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Designing
Multiple Master
Typefaces

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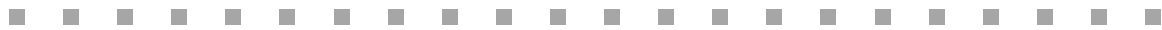
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Introduction

Type 1 multiple master typefaces represent a revolutionary breakthrough in font technology that gives graphic designers and desktop publishers the ability to customize fonts for specific needs. The typographic flexibility that multiple master typefaces provide to users is a significant advantage over previous technologies. To offer users more choices incorporating this flexibility, a variety of multiple master typefaces are currently under development. To encourage further creative application of multiple master technology, Adobe Systems has compiled these basic design guidelines and conventions for creating new typefaces or for “retrofitting” existing families in multiple master format.

Adobe urges type designers to apply the recommendations described in this document so multiple master typefaces will have consistent names and construction from one manufacturer to another, making them easy for the customer to use and for application developers to support. This document provides only general, non-application-specific guidelines for designing multiple master typefaces because each type designer may use a slightly different set of design tools. Platform or application-specific issues should be addressed by the application manufacturer.

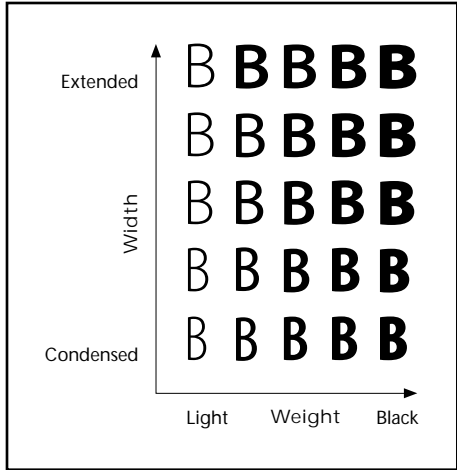
Part 1 of this document contains a brief overview of what multiple master typefaces are; general technical guidelines and considerations for constructing and designing multiple master typefaces; an explanation of Adobe’s multiple master typeface naming conventions; and Adobe’s suggestions for advanced multiple master support in existing typeface design and page-layout applications.

Part 2 of this document outlines fundamental design considerations and aesthetic guidelines for designing multiple master typefaces. It is a study of the process Adobe designers have used to develop the first multiple master typefaces. This process is unlike the design process typically employed for digital type, in that the designer must consider issues at both the master design and multiple master levels to create a successful multiple master typeface.



Both parts of this document are written primarily for type designers and typeface manufacturers, but may be useful for type design software developers and type-supporting application developers as well. The document assumes some familiarity with designing Type 1 outline typefaces.

Figure 1 *A multiple master design matrix is established by the design axes integrated into the typeface. Shown here is Myriad's two-dimensional matrix comprised of weight and width axes, and a small sampling of the possible font variations that can be custom-generated within it.*



For further technical information, please refer to Adobe's technical note #5015 *Adobe Type 1 Font Format Supplement*.

Definition of Terms

Definitions for several key terms used in this document are listed below. For a complete glossary of definitions, see Appendix B.

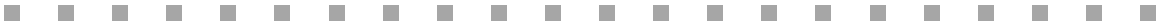
Multiple master technology

An enhancement of Type 1 font technology incorporating on-demand interpolation into a font program.

Multiple master typeface

A super-typeface—a very large family of related styles within a single Type 1 font program. Each multiple master typeface contains all the information necessary to generate hundreds of style variations as individual fonts, or *instances*.

■ **NOTE:** *In this document, the term typeface is not interchangeable with font.*



Multiple master font / font / instance

An individual Type 1 font generated from a multiple master typeface. A font or instance is a specific style variation from a family of related styles. For example, Myriad™ Semibold Condensed and Myriad Light Semi Extended are discrete instances of a single multiple master typeface. A multiple master font or instance is scalable, and may or may not be optimized for use at a particular point size.

Character / character shape / letterform

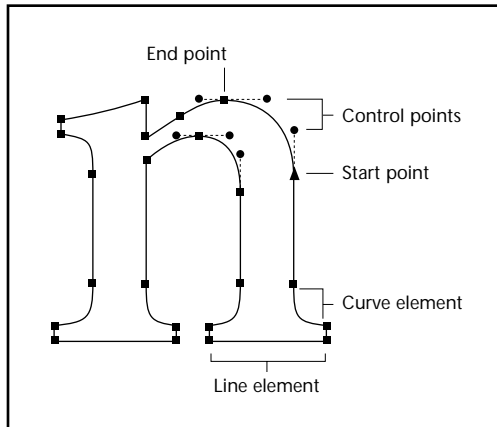
These words are used interchangeably in this document, and can mean either the outward appearance or shape of a letter, or its underlying concept. For example, the letter concept, or *character*, “A” can be embodied in various forms, sometimes referred to as *glyphs*, such as a, a, or *A*. Since many designers find the word *character* preferable to *glyph*, *character* is used throughout this document to represent both ideas.

Primary font

A type designer- or manufacturer-selected multiple master instance that is pre-defined and ready-to-use upon installing a multiple master typeface on a computer.

End point / control point

An end point on a character subpath is the point at which two elements, lines or curves, join. A control point is a point tangent to an adjoining end point on a curve which controls the direction of the curve.







Width

Only a few typeface families supply either condensed or extended versions of the basic design; consequently, the practice of artificially compressing or stretching existing typefaces is widespread. Multiple master typefaces with a width axis allow the creation of fonts of varying widths without distortion of the letterforms.

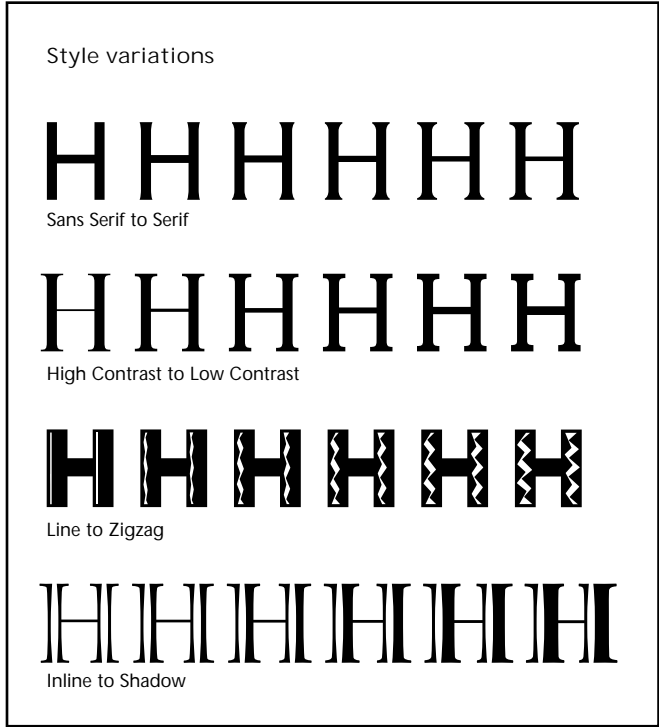
Optical size

In traditional metal typefounding, each style and point size of a typeface was cut by hand, and subtle adjustments to letter proportion, weight, contrast, and spacing were inherent, optimizing the type for readability at every point size. Multiple master typefaces with an optical size axis reintroduce the practice of optically adjusting type, allowing users to generate fonts that are highly readable at smaller sizes without sacrificing elegance at larger sizes.

Style

The potential for typographic expression with multiple master typefaces that have a style axis is nearly limitless. For example, a style axis might incorporate design variations that range from sans serif to serif, wedge serif to slab serif, or inline to shadow, to name just a few possibilities. The term “style” is used as a placeholder for a more specific design axis type that is determined by the designer.

Figure 1-2 *Examples of style variations*



Chapter 2: *Technical Design Guidelines*

In the course of developing multiple master technology, designing the first multiple master typefaces, and collecting input from designers in the field who are working on multiple master projects, Adobe has compiled a set of technical guidelines, recommendations, and tips to aid designers in creating multiple master typefaces.

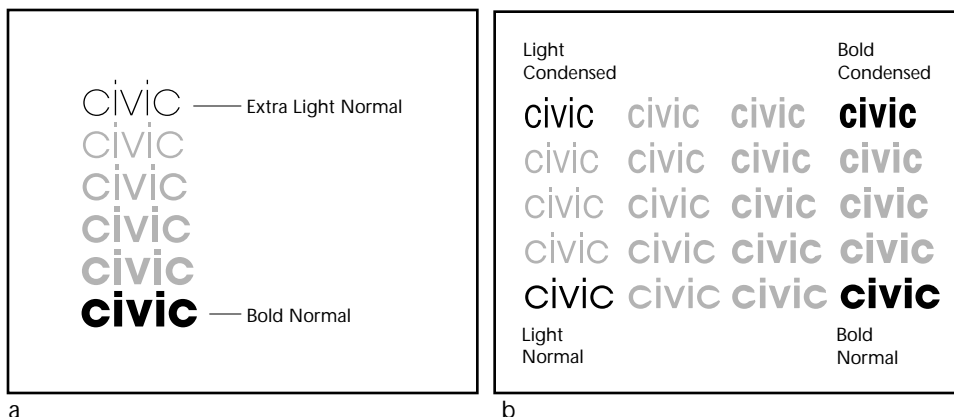
These guidelines include: determining design axis types and dynamic ranges when retrofitting an existing typeface family or creating a new multiple master design; conventions for arranging the master designs in a conceptual geometric design space of up to four dimensions; making the master designs compatible for interpolation; point placement tips to avoid interpolation problems; tips for designing optically adjusted master designs; fine-tuning the optical size axis to achieve more precise optical adjustment throughout a range of point sizes; selecting primary fonts; and several general technical considerations.

Determining Design Axes and Their Dynamic Ranges

Determining which design axes to include in a multiple master typeface, and what dynamic ranges they will have, are typeface specific decisions. The characteristics of the typeface design (serif or sans serif, high-contrast or low-contrast, oldstyle or modern) and its intended uses (for text, display or both) will help determine which design axes and dynamic ranges are appropriate for the design.

When retrofitting an existing digital typeface family for multiple master technology, these decisions may be relatively straightforward. For example, if light, regular, semibold, and bold fonts are the members of an existing family, the lightest and boldest fonts may be used as master designs for a one-axis multiple master typeface varying in weight only. If the family contains a bold condensed font as well, a light condensed font may be designed (based on the light, bold, and bold condensed fonts) to comprise the necessary master designs for a two-axis typeface varying in both weight and width. (Figure 2-1)

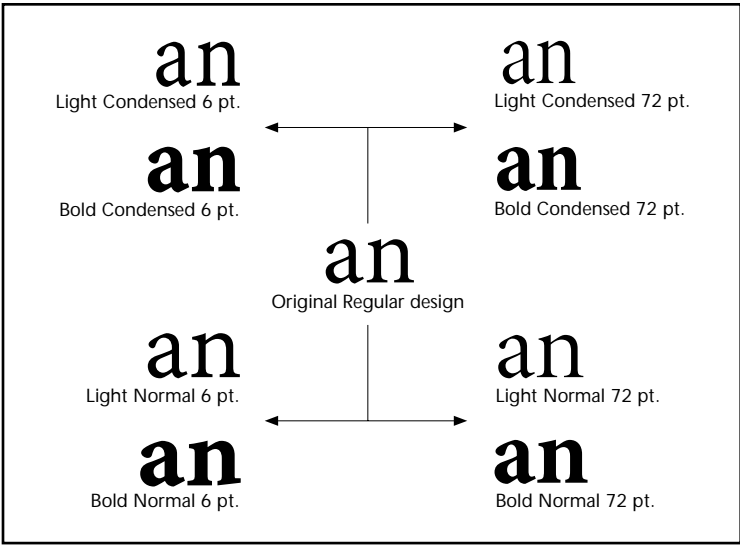
Figure 2-1 a. *Early tests for a one-axis multiple master retrofit of the ITC Avant Garde™ typeface family.* b. *The final master designs in the ITC Avant GardeMM design matrix. The Light Condensed master was developed explicitly to form a two-axis design space.*





If the designer thinks that an existing typeface with a weight axis would benefit from the addition of an optical size axis, the appropriate point size range for the design must be determined. For example, the range may vary from about 6 to 18 points if the design is intended solely for text use, 24 to 72 points for display setting, or perhaps a complete range from 6 to 72 points if the design is appropriate for both text and display use. Then the designer must create small and large size master designs for both the light and bold weights (i.e., creating four new masters based upon the existing fonts). Or, if the existing light and bold fonts are appropriate to use as master designs for either end of the optical size axis, the designer needs only add the corresponding larger or smaller size masters to complete the typeface. (Figure 2-2)

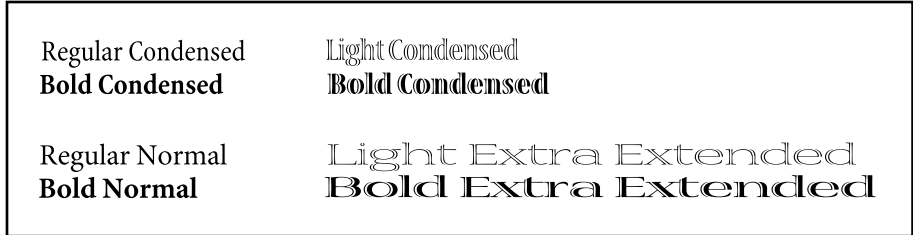
Figure 2-2 *A retrofit project may be accomplished by fashioning two or more master designs from a single regular original as was done for the eight master designs of the MinionMM typeface shown here.*





When creating a new multiple master typeface from scratch, the designer determines which design axes to include, and the limits of their ranges, by carefully considering the characteristics and uses of the typeface. A sans serif design with a large x-height, ample letterfit, and low stroke contrast that is already very readable at small sizes may not benefit from an optical size axis as much as a serif design with a small x-height and more extreme contrast. A typeface intended for display setting may call for more widely ranging weights and widths than a design intended primarily for text use. A modern or sans serif style, with more vertical stress to the letterforms, may adapt more easily to having extremely condensed or extended versions than a classical or oldstyle design having more oblique stress to its shapes. Designers should experiment with alternatives and make their best judgment. (Figure 2-3)

Figure 2-3 A display typeface, such as Viva™ on the right, may call for more widely varying weights and widths than a more classical oldstyle design, like MinionMM on the left, intended for use in lengthy text settings.



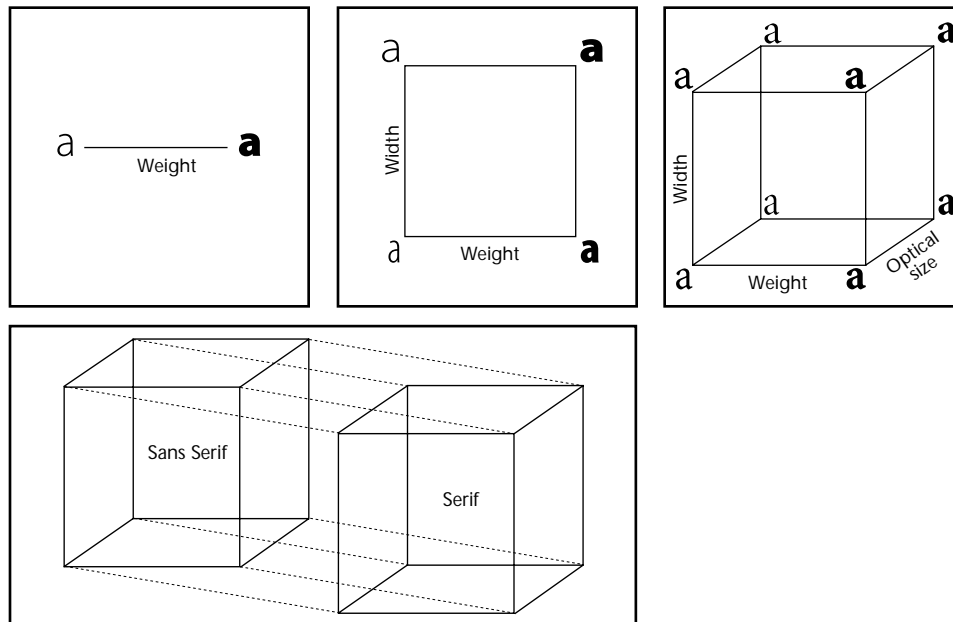
NOTE: The total file size (in bytes) of a multiple master typeface will be affected by the number of design axes incorporated into the typeface. See page 24.

Arranging Master Designs in a Conceptual Design Space

Organizing, designing, and editing between 2 and 16 outline fonts simultaneously can be a challenge. Arranging the master designs in a conceptual, geometric model is a helpful strategy for many people when beginning to design a multiple master typeface.

Conceptually, a multiple master typeface inhabits a design space which is essentially a Cartesian coordinate system of up to four dimensions; each dimension is analogous to a design axis. In this model, a one-axis design can be represented by a line with a master design at each extreme. Similarly, a two-axis design can be represented by a two dimensional square with a master design at each of the four corners. A three-axis typeface can be represented by a cube delineated by eight master designs, and a four-axis design by a hyper-cube with 16 master designs. (Figure 2-4)

Figure 2-4 Geometric models can represent one-, two-, three-, or four-axis multiple master design spaces. In this example, the one-dimensional design space incorporates a weight axis; the two-dimensional space represents weight and width axes; the three-dimensional space includes weight, width, and optical size; and the four-dimensional space incorporates the first three and adds the “style” variation of serif structure as the fourth axis.



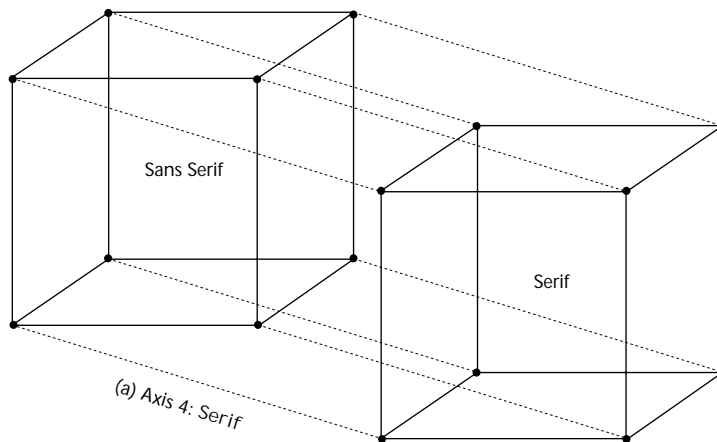
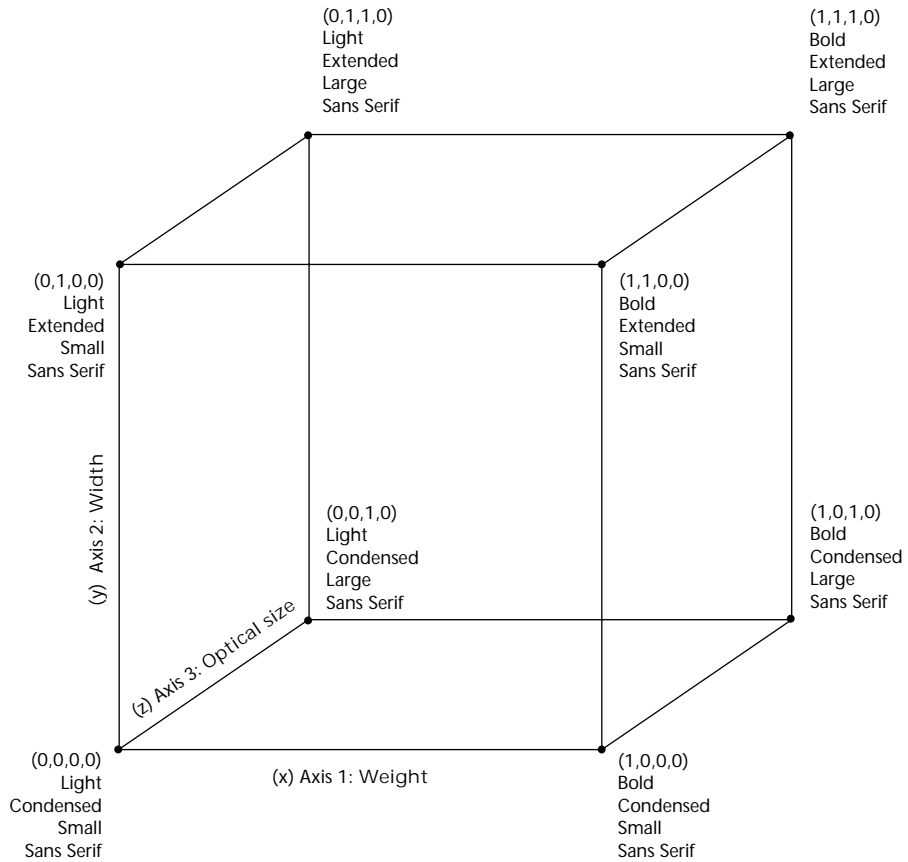
NOTE: Future multiple master support in ATM™ will allow the use of intermediate master designs positioned anywhere within the design space in addition to masters at the extremes; however, the current limit of 16 total master designs means that a four-axis typeface cannot have intermediate masters.

