Programming Notes for 'Monotype' Composing Machines

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Chapter 2

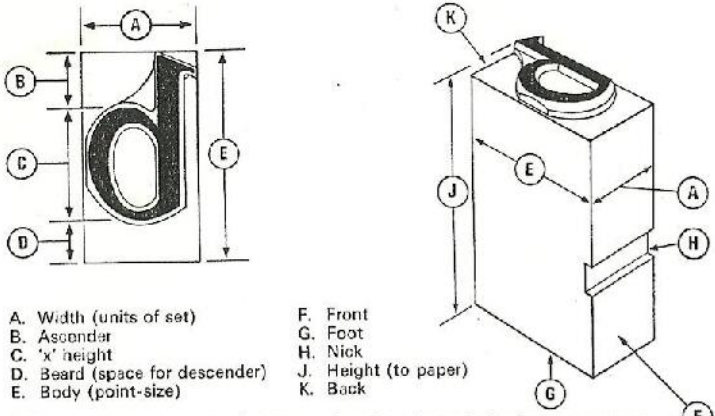
Typographical dimensions in the point system used on 'Monotype' machines

A piece of type has several critical dimensions, but, for the purposes of typographical calculations, only the width and height of the character (whether produced in solid type or as an image developed on film) are of importance.

The height of the character is measured up and down the printed page and is commonly expressed in *points* of 0.013833″. One point is a twelfth part of the *pica em*. One pica em equals 0.166″.

The width of the character is measured across the page or along the length of a line, and is expressed also in points which, to define the direction of measurement, are called *set points*. This is commonly abbreviated to *set* (see illustration 1).

The dimension of greatest importance in computer control of typesetting is the set-width of the characters, so that the content of a line can be calculated and controlled to produce proper *justification*. Justification is a technical term defining the routine production of lines of type of equal length, with straight margins on the right as well as on the left. This is accomplished by varying the word-spaces or letter-spaces.



A. Width (units of set)
B. Ascender
C. 'x' height
D. Beard (space for descender)
E. Body (point-size)
F. Front
G. Foot
H. Nick
J. Height (to paper)
K. Back

Illustration 1 *A piece of type showing the principal measurements.*

The system used on 'Monotype' machines classifies each size of each typeface in set points as well as points. Each complete type alphabet or *fount* (pronounced 'font') is given a categorical size which is generally the width of the largest characters of the fount (the capital W or M). These fount set-widths are expressed from 5 set up to 16 set in ¼pt steps and from 16½ set to 26 set in ½pt steps.

To classify the individual characters within the fount or alphabet, the set-width of the fount is treated as being divisible into 18 *units*. The narrow characters, such as the full point, the comma and the lowercase i, are usually 5 units of set and the capital W will usually be 18 units of set.

The basic unit of set, which is only used for the purpose of calculation, measures 0.0007685″, and it is normally referred to as *1 unit of 1 set.*

For instance, a lower-case t might have a width of 7 units. Its actual size in a fount of 8-set type would be:

$$0.0007685'' \times 7 \times 8 = 0.043036''$$

This is normally referred to as *7 units of 8 set* and it will be realised that the size of the units is always dependent upon the set-size of the fount.

Each character is given a specific unit-value when it is first designed. This width normally controls the space between itself and the next character. For special purposes, this width can be deliberately increased to a considerable degree to provide greater spacing between letters in a word. Decrease of the character set-width is obviously limited, because, if the characters overlap, they will lose their identity in phototypesetting, and, in metal type casting, the 'face' of the type would clash with those adjacent to it, unless special provision is made to accommodate the overhang.

'Monotype' machines are capable of dealing with a range of up to 15 different unit-widths in any given fount; therefore the design of the characters in that fount must (with certain exceptions – see Chapter 3, character selection) conform to this requirement.

Founts vary considerably in their characteristics, in that condensed typefaces have a narrow set-width relative to the body size, whereas an expanded typeface has a set-size larger than the body size. A versatile computer program will therefore have to contain complete tables of the relevant dimensions of all characters in all the typefaces used in a given installation.

Chapter 3

Character-selection and machine-input signalling

All 'Monotype' typesetting machines are automatic and receive instructions through the medium of a perforated paper tape record providing a co-ordinate system of 31 channels of perforations.

Character-selection is by means of an address code that employs the map-reference style of co-ordinates. A grid having 15 letter columns and 15 number rows is the basis of the system (see illustration 2).

BASIC SYSTEM

Originally the machines had 225 characters arranged in a 15 × 15 grid with the horizontal ordinate described by letters A–O and the vertical by figures 1–15. The O and 15 positions are represented in the paper tape by absence of a perforation; each of the

UNITS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
5	,	‰	,	.	f	j	i	□	l	‰	J	.	*i*	*l*	*j*	1
6	*J*	‘	,	’	*f*	]	t	□	-	’	i	f	j	l	-	2
7	J	J	:	s	!	r	t	s	:	;	:	‰	)	(	▣	3
8	*S*	*F*	*L*	*v*	*y*	*z*	*o*	*e*	*c*	*r*	*a*	*c*	*s*	*t*	;	4
9	*z*	*x*	*k*	*g*	S	F	g	e	y	0	r	c	2	1	0	5
9	*?*	*d*	*p*	*n*	?	9	8	□	v	1	2	J	3	4	5	6
9	*q*	*P*	*h*	*b*	*u*	*a*	7	6	5	4	3	9	8	7	6	7
10	*Y*	*R*	*A*	*V*	fl	L	x	n	h	o	k	p	a	v	z	8
10	*B*	*E*	*T*	*?*	ff	fi	P	E	u	d	q	b	e	g	y	9
11	**F**	**S**	**fi**	**k**	**b**	**d**	T	B	**u**	**o**	**n**	**h**	**p**	**q**	**x**	10
12	*ff*	*æ*	*K*	*C*	*D*	*U*	*O*	*w*	*R*	*V*	*Y*	**E**	**P**	**L**	**ff**	11
13	*Z*	*N*	*Q*	*G*	*H*	&	W	A	K	C	Z	&	**B**	**T**	**R**	12
14	*ffi*	*ffl*	*X*	*m*	X	H	U	w	G	D	**C**	**Y**	**V**	**K**	&	13
15	ffi	*M*	*œ*	*Q*	M	N	O	m	**w**	**A**	**D**	**G**	ffi	**W**	**Z**	14
15	ffl	W	ffi	...	—	**M**	m	—	**N**	**U**	**O**	**H**	**X**	**Q**	□	15
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	

Illustration 2 *A 15 × 15 matrix-case arrangement.*

other codings requires two perforations, one each from the two groups of 14, making 28 in all. The other three perforations are control codes. One is designated the 'S' code and it instructs the composing machine (primarily) to insert a space, the basic width of which has been modified by a predetermined amount in order to justify a line. The other two codes effect this predetermination by adding allowances of 0.0075″ and 0.0005″ in multiples of any whole number from 1 to 15, as may be required. The 'S' code can also similarly modify the width allocated to an individual character.

Briefly, the 'S', '0075' and '0005' codes are bound up with the justification procedure. The 0075 and 0005 codes, together with the related figure codes (designating the required multiple), are read at the beginning of each line; they prepare the composing machine to vary the widths for spaces and characters in the line whenever the space- or character-code is accompanied by the 'S' perforation.

The numbered co-ordinates have a double function in that besides addressing an actual character they also designate its unit-width value. Conversely, all characters in any numbered row have the same unit-value. There are exceptions to this rule listed later (see illustration 4).

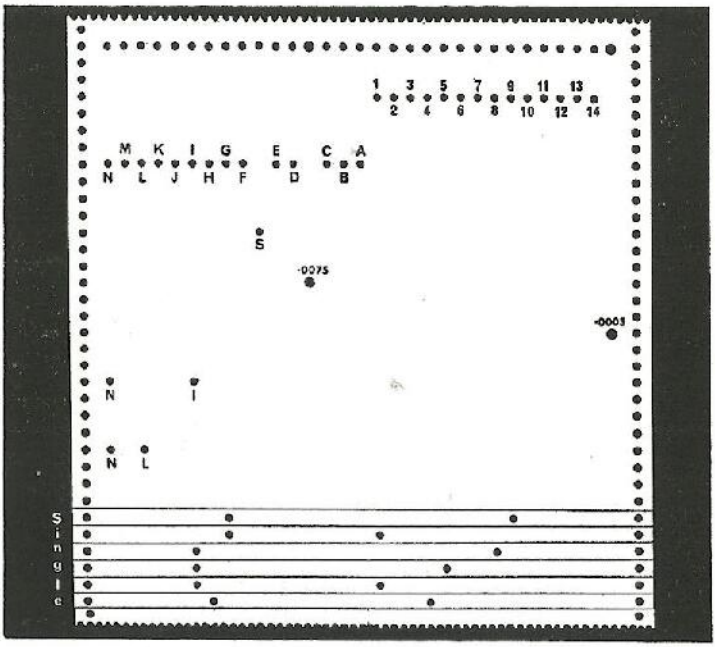


Illustration 3 *The perforated paper tape and address code.*

VARIATIONS FROM THE BASIC SYSTEM OF CHARACTER SELECTION

Subsequent to many years of use, the 225-matrix capacity was expanded to take 255 matrices. This was done by adding two extra columns to the 15×15 grid. The additions were made before the normal 'A' column, i.e. to the left of the grid. To address these columns, the combinations 'NI' and 'NL' respectively are used.

Later still, a further refinement known as 'Unit Shift' brought about another modification to the matrix case. One row was added to the 'Numbers' after row 15, increasing the capacity to 272 matrices. The address to this row is slightly more complex and affects all other rows in the numbered ordinates. To understand the change, the matrix grid can be imagined as consisting of two layers. In the lower one, each of the 15 rows represents a fixed number of units for the characters; laid over this is the upper one, actually containing the matrices, but in 16 rows – i.e. one more than the lower. In the normal situation, row 16 has no unit-width and is out of operation. To bring it into use, imagine the whole top layer as being shifted so as to bring row 16 up to over-lie row 15 on the lower layer. In this way row 16 adopts the unit-value of row 15, but only whilst in this position. Similarly, the other rows of the matrix case are 'shifted' upwards. The upper row (number 1) then moves off row 1 on the lower grid and is out of operation.

