the matrix case and mould shown above.[148] In this instance, the overhangs are on the top (anti-nick side) and set-wise.

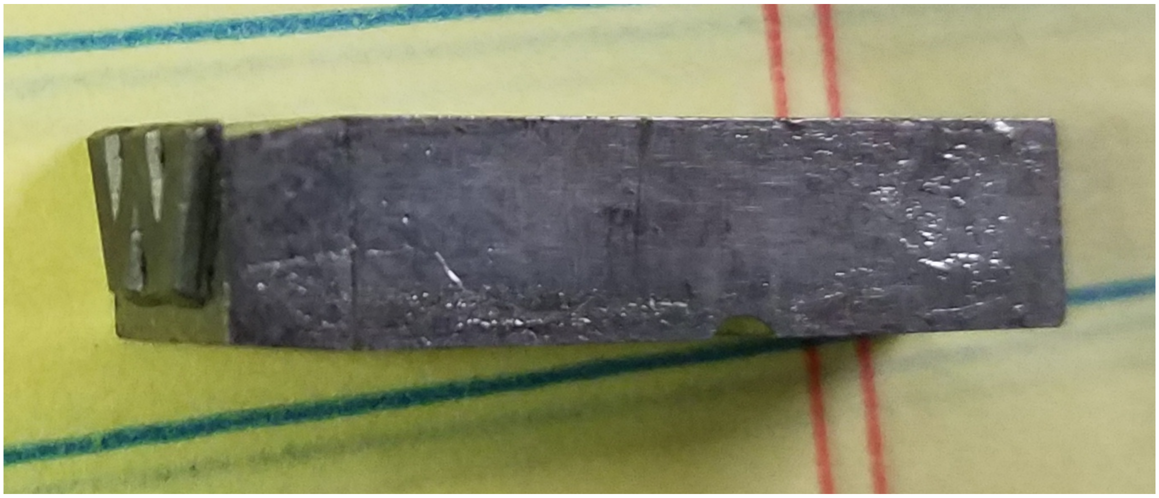


Figure 45: Type cast on an English "doghouse" composition mould

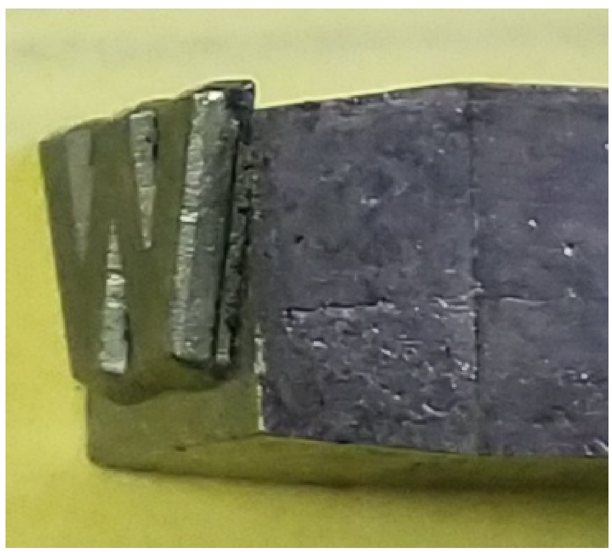


Figure 46: "Doghouse" mould type, close-up

It is important to realize that the overhang in this type, while certainly resembling a kern, is not a kern. It does not overhang the actual body of the type.

147 Face unidentified; this is not the 14 point Bembo shown earlier.
148 Photographs by the editor of a type cast by Richard L. Hopkins.

14.2 What's the Point?

Although it seems old to us now, the American Printers' Point is a relatively new innovation in the history of type. The first four hundred years of typefounding and printing did quite well without it - or any other point, for that matter. Who needs points when type bodies have names, after all. Still, for over a century the point has has been a unit basic to the daily work of the typefounder.

But what is the value, in decimal inches, of an American printers' point? The definitive study of this subject is Richard L. Hopkins' book *The Origin of the American Point System for Printers' Type Measurement.* {Hopkins 1976}. No typecaster should be without it.[149]

The simple answer to the question is that all versions of the American printer's point when expressed to four decimal places (that is, to the ten-thousandth of an inch) work out to 0.013,8 inches.[150] If you are working to thousandths (three decimal places), as is common enough in typecasting, then this value is more than sufficient. It may be sufficient for most type casting.

It was not sufficient for all typefounders and typecasting machinery makers, however. ATF, for example, published tables of the decimal equivalents of points which went out to six decimal plates (that is, millionths of an inch). The two Monotype companies published values of the unit underlying their definition of a point to *seven* decimal places. Whether these exceedingly precise values mattered in actual manufacturing practice is open to debate (see the section “How Close is Close Enough?” later).

However, in some cases encountered in practice precision to at least five decimal places may actually matter. For example, according to Duensing the side bearing of Lanston display matrices is 8 points. With a point rounded to 0.013,8″, this gives a side bearing of 0.110,4″. But with the actual Monotype point of 0.013,833″, it gives a side bearing of 0.110,7″. While the difference of 0.000,3″ is small, it is within the capabilities of any machine shop.

149 There is also an extensive historical discussion of the American and other point systems in {DeVinne 1900}, but Hopkins had access to archival material that DeVinne did not.

150 This statement is true even if you consider the very early and soon abandoned Mergenthaler Linotype value of 0.014”, because that value is only expressed to *three* decimal places and is a correct rounding to that degree of precision.

14.2.1 Pre-Point-System Points

[TO DO: It may or may not be useful to chart the “pre-history” of the point, especially in France. It also may or may not be useful to investigate pre-1886 type bodies and the standards employed by various foundries; e.g. Marder, Luse vs. the Johnson Pica of MacKellar, Smiths and Jordan. Much of this has already been done by DeVinne in *The Practice of Typography ... Plain Printing Types* (1899).]

14.2.2 The Type Founders' Association Point of 1886

The basic unit of the American printers' point system is the pica, not the point; the point is defined as 1/12 pica, exactly. The value of the pica adopted by the Type Founders' Association in 1886 was the MacKellar, Smiths and Jordan foundry's house standard, the “Johnson Pica.” This house standard had a long history, but for the purposes of establishing the new pica they found an expression of their standard in terms of centimeters: 83 picas per 35 centimeters.[151] Converting centimeters (35) to millimeters (350) and picas (83) to points (996), and then converting the whole expression to inches, we get a point of: $\frac{350}{996}/25.4 = 0.013{,}834{,}867\ldots$ [152]

When rounded to each decimal place out to six, the American printers' point as defined by the Type Founders' Association in 1886 becomes:

151 They had no choice but to use a metric basis, because at the time the US lacked even a practical definition of an inch which would be suitable for fine metrology. This was before the Mendenhall Order of 1893 established a pragmatic, if extra-legal, definition of the inch by adopting for the purposes of the U.S. Coast and Geodetic Survey the International Prototype Metre along with one of the several informal and inconsistent conversion values suggested in the US “Metric Act” of 1866. See {Mendenhall 1893} The US still lacks an actual legal standard for the inch.

152 Purists will note that the standard for metric conversion of 25.4 mm to the inch, exactly, was not adopted in industry by the American Standards Association until 1933 and by American federal government standards organizations until 1959. It remains an extra-legal definition, as the US Constitution charges the Congress to “fix the Standard of Weights and Measures” and the Congress has never done so. But the difference doesn't matter. If you employ the conversion in general use from the 1866 Metric Act and confirmed by the Mendenhall Order (1 yard = 3600/3937 meter) you get instead a value for the point of .013,834,839,... The difference is .000,000,028,.., which is beyond the precision required by even Linn Boyd Benton.

Decimal places	Rounded Value of the Point, in Inches
1	0.0 [obviously this is not useful]
2	0.01
3	0.014
4	0.013,8
5	0.013,83
6	0.013,835

Table 26: The American Printers' Point to Various Precisions

14.2.3 American Type Founders Company Points

The American Type Founders Company used or published at least three different values for the point.

In a chart dated May 1902, "Punch and Matrix Table," ATF published a value for 10 points of 0.138,37 inches. This table was reprinted in {Rehak 1993}, p. 181. This gives a value of 0.013,837 for one point and a value of 0.166,044 for the pica.[153]

I have been able to examine, through the courtesy of Patrick Goossens and the Letter-kunde Press (https://letter-kunde.be), a copy (No. 56/65/66, {ATF 1940}) of the American Type Founders Company A*TF Standards* internal document. This may be the only extant copy of this document which includes Section C on matters of "Type Design."[154] This Section C contains a report entitled "American Point System of Measuring Type," with an approval date of April 18, 1940. In this section, ATF confirms that its previous value for the point was 0.013,837 inches, but goes on to establish a new value, 0.013,835 (rounded from an a theoretical computation of 0.013,834,865,4). This revised value gives a pica of 0.166,02". It also corresponds more closely to the 1886 Type Founders' Association value. My thanks to Patrick for preserving this document and allowing me to consult it.

ATF also created a simplified chart of integral and fractional points to four decimal places of the inch. The ultimate source for this is the internal *ATF Standards* book, where

153 This 1902 chart also gives a value for 12 points (that is, one pica) of 0.166,044.

154 I am aware of only two extant copies, both in the collection of the Letter-kunde Press. The other, No. 18, cites a Section C in its contents but at least in its current state does not include the section.

it appears as page C-100.4 (see {ATF C-100.4} and the annotations for {ATF 1940}). This chart was also reprinted in {Rehak 1993}, pp. 186-187). It must have been reprinted or copied elsewhere, because I have scan of a photocopy of it sent to me by the late Stephen O. Saxe. This chart gives the value of a point a 0.013,8, which is identical to the 1886 Type Founders Association point if converted to decimal inches and rounded to four decimal places.

14.2.4 The Original and Later Mergenthaler Linotype Points

The Mergenthaler Linotype Company originally adopted a point size of 0.014 inches (giving a pica size of 0.0168, exactly). This may seem strange, but 0.014 is simply 0.013,8 rounded to the nearest thousandth of an inch.

In Mergenthaler's 1915 *Specimen Book of Type Styles* {Mergenthaler 1915, p. 10}, they say:

> Point System. The standard of measurement adopted by the Mergenthaler Linotype Company is the Pica em measuring .166 of an inch, which is the standard decided upon by the United States Typefounders' Association in 1886 and now adopted by practically all American type founders. One-twelfth of the Pica, .166, equals one point, .01383, and one quarter of a point is the unit used in the manufacture of our faces on the point set system.[155] The majority of our faces our made on this point set system, using the one-quarter of a point for the unit, and this plan greatly facilitates justification. Some of our older faces, however, are made on the basis of .014 to the point, or .168 to the Pica, which was our original point size.

It is interesting to note that this account does not give a correct value for the 1886 Typefounders' Association point, which is not 0.166 exactly but rather 0.166,018,...

I do not yet know when the Mergenthaler Linotype Company abandoned the 0.014" point. Their use of a pica of exactly 0.166 inches and a point of 0.0183 inches (which is 1/12 of a 0.166 pica, rounded) is confirmed in 1939 and 1940. For example, in both Linotype Faces {Mergenthaler 1939, p. XII} and *Linotype Machine Principles* {Mergenthaler 1940, pp. 442-443} they say:

> Point System

155 "Point set" type is type manufactured such that all set widths are integral multiples or relatively simple fractions of a point as opposed to arbitrary widths.

> Prior to about 1886, each typefounder was a law unto himself in the matter of type standards. Brevier, for example, made by one foundry would not justify with brevier from another foundry. The pica "em" in use up to that time had been obtained by dividing an inch into six parts, equaling, decimally, .166 2/3". When the present system of the American Type Founders' Association was decided upon in 1886, the fraction was eliminated and a standard "pica" em adopted measuring .166". This standard of measurement is used by the Mergenthaler Linotype Company, and one-twelfth of the pica, .166, equals one point, 0.01383. One-quarter of a point is the unit used in the manufacture of our matrices on the point-set system. (pp. 442-443)

Their account of the pre-1886 point and the Type Founders' Association's adoption of the Johnson Pica is a complete fiction and should never be repeated as historical fact[156], but these passages, especially as they appear in the highly technical *Linotype Machine Principles*, do confirm Mergenthaler Linotype's use of a point of 0.013,83 inches.

14.2.5 The Monotype Point

The Lanston Monotype Machine Company (and the company which became the The Monotype Corp. Ltd. in England) adopted a different value for their point: 0.013,833. This differs from the Typefounders' point by only 0.000,002, so in practical terms the two are the same. But it's interesting to see how Monotype got to their value.

The Monotype point was based on the assumption that the pica was 0.166 inch, exactly. That's not unreasonable when working to the thousandth (three decimal places), as the Type Founders' Association pica of 1866 is 0.166,018,... In retrospect, though, taking .166 exactly was a curious decision - it is a value rounded to the thousandth of an inch, but they then proceeded to multiply things out to *seven* decimal places (tenths of millionths of the inch) and to consider the rounded vaue of *that* number to be exact.

The Lanston unit system is based on a unit of 1/18th of the body size at any given body size. But they had to anchor this somewhere, and they did so with a body size of one point.