To complete the geometric analogy, the numbers 0 and 1, or *normalized coordinates*, are associated with the extremes of the design space. (Figure 2-5) When assigning master designs to the 0 and 1 ends of each dimension, Adobe suggests that the lightest, most condensed, smallest designs be assigned to the zero end, and the heaviest, most extended, largest designs be assigned to the one end. Conceptually, employ the idea that zero is equivalent to “less” and one is equivalent to “more” of whatever attribute is varying along each axis. The style axis is less straightforward but may follow the same concept. For example, a sans serif style is assigned to the zero (“less”) end and a serif style to the one (“more”) end of the Serif axis.

Adobe has formally registered four kinds of axes: *Weight*, *Width*, *OpticalSize*, and the “style” of *Serif* that correspond to the *x*-, *y*-, *z*- and *a*-axes of the design space, respectively. Designers may develop other axis types or style variations, but if the *Weight*, *Width* or *OpticalSize* axes are used, they should be assigned first and in the above relative order. For example, if the *Width* axis is not included, *OpticalSize* should take its place on the second axis; then any other axis types can be assigned to the third and fourth axes.



Figure 2-5 *The first, or x-axis, is weight (from lighter to bolder); the second, or y-axis, is width (from less extended to more extended); the third, or z-axis, is optical size (from smaller to larger); and the fourth, or a-axis, is the “style” variation of Serif (from sans serif to serif). All use the “less to more” concept.*





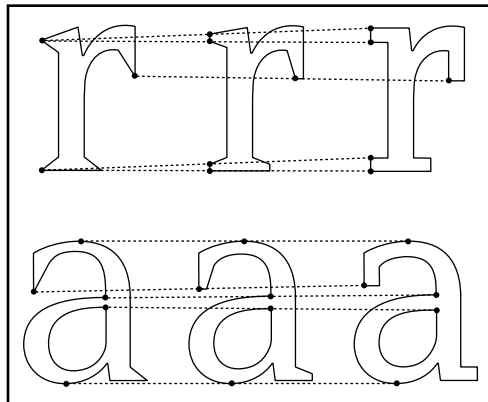
Adobe encourages the use of the above construction for multiple master typefaces. It is especially important that if a weight axis is included, it be assigned to the first, or x-axis and is assigned with the English word “Weight.” This will enable multiple master-savvy page layout applications to identify this axis consistently in order to perform intelligent tasks such as emboldening a font automatically when the user selects the Bold option from the application’s Format menu.

NOTE: Adobe will also register new axis types. If an axis type other than the ones defined above is developed, and would be useful for applications to manipulate automatically, please register it with the Adobe Developers Association; e-mail: ada@adobe.com.

Master Design Compatibility for Interpolation

To generate instances using the interpolation process, all master designs incorporated into a multiple master typeface must be *compatible*. In other words, there must be a one-to-one correspondence between the elements comprising the characters in one master design and those in the other master designs. To understand how outline compatibility functions in interpolation, consider a one-axis multiple master typeface delineated by two carefully designed master designs, one light and one bold. The process of interpolation calculates an intermediate outline linearly, on a point-by-point basis, between the two designed extremes. (Figure 2-6)

Figure 2-6 An interpolated *r* and *a* appear between the master designs for each.



When designing a multiple master typeface from scratch, it is advisable to digitize the master design outlines with compatibility in mind. A useful habit to develop is considering from the outset how each element from one master design will interpolate with its corresponding element in other master designs. When retrofitting an existing family, aspects of certain characters may need to be adjusted or redesigned to achieve compatibility in the following three areas:

Element Compatibility

The number of elements (curves and lines) must be the same in corresponding characters in each master design. For example, if a capital *O* consists of eight curves in one master design, the capital *O*'s in the other master designs must consist of eight curves.

If a character has more elements in one master design than another, it may be easier to add corresponding elements to that character in the other master designs than to try to do without a necessary element in the first master design. However, minimizing the number of necessary elements in each character is especially important when compatibilizing master designs, because very complicated character shapes (shapes consisting of many elements) increase the total file size of the resulting multiple master typeface. Character shapes containing fewer elements also decrease the potential for interpolation problems.

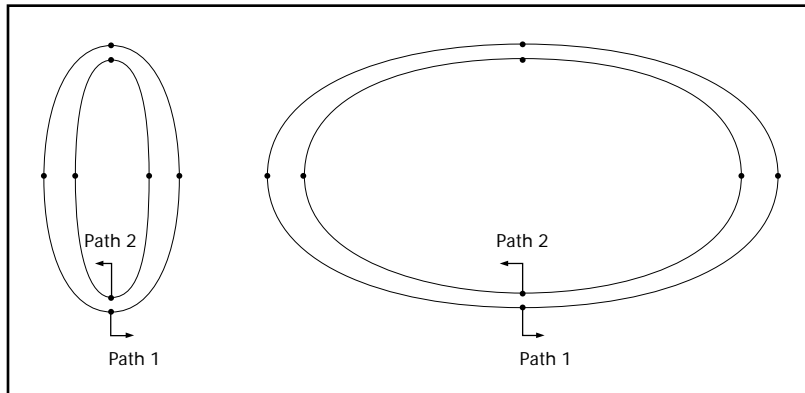
Start-Point Consistency

The relative location of the beginning of the outline path must be the same in corresponding characters in each master design.

Subpaths and Path Order Consistency

The number of subpaths, and the order and direction in which each subpath is drawn, must be the same in corresponding characters in each master design. For example, the capital *O* is made up of two subpaths, an outside counter-clockwise subpath and an inside clockwise path. If the outside subpath was drawn first in one master design, other master designs' subpaths must correspond to the same order. (Figure 2-7)

Figure 2-7 Here the O's from the light condensed and light extended master designs are compatible in number of elements and subpaths, start-point position, path order, and path direction.



NOTE: A character's path start-point, path direction, or subpath order may not be indicated or changeable in some drawing applications used to produce the master design outlines. Contact the software manufacturer if you have trouble interpolating characters after ruling out all other incompatibilities.

■ **NOTE:** Kerning lists must also be compatible. If kerning is included in one master design, the identical list of kerning pairs must be in all other master designs so that the kerning values will be correct for each pair in all interpolated instances.

■ **NOTE:** Compatibility of other typeface parameters, such as hints, may also be required. Refer to the type design application's user manual for details on compatibilizing auxiliary typeface parameters.

Point Placement for Interpolation

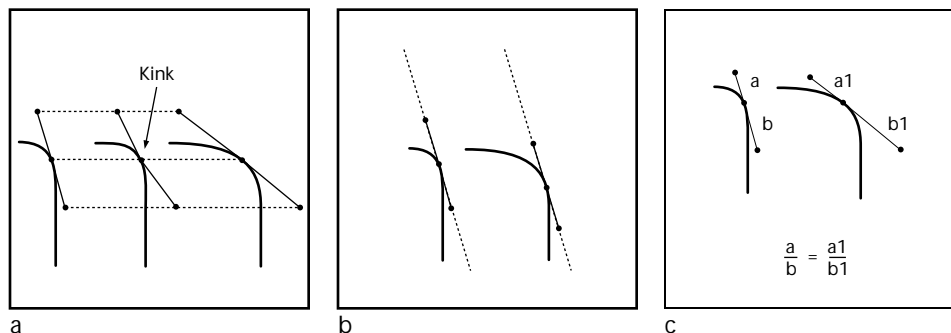
Careful point placement on all master design characters will result in better behaved (better looking) interpolated instances. As in nonmultiple master Type 1 outline fonts, end points should be placed at the horizontal and vertical extremes of curved character shapes. In addition to this rule, several point placement tips may help to avoid common interpolation side effects.

■ **NOTE:** For basic guidelines on point placement conventions, see Appendix A.

Because of the nature of the mathematics involved in linear interpolation, some visual side effects can occur when interpolating between character strokes or elements that vary widely from one master design to another (most notably between very condensed and very extended designs.) One side effect that can be avoided by careful point placement is a “kink” that can occur along an outline's curve. This happens most often at an end point positioned along a curve with a tangent angle between horizontal and vertical. (Figure 2-8a) There are several work-arounds for this problem:

- n Do without the point on the curve if it doesn't compromise the character shape in the master designs or in the interpolated instances.
- n Position the end point such that the tangent angle created by the associated control points is approximately the same on corresponding characters in each master design. This may require that the end points be in different relative positions on corresponding outlines to maintain the desired curve. (Figure 2-8b)
- n Position the control points so that the distance between the control points and the associated end point are as close in ratio as possible on corresponding outlines. (Figure 2-8c)

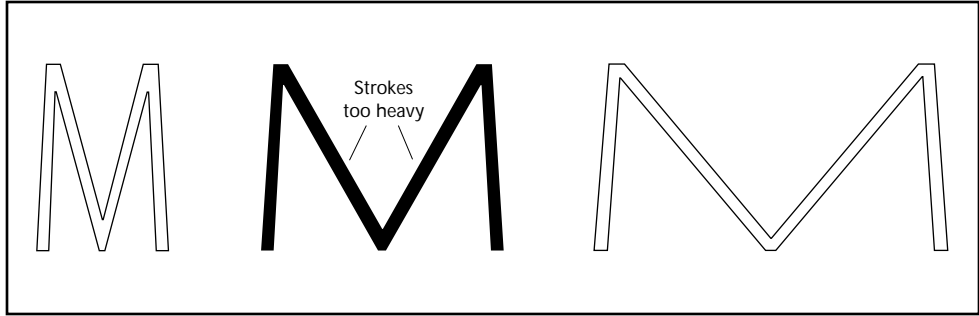
Figure 2-8 a. An example of a linear interpolation side effect: the interpolated tangent (defined by two control points and their shared end point) is not colinear, creating a discontinuous curve, or “kink,” and two possible work-arounds (b and c).



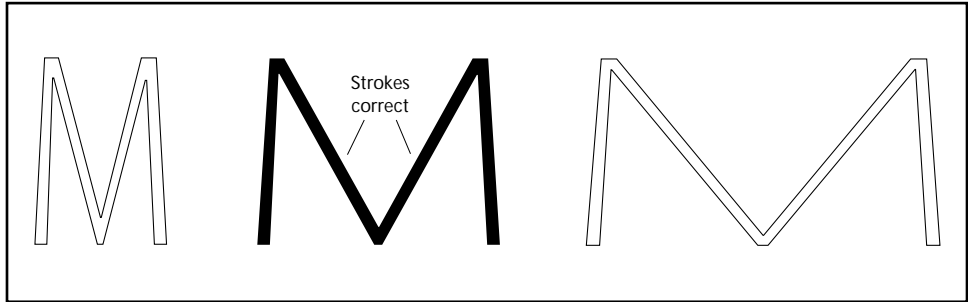


An imbalance in diagonal stroke weights is an effect that is often more noticeable in some interpolated instances than in others. If a character is made up predominantly of straight lines, such as a capital *M*, a *slight* overcompensation in the weights of diagonal strokes in the master designs may be required to achieve more evenly weighted interpolated strokes. (Figure 2-9)

Figure 2-9 Example a shows an imbalance of the diagonal stroke weights in the interpolated *M* even though the masters look correct. Example b shows the imbalance corrected by making the diagonal stroke weights in the masters slightly lighter to compensate.



a

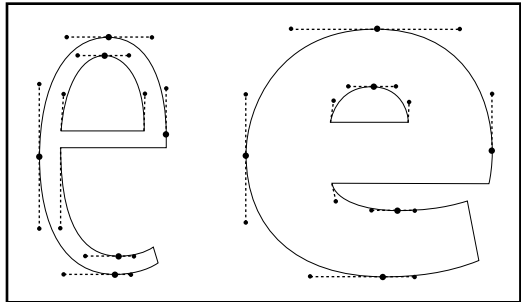


b

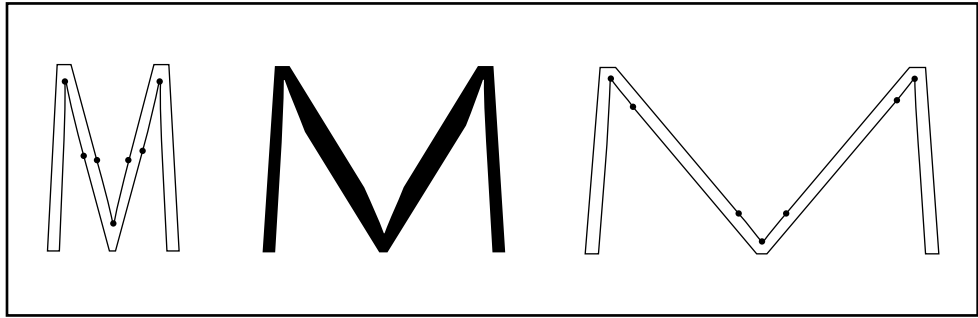


Other side effects can occur due to disparately positioned end points “crawling” around character outlines during interpolation. This may result in lumpy or distorted interpolations. To minimize crawling effects, the end points and associated control points that define corresponding character elements in the master designs should be as similar in relative position as possible—even though the characters themselves may be quite different in appearance, as in light condensed and bold extended forms. (Figure 2-10)

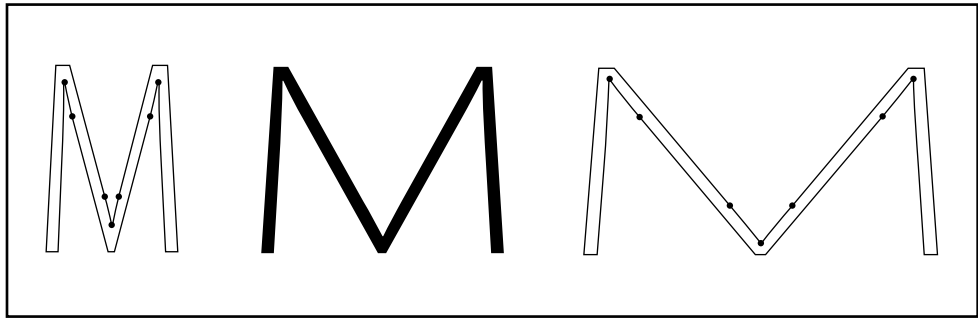
Figure 2-10 Example a shows characters with control and end points in similar relative positions. The extreme crawling problem shown in b is corrected in c by arranging points in the same relative position in both master designs.



a



b

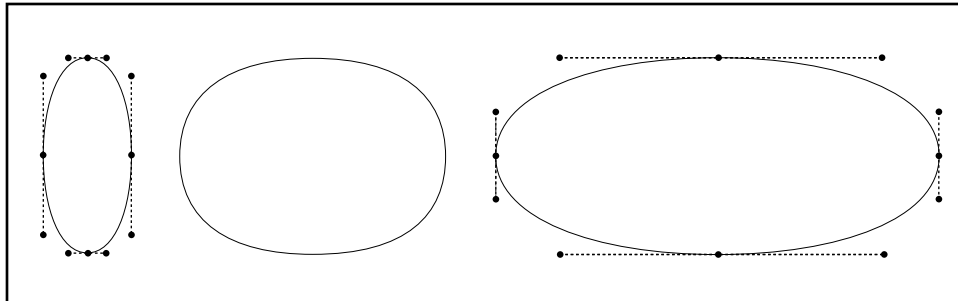


c

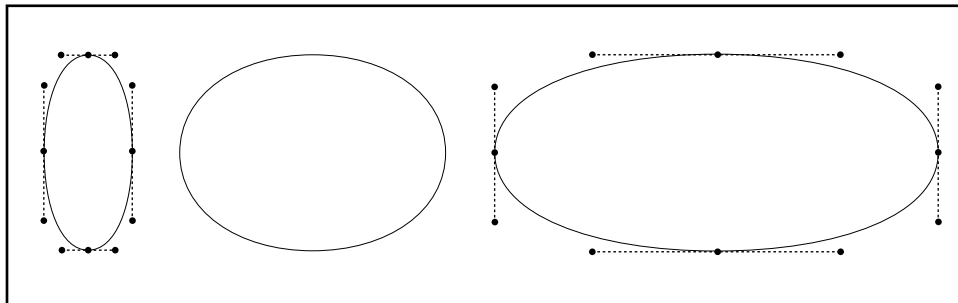


When working with round shapes over a wide dynamic range, maintaining similar end point and control point placement between master designs is critical to avoid a super-elliptical (TV screen shaped) appearance in the interpolated round shapes. (Figure 2-11)

Figure 2-11 In a, the relative position of corresponding control points differs between master designs, resulting in more super-elliptical interpolated curves. In b, the relative position of corresponding control points is similar between master designs, resulting in more round or oval interpolated curves.



a



b

NOTE: The larger the dynamic range, especially in the width axis, the worse the kinking or crawling side effects may become. If finessing the point placement or stroke weights on problem characters is not sufficient, reducing the dynamic range of the axis (and thus the widely varying angles and point placement from one master to another) may ease the problem.