This modification, although simple, has far-reaching effects. It enables the unit-width normally allocated to any row in the matrix grid to be changed for that allocated to the row next above. Two effects therefore are produced. Firstly row 16 is brought into operation by addressing it. The second effect is that, by using the same address code with any of the other rows, the unit-width normally associated with the row is changed to that of the one above, e.g. characters actually in row 12 assume the unit-value allocated to row 11.

The address for row 16 is 'D'. This code is removed from the alphabetical designations of the columns and in order to address the column previously addressed by 'D', the combination 'EF' is used.

NOTE: It is very important to grasp the full implications of Unit Shift and the 'D' signal. In general, the function of the system is to enable matrices of two different unit-widths to be mixed in one row. This is mainly a convenience in compiling the fount arrangement. In allocating addresses, the coding should be for the unit row in the shifted position.

For instance in illustration 4 the lower-case f in row 3 is addressed by the codes GD2. The D2 will then provide that the unit-value of row 2 (i.e. 6 units) is applied to the shifted matrix case when the f in row 3 is treated as though it were in row 2. Similarly the bold **Z** in row 13 has the code address ND12.

In this way three main coding systems are used on current 'Monotype' machines.

1) The 15 × 15 matrix case is addressed by 1–15 and A–O.
2) The 15 × 17 matrix case is addressed by 1–15 and NI, NL, A–O.
3) The 16 × 17 Unit-shift matrix case is addressed by 1–15 (or 1–15 with D) and NI, NL, EF, A–C, E–O.

NOTE: If there is no punching in the letter-section of the address, it is the equivalent of punching O. Similarly, if there is no punching in the numbered section of the address, it is the equivalent of punching 15. Consequently, the complete absence of punching gives the address O15. (See illustration 4.)

Further explanations concerning specific codes to address a character and function simultaneously are included later in this text. The foregoing is intended to explain the basic system in a general way.

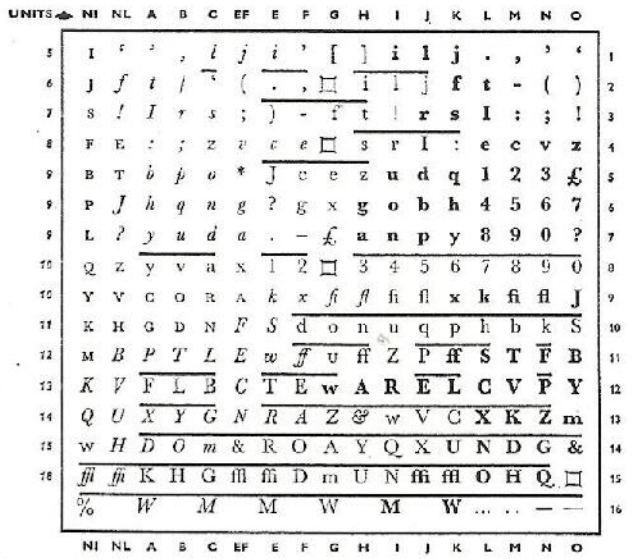


Illustration 4 *A 16 × 17 Unit-shift matrix-case arrangement. Heavy lines above a character indicate that Unit Shift is incorporated, and that the character will be allocated the unit-value of the row above.*

Chapter 4

Justification, applicable to Composition Casters and to Filmsetters Mark 1 and Mark 2

A knowledge of standard keyboard procedure used for processing data to control 'Monotype' typesetting machines will be helpful in understanding this section.

STANDARD KEYBOARD PROCEDURE

At the keyboard, the transcribing operator strikes keys that produce the perforated 31-channel control tape. The perforations serve two purposes, the addressing of characters and the registering of their unit-values for justification. The latter is produced at the end of each line and is the result of a calculation.

The keyboard is adjusted to work to a predetermined line-length. This line-length is expressed as a given number of units of set. As the line is composed, each character-width is recorded by the keyboard and deducted from the total line-allowance, so that a running balance of unset units is always displayed before the operator. Each word-space is designated for variable increase in the justification procedure and is generally allotted 4 units of set as a preliminary measure.

At some stage, the operator judges that he has composed sufficient characters in the line to produce suitably sized word-spaces after justification. At this stage he stops composing and commences justification. This procedure is simply a division of the number of spaces in the line into the remaining unset units.

The quotient of this division requires later to be added to each variable space provisionally recorded as 4 units of set. The keyboard procedure is completed by the operator perforating the necessary 0075 and 0005 signals (each being represented by a single key giving a single perforation) into the paper tape to cause the composing machine to respond by actually adding multiples of 0.0075″ and 0.0005″ to the basic 4-unit spaces designated by the 'S' punch code.

All the keyboard calculation is carried out automatically, so that the operator merely reads off the two figures applicable to the dimensions, and taps keys accordingly. The content of the codes

is the identification of either 0075 or 0005 and the number of increments required.

The justification coding has several separate functions. Normally both 0005 and 0075 codes require addressing, each with its multiplier. These addresses occupy separate frames.

Whereas the punched tape moves in a forward direction on the keyboard, it is read at the typesetting machine backwards, so that the **last code keyboarded is the first read** by the typesetter.

In this way, the typesetter reads the justification code with the 0005 address followed by the 0075 address.

The 0005 address has the extra function of causing the typesetter to reject all following codes except the 0075. If an 0075 code does not follow immediately after the 0005 code, all intermediate information is rejected or *killed.*

The two justification codes, when combined in one frame, are used to produce an end-of-line-and-reset operation on the typesetter.

Because of this, the justification codes are punched so that they are read in a certain form and sequence.

There are two procedures, known as *single justification* and *double justification* respectively. The following explanation serves to illustrate their respective functions.

DOUBLE JUSTIFICATION *(Reading: opposite direction to punching)*

The first code is a combination of 0005 and 0075 and establishes that the previous line has ended. The typesetting machine then reorganises itself to produce the next line and adjusts both its 0005 and 0075 increments according to the multiplier which has been given for the 0005 address.

The next code should be a 0075 address and multiplier. The 0075 increment mechanism is adjusted accordingly and all is ready for the next line to be read in, and the type to be set with correct space-widths.

SINGLE JUSTIFICATION *(Reading: opposite direction to punching)*

If the first justification code is not the combined 0005 and 0075, the line will not be regarded as ended. The presentation of single 0005 followed by 0075 is then used to justify sections of a part-line within the whole line. This is used for tabular and multi-column setting, in which case each column will be single justified except the last, which has double justification to denote the end of line.

LINE KILLER

Because the 0005 code has a separate function causing the rejection of all subsequent information until a 0075 code is received,

single justification codes must always be read by the casting machine with the 0005 first. At any time, the 0005 can be combined with any other code except the 0075, and it then has the effect already mentioned of killing the succeeding information up to the next line-end identified by a 0075 code.

JUSTIFICATION BY WORD-SPACES

When the function of justification is programmed in computer-aided typesetting systems, the standard procedure used in direct keyboard (or traditional) operations is not entirely suitable. It would, of course, be possible to program the standard procedure, but this would require lists of *constants* (see Keyboard Manual) to be stored for each set-size, also a minimum variable space of 4 units or the alternative allocation would be needed.

In a computer program, it is desirable to combine simplicity and versatility in the best way and to use, if necessary, the typesetting-machine functions in a practical, but possibly unusual, method.

A justified space is a normal fixed space addressed by its matrix-grid code and then modified by the S code.

The addition of the S code causes the normal space to be modified in size according to the predetermined justification increments specified at the line-ending.

In the case of typesetting in 12 set, the variable space would normally be a 6-unit fixed space reduced primarily by 2 units. That is, if the justification codes were 1/1 in 12 set, the space would be produced as a 4-unit space. To produce a 6-unit space it would be necessary to cause 0.018444″ to be added by justification increments, the method of achieving this being as follows:

$$\begin{aligned} \text{1 unit of 1 set} &= 0.0007685'' \\ \text{2 units of 1 set} &= 0.0007685'' \times 2 \\ \text{2 units of 12 set} &= 0.0007685'' \times 2 \times 12 \\ &= 0.018444'' \end{aligned}$$

To convert this dimension into machine-procedure, divide it by 0.0075″ and the remainder by 0.0005″.

$$\begin{array}{r} 0.0075)0.018444 \quad (2 \\ \underline{150} \\ 0.0005)0.0034 \quad (6.8* \\ \underline{0.0030} \\ 40 \\ \underline{40} \end{array}$$

*NOTE: As the quotient, 6.8, approximates to the integer 7, this is taken as the required number of 0.0005″ steps. The actual error is 0.0001″.

The justification is 2/7 to produce 2 units of 12 set.

These increments of 2/7 are then added to the minimum positions 1/1 to give 3/8 and this becomes a justification code to convert a variable space (of a 12-set basis) into a 6-unit space, i.e. to replace the 2 units deducted when justification is 1/1. This 3/8 coding is the key to the whole justification system. In other set-sizes it has been arranged that the same 3/8 justification produces type of the true width, i.e. nothing is added or subtracted when casting type which has the S signal included in the co-ordinates when justification is 3/8.

Because of this, a 3/8 justification code always produces a 6-unit space from the 6-unit row in a fount of any set size. A justification code of less than 3/8 will reduce the space below 6 units of the set in use and a justification code higher than 3/8 will increase the space size over 6 units of the set in use.

In order to use *one* standard justification procedure in a computer program, to work in a variety of set-sizes and to allow spaces to be specified to suit the work being processed, the following method is strongly recommended.

