

UNIX™ System V

DOCUMENTER'S WORKBENCH™ Software
Macro Package Reference

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DOCUMENTER'S WORKBENCHTM Software
Macro Package Reference

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Chapter 1

INTRODUCTION

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Chapter 1

INTRODUCTION

This book is a guide and reference manual for the text processing macro packages that are provided on the UNIX* system. These macro packages are a part of the DOCUMENTER'S WORKBENCH† software which provides an integrated system of text processing tools for easy, flexible, and professional documentation production. Books that describe other aspects of the DOCUMENTER'S WORKBENCH software are:

- *Introduction and Reference Manual*
- *Text Formatters Reference*
- *Preprocessor Reference*

Each of the chapters in this book is a user guide to a specific macro package. Information is provided in each chapter that will allow the user to understand and use the macros and access information quickly. The beginning user should refer to the *Introduction and Reference Manual* for a better overall description of the text processing tools available.

What is a Macro?

On the UNIX system, the text formatting programs (**nroff**, **troff**, **otroff**, and **sroff**) provide control of text format by the use of requests (sometimes called formatter primitives) that are mixed in with the text to be formatted. These requests normally consist of two lowercase letters preceded by a period, on a line by themselves in the text file. The request may be followed on the same line by numbers or letters that provide the formatter with more information

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about the function of the request. The formatter requests provide a low-level control of text formatting for items such as indentation, line length, spacing, filling, adjusting, centering, and titles.

One of the most useful functions of the formatters is the ability to define a group of formatter requests into a single request called a macro. The macro is given a one- or two-character name and is called, using the macro name, in the same manner as a formatter request. The normal call to a macro consists of a period at the beginning of a line, followed immediately by the one- or two-character macro name and any arguments. The arguments may consist of letters or numbers and each argument must be separated from the previous argument by a space. The arguments may be used inside the macro by the formatter requests. This is called argument substitution and it allows the user to provide specific information for the macro each time it is called. This process provides great flexibility in the function of a macro.

Macros allow the user to define powerful text formatting functions that can be called by a single name and modified easily. The use of macros simplifies the task of formatting a document. For more information on defining macros, refer to the book *Text Formatters Reference*.

Macro Packages

Several predefined macro packages that can be used with the text formatters are provided in the DOCUMENTER'S WORKBENCH software. Each of these packages contain a set of macros designed to be flexible and useful for most text formatting needs. The macro packages that are covered in this book are described below.

- **Memorandum (MM) Macros:** Chapter 2—These are the standard, general-purpose macros that work with the text

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formatters **nroff**, **troff**, and **otroff**. They provide all the macros usually needed to produce a wide variety of document styles ranging from a simple letter to a several hundred page book (such as this). Documents can be printed on a simple printer using **nroff** or on a phototypesetter using **troff** or **otroff**.

- **Sroff/MM Macros:** Chapter 3—These are a set of macros styled after the memorandum macros but designed to work with the **sroff** text formatter. **Sroff/MM** macros do not have the full capability of **MM** macros, and since they work with **sroff**, they cannot produce output for a phototypesetter. They are designed for documents that will be produced on a printer, but because of their simplicity, the time required to format a document is greatly reduced from that of **MM** macros with **nroff**, **troff**, or **otroff**. With a few exceptions, **sroff/MM** macros are compatible with **MM** macros (macro names, arguments, and functions), so a document could be produced from the same text file using either package.
- **Viewgraph (MV) Macros:** Chapter 4—These are a set of special-purpose macros designed to produce viewgraphs and slides using the **troff** or **otroff** formatter. The **MV** package provides several macros useful in controlling the format of text within a viewgraph or slide.

Note: The acronym “**MM**” is used to refer to the *Memorandum Macro* package as used by the **nroff**, **troff**, and **otroff** formatters. The term **sroff/MM** is used when the discussion is about the macro package used by the **sroff** formatter. The term **nroff/MM** is used to differentiate between the **nroff** and **sroff** formatters when discussions are about the respective macro packages. The term **mm** refers to the command, or option, used to invoke the **MM** macro package.

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MEMORANDUM MACROS USER GUIDE

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Chapter 2

MEMORANDUM MACROS USER GUIDE

1. Introduction

1.1 Purpose

This chapter is a guide and reference manual for users of Memorandum Macros (MM). These macros provide a general purpose package of text formatting macros for use with the UNIX operating system text formatters **nroff** and **troff/otroff**.

1.2 Conventions

Each part of this chapter explains a single facility of MM and progresses from general case to special-case facilities. It is recommended that a user read a part in detail only to the point where there is enough information to obtain the desired format, then skim the rest because some details may be of use to only a few.

Numbers enclosed in braces ({}) refer to paragraph numbers within this section. For example, this is paragraph {1.2}.

In the synopses of macro calls, square brackets ([]) surrounding an argument indicate that it is optional. Ellipses (...) show that the preceding argument may appear more than once.

In those cases in which the behavior of the two formatters **nroff** and **troff** is obviously different, the **nroff** formatter output is described first with the **troff** formatter output following in parentheses.

For Example:

The title is underlined (italic).

means that the title is underlined by the **nroff** formatter and italicized by the **troff** formatter.

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1.3 UNIX System Commands

Manual pages for the UNIX system commands are documented in the UNIX system reference manuals. These UNIX system reference manuals provide a brief description of the UNIX system commands and their options and the format for using these commands. A UNIX system command will have the form **name** when used in this guide, where the term **name** refers to a command name that can be found in a UNIX system reference manual. The following list contains the commands identified in this guide. In addition, the list categorizes the commands by the reference manual in which they can be found.

1. *UNIX System User Reference Manual* — **300**, **4014**, **450**, **col**, **ed**, **hp**, **sh**, and **spell**.
2. *UNIX System Programmer Reference Manual* — **term** and **termio**.
3. *Introduction and Reference Manual* — **checkmm**, **mmlint**, **eqn**, **eqnchar**, **mm**, **mmlint**, **mmt**, **mv**, **mvt**, **neqn**, **nroff**, **ocw**, **otroff**, **sroff**, **tbl**, and **troff**.

1.4 Document Structure

Input for a document to be formatted with the MM text formatting macro package has four major segments, any of which may be omitted; if present, the segments must occur in the following order:

- *Parameter setting segment* sets the general style and appearance of a document. The user can control page width, margin justification, numbering styles for heading and lists, page headers and footers {9}, and many other properties of the document. Also, the user can add macros or redefine existing ones. This segment can be omitted entirely if the user is satisfied with default values; it produces no actual output, but performs only the formatter setup for the rest of the document.
- *Beginning segment* includes those items that occur only once, at the beginning of a document, e.g., title, author's name, date.
- *Body segment* is the actual text of the document. It may be as small as a single paragraph or as large as hundreds of pages. It

may have a hierarchy of headings up to seven levels deep {4}. Headings are automatically numbered (if desired) and can be saved to generate the table of contents. Five additional levels of subordination are provided by a set of list macros for automatic numbering, alphabetic sequencing, and “marking” of list items {5}. The body may also contain various types of displays, tables, figures, references, and footnotes {7, 8, 11}.

- *Ending segment* contains those items that occur only once at the end of a document. Included are signature(s) and lists of notations (e.g., “Copy to” lists) {6.11}. Certain macros may be invoked here to print information that is wholly or partially derived from the rest of the document, such as the table of contents or the cover sheet for a document {10}.

Existence and size of these four segments varies widely among different document types. Although a specific item (such as date, title, author names, etc.) of a segment may differ depending on the document, there is a uniform way of typing it into an input text file.

1.5 Input Text Structure

In order to make it easy to edit or revise input file text at a later time:

- Input lines should be kept short.
- Lines should be broken at the end of clauses.
- Each new sentence should begin on a new line.

1.6 Definitions

Formatter refers to either the **nroff**, **troff** or **otroff** text-formatting program.

Note: Throughout this chapter, a reference to **troff** also means **otroff** unless otherwise indicated.

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Requests are built-in commands recognized by the formatters. Although a user seldom needs to use these requests directly {3.10}, this section {1} contains references to some of the requests. For example, the request

```
.sp
```

inserts a blank line in the output at the place the request occurs in the input text file.

Macros are named collections of requests. Each macro is an abbreviation for a collection of requests that would otherwise require repetition. The MM package supplies many macros, and the user can define additional ones. Macros and requests share the same set of names and are used in the same way.

A complete listing of memorandum macros is given in the *MM Macro Name Summary* {16} section of this chapter.

Strings provide character variables, each of which names a string of characters. Strings are often used in page headers, page footers, and lists. A string can be given a value via the **.ds** (define string) request, and its value can be obtained by referencing its name, preceded by “*” (for 1-character names) or “*(” (for 2-character names). For instance, the string **DT** in MM normally contains the current date, thus the input line

```
Today is \*(DT.
```

may result in the following output:

```
Today is July 25, 1983.
```

The current date can be replaced, e.g.:

```
.ds DT 01/01/79
```

by invoking a macro designed for that purpose {6.8}. A listing of MM string names is given in the *MM String Name Summary* {17} section of this chapter.

Number registers fill the role of integer variables. These registers are used for flags and for arithmetic and automatic numbering. (The registers share the pool of names used by requests and macros.) A register can be given a value using a `.nr` request and be referenced by preceding its name by "`\n`" (for 1-character names) or "`\n(`" (for 2-character names). For example, the following sets the value of the register `d` to one more than that of the register `dd`:

```
.nr d 1+\n(dd
```

A complete listing of MM number registers is given in the *MM Number Register Summary* {18} section of this chapter.

Paragraph 14.1 contains naming conventions for requests, macros, strings, and number registers. The last four sections of this chapter list all macros, strings, number registers, and error messages defined in MM.

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2. Usage

This part describes how to access MM, illustrates UNIX operating system command lines appropriate for various output devices, and describes command line flags for the MM text formatting macro package.

2.1 The *mm* Command

The **mm** command can be used to prepare documents using the **nroff** formatter and the MM macro package; this command invokes **nroff** with the **-cm** flag {2.2}. The **mm** command has options to specify preprocessing by **tbl** and/or by **neqn** and for postprocessing by various output filters.

Note: Options can occur in any order but must appear before the file names.

Any arguments or flags that are not recognized by the **mm** command, e.g., **-rC3**, are passed to the **nroff** formatter or to MM, as appropriate. Options are:

<i>OPTION</i>	<i>MEANING</i>
-e	The neqn is to be invoked; also causes neqn to read <i>/usr/pub/eqnchar</i> (see eqnchar).
-t	The tbl preprocessor is to be invoked.
-c	The col postprocessor is to be invoked.
-E	The -e option of the nroff formatter is to be invoked.
-y	The uncompact macros (-mm) are to be used instead of compacted macros (-cm).
-12	The 12-pitch mode is to be used. The pitch switch on the terminal should be set to 12 if necessary.
-T450	Output is to a DASI 450. This is the default terminal type (unless \$TERM is set; see sh). It is also equivalent to -T1620 .

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- T450-12 Output is to a DASI 450 in 12-pitch mode.
- T300 Output is to a DASI 300 terminal.
- T300-12 Output is to a DASI 300 in 12-pitch mode.
- T300s Output is to a DASI 300S.
- T300s-12 Output is to a DASI 300S in 12-pitch mode.
- T4014 Output is to a TEKTRONIX* 4014.
- T37 Output is to a TELETYPE† Model 37.
- T382 Output is to a DTC-382.
- T4000a Output is to a TRENDATA 4000A‡.
- TX Output is prepared for an EBCDIC line printer.
- Thp Output is to a Hewlett-Packard HP262x or HP264x (implies -c).
- T43 Output is to a TELETYPE Model 43 (implies -c).
- T40/4 Output is to a TELETYPE Model 40/4 (implies -c).
- T745 Output is to a Texas Instrument 700 series terminal (implies -c).
- T2631 Output is prepared for a HP2631 printer where -T2631-e and -T2631-c may be used for expanded and compressed modes, respectively (implies -c).
- Tlp Output is to a device with no reverse or partial line motions or other special features (implies -c).

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Any other `-T` option given does not produce an error; it is equivalent to `-Tlp`.

A similar command is available for use with the **troff** formatter (see **mmt**).

2.2 The `-cm` or `-mm` Flag

The MM package can also be invoked by including the `-cm` or `-mm` flag as an argument to the formatter. The `-cm` flag causes the precompact version of the macros to be loaded.

Note: The `-cm` option cannot be used with **troff** (device independent). The **troff** formatter does not allow compacted macros. The `-cm` option can be used with **otroff** (old troff).

The `-mm` flag causes the file `/usr/lib/tmac/tmac.m` to be read and processed before any other files. This action:

- Defines the Memorandum Macros
- Sets default values for various parameters
- Initializes the formatter to be ready to process input text files.

2.3 Typical Command Lines

The prototype command lines are as follows (various options are explained in paragraph 2.4):

- Text without tables or equations:

```
mm [options] file ...
or
nroff [options] -cm file ...

mmt [options] file ...
or
troff [options] -mm file ...
or
otroff [options] -cm file ...
```

- Text with tables:

```
mm -t [options] file ...
or
tbl file ... | nroff [options] -cm

mmt -t [options] file ...
or
tbl file ... | troff [options] -mm
or
tbl file ... | otroff [options] -cm
```

- Text with equations:

```
mm -e [options] file ...
or
neqn /usr/pub/eqnchar file ... | nroff [options] -cm

mmt -e [options] file ...
or
eqn /usr/pub/eqnchar file ... | troff [options] -mm
or
eqn /usr/pub/eqnchar file ... | otroff [options] -cm
```

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- Text with both tables and equations:

```
mm -t -e [options] file ...  
or  
tbl file ... ! neqn /usr/pub/eqnchar - ! nroff [options] -cm  
  
mmt -t -e [options] file ...  
or  
tbl file ... ! eqn /usr/pub/eqnchar - ! troff [options] -mm  
or  
tbl file ... ! eqn /usr/pub/eqnchar - ! otroff [options] -cm
```

Note: On any line shown above with a call to **otroff** (or **nroff**) using the **-cm** option, the **-mm** option may be used instead of **-cm**.

When formatting a document with the **nroff** processor, the output should normally be processed for a specific type of terminal. This is because the output may require some features that are specific to a given terminal, e.g., reverse paper motion or half-line paper motion in both directions.

Some commonly used terminal types and the command lines appropriate for them are given below. More information is found in paragraph 2.4 of this part, and **300**, **450**, **4014**, **hp**, **col**, **termio**, and **term** of the *UNIX System User Reference Manual*.

- DASI 450 in 10-pitch, 6 lines/inch mode, with 0.75 inch offset, and a line length of 6 inches (60 characters). This is the default terminal type, therefore no **-T** option is needed (unless **\$TERM** is set to another value).

```
mm file ...  
or  
nroff -T450 -h -cm file ...
```

- DASI 450 in 12-pitch, 6 lines/inch mode, with 0.75 inch offset, and a line length of 6 inches (72 characters):

```
mm -12 file ...
or
nroff -T450-12 -h -cm file ...
```

To increase the line length to 80 characters and decrease the offset to 3 characters:

```
mm -12 -rW80 -rO3 file ...
or
nroff -T450-12 -rW80 -rO3 -h -cm file ...
```

- Hewlett-Packard HP262x or HP264x CRT family:

```
mm -Thp file ...
or
nroff -cm file ... | col | hp
```

- Any terminal incapable of reverse paper motion and also lacking hardware tab stops (Texas Instruments 700 series, etc.):

```
mm -T745 file ...
or
nroff -cm file ... | col -x
```

The **tbl** and **eqn/neqn** preprocessors must be invoked as shown in the command lines illustrated earlier.

If 2-column processing {12.4} is used with the **nroff** formatter, either the **-c** option must be specified to **mm** [**mm** uses **col** automatically for many terminal types {2.1}] or the **nroff** formatter output must be postprocessed by **col**. In the latter case, the **-T37** terminal type must be specified to the **nroff** formatter, the **-h** option must not be specified, and the output of **col** must be processed by the appropriate terminal filter (e.g., **450**); **mm** with the **-c** option handles all this automatically.

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2.4 Parameters Set From Command Line

Number registers are commonly used within MM to hold parameter values that control various aspects of output style. Many of these values can be changed within the text files with `.nr` requests. In addition, some of these registers can be set from the command line. This is a useful feature for those parameters that should not be permanently embedded within the input text. If used, the number registers (with the exception of the *P* register) must be set on the command line or before the MM macro definitions are processed. The number register meanings are:

- `-rAn` $n = 1$ has effect of invoking the `.AF` macro without an argument {6.9}.