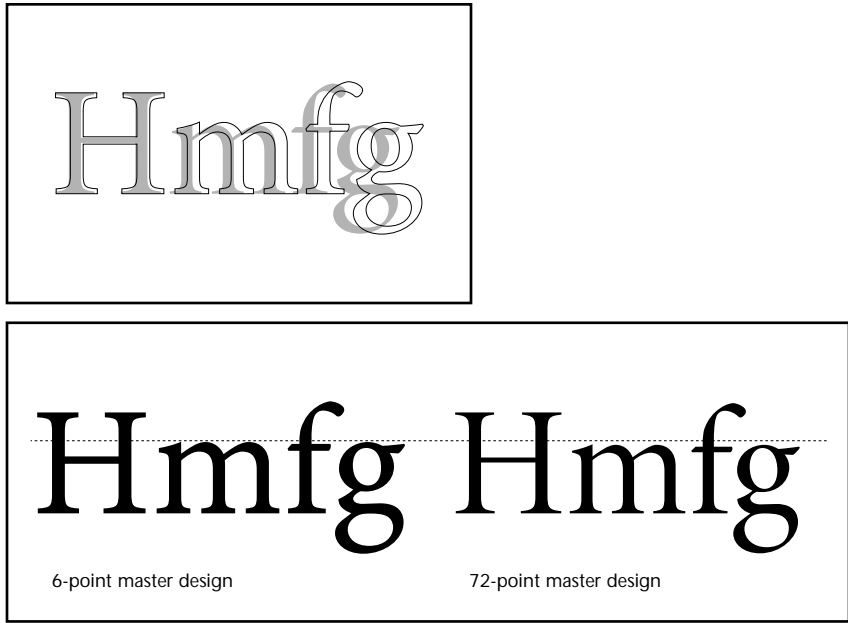
Designing Optically Adjusted Master Designs

Multiple master typefaces with an optical size axis allow interpolation between master designs that have been optically adjusted for use at specific point sizes. This capability reintroduces one of the advantages of metal type, which, being hand-cut at discrete point sizes, often embodied optical adjustments. It is also an advantage over the common digital type practice of algorithmically scaling a single design to different point sizes, which may reduce legibility at smaller sizes or sacrifice subtlety at larger sizes.



The objective of optical sizing is to maintain the integrity and legibility of multiple master instances throughout a range of point sizes. To accomplish this, the following adjustments are often made to the master designs to optimize them for different sizes. For larger point sizes, the space between characters (letter fit) tightens, the space within characters (counterforms) closes up (i.e., the letters are slightly more condensed), the serifs become finer and the stroke contrast becomes greater, the overall weight becomes lighter, and the x-height gradually diminishes. For smaller point sizes, opposite adjustments are made. (Figure 2-12)

Figure 2-12 *The figure shows a few characters from the 6-point (outline) and 72-point (filled) master designs of the Minion™ multiple master typeface, scaled to the same capital H height for comparison. Note the open counterforms, larger x-height, and looser fit of the 6-point design.*



These adjustments can improve the legibility of intermediate point sizes further if they do *not* occur linearly throughout the size range. More change in design features is required for the smaller sizes than is necessary for larger sizes. The following section describes how multiple master technology can accomplish non-linear adjustments using linear interpolation.

NOTE: *In designing an optical size axis for a typeface, it is important to remember that the variations along an axis may be very subtle, and not always apparent when proofing on a low resolution output device (~300 dots per inch or fewer). Proofing at a resolution of 1200 dots per inch or higher is recommended.*

Fine Tuning the Optical Size Axis

The optical size design axis should have a dynamic range appropriate for the typeface, representing the range of point sizes for which the typeface has been optically adjusted. For example, a typeface that incorporates a master design optimized for legibility at 6-point and a master design optimized for legibility at 72-point will have a dynamic range from 6 to 72 on the optical size axis. Although linear interpolation over this range can provide better quality than simple scaling of a single master design, the results can be dramatically improved by incorporating nonlinear interpolation. For example, the optical adjustments needed between a 6- and an 8-point font are greater (and more apparent to the eye) than are those needed between a 66- and a 68-point font. Non-linear interpolation allows each font generated at a size within the range to be more accurately optimized for use at that specific point size. (Figure 2-13)

Figure 2-13 *This illustration shows 7-point optically sized and 72-point optically sized Minion set at 7 points for comparison. Note that the 72-point optically sized type looks cramped.*

At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes into these precincts. Here is sanctity which shames our religions, and reality which discredits our heroes. At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes into these precincts. Here is sanctity which shames our religions, and reality which discredits our heroes. At

More legible: 7 op, set at 7 points

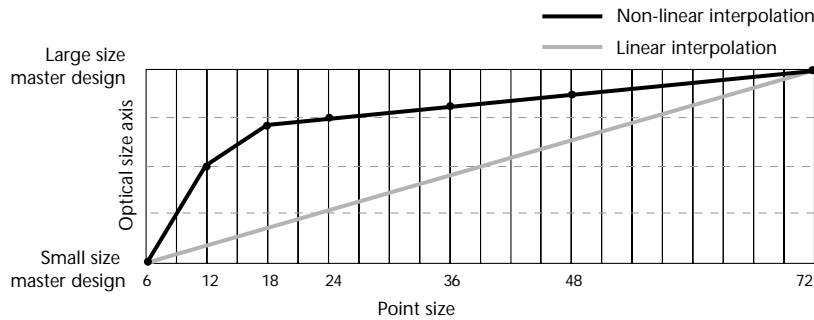
At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes into these precincts. Here is sanctity which shames our religions, and reality which discredits our heroes. At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes into these precincts. Here is sanctity which shames our religions, and reality which discredits our heroes. At the gates of the forest, the surprised man of the world is forced to leave his

Less legible: 72 op, set at 7 points



Multiple master technology enables the type designer to define an *axis map* for any design axis. The axis map provides a means for translating the default linear interpolation into a non-linear or “piece-wise linear” function. It is extremely useful for the optical size axis because with it the designer can better control the design feature variation occurring in all the instances throughout the size range. The character outlines, letter fit, and kerning values are interpolated together using the same axis map. (Figure 2-14)

Figure 2-14 In this non-linear axis map, an instance optimized for use at 6 points appears at the lower extreme of the optical size axis; an instance for 8 points appears 35% of the way along the axis, for 12 points at 50% of the way along the axis, and for 18 points at 70% of the way along the axis. The result of this axis map is that point sizes at the low end of the axis incorporate proportionally more design variation than those at the high end of the axis, rather than the variations occurring linearly and constantly along the axis. This more closely parallels how well-designed metal type functions. Although type design tools may differ in terms and techniques, the Type 1 definition for the axis map in this figure is: BlendDesignMap [[6 0][8 .35][12 .5][18 .7][72 1]]



Determining the correct axis map for an optical size axis is more art than science, requiring testing and visual judgement. The procedure entails first making an educated guess at a suitable axis map, then printing instances throughout the optical size range—each at the appropriate point size, and evaluating the proofs to determine if the axis map needs to be adjusted further to achieve better results.

NOTE: Refer to the type design application’s user manual to determine how to apply a non-linear axis map to a design axis.

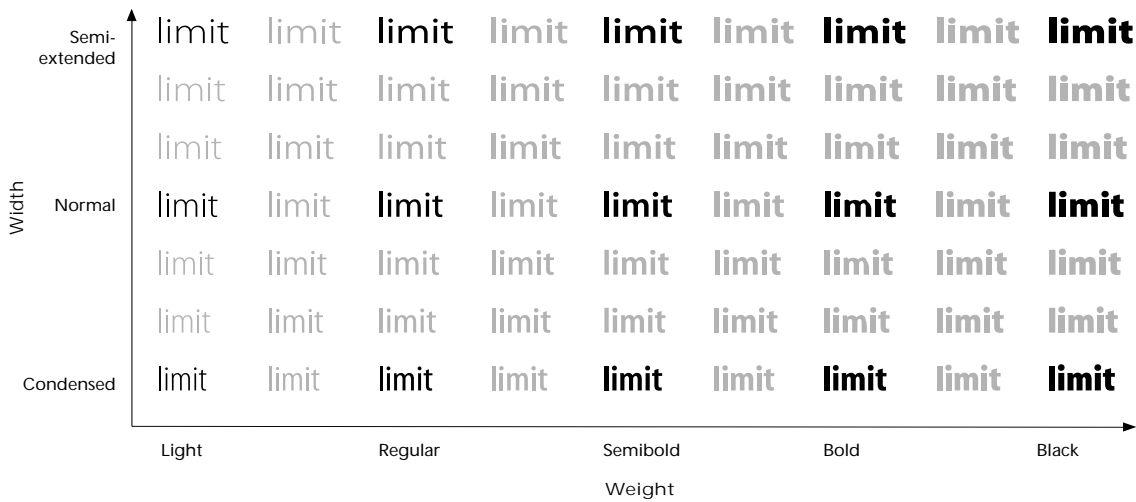
Selecting Primary Fonts

The type designer or manufacturer may want to select a set of *primary fonts* to provide the user with predefined, ready-to-use instances that will be available upon installing the multiple master typeface. Since some users will only work with the primary fonts provided in the package, the selected set should be chosen carefully, and consist of a workable number of instances representative of the range of possibilities offered by the multiple master typeface.



When choosing primary fonts, keep in mind the intended use of the design (for text, display, or both), and select instances that are most likely to be useful as a stand-alone set. For example, extra light, regular, and extra black weights might be a suitable set of primary fonts for a one-axis display typeface. Light, regular, semibold, and bold weights with corresponding condensed and extended versions might comprise a minimum set of primary fonts for a text typeface with both weight and width axes. (Figure 2-15)

Figure 2-15 Variations of the Myriad typeface with its 15 primary fonts highlighted in black



The best time to choose primary fonts is during the later stages of the design process. To do this, the designer may want to first assign temporary *design coordinate* values to the extremes of each design axis. Design coordinates represent the dynamic range for each axis and correspond to the normalized Cartesian coordinates of 0 and 1 established in the typeface’s geometric design space model. A common temporary dynamic range for each axis is 0–100; some designers find it easier to work with whole numbers rather than decimal normalized coordinate values. Proof instances at frequent, regular intervals throughout the design space, and select the primary fonts from these instances. Note the design coordinate along each axis where the selected primary fonts occur; for example, the often-used “regular” weight, “normal” width instance might be positioned at 30 along the temporary weight axis and 50 along the temporary width axis (30 and 50 correspond to .3 and .5 respectively, in a normalized coordinate range). Additional proofs may need to be run on sections of the design space to hone in precisely on particular primary font instances.

NOTE: Refer to the type design application’s user manual to determine how to apply temporary design coordinate values to the extremes of the design axes.

IMPORTANT: Once the typeface design is complete and the primary fonts have been chosen and given temporary values, see “Assigning Design Coordinate Values to Primary Fonts” in Chapter 3 to convert the temporary design coordinates or normalized coordinates into final design axis and primary font coordinate values.



General Technical Considerations

The following general considerations may affect how the designer approaches a multiple master project. First, the designer may need to alter his/her design strategy somewhat; second, technical restrictions may affect the choice of a multiple master typeface name; and third, the total file size (in bytes) of the multiple master typeface may affect its performance.

Design Strategy

When creating a multiple master typeface, the type designer must make some adjustments to design strategy that initially may seem awkward. First, at least two (and often four or eight) designs will need to be developed and tested simultaneously, in contrast to the common method of developing a regular design first, then finishing a bold, then a condensed, and so on. This takes some acclimatization. Second, only the master designs are designed explicitly, so they must be crafted carefully to ensure that the interpolated designs throughout the whole range look as they are intended, including the instance that will become the often used “Regular” primary font. The wider the dynamic range of each axis, the more challenging this job becomes.

In practice, the second adjustment is not as unusual as it sounds. The master designs are often created while referring to, or working directly from, an original regular weight drawing or design (i.e., the bold master is made by increasing the weight of a regular design, the light master is made by decreasing the weight of a regular design, etc). Then the character shapes of each master design are carefully fine-tuned while monitoring the interpolated instances. Experimenting with a few characters of each master design to determine functional dynamic ranges for the design axes is a crucial early step, see “*Stage 1: Keyword Exploration*” in *Part 2, Adobe’s Typeface Design Process*.

Future multiple master support will allow the designer to incorporate intermediate master designs within the design axes in addition to those at the extremes. For example, the original regular weight design may be incorporated as a discrete master design at an appropriate position between the light and bold masters on the weight axis. However, the complexity of working with yet another master design and the increase in total file size of the final typeface could outweigh any control over the interpolated letterforms that may be gained by including the additional master. Most often, very good results can be achieved without adding intermediate masters, by carefully crafting the master designs at the extremes and adjusting the dynamic range of the axes.

Macintosh Typeface Name Restrictions

The Family Name

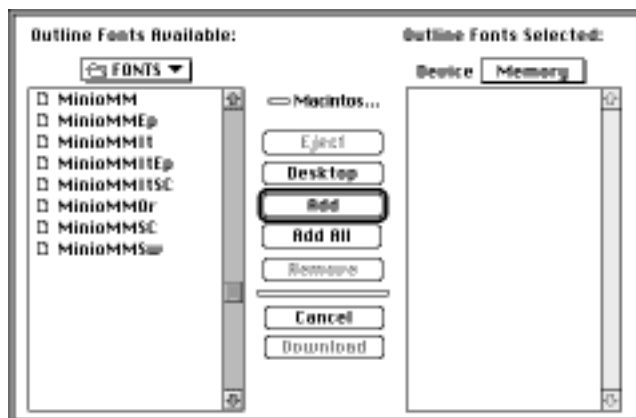
From the type designer's perspective, multiple master font naming begins with choosing the basic typeface family name. This name is used as the value for the FamilyName keyword in the Type 1 font program, and defines the stylistic family group to which its font variations belong. For example, MyriadMM_400 RG 200 CN is one instance of the Myriad family of font variations.

A significant consideration when choosing a multiple master typeface family name is that a constraint used to satisfy the limited space in application menus, called 5:3:3 truncation (discussed in Adobe Technical Note #5088, *Font Naming Issues*), may be imposed on the typeface name when a multiple master typeface is built by the type design software. This truncation is necessary in multiple master typefaces to ensure that the typeface menu name will match the PostScript outline font filename, allowing ATM to properly locate, generate, and display font instances.

For example, a typeface family name such as *Myriad* may be truncated to *Myria*, and *Minion* to *Minio*. (Figure 2-16) When choosing a name for a multiple master typeface, the effect of this truncation on the family name should be kept in mind, so the name that appears in font menus remains meaningful to the user and unique to software applications.

NOTE: Some designers name their typefaces with preceding initials (vendor IDs) to establish clear ownership of the typeface name, and to ensure unique font names. For example, JSRoman might signify the typeface called Roman from John Smith's digital type foundry. However, the font menu name for this multiple master typeface will be truncated to JSRom. Due to the rules of 5:3:3 truncation, the preceding initials use up valuable real estate which might be used to display more of the typeface family name. For this reason, Adobe recommends placing vendor IDs after the family name and before any style or character set attributes.

Figure 2-16 An example of a truncated typeface name in a font menu; Minion has become "Minio."



NOTE: Adobe's Type Reunion™ software expands a compatible typeface's truncated family name (and primary instance label abbreviations) to their full length wherever space allows.

Instance Font Menu Names

Font menu names for multiple master instances, particularly those from typefaces with two or more design axes with large dynamic ranges, currently require more room in font menus than standard font menu names. This is a significant consideration when determining how many design axes to include in a multiple master typeface, and their dynamic ranges.

To be compatible with earlier versions of Macintosh® system software, as well as applications and utilities, there is a font menu name length restriction of 30 characters (the first 28 must be unique). While multiple master technology currently allows up to four design axes, having potential dynamic ranges from 1 to 9999 (expanded from the 1 to 999 range listed in earlier Adobe documentation), the number of design axes included in a typeface and their dynamic ranges must be considered carefully so the font name length restriction is not exceeded. For example, fonts generated from a four-axis typeface with the weight, width, and style axes each ranging from 1 to 2000 will exceed the limit: A user-generated instance with the name “HippoMM_2000 wt 2000 wd 2000 sr 12 op” is 37 letters long, including recommended labels, and the MM identifier. Fonts from an accompanying italic or expert set typeface will further exceed the limit (i.e., HippoMMItaExp...). In cases like these, either the two-letter axis labels, a portion of the dynamic range on the axes (bringing one or more of the ranges down to three digits), or a whole design axis must be forfeited to avoid exceeding the limit. See “The Alphanumeric Font Naming System” in Chapter 3.

For references to detailed information on font naming issues for the Macintosh, see Appendix D.

Multiple Master Typeface File Size (in Bytes)

Several factors directly influence the total file size (in bytes) of the printer font portion of a multiple master typeface. These include the number of master designs, the number and complexity of characters in each master design (characters with many elements, particularly curves, take up more space than ones with fewer elements), the amount of hinting applied to the characters of each master design, and the number of kerning pairs included with each master design (the kerning pairs must be identical in all masters of a typeface).

When outputting to imagesetters and high resolution printing devices (or non-PostScript printers), the total printer font size is not usually an issue. However, smaller printer font file size is an important consideration for a typeface intended for general correspondence, for example, which is specifically designed for use on low memory printers in homes or offices.



A useful benchmark is that a multiple master typeface with a printer font file size larger than 150,000 bytes (150k) may cause problems for typical 300 dpi PostScript language printers that lack enough memory for downloading fonts (under three megabytes of RAM). To avoid problems, the number of design axes (i.e., the number of master designs) that are included in the typeface, as well as the complexity of the characters in each master, should be considered carefully, and the total file size should be monitored during development of the multiple master typeface. Each multiple master typeface package should list the printer font file size of the enclosed typeface.

Explicitly downloading fonts to a printer's hard disk (if available) can be a helpful work-around when memory problems occur while printing with multiple master typefaces. Characters from fonts that are explicitly downloaded to a printer's hard disk and accessed on an as-needed basis are a significant memory-saver for print jobs. However, the more typefaces (multiple master or otherwise) that are used in a document, the more likely a printer will run out of memory and be unable to print the document.

NOTE: *Multiple master technology currently allows up to four design axes, or 16 total master designs. However, some low memory printers are known to have trouble printing with three-axis typefaces incorporating eight master designs.*





Chapter 3: *Multiple Master Font Naming Conventions*

Objectives of the Alphanumeric Naming System

Two major objectives led to the development of the alphanumeric naming system used for Adobe's multiple master fonts: first, to clearly identify each instance generated from a multiple master typeface, and second, to meaningfully relate instances from one multiple master typeface to instances from others.

The first objective of the system, given that a vast number of variations may be generated from each typeface, is to make every instance uniquely identifiable to the user and compatible with existing software applications. The alphanumeric system indicates precisely where in a typeface's design space any given instance is located, giving the user a frame of reference when generating custom instances or looking through a font menu. It also allows applications to identify specific instances and regenerate those that are missing, if necessary. Traditional font names, such as regular, semibold, and bold, are not specific enough for these purposes.

Until now, users have had to rely solely upon common traditional style labels such as medium, book, and regular when comparing fonts from different typeface families. Unfortunately, there is no standard meaning for, or use of, these labels. The apparent *color* of fonts with the same label (their density of gray when printed as text on a page) can vary widely from one family to another; a medium font from one family is unlikely to have the same color as a medium from another.