EXAMPLES AND METHODS

1) The total value of the characters and variable spaces (temporarily recorded as having 4 units) is calculated in units of set and deducted from the total line-length also in units of set. This 4-unit allocation may be altered, in which case the same unit-value must be used in (3) below as the specification of the *low-limit*.

2) The remaining unset units are divided by the number of word spaces addressed in the line.

NOTE: The quotient is a width in units of set. This width, if added to 4 units of the set in use, would represent the size of the word-spaces to justify the line. In order to arrive at this objective, the justification mechanism of the typesetting machines has to be addressed by the signals 0075 and 0005 increments in the following manner.

3) Having arrived at the quotient of (2) above in units of set, the desired *low-limit* space-size in units of set is added and 6 units subtracted. This gives the amount to be added to the variable space by means of the 0.0005″ and 0.0075″ steps. This result may be a negative amount.

4) The numbers of steps of 0.0005″ and 0.0075″ are calculated by taking the result of (3) above and multiplying by the set size in use and the result by the factor 1.537. **(The factor 1.537 is the number of steps of 0.0005″ to equal 1 unit of 1 set.)**

The result is then the number of 0.0005″ steps to be added to the 3/8 code.

5) If the 3/8 code be expressed as 53 steps of 0.0005″, a direct addition of the result of (4) above to 53 will give a figure that, when divided by 15, results in the final justification figure expressed in 0.0075″ and 0.0005″ steps.

NOTE: After the 53 has been added, the result should always be positive, and in the range 16 – 240 inclusive.

a) Line length: 10 pica ems.
b) Set-size: 12.
c) Low-limit variable space: 4 units.
d) Normal variable-space size: 6 units.

NOTE: The *10 pica ems* mentioned above are converted to units of set by multiplying by 18 (the number of units per em). For any set other than 12, a conversion is necessary as follows: the pica em measure is multiplied by 12 (points to the em) and 18 (basic units to the point) and the result divided by the set-size. In this example, the number of units of set per line is 180.

This example follows the paragraph numbers given in the preceding detailed description of the calculations in sequence.

1) 180−158=22 units of set (total space).
2) 22÷3=7.333 units of set for each inter-word space.
3) 7.333+4−6=5.333 units of set to be added to each minimum variable space.
4) 5.333×12×1.537=98.361 required steps of 0.0005″.

NOTE: 0.361 is less than 0.5, therefore ignore, giving an adjusted answer of 98.

5) $\frac{98+53}{15}=\frac{151}{15}=10/1$ justification.

The full justification code, as read by the typesetting machine, is then:

0075, 0005, and 1 all in one frame, followed by 0075 and 10 in the next frame.

Provided the data described in (a) to (d) are available, the simple steps numbered (1) to (5) are all that is necessary to justify a line in any set-size.

The above justification method is based on the use of the *Pica* which measures 0.166″. However, there are other systems, the

commonest of which is the *Cicero* system employed in Europe. The cicero unit of measure is 12 *Didots* and is equivalent to 0.1776".

When programs are constructed to work in cicero, a minor change in the method of justification is necessary to convert to the larger dimension.

In the justification procedure described for pica, the calculation of the number of set-units per line mentioned in paragraph (e) appears under the example on a previous page. To work in cicero the same calculation is necessary, but the multiplier 12 becomes 12.84 (points converted to cicero) based on the pica 0.166". An example is shown below:

Line-length, 22 ciceros.

$$\therefore \frac{22 \times 12.84 \times 18}{10 \text{ (set size)}} = 508 \text{ units of 10 set.}$$

NOTE: Another system is also used in Europe based on the conversion of cicero to the *Old English Pica* which measures 0.1667". (The formula for calculating units of set based on this is shown in 'Useful Formulae' at the back.) It is important to ascertain the system used in a particular plant in order that the correct conversion formula may be used.

COMBINED SPACING

The use of combined spacing on 'Monotype' composition casters when used in conjunction with a computer typesetting program is recommended because a 15% increase in output is achieved by combining the space with the first character of a word.

Two forms of combined spacing are available, *normal-combined* and *close-combined.*

NOTE: 'Monotype' composition casters must be equipped with the correct space transfer wedge for the system in use, and all moulds must be suitable for combined spacing. Full details of the Attachment can be found in a 'Monotype' Composition Caster Manual, under the section headed 'Combined Spacing Attachment'.

NORMAL-COMBINED SPACING

Normal-combined spacing will produce a 6-unit space combined with the first character of a word when justification is 3/8.

Calculating the justification is the same as shown on page 15. The difference occurs in the output tape where the S perforation will be combined with the co-ordinates for the first character and not with separate space co-ordinates.

CLOSE-COMBINED SPACING

With close-combined spacing, a 2-unit space will be cast with the first character of the word when justification is 3/8.

The method used for calculating the justification figures is as follows:

Line length: 10 pica ems.
Set-size: 12.
Low-limit variable space: 1 unit.
Normal variable-space size: 2 units.
Number of units of set per line: 180.

180−149=31 units of set (total space remaining)
31 ÷ 3=10.333 units of set for each inter-word space
10.333+1−2=9.333 units of set to be added to 3/8 justification
9.333 × 12 × 1.537=172.137 required steps of 0.0005″

NOTE: 0.137 is less than 0.5 therefore ignore, giving an adjusted answer of 172.

$$\frac{172 \mid 53}{15} = 225 = 15/0$$

Since it is not possible to have a justification of 15/0, because justification starts at 1/1, the actual figures will be 14/15.

∴ justification is 14/15.

The full justification code to be read by the typesetting machine is then:
0075, 0005 and 15 all in one frame, followed by 0075 and 14 in the next frame.

NOTE: It is possible, using close-combined spacing, to reduce the space between words to zero units, but this will not have the desired effect of dividing the text into separate words. One unit was chosen as the lower space-limit in this example to illustrate the calculations required.

Chapter 5

Space-limits, applicable to Composition Casters and to Filmsetters Mark 1 and Mark 2

The size of the final justified word-space is subject to two limiting factors. Firstly, in metal type it is undesirable to reduce the space below the width that can safely be cast. Secondly, the mathematics of the machine system can only allow a maximum reduction of 2 units of 12 set or 0.0185". The minimum justification setting is 1/1 which, in 12 set, gives a 4-unit space from the 6-unit space matrix. Below 12 set, 1/1 will give a space smaller than 4 units.

For practical purposes the following limits are applicable; they are based on the limits employed when using conventional keyboarding equipment.

In set-sizes up to 12 set, the space should not be reduced by more than 2 units of the set-size in use.

12½ set to 24 set should not be reduced by more than 1 unit of the set-size in use.

Above 24 set, no reduction should be applied.

NOTE: These rules can be applied in different ways and a 3-unit minimum (i.e. less than 4 units) space is possible provided the variable space is located in a 5-unit matrix grid position, so that the 2-unit maximum deduction allowable up to 12 set can still apply and yet produce a 3-unit space.

Chapter 6

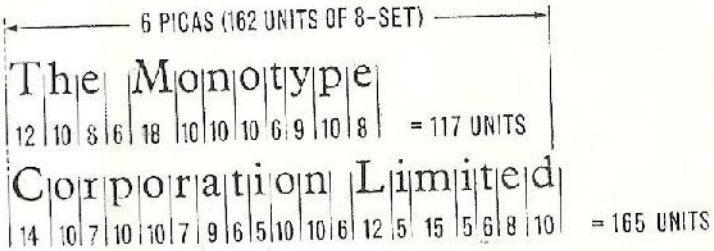
Justified letter-spacing methods for Composition Casters and Filmsetters Mark 1 and Mark 2

Another method of justifying lines is by *justified letter-spacing*. This is sometimes necessary when short-measure work is being undertaken and extremely few spaces (or none) occur in the line. When spaces are present (as in the example below) these are initially registered as fixed-width spaces of their full unit-width, and justified letter-spacing (the same as for the characters) is applied to them also. Because the additional width is cast on the left of the characters, the first character in a line is never justified. Justified letter-spacing is addressed by including the S code with each character and fixed-space code.

With justification figures of 3/8, nothing is added to or subtracted from the normal width of type bodies – in other words 3/8 becomes the zero (starting point) for letter-spaced lines in all set-sizes.

It must be remembered that if the size of the characters has to be reduced to squeeze the text into a given area, i.e. if the justification figures are less than 3/8, the maximum reduction permissible is one quarter of a unit of the set-size in use.

The following example shows how letter-spacing is applied to lines of type:



Line-length 6 pica ems

Set-size 8.

∴ The number of units per line will be

$$\frac{6 \times 12 \times 18}{8} = 162 \text{ units of 8 set}$$

FIRST LINE

The total unit-value of characters and spaces up to the end of 'Monotype' = 117 units.

162—117=45 units (remaining space).

These 45 units must now be divided equally between the 11 characters, which include the space between the words but not the first character in the line.

The justification will now be calculated as follows:

Divide the 45 units of space by 11	= 4.090 units of 8 set to be added to each character
Multiply by 8	= 32.720 basic units of set to be added to each character
Multiply by 1.537 (conversion factor)	= 50.290 steps of 0.0005″
Taking the nearest whole number and adding 53 (the equivalent of 3/8)	= 103 steps of 0.0005″
Dividing by 15	= 6/13 justification

CHARACTER EXPANSION LIMITS

There are two limits controlling the maximum number of units that can be added to characters when employing justified letter-spacing.

1) The 15/15 justification position.

2) The safe limit of the mould-blade opening; for 12pt this is 0.170″ and for below 12pt, 0.160″.

Those limits in (2) will not apply to moulds converted for combined spacing, nor to filmsetting machines.

As these limits exist, it is necessary to see that the largest character in the line plus justification increment does not exceed them. The justification figures (6/13) used above are well within the 15/15 limitation.

The capital M is the largest character, being 18 units wide. It is therefore necessary to calculate the width of this character plus the justification increment to ensure that the total is less than 0.160″.