- `-rCn` sets type of copy (e.g., DRAFT) to be printed at bottom of each page {9.2.4}.
 $n = 1$ for OFFICIAL FILE COPY.
 $n = 2$ for DATE FILE COPY.
 $n = 3$ for DRAFT with single spacing and default paragraph style.
 $n = 4$ for DRAFT with double spacing and 10-space paragraph indent.

- `-rD1` sets *debug* mode.
 This flag requests formatter to continue processing even if MM detects errors that would otherwise cause termination. It also includes some debugging information in the default page header {9.2.1, 12.3}.

- `-rEn` controls font of Subject/Date/From fields.
 $n = 0$, fields are bold (default for the **troff** formatter).
 $n = 1$, fields are Roman font (regular text-default for the **nroff** formatter).

- `-rLk` sets length of physical page to k lines.
 For the **nroff** formatter, k is an unscaled number representing lines.
 For the **troff** formatter, k must be scaled.
 Default value is 66 lines per page.

This flag is used, for example, when directing output to a Versatec* printer.

- rNn** specifies page numbering style (See Figure 2-1).
n = 0 (default), all pages get the prevailing header {9.2.1}.
n = 1, page header replaces footer on page 1 only.
n = 2, page header is omitted from page 1.
n = 3, “section-page” numbering {4.5} occurs (.FD {8.3} and .RP {11.4} defines footnote and reference numbering in sections).
n = 4, default page header is suppressed; however, a user-specified header is not affected.
n = 5, “section-page” and “section-figure” numbering occurs.

<i>n</i>	<i>PAGE 1</i>	<i>PAGES 2-END</i>
0	header	header
1	header replaces footer	header
2	no header	header
3	“section-page” as footer	same as page 1
4	no header	no header unless .PH defined
5	“section-page” as footer and “section-figure”	same as page 1

Figure 2-1. Table Showing Effects of The N Register on Page Numbering Style

Contents of the prevailing header and footer do not depend on number register *N* value; *N* controls whether the header (*N*=3) or the footer (*N*=5) is printed, as well as the page numbering style. If header and footer are null {9.2.1, 9.2.4}, the value of *N* is irrelevant.

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-rOk offsets output *k* spaces to the right.
For the **nroff** formatter, *k* is an unscaled number representing lines or character positions.
For the **troff** formatter, *k* must be scaled.
This flag is helpful for adjusting output positioning on some terminals. The default offset if this register is not set on the command line is 0.75 inch (**nroff**) and 0.5 inch (**troff**).

Note: This register name is the capital letter “O”.

-rPn specifies that pages of the document are to be numbered starting with *n*.
This register may also be set via a **.nr** request in the input text.

-rSn sets point size and vertical spacing for the document.
The default *n* is 10, i.e., 10-point type on 12-point vertical spacing, giving six lines per inch {12.10}.
This flag applies to the **troff** formatter only.

-rTn provides register settings for certain devices.
If *n* is 1, line length and page offset are set to 80 and 3, respectively.
Setting *n* to 2 changes the page length to 84 lines per page and inhibits underlining; it is meant for output sent to the Versatec printer.
The default value for *n* is 0.
This flag applies to the **nroff** formatter only.

-rU1 controls underlining of section headings.
This flag causes only letters and digits to be underlined. Otherwise, all characters (including spaces) are underlined {4.2.2.4.2}.
This flag applies to the **nroff** formatter only.

`-rWk` sets page width (line length and title length) to *k*.
 For the **nroff** formatter, *k* is an unscaled number representing character positions.
 For the **troff** formatter, *k* must be scaled.
 This flag can be used to change page width from the default value of 6 inches (60 characters in 10 pitch or 72 characters in 12 pitch).

2.5 Omission of `-cm` or `-mm` Flag

If a large number of arguments is required on the command line, it may be convenient to set up the first (or only) input file of a document as follows:

```
zero or more initializations of registers listed in paragraph 2.4
.so /usr/lib/tmac/tmac.m
remainder of text.
```

In this case, the user must not use the `-cm` or `-mm` flag [nor the **mm** or **mmt** command]; the `.so` request has the equivalent effect, but registers shown in paragraph 2.4 must be initialized before the `.so` request because their values are meaningful only if set before macro definitions are processed. When using this method, it is best to lock into the input file only those parameters that are seldom changed. For example:

```
.nr W 80
.nr O 10
.nr N 3
.so /usr/lib/tmac/tmac.m
.H 1 "INTRODUCTION"
.
.
.
```

specifies, for the **nroff** formatter, a line length (W) of 80, a page offset (O) of 10, and “section-page” (N) numbering.

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3. Formatting Concepts

3.1 Basic Terms

Normal action of the formatters is to fill output lines from one or more input lines. Output lines may be justified so that both the left and right margins are aligned. As lines are being filled, words may also be hyphenated {3.4} as necessary. It is possible to turn any of these modes on and off (`.SA` {12.2}, `Hy` {3.4}, and the `.nf` and `.fi` formatter requests). Turning off fill mode also turns off justification and hyphenation.

Certain formatting commands (requests and macros) cause filling of the current output line to cease, the line (of whatever length) to be printed, and subsequent text to begin a new output line. This printing of a partially filled output line is known as a *break*. A few formatter requests and most of the MM macros cause a break.

Formatter requests {3.10} can be used with MM; however, there are consequences and side effects that each such request might have. A good rule is to use formatter requests only when absolutely necessary. The MM macros described herein should be used in most cases because:

- It is much easier to control (and change at any later point in time) overall style of the document.
- Complicated features (such as footnotes or tables of contents) can be obtained with ease.
- User is insulated from peculiarities of the formatter language.

3.2 Arguments and Double Quotes

For any macro call, a null argument is an argument whose width is zero. Such an argument often has a special meaning; the preferred form for a null argument is `" "`. Omitting an argument is not the same as supplying a null argument (e.g., the `.MT` macro {6.7}). Omitted arguments can occur only at the end of an argument list; null arguments can occur anywhere in the list.

Any macro argument containing ordinary (paddable) spaces must be enclosed in double quotes. A double quote (") is a single character that must not be confused with two apostrophes (''), acute accents (´), or grave accents (`). Otherwise, it will be treated as several separate arguments.

Double quotes are not permitted as part of the value of a macro argument or of a string that is to be used as a macro argument. If it is necessary to have a macro argument value, two grave accents (``) and/or two acute accents (´´) may be used instead. This restriction is necessary because many macro arguments are processed (interpreted) a variable number of times. For example, headings are first printed in the text and may be reprinted in the table of contents.

3.3 Unpaddable Spaces

When output lines are justified to give an even right margin, existing spaces in a line may have additional spaces appended to them. This may distort the desired alignment of text. To avoid this distortion, it is necessary to specify a space that cannot be expanded during justification, i.e., an *unpaddable space*. There are several ways to accomplish this:

- The user may type a backslash followed by a space (\). This pair of characters directly generates an unpaddable space.
- The user may sacrifice some seldom-used character to be translated into a space upon output.

Because this translation occurs after justification, the chosen character may be used anywhere an unpaddable space is desired. The tilde (~) is often used with the translation macro for this purpose. To use the tilde in this way, the following is inserted at the beginning of the document:

```
.tr ~
```

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If a tilde must actually appear in the output, it can be temporarily “recovered” by inserting

```
.tr ~
```

before the place where needed. Its previous usage is restored by repeating the `.tr ~` after a break or after the line containing the tilde has been forced out.

Note: Use of the tilde in this fashion is not recommended for documents in which the tilde is used within equations.

3.4 Hyphenation

Formatters do not perform hyphenation unless requested. Hyphenation can be turned on in the body of the text by specifying

```
.nr Hy 1
```

at the beginning of the document input file. Paragraph 8.3 describes hyphenation within footnotes and across pages.

If hyphenation is requested, formatters will automatically hyphenate words if need be. However, the user may specify hyphenation points for a specific occurrence of any word with a special character known as a hyphenation indicator or may specify hyphenation points for a small list of words (about 128 characters).

If the *hyphenation indicator* (initially, the 2-character sequence “\%”) appears at the beginning of a word, the word is not hyphenated. Alternatively, it can be used to indicate legal hyphenation points inside a word. All occurrences of the hyphenation indicator disappear on output.

The user may specify a different hyphenation indicator.

```
.HC [hyphenation-indicator]
```

The circumflex ($\hat{\ }$) is often used for this purpose by inserting the following at the beginning of a document input text file:

```
.HC ^
```

Note: Any word containing hyphens or dashes (also known as *em dashes*) will be hyphenated immediately after a hyphen or dash if it is necessary to hyphenate the word, even if the formatter hyphenation function is turned off.

The user may supply, via the exception word **.hw** request, a small list of words with the proper hyphenation points indicated. For example, to indicate the proper hyphenation of the word “printout”, the user may specify

```
.hw print-out
```

3.5 Tabs

Macros **.MT** {6.7}, **.TC** {10.1}, and **.CS** {10.2} use the formatter tabs **.ta** request to set tab stops and then restore the default values of tab settings (every eight characters in the **nroff** formatter; every ½ inch in the **troff** formatter). Setting tabs to other than the default values is the user’s responsibility.

Default tab setting values are 9, 17, 25, ..., 161 for a total of 20 tab stops. Values may be separated by commas, spaces, or any other non-numeric character. A user may set tab stops at any value desired. For example:

```
.ta 9 17 25 33 41 49 57 ... 161
```

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A tab character is interpreted with respect to its position on the input line rather than its position on the output line. In general, tab characters should appear only on lines processed in no-fill (**.nf**) mode {3.1}.

The **tbl** program {7.3} changes tab stops but does not restore default tab settings.

3.6 BEL Character

The nonprinting character BEL is used as a delimiter in many macros to compute the width of an argument or to delimit arbitrary text, e.g., in page headers and footers {9}, headings {4}, and lists {5}. Users who include BEL characters in their input text file (especially in arguments to macros) will receive mangled output.

3.7 Bullets

A bullet (●) is often obtained on a typewriter terminal by using an “o” overstruck by a “+”. For compatibility with the **troff** formatter, a bullet string is provided by MM with the following sequence:

```
\*(BU
```

The bullet list (.BL) macro {5.1.1.2} uses this string to generate automatically the bullets for bullet listed items.

3.8 Dashes, Minus Signs, and Hyphens

The **troff** formatter has distinct graphics for a dash, a minus sign, and a hyphen; the **nroff** formatter does not.

- Users who intend to use the **nroff** formatter may use only the minus sign (–) for the minus, hyphen, and dash.
- Users who plan to use the **troff** formatter primarily should follow **troff** escape conventions.

- Users who plan to use both formatters must take care during input text file preparation. Unfortunately, these graphic characters cannot be represented in a way that is both compatible and convenient for both formatters.

The following approach is suggested:

Dash	Type “*(EM” for each text dash for both nroff and troff formatters. This string generates an em dash in the troff formatter and two dashes (--) in the nroff formatter. Dash list (.DL) macros {5.1.1.3} automatically generate the em dash for each list item.
Hyphen	Type “-” and use as is for both formatters. The nroff formatter will print it as is. The troff formatter will print - (a true hyphen).
Minus	Type “\ -” for a true minus sign regardless of formatter. The nroff formatter will ignore the \. The troff formatter will print a true minus sign.

3.9 Trademark String

A trademark string “*(Tm” is available with MM. This places the letters “TM” one-half line above the text that it follows.

For example:

```
The
.I
UNIX
.R
\*(Tm
.I
System User Reference Manual
.R
is available from the library.
```

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yields:

The *UNIX*[™] *System User Reference Manual* is available from the library.

3.10 Use of Formatter Requests

Most formatter requests should not be used with MM because MM provides the corresponding formatting functions in a much more user-oriented and surprise-free fashion than do the basic formatter requests. However, some formatter requests are useful with MM, namely the following:

.af	Assign format
.br	Break
.ce	Center
.de	Define macro
.ds	Define string
.fi	Fill output lines
.hw	Exception word
.ls	Line spacing
.nf	No filling of output lines
.nr	Define and set number register
.nx	Go to next file (does not return)
.rm	Remove macro
.rr	Remove register
.rs	Restore spacing
.so	Switch to source file and return
.sp	Space
.ta	Tab stop settings
.ti	Temporary indent
.tl	Title
.tr	Translate
!	Escape

The **.fp**, **.lg**, and **.ss** requests are also sometimes useful for the **troff** formatter. Use of other requests without fully understanding their implications very often leads to disaster.

4. Paragraphs and Headings

4.1 Paragraphs

`.P [type]`
one or more lines of text.

The `.P` macro is used to control paragraph style.

4.1.1 Paragraph Indention

An indented or a nonindented paragraph is defined with the *type* argument:

<i>type</i>	<i>RESULT</i>
0	left justified
1	indent

In a left-justified paragraph, the first line begins at the left margin. In an indented paragraph, the paragraph is indented the amount specified in the *Pi* register (default value is 5). For example, to indent paragraphs by ten spaces, the following is entered at the beginning of the document input file:

```
.nr Pi 10
```

A document input file possesses a default paragraph type obtained by specifying “.P” before each paragraph that does not follow a heading {4.2}. Default paragraph type is controlled by the *Pt* number register.

- The initial value of *Pt* is 0, which provides left-justified paragraphs.

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- All paragraphs can be forced to be indented by inserting the following at the beginning of the document input file:

```
.nr Pt 1
```

- All paragraphs can be indented except after headings, lists, and displays by entering the following at the beginning of the document input file:

```
.nr Pt 2
```

Both the *Pi* and *Pt* register values must be greater than zero for any paragraphs to be indented.

Note: Values that specify indentation must be unscaled and are treated as character positions, i.e., as a number of ens. In the **nroff** formatter, an en is equal to the width of a character. In the **troff** formatter, an en is the number of points (1 point = 1/72 of an inch) equal to half the current point size.

Regardless of the value of *Pt*, an individual paragraph can be forced to be left-justified or indented. The “.P 0” macro request forces left justification; “.P 1” causes indentation by the amount specified by the register *Pi*.

If .P occurs inside a list, the indent (if any) of the paragraph is added to the current list indent {5}.

4.1.2 Numbered Paragraphs

Numbered paragraphs may be produced by setting the *Np* register to 1. This produces paragraphs numbered within first level headings, e.g., 1.01, 1.02, 1.03, 2.01, etc.

A different style of numbered paragraphs is obtained by using the **.nP** macro rather than the **.P** macro for paragraphs. This produces paragraphs that are numbered within second level headings.

```
.H 1 " FIRST HEADING"
.H 2 " Second Heading"
.nP
one or more lines of text
```

The paragraphs contain a “double-line indent” in which the text of the second line is indented to be aligned with the text of the first line so that the number stands out.

4.1.3 Spacing Between Paragraphs

The *Ps* number register controls the amount of spacing between paragraphs. By default, *Ps* is set to 1, yielding one blank space (one-half a vertical space).

4.2 Numbered Headings

```
.H level [heading-text] [heading-suffix]
zero or more lines of text
```

The *level* argument provides the numbered heading level. There are seven heading levels; level 1 is the highest, level 7 is the lowest.

The *heading-text* argument is the text of the heading. If the heading contains more than one word or contains spaces, the entire argument must be enclosed in double quotes.

The *heading-suffix* argument may be used for footnote marks which should not appear with heading text in the table of contents.

There is no need for a *.P* macro immediately after a *.H* or *.HU* {4.3} because the *.H* macro also performs the function of the *.P* macro. Any immediately following *.P* macro is ignored. It is, however, good practice to start every paragraph with a *.P* macro, thereby ensuring that all paragraphs uniformly begin with a *.P* throughout an entire document.

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4.2.1 Normal Appearance

The effect of the .H macro varies according to the *level* argument. First-level headings are preceded by two blank lines (one vertical space); all others are preceded by one blank line (one-half a vertical space). The following table describes the default effect of the *level* argument.

.H 1 heading-text	Produces an underlined (italicized) font heading followed by a single blank line (one-half a vertical space). The following text begins on a new line and is indented according to the current paragraph type. Full capital letters should be used to make the heading stand out.
.H 2 heading-text	Produces an underlined (italicized) font heading followed by a single blank line (one-half a vertical space). The following text begins on a new line and is indented according to the current paragraph type. Initial capitals should be used in the heading text.
.H <i>n</i> heading-text	Produces an underlined (italicized) heading followed by two spaces ($3 \leq n \leq 7$). The following text begins on the same line.

Appropriate numbering and spacing (horizontal and vertical) occur even if the heading-text argument is omitted from a .H macro call.

