Typing Documents on the UNIX System: Using the –ms Macros with Troff and Nroff

M. E. Lesk

Text Formatting
Phototypesetting

ABSTRACT

This document describes a set of easy-to-use macros for preparing documents on the UNIX system. Documents may be produced on either the phototypesetter or a on a computer terminal, without changing the input.

The macros provide facilities for paragraphs, sections (optionally with automatic numbering), page titles, footnotes, equations, tables, two-column format, and cover pages for papers.

This memo includes, as an appendix, the text of the ‘‘Guide to Preparing Documents with –ms’’ which contains additional examples of features of –ms.

This manual is a revision of, and replaces, ‘‘Typing Documents on UNIX,’’ dated November 22, 1974.

May 13, 1987

Typing Documents on the UNIX System: Using the –ms Macros with Troff and Nroff

M. E. Lesk

Text Formatting
Phototypesetting

Introduction. This memorandum describes a package of commands to produce papers using the *troff* and *nroff* formatting programs on the UNIX system. As with other *roff*-derived programs, text is prepared interspersed with formatting commands. However, this package, which itself is written in *troff* commands, provides higher-level commands than those provided with the basic *troff* program. The commands available in this package are listed in Appendix A.

Text. Type normally, except that instead of indenting for paragraphs, place a line reading ‘‘.PP’’ before each paragraph. This will produce indenting and extra space.

Alternatively, the command .LP that was used here will produce a left-aligned (block) paragraph. The paragraph spacing can be changed: see below under ‘‘Registers.’’

Beginning. For a document with a paper-type cover sheet, the input should start as follows:

```
[optional overall format .RP – see below]
.TL
Title of document (one or more lines)
.AU
Author(s) (may also be several lines)
.AI
Author’s institution(s)
.AB
Abstract; to be placed on the cover sheet of a paper.
Line length is 5/6 of normal; use .ll here to change.
.AE  (abstract end)
text ... (begins with .PP, which see)
```

To omit some of the standard headings (e.g. no abstract, or no author’s institution) just omit the corresponding fields and command lines. The word ABSTRACT can be suppressed by writing ‘‘.AB no’’ for ‘‘.AB’’. Several interspersed .AU and .AI lines can be used for multiple authors. The headings are not compulsory: beginning with a .PP command is perfectly OK and will just start printing an ordinary paragraph. ***Warning:*** You can’t just begin a document with a line of text. Some –ms command must precede any text input. When in doubt, use .LP to get proper initialization, although any of the commands .PP, .LP, .TL, .SH, .NH is good enough. Figure 1 shows the legal arrangement of commands at the start of a document.

Cover Sheets and First Pages. The first line of a document signals the general format of the first page. In particular, if it is ".RP" a cover sheet with title and abstract is prepared. The default format is useful for scanning drafts.

In general –ms is arranged so that only one form of a document need be stored, containing all information; the first command gives the format, and unnecessary items for that format are ignored.

Warning: don’t put extraneous material between the .TL and .AE commands. Processing of the titling items is special, and other data placed in them may not behave as you expect. Don’t forget that some –ms command must precede any input text.

Page headings. The –ms macros, by default, will print a page heading containing a page number (if greater than 1). A default page footer is provided only in ***nroff***, where the date is used. The user can make

minor adjustments to the page headings/footings by redefining the strings LH, CH, and RH which are the left, center and right portions of the page headings, respectively; and the strings LF, CF, and RF, which are the left, center and right portions of the page footer. For more complex formats, the user can redefine the macros PT and BT, which are invoked respectively at the top and bottom of each page. The margins (taken from registers HM and FM for the top and bottom margin respectively) are normally 1 inch; the page header/footer are in the middle of that space. The user who redefines these macros should be careful not to change parameters such as point size or font without resetting them to default values.

Multi-column formats. If you place the command ‘‘.2C’’ in your document, the document will be printed in double column format beginning at that point. This feature is not too useful in computer terminal output, but is often desirable on the typesetter. The command ‘‘.1C’’ will go back to one-column format and also skip to a new page. The ‘‘.2C’’ command is actually a special case of the command

.MC [column width [gutter width]]

which makes multiple columns with the specified column and gutter width; as many columns as will fit across the page are used. Thus triple, quadruple, ... column pages can be printed. Whenever the number of columns is changed (except going from full width to some larger number of columns) a new page is started.

Headings. To produce a special heading, there are two commands. If you type

.NH
type section heading here
may be several lines

you will get automatically numbered section headings (1, 2, 3, ...), in boldface. For example,

.NH
Care and Feeding of Department Heads

produces

1. Care and Feeding of Department Heads

Alternatively,

.SH
Care and Feeding of Directors

will print the heading with no number added:

Care and Feeding of Directors

Every section heading, of either type, should be followed by a paragraph beginning with .PP or .LP, indicating the end of the heading. Headings may contain more than one line of text.