Lanston Monotype explained this in *The Monotype System* in 1912:

> "54. The Set Size of any eighteen-unit character in any twelve-set font is one pica (12 points); that is, .166″ If it were possible to make a one-set face, the

156 It also conflates, as a trap for the unwary, the Type Founders' Association with the later American Type Founders Company.

eighteen-unit characters of this one-set face would be one-twelfth as wide as the eighteen-unit characters of twelve-set, thus:

.166″ ÷ 12 = eighteen units of one set, which may be expressed

thus: $\frac{.166''}{12}$

“55. One unit of one set would be one-eighteenth of this size (eighteen units of one set), or

$$\frac{.166''}{12} \div 18 = \frac{.166''}{12 \times 18} = \frac{.166''}{216} = .0007685''$$, one-unit-of-one-set.

“56. Knowing the size of one unit of one set, to find the size of one unit of any set multiply the value of one unit of one set (.0007685″) by the set desired; to find the size of any number of units of this set multiply this product (one unit of its set) by the required number of units.”[157]

The result of this calculation (0.000,768,5) is the the correct rounding of what becomes an infinitely repeating decimal expansion. It represents both the Monotype “unit size” for one point bodies and the basic fixed decimal figure which Monotype could then multiply out to get any desired unit value. In particular, since this is the unit for one point bodies, and since the unit for any body size is 1/18th the body size, you simply multiply 0.000,768,5 by 18 to get the Monotype point: 0.013,833 (exactly).

Decades later, the English Monotype company put it more concisely (and, fortunately for us, in doing so made it clear that they employed the same point):

The base unit of 'Monotype' founts is .0007685. This is 1 unit of 1 point. A 'unit' is the 18th part of an em quad. By multiplying the measurement of 1 unit of 1 point by any number the unit value of the larger set is obtained.
Thus: .0007685” muptiplied by 8 ½ gives 0.0065324” as the measurement of 1 unit of 8 ½ set, and the em quad would be .1175 (taken to the fourth decimal position.[158]

14.2.6 Other Point Values

Several other values for the American Printers’ Point have been published.

157 From {Lanston 1912}, p. 25. {Lanston 1916}, p. 24, has essentially the same information.
158 {Monotype UK 1952}, p. 115.

14.2.6.1 0.013,835. Attributed to DeVinne by ATF & Rehak

Theo Rehak, in *Practical Typecasting*, presents an Appendix on "Standards" {Rehak 1993}, pp. 176-191. It is a valuable source to the typecaster, presenting information from a variety of sources, both attributed and anonymous. In particular, much of the language of the discussion of the printers' point on pp. 176-177 is taken from the report on the "American Point System of Measuring Type" which appears in Section C of the internal American Type Founders Company book *ATF Standards*. See the entry in the Bibliography for {ATF 1940} for a discussion of this source.

In its 1940 report, ATF says that the figure of 0.013,835 "collaborates with Theodore DeVinne in his book on the Practice of Typography of 1902." {ATF 1940}, p. C-100.3. Rehak says that a figure of 0.013,835 "correlates with that of Theodore L. DeVinne" in *The Practice of Typography* in 1902" {Rehak 1993}, p. 177.

However, I have been unable to identify this value in DeVinne. "The Practice of Typography" was not a single book but rather a series title given to several essentially independent books by DeVinne published and reprinted over the course of several years (1899/1900 to 1904). The first of these was *The Practice of Typography: A Treatise on the Process of Type-Making, The Point System, the Names, Sizes, Styles and Prices of Plain Printing Types* (NY: The Century Company, 1900[159]) {DeVinne 1900}. This was reprinted in a second edition in 1902. While this book contains a detailed discussion of the history of point systems, I have been unable to discover the value 0.013,835 anywhere in it. I have been unable to find this value cited explicitly in any volume of *The Practice of Typography*[160]; if anyone can locate it I would appreciate the reference.

14.2.6.2 0.013,834. Attributed to "other sources" by Rehak

Rehak goes on to say "but other sources usually state that 1 point = 0.013834" {Rehak 1993, p. 177}. He does not say what these "other sources" are, but he is following very closely the text of the 1940 ATF Standard document and at this point the ATF document cites "the Business Printers' Dictionary of Printing Terms" (which is probably Porte; see below) and a value from it of 0.013,84. It is possible that the value of 0.013,834 of these

159 Its copyright date is 1899, but 1900 is the date of publication as given on its title page.

160 The second volume of "The Practice of Typography," *Correct Composition*, was published in 1901 with a second edition in 1902 (DeVinne 1901}. The third volume, A Treatise on Title-Pages, was published in 1902 and is the only volume of the series to have appeared originally in 1902 {DeVinne 1902}. A subsequent volume, *Modern Methods of Book Composition* (NY: The Century Co.), did not appear until 1904.

“other sources” is a misprint for the “Business Printers’” 0.013,84 in {ATF 1940}. I have yet to find 0.013,834 in any other source.[161]

14.2.6.3 0.013,84. by Porte, Probably cited by ATF

The 1940 ATF report that Rehak is quoting from contains another potential source of confusion. It refers to a value of 0.013,84 in “the Business Printers’ Dictionary of Printing Terms.” I have been unable to discover a source by that name or publisher. [162] However, R. T. Porte, editor of *The Business Printer*, did publish a *Dictionary of Printing Terms* (see below) which contains this value.

R. T. Porte, in his *Dictionary of Printing Terms*, gives a value of 0.013,84 {Porte 1923, p. 197}. He gives no source for this value. I have verified by examination of an original 1923 example that this value is as stated; it is not a digital transcription error for 0.013,834.

14.2.6.4 0.013,836,6. “ATA Point,” Vakulenko and Following

At least two values for an “ATA Point” are cited by several secondary sources in the digital era.[163] The ATA in question is probably the Advertising Typographers’ Association. The ATA also published a value which does not coincide with the values attributed to it by later sources.

Tracing these values back can be difficult because various secondary sources simply copy each other without attribution. So for instance an online search for this value will turn up an ATA Point in what purport to be online versions of the 1913 *Webster’s Revised Unabridged Dictionary* (where it does not in fact appear). The confusion at this level seems to be due to the fact that by at least (and probably on) March 11, 2002 a definition for an “ATA point” was added to the Free Online Dictionary of Computing.[164] This definition, which is quite distinctive, reads:

---

161 It could be obtained by truncating, but not by rounding, the 1886 Type Founders’ Association value expressed in inches as 0.013,834,8...

162 That is, there is no book called the *Business Printers’ Dictionary of Printing Terms* and there is no book published by The Business Printer (a journal) called *Dictionary of Printing Terms*.

163 E.g., {Clair 2005}, p. 143 (but not {Clair 1999}). Note, however, that the discussion of the measurement of type bodies in this book is entirely wrong. Such a lack of understanding of real type is now, regrettably, the norm rather than the exception.

164 https://foldoc.org/ata+point, last updated 2002-03-11. Accessed 2022-08-08. No record of this entry appears in the Wayback Machine of the Internet Archive before this 2002 date.

> ATA point
>
> (Or "Anglo-Saxon point") One of the two most common variants of the point, equal to 0.3514598mm or 0.0138366 inch, or 1/72.272 inch. The ATA point is used on the island of the United Kingdom and on the American continent.

The earliest version that I have found of a text containing this value (0.013,836,6 inch) and distinctive text is a web page by Alex Vakulenko {Vakulenko 2000}, which says:

> "1 point (ATA) = 0.3514598 mm = 0.0138366 inch
>
> ...
>
> Two most widely used points are ATA points (also known as Anglo-Saxon point) and Didot points. Anglo-Saxon point which is about 1/72.272" has been used on the island of the United Kingdom and on the American continent.[165]

Vakulenko tabulates values for several kinds of points (Truchet, Didot, ATA, TeX, Postscript, L'Imprimerie Nationale), picas (ATA, TeX, Postscript) and the cicero (in Didot points). He does not give sources for any of these.

14.2.6.5 0.013,837. "ATA Point," Kuhn

A slightly earlier source, Marcus Kuhn, presents a table identifying the same entities ({Kuhn 1999}, which is also a web page). Kuhn, however, rounds the inch value of his ATA point to a different precision and thus has a different value:

> 1 point (ATA) 0.3514598 mm = 0.013837 inch

This rounded value is identical to the pre-1940 ATF value. Kuhn gives no sources for any of his values for points, picas, or the cicero.

14.2.6.6 0.013,83 "ATA Point" (ATA 1963)

At this point my research into the origins of an "ATA point" of 0.013,8366 or 0.013,837 has reached a dead end. There is no such definition in the *A.T.A. Type Comparison Book* (1965), the *ATA Advertising Production Handbook* (1954), the *A.T.A. Service Book* (1926). How the value of 0.013,836,6 for an "ATA point" entered the literature remains a mystery.

---

165 Vakulenko's second most widely used point is the Didot point.

However, there is a definition of a point in the second (1954) and third (1963) editions of the *ATA Advertising Production Handbook*: {Herold 1954}, p. 86, and {Bahr 1963}, pages 41 and 131.[166] It is defined as 0.013,83 inches, not 0.013,836,6 or 0.013,837 inches. (This ATA value is identical to the value used by the Mergenthaler Linotype Company.)[167]

It is curious that 21st century sources so resolutely cite an "ATA point" of 0.013,836,6 inches when the ATA's own *Production Handbook* has the Mergenthaler value.

In any event, the ATA, while involved in typography, was not a typefoundry or matrix manufacturer. Their value - whatever it is - is of small importance to the typecaster.

14.2.6.7 Still More Instances

Any number of companies, organizations, and individuals published charts and lists which included what they believed the value of the point might be. Listing them all would be impossible and have little point (no pun intended), because none of them have any particular authority. Still, it may be interesting to list a few.

Vandercook: The press manufacturers, Vandercook & Sons, Inc., printed a small card with many handy values for the printer.[168] Their value for the point was 0.013,83.

---

166 No decimal value for the point is given in the 1947 first edition of the ATA Production Hand Book {Herold 1947}. It just says that "A point is an arbitrary unit of measurement - very close of [sic] 1/72 of an inch." (p. 11).

167 Amusingly, this 1963 edition has a clear typographical error in its definition of the pica. It defines the pica correctly within the definition of the point, but defines it as 0.996 inches on its own (p. 131).

168 The agate, plate thicknesses, type height, press pressure settings, halftone etching depths, etc. This card (in DMM's possession) was printed after 1963 (it has a ZIP code). This particular card was formerly owned by the late Carl Schlesinger and was found in some of his papers within his copy of the *ATA Production Hand Book* (2nd ed.)

14.2.7 Approximate Point Values

Any number of sources have cited point or pica values which are clearly intended to be rough approximations rather than precise values. These should not be considered by the typemaker. I'll cite one instance here by way of example.

Eugene De Lopatecki, in his 1937 *Typographer's Desk Manual* {De Lopatecki 1937}, says "a pica is 1/6 inch." This dos not mean that he has adopted the "Postscript point" in the 1930s! The full context of this statement is:

> The length of a line of type is known as its "measure." Measures are expressed in picas. A pica is 1/6 inch (or one inch equals 6 picas). Thus a three-inch line measures 18 picas. (p. 13)

De Lopatecki's audience consists of advertising typographers. They aren't making type.[169] They're specifying the use of typefaces in layouts where everything is expressed in picas as the native unit. De Lopatecki's book is heavy on measurement; he has tables of measurements relating typefaces and their characters to picas. Inches do not appear in use. The only reason he gives a conversion between picas and inches is as an aid to a presumably beginning typographer who would be familiar with inches but might not yet have a sense of the size of a pica, so that they might have some notion of how long a line or how big a layout might be.

169 They might never actually handle type. Even at this now distant point in time we had fallen so far from Moxon that a "typographer" might know nothing of printing.

14.2.8 Comparing Point Values

On the next page is a tabulation of every published or otherwise cited value for the American Printers' Point that I am aware of[170], compared in each case with the theoretical value rounded to the same number of decimal places. Note that some of these sources have little authority.

170 From the era of metal type. I am largely ignoring the secondary sources since then.

14.2.8.1 Table Comparing American Printers' Point Values

Value	**Theoretical**[171]	**Difference**	**Source**
0.013,8	0.013,8	0	ATF, Chart C-100.4
0.013,83	0.013,83	0	Merganthaler Linotype, later[172]
0.013,833	0.013,835	-0.000,002	Monotype (US & UK)
0.013,834	0.013,835	-0.000,001	Rehak's "other sources" [173]
350/996 mm	same	0 (by definition)	T.F. Assn, 1886 (as defined)
0.013,834,839,...	same	0	T.F. Assn. 1886 (in Mendenhall inches)
0.013,834,865,4[174]	0.013,834,839,4[175]	+0.000,000,025,9	{ATF 1940} full calculated value
0.013,834,867,...	0.013,834,839,...	+0.000,000,028[176]	T.F. Assn. 1886 (in 1959 inches)
0.013,835	0.013,835	0	DeVinne ? [177]
0.013,835	0.013,835	0	ATF, from 1940-04-18
0.013,836,6	0.013,834,8	+0.000,001,8	"ATA" in {Vakulenko 2000}
0.013,837	0.013,835	+0.000,002	ATF, by May 1902 to 1940-04-17[178]
0.013,84	0.013,83	+0.000,01	{Porte 1926}
0.014	0.014	0	Mergenthaler Linotype, very early

Table 27: Various Values for the American Printers' Point, Compared

14.2.8.2 (Non-)Effect of the Changing Inch

Values in this table are in inches unless noted otherwise - but which inch?