This may be calculated as follows:

1 unit of 1 set	= 0.0007685″
Multiply by 8 (set-size)	= 0.0061480″
Multiply by 18 (number of units)	= 0.1106″
Add 0.0250″, the difference between justifications of 6/13 and 3/8	= 0.1356″

The final figure is well below the limit of 0.160″.

SECOND LINE

Continuing with the example to the same line-length etc., the second line will justify as follows:

The number of units to line = 162 of 8 set.

Total unit-value of characters and space to end of 'Limited' = 165 units.

Because the total number of units for the text is greater than the length of line, it will be necessary to reduce the character-size by an appropriate amount; the calculations are therefore

162 − 165 = −3 units of 8 set.

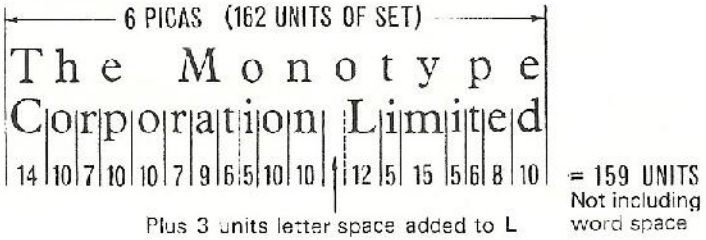
These 3 units must now be divided equally between the 18 characters including the space.

$\therefore \frac{3}{18} = 0.166$ units of 8 set to be *deducted* from each character and the space.

We can see immediately that 0.166 of a unit is well within the maximum permissible reduction of 0.25 of a unit, so that it is safe to proceed.

Multiply 0.166 units of 8 set by 8	= 1.328 basic units
Multiply by 1.537 (conversion factor)	= 2.041 steps of 0.0005"
Taking the nearest whole number and subtracting it from 53 (the equivalent of 3/8)	= 51 steps of 0.0005"
Dividing by 15	= 3/6 justification.

In the second line it is worth noting that composing the line with a normal 4-unit space would have resulted in the text exceeding the line-length by 1 unit. However, even by adding 2 units to the 4-unit space and making it 6 units, thereby increasing the text length by a further 2 units, it is possible, using justified letter-spacing to fit the text within the line.



There is another method of justifying the text for the second line which is worth noting. It could be accomplished as follows:

No space is inserted between the two words, but the first letter of the second word has justified letter-spacing applied to it while all the other characters remain normal i.e. not justified.

Line-length 162 units.
Length of text (with no provision for space) 159 units.
∴ Space to be provided = 162—159 = 3 units of 8 set.
Number of characters to which justification is applied, 1.
3×8 (set size) ×1.537 = 36.888 (steps of 0.0005″), or to the nearest whole number, 37.

53 ÷ 37 = 90
divide by 15 = 6/0 = 5/15 justification.

Apply the checks to see that this does not exceed the expansion-limits:
5/15 is within the 15/15 limitation.

The character to which justification is to be applied is the capital L which is 12 units wide. It is known from the preceding calculation that the number of units to be added to the capital L is 3. Therefore the 12-unit L will be justified to 15 units and as the largest character in the alphabet is almost always 18 units (in this case the capital M of 'Monotype' is already specified with 18 units) no further calculation is necessary. However, a check could proceed as follows:

1 unit of 1 set	= 0.0007685″
1 unit of 8 set	= 0.0061480″
12 units of 8 set	= 0.073776″ (the width of the capital L)
Add 0.0185″, the difference between 5/15 (the justification figures for the line) and 3/8	= 0.094″ which is well within the limit of 0.160″.

Chapter 7

Unit-adding method for Composition Casters and Filmsetters Mark 1 and Mark 2

A definite number of units may be added to the width of characters by the use of the justification mechanism or by use of the Unit Adding Attachment on hot metal composing machines.

Units are added to provide an artistic effect or for emphasis.

The Unit Adding Attachment on a composition caster permits unit adding of 1, 2 or 3 units. However, it is not possible to mix the number of units to be added i.e. 1 unit cannot be added to some characters and 2 or 3 units to others in the same job. This is because the caster operative is required to stop the machine in order to change the mechanism used on the Attachment.

The signals employed when using the Attachment are included in Chapter 9.

METHODS OF UNIT ADDING

Unit adding by means of the justification facilities can be accomplished as follows:

The number of 0.0005" steps for 1 unit of the set-size in use must be calculated, and the result added to the 3/8 justification. In the case of 12 set, this would be as follows:

1 unit of 1 set	= 0.0007685"
Multiply by 12 (set-size)	= 0.009222"
Divide by 0.0005" (one step of fine justification)	= 18.4 steps*
to the nearest whole number	= 18 steps
Add 53 (=3/8 code converted to steps of 0.0005")	= 71 steps
Divide by 15 (to re-convert to justification code)	= 4/11

*18 steps of 0.0005" or the 1/3 justification code represents one unit of 12 set. However, to produce a character at its correct unit-width when its address contains the S code requires an initial justification code of 3/8. Because of this, the 3/8 code has to be added to the 1/3 code to produce the code 4/11. This is best done as a simple addition of 53 as shown above.

The same limits apply to the ultimate character-sizes as have been described earlier, in the paragraph on character-expansion limits. However, these limits do not need complex calculation as the additions are not random variables, but fixed units.

When fixed units are added by justification increments in this way, the S code should be included with the designated character-codes – always excepting the first letter in a line because the increase is added to the left of the character; if used at the line-commencement, this would create an indention.

Where a line containing unit additions to the characters requires to be justified, it is necessary to calculate the justification in the usual way, but taking into account those characters augmented by the added units. The justification figures so obtained are put at the line-end*. The extra codes for the unit adding are then calculated and inserted immediately after the letters concerned and an additional line-justification code must then be inserted before the unit-added letters to re-establish the normal line-justification for the preceding word-spaces.

Because of the versatility of the system, it may produce most complex situations. For instance, fixed units of varying amounts may be used in a line that also contains normal justified word-spaces. Each *change* of use of the justification process must be coded appropriately with *re-establishment of normal parameters* wherever necessary.

A limiting factor not described so far is the need to avoid the situation where a unit-added or justified letter-space is similar to, or greater in width than the word-spaces, because this would interfere with the visual word-spacing in reading the final printed text. To avoid this, the whole line will require examination and the word-content adjusted, even by carrying a word or part of a word into the next line, if necessary.

*NOTE: When terms such as 'insert before' etc. are used, it always has to be realised that the typesetting machines read the tape from the line-endings i.e. backwards. Instructions such as 'before' and 'line-end' must therefore be understood and interpreted most carefully to produce correct meanings.

Chapter 8

Proportional justification system on Filmsetters Mark 3

With this method of justification, the additions to the normal spaces are proportional to the set-size in use, and not merely multiples of the 0.0005″ and 0.0075″ steps. Consequently, it is not necessary to convert the space-increments into steps of 0.0005″.

The coarse (or 0075) steps are, in this case, units of set and the fine (or 0005), fifteenths of units; therefore 15×15 (or 225) gradations are possible.

The number of units by which the line is short of measure is multiplied by 15 and divided by the number of spaces. The answer (to the nearest step) must be added to the justification figures 1/1 which represent the zero position.

COMBINED SPACING

A space may be combined with the first character of a word without requiring a special frame on the 31-channel paper ribbon. The space before a word is indicated by punching the S perforation in the frame with the first character of that word. The justification increment is then automatically added.

CODING

The minimum coding (1/1) at the end of a line means that no space is added whenever the S perforation occurs. An end-of-line coding of 4/1 would mean that 3 units were added to each character having an S signal. This is the usual minimum spacing between words, but, where justification is achieved by adding spaces between the characters of a word, it may go down to 1/1.

Example of justification

Composing 'The Quick Brown Fox' as a line

Length of line	= 160 units
Length of text	= 132 units
Remainder	= 28 units
Number of spaces	= 3
∴ Justification	$= \frac{28 \times 15}{3}$
	= 140 fifteenths of a unit
	= 9 units and 5 fifteenths
∴ coding	= 9/5+1/1
	= 10/6

Chapter 9

Summary of present tape-control signals on 'Monotype' machines

HOT METAL COMPOSITION CASTERS 15 × 15

Basic machine is rarely used today. It is listed here to show the origin of the code used.

On the basic machine, up to two perforations are used to select a matrix in a 15 × 15 arrangement, letters being used in the horizontal ordinate and numbers in the vertical. The last row or column is obtained when no signal occurs in the group responsible for that particular ordinate (for identification they are known as column O and row 15).

It follows that blank paper selects an extreme corner matrix (known as position O–15).

Justification

The two special signals 0005 and 0075 occur in two code frames at the beginning of the code perforations for establishing the space-widths in each line of type. They also set the increment affecting the size of the type body (but not its face) when the signal S occurs simultaneously with a character perforation.

The fine increment is set by the 0005 signal in conjunction with a number from 1 – 14 (or on its own for 15); each successive number increases the width of the type body (when S is present) in the same number of 0.0005″ steps. In the second cycle, the 0075 signal in conjunction with a number from 1–15 increases the width of the type body (when S is present) the same number of 0.0075″ steps.

Double Justification

In the first of these code-frames, the 0075 and 0005 signals may occur together to operate the line-collecting and line-stacking mechanisms. In the first cycle, both coarse and fine increments are set to the fine requirements, but the coarse increment is reset to its correct position in the second cycle.

Double justification is almost always used at the end of a line.

Line Kill

The presence of a 0005 signal inhibits the casting operation which can only be released by a 0075 signal. Thus the absence of the 0075 signal immediately after a 0005 signal at the beginning of a line prevents any signalled information in that line being translated into cast type.

Line Kill is deprecated in good casting practice and is little used. It should never be necessary to use this facility from computer-compiled data.

15×17 Attachment

The extra columns are obtained by combining N with I or L, in such a way that the N, I and L columns are ignored, the required matrix in the NI or NL column being selected instead. All other previous conditions apply.