The .NH command also supports more complex numbering schemes. If a numerical argument is given, it is taken to be a ‘‘level’’ number and an appropriate sub-section number is generated. Larger level numbers indicate deeper sub-sections, as in this example:

.NH
Erie-Lackawanna
.NH 2
Morris and Essex Division
.NH 3
Gladstone Branch
.NH 3
Montclair Branch
.NH 2
Boonton Line

generates:

2. Erie-Lackawanna

2.1. Morris and Essex Division

2.1.1. Gladstone Branch

2.1.2. Montclair Branch

2.2. Boonton Line

An explicit ‘‘.NH 0’’ will reset the numbering of level 1 to one, as here:

.NH 0
Penn Central

1. Penn Central

Indented paragraphs. (Paragraphs with hanging numbers, e.g. references.) The sequence

.IP [1]
Text for first paragraph, typed
normally for as long as you would
like on as many lines as needed.
.IP [2]
Text for second paragraph, ...

produces

[1] Text for first paragraph, typed normally for as long as you would like on as many lines as needed.

[2] Text for second paragraph, ...

A series of indented paragraphs may be followed by an ordinary paragraph beginning with .PP or .LP, depending on whether you wish indenting or not. The command .LP was used here.

More sophisticated uses of .IP are also possible. If the label is omitted, for example, a plain block indent is produced.

```
.IP
This material will
just be turned into a
block indent suitable for quotations or
such matter.
.LP
```

will produce

> This material will just be turned into a block indent suitable for quotations or such matter.

If a non-standard amount of indenting is required, it may be specified after the label (in character positions) and will remain in effect until the next .PP or .LP. Thus, the general form of the .IP command contains two additional fields: the label and the indenting length. For example,

```
.IP first: 9
Notice the longer label, requiring larger
indenting for these paragraphs.
.IP second:
And so forth.
.LP
```

produces this:

first: Notice the longer label, requiring larger indenting for these paragraphs.

second: And so forth.

It is also possible to produce multiple nested indents; the command .RS indicates that the next .IP starts from the current indentation level. Each .RE will eat up one level of indenting so you should balance .RS and .RE commands. The .RS command should be thought of as ‘‘move right’’ and the .RE command as ‘‘move left’’. As an example

```
.IP 1.
Bell Laboratories
.RS
.IP 1.1
Murray Hill
.IP 1.2
Holmdel
.IP 1.3
Whippany
.RS
.IP 1.3.1
Madison
.RE
.IP 1.4
Chester
.RE
.LP
```

will result in

1. Bell Laboratories
   - 1.1 Murray Hill
   - 1.2 Holmdel
   - 1.3 Whippany
     - 1.3.1 Madison
   - 1.4 Chester

All of these variations on .LP leave the right margin untouched. Sometimes, for purposes such as setting off a quotation, a paragraph indented on both right and left is required.

> A single paragraph like this is obtained by preceding it with .QP. More complicated material (several paragraphs) should be bracketed with .QS and .QE.

Emphasis. To get italics (on the typesetter) or underlining (on the terminal) say

```
.I
as much text as you want
can be typed here
.R
```

as was done for *these three words.* The .R command restores the normal (usually Roman) font. If only one word is to be italicized, it may be just given on the line with the .I command,

```
.I word
```

and in this case no .R is needed to restore the previous font. **Boldface** can be produced by

```
.B
Text to be set in boldface
goes here
.R
```

and also will be underlined on the terminal or line printer. As with .I, a single word can be placed in boldface by placing it on the same line as the .B command.

A few size changes can be specified similarly with the commands .LG (make larger), .SM (make smaller), and .NL (return to normal size). The size change is two points; the commands may be repeated for increased effect (here one .NL canceled two .SM commands).

If actual underlining as opposed to italicizing is required on the typesetter, the command

```
.UL word
```

will underline a word. There is no way to underline multiple words on the typesetter.

Footnotes. Material placed between lines with the commands .FS (footnote) and .FE (footnote end) will be collected, remembered, and finally placed at the bottom of the current page*. By default, footnotes are 11/12th the length of normal text, but this can be changed using the FL register (see below).

Displays and Tables. To prepare displays of lines, such as tables, in which the lines should not be re-arranged, enclose them in the commands .DS and .DE

```
.DS
table lines, like the
examples here, are placed
between .DS and .DE
.DE
```

By default, lines between .DS and .DE are indented and left-adjusted. You can also center lines, or retain the left margin. Lines bracketed by .DS C and .DE commands are centered (and not re-arranged); lines bracketed by .DS L and .DE are left-adjusted, not indented, and not re-arranged. A plain .DS is equivalent to .DS I, which indents and left-adjusts. Thus,

```
these lines were preceded
by .DS C and followed by
    a .DE command;
```

whereas

```
these lines were preceded
by .DS L and followed by
a .DE command.
```

Note that .DS C centers each line; there is a variant .DS B that makes the display into a left-adjusted block of text, and then centers that entire block. Normally a display is kept together, on one page. If you wish to have a long display which may be split across page boundaries, use .CD, .LD, or .ID in place of the commands .DS C, .DS L, or .DS I respectively. An extra argument to the .DS I or .DS command is taken as an amount to indent. Note: it is tempting to assume that .DS R will right adjust lines, but it doesn't work.

Boxing words or lines. To draw rectangular boxes around words the command

```
.BX word
```

will print word as shown. The boxes will not be neat on a terminal, and this should not be used as a substitute for italics.

Longer pieces of text may be boxed by enclosing them with .B1 and .B2:

```
.B1
text...
.B2
```

as has been done here.