171 "Theoretical" in this case is 1/12 of the "Johnson Pica" of MacKellar, Smiths and Jordan, adopted in 1886 by the Type Founders' Association.
172 And the Advertising Typographers Association (ATA) in their *Production Handbook*, but not as commonly cited today.
173 {Rehak 1993}, p. 177. However, this may be a reference to Porte and a misprint of Porte's value of 0.013,84.
174 This is the full calculated value in {ATF 1940}. ATF did this using an inch of 25.4mm (the "industrial"/Johansson/BSA 350:1933/ASA B48.1 value of the 20th century). I am here comparing it to a theoretical value calculated using the older "Mendenhall" inch of 1893. The "Difference" column here isn't meaningful; it's just an illustration of the pointlessness of empty decimal places.
175 (350/996) / (3600/3937/36 * 1000) = .013,834,839,357,...
176 This is about the length of four lead atoms lined up.
177 {ATF 1940}, p. C-100.3 (also quoted in {Rehak 1993}, p. 177); see discussion earlier.
178 Also in {Kuhn 1999}

As discussed in a later chapter, “Too Much Detail about Metrology,” the inch has never had a legal definition in the United States.[179] We have had to rely upon pragmatic conversion factors from the meter. Through the first decade of the 20th century, the most common pragmatic conversion factor used a yard of (3600/3937) meters, which gives an inch of (3600/3937) / 36 * 1000 = 25.400,050,800,... mm (or 25.400,051 mm/inch, rounded to micrometres). Sometimes I’ll call this the “Mendenhall inch.” It should be noted, however, that just because a source states a value for the point to this level of precision doesn’t mean that the person or firm in question was actually measuring to six or seven decimal places.

From the 1910s, C. E. Johansson introduced inch versions of his gage blocks, manufactured in the US. He adopted a different value, 25.4mm/inch, exactly. This was adopted by some industrial standards organizations in the 1930s,[180] by Canada as a legal standard in 1951, by the national metrology laboratories of the major English-speaking countries in 1959, by the UK as a legal standard in 1963, and, well, here in the US we still do not have a legal definition of an inch.

As discussed later in the section “How Close is Close Enough?” for the practical typefounder or type machinery maker this doesn’t matter. For the table which follows, which records probably wishfully precise values as stated in the literature, it does. For values of the point in inches through six decimal places (0.013,835) the difference between the two inches does not matter. For values more precise than that, the Mendenhal inch gives a value for the point of:

(350/996) / (3600/3937/36 * 1000) = 0.013,834,839,357,...

By comparison, the value of the Johansson (and modern) inch, 25.4, gives a value of

(350/996)/25.4 = 0.013,834,867,027,...

Lining them up:

0.013,834,839,357,... which rounds to 0.013,834,8

0.013,834,867,027,... which rounds to 0.013,834,9

No verified source[181] from the era of metal type cites a value past six decimal places.

179 No, the Metric Act of 1866 did not define the inch. No, the Mendenhall Order of 1893 is not a legal definition of the inch.

180 BS 350 : 1930. ASA B48.1-1933.

181 By “verified” I mean here that I have not yet found the original source of the “ATA point” as cited in the

14.3 Table of Didot Points in Inches

[TO DO]

secondary literature of the digital era.

14.4 How Close is Close Enough?

It is very easy to write down numbers to the sixth decimal place of an inch. But it is worth remembering that 0.000,001 is one millionth of an inch (one microinch). For comparison, that's the tolerance of the highest grade (grade 0.5) of gage block – and that gage blocks of this grade typically are intended for use not in production but as calibration masters for other gages.[182] In practical terms, when tolerances exceed the thousandth (0.001") or "tenth" (ten-thousandths of an inch, 0.000,1") costs rise sharply.

Here, then, is a miscellaneous collection of citations of claimed tolerances in excess of 0.001 for matrix or mold making.

- {Rehak 2004} (*The Fall of ATF*), p. 22, cites a tolerance of +/- 0.000,1 for matrix engraving at American Type Founders.
- Drawing D3437, dated February 6, 1929, of The Monotype Corporation Ltd. (UK) expresses critical dimensions to four decimal places (in inches).

It is also interesting to examine the practices of linecaster manufacturers for their molds (as yet I have no matrix data from the manufacturers).

Original engineering drawings of the Mergenthaler Linotype Company indicate:

- Fractional dimensions were toleranced to +/- 0.005 unless otherwise specified.[183]
- Decimal inch dimensions and tolerances to three places were typical, and tolerances to four places for precision features were not unusual.[184]
- In unusual cases tolerances to five decimal places occur. But I suspect that these are "soft decimal conversions" of fractions of "tenths." (In the example which prompts this remark, the value in question is 0.000,25. I suspect that this really means "a quarter tenth" rather than a true tolerance to five decimal places.[185])

In summary it would seem that work to four decimal places of the inch was common.

182 {NIST 180}, p. 13.

183 Example: Mergenthaler Linotype Co. Drawing F-517, "Mold Liner (R.H.)" Reprinted in {CR MLC DWG}.

184 Example: Mergenthaler Linotype Co. Drawing F-2930 [Recessed Display Mold]. Reprinted in {CR MLC DWG}

185 This occurs on MLC Drawing F-2930. In {CR MLC DWG}

I have not yet found evidence of accuracy beyond this, but of course much of the source material has been destroyed. We do not, for example, have the engineering drawings for Monotype or Thompson molds.

It should also be noted that for mold work, at least, both the American and English Monotype companies selectively employed hand fitting (resulting in parts which were not truly interchangeable and had to be fitted at the factory). This is shown in the film {*Making Sure* 2} and is reflected in instructions in parts lists such as {Thompson 1942}.

14.5 Beard Widths for Selected Depths and Angles

Here is a table computing the widths of the beard for a range of depths of drive. The depths cover a range around an assumed average of 8 degrees, plus 10 degrees because it's a round number and 16 degrees because ATF used for at least some molds. Not all of the values computed here are sensible, or were found in practice. For example, it is unlikely that a 16 degree beard ever really existed for 0.030 drive type, or for a Linotype matrix.

This table is maintained in a separate file (a LibreOffice / Apache OpenOffice spreadsheet) which may be found at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/literature/practices/index#beard-widths

as

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/literature/practices/beard-widths.ods

Here's a copy embedded within this present document. (It may not be completely up-to-date.)

Beard Widths

For Selected Depths of Drive and Beard Angles

	Width at						
Depth	**6 deg.**	**7 deg.**	**8 deg.**	**9 deg**	**10 deg**	**16 deg.**	**This depth used on**
0.1251	0.0131	0.0154	0.0176	0.0198	0.0221	0.0359	ATF B-4 (NY/Conner), 120 pt and up
0.1241	0.0130	0.0152	0.0174	0.0197	0.0219	0.0356	ATF B-4 (NY/Conner), 48 – 108 pt
0.0968	0.0102	0.0119	0.0136	0.0153	0.0171	0.0278	ATF B-3 (NY/Conner), 30 – 42 pt
0.0844	0.0089	0.0104	0.0119	0.0134	0.0149	0.0242	ATF STL-3 (Central or St. L.), 36 – 72 pt
0.0758	0.0080	0.0093	0.0107	0.0120	0.0134	0.0217	ATF B-2 (NY/Conner), 14 – 24 pt
0.0750	0.0079	0.0092	0.0105	0.0119	0.0132	0.0215	English Linotype
0.0650	0.0068	0.0080	0.0091	0.0103	0.0115	0.0186	Giant / Super/ Eng. Disp. > 36 pt / N-R
0.0535	0.0056	0.0066	0.0075	0.0085	0.0094	0.0153	ATF STL-2 (Central or St. L), 14 – 30 pt
0.0500	0.0053	0.0061	0.0070	0.0079	0.0088	0.0143	Lanston 14 – 36 pt / Eng. Displ < 36 pt
0.0430	0.0045	0.0053	0.0060	0.0068	0.0076	0.0123	Linotype / Thompson / Compositype
0.0420	0.0044	0.0052	0.0059	0.0067	0.0074	0.0120	ATF B-1 (NY/Conner), 6-12 pt
0.0309	0.0032	0.0038	0.0043	0.0049	0.0054	0.0089	ATF STL-1A (Central or St. L.), 6 – 12 pt
0.0300	0.0032	0.0037	0.0042	0.0048	0.0053	0.0086	Lanston cellular / Eng. Mono. 4 ½ pt

Formula: width = depth * tan (angle)

Note 1: All dimensions in inches.
Note 2: Not all values computed here are sensible.
Note 3: Ludlow overall depth is 0.153, but depth of the beard is smaller and not yet measured.
Note 4: Data for ATF from Rehak, Practical Typecasting.
Note 5: 16 deg. cited by Rehak for ATF molds: B-1/2/3/4, STL-1A/2/3.

REV A. 2015-02-21. DMM for CircuitousRoot

Figure 47: Calculated Beard Widths for Selected Depths of Drive and Beard Angles

14.6 Belief in the Expansion of Typemetal

14.6.1 Examples of the Myth

As has been noted in the section on "A Note on Mold Depths" in "Common Matrix Drives and Mold Depths," earlier, typemetal contracts during solidification. Yet the notion that it expands has been persistent throughout the last two centuries, at least. Laboratory evidence that it does not contract has been a part of the metallurgical literature since 1928[186], yet it shows up in at least one modern college textbook.[187] A quick online search in 2022 shows even the *Encyclopaedia Britannica* repeating the myth.

Here are some representative examples, spanning the period from 1835 to 2022:

An article in T*he Penny Magazine* in 1835 summarizes this myth quite well:

> "The peculiar adaptation of this alloy to this purpose is its property of expanding when it congeals from the melted state, by which it insinuates itself into the minutest parts of the mould."[188] [189]

An intermediate form of this myth holds that Antimony, specifically, expands during solidification[190] and that this counteracts shrinkage. Thus in Pasko (1894) we have:

> "Antimony is added for the purpose of giving hardness, in which lead is lacking, and because it has the quality of expanding when cooling, thus insuring that the molds shall be completely filled."[191]

This idea seemed firmly held by technically competent typefounders of the late 19th century. Carl Schraubstadter, Jr. (son of Carl Schraubstadter of the Central Type Foundry,

---

186 {Matsuyama 1928}, cited most accessibly in {ASTM 1948 / Gonser & Winkler}.

187 {Sivasankar 2008}, p. 41 "The addition of antimony to the lead-tin alloy hardens it and also makes the alloy expand on solidification."

188 {*Penny Magazine* 1835-10-03}, p. 387.

189 To be precise, the alloy referred to in the Penny Magazine article is one of lead, antimony and a trace of copper; as cited it contained no tin. Other alloys cited in this period were said to have contained bismuth (this goes back at least as far as Jost Annan in 1568), but aside from persistent reports in older literature (often cited without examination in modern literature up to and including Wikipedia), there is no evidence of typefounders using this quite expensive metal. Gonser and Winkler determined that it would take up to 25 percent Bismuth to make a stereotype alloy which did not shrink. {ASTM 1948 / Gonser & Winkler}, p. 958. In the absence of hard evidence, the historical use of bismuth in typemetal cannot be credited.

190 It may, but this expansion is negligible. See the section below on the "Expansion of Antimony."

191 {Pasko 1894}, p. 560.

and co-founder of the Inland Type Foundry) held that:

> "A peculiar property of Antimony is that of slightly expanding on solidifying, thus insuring sharp faces"[192]

Perhaps the strangest form of this myth is one in which the typemetal expands suddenly upon solidification (to make a sharper type) and then contracts again. One prominent typemetal supply company actually believed this:

> "Antimony has the valuable property of giving both hardness and fluidity to lead. Hardness when cold, fluidity when molten. Not only this but also the property of filling out the mould and expanding just as solidification occurs. The alloy contracts after solidifying just as any other metal or alloy, but at the instant of passing from the liquid to the solid it fills all the detail of the mould, and after solidifying draws away, retaining a perfect reproduction. This is a most remarkable and valuable property, and very essential to the alloy.[193]

To their credit, by the 1923 edition they had changed this to:

> "Antimony when added to lead has the valuable and unusual property of imparting hardness to the metal and also increasing the fluidity of the molten alloy. A lead alloy containing antimony, due to the fluidity has the property of filling out the type mould perfectly thus giving an exact reproduction of the mould."[194]

As an indication of its persistence, this myth can be seen in at least one 21st century college textbook:

> "The addition of antimony to the lead-tin alloy hardens it and also makes the alloy expand on solidification."[195]

Regrettably, it is now to be found in sources generally considered reliable. So for example the 29th edition (2012) of the usually more reliable *Machinery's Handbook* (it was not there in the earlier editions I've checked):

> "Type Metal. - Antimony gives to metals the property of expansion on solidification, and hence, is used in type metal for casting type for the printing

192 {Schraubstadter, Jr. 1888}, p. 729.

193 {Imperial 1918}, p. 9. A similar account also occurs in {Righter 1908} and {Righter 1923}, p. 39.

194 (Imperial 1923), p. 9. This is interesting as it suggests that {Matsuyama 1928} was not the first to demonstrate in the laboratory that typemetal does not expand on solidification.

195 {Sivasankar 2008}, p. 41

trades to insure completely filling the molds."[196]

In 2022 this myth remains in the online edition of the Encyclopaedia Britannica:

"Some antimony alloys have the rare quality of expanding on solidifying; these are used for castings and for type mtal."[197]

This idea seems to have as many lives as a cinematic zombie.