The following listing gives the first few .H calls used for this part:

```
.H 1 " Paragraphs and Headings"  
.H 2 " Paragraphs"  
.H 3 " Paragraph Indention"  
.H 3 " Numbered Paragraphs"  
.H 3 " Spacing Between Paragraphs"  
.H 2 " Numbered Headings"  
.H 3 " Normal Appearance"  
.H 3 " Altering Appearance"  
.H 4 " Prespacing and Page Ejection"  
.H 4 " Spacing After Headings"  
.H 4 " Centered Headings"  
.H 4 " Bold, Italic, and Underlined Headings"  
.H 5 " Control by Level:"
```

Note: Users satisfied with the default appearance of headings may skip to the paragraph entitled "Unnumbered Headings" {4.3}.

4.2.2 Altering Appearance

The user can modify the appearance of headings quite easily by setting certain registers and strings at the beginning of the document input text file. This permits quick alteration of a document's style because this style-control information is concentrated in a few lines rather than being distributed throughout the document.

4.2.2.1 Prespacing and Page Ejection

A first-level heading (.H 1) normally has two blank lines (one vertical space) preceding it, and all other headings are preceded by one blank line (one-half a vertical space). If a multiline heading were to be split across pages, it is automatically moved to the top of the next page. Every first-level heading may be forced to the top of a new page by inserting:

```
.nr Ej 1
```

at the beginning of the document input text file. Long documents may be made more manageable if each section starts on a new page. Setting the *Ej* register to a higher value causes the same effect for

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headings up to that level, i.e., a page eject occurs if the heading level is less than or equal to the *Ej* value.

4.2.2.2 Spacing After Headings

Three registers control the appearance of text immediately following a *.H* call. The registers are *Hb* (heading break level), *Hs* (heading space level), and *Hi* (post-heading indent).

- If the heading level is less than or equal to *Hb*, a break {3.1} occurs after the heading.
- If the heading level is less than or equal to *Hs*, a blank line (one-half a vertical space) is inserted after the heading.
- If a heading level is greater than *Hb* and also greater than *Hs*, then the heading (if any) is immediately followed by text on the same line.

These registers permit headings to be separated from the text in a consistent way throughout a document while allowing easy alteration of white space and heading emphasis. The default value for *Hb* and *Hs* is 2.

For any stand-alone heading, i.e., a heading on a line by itself, alignment of the next line of output is controlled by the *Hi* number register.

- If *Hi* is 0, text is left-justified.
- If *Hi* is 1 (the default value), text is indented according to the paragraph type as specified by the *Pt* register {4.1}.
- If *Hi* is 2, text is indented to line up with the first word of the heading itself so that the heading number stands out more clearly.

To cause a blank line (one-half a vertical space) to appear after the first three heading levels, to have no run-in headings, and to force the text following all headings to be left-justified (regardless of the value of *Pt*), the following should appear at the beginning of the document input text file:

```
.nr Hs 3
.nr Hb 7
.nr Hi 0
```

4.2.2.3 Centered Headings

The *Hc* register can be used to obtain centered headings. A heading is centered if its *level* argument is less than or equal to *Hc* and if it is also a stand-alone heading {4.2.2.2}. The *Hc* register is 0 initially (no centered headings).

4.2.2.4 Bold, Italic, and Underlined Headings

4.2.2.4.1 Control by Level: Any heading that is underlined by the **nroff** formatter is italicized by the **troff** formatter. The string *HF* (heading font) contains seven codes that specify fonts for heading levels 1 through 7. Legal codes, code interpretations, and defaults for *HF* codes are shown in Figure 2-2.

<i>FORMATTER</i>	<i>HF CODE</i>			<i>DEFAULT</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>HF CODE</i>
nroff	no underline	underline	bold	2 2 2 2 2 2
troff	Roman	italic	bold	2 2 2 2 2 2

Figure 2-2. Table Of HF String Codes, Effects, and Default Values

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Thus, all levels are underlined by the **nroff** formatter and italicized by the **troff** formatter. The user may reset HF as desired. Any value omitted from the right end of the list is assumed to be a 1. The following request would result in five bold levels and two underlined (italic) levels:

```
.ds HF 3 3 3 3 3
```

4.2.2.4.2 NROFF Underlining Style: The **nroff** formatter underlines in either of two styles:

- The normal style (**.ul** request) is to underline only letters and digits.
- The continuous style (**.cu** request) underlines all characters including spaces.

By default, MM attempts to use the continuous style on any heading that is to be underlined and is short enough to fit on a single line. If a heading is to be underlined but is longer than a single line, the heading is underlined in the normal style.

All underlining of headings can be forced to the normal style by using the **-rU1** flag when invoking the **nroff** formatter {2.4}.

4.2.2.4.3 Heading Point Sizes: The user may specify the desired point size for each heading level with the *HP* string (for use with the **troff** formatter only).

```
.ds HP [ps1] [ps2] [ps3] [ps4] [ps5] [ps6] [ps7]
```

By default, the text of headings (**.H** and **.HU**) is printed in the same point size as the body except that bold stand-alone headings are printed in a size one point smaller than the body. The string *HP*, similar to the string *HF*, can be specified to contain up to seven values, corresponding to the seven levels of headings. For example:

```
.ds HP 12 12 10 10 10 10 10
```

specifies that the first and second level headings are to be printed in 12-point type with the remainder printed in 10-point. Specified values may also be relative point-size changes, for example:

```
.ds HP +2 +2 -1 -1
```

If absolute point sizes are specified, then absolute sizes will be used regardless of the point size of the body of the document. If relative point sizes are specified, then point sizes for headings will be relative to the point size of the body even if the latter is changed.

Null or zero values imply that default size will be used for the corresponding heading level.

Note: Only the point size of the headings is affected. Specifying a large point size without providing increased vertical spacing (via `.HX` and/or `.HZ {4.6}`) may cause overprinting.

4.2.2.5 Marking Styles—Numerals and Concatenation

```
.HM [arg1] ... [arg7]
```

The registers named *H1* through *H7* are used as counters for the seven levels of headings. Register values are normally printed using Arabic numerals. The `.HM` macro (heading mark style) allows this choice to be overridden thus providing “outline” and other document styles. This macro can have up to seven arguments; each argument is

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a string indicating the type of marking to be used. Legal arguments and their meanings are:

<i>ARGUMENT</i>	<i>MEANING</i>
1	Arabic (default for all levels)
0001	Arabic with enough leading zeroes to get the specified number of digits
A	Uppercase alphabetic
a	Lowercase alphabetic
I	Uppercase Roman
i	Lowercase Roman
omitted	Interpreted as 1 (Arabic)
illegal	No effect

By default, the complete heading mark for a given level is built by concatenating the mark for that level to the right of all marks for all levels of higher value. To inhibit the concatenation of heading level marks, i.e., to obtain just the current level mark followed by a period, the heading mark type register (*Ht*) is set to 1.

For example, a commonly used “outline” style is obtained by:

```
.HM I A 1 a i  
.nr Ht 1
```

4.3 Unnumbered Headings

```
.HU heading-text
```

The **.HU** macro is a special case of **.H**; it is handled in the same way as **.H** except that no heading mark is printed. In order to preserve the hierarchical structure of headings when **.H** and **.HU** calls are intermixed, each **.HU** heading is considered to exist at the level given by register *Hu*, whose initial value is 2. Thus, in the normal case, the only difference between:

```
.HU heading-text
```

and

`.H 2 heading-text`

is the printing of the heading mark for the latter. Both macros have the effect of incrementing the numbering counter for level 2 and resetting to zero the counters for levels 3 through 7. Typically, the value of *Hu* should be set to make unnumbered headings (if any) be the lowest-level headings in a document.

The `.HU` macro can be especially helpful in setting up appendices and other sections that may not fit well into the numbering scheme of the main body of a document {14.2.1}.

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4.4 Headings and Table of Contents

The text of headings and their corresponding page numbers can be automatically collected for a table of contents. This is accomplished by doing the following:

- Specifying in the contents level register, *Cl*, what level headings are to be saved
- Invoking the .TC macro {10.1} at the end of the document.

Any heading whose level is less than or equal to the value of the *Cl* register is saved and later displayed in the table of contents. The default value for the *Cl* register is 2, i.e., the first two levels of headings are saved.

Due to the way headings are saved, it is possible to exceed the formatter's storage capacity, particularly when saving many levels of many headings, while also processing displays {7} and footnotes {8}. If this happens, the "Out of temp file space" formatter error message {19.2} will be issued; the only remedy is to save fewer levels and/or to have fewer words in the heading text.

4.5 First-Level Headings and Page Numbering Style

By default, pages are numbered sequentially at the top of the page. For large documents, it may be desirable to use page numbering of the "section-page" form where "section" is the number of the current first-level heading. This page numbering style can be achieved by specifying the -rN3 or -rN5 flag on the command line {9.3}. As a side effect, this also has the effect of setting *Ej* to 1, i.e., each first level section begins on a new page. In this style, the page number is printed at the bottom of the page so that the correct section number is printed.

4.6 User Exit Macros

Note: This paragraph is intended primarily for users who are accustomed to writing formatter macros.

```
.HX dlevel rlevel heading-text
.HY dlevel rlevel heading-text
.HZ dlevel rlevel heading-text
```

The **.HX**, **.HY**, and **.HZ** macros are the means by which the user obtains a final level of control over the previously described heading mechanism. These macros are not defined by MM, they are intended to be defined by the user. The **.H** macro call invokes **.HX** shortly before the actual heading text is printed; it calls **.HZ** as its last action. After **.HX** is invoked, the size of the heading is calculated. This processing causes certain features that may have been included in **.HX**, such as **.ti** for temporary indent, to be lost. After the size calculation, **.HY** is invoked so that the user may respecify these features. All default actions occur if these macros are not defined. If **.HX**, **.HY**, or **.HZ** are defined by the user, user-supplied definition is interpreted at the appropriate point. These macros can therefore influence handling of all headings because the **.HU** macro is actually a special case of the **.H** macro.

If the user originally invoked the **.H** macro, then the derived level argument (*dlevel*) and the real level argument (*rlevel*) are both equal to the level given in the **.H** invocation. If the user originally invoked the **.HU** macro {4.3}, *dlevel* is equal to the contents of register *Hu*, and *rlevel* is 0. In both cases, *heading-text* is the text of the original invocation.

By the time **.H** calls **.HX**, it has already incremented the heading counter of the specified level {4.2.2.5}, produced blank lines (vertical spaces) to precede the heading {4.2.2.1}, and accumulated the “heading mark”, i.e., the string of digits, letters, and periods needed for a numbered heading. When **.HX** is called, all user-accessible registers and strings can be referenced, as well as the following:

```
string }0
```

If *rlevel* is nonzero, this string contains the “heading mark”. Two unpaddable spaces (to separate the *mark* from the *heading*) have been appended to this

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string.

If *rlevel* is 0, this string is null.

- register ;0 This register indicates the type of spacing that is to follow the heading {4.2.2.2}.
A value of 0 means that the heading is run-in.
A value of 1 means a break (but no blank line) is to follow the heading.
A value of 2 means that a blank line (one-half a vertical space) is to follow the heading.
- string }2 If “register ;0” is 0, this string contains two unpaddingable spaces that will be used to separate the (run-in) heading from the following text.
If “register ;0” is nonzero, this string is null.
- register ;3 This register contains an adjustment factor for a **.ne** request issued before the heading is actually printed. On entry to **.HX**, it has the value 3 if *dlevel* equals 1, and 1 otherwise. The **.ne** request is for the following number of lines: the contents of the “register ;0” taken as blank lines (halves of vertical space) plus the contents of “register ;3” as blank lines (halves of vertical space) plus the number of lines of the heading.

The user may alter the values of }0, }2, and ;3 within **.HX**. The following are examples of actions that might be performed by defining **.HX** to include the lines shown:

- Change first-level heading mark from format *n.* to *n.0*:

```
.if \\$1=1 .ds }0 \\n(H1.0\<sp>\<sp>
```


(where <sp> stands for a space)
- Separate run-in heading from the text with a period and two unpaddingable spaces:

```
.if \\n(;0=0 .ds }2 .\<sp>\<sp>
```
- Assure that at least 15 lines are left on the page before printing a first-level heading:

```
.if \\$1=1 .nr ;3 (15-\\n(;0)v
```

- Add three additional blank lines before each first-level heading:
`.if \\$1=1 .sp 3`
- Indent level 3 run-in headings by five spaces:
`.if \\$1=3 .ti 5n`

If temporary strings or macros are used within `.HX`, their names should be chosen with care {14.1}.

When the `.HY` macro is called after the `.ne` is issued, certain features requested in `.HX` must be repeated.

For example:

```
.de HY
.if \\$1=3 .ti 5n
..
```

The `.HZ` macro is called at the end of `.H` to permit user-controlled actions after the heading is produced. In a large document, sections may correspond to chapters of a book; and the user may want to change a page header or footer, e.g.:

```
.de HZ
.if \\$1=1 .PF " Section \\$3"
..
```

4.7 Hints for Large Documents

A large document is often organized for convenience into one input text file per section. If the files are numbered, it is wise to use enough digits in the names of these files for the maximum number of sections, i.e., use suffix numbers 01 through 20 rather than 1 through 9 and 10 through 20.

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Users often want to format individual sections of long documents. To do this with the correct section numbers, it is necessary to set register *H1* to one less than the number of the section just before the corresponding **.H 1** call. For example, at the beginning of Part 5, insert

```
.nr H1 4
```

Caution: This is not good practice. It defeats the automatic (re)numbering of sections when sections are added or deleted. Such lines should be removed as soon as possible.

5. Lists

This part describes different styles of lists; automatically numbered and alphabetized lists, bullet lists, dash lists, lists with arbitrary marks, and lists starting with arbitrary strings, i.e., with terms or phrases to be defined.

5.1 List Macros

In order to avoid repetitive typing of arguments to describe the style or appearance of items in a list, MM provides a convenient way to specify lists. All lists share the same overall structure and are composed of the following basic parts:

- A *list-initialization macro* (.AL .BL, .DL, .ML, .RL, or .VL) determines the style of list: line spacing, indentation, marking with special symbols, and numbering or alphabetizing of list items {5.1.1}.
- One or more *list-item macros* (.LI) identifies each unique item to the system. It is followed by the actual text of the corresponding list item {5.1.2}.
- The *list-end macro* (.LE) identifies the end of the list. It terminates the list and restores the previous indentation {5.1.3}.

Lists may be nested up to six levels. The list-initialization macro saves the previous list status (indentation marking style, etc.); the .LE macro restores it.

With this approach, the format of a list is specified only once at the beginning of the list. In addition, by building onto the existing structure, users may create their own customized sets of list macros with relatively little effort ({5.2} and {5.3}).

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5.1.1 List-Initialization Macros

List-initialization macros are implemented as calls to the more basic `.LB` macro {5.2}. They are:

<code>.AL</code>	Automatically Numbered or Alphabetized List {5.1.1.1}
<code>.BL</code>	Bullet List {5.1.1.2}
<code>.DL</code>	Dash List {5.1.1.3}
<code>.ML</code>	Marked List {5.1.1.4}
<code>.RL</code>	Reference List {5.1.1.5}
<code>.VL</code>	Variable-Item List {5.1.1.6}

5.1.1.1 Automatically Numbered or Alphabetized List

```
.AL [type] [text-indent] [1]
```

The `.AL` macro is used to begin sequentially numbered or alphabetized lists. If there are no arguments, the list is numbered; and text is indented by *Li* (initially six) spaces from the indent in force when the `.AL` is called. This leaves room for a space, two digits, a period, and two spaces before the text. Values that specify indentation must be unscaled and are treated as “character positions”, i.e., number of ens.

Spacing at the beginning of the list and between items can be suppressed by setting the list space register (*Ls*). The *Ls* register is set to the innermost list level for which spacing is done. For example:

```
.nr Ls 0
```

specifies that no spacing will occur around any list items. The default value for *Ls* is six (which is the maximum list nesting level).

- The *type* argument may be given to obtain a different type of sequencing. Its value indicates the first element in the sequence

desired. If *type* argument is omitted or null, the value 1 is assumed.

<i>ARGUMENT</i>	<i>INTERPRETATION</i>
1	Arabic (default for all levels)
A	Uppercase alphabetic
a	Lowercase alphabetic
I	Uppercase Roman
i	Lowercase Roman

- If *text-indent* argument is non-null, it is used as the number of spaces from the current indent to the text; i.e., it is used instead of the *Li* register for this list only. If *text-indent* argument is null, the value of *Li* will be used.
- If the third argument is given, a blank line (one-half a vertical space) will not separate items in the list. A blank line will occur before the first item however.