Keeping blocks together. If you wish to keep a table or other block of lines together on a page, there are ''keep - release'' commands. If a block of lines preceded by .KS and followed by .KE does not fit on the remainder of the current page, it will begin on a new page. Lines bracketed by .DS and .DE commands are automatically kept together this way. There is also a ''keep floating'' command: if the block to be kept together is preceded by .KF instead of .KS and does not fit on the current page, it will be moved down through the text until the top of the next page. Thus, no large blank space will be introduced in the document.

Nroff/Troff commands. Among the useful commands from the basic formatting programs are the following. They all work with both typesetter and computer terminal output:

* Like this.

.bp - begin new page.
.br - ‘‘break’’, stop running text
from line to line.
.sp n - insert n blank lines.
.na - don’t adjust right margins.

Date. By default, documents produced on computer terminals have the date at the bottom of each page; documents produced on the typesetter don’t. To force the date, say ‘‘.DA’’. To force no date, say ‘‘.ND’’. To lie about the date, say ‘‘.DA July 4, 1776’’ which puts the specified date at the bottom of each page. The command

.ND May 8, 1945

in ".RP" format places the specified date on the cover sheet and nowhere else. Place this line before the title.

Signature line. You can obtain a signature line by placing the command .SG in the document. The authors’ names will be output in place of the .SG line. An argument to .SG is used as a typing identification line, and placed after the signatures. The .SG command is ignored in released paper format.

Registers. Certain of the registers used by –ms can be altered to change default settings. They should be changed with .nr commands, as with

.nr PS 9

to make the default point size 9 point. If the effect is needed immediately, the normal *troff* command should be used in addition to changing the number register.

Register	Defines	Takes effect	Default
PS	point size	next para.	10
VS	line spacing	next para.	12 pts
LL	line length	next para.	6″
LT	title length	next para.	6″
PD	para. spacing	next para.	0.3 VS
PI	para. indent	next para.	5 ens
FL	footnote length	next FS	11/12 LL
CW	column width	next 2C	7/15 LL
GW	intercolumn gap	next 2C	1/15 LL
PO	page offset	next page	26/27″
HM	top margin	next page	1″
FM	bottom margin	next page	1″

You may also alter the strings LH, CH, and RH which are the left, center, and right headings respectively; and similarly LF, CF, and RF which are strings in the page footer. The page number on *output* is taken from register PN, to permit changing its output style. For more complicated headers and footers the macros PT and BT can be redefined, as explained earlier.

Accents. To simplify typing certain foreign words, strings representing common accent marks are defined. They precede the letter over which the mark is to appear. Here are the strings:

Input	Output	Input	Output
*’e	é	*~a	ã
*`e	è	*Ce	e̊
*:u	ü	*,c	ç
*^e	ê		

Use. After your document is prepared and stored on a file, you can print it on a terminal with the command*

nroff –ms file

and you can print it on the typesetter with the command

troff –ms file

(many options are possible). In each case, if your document is stored in several files, just list all the filenames where we have used ‘‘file’’. If equations or tables are used, *eqn* and/or *tbl* must be invoked as preprocessors.

References and further study. If you have to do Greek or mathematics, see ***eqn*** [1] for equation setting. To aid ***eqn*** users, ***–ms*** provides definitions of .EQ and .EN which normally center the equation and set it off slightly. An argument on .EQ is taken to be an equation number and placed in the right margin near the equation. In addition, there are three special arguments to EQ: the letters C, I, and L indicate centered (default), indented, and left adjusted equations, respectively. If there is both a format argument and an equation number, give the format argument first, as in

.EQ L (1.3a)

for a left-adjusted equation numbered (1.3a).

Similarly, the macros .TS and .TE are defined to separate tables (see [2]) from text with a little space. A very long table with a heading may be broken across pages by beginning it with .TS H instead of .TS, and placing the line .TH in the table data after the heading. If the table has no heading repeated from page to page, just use

* If .2C was used, pipe the *nroff* output through *col;* make the first line of the input ‘‘.pi /usr/bin/col.’’

the ordinary .TS and .TE macros.

To learn more about *troff* see [3] for a general introduction, and [4] for the full details (experts only). Information on related UNIX commands is in [5]. For jobs that do not seem well-adapted to –ms, consider other macro packages. It is often far easier to write a specific macro packages for such tasks as imitating particular journals than to try to adapt –ms.

Acknowledgment. Many thanks are due to Brian Kernighan for his help in the design and implementation of this package, and for his assistance in preparing this manual.

References

[1] B. W. Kernighan and L. L. Cherry, *Typesetting Mathematics — Users Guide (2nd edition)*, Bell Laboratories Computing Science Report no. 17.

[2] M. E. Lesk, *Tbl — A Program to Format Tables*, Bell Laboratories Computing Science Report no. 45.

[3] B. W. Kernighan, *A Troff Tutorial*, Bell Laboratories, 1976.

[4] J. F. Ossanna, *Nroff/Troff Reference Manual*, Bell Laboratories Computing Science Report no. 51.

[5] K. Thompson and D. M. Ritchie, *UNIX Programmer's Manual*, Bell Laboratories, 1978.