The idea that typemetal expands upon solidification does not have the slightest basis in reality. Those before 1928 have the excuse that they were just guessing (though none of them actually admitted that it was guesswork); those after do not.

14.6.2 Expansion of Antimony

An intermediate form of this myth holds that Antimony, specifically, expands during solidification (it does not) and that this counteracts shrinkage. Thus in Pasko (1894) we have:

> "Antimony is added for the purpose of giving hardness, in which lead is lacking, and because it has the quality of expanding when cooling, thus insuring that the molds shall be completely filled."[198]

And Linn Boyd Benton (of the Northwestern Type Foundry of Benton, Waldo & Co. and later of ATF) wrote:

> "Type are made of type metal, a mixture of tin, antimony, lead, and copper. As antimony expands in solidifying, advantage is taken of this quality, and the mixture is so proportioned that the expansion of the antimony will practically counteract the shrinkage of the other ingredients."[199]

I have not yet found an authoritative scientific study of the basic properties of metallic antimony published in the last few decades. One earlier source, which is still being cited without attribution online, is Thorneycroft's volume of Friend's *Text-Book of Inorganic Chemistry*, devoted to antimony and bismuth {Thorneycroft 1936}, p. 20. He says:

---

196 {Machinery's 29th}, p. 3017.
197 {Britannica 2020}.
198 {Pasko 1894}, p. 560.
199 {Benton 1906}, p. 30.

> The values obtained by earlier workers for the *volume change* [of antimony] on solidification are confusing, the general conclusion being that the change is very small, antimony probably resembling bismuth in expanding on solidification. Toepler [note 4: Toepler, *Ann. Phys. Chem.*, 1894, [2], 53, 343.] concluded that there was a shrinkage on solidification to the extent of 1.4 per cent, or 0.0022 c.c. per gram. A more recent investigation, however, has revealed an expansion on solidification of 0.95 per cent., a result which appears to have been confirmed. [note 5: Matsuyama, *Science Rep. Tohoku Imp. Univ.*, 1928, 17, 1. See also Parlitz, *Sitzungsber. Naturforscher. Ges. Univ. Tartu*, 1929, 35, 121; Broniewski, *Inst. Intern. Phys. Solvay*, 4th *Conseil*, 1924, 1937, 185.]

While this "latest" research (nearly a century old now) suggests that antimony itself may expand, two notes are in order.

First, typemetal is a complex mixture of lead, tin, and antimony and also compounds of these formed during the alloying and melting/solidification processes (for example, the presence of a tin-antimony (Sn-Sb) compound is very important). The properties of individual atomic components of compounds are not necessarily the same as the properties of their alloys.

Second, typemetal consists of a very wide range of alloys. The amount of antimony in each is selected not for its expansion on solidification but for other reasons. For Linotype alloy, the eutectic alloy is used because it solidifies instantly without undergoing a slushy phase. For alloys for hand-set types, antimony is added (as Pasko says, above) for the purpose of hardness.

Blanket statements about the expansion of metallic antimony are of no value to the typefounder. Detailed metallurgical studies of particular typemetal alloys, however, would be of value.

14.7 Too Much Detail about Metrology

Certain aspects of typemaking inevitably become delightful exercises in unnecessary detail (the matter of the value of the American Printers' Point, discussed earlier, is an excellent example of this). It is no surprise, therefore, that matters of fine distinctions in metrology arise. The history of the inch is one of these matters.

14.7.1 Summary

For the typefounder, two questions often come up.

First, is there any significance to the fact that in the US the Type Founders' Association used the metric system to define the pica (and thus the point)? The answer is that there is no particular significance because they had no alternative. There has never been a legal definition of the inch in the US and in 1886 there wasn't even a pragmatic definition accepted by those federal government agencies involved in metrology. They simply picked a value and then figured out how to express it in the only system of metrology that they had.

Second, is there any significance to the pragmatic redefinition of the inch in 1959? No, there is not. It must be emphasized that the difference between the pre-1959 and post-1959 values for the inch is so slight that it makes no difference at all to the typecaster.

(For a discussion of what level of precision really matters to the typemaker, see the section "How Close Is Close Enough," earlier.)

14.7.2 The Metric Act of 1866

The US Constitution charges the Congress to "fix the Standard of Weights and Measures." It has, however, only done so partially and has never done so with respect to the inch. The "Metric Act" of 1866 (H.R. 596 of the 29th Congress, 1st Session; 15 USC 204) authorized the use of the metric system {Metric Act 1866}[200]. By this it meant that "no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights and measures of the metric system." But the Congress has never similarly authorized the

200 See also {Kasson 1866}.

inch (aka "customary" or sometimes "imperial") system.

The second section of the Metric Act, however, does something very strange. Having authorized the metric system, it does not in fact refer to the established values of the metric system as internationally maintained. Instead, it derives the authorized metric units from their "equivalents in denominations in use." So it authorizes the use of metric lengths from millimeters to Myriameters but derives their values from inches and miles.[201] But these "denominations in use" (inches, miles) were never defined. The Congress never defined them and it was a recurrent issue throughout the 19th century that all existing "native" standards for them were either destroyed or inadequate. This lack of an actual definition of the inch remains today. The 2007 "America COMPETES Act" (Public Law 110-69) amended the Metric Act to refer instead to the SI system, but it did not define the inch system.

This is an important point (if you're into fine detail) because many sources say or imply that the 1866 Metric Act "defined" the conversion from the meter to the yard (or inch).[202] It did not. It defined (inconsistently) various metric units in terms of "denominations in use" (such as inches) but left these "denominations" undefined. So for example it defined the meter in terms of the inch but it never established what the length of the inch was. You just had to know (and nobody knew, to any degree that would satisfy a metrologist). It created no workable definition of an inch.

So from a Constitutional point of view, the metric system of units has been legal in the US since 1866 but it had no proper definition in law until 2007. The inch system has no legal status (though of course it is not illegal) and has never had any legal definition. Until the next step, in 1893, it never even had a consistent practical definition (because the Metric Act of 1866 gives at least two conflicting conversion values, neither of which is

---

201 These definitions also contradict each other. So the meter is defined as 39.37 inches (which would give a millimeter of 0.039,37 inches, but the millimeter is defined as 0.039,4 inches. (This isn't just a matter of rounding to a limited number of decimal places; the Act defines the kilometer to five decimal places.) The value for the meter gives a value for an inch of 25.400,005,.... The value for the millimeter gives an inch of 25.419,420,... This may have worked in commerce in 1866, but you cannot build any system of industrial metrology on differences of this degree.

202 Even the "Mendenhall Order" makes this error, saying that the 1866 Act "[defined] the weights and measures in common use in terms of this system." This is backwards. Other organizations who might be expected to value precision make the same mistake. British standard {BS 350: 1944} says that "In America an Act of Congress of 1866 legalized the use of the conversion factor : 1 metre = 39.370000 inches. This statement is incorrect both because it implicitly assumes that the 1866 act was defining the inch in terms of the meter (it did the opposite) and because the 1866 Act did not specify its conversion to six decimal places.

intended to define an inch at all).

14.7.3 The 1893 "Mendenhall Order"

This situation was of course unworkable. At best, you could pick your favorite value for the inch from the Metric Act of 1866 and run the calculations "backwards." It defined a meter as 39.37 inches, so to find out what an inch was you could take a real meter (as internationally defined) and calculate the value of an inch in meters as (1/39.37) = 0.025,4... (or multiply by 1000 for millimeters: 25.4... Such a calculation has never had any Constitutional foundation, however.

In 1893, the US Coast and Geodetic Survey announced that it was already doing such a calculation. This was in the so-called "Mendenhall Order" published as their Bulletin No. 26, "Fundamental Standards: Length and Mass" {Mendenhall 1893}. It concludes:

> "In ... the absence of any material normal standards of customary weights and measures, the Office of Weights and Measures, with the approval of the Secretary of the Treasury, will in the future, regard the International Prototype Metre and Kilogramme as fundamental standards, and the customary units, the yard and the pound, will be derived therefrom in accordance with the Act of July 18, 1866.[203] Indeed, this course has been practically forced upon this Office for several years, but it is considered desirable to make this formal announcement for the information of all interested in the science of metrology or in measurements of precision." (p. 5)

This isn't a legal definition; the US Coast and Geodetic Survey could not enact laws. The inch remained (and remains) undefined legally. But as of 1893 an important federal agency announced that it was using the international metric standard and creating inches (or yards) by calculations taken from the 1866 Act (and that the Secretary of the Treasury did not object). Using this method, an inch is defined as ((3600/3937)/36 * 1000) = 25.400,050,800,... mm.

It should be noted that even this extra-legal formalization occurred seven years after the United States Type Founders' Association adopted the American Printers' Point in 1886. To define the pica, they had to use the metric system because there was no definition of the inch which stood on its own.[204]

---

203 They didn't discuss the problem that the 1866 Metric Act specifies multiple contradictory conversion values. They just picked one and went with it.

204 The "Mendenhall Order" discusses the "quite unsuitable" 82-inch scale manufactured by Troughton which was acquired for use by the US Treasury in 1814 and in general laments the need to have

14.7.4 The "Industrial Inch" of the 1930s

The next stage involved a long period of dissatisfaction with the relatively complex value of the inch/millimeter conversion (25.400,050,8... mm/inch). One early and very important instance of this was in the manufacture by Carl Edvard Johansson of his gage blocks[205] in inch denominations for the American market. Johansson developed his gage blocks in a metric environment, of course. He cited an accuracy of 0.000,001mm for them (1 µm, or 1 micrometre).[206] At a later point his company published a figure of the accuracy of their highest grade ("AA") commercial blocks of 0.000,002 inch {Johansson 1934}, p. 6. At this level of accuracy the "050" in 25.400,050,8... mm/in. becomes significant. Quite a number of sources note that when Johansson began manufacturing inch-system gage blocks he adopted a value of 25.4mm/inch, exactly.[207] It is no surprise that Johansson was a member of the American Standards Association committee which recommended this value in 1933 (in ASA B48.1, see below). Johansson's gage blocks became the standard tool where this level of accuracy was required and thus established 25.4 as the *de facto* value.

In 1930 the British Standards Institution adopted a value of the inch "for use in trade" [208]. This value was Johansson's value of exactly 25.4mm.[209] It should be noted that this wasn't the legal definition of the inch in England at the time. The inch[210] in England was defined by a series of Parliamentary Acts and was not set to 25.4mm until the Weights and Measures Act of 1963 adopted the 1959 value (see below). Like so many other documents in this field, BS 350 is rather fuzzy in its notion of what the word "legal" means. The legal inch (yard) in England was determined by the relevant act of Parliament. Full stop. But BS 350 says "... the convenient round figure, 1 inch = 25.4 mm., which already has legal sanction for use in trade in Great Britain, ..." without ever previously having said anything at all about this round figure. It cites no source or

"recourse to copies of the imperial yard of Great Britain." (pp. 3-4). This presumably referred to the 1855 "Bronze Yard No. 11."

205 Also "gauge blocks"; both spellings are correct and in use.

206 This information is probably in {Althin 1948), but I have not been able to examine that source. It is taken here from {Mitutoyo 2013}, p. 7, which cites Althin.

207 E.g., {Mitutoyo 2013}, p. 8. See also his obituary in the American Standards Association's magazine *Industrial Standardization*, {ASA 1943}. This figure is cited in his firm's own literature as well; see {Johansson 1934}, p. 34.

208 {BSI 350: 1944}, p. 6.

209 My reference here is the 1944 revision of BS 350, *Conversion Factors and Tables.* I have not yet located a copy of the original 1930 version.

210 The yard, actually.

authority at all to establish this “legal sanction for use in trade.”

The American Standards Association (ASA) adopted standard B48.1, *American Standard Practice for Inch-Millimeter Conversion for Industrial Use*, in 1933. The committee preparing this standard was chaired by C. B. Veal (Society of Automotive Engineers) and included C. E. Johansson as a member. Unsurprisingly, it adopted Johansson’s value of exactly 25.4 mm/inch. This standard did not have the force of law, but certainly made more formal Johansson’s earlier decision to use this value.

Canada adopted a yard of 0.9144 meters (giving an inch of 25.4mm, exactly) in 1951. This adoption is significant because unlike the BSI and ASA industrial recommendations, this adoption was by the Canadian Parliament and had the force of law {Canada 1951}.

14.7.5 The “International Yard” of 1959

So by the 1950s there were three values for the inch in either common or legal use in three of the major English-speaking countries[211].

- 25.4mm/inch (exactly) — Johansson’s value, which was in common use in industry in all three countries, was specified in ASA B48.1 (USA) and BS 350 (Britain), and was a legal standard in Canada.
- 25.400,050,8...[212] — The Mendenhall Order value, used informally by US standards and surveying agencies of the US federal government but without legal standing. The US had (and still has) no legal definition of an inch.
- 25.399,391mm/in — The legal value in Great Britain was the yard, defined by a physical object which was made in 1845 ({Connor 1987}, pp. 265-267}) and the use of which was reaffirmed in1878 {UK 41 & 42 Vict. c. 49}. But it was shrinking ({NBS 1958}, p. 44}). The then most recent (1947) length of this Imperial Standard Yard when compared to the International Prototype Metre is the value cited here.[213]

211 The USA, the UK, and Canada. Australia had not yet established a standard {NBS 1958}, p. 45.
212 (3600/3937) / 0.036.
213 The value for the inch (or yard) in Britain at this time is complicated because they adopted a physical

This situation was obviously untenable in an era where scientific and industrial measurements frequently required accuracy of this order. So in 1959 the national standards laboratories of six English speaking countries (the USA, Great Britain, Canada, Australia, New Zealand, and South Africa) agreed[214] that they would all adopt the value of 25.4mm/inch (exactly).[215] This agreement had no force of law, though an announcement of it by the US National Bureau of Standards was published in the Federal Register (NBS 1959a} and it was mentioned in the NBS' Annual Report ({NBS 1959b}, p. 13).