Unit Shift

Mechanism, incorporated in current-production machines, but available also as an Attachment for earlier machines, permits the upward movement of the matrix case by one row; it is triggered by the signal D. That is, with this mechanism, the presence of the D perforation would move the matrix assembly from A1 to present the matrix A2 without varying the position of the type-sizing mechanism. It permits greater freedom in arranging the matrices in the grid.

For this reason, the D signal no longer selects the D row. Because it is diverted, the combination EF is used instead to address the row previously designated by D.

**16×17 Attachment*

This Attachment is infrequently used. Access to an extra horizontal row is obtained by combination of the signals H, M and N. The signal HN gives access to row 16 in the H column, HNI, correspondingly to row 16 in the NI column and HNL to row 16 in the NL column.

MN gives access to the 16th position of column N and HMN gives access to the 16th position in the O column. All other positions in row 16 are gained by the combination HM and a letter from one of the groups A to G and I to L. All other previous conditions apply.

**This Attachment is not recommended for inclusion in a computer program except where a special request is made and proved by investigation to be valid.*

Alternative Justification System

In order to release signals 0075 and 0005 for purposes other than justification, the machine can be converted so that the combined signals NK and NJ can be used in their place.

The released signals are used as follows:

0075 with Unit Adding Attachment

0005 with Two-colour or Mathematical Attachment

N and 0075 } to operate auxiliary blades in the mould for exotic
N and 0005 } faces.

**Unit Adding Attachment*

This Attachment is a popular addition to the machine, being most common in Germany where extra spacing between characters is used (instead of italics) to indicate emphasis.

Signal 0075 is diverted from its usual function and can be used with character perforations to add units of set (usually 2 units) to the width of the piece of type. It can be used with all previous matrix-selection arrangements.

**Signalled Leading Attachment*

The S perforation may be included with the 0005 signal in the justification codes. The combined effect is to trigger off mechanism for providing additional spacing between lines, but this Signalled Leading Attachment is rarely used.

**Two-colour Attachment*

The two-colour Attachment is not in great demand. The 0005 perforation operates, through a mechanical switch on the auxiliary blade of the type mould, to open or close the top of the mould, according to the pre-set state of the switch. It is used for missal work (prayer books); only type characters to be printed black are cast on the first run-through of the tape; with the switch set over the other way, only type to be printed red is cast. In each case, the area not to be printed is completed with spaces. Each setting is then printed separately in its respective colour on the same sheet of paper. Because the spaces of the one setting have the unit values of the corresponding characters in the other, correct register is preserved.

Two-colour working may be used with Unit Adding or any of the systems previously outlined except that the revised Justification System must apply.

**This Attachment is not recommended for inclusion in a computer program except where a special request is made and proved by investigation to be valid.*

**Mathematical Attachment*

This Attachment is a recent optional addition and is becoming popular among printers of scientific books. The 0005 signal operates a blade which separates the matrix from the mould so that high spaces are produced. These are necessary since the faces of adjacent characters overhang the edges of their own type bodies and need support against printing pressure. This Attachment may not be used with the Two-colour Attachment.

The Alternative Justification system must be used so as to release the 0005 signal for this purpose.

**Triplex Mould Attachment*
**Duplex Mould Attachment*
**Dual Type Mould Attachment*

These Attachments are for use with exotic typefaces such as Arabic, Hebrew etc. They increase the range of matrices available, by modifying the aperture at the matrix face of the mould.

They are little used except in the Middle Eastern countries. Signals N plus 0005 and N plus 0075 are used to operate two auxiliary blades in the mould. The combined signals can only be applied to a restricted number of matrices and they are automatically encoded with their selection.

(Unit Adding, Two-colour and Mathematical Attachments may not be used with these Attachments.)

Either mode of justification may be used.

Quadding and Repeating

Signals B & C in combination lock the tape for five cycles so that five identical pieces of type are cast from one frame of perforations. Signals A & C in combination lock the tape until released by a gauge that indicates that the line has been filled with types. Quadding and Repeating cannot be applied to characters in the A, B or C column.

Neither the AC nor the BC combination may be used on moulds for exotic faces.

Stopping the Composition Caster

It is possible to stop the caster at the end of a galley by signalling two ems at the end of the last line, known as the galley line. The galley line must be terminated by the double justification code of 0075 and 0005, followed by 0005 in the next frame. The double-justification code delivers the line of type almost to the galley, but,

**This Attachment is not recommended for inclusion in a computer program except where a special request is made and proved by investigation to be valid.*

because the line is too long, the machine is automatically stopped. The 0005 perforation in the last frame on the spool causes the pump cut-out to operate, thereby ensuring that the pump is out of action when the caster stops.

'MONOPHOTO' FILMSETTERS MARK 1 AND 2 – BASIC MACHINE

Character Selection
As for 15 × 17 composition casters.

Variable Sizing
The same as for composition casters.

Justification
The combination NJ and 0005 triggers the fine-setting mechanism to select the number of steps of 0.0005" to be added to the character as determined by the number-code punched at the same time. The combination NK and 0075 selects the coarse-setting mechanism.

The complete signal NJK 0075 and 0005 (with or without a number) is used as 'Double Justification' to initiate a line feed on the film.

Line Kill
NJ inhibits the exposure of all characters until an NK signal is received. Lines preceded by NJ signals only will therefore be omitted from the film.

Character Deletion
This involves feeding the width of a character but cuts out exposure. The 0005 signal, occurring with a character signal, permits the appropriate feed but a shutter closes the optical path, so preventing exposure of the film.

'MONOPHOTO' FILMSETTER MARK 2 FOR MATHEMATICAL WORK – NEW STANDARD

The character-selection with 16 × 17 Unit Shift is identical to that of composition casters.

Variable Sizing
As on the basic machine.

Justification
NJK signals are used. The 0075 signal has a new function on Character Shift and the 0005 has other duties shown below; otherwise, as on the basic machine.

Line Kill
As on the basic machine.

Character Deletion
The combination of GH with a character-signal permits feed but no exposure, producing a blank space of the width allocated to the character addressed.

Double Exposure
No feed takes place between two exposures, resulting in a composite character made from the two matrices concerned.

The 0005 signal, occurring with the code co-ordinates for a character, prevents any feed from taking place. This combination must obviously be read before the second character in a double-exposure composite. This is used for building up formulae in mathematical settings.

Low Alignment
Signal 0075 with a character signal causes the character to be placed below its normal alignment by a prearranged amount. It is used for indices etc. in mathematical composition, superior characters thus being converted to inferiors or sub-scripts.

**Character Kill*
To make the perforations for a character inoperative, an additional function is recorded in the same frame, as follows:

Character Deletion	Signal GH prevents exposure
Double Exposure	Signal 0005 prevents any feed from taking place.
Justification Inhibition	Signal 0075 prevents signal N from combining with signal J or K (should either also be present) to cause a reset of justification and possibly line feed.

NOTE: This function is unlikely to be used in a computerised system. The description is included merely to illustrate the functions available.

**Quadding*
Signal HM, occurring in a combination, locks the tape feed for five cycles so that five consecutive exposures of the same character (or space) take place from the one signal-combination. This feature may *not* be applied to characters in the following columns of the matrix assembly: G, I, J, K, L, M, N and O.

**This function is not recommended for inclusion in a computer program.*

Leading on Film Feed

Additional increments of film feed of up to 6 points of printer's measure may be added to the basic feed by introducing the signal F alone or with D, E, G, H or M, with the double-justification signal, as follows:

Signal FD adds $\frac{1}{2}$ point (or 1 point)
Signal FE adds $1\frac{1}{2}$ points (or 2 points)
Signal FG adds $2\frac{1}{2}$ points (or 3 points)
Signal FH adds $3\frac{1}{2}$ points (or 4 points)
Signal FM adds $4\frac{1}{2}$ points (or 5 points)
Signal F adds $5\frac{1}{2}$ points (or 6 points).

The decision to utilise either of the two possible ranges of leading increments must be agreed between the operators of the keyboard and the filmsetter, as the latter requires manual adjustment to produce either set of increments. A change during one job is therefore not practicable.

NOTE: The code FE above, occurring with a justification signal, performs the required operation. The fact that, as constituting also the signal EF, it selects and positions what was the D column of the film matrix case, is of no significance.

Machine Stop Code

The signal HM 0005 will stop the machine exactly on the signal. It can be introduced when change of point-size, set-size, column-position or matrix layout is to be made by hand before restarting the machine.

'MONOPHOTO' FILMSETTER MARK 3

Character Selection

16×17 Unit Shift. As for Mark 2 Mathematical Filmsetters.

Justification

Proportional, in increments of units and fifteenths of units of the set-size in use, as opposed to increments that are multiples of 0.0075″ and 0.0005″. Spaces may be combined with the first character of the word, or produced individually. Increased output results from combining the space.

The signal NJ 0005 gives fine justification, and line kill. The signal NK gives coarse justification. The signal NJK gives double justification.

Character Deletion
Quadding
Machine Stop Code
Automatic variable Line Feed
The same as for Mark 2 Mathematical Filmsetter.

0075
The same as for Mathematical Filmsetter.

Variable Spaces
When combined spacing is used, these are obtained by combining the S signal with the first character of the word.

Variable spaces uncombined will require the S signal plus GH (to close the shutter) and the appropriate row number for the 1-unit row.

Fixed spaces can be obtained for any unit-value in the case by combining GH with the appropriate row number. A blank matrix usually exists only in the H15 position.

'MONOPHOTO' FILMSETTER MARK 4

General
A Mark 4 'Monophoto' Filmsetter is a new addition to the range of machines. Its outstanding feature is a larger matrix case containing 17 rows of 20 locations each, giving 340 matrix positions (see illustration 5). Provision is made for the substitution of up to 16 matrices of larger size (.2″ × .4″) in two columns of the case, in place of double the number of normal-size matrices. When included, these larger matrices will always be in the H and I columns (see illustration 6).