Appendix A
List of Commands

1C	Return to single column format.	LG	Increase type size.
2C	Start double column format.	LP	Left aligned block paragraph.
AB	Begin abstract.		
AE	End abstract.		
AI	Specify author's institution.		
AU	Specify author.	ND	Change or cancel date.
B	Begin boldface.	NH	Specify numbered heading.
DA	Provide the date on each page.	NL	Return to normal type size.
DE	End display.	PP	Begin paragraph.
DS	Start display (also CD, LD, ID).		
EN	End equation.	R	Return to regular font (usually Roman).
EQ	Begin equation.	RE	End one level of relative indenting.
FE	End footnote.	RP	Use released paper format.
FS	Begin footnote.	RS	Relative indent increased one level.
		SG	Insert signature line.
I	Begin italics.	SH	Specify section heading.
		SM	Change to smaller type size.
IP	Begin indented paragraph.	TL	Specify title.
KE	Release keep.		
KF	Begin floating keep.	UL	Underline one word.
KS	Start keep.		

Register Names

The following register names are used by –ms internally. Independent use of these names in one's own macros may produce incorrect output. Note that no lower case letters are used in any –ms internal name.

Number registers used in –ms

:	DW	GW	HM	IQ	LL	NA	OJ	PO	T.	TV
#T	EF	H1	HT	IR	LT	NC	PD	PQ	TB	VS
1T	FL	H3	IK	KI	MM	NF	PF	PX	TD	YE
AV	FM	H4	IM	L1	MN	NS	PI	RO	TN	YY
CW	FP	H5	IP	LE	MO	OI	PN	ST	TQ	ZN

String registers used in –ms

′	A5	CB	DW	EZ	I	KF	MR	R1	RT	TL
`	AB	CC	DY	FA	I1	KQ	ND	R2	S0	TM
^	AE	CD	E1	FE	I2	KS	NH	R3	S1	TQ
~	AI	CF	E2	FJ	I3	LB	NL	R4	S2	TS
:	AU	CH	E3	FK	I4	LD	NP	R5	SG	TT
,	B	CM	E4	FN	I5	LG	OD	RC	SH	UL
1C	BG	CS	E5	FO	ID	LP	OK	RE	SM	WB
2C	BT	CT	EE	FQ	IE	ME	PP	RF	SN	WH
A1	C	D	EL	FS	IM	MF	PT	RH	SY	WT
A2	C1	DA	EM	FV	IP	MH	PY	RP	TA	XD
A3	C2	DE	EN	FY	IZ	MN	QF	RQ	TE	XF
A4	CA	DS	EQ	HO	KE	MO	R	RS	TH	XK

Order of Commands in Input

RP

TL

AU

AI

AB

AE

NH, SH

PP, LP

text ...

Figure 1

A Guide to Preparing Documents with –ms

M. E. Lesk

Bell Laboratories August 1978

This guide gives some simple examples of document preparation on Bell Labs computers, emphasizing the use of the ***–ms*** macro package. It enormously abbreviates information in

1. ***Typing Documents on UNIX and GCOS,*** by M. E. Lesk;
2. ***Typesetting Mathematics – User's Guide,*** by B. W. Kernighan and L. L. Cherry; and
3. ***Tbl – A Program to Format Tables,*** by M. E. Lesk.

These memos are all included in the ***UNIX Programmer's Manual, Volume 2.*** The new user should also have ***A Tutorial Introduction to the UNIX Text Editor,*** by B. W. Kernighan.

For more detailed information, read ***Advanced Editing on UNIX*** and ***A Troff Tutorial,*** by B. W. Kernighan, and (for experts) ***Nroff/Troff Reference Manual*** by J. F. Ossanna. Information on related commands is found (for UNIX users) in ***UNIX for Beginners*** by B. W. Kernighan and the ***UNIX Programmer's Manual*** by K. Thompson and D. M. Ritchie.

Contents

A TM 2
A released paper 3
An internal memo, and headings 4
Lists, displays, and footnotes 5
Indents, keeps, and double column 6
Equations and registers 7
Tables and usage 8

Throughout the examples, input is shown in
this Helvetica sans serif font
while the resulting output is shown in
this Times Roman font.

UNIX Document no. 1111

Commands for a TM

```
.TM 1978-5b3 99999 99999-11
.ND April 1, 1976
.TL
The Role of the Allen Wrench in Modern
Electronics
.AU "MH 2G-111" 2345
J. Q. Pencilpusher
.AU "MH 1K-222" 5432
X. Y. Hardwired
.AI
.MH
.OK
Tools
Design
.AB
This abstract should be short enough to
fit on a single page cover sheet.
It must attract the reader into sending for
the complete memorandum.
.AE
.CS 10 2 12 5 6 7
.NH
Introduction.
.PP
Now the first paragraph of actual text ...
...
Last line of text.
.SG MH-1234-JQP/XYH-unix
.NH
References ...
```

Commands not needed in a particular format are ignored.