5.1.1.2 Bullet List

`.BL [text-indent] [1]`

The **.BL** macro begins a bullet list. Each list item is marked by a bullet (•) followed by one space.

- If the *text-indent* argument is non-null, it overrides the default indentation (the amount of paragraph indentation as given in the *Pi* register {4.1.1}). In the default case, the text of a bullet list lines up with the first line of indented paragraphs.
- If the second argument is specified, no blank lines will separate items in the list.

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5.1.1.3 Dash List

`.DL [text-indent] [1]`

The **.DL** macro begins a dash list. Each list item is marked by a dash (—) followed by one space.

- If the *text-indent* argument is non-null, it overrides the default indentation (the amount of paragraph indentation as given in the *Pi* register {4.1.1}). In the default case, the text of a dash list lines up with the first line of indented paragraphs.
- If the second argument is specified, no blank lines will separate items in the list.

5.1.1.4 Marked List

`.ML mark [text-indent] [1]`

The **.ML** macro is much like **.BL** and **.DL** macros but expects the user to specify an arbitrary *mark* which may consist of more than a single character.

- Text is indented *text-indent* spaces if the second argument is not null; otherwise, the text is indented one more space than the width of *mark*.
- If the third argument is specified, no blank lines will separate items in the list.

Note: The *mark* must not contain ordinary (paddable) spaces because alignment of items will be lost if the right margin is justified {3.3}.

5.1.1.5 Reference List

`.RL [text-indent] [1]`

A **.RL** macro call begins an automatically numbered list in which the numbers are enclosed by square brackets ([]).

- If *text-indent* argument is non-null, it is used as the number of spaces from the current indent to the text; i.e., it is used instead of *Li* for this list only. If *text-indent* argument is omitted or null, the value of *Li* is used.
- If the second argument is specified, no blank lines will separate the items in the list.

5.1.1.6 Variable-Item List

`.VL text-indent [mark-indent] [1]`

When a list begins with a **.VL** macro, there is effectively no current *mark*; it is expected that each **.LI** will provide its own mark. This form is typically used to display definitions of terms or phrases.

- *Text-indent* provides the distance from current indent to beginning of the text.
- *Mark indent* produces the number of spaces from current indent to beginning of the *mark*, and it defaults to 0 if omitted or null.
- If the third argument is specified, no blank lines will separate items in the list.

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An example of .VL macro usage is shown below:

```
.tr ~
.VL 20 2
.LI mark~1
Here is a description of mark 1;
“mark 1” of the .LI line contains a tilde
translated to an unpaddable space in order
to avoid extra spaces between
“mark” and “1” {3.3}.
.LI second~mark
This is the second mark also using a tilde translated
to an unpaddable space.
.LI third~mark~longer~than~indent:
This item shows the effect of a long mark; one space
separates the mark from the text.
.LI ~
This item effectively has no mark because the
tilde following the .LI is translated into a space.
.LE
```

when formatted yields:

mark 1	Here is a description of mark 1; “mark 1” of the .LI line contains a tilde translated to an unpaddable space in order to avoid extra spaces between “mark” and “1” {3.3}.
second mark	This is the second mark also using a tilde translated to an unpaddable space.
third mark longer than indent:	This item shows the effect of a long mark; one space separates the mark from the text.
	This item effectively has no mark because the tilde following the .LI is translated into a space.

The tilde argument on the last `.LI` above is required; otherwise, a “hanging indent” would have been produced. A “hanging indent” is produced by using `.VL` and calling `.LI` with no arguments or with a null first argument. For example:

```
.VL 10
.LI
Here is some text to show a hanging indent.
The first line of text is at the left margin.
The second is indented 10 spaces.
.LE
```

when formatted yields:

```
Here is some text to show a hanging indent. The first line of text is
    at the left margin. The second is indented 10 spaces.
```

Note: The *mark* must not contain ordinary (paddable) spaces because alignment of items will be lost if the right margin is justified {3.3}.

5.1.2 List-Item Macro

```
.LI [mark] [1]
one or more lines of text that make up the list item.
```

The `.LI` macro is used with all lists and for each list item. It normally causes output of a single blank line (one-half a vertical space) before its list item although this may be suppressed.

- If no arguments are given, `.LI` labels the item with the current *mark* which is specified by the most recent list-initialization macro.
- If a single argument is given, that argument is output instead of the current *mark*.
- If two arguments are given, the first argument becomes a prefix to the current *mark* thus allowing the user to emphasize one or

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more items in a list. One unpaddingable space is inserted between the prefix and the mark.

For example:

```
.BL 6
.LI
This is a simple bullet item.
.LI +
This replaces the bullet with a “plus”.
.LI + 1
This uses a “plus” as prefix to the bullet.
.LE
```

when formatted yields:

- This is a simple bullet item.
- + This replaces the bullet with a “plus”.
- + • This uses a “plus” as prefix to the bullet.

Note: The *mark* must not contain ordinary (paddingable) spaces because alignment of items will be lost if the right margin is justified {3.3}.

If the current *mark* (in the current list) is a null string and the first argument of `.LI` is omitted or null, the resulting effect is that of a “hanging indent”, i.e., the first line of the following text is moved to the left starting at the same place where *mark* would have started {5.1.1.6}.

5.1.3 List-End Macro

```
.LE [1]
```

The `.LE` macro restores the state of the list to that existing just before the most recent list-initialization macro call. If the optional argument is given, the `.LE` outputs a blank line (one-half a vertical

space). This option should generally be used only when the `.LE` is followed by running text but not when followed by a macro that produces blank lines of its own such as the `.P`, `.H`, or `.LI` macro.

The `.H` and `.HU` macros automatically clear all list information. The user may omit the `.LE` macros that would normally occur just before either of these macros and not receive the “LE:mismatched” error message. Such a practice is not recommended because errors will occur if the list text is separated from the heading at some later time (e.g., by insertion of text).

5.1.4 Example of Nested Lists

An example of input for the several lists and the corresponding output is shown below. The `.AL` and `.DL` macro calls {5.1.1} contained therein are examples of list-initialization macros.

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Input text is:

.AL A

.LI

This is alphabetized list item A.

This text shows the alignment of the second line of the item.

Notice the text indentations and alignment of left and right margins.

.AL

.LI

This is numbered item 1.

This text shows the alignment of the second line of the item.

The quick brown fox jumped over the lazy dog's back.

.DL

.LI

This is a dash item.

This text shows the alignment of the second line of the item.

The quick brown fox jumped over the lazy dog's back.

.LI + 1

This is a dash item with a "plus" as prefix.

This text shows the alignment of the second line of the item.

The quick brown fox jumped over the lazy dog's back.

.LE

.LI

This is numbered item 2.

.LE

.LI

This is another alphabetized list item B.

This text shows the alignment of the second line of the item.

The quick brown fox jumped over the lazy dog's back.

.LE

.P

This paragraph follows a list item and is aligned with the left margin.

A paragraph following a list resumes the normal line length and margins.

The output is:

- A. This is alphabetized list item A. This text shows the alignment of the second line of the item. Notice the text indentations and alignment of left and right margins.
 - 1. This is numbered item 1. This text shows the alignment of the second line of the item. The quick brown fox jumped over the lazy dog's back.
 - This is a dash item. This text shows the alignment of the second line of the item. The quick brown fox jumped over the lazy dog's back.
 - + — This is a dash item with a “plus” as prefix. This text shows the alignment of the second line of the item. The quick brown fox jumped over the lazy dog's back.
 - 2. This is numbered item 2.
- B. This is another alphabetized list item B. This text shows the alignment of the second line of the item. The quick brown fox jumped over the lazy dog's back.

This paragraph follows a list item and is aligned with the left margin. A paragraph following a list resumes the normal line length and margins.

5.2 List-Begin Macro and Customized Lists

```
.LB text-indent mark-indent pad type [mark] [LI-space] [LB-space]
```

List-initialization macros described above suffice for almost all cases. However, if necessary, the user may obtain more control over the

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layout of lists by using the basic list-begin macro (**.LB**). The **.LB** macro is used by the other list-initialization macros. Its arguments are as follows:

- The *text-indent* argument provides the number of spaces that text is to be indented from the current indent. Normally, this value is taken from the *Li* register (for automatic lists) or from the *Pi* register (for bullet and dash lists).
- The combination of *mark-indent* and *pad* arguments determines the placement of the mark. The mark is placed within an area (called *mark area*) that starts *mark-indent* spaces to the right of the current indent and ends where the text begins (i.e., ends *text-indent* spaces to the right of the current indent). The *mark-indent* argument is typically 0.
- Within the *mark area*, the mark is left justified if the *pad* argument is 0. If *pad* is a number *n* (greater than 0) then *n* blanks are appended to the mark; the *mark-indent* value is ignored. The resulting string immediately precedes the text. The *mark* is effectively right justified *pad* spaces immediately to the left of text.
- Arguments *type* and *mark* interact to control the type of marking used. If *type* is 0, simple marking is performed using the mark character(s) found in the *mark* argument. If *type* is greater than 0, automatic numbering or alphabetizing is done; and *mark* is then interpreted as the first item in the sequence to be used for numbering or alphabetizing, i.e., it is chosen from the set (1, A, a, I, i) as in {5.1.1.1}. This is summarized below:

ARGUMENT		RESULT
<i>type</i>	<i>mark</i>	
0	omitted	hanging indent
0	<i>string</i>	<i>string</i> is the mark
>0	omitted	Arabic numbering
>0	one of: 1, A, a, I, i	automatic numbering or alphabetic sequencing

Each nonzero value of *type* from one to six selects a different way of displaying the marks. The following table shows the output appearance for each value of *type*:

VALUE	APPEARANCE
1	<i>x</i> .
2	(<i>x</i>)
3	(<i>x</i>)
4	[<i>x</i>]
5	< <i>x</i> >
6	{ <i>x</i> }

where *x* is the generated number or letter.

Note: The *mark* must not contain ordinary (paddable) spaces because alignment of items will be lost if the right margin is justified {3.3}.

- The *LI-space* argument gives the number of blank lines (halves of a vertical space) that should be output by each `.LI` macro in the list. If omitted, *LI-space* defaults to 1; the value 0 can be used to obtain compact lists. If *LI-space* is greater than 0, the `.LI` macro issues a `.ne` request for two lines just before printing the mark.
- The *LB-space* argument is the number of blank lines (one-half a vertical space) to be output by `.LB` itself. If omitted *LB-space* defaults to 0.

There are three combinations of *LI-space* and *LB-space*:

- The normal case is to set *LI-space* to 1 and *LB-space* to 0 yielding one blank line before each item in the list; such a list is usually terminated with a `.LE 1` macro to end the list with a blank line.
- For a more compact list, *LI-space* is set to 0, *LB-space* is set to 1, and the `.LE 1` macro is used at the end of the list. The result is a list with one blank line before and after it.

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- If both *LI-space* and *LB-space* are set to 0 and the `.LE` macro is used to end the list, a list without any blank lines will result.

Paragraph 5.3 shows how to build upon the supplied list of macros to obtain other kinds of lists.

5.3 User-Defined List Structures

Note: This part is intended for users accustomed to writing formatter macros.

If a large document requires complex list structures, it is useful to define the appearance for each list level only once instead of having to define the appearance at the beginning of each list. This permits consistency of style in a large document. A generalized list-initialization macro might be defined in such a way that what the macro does depends on the list-nesting level in effect at the time the macro is called. Levels 1 through 5 of the lists to be formatted may have the following appearance:

A.

[1]

•

a)

+

The following code defines a macro (`.aL`) that always begins a new list and determines the type of list according to the current list level. To understand it, the user should know that the number register `:g` is used by the MM list macros to determine the current list level; it is 0 if there is no currently active list. Each call to a list-initialization macro increments `:g`, and each `.LE` call decrements it.

```

.\" register g is used as a local temporary to save :g
.de aL
.nr g \\n(:g
.if \\ng=0 .AL A          \" produces an A.
.if \\ng=1 .LB \\n(Li 0 1 4 \" produces a [1]
.if \\ng=2 .BL           \" produces a bullet
.if \\ng=3 .LB \\n(Li 0 2 2 a \" produces an a)
.if \\ng=4 .ML +         \" produces a +
..

```

This macro can be used (in conjunction with .LI and .LE) instead of .AL, .RL, .BL, .LB, and .ML. For example, the following input:

```

.aL
.LI
First line.
.aL
.LI
Second line.
.LE
.LI
Third line.
.LE

```

when formatted yields

A. First line.

[1] Second line.

B. Third line.

There is another approach to lists that is similar to the .H mechanism. List-initialization, as well as the .LI and the .LE macros, are all included in a single macro. That macro (defined as .bL below) requires an argument to tell it what level of item is required; it

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adjusts the list level by either beginning a new list or setting the list level back to a previous value, and then issues a .LI macro call to produce the item:

```
.de bL
.ie \n($ .nr g \\\$1          \" argument given, that is the level
.el .nr g \n(:g              \" no argument, use current level
.if \ng-\n(:g>1 .)D          \" **ILLEGAL SKIPPING OF LEVEL
.\"                            increasing level by more than 1
.if \ng>\n(:g \{\.aL \ng-1    \" if g > :g, begin new list
.nr                            \" and reset g to current level
.\"                            (.aL changes g)
.if \n(:g>\ng .LC \ng        \" if :g > g, prune back to correct level
.\"                            if :g = g, stay within current list
.LI                            \" in all cases, get out an item
..
```

For .bL to work, the previous definition of the .aL macro must be changed to obtain the value of *g* from its argument rather than from *:g*. Invoking .bL without arguments causes it to stay at the current list level. The .LC (List Clear) macro removes list descriptions until the level is less than or equal to that of its argument. For example, the .H macro includes the call “.LC 0”. If text is to be resumed at the end of a list, insert the call “.LC 0” to clear out the lists completely. The example below illustrates the relatively small amount of input needed by this approach. The input text

The quick brown fox jumped over the lazy dog’s back.

```
.bL 1
First line.
.bL 2
Second line.
.bL 1
Third line.
.bL
Fourth line.
.LC 0
Fifth line.
```

when formatted yields:

The quick brown fox jumped over the lazy dog's back.

A. First line.

[1] Second line.

B. Third line.

C. Fourth line.
Fifth line.

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6. Memorandum and Released-Paper Documents

One use of MM is for the preparation of memoranda and released-paper documents (a documentation style used by Bell Laboratories) which have special requirements for the first page and for the cover sheet. Data needed (title, author, date, case numbers, etc.) is entered the same for both styles; an argument to the .MT macro indicates which style is being used.

6.1 Sequence of Beginning Macros

Macros, if present, must be given in the following order:

```
.ND new-date  
.TL [charging-case] [filing-case]  
one or more lines of text  
.AF [company-name]  
.AU name [initials] [loc] [dept] [ext] [room] [arg] [arg]  
.AT [title] ...  
.TM [number] ...  
.AS [arg] [indent]  
one or more lines of abstract text  
.AE  
.NS [arg] [1]  
one or more lines of "copy to" notation  
.NE  
.OK [keyword] ...  
.MT [type] [addressee]
```

The only required macros for a memorandum for file or a released-paper document are .TL, .AU, and .MT; all other macros (and their associated input lines) may be omitted if the features are not needed. Once .MT has been invoked, none of the above macros (except .NS and .NE) can be reinvoked because they are removed from the table of defined macros to save memory space.

If neither the memorandum nor released-paper style is desired, the TL, AU, TM, AE, OK, MT, ND, and AF macros should be omitted

from the input text. If these macros are omitted, the first page will have only the page header followed by the body of the document.

Note: The macros for memorandum and released-paper documents require the postprocessor *col* when you are using the **nroff** text formatter.

6.2 Title

```
.TL [charging-case] [filing-case]
one or more lines of title text
```

Arguments to the **.TL** macro are the charging-case number(s) and filing-case number(s).

- The *charging-case* argument is the case number to which time was charged for the development of the project described in the memorandum. Multiple charging-case numbers are entered as “subarguments” by separating each from the previous with a comma and a space and enclosing the entire argument within double quotes.
- The *filing-case* argument is a number under which the memorandum is to be filed. Multiple filing case numbers are entered similarly. For example:

```
.TL " 12345, 67890" 987654321
Construction of a Table of All Even Prime Numbers
```

The title of the memorandum or released-paper document follows the **.TL** macro and is processed in fill mode. The **.br** request may be used to break the title into several lines as follows:

```
.TL 12345
First Title Line
.br
\!.br
Second Title Line
```

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On output, the title appears after the word "subject" in the memorandum style and is centered and printed in bold in the released-paper document style.