Operated by a continuous rotary drive, the shutter incorporates a variable aperture that is automatically enlarged body-wise when the matrix negative for a double-size character is to be exposed.

Character Selection
Perforations A–J and O, and AJ–IJ are used to select positions in the horizontal ordinate and the perforations numbered 1–16 for the vertical (see illustration 5).

Unit Shift
When the signal K is included with the co-ordinate perforations, it moves the matrix case upwards one row, so that the seventeenth row is reached by the inclusion of the K perforation with the signal for row 16.

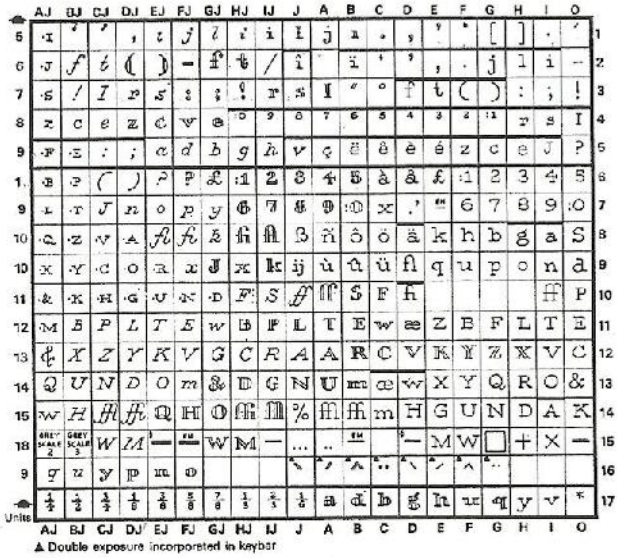


Illustration 5 *A matrix-case arrangement for a Mark 4 filmsetter, showing 340 .2" × .2" matrix positions.*

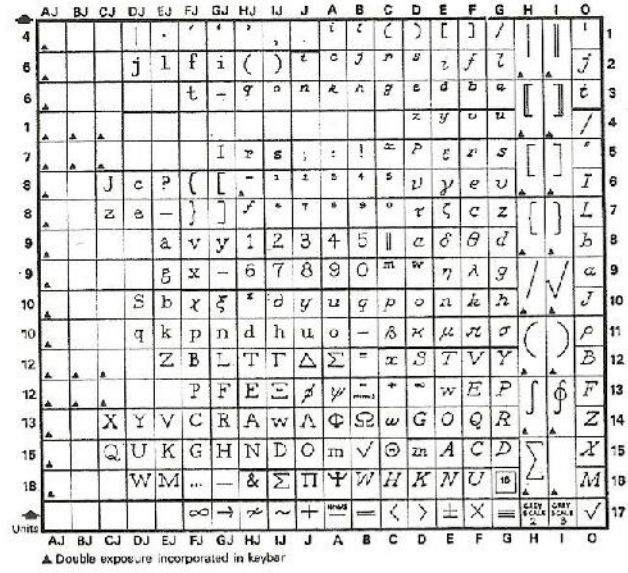


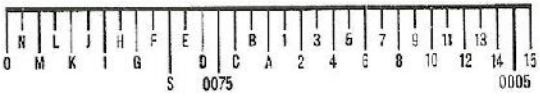
Illustration 6 *A mathematical arrangement for Mark 4 filmsetters, showing 308 .2" × .2" matrix positions, 16 double-depth .2" × .4" matrix positions, and a number of blank positions.*

Justification

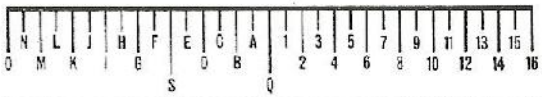
Justification is proportional, in increments of units and fifteenths of units of the set-size in use. Spaces may be combined with the first character of the word (by inclusion of the S perforation) or produced individually. Increased output results from combining the space.

Mark 4 Filmsetters employ a perforation code different from that of earlier types.

In the Mark 4 code (bottom diagram) A, B, and C are the justification perforations; BC gives fine justification and line kill, and AC gives coarse justification. The signal ABC gives double justification and film feed.



Perforation codes for filmsetters Mark 3 (above) and Mark 4 (below)



Character Deletion

The signal M, occurring with a character signal, permits the appropriate feed but closes the optical path, so preventing exposure of the film.

Double Exposure

The signal N, occurring with a character signal, prevents any feed from taking place.

Low Alignment

Signal L, occurring with a character signal, causes the character to be placed below its normal alignment by a pre-set amount.

Double-Exposure and Low Alignment

Both functions occur as the result of the combined signal NL being included with the code co-ordinates for a character, allowing (for example) inferiors and superiors to appear vertically aligned.

**Character Kill*

The effects of perforations for a character are cancelled when the signal LMN is recorded simultaneously.

**Quadding*

The signal GH locks the tape-feed for five cycles so that five consecutive exposures of the same character (or space) take place from one signal combination. This feature cannot be applied to characters in the H, I or O columns of the matrix assembly.

Leading on Film Feed

Additional increments of film feed of up to 6 points may be added to the basic feed by combining the appropriate one of the following signals with the double justification code:

Signal D adds $5\frac{1}{2}$ points (or 6 points)
Signal DE adds $4\frac{1}{2}$ points (or 5 points)
Signal DF adds $3\frac{1}{2}$ points (or 4 points)
Signal DG adds $2\frac{1}{2}$ points (or 3 points)
Signal DH adds $1\frac{1}{2}$ points (or 2 points)
Signal DI adds $\frac{1}{2}$ point (or 1 point)

The instruction as to which of the two ranges of leading increments is to be used must be notified to the operator of the filmsetter, as the machine requires manual adjustment to initiate either set. A change while a job is in progress is therefore not practicable.

Variable Shutter

The shutter aperture is increased for the projection of the larger characters from .2″×.4″ matrices, by the inclusion of the Q signal with the character co-ordinates.

NOTE: Because it is not possible to locate the large-size (.2″×.4″) matrices in rows corresponding to their correct unit-values, the double-exposure signal is always incorporated with that of the character and the appropriate feed is signalled separately.

Machine Stop Code

The signal GHN will stop the machine exactly on the signal. It can be introduced when change of point-size, set-size, column positions or matrix layout is to be made, after which the machine may be re-started.

**This function is unlikely to be used in a computerised system.*

Chapter 10

Coding system for 'Monotype' Paper-tape Conversion Equipment

The system used by 'Monotype' Paper-tape Conversion Equipment for converting coded information on narrow punched tape received from a computer into 31-channel paper ribbon is described below. The resulting output in 31-channel paper ribbon is then suitable for operating any 'Monotype' composing or 'Monophoto' filmsetting machine.

Coded information may be supplied to the Conversion Equipment on input tape having 5, 6, 7 or (preferably) 8 tracks.

NARROW-TAPE CODE

The attached chart shows an appropriate narrow-tape coding for each of the 31 channels in 'Monotype' ribbon. The extra code called *Stop Feed* (S.F.) prevents the 31-channel perforator from feeding after making any letter-perforation signalled at the same time. Consecutive input signals may contain the S.F. signal in order that all the composite signals needed for operating 'Monotype' typesetting machines, and using more than two perforations, may be built up in one row on the 31-channel ribbon.

For signalling purposes, the eight tracks are divided into two groups of four. One group is assigned to the numbered punches on the 31-channel ribbon, and includes the S.F. signal. The other group of four covers all the lettered punches and 0005. To signal 0075 and S, the S.F. is used in conjunction with one of the lettered group. (0075=G+S.F., and S=O+S.F.).

For tape having less than 8 tracks i.e. 5, 6 or 7, only 5 tracks are required. The letter-group of four is punched first in one frame, followed, in the next frame, by the number-group with the addition of a perforation in the remaining track to identify it. This additional perforation will always be present in alternate frames throughout the tape, its purpose being to keep the grouping of signals in phase. The only exception to this rule is blank tape, which will be ignored.

TYPICAL TRACK ARRANGEMENTS
(sprocket hole is shown thus ●)

8-channel tape

Track numbers	87654●321	
Binary values	84218●421	
	letters numbers	

The above example shows how the 8-channel tape may be divided into two groups of four.

5-, 6- or 7-channel tape

Track numbers	7654●321	
Binary values	84●21	First frame, 'letters'
	84●210	Second frame, 'numbers' with synchronising hole

The 5-track code applies to 5-, 6- or 7-track tape as illustrated.

Track arrangements may vary according to customers' requirements. On 5-, 6- or 7-track tape, the synchronising hole (which may be on any track-number) must occur in frames alternating with the number-group as illustrated.

8-channel tape code

Letters (left part)			*Figures (right part)*		
Dec.	*Letter*	*Binary 8421*	*Dec.*	*Figures*	*Binary 8421*
0	O	0000	0	15	0000
1	A	0001	1	1	0001
2	B	0010	2	2	0010
3	C	0011	3	3	0011
4	D	0100	4	4	0100
5	E	0101	5	5	0101
6	F	0110	6	6	0110
7	G	0111	7	7	0111
8	H	1000	8	8	1000
9	I	1001	9	9	1001
10	J	1010	10	10	1010
11	K	1011	11	11	1011
12	L	1100	12	12	1100
13	M	1101	13	13	1101
14	N	1110	14	14	1110
15	0005	1111	15	S.F. (Stop Feed)	1111

1 denotes a hole 0 denotes no hole

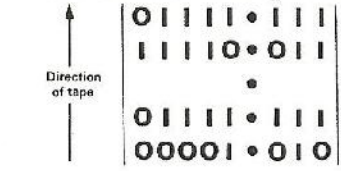
The signal 0075 is produced by a combination of G+S.F. (0111+1111), and signal S by O+S.F. (0000+1111).