The second objective of the naming system addresses this issue by enabling a font's design coordinate value to relate from one multiple master typeface to others, regardless of its manufacturer and independently of any style labels that may be applied. When design axis coordinates are assigned consistently, a font generated with a value of 500 in weight from one multiple master typeface will have approximately the same apparent color as a font of the same weight value from another typeface. Similarly, fonts generated with the same width values will have approximately the same apparent width from one typeface to another. (Figure 3-1)



Figure 3-1 *The instances of Myriad, MinionMM and TektonMM shown here have been generated in Adobe’s Font Creator utility with the same design coordinate for weight, and so appear a similar color, or value of gray, when set in text.*

At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes

Myriad

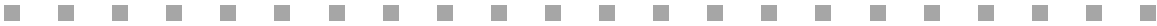
At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes

Minion multiple master

At the gates of the forest, the surprised man of the world is forced to leave his city estimates of great and small, wise and foolish. The knapsack of custom falls off his back with the first step he makes

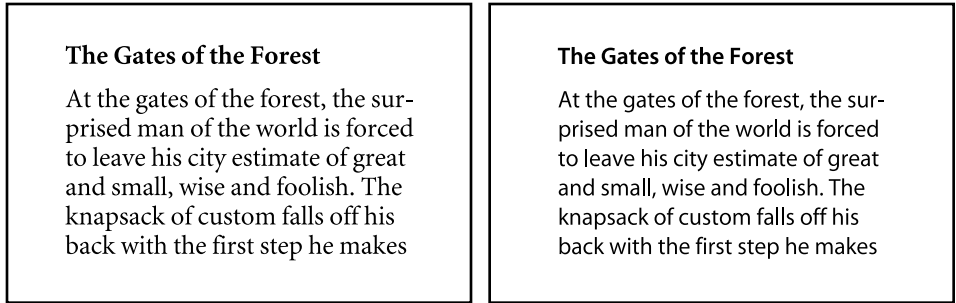
Tekton multiple master

NOTE: *This labeling system assumes that weight and width comparisons are made between fonts of similar apparent size, that is, typeset so that they have similar x-height and leading measurements rather than equal point sizes. See “Assigning Design Coordinate Ranges to Weight and Width Axes” later in this chapter.*



Corresponding relationships of weight and width are useful as well as convenient, especially in text typesetting. For example, if the color or width of one multiple master font works well for a particular job, a font similar in weight or width from another family might be desired for a new job, and the alphanumeric system quickly indicates which instance from the other family would be the best replacement. (Figure 3-2)

Figure 3-2 On the left, *MinionMM Normal* and *MinionMM Bold Normal* are used together. On the right, by choosing instances of the same weight and width values from *Myriad*, similar color relationships can be maintained.



Adobe’s goal is to enable people to use multiple master typefaces easily. If the alphanumeric naming system is adhered to by typeface designers and manufacturers, the user will recognize multiple master font names as representing approximate points along a relative, meaningful scale of variations rather than a list of arbitrary numbers in current font menus.

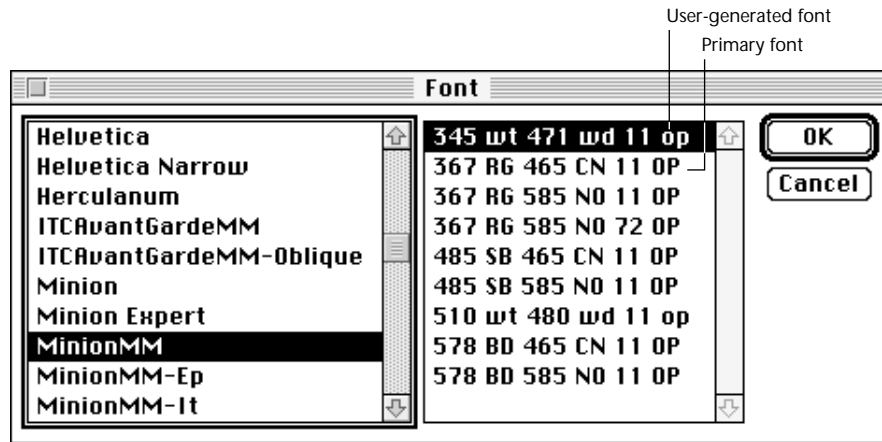
NOTE: Adobe anticipates that in future applications users will have the option to define their own instance names in addition to the alphanumeric instance names.

The Alphanumeric Font Naming System

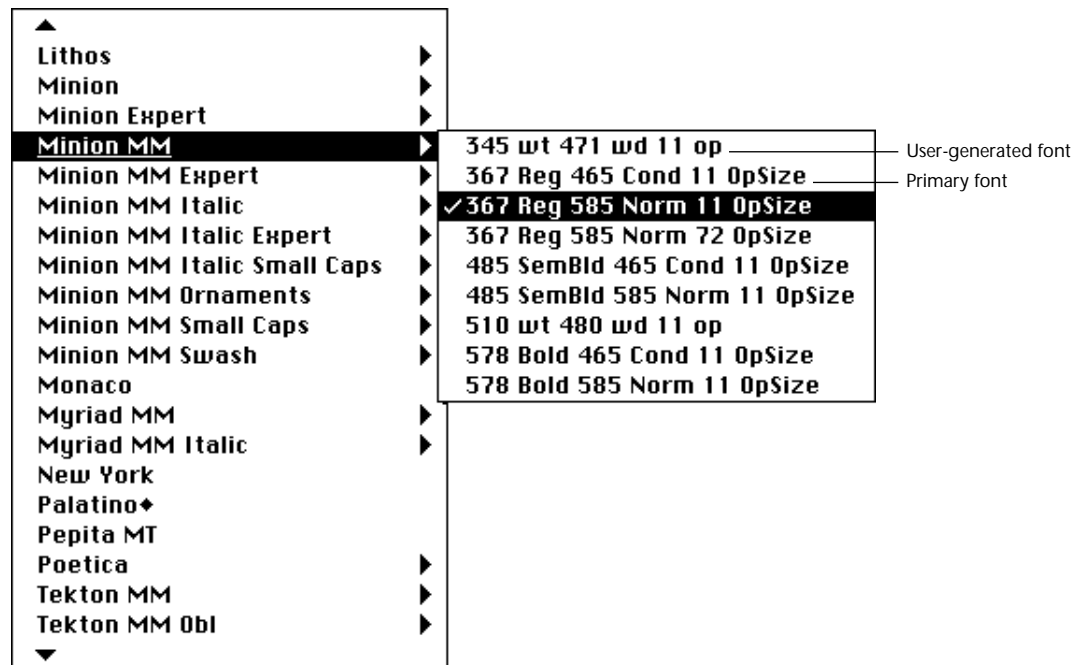
Adobe’s multiple master font instances are named according to the convention of *FamilyMM_font identification*, where Family is the name of the typeface, MM_ indicates that it is a multiple master typeface, and font identification is a string of alphanumeric characters (a combination of letters and numbers) that identify a specific font instance. An instance can be either a primary font (manufacturer defined) or a custom font (user-generated). (Figure 3-3)

IMPORTANT: The MM indicator is optional, but recommended. The underscore (_) is required to visually separate the family name from the font identification, and to indicate to applications and rasterizing software that, if this is a multiple master typeface, the design coordinates defining the instance follow.

Figure 3-3 a. Shown here are MinionMM primary fonts along with user-generated (custom) fonts as they appear in the Font menu of an application without Adobe Type Reunion software. The primary fonts are distinguished by two letter uppercase abbreviations for weight, width, or size, while user-generated fonts have lowercase abbreviations for each axis type. b. When using Adobe Type Reunion software, the abbreviations for the primary fonts are expanded as space allows for easier identification.



a



b



The font identification consists of one alphanumeric string (a required design coordinate value and an optional label) for each design axis in the typeface. If the typeface has one design axis, there is a single alphanumeric string. If there are two design axes, there are two alphanumeric strings, and so on. (Figure 3-4)

Figure 3-4 Examples of one-axis, two-axis, and three-axis font names. Extra space has been added between name-parts for clarity.

	FamilyMM	Weight	Width	Optical size
One-axis typeface	CaflichScriptMM	380 RG		
Two-axis typeface	MyriadMM	400 RG	600 NO	
Three-axis typeface	MinionMM	367 RG	586 NO	11 OP

The design coordinates indicate the position of the font along each design axis, and the letters label the font’s style (i.e., regular, bold, condensed) if it is a primary font, or the design axis that is being varied (i.e., weight, width, optical size) if it is a user-generated font. (Refer to Figure 3-3)

Because there is a Macintosh font name length restriction of 30 characters, style labels must be abbreviated to fit the necessary information into this restricted length. Adobe Type Reunion will expand typical primary font label abbreviations when installed on a user’s Macintosh.

Design Axis Abbreviations

As mentioned previously, Adobe has defined four design axis types: Weight, Width, OpticalSize, and the “style” called Serif, and encourages type designers to use these standard labels whenever appropriate. Any other axis types that designers believe are useful for multiple master typefaces may be publicly registered with Adobe’s Developer Support department. If they are registered, other type designers may incorporate them into their typefaces, and software applications will be able to identify and use them intelligently in the future.

Adobe’s convention for labeling the design axes in user-generated fonts are the following *lowercase* letter abbreviations:

Weight	wt
Width	wd
OpticalSize	op
Serif	sr

Primary Font Label Abbreviations

To distinguish primary fonts from user-generated fonts, Adobe's primary font labels use the following two-letter *uppercase* abbreviations. These labels indicate each primary font's style (regular, bold, condensed, etc.), and act as guideposts in long menus of multiple master instances. (Refer to Figure 3-3) These labels in both weight and width can accommodate design axes with wide dynamic ranges. Adobe strongly recommends that type designers use these abbreviations whenever applicable in their new multiple master typefaces.

Weight:	XL	ExtraLight	Width:	XC	ExtraCondensed
	LT	Light		CN	Condensed
	RG	Regular		SC	SemiCondensed
	SB	Semibold		NO	Normal
	BD	Bold		SE	SemiExtended
	BL	Black		EX	Extended
	XB	ExtraBlack		XE	ExtraExtended
Optical Size:	OP	OpticalSize			
Serif:	SA	Sans			
	SR	Serif			

Retrofit designs that include primary font weights and/or widths that closely match those in an existing family may require abbreviated versions of common labels, such as Thin (TH), Book (BK), Medium (MD), Demi (DM), Heavy (HV), Nord (ND), Extra Bold (EB), Super (SU), Ultra (UL), Compressed (CM), Compact (CT), Narrow (NR), and Wide (WI). These and the abbreviations listed in the chart above are currently recognized by Adobe Type Reunion, and may be expanded out as font menu space allows. As new multiple master typefaces are developed, the list of standard label abbreviations is likely to grow. Contact Adobe's customer support department at 415-961-4111.

NOTE: Refer to the type design application's user manual to determine how to apply multiple master typeface instance labels while following the above conventions.

NOTE: In this alphanumeric naming system, it is more important that the design coordinate portion of the font identification correspond over typeface families than the letter labels, however, if both parts of the font name are as consistent as possible between typeface families, the user will find them easy to recognize and understand.



Assigning Design Coordinate Ranges to Weight and Width Axes

The apparent weights and widths of typefaces can be subjective and involve many visual variables. Therefore, they cannot be defined in numerical terms by algorithm alone, and design coordinate numbers must be assigned to them in a primarily visual process. By combining typeface specific data with extensive visual comparisons of existing typefaces in its library, Adobe has established the relative numerical scale used to determine the design coordinate ranges for the weight and width axes of the first multiple master typefaces: Myriad, MinionMM, Viva, TektonMM, ITCAvantGardeMM, and CaffischScript.™ A catalog of font samples with associated design coordinate values covering a wide range in both weight and width is available from Adobe System's OEM support department at 415-962-4805. In conjunction with the procedures in the following sections, Adobe's catalog can be used as a standard scale when visually assigning design coordinate values to the weight and width axes in a new multiple master typeface.

Using a visual process to assign appropriate values to the extremes of each design axis results in numerical ranges that are not absolutes. Instead, they function as approximate indications of how light or bold, condensed or extended the extremes of each design axis in the typeface are, and require careful selection to fill this role. It is more critical that text typefaces use this relative numerical scale than display typefaces, and that weight and width axes adhere to the system over other axis types.

Assigning Coordinate Values to the Extremes of Each Design Axis

By visually comparing samples of a new multiple master typeface to Adobe's catalog samples, final, relative design coordinates can be assigned to the extremes of the weight and width design axes.

The major visual variables affecting a typeface's apparent weight and width are: point size, x-height, leading, serif length and weight, letter fit, stroke contrast, typeface weight (when judging width), and typeface width (when judging weight). These variables may combine in complex ways. For example, a font with a lighter stem weight and a larger x-height but which is very condensed and tightly spaced may create a darker apparent color than one with a heavier stem weight and a smaller x-height which is extended and loosely spaced. The samples in Adobe's catalog are typeset such that the x-height, leading, overall weight (in the "Width" section) and overall width (in the "Weight" section) are held constant in order to eliminate as many variables as possible from the visual equation. Typesetting samples from a new multiple master typeface in a similar way will make comparison between these and the catalog samples easier.

The designer will need to have chosen the primary fonts for the new multiple master typeface prior to assigning final design coordinate values to the extremes of the weight and width design axes. Instances in the *regular* weight and *normal* width will be used for comparison with Adobe's catalog font samples, as detailed below.



Because most text is comprised primarily of lowercase letters, making overall color and width judgments based on lowercase text (whenever possible) will yield the best results. Also, because point size alone is not a standard measure for the apparent size of a typeface, scaling the lowercase x-height of the new multiple master instances to match that of the catalog samples will equalize their apparent sizes for better weight and width comparison. (All capital typefaces, or display typefaces with extremely large or small x-heights may require that the designer use this recommendation with discretion to achieve reasonable results.)

Use the steps below to assign appropriate design coordinate values to the extremes of the weight and width axes of a multiple master typeface.

1. *Typeset Samples* To establish a foundation for accurate comparison, typeset the following instances of the multiple master typeface, using the text as it appears in Adobe's samples, on smooth, white paper from a high-resolution printer (1200 dpi is recommended):
 - n For weight: Typeset a sample of the lightest and the heaviest weight instances in the *normal* width,
 - n For width: Typeset a sample of the most condensed and the most extended width instances in the *regular* or *book* weight.

Typeset these samples at a point size such that the x-height matches Adobe's samples ($x = 1.75\text{mm}$ tall), or, for a capital-only typeface, so that the capital height matches ($H = 2.5\text{mm}$ tall), with 13 points between baselines.

2. *Assign Weight Coordinates* For both the lightest and heaviest samples (in the normal width), visually determine which of the numbered instances in the "weight" section of Adobe's catalog best matches each sample in *overall* weight or grey value, not absolute stem weight (squinting slightly as the samples are held next to those in the catalog can help), and note the corresponding number for each sample. These numbers are then assigned to the lightest and heaviest extremes of the weight axis, respectively.

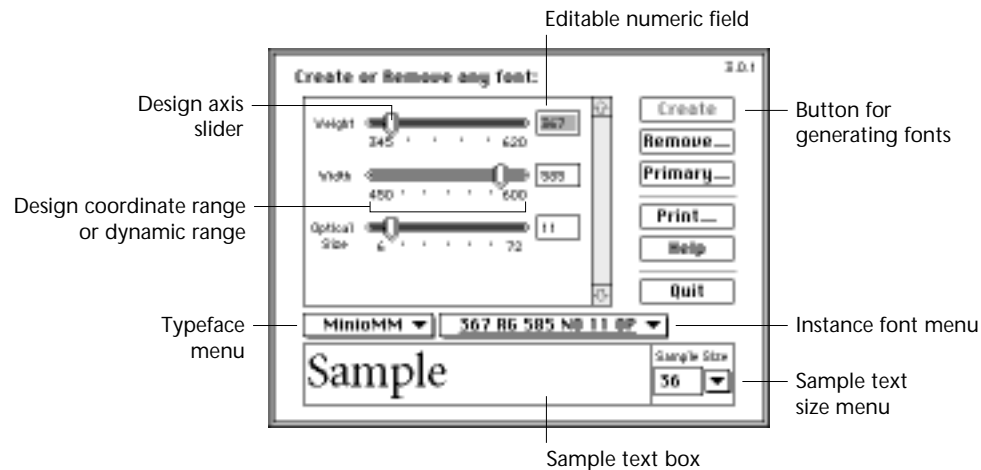
By using the normal width of the lightest and heaviest extremes, the weights of the light condensed and light extended master designs are essentially averaged together, and the weights of the bold condensed and bold extended master designs are averaged together, in order to assign only a single design coordinate value to each extreme of the weight axis.

3. *Assign Width Coordinates* For both the condensed and extended samples (in the regular or book weight), visually determine which of the numbered instances in the "width" section of Adobe's catalog best matches each sample in *overall* width, not character for character width (try to discount letter fit and serif length, which can distort the overall impression of the font's width as the samples are held next to those in the catalog), and note the corresponding number for each sample. These numbers are then assigned to the most condensed and most extended extremes of the width axis, respectively.

By using the regular weight of the condensed and extended extremes, the widths of the light condensed and bold condensed master designs are essentially averaged together, and the widths of the light extended and bold extended master designs are averaged together, in order to assign only a single design coordinate value to each extreme of the width axis.

These final values represent the dynamic range of each design axis in the new multiple master typeface. They will appear, for example, at the ends of the design axis sliders in Adobe's Font Creator utility, which enables users to generate font variations from the multiple master typeface. (Figure 3-5)

Figure 3-5 The Font Creator dialog box contains a slider bar for each design axis in the typeface, allowing the user to select and generate any font instance within the dynamic ranges.



NOTE: Refer to the type design application's user manual to determine how to apply design coordinate values to multiple master design axes.

In previous Adobe documentation, the overall coordinate range for a design axis has been listed as 1–999. Multiple master technology now allows the coordinate ranges to extend from 1–9999 to allow for four-digit design axis values. This is especially useful for extremely extended designs. Viva's Extra Extended designs, for example, have a width value of 1500. This new scale merely adds to the range that was established earlier; it does not change the value of the design coordinates assigned to the first Adobe multiple master typefaces (i.e., a value of 500 is still 500 in the new scale). However, Macintosh font name length restrictions may preclude having more than two axes containing four digit design coordinate values in any typeface. See "Macintosh Typeface Name Restrictions" in Chapter 2.

Assigning Design Coordinate Values to Primary Fonts

Assign final design coordinate values to the primary instances based on the design coordinate ranges determined in the section “Assigning Design Coordinate Ranges to Weight and Width Axes” earlier in this chapter. From running proofs throughout the design space to choose the primary font instances (see “Selecting Primary Fonts” in Chapter 2), the designer knows where along the normalized or temporary ranges of each axis the primary fonts occur. Converting the normalized or temporary primary font values using the following mathematical equation will yield the appropriate final design coordinates for each primary font.

For example, if the “Regular” primary instance was chosen at a position 30% of the way along the weight axis (i.e., a value of 30 along a temporary range of 0-100, or .3 along the normalized range of 0-1 in Cartesian coordinates), and the newly assigned design coordinate range of the weight axis is from 200 (light) to 800 (black), the regular primary font should be assigned a final coordinate value of 380. The equation used to arrive at this value is

$$((30 - 0) \times (800 - 200) / (100 - 0)) + 200 = 380$$

In more generic terms, the equation is

$$((TP - Tmin) \times (DCmax - DCmin) / (Tmax - Tmin)) + DCmin = P$$

where

TP = temporary design coordinate value of primary font

DCmin = minimum (i.e., lightest) value of the final design coordinate range

DCmax = maximum (i.e., heaviest) value of the final design coordinate range

Tmin = minimum value of the temporary range

Tmax = maximum value of the temporary range

P = final design coordinate value of the primary font

Solve this equation for any temporary primary font values to determine final design coordinates for each of the primary fonts in the typeface.



Chapter 4: *Application Support*

With the development of multiple master technology and the first multiple master typefaces, Adobe has created key components for the enhancement of typographic control and expression provided by current type-supporting applications. To complete the picture and ensure that type users have easy access to these powerful enhancements, applications should support multiple master typefaces in an efficient, intuitive, and largely transparent manner.