If only a charging case number or only a filing case number is given, it will be separated from the title in the memorandum style by a dash and will appear on the same line as the title. If both case numbers are given and are the same, then "Charging and Filing Case" followed by the number will appear on a line following the title. If the two case numbers are different, separate lines for "Charging Case" and "File Case" will appear after the title.

6.3 Authors

```
.AU name [initials] [loc] [dept] [ext] [room] [arg] [arg]  
.AT [title] ...
```

The **.AU** macro receives as arguments information that describes an author. If any argument contains blanks, that argument must be enclosed within double quotes. The first six arguments must appear in the order given. A separate **.AU** macro is required for each author.

The **.AT** macro is used to specify the author's title. Up to nine arguments may be given. Each will appear in the signature block for memorandum style {6.11} on a separate line following the signer's name. The **.AT** must immediately follow the **.AU** for the given author. For example:

```
.AU " J. J. Jones" JJJ PY 9876 5432 1Z-234  
.AT Director " Materials Research Laboratory"
```

In the "from" portion in the memorandum style, the author's name is followed by location and department number on one line and by room number and extension number on the next line. The "x" for the extension is added automatically. Printing of the location, department number, extension number, and room number may be suppressed on the first page of a memorandum by setting the register *Au* to 0; the default value for *Au* is 1. Arguments 7 through 9 of the

.AU macro, if present, will follow this normal author information in the “from” portion, each on a separate line. These last three arguments may be used for organizational numbering schemes, etc. For example:

```
.AU " S. P. LeName" SPL IH 9988 7766 5H-444 9876-543210.01MF
```

The name, initials, location, and department are also used in the signature block. Author information in the “from” portion, as well as names and initials in the signature block will appear in the same order as the .AU macros.

Names of authors in the released-paper style are centered below the title. Following the name of the last author, “Bell Laboratories” and the location are centered. The paragraph on memorandum types {6.7} contains information regarding authors from different locations.

6.4 TM Numbers

```
.TM [number] ...
```

If the memorandum is a technical memorandum, the TM numbers are supplied via the .TM macro. Up to nine numbers may be specified. For example:

```
.TM 7654321 77777777
```

This macro call is ignored in the released-paper and external-letter styles {6.7}.

6.5 Abstract

```
.AS [arg] [indent]  
text of abstract  
.AE
```

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If a memorandum has an abstract, the input is identified with the **.AS** (abstract start) and **.AE** (abstract end) delimiters. Abstracts are printed on page 1 of a document and/or on its cover sheet. There are three styles of cover sheets:

- Released paper
- Technical memorandum
- Memorandum for file {10.2} (also used for engineer's notes, memoranda for record, etc.).

Cover sheets for released papers and technical memoranda are obtained by invoking the **.CS** macro {10.2}.

In released-paper style (first argument of the **.MT** macro {6.7} is 4) and in technical memorandum style if the first argument of **.AS** is:

- 0 - Abstract will be printed on page 1 and on the cover sheet (if any).
- 1 - Abstract will appear only on the cover sheet (if any).

In memoranda for file style and in all other documents (other than external letters) if the first argument of **.AS** is:

- 0 - Abstract will appear on page 1 and there will be no cover sheet printed.
- 2 - Abstract will appear only on the cover sheet which will be produced automatically (i.e., without invoking the **.CS** macro).

It is not possible to get either an abstract or a cover sheet with an external letter (first argument of the **.MT** macro is 5).

Notations such as a "copy to" list {6.11.2} are allowed on memorandum for file cover sheets; the **.NS** and **.NE** macros must

appear after the .AS 2 and .AE macros. Headings {4.2, 4.3} and displays {7} are not permitted within an abstract.

The abstract is printed with ordinary text margins; an indentation to be used for both margins can be specified as the second argument of .AS. Values that specify indentation must be unscaled and are treated as “character positions”, i.e., as the number of *ens*.

6.6 Other Keywords

.OK [keyword] ...

Topical keywords should be specified on a technical memorandum cover sheet. Up to nine such keywords or keyword phrases may be specified as arguments to the .OK macro; if any keyword contains spaces, it must be enclosed within double quotes.

6.7 Memorandum Types

.MT [type] [addressee]

The .MT macro controls the format of the top part of the first page of a memorandum or of a released-paper document and the format of the cover sheets. The *type* arguments and corresponding values are:

<i>type</i>	<i>VALUE</i>
" "	no memorandum type printed
0	no memorandum type printed
none	MEMORANDUM FOR FILE
1	MEMORANDUM FOR FILE
2	PROGRAMMER'S NOTES
3	ENGINEER'S NOTES
4	released-paper style
5	external-letter style
" <i>string</i> "	<i>string</i> (enclosed in quotes)

If the *type* argument indicates a memorandum style document, the corresponding statement indicated under “VALUE” will be printed

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after the last line of author information. If *type* is longer than one character, then the string, itself, will be printed. For example:

```
.MT " Technical Note #5"
```

A simple letter is produced by calling `.MT` with a null (but not omitted) or 0 argument.

The second argument to `.MT` is the name of the addressee of a letter. If present, that name and the page number replace the normal page header on the second and following pages of a letter. For example:

```
.MT 1 " John Jones"
```

produces

```
John Jones - 2
```

The *addressee* argument may not be used if the first argument is 4 (released-paper style document).

The released-paper style is obtained by specifying

```
.MT 4 [1]
```

This results in a centered, bold title followed by centered names of authors. The location of the last author is used as the location following "Bell Laboratories" (unless the `.AF` macro specifies a different company). If the optional second argument to `.MT 4` is given, then the name of each author is followed by the respective company name and location. Information necessary for the memorandum style document but not for the released-paper style document is ignored.

If the released-paper style document is utilized, most Bell Laboratories (BTL) location codes are defined as strings that are the addresses of the corresponding BTL locations. These codes are

needed only until the .MT macro is invoked. Thus, following the .MT macro, the user may reuse these string names. In addition, the macros for the end of a memorandum {6.11} and their associated lines of input are ignored when the released-paper style is specified.

Authors from non-BTL locations may include their affiliations in the released-paper style by specifying the appropriate .AF macro {6.9} and defining a string (with a 2-character name such as ZZ) for the address before each .AU. For example:

```
.TL
A Learned Treatise
.AF " Getem Inc."
.ds ZZ " 22 Maple Avenue, Sometown 09999"
.AU " F. Swatter" "" ZZ
.AF " Bell Laboratories"
.AU " Sam P. LeName" "" CB
.MT 4 1
```

In the external-letter style document (.MT 5), only the title (without the word "subject:") and the date are printed in the upper left and right corners, respectively, on the first page. It is expected that preprinted stationery will be used with the company logo and address of the author.

6.8 Date Changes

```
.ND new-date
```

The .ND macro alters the value of the string *DT*, which is initially set to produce the current date. If the argument contains spaces, it must be enclosed within double quotes.

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6.9 Alternate First-Page Format

`.AF [company-name]`

An alternate first-page format can be specified with the `.AF` macro. The words “subject”, “date”, and “from” (in the memorandum style) are omitted and an alternate company name is used.

If an argument is given, it replaces “Bell Laboratories” without affecting other headings. If the argument is null, “Bell Laboratories” is suppressed; and extra blank lines are inserted to allow room for stamping the document with a logo or a Bell Laboratories stamp.

The `.AF` with no argument suppresses “Bell Laboratories” and the “Subject/Date/From” headings, thus allowing output on preprinted stationery. The use of `.AF` with no arguments is equivalent to the use of `-rA1 {2.4}`, except that the latter must be used if it is necessary to change the line length and/or page offset (which default to 5.8i and 1i, respectively, for preprinted forms). The command line options `-rOk` and `-rWk {2.4}` are not effective with `.AF`. The only `.AF` use appropriate for the **troff** formatter is to specify a replacement for “Bell Laboratories”.

The command line option `-rEn {2.4}` controls the font of the “Subject/Date/From” block.

6.10 Example

Input text for a document may begin as follows:

```
.TL
MM\*(EMMemorandum Macros
.AU " D. W. Smith" DWS PY
.AU " J. R. Mashey" JRM PY
.AU " E. C. Pariser (January 1980 Revision)" ECP PY
.AU " N. W. Smith (June 1980 Revision)" NWS PY
.MT 4
```

Figures 2-3, 2-4, and 2-5 show the input text file and both the **nroff** and **troff** formatter outputs for a simple letter.

```
.ND "May 31, 1983"
.TL 334455
Out-of-Hours Course Description
.AU "D. W. Stevenson" DWS PY 9876 5432 1X-123
.AF "Your Company"
.MT 0
.DS
J. M. Jones:
.DE
.P
Please use the following description for the out-of-hours course
.I
Document Preparation on the UNIX*
.R
.FS *
Trademark of Bell Laboratories.
.FE
.I "System:"
.P
The course is intended for clerks, typists, and others
who intend to use the UNIX system for preparing documentation.
The course will cover such topics as:
.VL 18
.LI Environment:
utilizing a time-sharing computer system;
accessing the system; using appropriate output terminals.
.LI Files:
how text is stored on the system; directories; manipulating files.
.LI "Text editing:"
how to enter text so that subsequent revisions are easier to make;
how to use the editing system to add, delete, and move lines of text;
how to make corrections.
.LI "Text processing:"
basic concepts; use of general purpose formatting packages.
.LI "Other facilities:"
additional capabilities useful to the typist such as the \fispell\fR,
\fIdiff\fR, and \fIgrep\fR commands,
and a desk-calculator package.
.LE
.SG jrm
.NS 0
S. P. LeName
I. M. Here
U. R. There
R. Rhoadé
.NE
```

Figure 2-3. Example of Input For a Simple Letter

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Your Company

subject: Out-of-Hours Course Description -
Case 334455

date: May 31, 1983
from: D. W. Stevenson
PY 9876
1X-123 x5432

J. M. Jones:

Please use the following description for the out-of-hours course
Document Preparation on the UNIX* System:

Environment: utilizing a time-sharing computer system; accessing the
system; using appropriate output terminals.

Files: how text is stored on the system; directories;
manipulating files.

Text editing: how to enter text so that subsequent revisions are
easier to make; how to use the editing system to add,
delete, and move lines of text; how to make corrections.

Text processing: basic concepts; use of general-purpose formatting
packages.

Other facilities: additional capabilities useful to the typist such as the
spell, diff, and grep commands, and a desk-calculator
package.

PY-9876-DWS-jrm

D. W. Stevenson

Copy to
S. P. LeName
I. M. Here
U. R. There
R. Rhoades

* Trademark of Bell Laboratories

Figure 2-4. Example of *Nroff* Output for a Simple Letter

MM MACROS

Your Company

subject: **Out-of-Hours Course Description -
Case 334455**

date: **May 31, 1983**
from: **D. W. Stevenson**
PY 9876
1X-123 x5432

J. M. Jones:

Please use the following description for the out-of-hours course *Document Preparation on the UNIX* System*:

Environment: utilizing a time-sharing computer system; accessing the system; using appropriate output terminals.

Files: how text is stored on the system; directories; manipulating files.

Text editing: how to enter text so that subsequent revisions are easier to make; how to use the editing system to add, delete, and move lines of text; how to make corrections.

Text processing: basic concepts; use of general-purpose formatting packages.

Other facilities: additional capabilities useful to the typist such as the *spell*, *diff*, and *grep* commands, and a desk-calculator package.

PY-9876-DWS-jrm

D. W. Stevenson

Copy to
S. P. LeName
I. M. Here
U. R. There
R. Rhoades

* Trademark of Bell Laboratories

Figure 2-5. Example of *Troff* Output for a Simple Letter

MM MACROS

6.11 End of Memorandum Macros

At the end of a memorandum document (but not of a released-paper document), signatures of authors and a list of notations can be requested. The following macros and their input are ignored if the released-paper style document is selected.

6.11.1 Signature Block

.FC [closing]
.SG [arg] [1]

The **.FC** macro prints “Yours very truly,” as a formal closing, if no closing argument is used. It must be given before the **.SG** macro. A different closing may be specified as an argument to **.FC**.

The **.SG** macro prints the author’s name(s) after the formal closing, if any. Each name begins at the center of the page. Three blank lines are left above each name for the actual signature.

- If no arguments are given, the line of reference data (location code, department number, author’s initials, and typist’s initials, all separated by hyphens) will not appear.
- A non-null first argument is treated as the typist’s initials and is appended to the reference data.
- A null first argument prints reference data without the typist’s initials or the preceding hyphen.
- If there are several authors and if the second argument is given, reference data is placed on the line of the first author.

Reference data contains only the location and department number of the first author. Thus, if there are authors from different departments and/or from different locations, the reference data should be supplied manually after the invocation (without arguments) of the **.SG** macro.

For example:

```
.SG
.rs
.sp -1v
PY/MH-9876/5432-JJJ/SPL-cen
```

6.11.2 “Copy to” and Other Notations

```
.NS [arg] [1]
zero or more lines of the notation
.NE
```

Many types of notations (such as a list of attachments or “Copy to” lists) may follow signature and reference data. Various notations are obtained through the `.NS` macro, which provides for proper spacing and for breaking notations across pages, if necessary.

The optional second argument, if present, causes the first argument to be used as the *entire* notation string. Codes for *arg* and the corresponding notations are:

<i>arg</i>	<i>NOTATIONS</i>
none	Copy to
""	Copy to
0	Copy to
1	Copy (with att.) to
2	Copy (without att.) to
3	Att.
4	Atts.
5	Enc.
6	Encs.
7	Under Separate Cover
8	Letter to
9	Memorandum to
10	Copy (with atts.) to
11	Copy (without atts.) to
12	Abstract Only to
13	Complete Memorandum to
<i>“string”</i>	Copy (<i>string</i>) to
<i>“string”, with 2nd arg</i>	<i>string</i>

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If *arg* consists of more than one character, it is placed within parentheses between the words "Copy" and "to".

For example:

.NS" with att. 1 only"

will generate

Copy (with att. 1 only) to

as the notation.

More than one notation may be specified before the .NE macro because a .NS macro terminates the preceding notation, if any. For example:

```
.NS 4  
Attachment 1-List of register names  
Attachment 2-List of string and macro names  
.NS 1  
J. J. Jones  
.NS 2  
S. P. LeName  
G. H. Hurtz  
.NE
```

would be formatted as

Atts.

Attachment 1-List of register names

Attachment 2-List of string and macro names

Copy (with att.) to

J. J. Jones

Copy (without att.) to

S. P. LeName

G. H. Hurtz

If the second argument is used, then the first argument becomes the entire notation.

For example:

.NS " Table of Contents to" 1

would be formatted with

Table of Contents to

as the notation.

The .NS and .NE macros may also be used at the beginning following .AS 2 and .AE to place the notation list on the memorandum for file cover sheet {6.5}. If notations are given at the beginning without .AS 2, they will be saved and output at the end of the document.

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6.11.3 Approval Signature Line

.AV approver's-name [1]

The **.AV** macro may be used after the last notation block to automatically generate a line with spaces for the approval signature and date. For example:

.AV " Jane Doe"

produces

APPROVED:

Jane Doe

Date

The optional second argument, if present, prevents the "APPROVED:" mark from appearing above the approval line.

6.12 One-Page Letter

At times, the user may like more space on the page forcing the signature or items within notations to the bottom of the page so that the letter or memo is only one page in length. This can be accomplished by increasing the page length with the **-rLn** option, e.g., **-rL90**. This has the effect of making the formatter believe that the page is 90 lines long and therefore providing more space than usual to place the signature or the notations.

Note: This will work only for a single-page letter or memo.

7. Displays

Displays are blocks of text that are to be kept together on a page and not split across pages. They are processed in an environment that is different from the body of the text (see the `.ev` request). The MM package provides two styles of displays: a *static* (`.DS`) style and a *floating* (`.DF`) style.

- In the *static* style, the display appears in the same relative position in the output text as it does in the input text. This may result in extra white space at the bottom of the page if the display is too long to fit in the remaining page space.
- In the *floating* style, the display “floats” through the input text to the top of the next page if there is not enough space on the current page. Thus input text that follows a floating display may precede it in the output text. A queue of floating displays is maintained so that their relative order of appearance in the text is not disturbed.

By default, a display is processed in no-fill mode with single spacing and is not indented from the existing margins. The user can specify indentation or centering as well as fill-mode processing.

Note: Displays and footnotes {8} may never be nested in any combination. Although lists {5} and paragraphs {4.1} are permitted, no headings (`.H` or `.HU`) {4.2, 4.3} can occur within displays or footnotes.