♥ **Bell Laboratories** Cover Sheet for TM

This information is for employees of Bell Laboratories. (GEI 13.9-3)

Title- **The Role of the Allen Wrench in Modern Electronics**

Date- **April 1, 1976**

TM- **1978-5b3**

Other Keywords- **Tools Design**

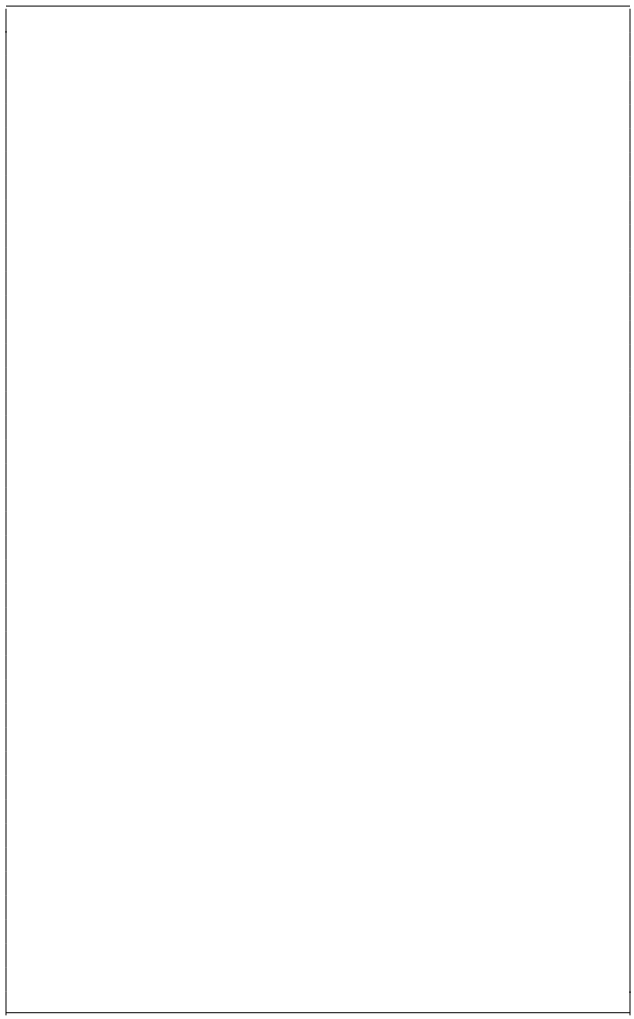
Author	Location	Ext.	Charging Case- **99999**
J. Q. Pencilpusher	**MH 2G-111**	**2345**	Filing Case- **99999a**
X. Y. Hardwired	**MH 1K-222**	**5432**	

ABSTRACT

This abstract should be short enough to fit on a single page cover sheet. It must attract the reader into sending for the complete memorandum.

Pages Text 10	Other 2	Total 12	
No. Figures 5	No. Tables 6	No. Refs. 7	

E-1932-U (6-73) SEE REVERSE SIDE FOR DISTRIBUTION LIST



A Released Paper with Mathematics

```
.EQ
delim $$
.EN
.RP

... (as for a TM)

.CS 10 2 12 5 6 7
.NH
Introduction
.PP
The solution to the torque handle equation
.EQ (1)
sum from 0 to inf F ( x sub i ) = G ( x )
.EN
is found with the transformation $ x = rho over
theta $ where $ rho = G prime (x) $ and $theta$
is derived ...
```

The Role of the Allen Wrench
in Modern Electronics

J. Q. Pencilpusher

X. Y. Hardwired

Bell Laboratories
Murray Hill, New Jersey 07974

ABSTRACT

This abstract should be short enough to fit on a single page cover sheet. It must attract the reader into sending for the complete memorandum.

April 1, 1976

The Role of the Allen Wrench
in Modern Electronics

J. Q. Pencilpusher

X. Y. Hardwired

Bell Laboratories
Murray Hill, New Jersey 07974

1. Introduction

The solution to the torque handle equation

(1)

is found with the transformation $x = \frac{\rho}{\theta}$ where $\rho = G'(x)$ and θ is derived from well-known principles.

An Internal Memorandum

```
.IM
.ND January 24, 1956
.TL
The 1956 Consent Decree
.AU
Able, Baker &
Charley, Attys.
.PP
Plaintiff, United States of America, having filed
its complaint herein on January 14, 1949; the
defendants having appeared and filed their
answer to such complaint denying the
substantive allegations thereof; and the parties,
by their attorneys, ...
```

♥

Bell Laboratories

Subject: **The 1956 Consent Decree** date: **January 24, 1956**

from: **Able, Baker & Charley, Attys.**

Plaintiff, United States of America, having filed its complaint herein on January 14, 1949; the defendants having appeared and filed their answer to such complaint denying the substantive allegations thereof; and the parties, by their attorneys, having severally consented to the entry of this Final Judgment without trial or adjudication of any issues of fact or law herein and without this Final Judgment constituting any evidence or admission by any party in respect of any such issues;

Now, therefore before any testimony has been taken herein, and without trial or adjudication of any issue of fact or law herein, and upon the consent of all parties hereto, it is hereby

Ordered, adjudged and decreed as follows:

I. [Sherman Act]

This Court has jurisdiction of the subject matter herein and of all the parties hereto. The complaint states a claim upon which relief may be granted against each of the defendants under Sections 1, 2 and 3 of the Act of Congress of July 2, 1890, entitled ‘‘An act to protect trade and commerce against unlawful restraints and monopolies,’’ commonly known as the Sherman Act, as amended.

II. [Definitions]

For the purposes of this Final Judgment:

(a) ‘‘Western’’ shall mean the defendant Western Electric Company, Incorporated.

Other formats possible (specify before .TL) are: .MR (‘‘memo for record’’), .MF (‘‘memo for file’’), .EG (‘‘engineer’s notes’’) and .TR (Computing Science Tech. Report).