In Canada, this agreement was redundant, since Canada had adopted 25.4mm/inch as a legal standard in 1951.

In the United States this agreement never led to any legal standard; the US still has no legal definition of an inch. But it did result in the pragmatic adoption of 25.4mm/in by the National Bureau of Standards, replacing its pragmatic use of the "Mendenhall" inch. The earlier Mendenhall inch remained in use for the federal surveying as a subdivision of the "US Survey Foot."

In the United Kingdom, this agreement led to the adoption of 25.4mm/inch as a legal standard in the (UK) Weights and Measures Act of 1963 {UK 1963 c. 31}.[216]

14.7.6 Does This Matter?

Does any of this detailed history really matter to the practical typemaker? No, not really.

Anyone working today to these levels of accuracy either will be working in metric or using an inch of 25.4mm (the underlying metrology standards[217] have been metric for nearly two centuries). The different values for the inch could only be relevant if they

standard for the yard but made it less well than the physical standard for the meter. When compared to the meter in 1895 it gave an inch of 25.399,978mm, but in 1922 this had become 25.399,956, and in 1932 it had shrunk again to 25.399,950mm/inch {NBS 1958}, p. 44. There are no doubt many good histories of length measurement in Great Britain; one good one is {Poppy 1958}.

214 I have been unable to discover the actual text of this agreement anywhere, despite relatively extensive searching. It was announced in many places, but nowhere is theret even a citation for the agreement itself.

215 The United States made an exception for the US "Survey Foot," which retained the old Mendenhall value.

216 More particularly, it made either the yard or the metre legal units of length and defined the yard as 0.9144 metre exactly. That gives an inch of 25.4mm exactly.

217 With the exception of the Imperial Standard Yard as reconstructed in 1845, which has never been relevant to the United States and which is no longer relevant anywhere.

introduced an error in evaluating older work using modern values.

But typefounders have never worked to a level of accuracy where the distinctions here even show up.

Twentieth-century type machinery makers and matrix makers may have stated values with precisions on this scale, but none of them ever really worked to the millionth of an inch. The makers of their metrology standards may have worked to the millionth, but they worked to the ten-thousandth of an inch and (in the case at least of both Monotype firms) resorted to hand fitting for any precision greater than that.

All of this messing about with numbers more precise than 0.000,0x is great fun, but not meaningful to either the history or the practice of typemaking.

14.8 Technical Drawings

These are drawings done in the general style of real engineering drawings (though I make no claim that they conform to any specific drafting standard, ancient or modern). They should be comprehensible to a machinist called upon to make a matrix.

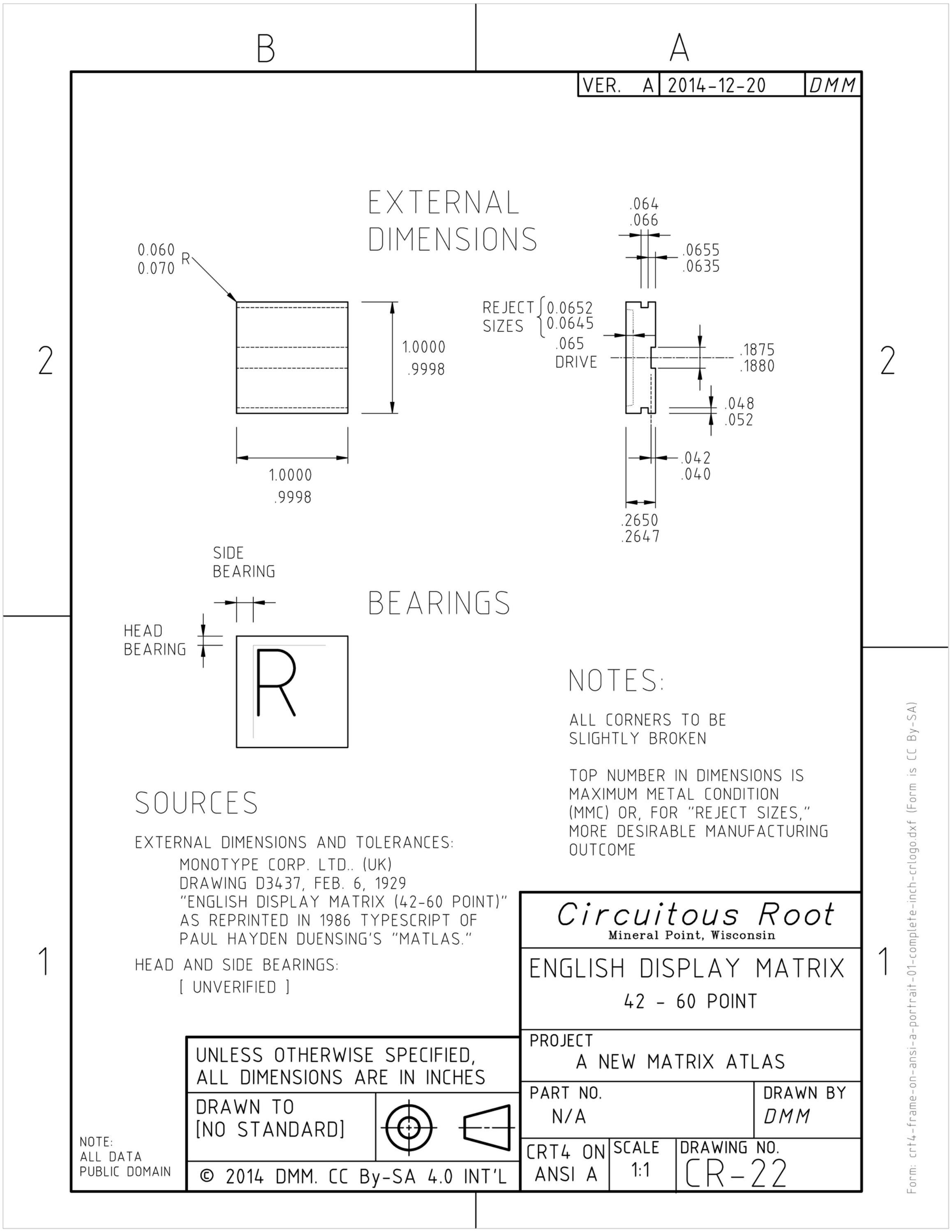
Please note that things such as fine dotted lines do not necessarily show up will when exported from a CAD program to a bitmap image and then imported into a desktop publishing program and scaled. These drawings as seen here do not appear at their best. If you really want to use these drawings, you would be better off obtaining their DXF format source and opening them in the CAD program of your choice.

The DXF format source files for these drawings are available online with the rest of the source material for this *New Matrix Atlas*, at:

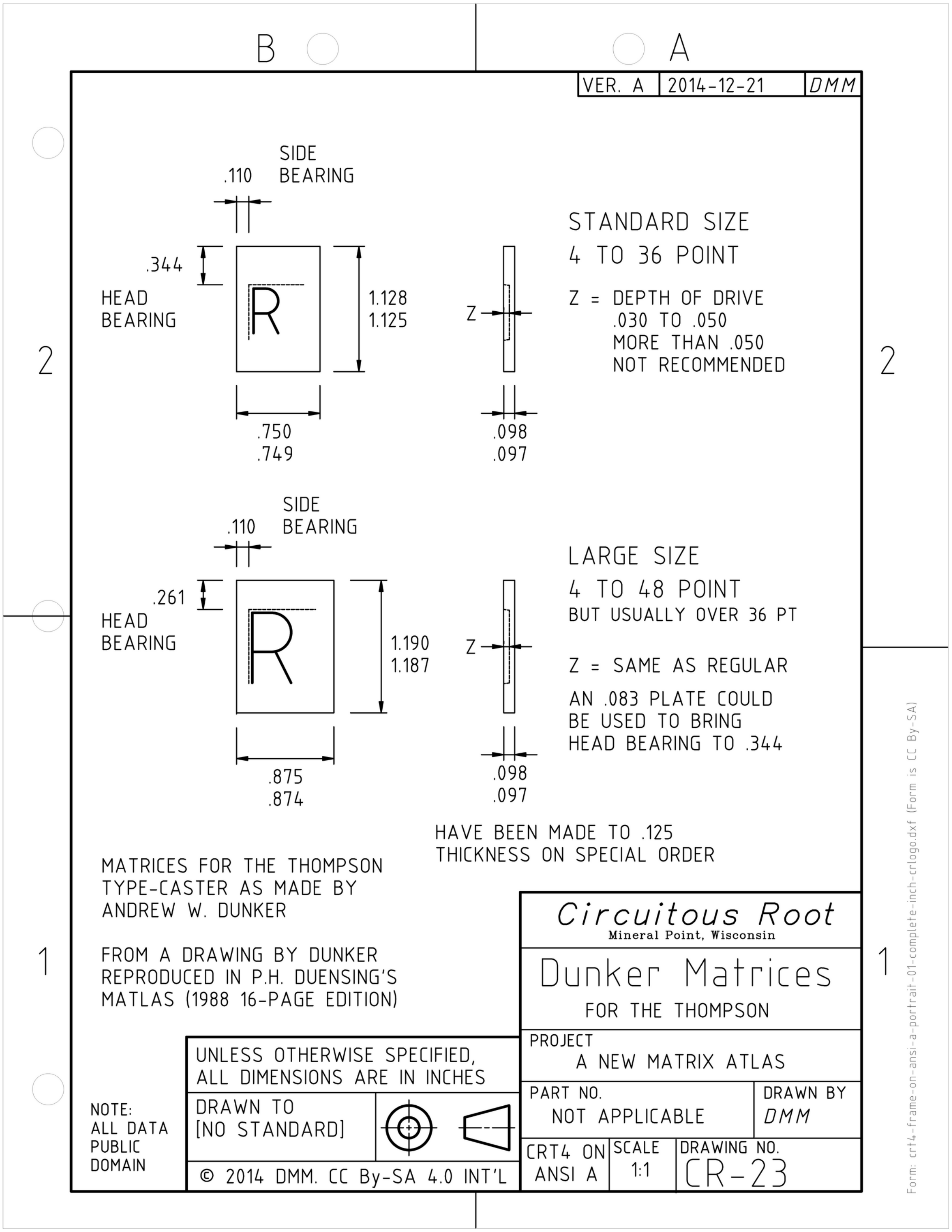
http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/literature/practices/index.html

The following drawings should be present:

- CR-22. ENGLISH DISPLAY MATRIX, 42-60 POINT.
- CR-23. DUNKER MATRICES FOR THE THOMPSON



Drawing 1: CR-22 English Display Matrix (42-60pt)


B
A
VER. A
2014-12-21
DMM
SIDE BEARING
.110
.344
HEAD BEARING
1.128
1.125
Z
.750
.749
.098
.097
STANDARD SIZE
4 TO 36 POINT
Z = DEPTH OF DRIVE
.030 TO .050
MORE THAN .050
NOT RECOMMENDED
2
2
SIDE BEARING
.110
.261
HEAD BEARING
1.190
1.187
Z
.875
.874
.098
.097
LARGE SIZE
4 TO 48 POINT
BUT USUALLY OVER 36 PT
Z = SAME AS REGULAR
AN .083 PLATE COULD
BE USED TO BRING
HEAD BEARING TO .344
HAVE BEEN MADE TO .125
THICKNESS ON SPECIAL ORDER
MATRICES FOR THE THOMPSON
TYPE-CASTER AS MADE BY
ANDREW W. DUNKER
FROM A DRAWING BY DUNKER
REPRODUCED IN P.H. DUENSING'S
MATLAS (1988 16-PAGE EDITION)
1
1
Circuitous Root
Mineral Point, Wisconsin
Dunker Matrices
FOR THE THOMPSON
PROJECT
A NEW MATRIX ATLAS
UNLESS OTHERWISE SPECIFIED,
ALL DIMENSIONS ARE IN INCHES
DRAWN TO
[NO STANDARD]
NOTE:
ALL DATA
PUBLIC
DOMAIN
PART NO.
NOT APPLICABLE
DRAWN BY
DMM
CRT4 ON
ANSI A
SCALE
1:1
DRAWING NO.
CR-23
© 2014 DMM. CC By-SA 4.0 INT'L
Form: crt4-frame-on-ansi-a-portrait-01-complete-inch-crlogo.dxf (Form is CC By-SA)

15 Uncertain Information

15.1 Duensing's 1986 Table

[NOTE: I need to rethink and revise this section. I wrote it before I understood that Lanston manufactured distinct flat composition matrices for the Thompson in 42 and 48 point body sizes. That explains a lot of my confusion with the “Balto & Mono” section of Duensing's table.]