Examples of 8-channel tape code:

Tape Punching	*Character*
10111 ● 000	K8
00110 ● 111	C7

During the setting of the justification increments at the commencement of a line, it will be necessary to build up several signals in one frame. Because there is always only one number-signal in a frame, but frequently more than one letter, the stop-feed code is placed on the number side.

Double-Justification settings at the commencement of a line of text would be built up as follows:



0075 (G+S.F.)
0005 + 3 End of signal
31-channel ribbon feeds on
0075 (G+S.F.)
0+10 End of signal
31-channel ribbon feeds on

From the example, it can be seen how the 31-channel ribbon is prevented from feeding until the perforations for an entire signal are complete.

5-, 6-, or 7-channel tape code

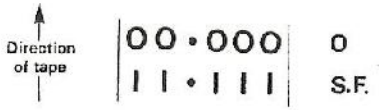
When using 5-, 6- or 7-channel tape, only 5 channels are necessary; the code is therefore shown for 5-channel tape.

Letters (First Frame)			*Figures (Second Frame)*		
Dec.	*Letter*	*Binary 84210*	*Dec.*	*Figure*	*Binary 84210*
0	O	00000	0	15	00001
1	A	00010	1	1	00011
2	B	00100	2	2	00101
3	C	00110	3	3	00111
4	D	01000	4	4	01001
5	E	01010	5	5	01011
6	F	01100	6	6	01101
7	G	01110	7	7	01111
8	H	10000	8	8	10001
9	I	10010	9	9	10011
10	J	10100	10	10	10101
11	K	10110	11	11	10111
12	L	11000	12	12	11001
13	M	11010	13	13	11011
14	N	11100	14	14	11101
15	0005	11110	15	S.F. (Stop Feed)	11111

1 denotes a hole 0 denotes no hole

The signal 0075 is obtained by punching G in the first frame followed by S.F. in the second.

Signal S is obtained by punching O in the first frame followed by S.F. in the second.



A stop signal is available so that spools of galley-length or page-length may be produced. The code for this is O and S.F. twice. This stops the feed from taking place on the 31-channel punch and produces the S perforation. This was chosen as it is a signal never required twice in succession. When this signal is used, it must always be followed by a minimum of 5 blank frames.

Chapter 11

Coding system for 'Monotype' Paper-tape Conversion Unit Mark 2

The system used by Mark 2 'Monotype' Paper-tape Conversion equipment, for converting coded information on narrow punched tape (received from a computer) into 31-channel paper ribbon, is described below. The resulting output, in 31-channel ribbon, is suitable for operating 'Monotype' composition casters made in Britain or 'Monophoto' filmsetters.

Coded information on the narrow paper tape forming the input to the converter requires 7 tracks.

NARROW-TAPE CODES

The two accompanying code tables give the appropriate narrow-tape coding for the following:

Paper-Tape Code 1

'Monotype' composition casters 15×15, 15×17 and 16×17 Unit Shift, and 'Monophoto' filmsetters Marks 1, 2 and 3.

Paper-Tape Code 2

'Monophoto' filmsetter Mark 4. It will be noted that a different signal-arrangement is used on the Mark 4 filmsetter.

Both the corresponding signal arrangements are shown on the diagram. Standard perforation code (top), punch numbers (centre) and 'Monophoto' filmsetter Mark 4 (below).

For signalling purposes, *two frames of narrow tape* are normally used to convey the information relating to one frame of 31-channel ribbon, but there are exceptions to this – see 'Stop Feed'.

Our customary 31-channel ribbon is divided into two groups of perforations, designated by letters and numbers respectively.

On the narrow tape, the letter-information is always punched in the first of the two frames and it uses six of the seven tracks. The number-information is punched in the second frame. This always contains a perforation in the seventh track, which is known as the synchronising hole. Consequently, it will be present in alternate frames throughout the tape; its purpose is to keep the grouping of signals in phase.

STOP FEED

The code called 'stop feed' has an entirely different meaning from the function described in the Mark 1 Tape Conversion Unit. In the Mark 2 Tape Conversion Unit no punch is activated nor paper feed initiated until a 'numbered' input code is received. These numbered codes are defined always by the existence of the synchronising bit in track number 7. Unless a code containing the synchronising bit in track 7 is read, no punch feed takes place in the output 31-channel tape.

In this method, a series of 'lettered' codes can be read in and no punch will be fired in the output paper tape. However, this facility is limited by the electrical functions of the actual punch which will not operate more than 6 punches at once. Where it is desired to exceed this number, the stop-feed code should be used after encoding a group of less than 6 'lettered' punches and then the rest of the desired 'lettered' punches can be encoded prior to the use of the 'numbered' code, which finally will cause the 31-channel tape to feed forward normally.

STOP SIGNAL

The conversion process may be halted by a stop signal in the narrow tape to permit spools of specified length (e.g. galley or page) to be produced. When this signal is used, it must be followed by a minimum of five blank frames.

As a result of the innovation represented by the Mark 2 paper-tape converter, the speeds of the computer output and of the converter throughput have been appreciably increased.

Paper-Tape Code 1 for 15×15, 15×17, 16×17 Unit-shift composition casters and 'Monophoto' filmsetters Marks 1, 2 and 3.

Letters First Frame

Dec.	*Binary*	*Letter*	*Punch Nos.*
0	0000.000	O	0
1	0000.001	A	16
2	0000.010	B	15
3	0000.011	C	14
4	0000.100	D	12
5	0000.101	E	11
6	0000.110	F	9
7	0000.111	G	8
8	0001.000	H	7
9	0001.001	I	6
10	0001.010	J	5
11	0001.011	K	4
12	0001.100	L	3
13	0001.101	M	2
14	0001.110	N	1
15	0001.111	NI	1.6
16	0010.000	NL	1.3
17	0010.001	EF	11.9
18	0010.010		
19	0010.011	NKJ	1.4.5
20	0010.100	NKJFH	1.4.5.9.7
21	0010.101	NK	1.4
22	0010.110	NJ	1.5
23	0010.111	MD	2.12
24	0011.000	GD	8.12
25	0011.001	AD	16.12
26	0011.010	BD	15.12
27	0011.011	CD	14.12
28	0011.100	EFD	11.9.12
29	0011.101	ED	11.12
30	0011.110	FD	9.12
31	0011.111		
32	0100.000	HD	7.12
33	0100.001	ID	6.12
34	0100.010	JD	5.12
35	0100.011	KD	4.12
36	0100.100	LD	3.12
37	0100.101		
38	0100.110	ND	1.12
39	0100.111	NID	1.6.12
40	0101.000	NLD	1.3.12
41	0101.001		
42	0101.010		
43	0101.011		
44	0101.100		
45	0101.101		

Numbers (Second Frame) with synchronising bit in Channel 7

Dec.	*Binary*	*Number*	*Punch Nos.*
0	1000.000	0 (15)	32
1	1000.001	1	17
2	1000.010	2	18
3	1000.011	3	19
4	1000.100	4	20
5	1000.101	5	21
6	1000.110	6	22
7	1000.111	7	23
8	1001.000	8	24
9	1001.001	9	25
10	1001.010	10	26
11	1001.011	11	27
12	1001.100	12	28
13	1001.101	13	29
14	1001.110	14	30
15	1001.111		
16	1010.000		
17	1010.001	0005+1	31.17
18	1010.010	0005+2	31.18
19	1010.011	0005+3	31.19
20	1010.100	0005+4	31.20
21	1010.101	0005+5	31.21
22	1010.110	0005+6	31.22
23	1010.111	0005+7	31.23
24	1011.000	0005+8	31.24
25	1011.001	0005+9	31.25
26	1011.010	0005+10	31.26
27	1011.011	0005+11	31.27
28	1011.100	0005+12	31.28
29	1011.101	0005+13	31.29
30	1011.110	0005+14	31.30
31	1011.111		
32	1100.000	S	10
33	1100.001	S1	10.17
34	1100.010	S2	10.18
35	1100.011	S3	10.19
36	1100.100	S4	10.20
37	1100.101	S5	10.21
38	1100.110	S6	10.22
39	1100.111	S7	10.23
40	1101.000	S8	10.24
41	1101.001	S9	10.25
42	1101.010	S10	10.26
43	1101.011	S11	10.27
44	1101.100	S12	10.28
45	1101.101	S13	10.29

46	0101.110		
47	0101.111		
48	0110.000	.0075	13
49	0110.001	AC	16.14
50	0110.010	BC	15.14
51	0110.011	GH	8.7
52	0110.100	HM	7.2
53	0110.101	S*	10
54	0110.110		
55	0110.111		
56	0111.000		
57	0111.001	NKJF	1.4.5.9
58	0111.010	NKJFD	1.4.5.9.12
59	0111.011	NKJFE	1.4.5.9.11
60	0111.100	NKJFG	1.4.5.9.8
61	0111.101	NKJFM	1.4.5.9.2
62	0111.110		
63	0111.111	Stop Code NIL	

46	1101.110	S14	10.30
47	1101.111		
48	1110.000	.0005	31
49	1110.001		
50	1110.010		
51	1110.011		
52	1110.100		
53	1110.101		
54	1110.110		
55	1110.111		
56	1111.000		
57	1111.001		
58	1111.010		
59	1111.011		
60	1111.100		
61	1111.101		
62	1111.110	Stop Feed NIL	
63	1111.111	Stop Code NIL	

*The 'S' code shown here is for use with signalled leading on Composition Casters and not for inter-word spaces.

Note: There is no punch in position 0 or 32. These codes are represented by blank ribbon in the respective tracks.