Headings

```
.NH
Introduction.
.PP
text text text
```

1. Introduction

text text text

```
.SH
Appendix I
.PP
text text text
```

Appendix I

text text text

A Simple List

```
.IP 1.
J. Pencilpusher and X. Hardwired,
.I
A New Kind of Set Screw,
.R
Proc. IEEE
.B 75
(1976), 23-255.
.IP 2.
H. Nails and R. Irons,
.I
Fasteners for Printed Circuit Boards,
.R
Proc. ASME
.B 23
(1974), 23-24.
.LP  (terminates list)
```

1. J. Pencilpusher and X. Hardwired, *A New Kind of Set Screw*, Proc. IEEE **75** (1976), 23-255.
2. H. Nails and R. Irons, *Fasteners for Printed Circuit Boards*, Proc. ASME **23** (1974), 23-24.

Displays

```
text text text text text text
.DS
and now
for something
completely different
.DE
text text text text text text
```

hoboken harrison newark roseville avenue grove street east orange brick church orange highland avenue mountain station south orange maplewood millburn short hills summit new providence

```
and now
for something
completely different
```

murray hill berkeley heights gillette stirling millington lyons basking ridge bernardsville far hills peapack gladstone

Options: .DS L: left-adjust; .DS C: line-by-line center; .DS B: make block, then center.

Footnotes

```
Among the most important occupants
of the workbench are the long-nosed pliers.
Without these basic tools*
.FS
* As first shown by Tiger & Leopard
(1975).
.FE
few assemblies could be completed.  They may
lack the popular appeal of the sledgehammer
```

Among the most important occupants of the workbench are the long-nosed pliers. Without these basic tools* few assemblies could be completed. They may lack the popular

appeal

of the sledgehammer

* As first shown by Tiger & Leopard (1975).

Multiple Indents

```
This is ordinary text to point out
the margins of the page.
.IP 1.
First level item
.RS
.IP a)
Second level.
.IP b)
Continued here with another second
level item, but somewhat longer.
.RE
.IP 2.
Return to previous value of the
indenting at this point.
.IP 3.
Another
line.
```

This is ordinary text to point out the margins of the page.

1. First level item
   a) Second level.
   b) Continued here with another second level item, but somewhat longer.
2. Return to previous value of the indenting at this point.
3. Another line.

Keeps

Lines bracketed by the following commands are kept together, and will appear entirely on one page:

.KS	not moved	.KF	may float
.KE	through text	.KE	in text

Double Column

```
.TL
The Declaration of Independence
.2C
.PP
When in the course of human events, it becomes
necessary for one people to dissolve the political
bonds which have connected them with another, and
to assume among the powers of the earth the
separate and equal station to which the laws of
Nature and of Nature's God entitle them, a decent
respect to the opinions of
```

The Declaration of Independence

When in the course of human events, it becomes necessary for one people to dissolve the political bonds which have connected them with another, and to assume among the powers of the earth the separate and equal station to which the laws of Nature and of Nature's God entitle them, a decent respect to the opinions of

mankind

requires that they should declare the causes which impel them to the separation.

We hold these truths to be self-evident, that all men are created equal, that they are endowed by their creator with certain unalienable rights, that among these are life, liberty, and the pursuit of happiness. That to secure these rights, governments are instituted among men,

Equations

A displayed equation is marked
with an equation number at the right margin
by adding an argument to the EQ line:

```
.EQ (1.3)
x sup 2 over a sup 2 ~=~ sqrt {p z sup 2 +qz+r}
.EN
```

A displayed equation is marked with an equation number at the right margin by adding an argument to the EQ line:

$$\frac{x^2}{a^2} = \sqrt{pz^2+qz+r} \qquad (1.3)$$

```
.EQ  I (2.2a)
bold V bar sub nu~=~left [ pile {a above b above
c } right ] + left [ matrix { col { A(11) above .
above . } col { . above . above .} col {. above .
above A(33) }} right ] cdot left [ pile { alpha
above beta above  gamma } right ]
.EN
```

$$\bar{\mathbf{V}}_{\nu} = \begin{bmatrix} a \\ b \\ c \end{bmatrix} + \begin{bmatrix} A(11) & . & . \\ . & . & . \\ . & . & A(33) \end{bmatrix} \cdot \begin{bmatrix} \alpha \\ \beta \\ \gamma \end{bmatrix} \qquad (2.2a)$$

```
.EQ  L
F hat ( chi ) ~ mark = ~ | del V | sup 2
.EN
.EQ  L
lineup =~ {left ( {partial V} over {partial x} right ) } sup 2
+ { left ( {partial V} over {partial y} right ) } sup 2 ~~~~~
lambda -> inf
.EN
```

$$\hat{F}(\chi) = |\nabla V|^2$$

$$= \left(\frac{\partial V}{\partial x}\right)^2 + \left(\frac{\partial V}{\partial y}\right)^2 \qquad \lambda \to \infty$$

$ a dot $, $ b dotdot$, $ xi tilde times y vec$:

$\dot{a}$, $\ddot{b}$, $\tilde{\xi} \times \vec{y}$. (with delim $$ on, see panel 3).

See also the equations in the second table, panel 8.