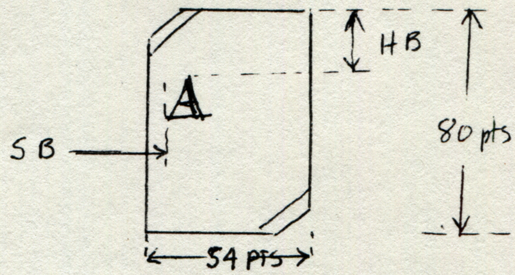
In versions of *Matlas* from 1988 on, the tables for head and foot bearings for Lanston Monotype display matrices and pre-Monotype Thompson large-sized matrices both appear in the “U.S. Lanston Monotype Display” section (labeled “MONOTYPE STANDARD” and “THOMPSON STANDARD”). See {*Matlas* 1988}, Table 4 (p. 4), for example. While it is initially confusing to have the Thompson large-matrix table in the Lanston display matrix section, the tables themselves are clear and the information in them appears to be accurate. However, these versions of Matlas do not have information on pre-Monotype Thompson small/narrow matrices or on pre-Monotype large matrices over 36 points. For that you must go back to {*Matlas* 1986}.

But while {*Matlas* 1986} does have a table for pre-Monotype Thompson small/narrow matrix head bearings (p. 5, Table 6), its treatment of Lanston Monotype display and pre-Monotype Thompson large matrices is done in a complex multi-part table which is difficult to understand. Yet the information which it includes on Baltotype matrices and on large pre-Monotype Thompson matrices in 42 and 48 point sizes is potentially useful and does not appear in later editions.

Here is the table (as an image, so as to avoid transcription errors). Values are in points.

American Mono Display

7 PTS THICK



	Balto & Mono	
	Head	Foot
12	32	36
T-Mold 14	29	37
18	25	37
24	31	25
U-Mold 30	25	25
36	19	25
Thompson 42	18	20 NG use
48	18	12 large mat

	Mono. Std.	
12	32	36
14	30	36
18	24	36
24	32	24
30	26	24
36	20	24

	Thompson	
12	18	50
14	18	48
18	18	44
24	18	38
30	18	32
36	18	26

Table 28: Table 4 from {Matlas 1986}, "American Mono Display"

Questions:

- Why do the (apparently correct) values for “Mono. Std.” differ from those for “Balto & Mono”?

- Are the 42pt and 48pt “Balto & Mono” lines for Baltotype matrices for the Thompson or for Lanston Monotype matrices for the Thompson?
- What does “NG use large mat” mean? (These two lines work out to 80 pt and 78 pt matrices?
- Why are these two lines in this section, rather than with the pre-Monotype Thompson large matrix data further on in the same table?
- If these two lines are for “small” (1.125” long) matrices, why do they use the 18pt head bearing of the “large” pre-Monotype Thompson matrices?
- If these two lines are for “small” pre-Monotype Thompson matrices, why do their head bearings (18 pt) differ from those in Table 6 of {*Matlas* 1986}, which gives head bearings of 15 pt and 9 pt, respectively?
- Why do the numbers for Mono. Std. 18 point not add up to 80? (Kevin Martin spotted this, and suggests that the head bearing should be stated as 26 rather than 24.)[218]

15.2 Rice's Chart

A carefully drawn but undated and unpublished chart by Roy Rice (The Recalcitrant Press), found among Dunsing's papers, gives the head and foot bearings (and other data) for six sizes of “Monotype Display” matrices (that is, with the corner-cut geometry)[219]. It is interesting for two reaons

First, the head and foot bearing information that it gives for 14, 18, 34, 30, and 36 point matrices does not match Duensing's. Rice gives:

218 Personal communication, 2015-01-22.
219 {Rice MDMD} I do not yet have permission to reprint this chart.

Body (points)	Head Bearing (points / in)	Foot Bearing (points)
14	29 / .4012	38 / .5257
18	25 / .3458	38 / .5257
24	31 / .4289	26 / .3597
30	25 / .3458	26 / .3597
36	19 / .2628	26 / .3597

Table 29: Roy Rice's Values for Monotype Display Matrix Head and Foot Bearings

These values do not seem to be correct for factory-produced Lanston Monotype matrices. It is possible, however, that independently produced matrices exist which employ them. The sum of head bearing + body + foot bearing for each of these values is 81 points, which is closer to the apparent “real”overall length of a Lanston display matrix (1.125 in.) than Duensing's 80 points.

Rice gives conventional values for the other dimension: planchet width 0.75 in., planchet length 1.125 in., rough thickness .125 in., finished thickness .094 in., and side bearing 8 points (.111 in.)

The other reason that this table is interesting is that it shows a 48 point “Monotype Display” matrix (with corner cuts). This matrix is shown as 1.0 in. wide. It isn't clear to me that such a matrix could be cast on a Type-&-Rule Caster. He gives a head bearing for it of 19 points (.2628 in.) and a foot bearing of 26 points (.3597 in.) Together with a body of 48 points, these sum to an overall length of 93 points (1.286 in.). Rice does not explicitly state the overall length, and draws this matrix at the same length as the others.

Clearly this chart presents several puzzles.

16 Bibliography and References

The entries here are ordered by **{**bracketed reference identifier**}**.

{Abbott 1953} Abbott, W. *The Dimensioning of Engineering Drawings.* London: Blackie & Son, Ltd., 1953.

{Althin 1948} Althin, Torsten Carl Vilhelm. Translated by Cyril Marshall. *C. E. Johansson, 1864-1943; the Master of Measurement*. Stockholm, Sweden: [publisher not known], 1948.

This is a translation of *C.E. Johansson : 1864-1943 ; måttens mästare ; på uppdrag av AB C.E. Johansson*. (Stockholm: Nordisk Rotogravyr, 1948), a book I have not yet been able to acquire or examine.

{Annenberg 1994} Annenberg, Maurice, and Stephen O. Saxe (ed.) *Type Foundries of America and their Catalogues.* Second Edition. New Castle, DE: Oak Knoll Press, 1994.

{ASA 1933} American Standard Pracice for Inch-Millimeter Conversion for Industrial Use. Approved March 13, 1933. NY: American Standards Association, 1933.

This is online in a Google scan of the University of Wisconsin copy, at The Hathi Trust:

https://hdl.handle.net/2027/wu.89097737274

{ASA 1943} Carl Edvard Johansson: Grand Master of Industrial Measurement, 1864-1943. Industrial Standardization. Vol. 14, no. 10 (October 1943): 293.

This is online in a Google scan of the University of Minnesota copy, at

https://books.google.com/books?id=3rUaAQAAMAAJ

{ASME Y14.5-2009} *Engineering Drawing and Related Documentation Practices: Dimensioning and Tolerancing.* NY: The American Society of Mechanical Engineers, 2009.

{ATFNL 32} *American Typecasting Fellowship Newsletter*, No. 32 (August, 2008). Terra Alta, WV: The Hill and Dale Private Typefoundry and Press, 2008.

{ASTM 1938 / Hiers} Hiers, George O. "The Properties of Lead-Tin-Antimony Alloys." [article in] *Metals Handbook*. Clevaland, OH: The American Society for Metals, 1939.

{ASTM 1948 / Gonser & Winkler} Gonser, Bruce W. and J. Homer Winkler. "Type Metals." [article in] Lyman, Taylor, ed. *Metals Handbook*. Cleveland, OH: The

American Society for Metals, 1948. Reprinted 1958.

{ATF 1940} "American Point System of Measuring Type." *ATF Standards*, Section C, pages C-100.1 to C-100.3. Approved April 18, 1940. Elizabeth, NJ: American Type Founders Company, 1940.

The book *ATF Standards* was a looseleaf American Type Founders Company publication which was issued internally in numbered copies. Its Section C concerned matters of "Type Design." Two copies of this book survive: No. 18 (issued to F. Peters) and No. 56 (issued to Everett Clyde; later renumbered 65, then 66). Both were preserved by Theo Rehak and The Dale Guild and are now preserved by Patrick Goossens and the Letter-kunde Press. This section C does not appear in No. 18 as it now exists; it does appear in No. 56/65/66.

{ATF C-100.4} "Table of Points and Inches." *ATF Standards*, p. C-100.4. Elizabeth, NJ: American Type Founders Company, n.d.

See {ATF 1940} for the source of this chart in copy no. 56/65/66 of *ATF Standards*. It has also been reprinted in {Rehak 1993}, p. 186-187. It may have been reprinted elsewhere, as I have a scan of a photocopy of it given to me by the late Stephen O. Saxe.

{Bahr 1963} Bahr, Leonard F. *ATA Advertising Production Handbook,* 3rd ed. [No location]: Advertising Typographers Association of America, Inc., 1963.

Online at The Hathi Trust:

https://hdl.handle.net/2027/coo.31924013985

Note: The previous (2nd) edition was by Don Herold, edited by Harry L. Gage: {Herold 1954}.

{Benton 1906} Benton, Linn Boyd. "The Making of Type." in Frederick H. Hitchcock, ed. *The Building of a Book*. NY: The Grafton Press, 1906. pp. 31-40.

{Britannica 2020} Britannica, The Editors of the Encyclopaedia. "antimony summary." *Encyclopaedia Britannica*, 2 May, 2020. https://www.britannica.com/summary/antimony . Accessed 2022-08-24.

{BS 308 : 1927} British Standard 308 : 1927. *Engineering Drawing Office Practice.* London: British Standards Intitution, 1927.

This outlines various practices not all of which were followed by The Monotype Corporation Limited in the 1920s.

{BS 308 : 1943} British Standard 308 : 1943. *Engineering Drawing Office Practice.* London: British Standards Institution, 1943.

{BS 308 : 1953} British Standard 308 : 1953. *Engineering Drawing Practice.* London:

British Standards Institution, 1953.

{BS 350: 1944} Bristish Standard 350 : 1944. Conversion Factors and Tables. London: British Standards Institution, 1944.

{Buckingham 1921} Buckingham, Earle. Principles of Interchangeable Manufacturing. NY: The Industrial Press, 1921.

It is worth trying to find a physical copy of this work, as it is the primary document describing the theory of interchangeable manufacturing in the first half of the 20th century. It is also online at Google Books at

http://books.google.com/books?id=Wk9DAAAAIAAJ

and at the Hathi Trust (search on the author and title at: http://www.hathitrust.org

{Canada 1951} [Parliament of Canada] *Length and Mass Units Act, 1951. The Revised Statutes of Canada*, 1952, Chapter 164, "An Act respecting Units of Length and Mass."

Online in a digitization of the Stanford University copy at:

https://books.google.com/books?id=rbE1AAAAIAAJ

{Clare 1999} Clare, Kate. "A Typographic Workbook." 1st edition. NY: John Wiley & Sons, 1999.

{Clare 2005} Clare, Kate and Cynthia Busic-Snyder. "A Typographic Workbook." 2nd edition. NY: John Wiley & Sons, 2005.

Note that Clare and Busic-Snyder have little understanding of metal type and their discussion of the measurement of type body size is entirely wrong.

{Connor 1987} Connor, R. D. *The Weights and Measures of England*. [For the Science Museum, London, by] London: Her Majesty's Stationery Office, 1987.

{CR CC} The CircuitousRoot essay "Clubs and Cults: Revisiting the Concept of 'Typeface' and the Optical Scale in Typefounding." Online at:

http://www.CircuitousRoot.com/artifice/letters/press/typemaking/making-matrices/terms/logical-grouping/clubs-and-cults/index.html

Note that this piece is a radical argument which does not represent mainstream 21st century thought about type.

{CR Composite Lanston Specimen} "A Composite Specimen of Lanston Monotype Faces." This is incomplete, but what exists is online at:

http://www.CircuitousRoot.com/artifice/letters/press/comptype/monotype/typography/composite-specimen/index.html

{CR DT} MacMillan, David M. “Drawing Studies: Dimensioning and Tolerancing.” Online on CircuitousRoot at:

http://www.CircuitousRoot.com/artifice/drafting/drawing-studies/dt/index.html

{CR Lanston 1903} A CircuitousRoot Notebook reprinting advertisements by the Lanston Monotype Machine Company from The Inland Printer in 1903. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/comptype/monotype/literature/ads/index.html

{CR MDST} The CircuitousRoot Notebooks on Lanston Monotype Matrix Data, Specimens, and Typography. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/comptype/monotype/typography/index.html

{CR MLC DWG} The CircuitousRoot Notebooks reprinting Mergenthaler Linotype Company engineering drawings. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/compline/literature/linotype/engineering-drawings/index.html

{CR NR} The CircuitousRoot Notebooks on the Nuernberger-Rettig Type-Caster, also known as the Universal Type-Making Machine. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/nuernberger-rettig/index.html

{CR Point/Pica} The CircuitousRoot Notebook “Point and Pica Conversion Tables.” Online at:

http://www.CircuitousRoot.com/artifice/letters/press/typemaking/measurement/pointcharts/index.html

{CR Thompson} The CircuitousRoot Notebooks on the Thompson Type-Caster. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/thompson/index.html

{CR TR} The CircuitousRoot Notebooks on the Lanston Monotype Type-&-Rule Caster (sales and technical literature. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/type-and-rule/index.html

{CR TR Mats} The CircuitousRoot Notebook on Lanston Monotype Type-&-Rule Caster Matrices. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/typemaking/mats/gallery/monodisplay-us/index.html

{De Lopatecki 1937} De Lopatecki, Eugene. Typographer’s Desk Manual. NY: Ronald Press Company, 1937.