Some multiple master features are currently being supported or developed in page layout applications. Of those that Adobe anticipates will be implemented, several are of major importance, such as interactive text and headline-fitting capabilities; automatic optical sizing, so that when 10-point is selected as the font size, for example, the application will automatically generate an instance that is optically adjusted for use at 10 points; hyphenation and justification (H&J) algorithms that take advantage of multiple master width axes to achieve better copyfitting; the ability to generate font instances from within page layout applications rather than through a separate utility; the ability to define names for multiple master instances in lieu of or in addition to the alphanumeric names; and efficient management of custom-generated instances in font menus.

Adobe anticipates that independent type designers and type users of all kinds will encourage application developers to fully support multiple master technology. Page layout and other applications that take advantage of the flexibility of multiple master typefaces will provide significantly enhanced tools for graphic designers, desktop publishers, and type users in all industries.

Conclusion

To encourage the design of consistently structured and named multiple master typefaces, we have outlined guidelines for these procedures in Part 1. Also through Part 1, we hope to enrich the understanding of multiple master typeface structure so that powerful and creative software applications can continue to be built to support them. To offer customers more choices which incorporate the flexibility of multiple master technology, more typefaces are currently being developed at Adobe and other design sites. By adhering to the conventions and recommendations described in Part 1, designers can make multiple master typefaces which are easy for customers to use and for application developers to support.





Part 2: *Adobe's Typeface Design Process*

Adobe's Multiple Master Typeface Design Process

Although designers differ in their methods and working style, at Adobe each new typeface typically goes through four basic design stages from concept to completion: research and concept development, keyword exploration, preliminary character set development, and full character set completion. In a multiple master project, while each master design goes through these stages, the multiple master typeface as a whole is continually evaluated. To give designers an approach to the creation of a new multiple master typeface, or to retrofitting an existing typeface family, the four stages we've found useful in our projects are reviewed below.

Outlined in Part 2 are fundamental design considerations and tips for designing multiple master typefaces (many of these apply to standard typeface design as well). At the master design level these include character height relationships, character weights and typeface color, character proportions and typeface width, stroke contrast, companion italics, letter spacing (or letter fit), and kerning. At the multiple master typeface level, design considerations include the typeface's function, choosing appropriate design axis ranges, and evaluation of the interpolated instances. In conclusion, procedures for creating marketable font software from the finished typeface are outlined.

Although many parts of the design process—and almost all of the design considerations—apply to creating typefaces for any medium, multiple master typefaces are inherently digital, so we have focused on procedures for the digital medium. In reading this document, keep in mind that the design process and general guidelines mentioned do not constitute formal rules. Type design is primarily a process of visual judgement, and specific design considerations and methods are likely to differ for each project and designer. We do not attempt to cover every procedure in detail, but to offer basic tips for the first-time multiple master designer that may be useful for the experienced designer as well.



Overview

Both visual and technical aspects of a typeface should progress simultaneously throughout the design process in order to create a successful multiple master typeface.

As Adobe's typefaces proceed through the four design stages described below, specific tasks are completed in the following general order.

1. Design stage 1: concept research; optionally design or work from an original regular font; determine the primary typeface function (for text, display, or both). (Part 2)
2. Design stage 2: beginning with a keyword, determine which design axes will be included in the typeface and appropriate dynamic ranges for each. (Part 2)
3. Model the concept in a geometric design space, and assign normalized coordinates to each master design. (Part 1)
4. Optionally choose a temporary design coordinate range for each axis (0–100 is a common choice). (Part 1)
5. Begin trademark search/application for the typeface name. (Part 2)
6. Select a working regular weight, normal width primary font instance. (Part 1)
7. Design stages 3 and 4: preliminary and full character set completion; finalize the design of the multiple master typeface, including the full character set, spacing, kerning, and auxiliary typeface parameters (hints, etc.) for each master design. (Part 2)
8. Select all final primary font instances to be included in the typeface. (Part 1)
9. Assign a final design coordinate range, based on Adobe's relative numerical scale, to each design axis. (Part 1)
10. Assign final design coordinate values to each primary font based on the ranges determined in #9 above. Assign descriptive labels (and appropriate abbreviations) to each primary font. (Part 1)

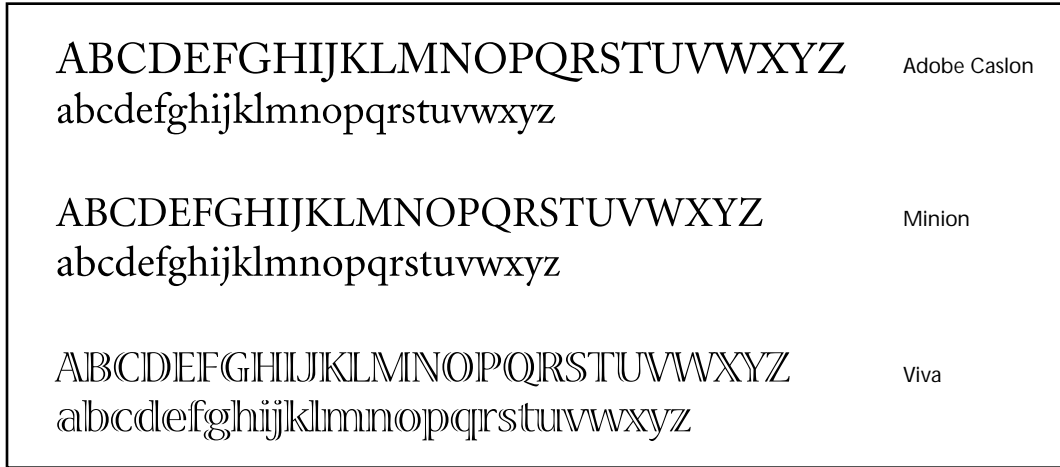
Stage 1: Research and Concept Development

The method for developing an initial design concept differs depending on what sort of typeface the designer has in mind. Some projects may require extensive research and finished drawings, and others may be spontaneous ideas that can be worked out by writing, sketching, or by constructing letterforms directly on a computer screen.



Typeface design projects usually fall into one of three roughly defined, often overlapping categories: a *historical adaptation* (sometimes referred to as a *historical revival*) of an existing typeface or lettering style; an *inspired interpretation* of an existing typeface or lettering style—this category covers a wide spectrum of typefaces, some showing strong influence and others only remote influence from the model letterforms; or a *new design* which is not based on any pre-existing model. The last two categories are sometimes referred to as *original designs* as opposed to *revivals*, but a historical revival is technically original also, provided it incorporates some adaptation of the model letterforms to function in a new medium. A multiple master typeface can be any one of the above sorts, or it might be a *retrofit* of an existing digital typeface family requiring few changes to the original design to allow it to incorporate multiple master capabilities. (Figure 1)

Figure 1 Historical adaptation—*Adobe Caslon™* is an adaptation (or historical revival) of the metal types designed and hand-cut by William Caslon in the 1720s. Extensive research of early specimen pages and books printed with the original types formed the foundation for Adobe’s version designed for digital typesetting. Inspired interpretation—*Minion* is a typeface family inspired by types from the punchcutters of the late Renaissance, such as Jenson, Griffo, and Garamond. It is not modeled on any single source, but is a synthesis of historical and contemporary elements along with broad-edged pen lettering. New design—*Viva* is a multiple master typeface that is not based on any existing models. It is an “inline” design that takes advantage of multiple master technology to add a new twist to the concept of typeface weight: the weight axis doubles as a shadow axis.



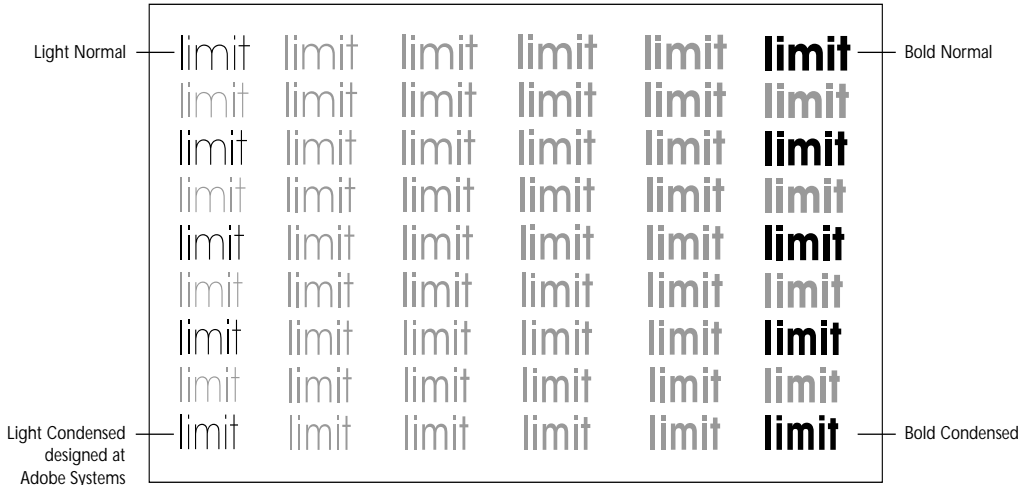
If the design is a historical adaptation, in-depth research is often done to find clear, reliable sources of the original style. Sometimes incomplete samples are the only ones available—bits and pieces from early manuscripts or specimen books—and interpretive design work must be done to invent missing characters. By scrutinizing the source material, careful drawings can be made of the original shapes, keeping in mind the effects of time on the ink and paper of manuscripts, or the effects of letterpress printing such as “ink-squash” on early type specimens. The challenge lies in recreating the spirit and look of the model while adapting it to the requirements of the new digital typesetting medium.



If the design is either an inspired interpretation or completely new, varying levels of research, sketching, and experimentation are necessary to establish the initial design concept, depending on the specifics of the project and the designer’s working style. An inspired interpretation may begin as clean, careful drawings based on a model or as hand-lettering capturing the essence of a particular style. These may be subsequently refined on the drawing board before digitization, and fine-tuned on the computer. A new design may be carefully worked out on paper prior to digitization, or perhaps only rough sketches of a few characters on notebook paper are needed to suggest a concept that the designer can digitize and improvise from directly on the computer screen. Some designers have developed their own models, refining a personal lettering style over many years before adapting it into a typeface. Others have worked more spontaneously from outside sources, inspired by anything from children’s lettering to the jagged look of early digital images.

If the design is a retrofit combining the existing light and heavy weights of a typeface family into a one-axis multiple master typeface, for example, the design process can be fairly straightforward. If the existing family includes condensed versions of both the light and heavy fonts, a second axis for width may be relatively easy to incorporate as well. (Figure 2) Most families, however, do not include condensed or extended versions, or fonts optimized for use at specific point sizes. In these cases, adding a width or optical size axis will usually require creating condensed or extended master designs, or optically adjusted masters based on the existing fonts in the family. This can be a design-intensive task. For more information on retrofitting typefaces for use with multiple master technology, please see “Determining Design Axes and Their Dynamic Ranges” in Chapter 2 of *Part 1: Technical Guidelines for Designing Multiple Master Typefaces*.

Figure 2 *The ITC Avant Garde™ family was retrofitted for use with multiple master technology. The Light Normal, Bold Normal, and Bold Condensed master designs were created from the fonts in the existing family, and the Light Condensed master was designed at Adobe to complete the design space.*



ITC Avant GardeMM; primary fonts highlighted in black



Whichever category the typeface project fits into, once the concept is on paper or clearly in mind, the designer scans or digitizes the drawings into the computer to begin working directly on the screen; working in the digital medium from the outset gives the designer immediate feedback in the same environment in which the final typeface will be used. Starting with a handful of letters is a good way to test out early concepts to see if the design has potential.

Stage 2: Keyword Exploration

The keyword used most often at Adobe is *hamburgevons*. This set of letters is useful because all the major stroke types are represented—straight, round, diagonal, and s-curve—and it includes some of the most distinctive letters in the alphabet (*R, B, G, a, e, g, s*). Developing capital and lowercase keyword letters for each master design and setting them in rudimentary texts gives an early impression of how the designs will look. A majority of the design decisions for the multiple master typeface can be made by initial concentration on the twelve letters of this keyword in capitals and lowercase, and it is easier to make global changes to each master design when the character set is relatively small. (Figure 3)

Figure 3 *A useful upper- and lowercase “keyword” with which to establish a workable typeface concept*



The keyword stage is the primary exploration and development period. The first master design keywords will not be without problems; in fact, it is common to go through many rounds of experimentation. Sometimes a new design will change quite a bit in underlying structure during this stage, while often (as in retrofit projects) it is a matter of fine-tuning the “flesh” on already sound “skeletons.” The principal concern at the keyword stage is developing letterforms that are harmonious in weight, proportion, and spacing. There should be a unified visual concept throughout the master designs, and element compatibility so that they interpolate well. Once the shape and basic letter spacing of the keyword characters are resolved, the design of the remaining characters for each master should build upon the discoveries and decisions made at this stage.



Proofing the Master Designs

To evaluate the design at the keyword stage (and beyond), proof each master design by setting the keyword letters in text samples at various appropriate point sizes (smaller sizes for text designs and larger sizes for display designs). Also set a complete showing of the characters at a relatively large size (such as 48-point) to check for unwanted bumps and design “glitches.” Proof the letter spacing by setting control character chains (see “Letter Spacing” below) as well as reviewing the spacing in blocks of text. Look for problems with the shapes of individual characters. Observe how each character’s shape, weight, and width relates to other characters in the same master as well as to characters in the other master designs, and how the characters look at different point sizes. Check proofs at as many different output resolutions as possible; 300 and 1200 dpi (dots per inch) are essential; they represent common laser printer and typesetter resolutions, respectively. When proofing the master designs for an optical size axis where differences may be very subtle, be sure to review high resolution samples set at the point sizes for which each master design is optimized (i.e., proof the 6-point master design at 6 points, the 72-point master at 72 points). For specific design issues to consider when looking at the proofs, see the “Design Considerations” sections below. Some useful sample proofs are shown in Appendix F.

Proofing the Multiple Master Typeface

In critiquing a multiple master typeface, the criteria should be how well the integrity of the original design concept is maintained throughout the entire design space. That concept may be embodied in a manuscript model for a historical adaptation, an original “regular” drawing for a new design, or in the members of an existing typeface family that is being retrofitted.

Begin testing the design as a multiple master typeface during the keyword stage to evaluate global issues of proportion, spacing, and weight in the interpolated instances. Proof instances throughout the design space at various point sizes. It is helpful to proof instances that are positioned incrementally within the design space as well as instances that represent current best guesses for the primary fonts (i.e., always proof the instance you think will eventually be designated the *regular* weight, *normal* width font). With experience it becomes easier to determine which master design (or designs) may be causing specific interpolation or design problems by examining these incremental proofs and noting where (i.e., closest to which master) the problems begin to appear. Run similar tests on the interpolated instances as those recommended for the individual master designs (text blocks, spacing chains, and large characters), and check proofs at as many different output resolutions as possible. For specific design issues to consider when looking at the proofs, see the “Design Considerations” sections below.

When testing instances along an optical size axis, make sure to proof each instance at the point size it is optimized for (i.e. proof the 12-point instance at 12 points, the 18-point instance at 18 points). This may require some figuring; for example, if the dynamic range runs from 6 to 18 points, the 12-point instance will occur 50% of the way along the axis using simple linear interpolation. For information on applying non-linear interpolation to an optical size axis, see “Fine-Tuning the Optical Size Axis” in Chapter 2 of *Part I: Technical Guidelines for Designing Multiple Master Typefaces*.



Evaluation and Changes to the Keywords

After the designs are proofed and evaluated, the consequences of any proposed change must be considered. For example, if a subtle shape adjustment seems necessary in one character of one master design, the rest of the characters must be considered in light of the change. How the changed character looks in context with other characters of the same master design (in shape, proportion, and weight), whether or not this change requires a change in corresponding characters in the other master designs, and how the changed character interpolates must all be considered and addressed. After any change is made, the proofs discussed in the previous section must be rerun.

Every design requires careful attention to detail to be successful. Sometimes the solutions to problems are clear, but sometimes repeated experimentation and evaluation are required to solve them.

Stages 3 and 4: Preliminary and Full Character Sets

These two stages are mainly for applying the decisions made during the keyword stage, first to the preliminary characters, and then to the full character set for each master design. (Figure 4) The preliminary character set stage is the time to work out the shapes and basic letter fit of the remaining capitals, lowercase characters, and figures, many of which can be based directly on the keyword characters of each master design. In the full character set stage, the balance of the extra characters are designed and all the character shapes and their spacing are fine-tuned. (See *Letter Spacing* below for details.) At the end of the full character set stage, once the basic letter fit and character shapes have been finalized, the kerning pairs can be edited for each master design (see Appendix E for Adobe’s list of basic kerning pairs).

Figure 4 Preliminary character subset (black) and full ISOAdobe character set (black and gray)





Sometimes during the preliminary character set stage, problems with individual character shapes or in a master design's overall weight or width will become apparent that were not noticeable in the keyword stage. Or, while evaluating a master design's kerning pairs, basic letter fit problems may become apparent that must be addressed before the kerning can be completed. Flexibility is required at all stages so when unforeseen trouble arises, the designer can backtrack and fix the problems, possibly in more than one master design, rather than build upon errors irrevocably. Repeated proofing, evaluation, and adjustment is essential to finalizing each master design and the multiple master typeface as a whole.

Finalizing the Multiple Master Typeface

After the four stages of the design process are complete, the designer selects the final set of primary fonts to be included in the multiple master typeface package, and assigns the final design coordinate values (the dynamic range) for each axis and primary font in the typeface. For more information on selecting primary fonts and determining design coordinate values, see Chapters 2 and 3 of *Part 1: Technical Guidelines for Designing Multiple Master Typefaces*.

The Typeface Name / Trademark and Copyright

Naming a typeface can be difficult, so the earlier this aspect of the design is tackled, the better. It is best to have more than one name in mind in case the first choice has been used previously or is a current registered trademark. Look through as many typeface specimen books as possible for names already in use. Contact the International Center for Font Technology at the Rochester Institute of Technology where a list of current typeface names is being compiled. For information call 716-475-2052.

Registering the typeface name as a trademark protects the product name. The procedures underlying the trademark registration process can become time consuming and expensive, and if the trademark registration is pursued, consultation with an attorney is recommended.

Copyright protection for typeface designs in the international arena varies depending upon the country from which registration is sought. Some countries extend copyright protection to typeface designs while others do not. Consultation with an attorney specializing in copyright law is recommended prior to initiating the registration process in a non-U.S. country.

In 1992 the U.S. Copyright Office held that digital type manufacturers may copyright an original software program that generates a font, as opposed to the typeface outlines themselves (i.e. the shapes of the letters — which are not currently covered by U.S. copyright). Although neither the U.S. trademark nor copyright option offers complete protection for a new typeface, the designer may choose to pursue one or both. References to more information on typeface protection can be found in Appendix D.

NOTE: For technical information regarding multiple master typeface name restrictions, see “Macintosh Typeface Name Restrictions” in Chapter 2 of *Part 1: Technical Guidelines for Designing Multiple Master Typefaces*.