Some Registers You Can Change

Line length
.nr LL 7i

Title length
.nr LT 7i

Point size
.nr PS 9

Vertical spacing
.nr VS 11

Column width
.nr CW 3i

Intercolumn spacing
.nr GW .5i

Margins – head and foot
.nr HM .75i
.nr FM .75i

Paragraph indent
.nr PI 2n

Paragraph spacing
.nr PD 0

Page offset
.nr PO 0.5i

Page heading
.ds CH Appendix (center)
.ds RH 7-25-76 (right)
.ds LH Private (left)

Page footer
.ds CF Draft
.ds LF
.ds RF similar

Page numbers
.nr % 3

Tables

```
.TS                ( ⍑ indicates a tab)
allbox;
c s s
c c c
n n n.
AT&T Common Stock
Year ⍑Price ⍑Dividend
1971 ⍑41-54 ⍑$2.60
2 ⍑41-54 ⍑2.70
3 ⍑46-55 ⍑2.87
4 ⍑40-53 ⍑3.24
5 ⍑45-52 ⍑3.40
6 ⍑51-59 ⍑.95*
.TE
* (first quarter only)
```

AT&T Common Stock		
Year	Price	Dividend
1971	41-54	$2.60
2	41-54	2.70
3	46-55	2.87
4	40-53	3.24
5	45-52	3.40
6	51-59	.95*

* (first quarter only)

The meanings of the key-letters describing the alignment of each entry are:

c	center	n	numerical
r	right-adjust	a	subcolumn
l	left-adjust	s	spanned

The global table options are center, expand, box, doublebox, allbox, tab (*x*) and linesize (*n*).

```
.TS                (with delim $$ on, see panel 3)
doublebox, center;
c c
l l.
Name ⍑Definition
.sp
Gamma ⍑$GAMMA (z) = int sub 0 sup inf \
   t sup {z-1} e sup -t dt$
Sine ⍑$sin (x) = 1 over 2i ( e sup ix - e sup -ix )$
Error ⍑$ roman erf (z) = 2 over sqrt pi \
  int sub 0 sup z e sup {-t sup 2} dt$
Bessel ⍑$ J sub 0 (z) = 1 over pi \
  int sub 0 sup pi cos ( z sin theta ) d theta $
Zeta ⍑$ zeta (s) = \
  sum from k=1 to inf k sup -s ~~( Re~s > 1)$
.TE
```

Name	Definition
Gamma	$\Gamma(z)=\int_0^\infty t^{z-1}e^{-t}\,dt$
Sine	$\sin(x)=\frac{1}{2i}(e^{ix}-e^{-ix})$
Error	$\operatorname{erf}(z)=\frac{2}{\sqrt{\pi}}\int_0^z e^{-t^2}dt$
Bessel	$J_0(z)=\frac{1}{\pi}\int_0^\pi \cos(z\sin\theta)d\theta$
Zeta	$\zeta(s)=\sum_{k=1}^{\infty}k^{-s}\quad(\mathrm{Re}\,s>1)$

Usage

Documents with just text:
troff -ms files
With equations only:
eqn files | troff -ms
With tables only:
tbl files | troff -ms
With both tables and equations:

```
tbl files | eqn | troff -ms
```

The above generates STARE output on GCOS: replace –st with –ph for typesetter output.

A Revised Version of −ms

Bill Tuthill

Computing Services
University of California
Berkeley, CA 94720

The −ms macros have been slightly revised and rearranged. Because of the rearrangement, the new macros can be read by the computer in about half the time required by the previous version of −ms. This means that output will begin to appear between ten seconds and several minutes more quickly, depending on the system load. On long files, however, the savings in total time are not substantial. The old version of −ms is still available as −mos.

Several bugs in −ms have been fixed, including a bad problem with the .1C macro, minor difficulties with boxed text, a break induced by .EQ before initialization, the failure to set tab stops in displays, and several bothersome errors in the **refer** macros. Macros used only at Bell Laboratories have been removed. There are a few extensions to previous −ms macros, and a number of new macros, but all the documented −ms macros still work exactly as they did before, and have the same names as before. Output produced with −ms should look like output produced with −mos.

One important new feature is automatically numbered footnotes. Footnote numbers are printed by means of a pre-defined string (**), which you invoke separately from .FS and .FE. Each time it is used, this string increases the footnote number by one, whether or not you use .FS and .FE in your text. Footnote numbers will be superscripted on the phototypesetter and on daisy-wheel terminals, but on low-resolution devices (such as the lpr and a crt), they will be bracketed. If you use ** to indicate numbered footnotes, then the .FS macro will automatically include the footnote number at the bottom of the page. This footnote, for example, was produced as follows:[1]

```
This footnote, for example, was produced as follows:\**
.FS
        ...
.FE
```

If you are using ** to number footnotes, but want a particular footnote to be marked with an asterisk or a dagger, then give that mark as the first argument to .FS: †

```
then give that mark as the first argument to .FS: \(dg
.FS   \(dg
        ...
.FE
```

Footnote numbering will be temporarily suspended, because the ** string is not used. Instead of a dagger, you could use an asterisk * or double dagger ‡, represented as \(dd.

Another new feature is a macro for printing theses according to Berkeley standards. This macro is called .TM, which stands for thesis mode. (It is much like the .th macro in −me.) It will put page numbers in the upper right-hand corner; number the first page; suppress the date; and doublespace everything except quotes, displays, and keeps. Use it at the top of each file making up your thesis. Calling .TM defines the .CT macro for chapter titles, which skips to a new page and moves the pagenumber to the center footer. The .P1 (P one) macro can be used even without thesis mode to print the header on page 1, which is suppressed except in thesis mode. If you want roman

---

[1] If you never use the ‘‘**’’ string, no footnote numbers will appear anywhere in the text, including down here. The output footnotes will look exactly like footnotes produced with −mos.