'MONOTYPE' PAPER-TAPE CONVERSION UNIT MARK 2

Paper-tape code 2 for Mark 4 'Monophoto' filmsetters

Letters First Frame

Dec.	*Binary*	*Letter*	*Punch Nos.*
0	0000.000	O	0
1	0000.001	AJ	15.5
2	0000.010	BJ	14.5
3	0000.011	CJ	13.5
4	0000.100	DJ	12.5
5	0000.101	EJ	11.5
6	0000.110	FJ	9.5
7	0000.111	GJ	8.5
8	0001.000	HJ	7.5
9	0001.001	IJ	6.5
10	0001.010	J	5
11	0001.011	A	15
12	0001.100	B	14
13	0001.101	C	13
14	0001.110	H	12
15	0001.111	E	11
16	0010.000	F	9
17	0010.001	G	8
18	0010.010		
19	0010.011	I	6

Numbers (Second Frame) with synchronising bit in Channel 7

Dec.	*Binary*	*Number*	*Punch Nos.*
0	1000.000	0 (16)	32
1	1000.001	1	17
2	1000.010	2	18
3	1000.011	3	19
4	1000.100	4	20
5	1000.101	5	21
6	1000.110	6	22
7	1000.111	7	23
8	1001.000	8	24
9	1001.001	9	25
10	1001.010	10	26
11	1001.011	11	27
12	1001.100	12	28
13	1001.101	13	29
14	1001.110	14	30
15	1001.111	15	31
16	1010.000		
17	1010.001	S15	10.31
18	1010.010		
19	1010.011		

20	0010.100	K	4
21	0010.101	AJK	15.5.4
22	0010.110	BJK	14.5.4
23	0010.111	CJK	13.5.4
24	0011.000	DJK	12.5.4
25	0011.001	EJK	11.5.4
26	0011.010	FJK	9.5.4
27	0011.011	GJK	8.5.4
28	0011.100	HJK	7.5.4
29	0011.101	IJK	6.5.4
30	0011.110	JK	5.4
31	0011.111		
32	0100.000	BK	14.4
33	0100.001	CK	13.4
34	0100.010	DK	12.4
35	0100.011	EK	11.4
36	0100.100	FK	9.4
37	0100.101	GK	8.4
38	0100.110	HK	7.4
39	0100.111	IK	6.4
40	0101.000		
41	0101.001		
42	0101.010		
43	0101.011		
44	0101.100	D	12
45	0101.101		
46	0101.110	AK	15.4
47	0101.111	GHN	8.7.1
48	0110.000	AC	15.13
49	0110.001	BC	14.13
50	0110.010	ABC	15.14.13
51	0110.011	DABC	12.15.14.13
52	0110.100	DEABC	12.11.15.14.13
53	0110.101	DFABC	12.9.15.14.13
54	0110.110	DGABC	12.8.15.14.13
55	0110.111	DHABC	12.7.15.14.13
56	0111.000	DIABC	12.6.15.14.13
57	0111.001	L	3
58	0111.010	M	2
59	0111.011	N	1
60	0111.100	GH	8.7
61	0111.101	Q	16
62	0111.110		
63	0111.111	Stop Code	

20	1010.100		
21	1010.101		
22	1010.110		
23	1010.111		
24	1011.000		
25	1011.001		
26	1011.010		
27	1011.011		
28	1011.100		
29	1011.101		
30	1011.110		
31	1011.111		
32	1100.000	S	10
33	1100.001	S1	10.17
34	1100.010	S2	10.18
35	1100.011	S3	10.19
36	1100.100	S4	10.20
37	1100.101	S5	10.21
38	1100.110	S6	10.22
39	1100.111	S7	10.23
40	1101.000	S8	10.24
41	1101.001	S9	10.25
42	1101.010	S10	10.26
43	1101.011	S11	10.27
44	1101.100	S12	10.28
45	1101.101	S13	10.29
46	1101.110	S14	10.30
47	1101.111		
48	1110.000		
49	1110.001		
50	1110.010		
51	1110.011		
52	1110.100		
53	1110.101		
54	1110.110		
55	1110.111		
56	1111.000		
57	1111.001		
58	1111.010		
59	1111.011		
60	1111.100		
61	1111.101		
62	1111.110	Stop Feed NIL	
63	1111.111	Stop Code NIL	

Note: There is no punch in position 0 or 32. These codes are represented by blank ribbon in the respective tracks.

START-UP PROCEDURE

To ensure that all memory stores are unloaded when work commences, all input tapes should commence with a series of codes containing the synchronising bit only. This will produce feeds of blank 31-channel tape and when the first data are processed no spurious information will appear in the first code punched.

This action is only necessary after an electrical shut down *or failure*, but is a good practice to adopt for all input tapes. In the case of an electrical failure in the middle of an input tape, the reader head should be cleared of the job tape and a small piece of tape containing synchronising bit should be run through before the job-tape process is resumed from the last justification coding.

Glossary

Bold Characters: Type which gives a darker or heavier impression than normal.
Capitals: Large form of the characters, technically described as majuscule.
Cicero: Traditional printer's unit of measure, commonly used in Europe. 1 cicero=0.1776". Line-lengths are usually expressed as *n*-douze in length where *n* is the number. 1 cicero=1 douze=12 didot points.
Composing Room: Department where text is assembled and set.
Copy: Matter that the printer is to compose.
Didot: A unit of linear measure. It is one twelfth part of a cicero and measures 0.0148".
Display Matter: Headlines, title pages and cross heads as distinct from solid composition.
Editing: Modifications made to original text.
Em: Unit for measuring the amount of printed matter in one line.
Em Quad: Standard fixed spacing unit. In 12 set, measures 0.166" (known as a 'Mutton' in printer's terms).
En Quad: Standard fixed spacing unit. Half the size of an Em Quad (known as a 'Nut').
Fount: Denotes a family of type of the same style and size. (Pronounced 'font').
Galley: Flat oblong tray for holding composed type.
Galley Proof: Proof taken before type matter is made up into pages.
Gravure: Where ink printing design is formed as minute inkwells below the cylinder surface.
Hanging Indent: Text where the first line is of full measure and the succeeding lines are indented.
Hard Copy: A printed copy of machine output.
House Corrections: Corrections in galley or page proofs, other than those made by the author.
Idiot Tape: A colloquial phrase used when referring to unjustified tape.

Indent: Set further in from margin than rest of paragraph(s).
Italic Characters: Characters that slant to the right.
Justification: The process of producing successive lines of type to the same length, usually accomplished by varying the inter-word spacing.
Leader: An image or character having 1, 2, 3, 4, 5 or 6 dots in line, to guide the eye to other relevant matter, or to give the alignment for a manuscript insertion.
Leading: The white space between lines of type.
Letterpress: Printing from the raised inked surface of type or blocks.
Ligature: Two or more characters joined together forming one type character.
Litho: Chemical treatment of plate surface defines the printing areas, water being used to repel ink from unwanted part of plate.
Lower Case: The small form of letters, technically described as minuscule where capitals are referred to as majuscule.
Matrix: The means whereby the shape of the character is imparted. Usually an interchangeable part applied to the mould for casting metallic type or, in the form of a film negative, interposed in the light-path of a filmsetter. Each character-form needs its own matrix.
Measure: The length of the printed line, normally expressed in one of the printer's units of measurement. (i.e. picas, quadrats, ciceros etc.).
Mould: The cavity into which molten metal is injected to produce the body or shank of the type. The face of the type is produced by a matrix (q.v.) which is individual to the character, and which acts as a temporary part of the mould.
Pica: The printer's traditional unit of measure, it is equal to 12 points and measures 0.166″. The pica of 0.166″ is commonly used in England and America. The Old English Pica measuring 0.1667″ is still used and systems based on this are sometimes found. Line-lengths are normally expressed as *n* (number of) *picas long*.
Pi Mats: Matrices which are normally inserted and withdrawn by hand from a line. Generally includes accents and special characters (Line Casters only).
Point: Customary British and American unit of measurement. It is one twelfth part of a pica and measures 0.0138″.
Reproduction Proof: A high-quality proof, usually for mounting in the copyboard of a process camera, for copying into positive or negative form of the required size which is used for the production of a printing plate.

Run Around: Type which has been set to fit closely around an illustration or block.

Running Headline: The title or abbreviated title of a book repeated at the top of each page.

Set: An abbreviation of *set point*, where the word *set* defines the direction of measurement as being along the length of the line. See also *units*. One set point measures the same as a point.

Small Capitals: Characters which have the same form as capitals but are smaller, being produced to the same x-height as the lower-case characters; x-height is the height of the lower-case x in any given fount.

Solid Type: Lines of type set without intervening leads.

Stone: Imposing stone, usually made of steel in the form of a table-top, on which pages of type are assembled.

Type Face: Printing surface of a piece of type.

Units: A unit of set is a variable dimension, dependent on the set of the fount. The basic unit of set is one eighteenth of 1 point= 0.0007685″, a figure that is used only as a foundation for calculations. One unit of an 8-set fount is therefore $8 \times 0.0007685'' = 0.006148''$. When referring to units, it is essential to stipulate 'basic units' *or* the set of the fount concerned – the expression '10 units' (unspecified) has no meaning, but '10 units of 6 set' (for example) is 0.04611″. Note that 6 units of 10 set have the same total width as 10 units of 6 set, as, in each case, 60 basic units are required.

Upper Case: Capital letters of the alphabet.

Widow: Usually a short last line of a paragraph appearing at the top of a page; considered bad typography.

Useful Formulae

CONVERSION OF PICA EMS INTO UNITS OF A GIVEN SET

Based on pica=0.166″

$$\frac{\text{Line-length in picas} \times 12 \text{ (points to pica em)} \times 18 \text{ (basic units)}}{\text{set-size}}$$

CONVERSION OF CICERO INTO UNITS OF A GIVEN SET

Based on pica=0.166″

$$\frac{\text{Line-length in ciceros} \times 12.84 \text{ (points to cicero)} \times 18 \text{ (basic units)}}{\text{set-size}}$$

CONVERSION OF CICERO INTO UNITS OF A GIVEN SET

Based on Old English Pica=0.1667″

$$\frac{\text{Line-length in ciceros} \times 12.8 \text{ (points to cicero)} \times 18 \text{ (basic units)}}{\text{set-size}}$$