{DeVinne 1890} DeVinne, Theodore Low. “Report of the Committee on Uniformity in the Bodies of Types.” United Typothetae of America, Proceedings of the Fourth

Annual Meeting, 1890. Appendix A, pp. 1-8.

I have not yet found a copy of or read this source. It may (or may not) be identical to the version of this Report published in *The American Bookmaker* {Typothetae 1890a}.

{DeVinne 1900} DeVinne, Theodore Low. *The Practice of Typography: A Treatise on the Process of Type-Making, the Point System, the Names, Sizes, Styles and Prices of Plain Printing Types.* NY: The Century Co., 1900 [copyright 1899].

The 1900 Century edition and the 1914 (NY: Oswald Publishing Co.) are online on Google Books.

A second edition was published in 1902 (NY: The Century Co.) This is online at The Internet Archive. The date of this second edition may be significant in evaluating {ATF 1940}, p. C-100.3, and {Rehak 1993}, p. 177.

{DeVinne 1901} DeVinne, Theodore Low. T*he Practice of Typography: Correct Composition.* NY: The Century Company, 1901.

A second edition was published in 1902 (NY: The Century Co.) This is online on Google Books. The date of this second edition may be significant in evaluating {ATF 1940}, p. C-100.3, and {Rehak 1993}, p. 177.

{DeVinne 1902} DeVinne, Theodore Low. The Practice of Typography: A Treatise on Title-Pages. NY: The Century Company, 1902.

This is online on Google Books from a Harvard copy. It is the only volume of The Practice of Typography to have appeared originally in 1902 (this may be significant in evaluating {ATF 1940}, p. C-100.3, and {Rehak 1993}, p. 177.

{foldoc 2002} “ATA point” entry in *The Free On-Line Dictionary of Computing*. https://foldoc.org/ata+point. Entry last updated (and probably first added) 2002-03-11. Accessed 2022-08-08.

{Herold 1947} Herold, Don. *ATA Advertising Production Hand Book*. 1st edition. [No location]: Advertising Typographers Association of America, Inc., 1947.

Note: The next (2nd) edition was by Herold but edited by Harry L. Gage: {Herold 1954}.

{Herold 1954} Herold, Don. Ed. Harry L. Gage. *ATA Advertising Production Hand Book*. 2nd edition. [No location]: Advertising Typographers Association of America, Inc., 1954.

Online at The Hathi Trust:

https://hdl.handle.net/2027/mdp.39015061016260

Note: The previous (1st) edition was by Herold alone: {Herold 1947}.

The next (3rd) edition was by Leonard F. Bahr: {Bahr 1963}.

{Hopkins 1976} Hopkins, Richard L. *The Origin of the American Point System for Printers' Type Measurement*. Terra Alta, WV: Hill & Dale Press.

A second edition was published under the imprint of Hill & Dale Private Press in 1989.

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

You need this book.

{*IP* 39.2 p. 250} "Printers to Make Their Own Type." [trade note] *The Inland Printer.* Vol. 39, No. 2 (May 1907), p. 250.

An essentially identical press release appeared as "A New Typecasting Machine for Printers" in *The American Printer,* Vol. 44, No. 3 (May 1907), p. 321. Both are reprinted at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/thompson/anthology.html

{Johanson 1934} *Johansson Gage Blocks and Accessories*. ["Catalogue No. 10, Prices Effective April 1, 1934"] Dearborn, MI: Johansson Division, Ford Motor Company, 1934.

{Kasson 1866} Kasson, John A. "Report of the Committee on Coinage, Weights, and Measures to the House of Representatives, U.S." ("To accompany bills H.R. Nos. 596 and 597, and H. Res. No. 141.") Washington, DC: Government Printing Office, 1866.

This is the report backing up the Metric Act of 1866. It is online in a Google scan of the University of Michigan copy, at:

https://books.google.com/books?id=PgIEJ6PJpzQC

{Imperial 1918} *Type Metal Explained*. Philadelphia, PA: Imperial Type Metal Company, 1918.

This is available online via Google Books.

{Kuhn 1999} Kuhn, Marcus. "Metric typographic units." https://www.cl.ac.uk/~mgk25/metric-typo/ (but self-identifying as https://www.cl.ak.uk/~mgh25/metric-typo.html). Created 1999-01-16. Last modified 2003-02-24. Accessed 2022-08-08.

{Lanston 1912} The Monotype System: A Book for Owners and Operators of Monotypes. First Edition. Philadelphia, PA: Lanston Monotype Machine Company, 1912.

This has been scanned by Google Books from the University of Michigan copy, but they didn't fold out the plates. A copy of this Google digitization, augmented by scans of the plates done from my own copy, is online at:

http://www.CircuitousRoot.com/artifice/letters/press/comptype/monotype/literature/technical/index.html

{Lanston 1916} *The Monotype System: A Book for Owners and Operators of Monotypes.* Second Edition. Philadelphia, PA: Lanston Monotype Machine Company, 1916. Online at:

This second edition has not yet been digitized.

{Lanston 1918 1T/1U} "Directions for Care and Cleaning Styles 1T and 1U Sorts Casting Molds." Philadelphia: Lanston Monotype Machine Company, 1918.

A 16-page folded maintenance brochure. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/type-and-rule/literature/index.html

{Lanston 1941} *Parts Price List[:] Monotype Type-&-Rule Caster*. Philadelphia, PA: Lanston Monotype Machine Company, 1941).

An un-illustrated parts price list. First published March 1, 1941 and revised November 14, 1941. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/type-and-rule/literature/index.html

{Lanston 1949 2T/2U} "Directions for Care and Cleaning Styles 1T and 1U (Also Styles 2T and 2U) Sorts Casting Molds." Philadelphia: Lanston Monotype Machine Company, 1949. Document Number 8095-11-49-500.

A 16-page folded maintenance brochure. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/type-and-rule/literature/index.html

{Lanston 1955} *Handy Index of 'Monotype' Rental Matrices*. Philadelphia, PA: Lanston Monotype Machine Company, 1955.

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/typography/monotype/index.html

{Lanston Giant 12pg} *The Monotype Giant Caster.* Philadelphia, PA: Lanston Monotype Machine Company, [n.d.].

A twelve page brochure describing the Lanston Monotype Giant Caster. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/casters/giant/literature/sales/

index.html

{Lanston MMI} "Monotype Matrix Information: For the Use and Convenience of Monotype Owners and Operators." Philadelphia: Lanston Monotype Machine Co., [n.d.]

This is an eight-page booklet which appeared as a section in the loose-leaf Lanston Monotype specimen book in the 1930s and 1940s. A copy is online at:

http://www.CircuitousRoot.com/artifice/letters/press/comptype/monotype/typography/matrix-case/index.html

{Lanston Stymie 21} "Advance Proof: New Sizes of Monotype Stymie Bold, Series No. 790." Philadelphia: Lanston Monotype Machine Co., [n.d.] An advertising proof sheet. Online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/typography/monotype/index.html

{Lanston TLD} "Traditional Length Descenders for Monotype Machine Composition." Philadelphia: Lanston Monotype Machine Co., [n.d.]

This is an eight-page booklet which appeared as a section in the loose-leaf Lanston Monotype specimen book in the 1930s and 1940s.

{Ludlow L1} "Now a New and Improved Ludlow." [undated brochure apparently introducing the Ludlow Typograph.

[TO DO: scan and put online.]

{Ludlow LS47} *Confidential Information for Ludlow Salesmen*, Chicago: Ludlow Typography Company, [updated through 1962]. Copy No. 47 of this book is online (with thanks to Jeff Shay for lending it for reprinting) at:

http://www.CircuitousRoot.com/artifice/letters/press/noncompline/ludlow/literature/sales/salesmens-book-47/index.html

{*Ludlow Typefaces* D} Ludlow Typefaces. Chicago: Ludlow Typograph Company, [n.d.]

There were apparently four editions of the *hardcover* Ludlow specimen book, of which three are now attested ([A], B, and D; I know of no copies of editon C). The hardcover specimen books bore the title "*Ludlow Typefaces*," while the various softcover and comb-bound specimen books were entitled "*Some Ludlow Typefaces*." Edition D of the hardcover specimen book is the one with the red or maroon cover. It is online at:

http://www.CircuitousRoot.com/artifice/letters/press/noncompline/ludlow/typography/specimen-books/index.html

{Machinery's 29th} Oberg, Eric, et. al., eds. *Machinery's Handbook*, 29th edition, additional material on the CD-ROM. NY: Industrial Press, 2012.

{*Making Sure* 1} *'Making Sure' At the Monotype Works: How the Machines are Made.* Film. [after Spring 1953 but before Autumn 1956] Peak Film Productions for The Monotype Corporation, Limited. [n.d., but after spring 1953 and before autumn 1956].

{*MR* 40.1} seems to have been made *after* this film, not in conjunction with it.

{*Making Sure* 2} *'Making Sure' At the Monotype Works: Type Faces In the Making*. Film. Peak Film Productions for The Monotype Corporation, Limited, circa 1956.

Made in conjunction with {*MR* 4.3}.

This is the second of two films with the main title ”'*'Making Sure' At the Monotype Works.”*. The first bore the subtitle “H*ow the Machines are Made*.”

{Martin 2015-01-23} Personal correspondence (e-mail) from Kevin Martin of The Papertrail Handmade Paper and Book Arts, 2015-01-23.

{Matlas 1986}

{Matlas 1988}

{Matlas 2008} Duensing, Paul Hayden. *Matlas*. [Various locations]: The Private Press and Typefoundry of Paul Hayden Duensing, [various dates].

Duensing's *Matlas* was produced as an ongoing project over a number of years; it was never released as a single published work. All currently known verions have been reprinted at:

http://www.CircuitousRoot.com/artifice/letters/press/noncomptype/literature/practices/index.html

The 2008 version was edited by Richard L. Hopkins and contains additional material by him.

{Matsuyama 1928} Matsuyama, Y. “On the Volume Change in Certain Type Metals During Solidification.” Sci. Reports, Tohoku Imperial University, Series 1, Vol. 17, No. 1 (1928).

Cited in {ASM 1949 / Gonser & Winkler}, note 7. Also cited in {Thompson, J. G. 1930}, who write “Matuyama.”

{McCue 1909, Part 2} McCue, Alfred. “Talks on Typecasting, No. II.” *The Inland Printer*, Vol. 44, No. 3 (Dec. 1909): 381-382.

Reviews the Compositype, Nuernberger-Rettig, and Thompson. It is online at:

http://www.CircuitousRoot.com/artifice/letters/press/typemaking/literature/general/index.html#inland-printer-v044-hathi-umn-31951001898769z-mccue-talks-on-typecasting

{McGrew, Mac} American Metal Typefaces of the Twentieth Century. New Castle, DE: Oak Knoll Books, 1993.

The 1993 edition is the “second edition,” but it is effectively the initial definitive version. The “first edition” was a loose-leaf compilation distributed by McGrew to friends in the community to solicit additional material.

{Mendenhall 1893} United States Coast and Geodetic Survey Bulletin No. 26, “Fundamental Standards of Length and Mass.” Washington, DC: Government Printing Office, 1893.

This is the so-called “Mendenhall Order” which adopted for this department the International Prototype Metre as a standard and the conversion values suggested by the 1866 “Metric Act.” This became the *de facto* US standard for the inch until 1959. This Bulletin was approved for publication on April 5, 1893, and was collected in Volume II of the U.S. Coast and Geodetic Survey Bulletins. This is online via Google Books at:

https://books.google.com/books?id=8EobAAAAMAAJ

https://books.google.com/books?=id=5hU6AQAAIAAJ

{Mendenhall 1893} Mendenhall, T. C. Fundamental Standards of Length and Mass. Bulletin No. 26, United States Coast and Geodetic Survey. Washington, DC: Government Printing Office, 1893.

This “bulletin” is commonly called the “Mendenhall Order,” but it is no in fact an order. It is a paper explaining an existing practice. It was published in Volume 2 of the Bulletins of the US CGS. This volume has been digitized by Google from an Indiana University copy and is online at

https://books.google.com/books?id=VjluGztiH0MC

{Mergenthaler 1915} *Specimen Book of Type Styles*. Brooklyn, NY: Mergenthaler Linotype Company, 1915.

{Mergenthaler 1939} *Linotype Faces*. Brooklyn, NY: Mergenthaler Linotype Company, 1939.

{Mergenthaler 1940} *Linotype Machine Principles*. Brooklyn, NY: Mergenthaler Linotype Company, 1940.

{Metric Act 1866} ”An Act to authorize the use of the metric system of weights and measures.” Bill H.R. 596 of the 39th Congress of the United States of American, 1st Session (May 13, 1866). This was codified into law in 15 USC 204.

The original text of the “Metric Act” is both easy and difficult to obtain. Scans of the original bill, in its Senate form, are reproduced by the US Metric Association (but they do not indicate the source of their scans and I have been unable to determine the original print publication from which they scanned them):

https://usma.org/laws-and-bills/h-r-596-39th-congress

The USMA also reproduces some legislative history prior to the adoption of this Act:

https://usma.org/laws-and-bills/journals-of-the-house-and-senate-on-h-r-596

The Act was reprinted from an early period. In 1866 the Annual Report of the Smithsonian Institution contained a paper by H. A. Newton on the Act which reprinted its text. This report was submitted to the Congress and became a part of the Executive Documents of the House of Representatives. See {Newton 1866}.