† In the footnote, the dagger will appear where the footnote number would otherwise appear, as on the left.

numeral page numbering, use an ‘‘.af PN i’’ request.

There is a new macro especially for bibliography entries, called .XP, which stands for exdented paragraph. It will exdent the first line of the paragraph by \n(PI units, usually 5n (the same as the indent for the first line of a .PP). Most bibliographies are printed this way. Here are some examples of exdented paragraphs:

Lumley, Lyle S., *Sex in Crustaceans: Shell Fish Habits*, Harbinger Press, Tampa Bay and San Diego, October 1979. 243 pages. The pioneering work in this field.

Leffadinger, Harry A., ‘‘Mollusk Mating Season: 52 Weeks, or All Year?’’ in *Acta Biologica*, vol. 42, no. 11, November 1980. A provocative thesis, but the conclusions are wrong.

Of course, you will have to take care of italicizing the book title and journal, and quoting the title of the journal article. Indentation or exdentation can be changed by setting the value of number register PI.

If you need to produce endnotes rather than footnotes, put the references in a file of their own. This is similar to what you would do if you were typing the paper on a conventional typewriter. Note that you can use automatic footnote numbering without actually having .FS and .FE pairs in your text. If you place footnotes in a separate file, you can use .IP macros with ** as a hanging tag; this will give you numbers at the left-hand margin. With some styles of endnotes, you would want to use .PP rather then .IP macros, and specify ** before the reference begins.

There are four new macros to help produce a table of contents. Table of contents entries must be enclosed in .XS and .XE pairs, with optional .XA macros for additional entries; arguments to .XS and .XA specify the page number, to be printed at the right. A final .PX macro prints out the table of contents. Here is a sample of typical input and output text:

```
.XS ii
Introduction
.XA 1
Chapter 1: Review of the Literature
.XA 23
Chapter 2: Experimental Evidence
.XE
.PX
```

Table of Contents

Introduction ii
Chapter 1: Review of the Literature 1
Chapter 2: Experimental Evidence 23

The .XS and .XE pairs may also be used in the text, after a section header for instance, in which case page numbers are supplied automatically. However, most documents that require a table of contents are too long to produce in one run, which is necessary if this method is to work. It is recommended that you do a table of contents after finishing your document. To print out the table of contents, use the .PX macro; if you forget it, nothing will happen.

As an aid in producing text that will format correctly with both **nroff** and **troff**, there are some new string definitions that define quotation marks and dashes for each of these two formatting programs. The *− string will yield two hyphens in **nroff**, but in **troff** it will produce an em dash— like this one. The *Q and *U strings will produce ‘‘ and ’’ in **troff**, but " in **nroff**. (In typesetting, the double quote is traditionally considered bad form.)

There are now a large number of optional foreign accent marks defined by the −ms macros. All the accent marks available in −mos are present, and they all work just as they always did. However, there are better definitions available by placing .AM at the beginning of your document. Unlike the −mos accent marks, the accent strings should come *after* the letter being accented. Here is a list of the diacritical marks, with examples of what they look like.

name of accent	input	output
acute accent	e*´	é
grave accent	e*`	è
circumflex	o*^	ô
cedilla	c*,	ç
tilde	n*~	ñ
question	*?	¿
exclamation	*!	¡
umlaut	u*:	ü
digraph s	*8	ß
hacek	c*v	č
macron	a*_	ā
underdot	s*.	ṣ
o-slash	o*/	ø
angstrom	a*o	å
yogh	kni*3t	kni$_3$t
Thorn	*(Th	Þ
thorn	*(th	þ
Eth	*(D-	Ð
eth	*(d-	ð
hooked o	*q	ǫ
ae ligature	*(ae	æ
AE ligature	*(Ae	Æ
oe ligature	*(oe	œ
OE ligature	*(Oe	Œ

If you want to use these new diacritical marks, don't forget the .AM at the top of your file. Without it, some will not print at all, and others will be placed on the wrong letter.

It is also possible to produce custom headers and footers that are different on even and odd pages. The .OH and .EH macros define odd and even headers, while .OF and .EF define odd and even footers. Arguments to these four macros are specified as with .tl. This document was produced with:

```
.OH ´\fIThe -mx Macros´´Page %\fP´
.EH ´\fIPage %´´The -mx Macros\fP´
```

Note that it would be a error to have an apostrophe in the header text; if you need one, you will have to use a different delimiter around the left, center, and right portions of the title. You can use any character as a delimiter, provided it doesn't appear elsewhere in the argument to .OH, .EH, .OF, or EF.

The −ms macros work in conjunction with the **tbl**, **eqn**, and **refer** preprocessors. Macros to deal with these items are read in only as needed, as are the thesis macros (.TM), the special accent mark definitions (.AM), table of contents macros (.XS and .XE), and macros to format the optional cover page. The code for the −ms package lives in /usr/lib/tmac/tmac.s, and sourced files reside in the directory /usr/ucb/lib/ms.

May 13, 1987