7.1 Static Displays

```
.DS [format] [fill] [rindent]
one or more lines of text
.DE
```

A static display is started by the `.DS` macro and terminated by the `.DE` macro. With no arguments, `.DS` accepts lines of text exactly as typed (no-fill mode) and will not indent lines from the prevailing left margin indentation or from the right margin.

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- The *format* argument is an integer or letter used to control the left margin indentation and centering with the following meanings:

<i>format</i>	<i>MEANING</i>
" "	no indent
0 or L	no indent
1 or I	indent by standard amount
2 or C	center each line
3 or CB	center as a block
omitted	no indent

- The *fill* argument is an integer or letter and can have the following meanings:

<i>fill</i>	<i>MEANING</i>
" "	no-fill mode
0 or N	no-fill mode
1 or F	fill mode
omitted	no-fill mode

- The *rindent* argument is the number of characters that the line length should be decreased, i.e., an indentation from the right margin. This number must be unscaled in the **nroff** formatter and is treated as *ens*. It may be scaled in the **troff** formatter or else defaults to *ems*.

The standard amount of static display indentation is taken from the *Si* register, a default value of five spaces. Thus, text of an indented display aligns with the first line of indented paragraphs, whose indent is contained in the *Pi* register {4.1}. Even though their initial values are the same (default values), these two registers are independent.

The display *format* argument value 3 (or CB) centers (horizontally) the entire display as a block (as opposed to .DS 2 and .DF 2 which center each line individually). All collected lines are left justified, and the display is centered based on width of the longest line. This format must be used in order for the **eqn/neqn** “mark” and “lineup” feature to work with centered equations {7.4}.

By default, a blank line (one-half a vertical space) is placed before and after *static* and *floating* displays. These blank lines before and after *static* displays can be inhibited by setting the register *Ds* to 0.

The following example shows usage of all three arguments for *static* displays. This block of text will be indented five spaces (ems in **troff**) from the left margin, filled, and indented five spaces (ems in **troff**) from the right margin (i.e., centered). The input text

```
.DS I F 5
"We the people of the United States,
in order to form a more perfect union,
establish justice, ensure domestic tranquillity,
provide for the common defense,
and secure the blessings of liberty to
ourselves and our posterity,
do ordain and establish this Constitution to the
United States of America."
.DE
```

produces

```
"We the people of the United States, in order to form
a more perfect union, establish justice, ensure
domestic tranquillity, provide for the common defense,
and secure the blessings of liberty to ourselves and
our posterity, do ordain and establish this
Constitution to the United States of America."
```

7.2 Floating Displays

```
.DF [format] [fill] [rindent]
one or more lines of text
.DE
```

A floating display is started by the **.DF** macro and terminated by the **.DE** macro. Arguments have the same meanings as static displays described above, except indent, no indent, and centering are calculated with respect to the initial left margin. This is because

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prevailing indent may change between when the formatter first reads the floating display and when the display is printed. One blank line (one-half a vertical space) occurs before and after a floating display.

The user may exercise precise control over the output positioning of floating displays through the use of two number registers, *De* and *Df* (see below). When a floating display is encountered by the **nroff** or **troff** formatter, it is processed and placed onto a queue of displays waiting to be output. Displays are removed from the queue and printed in the order entered, which is the order they appeared in the input file. If a new floating display is encountered and the queue of displays is empty, the new display is a candidate for immediate output on the current page. Immediate output is governed by size of display and the setting of the *Df* register code. The *De* register code controls whether text will appear on the current page after a floating display has been produced.

As long as the display queue contains one or more displays, new displays will be automatically entered there, rather than being output. When a new page is started (or the top of the second column when in 2-column mode), the next display from the queue becomes a candidate for output if the *Df* register code has specified “top-of-page” output. When a display is output, it is also removed from the queue.

When the end of a section (using section-page numbering) or the end of a document is reached, all displays are automatically removed from the queue and output. This occurs before a .SG, .CS, or .TC macro is processed.

A display will fit on the current page if there is enough room to contain the entire display or if the display is longer than one page in length and less than half of the current page has been used. A wide (full-page width) display will not fit in the second column of a 2-column document.

The *De* and *Df* number register code settings and actions are as follows:

De REGISTER

CODE ACTION

- 0 No special action occurs (also the default condition).
- 1 A page eject will always follow the output of each floating display, so only one floating display will appear on a page and no text will follow it.

Note: For any other code, the action performed is the same as for code 1.

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Df REGISTER

CODE ACTION

- | | |
|---|--|
| 0 | Floating displays will not be output until end of section (when section-page numbering) or end of document. |
| 1 | Output new floating display on current page if there is space; otherwise, hold it until end of section or document. |
| 2 | Output exactly one floating display from queue to the top of a new page or column (when in 2-column mode). |
| 3 | Output one floating display on current page if there is space; otherwise, output to the top of a new page or column. |
| 4 | Output as many displays as will fit (at least one) starting at the top of a new page or column. If the <i>De</i> register is set to 1, each display will be followed by a page eject causing a new top of page to be reached where at least one more display will be output. |
| 5 | Output a new floating display on the current page if there is room (default condition). Output as many displays (but at least one) as will fit on the page starting at the top of a new page or column. If the <i>De</i> register is set to 1, each display will be followed by a page eject causing a new top of page to be reached where at least one more display will be output. |

Note: For any code greater than 5, the action performed is the same as for code 5.

The `.WC` macro {12.5} may also be used to control handling of displays in double-column mode and to control the break in text before floating displays.

7.3 Tables

```
.TS [H]
  global options;
  column descriptors.
  title lines
  [.TH [N]]
  data within the table.
.TE
```

The **.TS** (table start) and **.TE** (table end) macros make possible the use of the **tbl** program. These macros are used to delimit text to be examined by **tbl** and to set proper spacing around the table. The display function and the **tbl** delimiting function are independent. In order to permit the user to keep together blocks that contain any mixture of tables, equations, filled text, unfilled text, and caption lines, the **.TS/.TE** block should be enclosed within a display (**.DS/.DE**). Floating tables may be enclosed inside floating displays (**.DF/.DE**).

Macros **.TS** and **.TE** permit processing of tables that extend over several pages. If a table heading is needed for each page of a multipage table, the “H” argument should be specified to the **.TS** macro as above. Following the options and format information, table title is typed on as many lines as required and is followed by the **.TH** macro. The **.TH** macro must occur when “.TS H” is used for a multipage table. This is not a feature of **tbl** but of the definitions provided by the MM macro package.

The **.TH** (table header) macro may take as an argument the letter **N**. This argument causes the table header to be printed only if it is the first table header on the page. This option is used when it is necessary to build long tables from smaller **.TS H/.TE** segments.

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For example:

```
.TS H
global options;
column descriptors.
Title lines
.TH
data
.TE

.TS H
global options;
column descriptors.
Title lines
.TH N
data
.TE
```

will cause the table heading to appear at the top of the first table segment and no heading to appear at the top of the second segment when both appear on the same page. However, the heading will still appear at the top of each page that the table continues onto. This feature is used when a single table must be broken into segments because of table complexity (e.g., too many blocks of filled text). If each segment had its own .TS H/.TH sequence, it would have its own header. However, if each table segment after the first uses .TS H/.TH N, the table header will appear only at the beginning of the table and the top of each new page or column that the table continues onto.

For the **nroff** formatter, the `-e` option [`-E` for **mm** {2.1}] may be used for terminals, such as the 450, that are capable of finer printing resolution. This will cause better alignment of features such as the lines forming the corner of a box. The `-e` is not effective with *col*. (See *Preprocessor Reference* for more information on tables.)

7.4 Equations

```
.DS
.EQ [label]
equation(s)
.EN
.DE
```

Mathematical typesetting programs **eqn** and **neqn** expect to use the **.EQ** (equation start) and **.EN** (equation end) macros as delimiters in the same way that **tbl** uses **.TS** and **.TE**; however, **.EQ** and **.EN** must occur inside a **.DS/.DE** pair. There is an exception to this rule – if **.EQ** and **.EN** are used to specify only the delimiters for in-line equations or to specify **eqn/neqn** defines, the **.DS** and **.DE** macros must not be used; otherwise, extra blank lines will appear in the output.

The **.EQ** macro takes an argument that will be used as a label for the equation. By default, the label will appear at the right margin in the “vertical center” of the general equation. The *Eq* register may be set to 1 to change labeling to the left margin.

The equation will be centered for centered displays; otherwise, the equation will be adjusted to the opposite margin from the label.

7.5 Figure, Table, Equation, and Exhibit Titles

```
.FG [title] [override] [flag]
.TB [title] [override] [flag]
.EC [title] [override] [flag]
.EX [title] [override] [flag]
```

The **.FG** (figure title), **.TB** (table title), **.EC** (equation caption), and **.EX** (exhibit caption) macros are normally used inside **.DS/.DE** pairs to automatically number and title figures, tables, and equations.

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These macros use registers *Fg*, *Tb*, *Ec*, and *Ex*, respectively (see paragraph 2.4 on *-rN5* to reset counters in sections). For example:

```
.FG " This is a Figure Title"
```

yields

Figure 1. This is a Figure Title

The *.TB* macro replaces “Figure” with “TABLE”, the *.EC* macro replaces “Figure” with “Equation”, and the *.EX* macro replaces “Figure” with “Exhibit”. The output title is centered if it can fit on a single line; otherwise, all lines but the first are indented to line up with the first character of the title. The format of the numbers may be changed using the *.af* request of the formatter. By setting the *Of* register to 1, the format of the caption may be changed from

Figure 1. Title

to

Figure 1 – Title

The *override* argument is used to modify normal numbering. If the *flag* argument is omitted or 0, *override* is used as a prefix to the number; if the *flag* argument is 1, *override* is used as a suffix; and if the *flag* argument is 2, *override* replaces the number. If *-rN5* {2.4} is given, “section-figure” numbering is set automatically and user-specified *override* argument is ignored.

As a matter of formatting style, table headings are usually placed above the text of tables, while figure, equation, and exhibit titles are usually placed below corresponding figures and equations.

7.6 List of Figures, Tables, Equations, and Exhibits

A list of figures, tables, exhibits, and equations are printed following the table of contents if the number registers *Lf*, *Lt*, *Lx*, and *Le* (respectively) are set to 1. The *Lf*, *Lt*, and *Lx* registers are 1 by default; *Le* is 0 by default {18}.

Titles of these lists may be changed by redefining the following strings which are shown here with their default values:

```
.ds Lf LIST OF FIGURES
.ds Lt LIST OF TABLES
.ds Lx LIST OF EXHIBITS
.ds Le LIST OF EQUATIONS
```

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8. Footnotes

There are two macros (.FS and .FE) that delimit text of footnotes, a string (*F*) that automatically numbers footnotes, and a macro (.FD) that specifies the style of footnote text. Footnotes are processed in an environment different from that of the body of text, refer to `.ev` request.

8.1 Automatic Numbering of Footnotes

Footnotes may be automatically numbered by typing the three characters “*F” (i.e., invoking the string *F*) immediately after the text to be footnoted without any intervening spaces. This will place the next sequential footnote number (in a smaller point size) a half line above the text to be footnoted.

8.2 Delimiting Footnote Text

```
.FS [label]
one or more lines of footnote text
.FE
```

There are two macros that delimit the text of each footnote. The **.FS** (footnote start) macro marks the beginning of footnote text, and the **.FE** (footnote end) macro marks the end. The *label* on the .FS macro, if present, will be used to mark footnote text. Otherwise, the number retrieved from the string *F* will be used. Automatically numbered and user-labeled footnotes may be intermixed. If a footnote is labeled (.FS *label*), the text to be footnoted must be followed by *label*, rather than by “*F”. Text between .FS and .FE is processed in fill mode. Another .FS, a .DS, or a .DF are not permitted between .FS and .FE macros. If footnotes are required in the title, abstract, or table {7.3}, only labeled footnotes will appear properly. Everywhere else automatically numbered footnotes work correctly.

For example:

Automatically numbered footnote:

```
This is the line containing the word\*F
.FS
This is the text of the footnote.
.FE
to be footnoted.
```

Labeled footnote:

```
This is a labeled*
.FS *
The footnote is labeled with an asterisk.
.FE
footnote.
```

Text of the footnote (enclosed within the .FS/.FE pair) should immediately follow the word to be footnoted in the input text, so that “*F” or *label* occurs at the end of a line of input and the next line is the .FS macro call. It is also good practice to append an unpaddable space {3.3} to “*F” or *label* when they follow an end-of-sentence punctuation mark (i.e., period, question mark, exclamation point).

Figure 2-6 illustrates the various available footnote styles as well as numbered and labeled footnotes.

8.3 Format Style of Footnote Text

```
.FD [arg] [1]
```

Within footnote text, the user can control formatting style by specifying text hyphenation, right margin justification, and text indentation, as well as left or right justification of the label when text indenting is used. The **.FD** macro is invoked to select the appropriate style.

The first argument (**arg**) is a number from the left column of the following table. Formatting style for each number is indicated in the

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remaining four columns. Further explanation of the first two of these columns is given in the definitions of the **.ad**, **.na**, **.hy**, and **.nh** (adjust, no adjust, hyphenation, and no hyphenation, respectively) requests.

<i>arg</i>	<i>HYPHENATION</i>	<i>ADJUST</i>	<i>TEXT</i> <i>INDENT</i>	<i>LABEL</i> <i>JUSTIFICATION</i>
0	.nh	.ad	yes	left
1	.hy	.ad	yes	left
2	.nh	.na	yes	left
3	.hy	.na	yes	left
4	.nh	.ad	no	left
5	.hy	.ad	no	left
6	.nh	.na	no	left
7	.hy	.na	no	left
8	.nh	.ad	yes	right
9	.hy	.ad	yes	right
10	.nh	.na	yes	right
11	.hy	.na	yes	right

If the first argument to **.FD** is greater than 11, the effect is as if **.FD 0** were specified. If the first argument is omitted or null, the effect is equivalent to **.FD 10** in the **nroff** formatter and to **.FD 0** in the **troff** formatter; these are also the respective initial default values.

If the second argument is specified, then when a first-level heading is encountered, automatically numbered footnotes begin again with 1. This is most useful with the “section-page” page numbering scheme. As an example, the input line

```
.FD " " 1
```

maintains the default formatting style and causes footnotes to be numbered afresh after each first-level heading in a document.

Hyphenation across pages is inhibited by MM except for long footnotes that continue to the following page. If hyphenation is permitted, it is possible for the last word on the last line on the current page footnote to be hyphenated. The user has control over this situation by specifying an even **.FD** argument.

Footnotes are separated from the body of the text by a short line rule. Those that continue to the next page are separated from the body of the text by a full-width rule. In the **troff** formatter, footnotes are set in type two points smaller than the point size used in the body of text.

8.4 Spacing Between Footnote Entries

Normally, one blank line (a 3-point vertical space) separates footnotes when more than one occurs on a page. To change this spacing, the *Fs* number register is set to the desired value. For example:

```
.nr Fs 2
```

will cause two blank lines (a 6-point vertical space) to occur between footnotes.