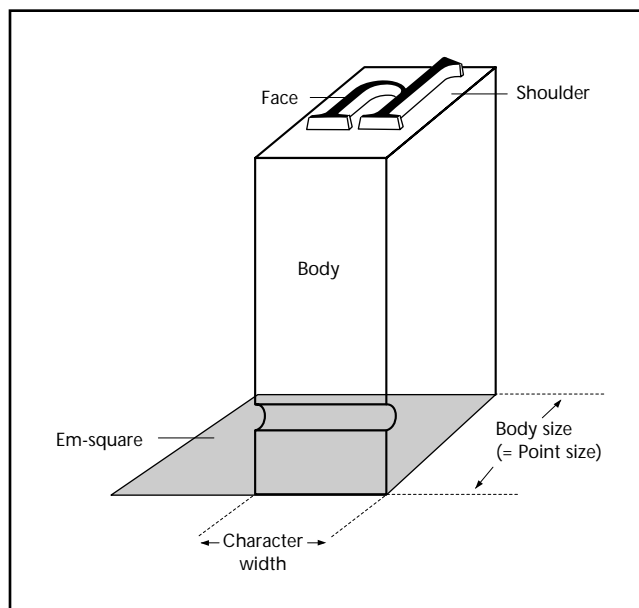
Design Considerations at the Master Design Level

Many of the following basic considerations are more applicable to designs intended for text use than display use. There is more leeway to bend rules of thumb when designing display type. The tips below are fundamental guidelines only; historical issues and stylistic choices may influence how closely the designer adheres to them. Experienced designers are no doubt already familiar with these concepts.

Character Heights

Apparent Size Versus Point Size There are no absolute standards for the capital, lowercase (x-height), ascender, descender, and other character heights in a typeface. This is why two typefaces set at the same point size may have very different apparent sizes. In digital type, all the letters rest on a consistently aligned baseline within an invisible *body*. The body concept is inherited from metal type where the face of each character is cast on a rectangular bar, or body, of metal—the body is a consistent height throughout the typeface. (Figure 5) Point size refers only to the height, in points, of the body of the typeface—it does not reflect the apparent size of the characters within that body. For example, a typeface with a small x-height (in relation to its capital height) will appear smaller at a given point size than a typeface with a large x-height. With the exception of typefaces that incorporate optically sized designs, different point sizes of digital type are created by mathematically scaling the body size of a single master design. (Figure 6)

Figure 5 A diagram of a piece of metal type; the face sits on the body. The term em-square, inherited from metal type, refers to the square of the body size; 12 by 12 points in a 12 point font. Adobe's typefaces are designed on a master body size of 1000 by 1000 units to the em-square.





Although digital type is not dependent on solid metal bodies, a new typeface should be a comfortable size within its invisible body measure. For example, in most cases the type should not be so small that a 10-point setting looks like most other types at 7-point, or so large that the ascenders and descenders stick out of the invisible body measure and tangle or overlap when lines of type are set solid (without extra leading or line spacing).

Figure 6 Characters of a digital typeface generally fit within invisible guidelines on an overall body size somewhat taller than the extruders (ascenders and descenders).



X-height The x-height should be appropriate for the design. Designs in the “Oldstyle” or “Classical” category generally have shorter x-heights than “Modern” designs. Display typefaces (or master designs optimized for use at large sizes in a typeface with an optical size axis) usually have smaller x-heights and tighter letter spacing than designs intended solely for text setting. As a character gets bolder, the white space in the inner counters and bowls becomes smaller, creating the illusion of a shorter x-height. To compensate for this, the x-height often needs to be slightly taller in the bolder designs than in the lighter designs of a typeface in order for them to appear the same height. For the same reason, condensed designs may need to have a slightly taller x-height than extended designs.

Capital Height Although sometimes stylistically or historically determined, the cap height to x-height relationship in text designs should be comfortable for extended reading. The capitals should not be so small that they are hidden in text, or so large that they are obtrusive—test this relationship by setting text in a language which uses lots of capitals; German, for example. Titling capitals (capital-only typefaces) may use more of the total body size because there are no ascenders and descenders to take up space between lines; however, enough space should be allowed within the body measure to accommodate accented capitals.

Ascender / Descender Length The ascender height and descender length should look appropriate for the overall design and be balanced with each other in a text design. They should not be so long that they are distracting or obtrusive, or so short that they look skimpy and seem to disappear, making the text less legible. The ascenders and descenders may need to be slightly longer in extended designs and slightly shorter in condensed designs to appear the same length throughout the width range.



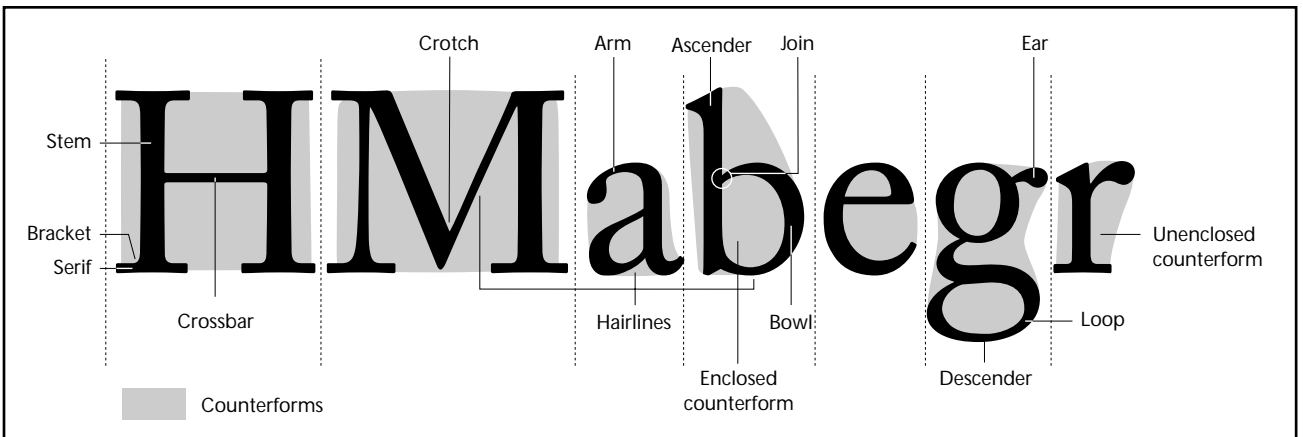
Figure Height The lining figures should look comfortable in combination with both the lowercase and capital letters of a typeface. Lining figures are usually somewhat shorter than the capitals and a little narrower so they don't overpower the lowercase. Oldstyle (or lowercase) figures have approximately the same x-height as the lowercase letters so they are unobtrusive when set within lowercase text. The 0, 1, and 2 are x-height tall or slightly taller, the 3, 4, 5, 7, and 9 traditionally have descenders, while the 6 and 8 ascend somewhat, but usually not to the full ascender height. 1234567890 (Lining); 1234567890 (Oldstyle).

Small Capitals Small capitals are designed to coordinate with the lowercase letters, and are usually slightly taller than the x-height. They are also similar to the weight of the lowercase characters, and have slightly wider proportions than the normal capitals. Algorithmically scaled capitals often appear too light and narrow to function well as small capitals.

Individual Character Weights and Overall Typeface Color

There should be a balance of weight within the individual characters of each master design. Although perfectly even color may be appropriate for some designs and not others, generally there should be a consistent color (or grey value) on the page when each master design is set in text (or in short phrases for a display design); there should be no dark spots in stems, joins, or crotches, or light areas in bowls or hairlines that call attention to themselves and distract the reader. (Figure 7)

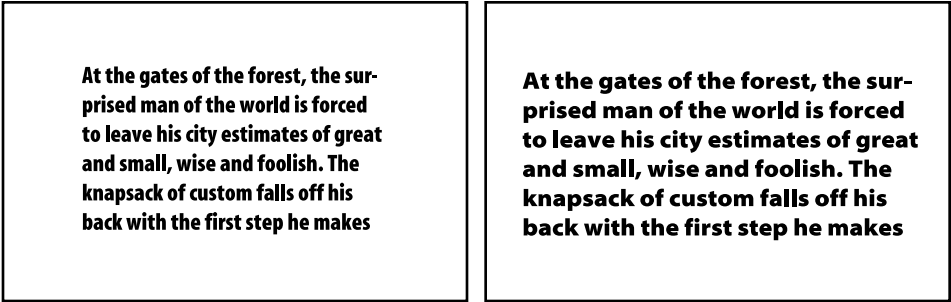
Figure 7 Some major letterform parts. The coincident sidebearings (dotted lines) establish the white space on both sides of each letter and determine how one letter fits in combination with others (i.e., letter spacing).





Particularly in a text family, the overall weight of corresponding master designs should harmonize. For example, the light condensed master ought to be similar in color to the light extended master, and the bold condensed master should be similar in color to the bold extended master. (Figure 8)

Figure 8 *Myriad Black Condensed and Myriad Black Semi Extended at 9 points. Both have a similar apparent color or weight, independent of width.*

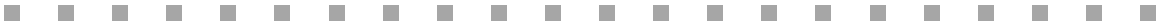


Individual Character Proportions and Overall Typeface Width

The character proportions should be appropriate for each master design. A classically inspired design often uses classical letter proportions, while a modern or sans serif design may have letter proportions of more equal width. (Figure 9)

Figure 9 *The top line of characters is from a classically proportioned design—containing a combination of wider and narrower letters. The bottom line of characters, from a sans serif design, has letters of more equal width.*





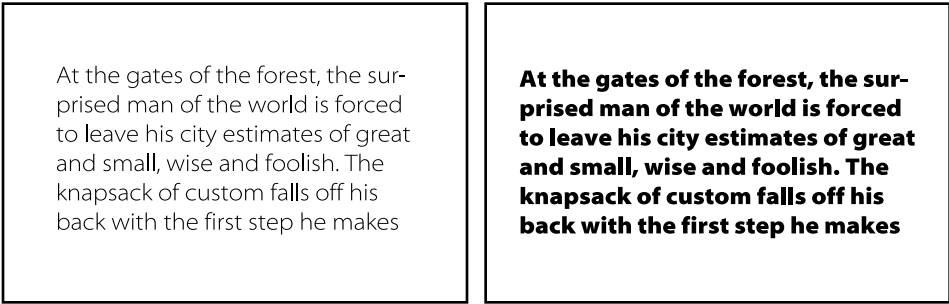
The overall widths of condensed or extended master designs should be comfortable. The condensed masters should look condensed but not compressed to the point of distortion, and the extended masters should look extended but not stretched to the point of distortion. The idea behind designing condensed and extended master designs is to provide font variations that are an improvement over those that can be produced by artificially compressing and stretching an existing typeface. (Figure 10)

Figure 10 *Three width variations of Viva, showing its wide dynamic range without the distortion to shapes and stroke weights common in artificially compressed or stretched fonts*



Particularly in a text family, the overall width of corresponding master designs ought to harmonize. For example, the light condensed master should be similar in visual (apparent, not absolute) width to the bold condensed master, and the light extended master should be similar in visual width to the bold extended master. (Figure 11)

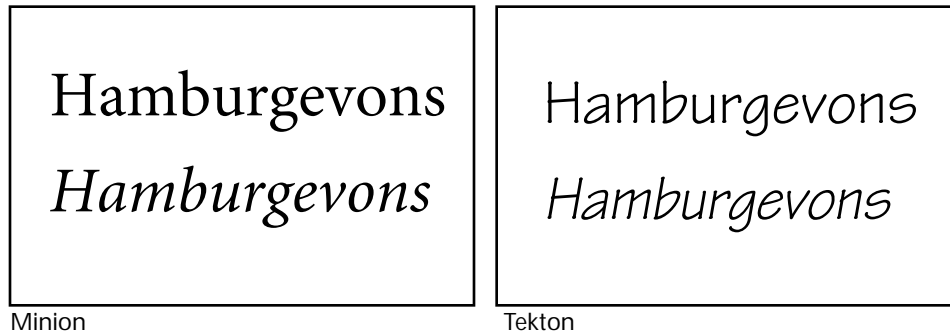
Figure 11 *Myriad Light Semi Extended and Myriad Black Semi Extended at 9 points. Both have a similar apparent width independent of weight.*



Companion Italic Designs

A *true italic* typeface that is designed to compliment a roman design ought to harmonize with its companion while incorporating some distinctly different shapes, often reminiscent of formal chancery script or other handwritten models. To be distinguishable from the roman and function as emphasis in text, a true italic design traditionally is somewhat narrower and lighter, and at a distinct angle, generally between 8 and 15 degrees from vertical. (Figure 13) An *oblique* design, which is a slanted version of the roman letterforms, designed by hand or generated mechanically, may need to have a more pronounced angle to be distinct from the roman design when set in text.

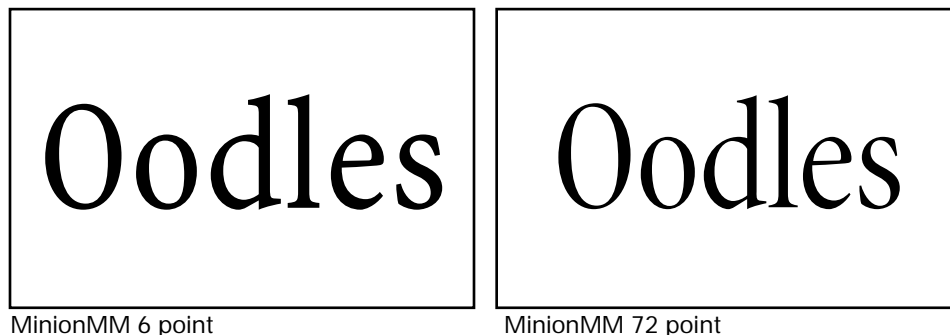
Figure 13 A true italic design, as in *Minion*, versus an oblique design, as in *Tekton*



Letter Spacing

Text Versus Display Text typefaces are usually designed with a comparatively straightforward, clear appearance so they read well when set at smaller sizes, commonly ranging from 6 to about 18 points. Text type usually requires more open letter spacing than display typefaces for the letters to be clearly distinguishable from one another at small sizes. Display typefaces are meant to be used at larger sizes, from about 18 points and up, and are often more delicate, detailed, emphatic, or ornate than text faces. They usually require somewhat tighter letter spacing than text sizes so words appear as whole units and can be read more easily at larger sizes. However, spacing so tight that letters touch or overlap is best reserved for display headlines and logotypes. Often text and display types require slightly different spacing relationships (i.e., merely globally tracking a single design by various amounts for use at a wide range of point sizes may not result in the best letter spacing). (Figure 14)

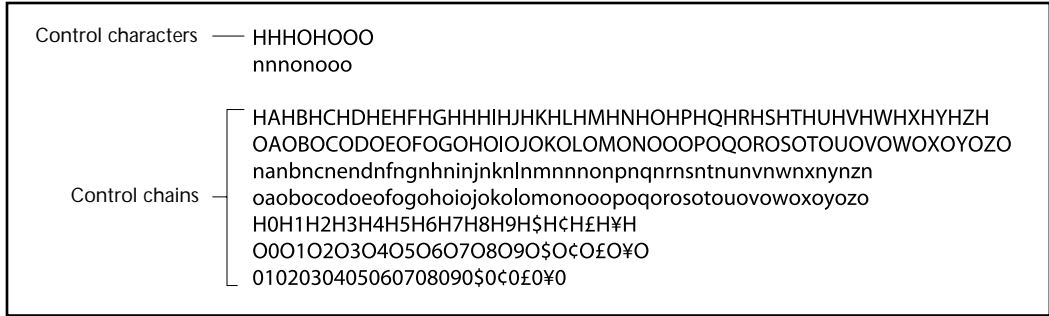
Figure 14 In this example, the round-to-round relationships change more between *MinionMM*'s text and display designs than do the straight-to-straight relationships.





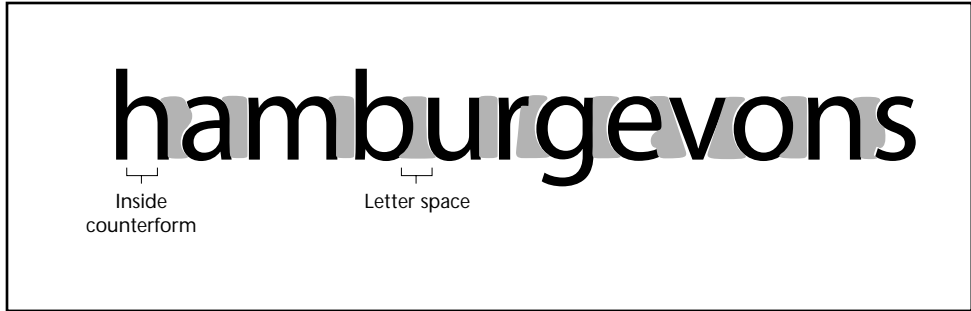
Control Chains To work out the basic letter fit of a type design, begin with lowercase *n*, *o* and capital *H*, *O* combinations to first determine comfortable spacing relationships between the straight-to-straight, straight-to-round, and round-to-round elements in the typeface. Then apply the values from these relationships to the rest of the characters (some values can be transferred directly to similar shaped characters, others require an educated guess), and position each letter between the control characters (*n*, *o*, *H*, *O*) to form control chains. Adjust the sidebearings of each letter (the amount of white space on either side of the letter) so that there is an even texture in the chains and in sample text settings. (Figure 15)

Figure 15 An example of common control chains



Lowercase Although personal tastes differ, generally lowercase letters are spaced so that there is approximately the same apparent volume (or a bit less) of white space between each letter as there is within the counterforms. Thus bolder, more condensed designs require slightly tighter letter spacing than lighter, more extended designs to maintain this balance of inner white space to surrounding white space. The lowercase letters of a text typeface should create a smooth texture when set in a page of text without light, loose areas or dark, tight tangles. (Figure 16)

Figure 16 In the *Myriad* text typeface, the volume of white space between lowercase letters is slightly less than the volume inside the counterforms





Capitals The capitals, most often used to begin sentences, are generally spaced to set comfortably next to each of the lowercase characters; not too tight and not too loose. (Figure 17) For this reason, most all-capital settings are too tight without adjustment, and require hand tuning of the letter fit to achieve balanced volumes of white space inside and between the letters. Capital-only typefaces are often full of problem characters. Letters with diagonal strokes are the most notorious and often require hand tuning even when spaced loosely. Some typefaces correct the capital-to-capital relationships for the user by incorporating extensive kerning pair tables. (Figure 18)

Figure 17 The first example shows Myriad Regular Normal capitals spaced too tightly compared to the default spacing of the lowercase letters, the second example shows the capitals spaced too loosely, and the third example shows a more balanced relationship.

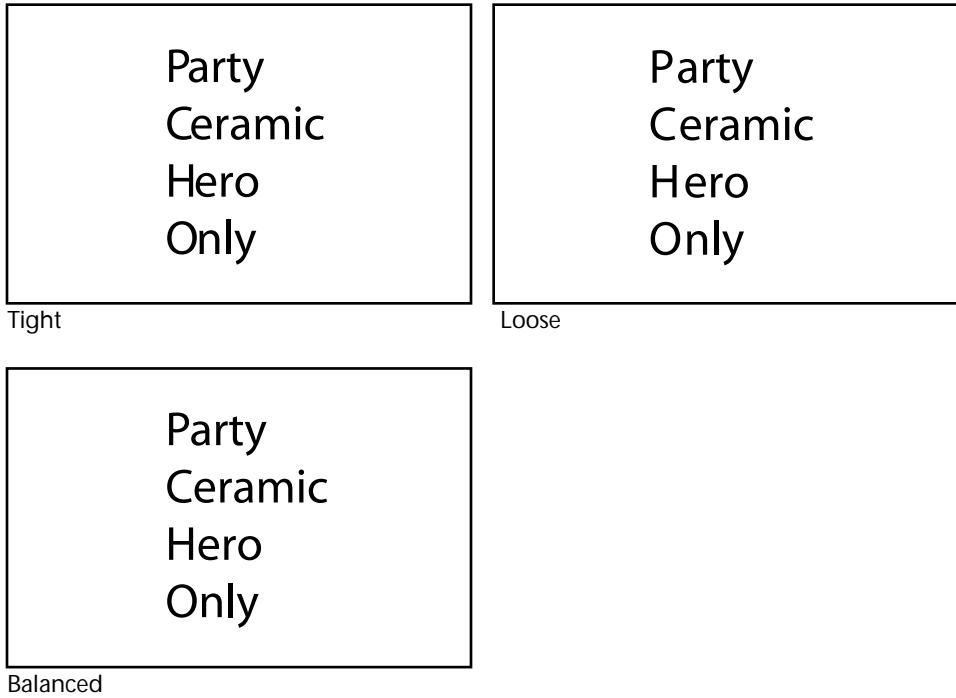


Figure 18 The top line shows Trajan™ without manual letter spacing; the marks indicate the congruent sidebearings of the letters. In the bottom line, the marks indicate the amount by which letter pairs have been manually kerned (in this case negatively kerned, or shifted so their sidebearings overlap), creating tighter, more balanced letter spacing for this title.