The actual report on which the Act was based was published by the Government Printing Office for the House of Representatives as an independent document. See {Kasson 1866}.

{Mitutoyo 2013} Mitutoyo Corporation. The History of Gauge Blocks. [No location}: Mitutoyo Corporation, 2013.

This document is published by Mitutoyo (a major manufacturer of measuring instruments, including gauge blocks) as their Catalog No. E12016. It is available from them online at:

mitutoyo.com/webfoo/wp-content/uploads/E12016-History-of-The-Gage-Block.pdf

It indicates that much of its content is derived from {Althin 1948}.

{Monotype UK 1952} The 'Monotype' Casting Machine Manual. London: The National Committee of Monotype Users' Associations in Association with The Monotype Corporation Limited, 1952.

{MOSI 2001} "The Linotype & Machinery Co. Ltd." Manchester, GB: Museum of Science & Industry, 2001. Online at: http://www.mosi.org.uk/media/33870636/thelinotypeandmachineryco.pdf

{*MR* 40.1} "'Monotype' Machines in the Making." [the full issue of] *The Monotype Recorder*, Vol. 40, No. 1 (Spring, 1953).

This is a tour of the (English) Monotype factory at Salfords, illustrated with photographs by Guy Gravett. It appears to have been produced *before* {*Making Sure* 1}, even though from our perspective today it serves as if it were a companion piece.

{*MR* 40.3} "'Monotype' Matrices and Moulds in the Making." [the full issue of] *The Monotype Recorder*, Vol. 40, No. 3 (Autumn 1956).

Issued in conjunction with {*Making Sure* 2}.

{NBS 1957} Report of the 42nd National Conference on Weights and Measures, 1957. Washington, DC: U. S. Government Printing Office, 1957.

{Newton 1866} "Newton, H. A. The Metric System of Weights and Measures."

This is a report on "the French system of weights and measures" which, as published, included the text of the 1866 Metric Act. It was published as an appendix to the 1866 *Annual Report of the Board of Regents of the Smithsonian Institution* (Washington, DC: Government Printing Office, 1866). This is online in a Google Books scan of the Smithsonian's copy, at:

https://books.google.com/books?id=zMMWAAAAYAAJ

This Annual Report was also submitted to the Congress and became a part of the *Executive Documents Printed by Order of the House of Representatives, During the First Session of the Thirty-Ninth Congress 1865-1866*. (Washington, DC: Government Printing Office, 1866). This is also online, from a Google scan of the Bavarian State Library copy, at:

https://books.google.com/books?id=Kf9UAAAAcAAJ

{NBS 1957} Poppy, T. G. "The Development of Weights and Measures Control in the United Kingdom." *Report of the 42d [sic] National Conference on Weights and Measures 1957*. National Bureau of Standards Miscellaneous Publication 222, issued December 20, 1957. pp. 22-40. Washington, DC: U. S. Government Printing Office, 1957.

Online from a Pennsylvania State University copy at Google Books:

https://books.google.com/books?id=CEgJAQAAMAAJ

{NBS 1958} "Standardization of the Inch." *National Bureau of Standards Technical News Bulletin*. Vo. 42, no. 3 (March 1958): 41-45.

Online from a University of Chicago copy at The Hathi Trust:

https://hdl.handle.net/2027/chi.098086105

{NBS 1959a} US Dept. of Commerce, National Bureau of Standards. "Refinement of Values for the Yard and the Pound." [Reprinted from the] Federal Register, July 1, 1959.

This was the official announcement of the NBS' participation in the adoption of the "International Yard" and the inch of 25.4mm. It is online at the National Institute of Standards and Technology (the successor to the NBS) at:

https://www.nist.gov/system/files/documents/2017/05/09/frn-59-5442-1959.pdf

{NBS 1959b} *Research Highlights of the National Bureau of Standards, Annual Report, Fiscal Year 1959*. NBS Miscellaneous Publication 229. Washington, DC: U. S. Government Printing Office, 1959.

On p. 13, this confirms the adoption of the International Yard. It is online in a Google scan of the University of Michigan copy at:

https://books.google.com/books?id=4aWN-VRV1AoC

{NIST 180} Doiron, Ted and John Beers. "The Gage Block Handbook." NIST Monograph 180.Gaithersburg, MD: National Institute of Standards and Technology, 1995. Online at:

http://emtoolbox.nist.gov/Publications/NISTMonograph180.asp

{Pasko 1895} Pasko, Wesley Washington. American Dictionary of Printing and Bookmaking. NY: Howard Lockwood, 1894.

{*Penny Magazine* 1835-10-03} Anon. "Mineral Kingdom – Section XLV [of an ongoing series of articles)] in *The Penny Magazine*. No. 225 (Oct. 3, 1835): 387.

The section of this article on "Antimony" contains a statement asserting the expansion of typemetal on solidification, although, curiously, the alloy it specifies contains no tin.

{Parrish LFSN} Parrish, James A., ed. *Ludlow Field Service Notes.* Privately printed.

This book is still available from Parrish's successor, Dave Seat of Hot Metal Services:

http://www.hotmetalservices.com

{Porte 1923} Porte, R.T. and Frank Pearson, ed. *Dictionary of Printing Terms and Compendium of Historical and Useful Information Relating to the Graphic Arts*. Salt Lake City, UT: Porte Publishing Company, 1923. Online from a scan of a Univ. of Michigan copy, at the Hathi Trust:

https://catalog.hathitrust.org/Record/001159699

{Rice MDMD} Rice, Roy. "Monotype Display Matrix Dimensions." Atlanta, GA: The Recalcitrant Press, [n.d., probably early 1980s]

A single page chart found in the papers of Paul Hayden Duensing in the posession of Richard L. Hopkins. It is not clear how widely this circulated, if at all.

{Rehak 1993} Rehak, Theo. *Practical Typecasting.* New Castle, DE: Oak Knoll Books, 1993.

{Rehak 2004} Rehak, Theo. The Fall of ATF: A Serio-Comedic Tragedy. Printed Privately, 2004. [Actual printing at Richard L. Hopkins' Pioneer Press of West Virginia.]

{Righter 1908} Righter, Guy A. Mixing Printers' Metals. Decatur, IL: [by the author], 1908.

{Righter 1923} Righter, Guy A. Casting and Mixing Printers' Metals. Richmond, IN: [by the author], 1923.

A digital version of this is online at http://www.FolioCIII.com/

{Schraubstadter, Jr. 1888} Schraubstadter, Jr., Carl. "Type Metal." in The Inland Printer. Vol. 5, No. 10 (July, 1888): 729-730.

{Sivasankar 2008} Sivasankar, B. *Engineering Chemistry*. New Delhi, India: Tata McGraw-Hill Publishing Co. Ltd., 2008.

{Slinn *et al.* 2014} Slinn, Judy, Sebastian Carter and Richard Southall. History of the Monotype Corporation. London & Woodstock, UK: The Printing Historical Society and Vanbrugh Press, 2014.

{Thompson, J. G. 1930} "Properties of Lead-Bismuth, Lead-Tin, Type Metal, and Fusible Alloys." *Bureau of Standards Journal of Research*. Vo. 5, No. 5 (November 1930). Washington, DC: United States Department of Commerce, Bureau of Standards, 1930.

{Thompson 1942} *Monotype-Thompson Type-Caster Parts Price List.* Philadelphia, PA: Lanston Monotype Machine Co. Effective March 1, 1941 (Revised April 2, 1942). Online on {CR Thompson}

{Thorneycroft 1936} Thorneycroft, W. E., Edited by J. Newton Friend. *A Text-Book of Inorganic Chemistry*. Vol. VI, Part V. [Antimony and Bismuth.] London: Charles Griffin & Company, Ltd., 1936.

A scan of this is online at

https://library.sciencemadness.org/library/book/ATBOIC/atboic_vi_v_SbBi.pdf

{Typothetae 1890a} "United Typothetae of America, Fourth Annual Meeting." [Proceedings, as reprinted in] *The American Bookmaker*[220], Vol. 11, No. 3 (Sept. 1890): 81-97.

The Proceedings of this meeting contains the "Report on the Committee on Uniformity in the Bodies of Type." This Report is dated August 1, 1890; the Committee consisted of Theodore L. DeVinne, W.H. Woodward, and A.H.Pugh. This Report was followed by a "Table of Measurements" of "The American Point System" in which one point was given as 0.013,8 inches.

This Report as published in *The American Bookmaker* may or may not be identical to the version published by the Typothetae in their proceedings; see {DeVinne 1890a}.

{UK 1963 c.31} *Weights and Measures Act 1963*. Parliament of the United Kingdom, 1963 Chapter 31. 31 July 1963.

One online source of the text of this Act is on the v|lexJustis website at:

220 This periodical was later named *The American Printer* and, still later, *The American Printer and Lithographer*.

https://vlex.co.uk/vid/weights-and-measures-act-808389885

{UK 41 & 42 Vict. c. 49} *An Act to consolidate the Law relating to Weights and Measures*. [Weights and Measures Act, 1878.] Parliament of the United Kingdom, Public General Statues of the 41^{st} and 42^{nd} years of the reign of Victoria, Chatper 49. 8 August 1878.

This statue is no doubt online in many sources. Two of these are reprintings by third parties: The Public General Statutes passed in the Forty-First and Forty-Second Years of the reign of Her Majesty Queen Victoria, 1878. (London: Eyre and Spottiswoode, 1878): 308-341. Online in a Google scan of the University of Michigan copy, at:

https://books.google.com/books?id=v39KAAAAMAAJ

The Practical Statutes of the Session of 1878 (41 & 42 Victoria). London: Law Times Office, 1878. Online in a Google scan of the Harvard University copy, at:

https://books.google.com/books?id=zKQaAAAAYAAJ

{US 883,378} US patent 883,378, "Type-Machine," issued to John Sellers Bancroft and Mauritz C. Indahl. Filed 1904-12-01 as application serial number 235,126. Filing renewed 1905-11-08 as serial number 286,366. Issued 1908-03-31. Assigned to the Lanston Monotype Machine Company.

This is the basic patent for the display casting attachment for the Monotype caster, although it does not yet employ the corner-cut mats used later.

This patent is available online from the USPTO and other sites such as pat2pdf.org. It is also reprinted in {CR TR Mats}

{US 904,510} US patent 904,510, "Matrix and Holder Therefor," issued to William Elmer Chalfant. Filed 1907-10-12 as application serial no. 397,215. Issued 1908-11-24. Assigned to the Lanston Monotype Machine Company.

This is the patent for the corner-cut Lanston Monotype display matrix and its holder. Its issue date was stamped on the back of innumerable Lanston mats.

{US 1,193,345} US patent 1,193,345, “Matrix-Holder for Type-Casting Machines,” issued to John Sellers Bancroft and Maruitz C. Indahl. Filed 1915-12-16 as application serial no. 67,222. Issued 1916-08-01. Assigned to the Lanston Monotype Machine Company.

This is the patent for the removable X41A Matrix Holder.

{Vakulenko 2000} Vakulenko, Alex. “Difference between point systems.” https://oberonplace.com/dtp/fonts/point.htm. Copyright 2000. Last updated 2000-02-20. Accessed 2022-08-08

17 Revision History

If you're printing out a copy of this document, there's really no need to print this section. Dates are of the final commit of the revision.

Revision 11, 2022-08-25. Revised American Printers' Point section; added {ATF 1940}, Mergenthaler data, DeVinne puzzle, Porte. Identified {Rehak 1993}, pp. 176-177 with {ATF 1940}. Found {Typothetae 1890a}. Traced various claims and examples of an "ATA point." Updated "Belief in the Expansion of Typemetal" section. Added Too Much Detail about Metrology. Also restored all images (which libreoffice had lost on moving from Revision 10).

Revision 10, 2020-10-25. Lanston Monotype vertical alignment for composition. Appendix on the doghouse mold. Substantial formatting changes, including fully numbered sub-sub(-sub)sections. Added conventions for company names section. Added discussion of Elrod vs Monotype/Knight stripcasting. Various updates from old correspondence. Changed from "DRAFT" to "A Work in Process" on cover.

Revision 9, 2015-02-21. Acknowledgments. Mold depth notes. Belief in the expansion of type metal (appendix with historical citations).

Revision 8, 2015-02-21. ATF matrix depth of drive data. Beard width calculations. Also first version visible to the general public on the CircuitousRoot website.

Revision 7, 2015-01-12. Nothing of note.

Revision 6, 2015-01-12. Compositype & N-R history (but no matrix data yet). Added new (to me) type of matrix: American Display (42 & 48 point, for the Thompson).

Revision 5, 2015-01-11. Lanston display. {*Matlas* 1986} "Balto & Mono" (etc.) table. Roy Rice's data.

Revision 4, 2014-12-25. Ludlow head bearing (except when lengthwise); Ludlow drawings not yet begun. Revised point system discussion and added Monotype point derivation.

Revision 3, 2014-12-22. Printers' Point. How Close? Revised TTMC material. Ludlow errors in *Matlas*.

Revision 2, 2014-12-21. Dunker. Thompson (TTMC). Introduction and illustration of bearings and alignment. Also Baltotype and Iwata Bokei (minor information)

Revision 1, 2014-12-20. English Display.