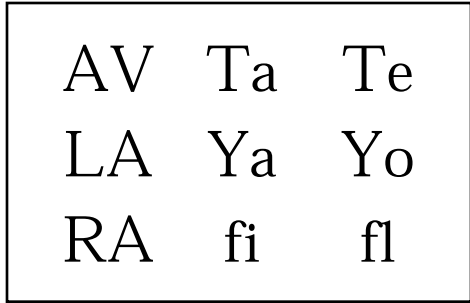




Problem Characters Diagonal or oddly shaped letters often defy all efforts to achieve balanced spacing by adjustment within control chains alone. First, these letters should be adjusted as carefully as possible within the control chains and by evaluating the letters in combination with others in text. Then, extremely obstinate pairs should be put into a list for individual kerning adjustment after the basic letter spacing has been finalized.

Kerning Pairs “Problem pairs” can differ from one typeface to another, but there are some letter pairs that seem to cause spacing trouble in most typefaces. (Figure 19) A list of Adobe’s basic kerning pairs is shown in Appendix E. This basic set is a useful one to start from when adding pairs to a multiple master typeface. Comprehensive text families may incorporate many more; for example, some Adobe Originals designs contain up to 1200 pairs. Each kerning pair in each master design must be proofed, evaluated, and adjusted to achieve the proper fit in all interpolated instances.

Figure 19 *An example of a few common “problem pairs”*

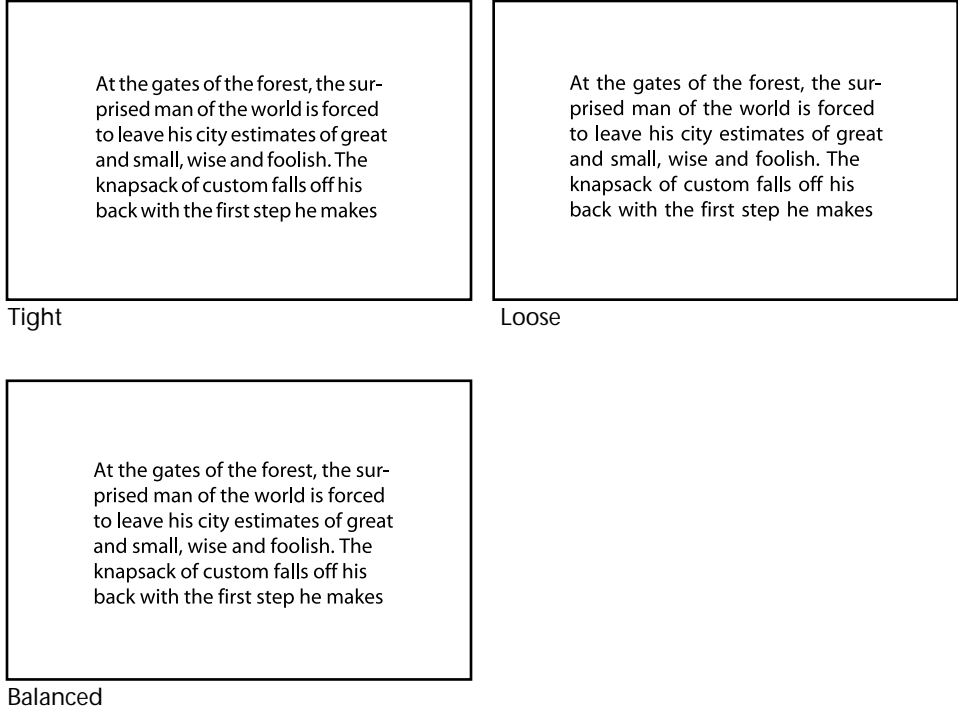


Word Space The word space should look correct throughout the range of sizes the design is intended for. It should not be so small that the words run together, or so large that it creates gaps and rivers in the text. A common rule of thumb recommends that, for a text typeface, the word space be approximately the width of a lowercase *i*. (Figure 20) In bold or condensed designs, where the overall letter fit is somewhat tighter than in related light or extended designs, the word space must also be somewhat smaller.

NOTE: *The default word space is generally designed with unjustified text in mind. When text is justified, the word space is often made somewhat wider or narrower on a line-by-line basis by the page layout application.*



Figure 20 Three settings of Myriad Regular Normal at 9/11 points. In the first example the word space is too small, in the second the word space is too large, and in the third the word space is a comfortable width for the default lowercase letter spacing.



Design Considerations at the Multiple Master Typeface Level

Typeface Function

As the concept of the design is first being developed, the primary function of the typeface must be determined; whether it is for text setting, display setting, or both. If the design is intended for text use, concentrate on making the typeface legible at sizes between about 6 and 18 points, with the major focus on the normal text sizes of 9 to 12 points. If the design is intended for display setting, concentrate on making the sizes between about 18 and 72 points look best, with a focus on the common display sizes of 24 to 48 points. If the design is intended to cover both functions, it must work well from 6 to 72 points.

If the typeface includes an optical size axis, determine the size range the master designs will cover, based on the above guidelines, and create a master design that works well at each extreme of the size range. For more information about optical size axes, see “Designing Optically Adjusted Master Designs” and “Fine-Tuning the Optical Size Axis” in Chapter 2 of *Part 1: Technical Guidelines for Designing Multiple Master Typefaces*.

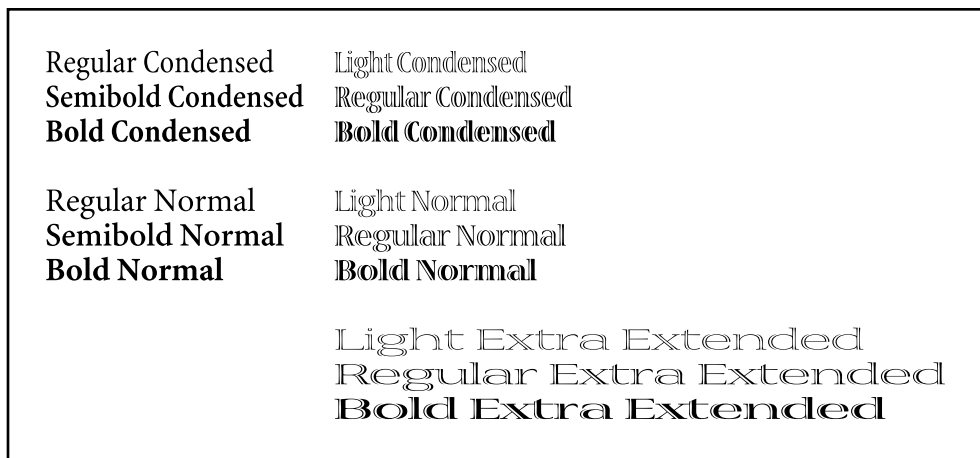
Master Design Compatibility

The master design outlines should be compatibilized for optimum interpolation results. For detailed information on compatibilization, see “Master Design Compatibility for Interpolation” and “Point Placement for Interpolation” in Chapter 2 of *Part 1: Technical Guidelines for Designing Multiple Master Typefaces*.

Design Axis Ranges

The weight, width, optical size, and any other ranges of variation should be appropriate for the design. What is appropriate will depend on the aesthetic characteristics and primary function of the design, that is, for text or display setting. Text typefaces may be best suited to relatively short dynamic ranges (i.e., from light to bold or condensed to normal) while display designs may call for wider ranges (i.e., from extra light to black or extra condensed to extra extended). (Figure 21) For more information on determining axis ranges, see “Determining Design Axes and Their Dynamic Ranges” in Chapter 2 of *Part 1: Technical Guidelines for Designing Multiple Master Typefaces*.

Figure 21 *Exuberant display type often calls for more widely varying weights and widths than a more classical design for use in lengthy text settings, as seen here with MinionMM (left) compared to Viva (right)*

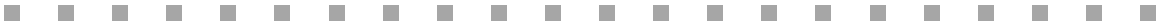


Interpolated Instances and Primary Fonts

The integrity of the typeface design should be maintained throughout the entire multiple master design space. All interpolated instances should be free from unintentional shape and weight idiosyncrasies. (Figure 22)

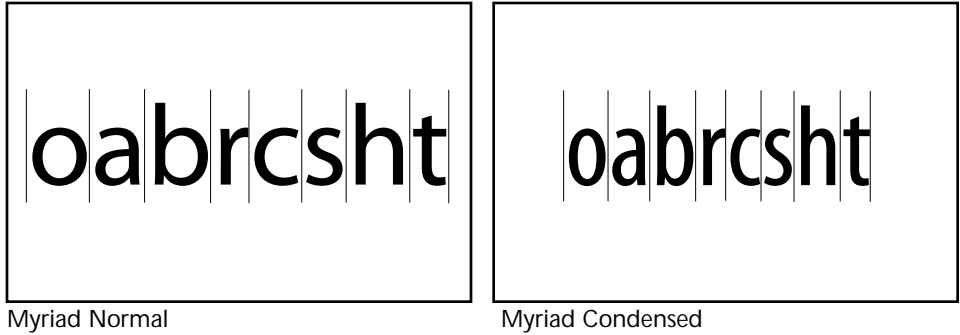
Figure 22 *An example of unintentional “kinks,” or interpolation side effects, in early Viva characters*





The proportions of the intermediate instances should look balanced; and may be more mono-width in the condensed designs than in the normal or extended designs (especially in a classically proportioned typeface). (Figure 23)

Figure 23 *In the condensed version of a more classically proportioned text typeface, characters may need to be condensed by different amounts so they become similar in width to create a more even texture, as seen in Myriad Condensed compared to Myriad Normal.*



The weights of the selected primary fonts should be useful as stand-alone members of a typeface family, or comprise a representative sampling of the possible variations from the multiple master typeface. In a text design, the regular weight primary font should not be too light or too heavy for comfortable reading in long texts, and the semibold primary font should be different enough from the regular weight font to function as emphasis in text.

The widths of the selected primary fonts should be useful as members of a typeface family as well. In a text design, the condensed width should be sufficiently condensed but still function as a readable face at smaller sizes; the extended width should be sufficiently extended to be clearly distinguishable from the normal width design while functioning as a clear, readable font.

Typeface Production

After the typeface design itself is complete, subsequent production tasks must occur to produce a marketable typeface package. Although this very important work is beyond the scope of this document, a brief list of necessary production tasks includes fine-tuning the character shapes and letter fit in conjunction with applying hints for improved low resolution printing, producing floppy disks with the appropriate resource files and font identification numbers, and testing the typeface in real world software applications for quality assurance. Attractive packaging and informative collateral material are also critical parts of getting a typeface product ready for the market.



Conclusion

As with all high quality type design, multiple master typeface design can be a time intensive task, and is primarily a process of visual judgement. To give designers an approach to the creation of new or retrofitted multiple master typefaces, the four-stage design process we have found useful in our projects has been reviewed in this document. With this outline of basic design considerations and tips at both the master design and the multiple master typeface levels, Adobe encourages type designers to explore both traditional and innovative multiple master design projects.

Appendix A: *Type 1 Point Placement Basics*

The following basic tips apply when designing multiple master typefaces, as well as standard Type 1 fonts. It is helpful to position key points correctly along the outlines as you digitize the character shapes. This way compatibility between master designs begins at the outset of the design process, requiring less editing (or compatibilizing) when it is time to build a multiple master typeface from the individual master designs.

Typeface Guidelines

Set up the following horizontal guidelines to assist in drawing and editing the characters: baseline, x-height (lowercase height) line, capital height line, ascender height line, descender depth line, figure height line (if different from the capital height), and overshoot lines for each of these. Round and pointed characters in a typeface often need to overshoot the flat character heights by an amount such that all flat, pointed, and round characters appear to be the same height, and appear to sit solidly on the baseline. The amount of overshoot required for capital letters and figures may be slightly larger than for lowercase letters. Likewise, pointed elements (*v*, *w*) often require more overshoot than round letters (*o*, *e*). (Figure A-1)

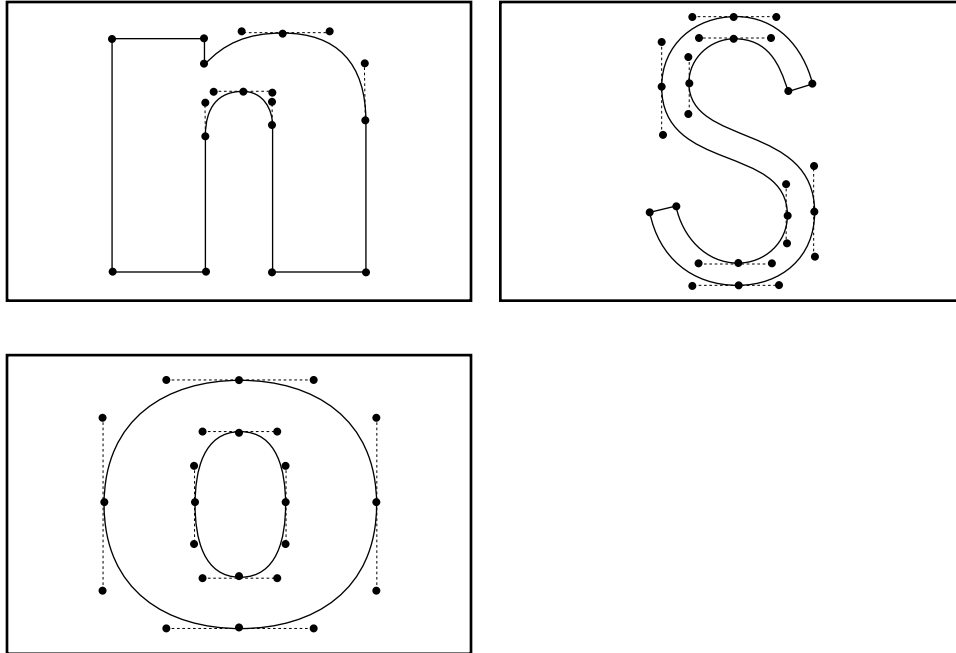
Figure A-1 Shown here are common guidelines for aligning characters of a typeface during the design process.



Points at Extremes

To help PostScript language hints function properly for accurate rasterization and printing at lower resolutions, position an end point at the horizontal or vertical extreme of each major curved element in an outline character. Make sure that the tangent line through each of these end points, defined by its associated control points, is absolutely vertical or horizontal (whichever is appropriate). (Figure A-2)

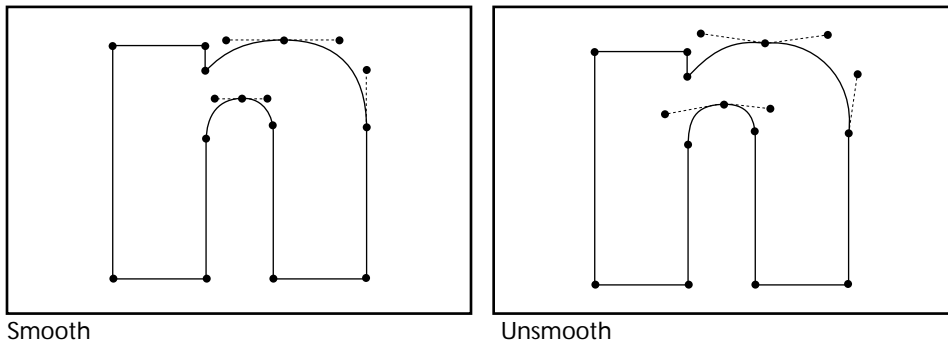
Figure A-2 *Examples of major curved character elements with end points placed at the horizontal and vertical extremes*



Smooth Transitions

Make sure all transitions that should appear smooth (i.e., from one curve into another, or from a straight line into a curve) are defined by straight, unbroken tangent lines at each transition (i.e., the end points and their associated control points are colinear). (Figure A-3)

Figure A-3 *Unless a corner or kink is desired in the outline, make smooth transitions between path elements.*

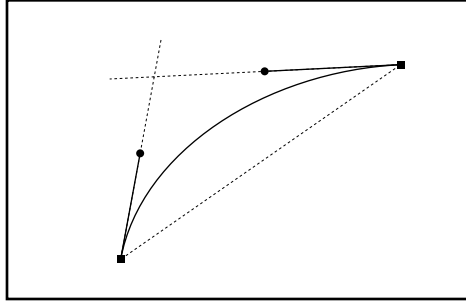




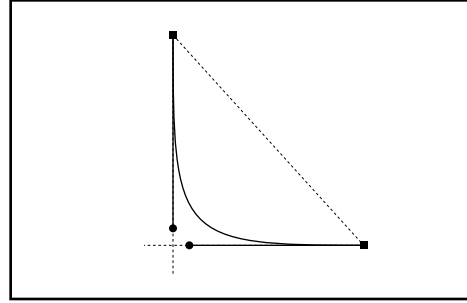
Triangle Guideline

As a rule of thumb, the control points of a curve segment should fall inside an imaginary triangle formed by the two end points and the lines that connect each end point to its associated control point, extended to their intersection. (Figure A-4)

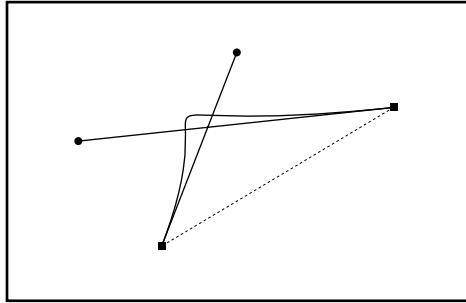
Figure A-4 Control points should fall inside an imaginary triangle.



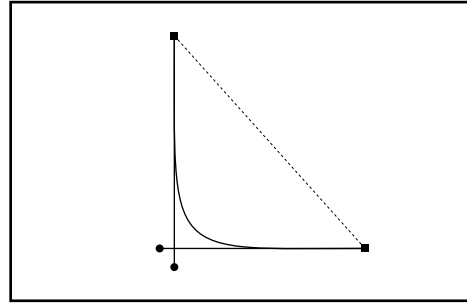
Correct



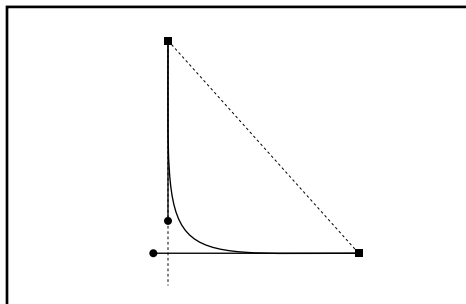
Correct



Incorrect



Incorrect

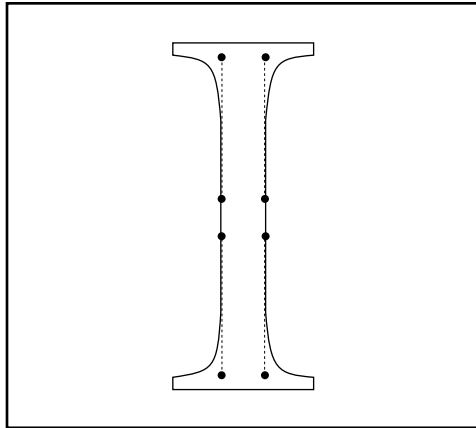


Incorrect

Vertical Stems

Using a single end point to define the center of a swelling stem may result in proper rasterization. However, to ensure that stems are hinted properly for consistent low resolution printing, it may be beneficial to put a straight line segment (even if it's very small) rather than a single end point on major flaring vertical stem elements. (Figure A-5)

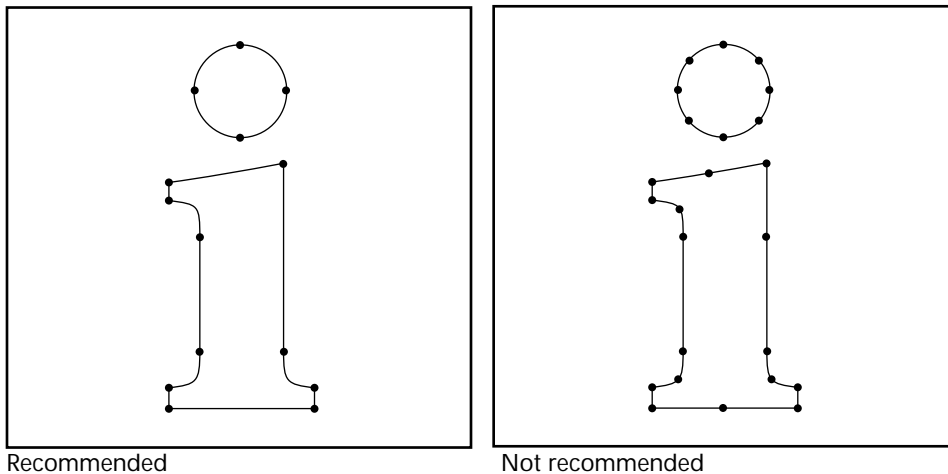
Figure A-5 *A small vertical line segment on a swelling stem*




Economy of Points

Use the smallest number of points that successfully describes the shape of a character. Don't compromise the letter shape by skimping on points, but keep in mind that extraneous points can make the outline lumpier (which may be desirable in some cases), be more time consuming to edit on screen, make the file size of the typeface larger, and increase the potential for interpolation side effects. One approach is to attempt to make the shape work first by using a minimum number of end points and adjusting the control point positions before resorting to adding more points. Another approach when working from complex digital data or from automatically scanned drawings or lettering is to delete points in strategic places to simplify the outlines while maintaining the desired shapes. (Figure A-6)

Figure A-6 *Fewer elements can improve the performance of a multiple master typeface.*





Appendix B: *Glossary*

copyfitting

The practice of making text or “copy” fit a given space or measure.

design axis

The one-dimensional range of possible font variations delineated by at least two master designs, one at each extreme.

design coordinate

1) The final numerical value assigned to the extreme of each design axis, representing the dynamic range; 2) a numerical value within the dynamic range identifying the position of a specific instance along the design axis. Design coordinates fall within a total range of 1–9999.

design space

The conceptual one-, two-, three-, or four-dimensional space in which variations of a multiple master typeface exist.

dynamic range

How much a multiple master font can vary along a given design axis. For example, if a design axis for weight is delineated by extra light and extra black master designs, the dynamic range of that axis will be from extra light to extra black. The dynamic range of a design axis can be expressed in design coordinate values as well, as seen on the “sliders” in Adobe’s Font Creator utility.

font

See *multiple master font*.

Font Creator

Adobe’s utility for generating (interpolating) custom instances from a multiple master typeface.

interpolation

A mathematical calculation that generates intermediate values between two extremes.

multiple master font, font, instance

A scalable Type 1 font program; a single style variation generated from a multiple master typeface. See “Definition of Terms” in Chapter 1.



multiple master typeface

A PostScript Type 1 font program from which a user can generate instances on demand that may vary in weight, width, optical size, or other style characteristics. See “Definition of Terms” in Chapter 1.

normalized coordinate

The Cartesian coordinate assigned to a master design arranged within a conceptual one- to four-dimensional design space.

PostScript Language

A device independent programming language developed by Adobe Systems to describe the position of text and graphic elements in electronic documents that can be viewed or printed on various output devices.

primary font, primary instance

A multiple master instance, selected by the type designer or manufacturer, that is predefined and ready-to-use upon installing a multiple master typeface on a computer.

retrofitting

Adapting an existing typeface family to take advantage of multiple master technology, allowing custom fonts to be generated from it.

typeface

See *multiple master typeface*.

Type 1 outline font

A digital font comprised of outline characters described by end points and connected by Beziér curves. Type 1 is the default font format used in the PostScript page description language (see the *Adobe™ Type 1 Font Format Specification*).



Appendix C: *Bibliography*


MinionMM, a Specimen Book. Mountain View, California: Adobe Systems Incorporated, 1992.

Myriad, a Specimen Book. Mountain View, California: Adobe Systems Incorporated, 1992.

Adobe Type 1 Font Format: Multiple Master Extensions. Mountain View, California: Adobe Systems Incorporated, 1992.

Multiple Master User Guide. Mountain View, California: Adobe Systems Incorporated, 1991.

Adobe Font Production Software Manual. Mountain View, California: Adobe Systems Incorporated, 1992.



Appendix D: *References*

Part 1:

Adobe Type 1 Font Format. Mountain View, California: Addison-Wesley, 1991.

Adobe Technical Note #5015, *Type 1 Font Format Supplement*, November 1993.

Adobe Technical Note #0091, *Macintosh FOND Resources*, March 1992.

Adobe Technical Note #5088, *Font Naming Issues*, April 1993.

Part 2:

Trademarking a Typeface Name:

Trademark searches can be performed by the Thomson & Thomson Company (800-692-8833).

Patent and Trademark Office: 1-408-730-7290

Typeface Copyright and Font Program Copyright Articles:

“Use a Font, Go to Jail,” *Publish* magazine, December 1992.

“The Copyright Status of Typeface Software,” by Diane Savage and Douglas Brotz, *The Computer Lawyer*, Volume 6 Number 10, October 1989, Adobe Systems, Inc., Mountain View, CA with Prentice Hall Law and Business. (This paper was written prior to the latest regulation from the Copyright Office below.)

“Registrability of Computer Programs that Generate Typefaces,” Announcement from the Copyright Office, Library of Congress, Washington, D.C., Final Regulation, February 21, 1992.


Appendix E: *Standard Kerning Pairs*

AC	Ju	TA	W,	ew	o.	ya
AG	J,	TO	W.	ex	py	ye
AO	J.	Ta	YA	ey	p,	yo
AQ	KO	Te	YO	e,	p.	y,
AT	Ke	Th	YS	e.	ra	y.
AU	Ko	Ti	Ya	fa	rc	ze
AV	Ku	To	Ye	fe	rd	zo
AW	Ky	Tr	Yi	ff	re	: (space)
AY	LT	Tu	Yo	fi	rg	, (space)
Ap	LV	Tw	Yu	fl	ri	, ”
Au	LW	Ty	Y:	fo	rk	, ’
Av	LY	T:	Y;	fl	rl	. ”
Aw	Ly	T;	Y-	f”	rm	. ’
Ay	L”	T-	Y,	f’	rn	. (space)
A”	L’	T,	Y.	f,	ro	“ A
A’	NA	T.	ab	f.	rp	“ ‘
BA	N,	UA	ag	ga	rq	‘ ‘
AU	N.	U,	ap	ge	rr	‘ A
B,	OA	VA	at	gg	rs	” (space)
B.	OT	VG	av	gi	rt	, ”
CA	OV	VO	aw	go	ru	, ’
C,	OW	Va	ay	gr	rv	’ d
C.	OX	Ve	bb	gy	ry	’ l
DA	OY	Vi	bl	g,	r:	’ r
DV	O,	Vo	bu	g.	r;	’ s
DW	O.	Vu	bv	hy	r-	’ t
DY	PA	V:	by	iv	r,	’ v
D,	Pa	V;	b,	ke	r.	’ (space)
D.	Pe	V-	b.	ko	sw	; (space)
FA	Po	V,	ch	ky	s,	(space) A
Fa	P,	V.	ck	lw	s.	(space) T
Fe	P.	WA	cl	ly	va	(space) V
Fi	QU	WO	cy	mu	ve	(space) W
Fo	Q,	Wa	c,	my	vo	(space) Y
Fr	Q.	We	c.	nu	v,	(space) “
F,	RO	Wh	dd	nv	v.	(space)
F.	RT	Wi	dv	ny	wa	
G,	RU	Wo	dw	og	we	
G.	RV	Wu	dy	ov	wh	
JA	RW	Wy	eb	ow	wo	
Ja	Ry	W:	eg	ox	w,	
Je	S,	W;	ep	oy	w.	
Jo	S.	W-	ev	o,	xe	

Appendix F: **Sample Tests**

Full Character Set

A B C D E F G H I J K L Ł M N O Ø
P Q R S T U V W X Y Z Æ Œ Đ Þ
& a b c d e f g h i j k l ł m n o ø
p q r s t u v w x y z æ œ fi fl ß
đ þ ª º ¹ º ¹ º ² ³ ⁴ ⁵ ⁶ ⁷ ⁸ ⁹ ⁰ \$ ¢
£ ¥ ¢ ¤ / ¼ ½ ¾ % ‰ # · ^ ~ < >
¬ = − + ± × μ ° . , : ; ! ? ¡ ¢ " ' ' ' " " "
, " − — − < > « » () [] { } _ ... / \ | ¡
† ‡ § ¶ • * @ © ® ™ ` ´ ^ ~ - ~ . . . °
ˆ ˇ Á Â Ã Ä Å Æ Ç È É Ê Ë Ì Í Î Ï Ñ⁵
Ó Ô Ö Ò Õ Š Ú Û Ü Ù Ý ÿ Ž á â ã
à å ã ç é ê ë è í î ï ñ ó ô ö ò õ š
ú û ü ù ý ÿ ž



“Hamburgevons” Keyword Text

Hamburgevons verbs On Ruman hen ran Verbs aurora Bas even among rumors Uever oregano more Esugar remorse An sorghum on Measure Governor snores are game here Sour greenhouse Nag humerous has mmaeuvers her over gush hug among masons shuns or oases heaven nouveau sausage someone gruesome ro rummage enormous shoehorn she verse ashore as agrees runas gorgeous name manage sea nano governess see nose rough ransom be ego engrave snore generous ore sugar remorse an sausage someone hen ran verbs shuns or ona sorghum on measure over verse ashore as here sour oregano more aurora as even rumors ever oregano maneuvers her over ashore on vague over on rum orb an over ashore ransom snores her over ban rumors ever oregano more sugar remorse an sorghum on measure governor snores are game here sour greenhouse nag humerous has Maneuvers her over gush hug among masons shuns or Oases heaven nouveau sausage someone gruesome o rummage enormous shoehorn she verse Ashore as agrees runas gorgeous name manage Sea nano governess see Nose rough ransom be ego engrave snore generous ore sugar remorse an sausage someone Hen ran verbs shuns or ona sorghum on measure over verse ashore as here sour oregano more aurora as Even rumors ever oregano maneuvers her over ashore on vague over on rum orb an over ashore ransom snores her over Ban Rumors ever oregano more sugar remorse an sorghum Uon measure governor snores are Game here sour greenhouse nag humerous has maneuvers her over gush hug among masons shuns or oases heaven nouveau sausage someone gruesome o rummage enormous shoehorn she verse ashore Vas agrees runas gorgeous name manage sea nano governess see nose rough ransom Be ego engrave snore generous ore sugar remorse an sausage someone hen ran verbs shuns or ona sorghum On measure over verse ashore as here sour oregano more Aurora as even rumors ever oregano maneuvers her over ashore on vague over on rum orb an over ashore Ransom snores her over ban governor Snores are game here sour greenhouse nag humerous has maneuvers her over gush hug among Masons shuns or oases heaven nouveau sausage someone gruesome o rummage enormous shoehorn SHE VERSE ASHORE AS AGREES RUNAS GORGEOUS NAME MANAGE SEA NANO GOVERNESS SEE NOSE ROUGH RANSOM BE EGO ENGRAVE SNORE GENEROUS ORE SUGAR REMORSE AN SAUSAGE SOMEONE HEN



H¿H¿O¿O¿n¿o¿o	>H>H>O>O>n>n>o>o	H`H`O`O`n`n`o`o`
H¡H¡O¡O¡n¡o¡o	«H«H«O«O«n«n«o«o«o»	H~H~O~O~n~n~o~o~
H/H/O/O/n/n/o/o	«H» «O» «VF» «hf»	H^H^O^O^n^n^o^o^
H\H\O\O\n\n\o\o	«H»H»O»O»n»n»o»o»o	H`H`O`O`n`n`o`o`
H H O O n n o o	H,H,O,O,n,n,o,o	H·H·O·O·n·n·o·o·
H†H†O†O†n†n†o†o	,VF, ,hf,	H°H°O°O°n°n°o°o°
H‡H‡O‡O‡n‡n‡o‡o	„H„H„O„O„n„n„o„o„o	HˇHˇOˇOˇnˇnˇoˇoˇ
@WORD@sign@	„VF„ „hf„	HₓHₓOₓOₓnₓnₓoₓoₓ
WORD®sign®	H\$H\$O\$O\$n\$n\$o\$o	H₄H₄O₄O₄n₄n₄o₄o₄
WORD™sign™	H¶H¶O¶O¶n¶n¶o¶o¶o	H₆H₆O₆O₆n₆n₆o₆o₆
	H&H&O&O&n&n&o&o&o	

010203040506070809000\$0¢0£0¥0ƒ0α0μ0%0‰0#0°0¹0²0³0¼0½0¾0⁰0

0#1#2#3#4#5#6#7#8#9#0

H1HH1OH1OO1O	H2HH2OH2OO2O	H3HH3OH3OO3O
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H7HH7OH7OO7O	H8HH8OH8OO8O	H9HH9OH9OO9O
H0HH0OH0OO0O	n1nn1on1oo1o	n2nn2on2oo2o
n3nn3on3oo3o	n4nn4on4oo4o	n5nn5on5oo5o
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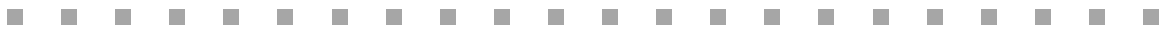
111111111111111111	0•0•1•2•3•4•5•6•7•8•9•
2222222222222222	0@0@1@2@3@4@5@6@7@8@9@
3333333333333333	0*0*1*2*3*4*5*6*7*8*9*
4444444444444444	0&0&1&2&3&4&5&6&7&8&9&
5555555555555555	0 0 1 2 3 4 5 6 7 8 9
6666666666666666	0 0 1 2 3 4 5 6 7 8 9
7777777777777777	0/0/1/2/3/4/5/6/7/8/9/
8888888888888888	0\0\1\2\3\4\5\6\7\8\9\
9999999999999999	0_0_1_2_3_4_5_6_7_8_9_
0000000000000000	0°0°1°2°3°4°5°6°7°8°9°
\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$\$	0-0-1-2-3-4-5-6-7-8-9
¢¢¢¢¢¢¢¢¢¢¢¢¢¢	0\$0\$1\$2\$3\$4\$5\$6\$7\$8\$9\$
££££££££££££££	0¢0¢1¢2¢3¢4¢5¢6¢7¢8¢9¢
¥¥¥¥¥¥¥¥¥¥¥¥¥¥	0£0£1£2£3£4£5£6£7£8£9£
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒ	0¥0¥1¥2¥3¥4¥5¥6¥7¥8¥9¥
#####	0ƒ0ƒ1ƒ2ƒ3ƒ4ƒ5ƒ6ƒ7ƒ8ƒ9ƒ
αααααααααααααααα	0/0/1/2/3/4/5/6/7/8/9/
# #	(0)(1)(2)(3)(4)(5)(6)(7)(8)(9)
.....	[0][1][2][3][4][5][6][7][8][9]
.....	{0}{1}{2}{3}{4}{5}{6}{7}{8}{9}
.....	
.....	
.....	



0^0^1^2^3^4^5^6^7^8^9^	0%0%1%2%3%4%5%6%7%8%9%
0~0~1~2~3~4~5~6~7~8~9~	0‰0‰1‰2‰3‰4‰5‰6‰7‰8‰9‰
0>0>1>2>3>4>5>6>7>8>9>	0μ0μ1μ2μ3μ4μ5μ6μ7μ8μ
0<0<1<2<3<4<5<6<7<8<9<	0¼0¼1¼2¼3¼4¼#¼#¼#¼#¼#¼
0<0><1><2><3><4><5><6><7><8><9>	0½0½1½2½0½#½#½#½#½#½
0x0x1x2x3x4x5x6x7x8x9x	0³0³1³2³3³4³5³6³7³8³9³
0+0+1+2+3+4+5+6+7+8+9+	0²0²1²2²3²4²5²6²7²8²9²
0±0±1±2±3±4±5±6±7±8±9±	0³0³1³2³3³4³5³6³7³8³9³
0-0-1-2-3-4-5-6-7-8-9-	a+b=c a + b = c (x+1)(z - 1) = y
0=0=1=2=3=4=5=6=7=8=9=	97½ ± 47¾ 98.6° ± (x ÷ y) × (m ÷ n) = a
0÷0÷1÷2÷3÷4÷5÷6÷7÷8÷9÷	21 apples @ 12¢ ea. = \$2.52
0-0-1-2-3-4-5-6-7-8-9-	xμn x yμn = r axb=c 45°
	620¼ ÷ 41² = 0.369 let μ = x ÷ y
	\$98 32¢ £55 ¥67 f81 22' 87"

HaHbHcHdHeHfHgHhHiHjHkHlHmHnHoHpHqHrHsHtHuHvHwHxHyHzH

Up to the last quarter of the nineteenth century the creation of a type was a handcraft, and there was nothing in the method to restrict the style, shape or detail of the Design So Produced. When Composing Machines Were Introduced There were 13,970 juxtapositions in the `machines' which imposed constraints on the proportions of characters: but \$465.28 shapes detail's size edge quality (of them) were never affected! Is it {it is not} possible to make statements and exaggerations about digital type design? fl fi float figure fl fi float figure
 ABCDEFGHIJKLMNOPQRSTUVWXYZ& PRODUCTION FOR ELECTRONIC TYPESETTING SYSTEMS. BUT IT IS NECESSARY TO PARTICULARIZE. BOTH OF US QUICKLY JUMP WHILE VEXED. VERBSGOHUMAN WITH HAMBURGEVONS. AREN'T THEY?



All typography is an arrangement of elements in two dimensions. sensitive to it not only as words & lines, but as part of the design smaller size or 2987 to alter the graphic appearance of some of the A line need not be full out to the left but may be moved a little or a white space? in either CASE; the line can be so placed to achieve the quam obedientiam singularem, Amicus Dei audit : 2 Par 20:
Jac. 2: 25. Pack my box with five dozen liquor jugs. QUICK WAFTING ZEPHYRS VEX BOLD JIM. SIGNUM GRAPHIC CONTRAST MAXIMA RE

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