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```
.FD 10
.P
This example illustrates several footnote styles
for both labeled and automatically numbered footnotes.
With the footnote style set to the \fBnroff\fR default style,
the first footnote is processed\*F
.FS
This is the first footnote text example.
This is the default style (.FD 10) for the \fBnroff\fR formatter.
The right margin is not justified,
hyphenation is not permitted,
text is indented, and the automatically generated label is
right justified in the text-indent space.
.FE
and followed by a second footnote.*****
.FS *****
This is the second footnote text example.
This is also the \fBnroff\fR formatter default style (.FD 10)
but with a long footnote label (*****) provided by the user.
.FE
.FD 1
Footnote style is changed by using the .FD macro to
specify hyphenation, right margin justification,
indentation, and left justification of the label.
This produces the third footnote,\*F
.FS
This is the third footnote example (.FD 1).
The right margin is justified, the footnote text is indented,
and the label is left justified in the text-indent space.
Although not necessarily illustrated by this example,
hyphenation is permitted.
.FE
and then the fourth footnote.\(dg
.FS \(dg
This is the fourth footnote example (.FD 1).
The style is the same as the third footnote.
.FE
.FD 6
Footnote style is set again via the .FD macro for no hyphenation,
no right margin justification,
no indentation, and with the label left justified.
This produces the fifth footnote.\*F
.FS
This is the fifth footnote example (.FD 6).
The right margin is not justified, hyphenation is not permitted,
footnote text is not indented,
and the label is placed at the beginning of the first line.
.FE
```

Figure 2-6. Example of Input for Various Footnote Styles

This example illustrates several footnote styles for both labeled and automatically numbered footnotes. With the footnote style set to the **nroff** default style, the first footnote is processed¹ and followed by a second footnote.² Footnote style is changed by using the **.FD** macro to specify hyphenation, right margin justification, indentation, and left justification of the label. This produces the third footnote,² and then the fourth footnote.[†] Footnote style is set again via the **.FD** macro for no hyphenation, no right margin justification, no indentation, and with the label left justified. This produces the fifth footnote.³

Figure 2-7. Example of Output for Various Footnote Styles

1. This is the first footnote text example. This is the default style (**.FD 10**) for the **nroff** formatter. The right margin is not justified, hyphenation is not permitted, text is indented, and the automatically generated label is right justified in the text-indent space.

**** This is the second footnote text example. This is also the **nroff** formatter default style (**.FD 10**) but with a long footnote label (****) provided by the user.

2. This is the third footnote example (**.FD 1**). The right margin is justified, the footnote text is indented, and the label is left justified in the text-indent space. Although not necessarily illustrated by this example, hyphenation is permitted.

† This is the fourth footnote example (**.FD 1**). The style is the same as the third footnote.

3. This is the fifth footnote example (**.FD 6**). The right margin is not justified, hyphenation is not permitted, footnote text is not indented, and the label is placed at the beginning of the first line.

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9. Page Headers and Footers

Text printed at the top of each page is called *page header*. Text printed at the bottom of each page is called *page footer*. There can be up to three lines of text associated with the header – every page, even page only, and odd page only. Thus the page header may have up to two lines of text – the line that occurs at the top of every page and the line for the even- or odd-numbered page. The same is true for the page footer.

This part describes the default appearance of page headers and page footers and ways of changing them. The term *header* (not qualified by *even* or *odd*) is used to mean the page header line that occurs on every page, and similarly for the term *footer*.

9.1 Default Headers and Footers

By default, each page has a centered page number as the header. There is no default footer and no even/odd default headers or footers except as specified in paragraph 9.3.

In a memorandum or a released-paper style document, the page header on the first page is automatically suppressed provided a break does not occur before the `.MT` macro is called. Macros and text in the following categories do not cause a break and are permitted before the memorandum types (`.MT`) macro:

- Memorandum and released-paper style document macros (`.TL`, `.AU`, `.AT`, `.TM`, `.AS`, `.AE`, `.OK`, `.ND`, `.AF`, `.NS`, and `.NE`)
- Page headers and footers macros (`.PH`, `.EH`, `.OH`, `.PF`, `.EF`, and `.OF`)
- The `.nr` and `.ds` requests.

9.2 Header and Footer Macros

For header and footer macros (.PH .EH, .OH, .PF, .EF, and .OF) the argument [arg] is of the form:

```
" 'left-part'center-part'right-part'"
```

If it is inconvenient to use apostrophe (') as the delimiter because it occurs within one of the parts, it may be replaced uniformly by any other character. The **.fc** request redefines the delimiter. In formatted output, the parts are left justified, centered, and right justified, respectively.

9.2.1 Page Header

```
.PH [arg]
```

The **.PH** macro specifies the header that is to appear at the top of every page. The initial value is the default centered page number enclosed by hyphens. The page number contained in the *P* register is an Arabic number. The format of the number may be changed by the **.af** macro request.

If “*debug mode*” is set using the flag `-rD1` on the command line {2.4}, additional information printed at the top left of each page is included in the default header. This consists of the Source Code Control System (SCCS) release and level of MM (thus identifying the current version {12.3}) followed by the current line number within the current input file.

9.2.2 Even-Page Header

```
.EH [arg]
```

The **.EH** macro supplies a line to be printed at the top of each even-numbered page immediately following the header. Initial value is a blank line.

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9.2.3 Odd-Page Header

`.OH [arg]`

The `.OH` macro is the same as the `.EH` except that it applies to odd-numbered pages.

9.2.4 Page Footer

`.PF [arg]`

The `.PF` macro specifies the line that is to appear at the bottom of each page. Its initial value is a blank line. If the `-rCn` flag is specified on the command line {2.4}, the type of copy follows the footer on a separate line. In particular, if `-rC3` or `-rC4` (DRAFT) is specified, the footer is initialized to contain the date {6.8} instead of being a blank line.

9.2.5 Even-Page Footer

`.EF [arg]`

The `.EF` macro supplies a line to be printed at the bottom of each even-numbered page immediately preceding the footer. Initial value is a blank line.

9.2.6 Odd-Page Footer

`.OF [arg]`

The `.OF` macro supplies a line to be printed at the bottom of each odd-numbered page immediately preceding the footer. Initial value is a blank line.

9.2.7 First Page Footer

By default, the first page footer is a blank line. If, in the input text file, the user specifies `.PF` and/or `.OF` before the end of the first page of the document, these lines will appear at the bottom of the first page.

The header (whatever its contents) replaces the footer on the first page only if the `-rN1` flag is specified on the command line {2.4}.

9.3 Default Header and Footer With Section-Page Numbering

Pages can be numbered sequentially within sections by “section-number page-number” {4.5}. To obtain this numbering style, `-rN3` or `-rN5` is specified on the command line. In this case, the default *footer* is a centered “section-page” number, e.g., 7-2; and the default page header is blank.

9.4 Strings and Registers in Header and Footer Macros

String and register names may be placed in arguments to header and footer macros. If the value of the string or register is to be computed when the respective header or footer is printed, invocation must be escaped by four backslashes. This is because string or register invocation will be processed three times:

1. As the argument to the header or footer macro
2. In a formatting request within the header or footer macro
3. In a `.tl` request during header or footer processing.

For example, page number register *P* must be escaped with four backslashes in order to specify a header in which the page number is to be printed at the right margin, e.g.:

```
.PH "'''Page \\\nP'"
```

creates a right-justified header containing the word “Page” followed

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by the page number. Similarly, to specify a footer with the “section-page” style, the user specifies (see paragraph 4.2.2.5 for meaning of *H1*):

```
.PF '''- \\n(H1-\\nP -' "
```

If the user arranges for the string *a* to contain the current section heading which is to be printed at the bottom of each page, the .PF macro call would be:

```
.PF ''\\n*(a)''
```

If only one or two backslashes were used, the footer would print a constant value for *a*, namely, its value when .PF appeared in the input text.

9.5 Header and Footer Example

The following sequence specifies blank lines for header and footer lines, page numbers on the outside margin of each page (i.e., top left margin of even pages and top right margin of odd pages), and “Revision 3” on the top inside margin of each page (nothing is specified for the center):

```
.PH ""  
.PF ""  
.EH ''\\nP'Revision 3'  
.OH ''Revision 3'\\nP''
```

9.6 Generalized Top-of-Page Processing

Note: This part is intended only for users accustomed to writing formatter macros.

During header processing, MM invokes two user-definable macros:

- The **.TP** (top of page) macro is invoked in the environment (refer to **.ev** request) of the header.
- The **.PX** is a page header user-exit macro that is invoked (without arguments) when the normal environment has been restored and with the “no-space” mode already in effect.

The effective initial definition of **.TP** (after the first page of a document) is

```
.de TP
.sp 3
.tl \\*{}t
.if e 'tl \\*{}e
.if o 'tl \\*{}o
.sp 2
..
```

The string `}t` contains the header, the string `}e` contains the even-page header, and the string `}o` contains the odd-page header as defined by the **.PH**, **.EH**, and **.OH** macros, respectively. To obtain more specialized page titles, the user may redefine the **.TP** macro to cause the desired header processing {12.6}. Formatting done within the **.TP** macro is processed in an environment different from that of

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the body. For example, to obtain a page header that includes three centered lines of data, i.e., document number, issue date, and revision date, the user could define the .TP as follows:

```
.de TP
.sp
.ce 3
777-888-999
Iss. 2, AUG 1977
Rev. 7, SEP 1977
.sp
..
```

The .PX macro may be used to provide text that is to appear at the top of each page after the normal header and that may have tab stops to align it with columns of text in the body of the document.

9.7 Generalized Bottom-of-Page Processing

```
.BS
zero or more lines of text
.BE
```

Lines of text that are specified between the **.BS** (bottom-block start) and **.BE** (bottom-block end) macros will be printed at the bottom of each page after the footnotes (if any) but before the page footer. This block of text is removed by specifying an empty block, i.e.:

```
.BS
.BE
```

The bottom block will appear on the table of contents, pages, and the cover sheet for memorandum for file, but not on the technical memorandum or released-paper cover sheets.

9.8 Top and Bottom (Vertical) Margins

`.VM [top] [bottom]`

The `.VM` (vertical margin) macro allows the user to specify additional space at the top and bottom of the page. This space precedes the page header and follows the page footer. The `.VM` macro takes two unscaled arguments that are treated as v's. For example:

`.VM 10 15`

adds 10 blank lines to the default top of page margin and 15 blank lines to the default bottom of page margin. Both arguments must be positive (default spacing at the top of the page may be decreased by redefining `.TP`).

9.9 Proprietary Marking

`.PM [code]`

The `.PM` (proprietary marking) macro appends to the page footer a proprietary disclaimer. The *code* argument may be:

<i>code</i>	<i>DISCLAIMER</i>
none	turn off previous disclaimer, if any
P	PRIVATE
N	NOTICE
BP	BELL LABORATORIES PRIVATE
BPP (or BR)	BELL LABORATORIES PROPRIETARY - PRIVATE
BPN	BELL LABORATORIES - NOTICE
ILL	"RENDERED ILLEGIBLE" message
CI-II	Computer Inquiry II message

These disclaimers are in a form approved for use by the Bell System. The user may alternate disclaimers by use of the `.BS/.BE` macro pair.

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Markings are underlined (italic in **troff**). The CI-II marking may be used with any other message by two separate .PM requests. For example:

```
.PM CI-II  
.PM N
```

produces a CI-II *and* NOTICE mark.

9.10 Private Documents

```
.nr Pv value
```

The word “PRIVATE” may be printed, centered, and underlined on the second line of a document (preceding the page header). This is done by setting the *Pv* register *value*:

<i>value</i>	<i>MEANING</i>
0	do not print PRIVATE (default)
1	PRIVATE on first page only
1	PRIVATE on all pages

If *value* is 2, the user definable .TP macro may not be used because the .TP macro is used by MM to print “PRIVATE” on all pages except the first page of a memorandum on which .TP is not invoked.

10. Table of Contents and Cover Sheet

The table of contents and the cover sheet for a document are produced by invoking the `.TC` and `.CS` macros, respectively.

Note: This section refers to cover sheets for technical memoranda and released papers only. The mechanism for producing a memorandum for file cover sheet was discussed earlier {6.5}.

These macros normally appear once at the end of the document, after the Signature Block {6.11.1} and Notations {6.11.2} macros, and may occur in either order.

The table of contents is produced at the end of the document because the entire document must be processed before the table of contents can be generated. Similarly, the cover sheet may not be desired by a user and is therefore produced at the end.

10.1 Table of Contents

`.TC [slevel] [spacing] [tlevel] [tab] [h1] [h2] [h3] [h4] [h5]`

The `.TC` macro generates a table of contents containing heading levels that were saved for the table of contents as determined by the value of the `Cl` register {4.4}. Arguments to `.TC` control spacing before each entry, placement of associated page number, and additional text on the first page of the table of contents before the word "CONTENTS".

Spacing before each entry is controlled by the first and second arguments (*slevel* and *spacing*). Headings whose level is less than or equal to *slevel* will have *spacing* blank lines (halves of a vertical space) before them. Both *slevel* and *spacing* default to 1. This means that first-level headings are preceded by one blank line (one-half a vertical space). The *slevel* argument does not control what levels of heading have been saved; saving of headings is the function of the `Cl` register.

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The third and fourth arguments (*tlevel* and *tab*) control placement of associated page number for each heading. Page numbers can be justified at the right margin with either blanks or dots (called leaders) separating the heading text from the page number, or the page numbers can follow the heading text.

- For headings whose level is less than or equal to *tlevel* (default 2), page numbers are justified at the right margin. In this case, the value of *tab* determines the character used to separate heading text from page number. If *tab* is 0 (default value), dots (i.e., leaders) are used. If *tab* is greater than 0, spaces are used.
- For headings whose level is greater than *tlevel*, page numbers are separated from heading text by two spaces (i.e., page numbers are “ragged right”, not right justified).

Additional arguments (*h1* ... *h5*) are horizontally centered on the page and precede the table of contents.

If the `.TC` macro is invoked with at most four arguments, the user-exit macro `.TX` is invoked (without arguments) before the word “CONTENTS” is printed or the user-exit macro `.TY` is invoked and the word “CONTENTS” is not printed.

By defining `.TX` or `.TY` and invoking `.TC` with at most four arguments, the user can specify what needs to be done at the top of the first page of the table of contents.

For example:

```
.de TX
.ce 2
Special Application
Message Transmission
.sp 2
.in +5n
Approved: \l'2.5i'
.in
.sp
..
.TC
```

yields the following output when the file is formatted

Special Application
Message Transmission

Approved: _____

CONTENTS

.
.
.

If the .TX macro were defined as .TY, the word "CONTENTS" would be suppressed. Defining .TY as an empty macro will suppress "CONTENTS" with no replacement:

```
.de TY
..
```

By default, the first level headings will appear in the table of contents left justified. Subsequent levels will be aligned with the text of headings at the preceding level. These indentations may be

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changed by defining the *Ci* string which takes a maximum of seven arguments corresponding to the heading levels. It must be given at least as many arguments as are set by the *CI* register. Arguments must be scaled.

For example, with “*CI* = 5”:

```
.ds Ci .25i .5i .75i 1i 1i \ " troff
```

or

```
.ds Ci 0 2n 4n 6n 8n \ " nroff
```

Two other registers are available to modify the format of the table of contents - *Oc* and *Cp*.

- By default, table of contents pages will have lowercase Roman numeral page numbering. If the *Oc* register is set to 1, the *.TC* macro will not print any page number but will instead reset the *P* register to 1. It is the user's responsibility to give an appropriate page footer to specify the placement of the page number. Ordinarily, the same *.PF* macro (page footer) used in the body of the document will be adequate.
- The list of figures, tables, etc. pages will be produced separately unless *Cp* is set to 1 which causes these lists to appear on the same page as the table of contents.

10.2 Cover Sheet

```
.CS [pages] [other] [total] [figs] [tbls] [refs]
```

The *.CS* macro generates a cover sheet in either the released paper or technical memorandum style (see paragraph 6.5 for details of the memorandum for file cover sheet). All other information for the cover sheet is obtained from data given before the *.MT* macro call {6.1}. If the technical memorandum style is used, the *.CS* macro generates the “Cover Sheet for Technical Memorandum”. The data that appear in the lower left corner of the technical memorandum

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cover sheet (counts of: pages of text, other pages, total pages, figures, tables, and references) are generated automatically (0 is used for “other pages”). These values may be changed by supplying the corresponding arguments to the .CS macro. If the released-paper style is used, all arguments to .CS are ignored.

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11. References

There are two macros (.RS and .RF) that delimit the text of references, a string that automatically numbers the subsequent references, and an optional macro (.RP) that produces reference pages within the document.

11.1 Automatic Numbering of References

Automatically numbered references may be obtained by typing `*(Rf)` (invoking the string *Rf*) immediately after the text to be referenced. This places the next sequential reference number (in a smaller point size) enclosed in brackets one-half line above the text to be referenced. Reference count is kept in the *Rf* number register. The number register actually used to print the reference number for each reference call (`*(Rf)` in the text is `:R`. The `:R` register may have its format or value changed to effect the reference marks, without affecting the total count of references.

11.2 Delimiting Reference Text

```
.RS [string-name]
.RF
```

The **.RS** and **.RF** macros are used to delimit text of each reference as shown below:

```
A line of text to be referenced.\*(Rf
.RS
reference text
.RF
```

11.3 Subsequent References

The **.RS** macro takes one argument, a *string-name*. For example:

```
.RS aA
reference text
.RF
```

The string *aA* is assigned the current reference number. This string may be used later in the document as the string call, `*(aA`, to reference text which must be labeled with a prior reference number. The reference is output enclosed in brackets one-half line above the text to be referenced. No `.RS/.RF` pair is needed for subsequent references.

11.4 Reference Page

```
.RP [arg1] [arg2]
```

A reference page, entitled by default “REFERENCES”, will be generated automatically at the end of the document (before table of contents and cover sheet) and will be listed in the table of contents. This page contains the reference items (i.e., reference text enclosed within `.RS/.RF` pairs). Reference items will be separated by a space (one-half a vertical space) unless the *Ls* register is set to 0 to suppress this spacing. The user may change the reference page title by defining the *Rp* string:

```
.ds Rp " New Title"
```

The **.RP** (reference page) macro may be used to produce reference pages anywhere else within a document (i.e., after each major section). It is not needed to produce a separate reference page with default spacings at the end of the document.

Two `.RP` macro arguments allow the user to control resetting of reference numbering and page skipping.

<i>arg1</i>	<i>MEANING</i>
0	reset reference counter (default)
1	do not reset reference counter

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<i>arg2</i>	<i>MEANING</i>
0	put on separate page (default)
1	do not cause a following .SK
2	do not cause a preceding .SK
3	no .SK before or after

If no .SK macro is issued by the .RP macro, a single blank line will separate the references from the following/preceding text. The user may wish to adjust spacing. For example, to produce references at the end of each major section:

```
.sp 3  
.RP 1 2  
.H 1 " Next Section"
```

12. Miscellaneous Features

12.1 Bold, Italic, and Roman Fonts

```
.B [bold-arg] [previous-font-arg] ...
.I [italic-arg] [previous-font-arg] ...
.R
```

When called without arguments, the **.B** macro changes the font to bold and the **.I** macro changes to underlining (italic). This condition continues until the occurrence of the **.R** macro which causes the Roman font to be restored. Thus:

```
.I
here is some text.
.R
```

yields underlined text via the **nroff** and italic text via the **troff** formatter.

If the **.B** or **.I** macro is called with one argument, that argument is printed in the appropriate font (underlined in the **nroff** formatter for **.I**). Then the previous font is restored (underlining is turned off in the **nroff** formatter). If two or more arguments (maximum six) are given with a **.B** or **.I** macro call, the second argument is concatenated to the first with no intervening space (1/12 space if the first font is italic) but is printed in the previous font. Remaining pairs of arguments are similarly alternated. For example:

```
.I italic " <sp>text<sp>" right -justified
<sp> indicates a space
```

produces

italic text right-justified

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The `.B` and `.I` macros alternate with the prevailing font at the time the macros are invoked. To alternate specific pairs of fonts, the following macros are available:

`.IB .BI .IR .RI .RB .BR`

Each macro takes a maximum of six arguments and alternates arguments between specified fonts.

When using a terminal that cannot underline, the following can be inserted at the beginning of the document to eliminate all underlining:

```
.rm ul
.rm cu
```

Note: Font changes in headings are handled separately {4.2.2.4.1}.

12.2 Justification of Right Margin

`.SA [arg]`

The `.SA` macro is used to set right-margin justification for the main body of text. Two justification flags are used - *current* and *default*. Initially, both flags are set for no justification in the **nroff** formatter and for justification in the **troff** formatter. The argument causes the following action:

<i>arg</i>	<i>MEANING</i>
0	Sets both flags to no justification. It acts like the <code>.na</code> request.
1	Sets both flags to cause both right and left justification, the same as the <code>.ad</code> request.
omitted	Causes the current flag to be copied from the default flag, thus performing either a <code>.na</code> or <code>.ad</code> depending on the default condition.

In general, the no adjust request (**.na**) can be used to ensure that justification is turned off, but **.SA** should be used to restore justification, rather than the **.ad** request. In this way, justification or no justification for the remainder of the text is specified by inserting “.SA 0” or “.SA 1” once at the beginning of the document.

12.3 SCCS Release Identification

The *RE* string contains the SCCS release and the MM text formatting macro package current version level. For example:

```
This is version \*(RE of the macros.
```

produces

```
This is version 10.129 of the macros.
```

This information is useful in analyzing suspected bugs in MM. The easiest way to have the release identification number appear in the output is to specify `-rD1 {2.4}` on the command line. This causes the *RE* string to be output as part of the page header {9.2.1}.

12.4 Two-Column Output

```
.2C
text and formatting requests (except another .2C)
.1C
```

The MM text formatting macro package can format two-columns on a page. The **.2C** macro begins 2-column processing which continues until a **.1C** macro (1-column processing) is encountered. In 2-column processing, each physical page is thought of as containing 2-columnar “pages” of equal (but smaller) “page” width. Page headers and footers are not affected by 2-column processing. The **.2C** macro does not balance 2-column output.

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12.5 Footnotes and Displays for Two-Column Output

It is possible to have full-page width footnotes and displays when in 2-column mode, although default action is for footnotes and displays to be narrow in 2-column mode and wide in 1-column mode. Footnote and display width is controlled by the **.WC** (width control) macro, which takes the following arguments:

arg *MEANING*

N Default mode (-WF, -FF, -WD, FB).

WF Wide footnotes (even in 2-column mode).

-WF DEFAULT: Turn off WF. Footnotes follow column mode; wide in 1-column mode (1C), narrow in 2-column mode (2C), unless FF is set.

FF First footnote. All footnotes have same width as first footnote encountered for that page.

-FF DEFAULT: Turn off FF. Footnote style follows settings of WF or -WF.

WD Wide displays (even in 2-column mode).

-WD DEFAULT: Displays follow the column mode in effect when display is encountered.

FB DEFAULT: Floating displays cause a break when output on the current page.

-FB Floating displays on current page do not cause a break.

Note: The **.WC WD FF** command will cause all displays to be wide and all footnotes on a page to be the same width while **.WC N** will reinstate default actions. If conflicting settings are given to **.WC**, the last one is used. A **.WC WF -WF** command has the effect of a **.WC -WF**.

12.6 Column Headings for Two-Column Output

Note: This section is intended only for users accustomed to writing formatter macros.

In 2-column processing output, it is sometimes necessary to have headers over each column, as well as headers over the entire page. This is accomplished by redefining the .TP macro {9.6} to provide header lines both for the entire page and for each of the columns. For example:

```
.de TP
.sp 2
.tl 'Page \\nP'OVERALL'
.tl "TITLE"
.sp
.nf
.ta 16C 31R 34 50C 65R
leftⓉcenterⓉrightⓉleftⓉcenterⓉright
Ⓣfirst columnⓉⓉⓉsecond column
.fi
.sp 2
..
```

where Ⓣ stands for the tab character.

The above example will produce two lines of page header text plus two lines of headers over each column. Tab stops are for a 65-en overall line length.

12.7 Vertical Spacing

```
.SP [lines]
```

There exists several ways of obtaining vertical spacing, all with different effects. The .sp request spaces the number of lines specified unless the no space (.ns) mode is on, then the .sp request is ignored. The no space mode is set at the end of a page header to eliminate spacing by a .sp or .bp request that happens to occur at

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the top of a page. This mode can be turned off by the `.rs` (restore spacing) request.

The `.SP` macro is used to avoid the accumulation of vertical space by successive macro calls. Several `.SP` calls in a row will not produce the sum of the arguments but only the maximum argument. For example, the following produces only three blank lines:

```
.SP 2
.SP 3
.SP
```

Many MM macros utilize `.SP` for spacing. For example, “`LE 1`” {5.1.3} immediately followed by “`P`” {4.1} produces only a single blank line (one-half a vertical space) between the end of the list and the following paragraph. An omitted argument defaults to one blank line (one vertical space). Negative arguments are not permitted. The argument must be unscaled but fractional amounts are permitted. The `.SP` macro (as well as `.sp`) is also inhibited by the `.ns` request.

12.8 Skipping Pages

```
.SK [pages]
```

The `.SK` macro skips pages but retains the usual header and footer processing. If the *pages* argument is omitted, null, or 0, `.SK` skips to the top of the next page unless it is currently at the top of a page (then it does nothing). A “`.SK n`” command skips *n* pages. A “`.SK`” positions text that follows it at the top of a page, while “`.SK 1`” leaves one page blank except for the header and footer.

12.9 Forcing an Odd Page

```
.OP
```

The `.OP` macro is used to ensure that formatted output text following the macro begins at the top of an odd-numbered page.

- If currently at the top of an odd-numbered page, text output begins on that page (no motion takes place).
- If currently on an even page, text resumes printing at the top of the next page.
- If currently on an odd page (but not at the top of the page), one blank page is produced, and printing resumes on the next odd-numbered page after that.

12.10 Setting Point Size and Vertical Spacing

`.S [point size] [vertical spacing]`

The prevailing point size and vertical spacing may be changed by invoking the `.S` macro. In the `troff` formatter, the default point size (obtained from the MM register `S {2.4}`) is 10 points, and the vertical spacing is 12 points (six lines per inch). The mnemonics D (default value), C (current value), and P (previous value) may be used for both arguments.

- If an argument is *negative*, current value is decremented by the specified amount.
- If an argument is *positive*, current value is incremented by the specified amount.
- If an argument is *unsigned*, it is used as the new value.
- If there are no arguments, the `.S` macro defaults to P.
- If the first argument is specified but the second is not, then (default) D is used for the vertical spacing.

Default value for vertical spacing is always two points greater than the current point size. Footnotes `{8}` are two points smaller than the

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body with an additional 3-point space between footnotes. A null ("") value for either argument defaults to C (current value). Thus, if *n* is a numeric value:

```
.S          = .S P P
.S "" n    = .S C n
.S n ""    = .S n C
.S n       = .S n D
.S ""      = .S C D
.S "" ""   = .S C C
.S n n     = .S n n
```

If the first argument is greater than 99, the default point size (10 points) is restored. If the second argument is greater than 99, the default vertical spacing (current point size plus two points) is used. For example:

```
.S 100      = .S 10 12
.S 14 111   = .S 14 16
```

12.11 Reducing Point Size of a String

```
.SM string1 [string2] [string3]
```

The **.SM** macro allows the user to reduce by one point the size of a string. If the third argument (*string3*) is omitted, the first argument (*string1*) is made smaller and is concatenated with the second argument (*string2*) if specified. If all three arguments are present (even if any are null), the second argument is made smaller and all three arguments are concatenated. For example:

<i>INPUT</i>	<i>OUTPUT</i>
.SM X	X
.SM X Y	XY
.SM Y X Y	YXY
.SM YXYX	YXYX
.SM YXYX)	YXYX)
.SM (YXYX)	(YXYX)
.SM Y XYX " "	YXYX

12.12 Producing Accents

Strings may be used to produce accents for letters as shown in the following examples:

	<i>INPUT</i>	<i>OUTPUT</i>
Grave accent	c\ <i>*</i>	ç
Acute accent	e\ <i>*'</i>	é
Circumflex	o\ <i>*^</i>	ô
Tilde	n\ <i>*~</i>	ñ
Cedilla	c\ <i>*,</i>	ç
Lower-case umlaut	u\ <i>*,</i>	ü
Upper-case umlaut	U\ <i>*,</i>	Û

The string definitions that generated these letters are:

```
.ds ` \k:h@-\n(.wu*8u/10u@h@\n(.fu/2u*2u+1u-\n(.fu*.2m@\
\ga h@f\n:u@
.ds ' \k:h@-\n(.wu*8u/10u@h@\n(.fu/2u*2u+1u-\n(.fu*.2m+.07m@\
\aa h@f\n:u@
.ds ^ \k:h@-\n(.wu*8u/10u@h@\n(.fu/2u*2u+1u-\n(.fu*.15m-.07m@\
\h@\n(.fu-1u/2u*.02m@ ^h@f\n:u@
.ds ~ \k:h@-\n(.wu*8u/10u@h@\n(.fu/2u*2u+1u-\n(.fu*.2m-.07m@\
\h@\n(.fu-1u/2u*.05m@ ~h@f\n:u@
.ds , \k:h@-\n(.wu*85u/100u@v@.07m@,v@-.07m@h@f\n:u@
.ds : \k:h@-\n(.wu*85u/100u@h@\n(.fu/2u*2u+1u-\n(.fu*3u*.06m@\
\h@3u-\n(.fu/2u*.05m-.1m@\
\v@-.6m@z.h@\n(.fu-1u/2u*.05m+.2m@.v@.6m@h@f\n:u@
```


produces

Name: J. Jones (user types name)
16 Elm Rd.,
Piscataway

The diverted macro `.aA` will contain

J. Jones
16 Elm Rd.,
Piscataway

The string `bB(*(bB)` contains "J. Jones".

A newline character followed by an EOF (user specifiable CONTROL d) also allows the user to resume normal output.

13. Errors and Debugging

13.1 Error Terminations

When a macro detects an error, the following actions occur:

- A break occurs.
- The formatter output buffer (which may contain some text) is printed to avoid confusion regarding location of the error.
- A short message is printed giving the name of the macro that detected the error, type of error, and approximate line number in the current input file of the last processed input line. Error messages are explained in the last section of this chapter.
- Processing terminates unless register D {2.4} has a positive value. In the latter case, processing continues even though the output is guaranteed to be deranged from that point on.

The error message is printed by outputting the message directly to the user terminal. If an output filter, such as **300**, **450**, or **hp** is being used to post-process the **nroff** formatter output, the message may be garbled by being intermixed with text held in that filter's output buffer.

Note: If any of **ocw**, **eqn/neqn**, and **tbl** programs are being used and if the **-olist** option of the formatter causes the last page of the document not to be printed, a harmless "broken pipe" message may result.

13.2 Disappearance of Output

Disappearance of output usually occurs because of an unclosed diversion (e.g., a missing **.DE** or **.FE** macro). Fortunately, macros that use diversions are careful about it, and these macros check to make sure that illegal nestings do not occur. If any error message is issued concerning a missing **.DE** or **.FE**, the appropriate action is to search backwards from the termination point looking for the corresponding associated **.DF**, **.DS**, or **.FS** (since these macros are used in pairs).

The following command:

```
grep -n '^\. [EDFRT][EFNQS]' files ...
```

prints all the .DF, .DS, .DE, .EQ, .EN, .FS, .FE, .RS, .RF, .TS, and .TE macros found in *files* ..., each preceded by its file name and the line number in that file. This listing can be used to check for illegal nesting and/or omission of these macros.

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14. Extending and Modifying MM Macros

14.1 Naming Conventions

In this part, the following conventions are used to describe names:

- n: Digit
- a: Lowercase letter
- A: Uppercase letter
- x: Any alphanumeric character (n, a, or A, i.e., letter or digit)
- s: Any nonalphanumeric character (special character)

All other characters are literals (characters that stand for themselves).

Request, macro, and string names are kept by the formatters in a single internal table; therefore, there must be no duplication among such names. Number register names are kept in a separate table.

14.1.1 Names Used by Formatters

- requests: aa (most common)
an (only one, currently: c2)
- registers: aa (normal)
.x (normal)
.s (only one, currently: .s)
a. (only one, currently: c.)
% (page number)

14.1.2 Names Used by MM

- macros and strings: A, AA, Aa (accessible to users; e.g., macros P and HU, strings F, BU, and Lt)

nA (accessible to users; only two, currently: 1C and 2C)

aA (accessible to users; only one, currently: nP)

s (accessible to users; only the seven accents, currently {12.10})

)x, }x,]x, >x, ?x (internal)

registers: An, Aa (accessible to users; e.g., H1, Fg)

A (accessible to users; meant to be set on the command line; e.g., C)

:x, ;x, #x, ?x, !x (internal)

14.1.3 Names Used by ocw, eqn/neqn, and tbl

The *ocw* program is the constant-width font preprocessor for the **otroff** formatter. It uses the following five macro names:

.CD .CN .CP .CW .PC

This preprocessor also uses the number register names *cE* and *cW*.

Note: The *ocw* preprocessor cannot be used with device-independent **troff**.

Mathematical equation preprocessors, **eqn** and **neqn**, use registers and string names of the form *nn*. The table preprocessor, **tbl**, uses T&, T#, and TW, and names of the form:

a- a+ a! nn na ^a #a #s

14.1.4 Names Defined by User

Names that consist either of a single lowercase letter or a lowercase letter followed by a character other than a lowercase letter (names

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.c2 and .nP are already used) should be used to avoid duplication with already used names. The following is a possible naming convention:

```
macros:    aA (e.g., bG, kW)
strings:   as (e.g., c), f], p})
registers: a (e.g., f, t)
```

14.2 Sample Extensions

14.2.1 Appendix Headings

The following is a way of generating and numbering appendix headings:

```
.nr Hu 1
.nr a 0
.de aH
.nr a +1
.nr P 0
.PH "''Appendix \\na-\\\\\\\\\\\\\\\\nP' "
.SK
.HU " \\$1"
..
```

After the above initialization and definition, each call of the form

```
.aH " title"
```

begins a new page (with the page header changed to “Appendix *a-n*”) and generates an unnumbered heading of *title*, which, if desired, can be saved for the table of contents. To center appendix titles the *Hc* register must be set to 1 {4.2.2.3}.

14.2.2 Hanging Indent With Tabs.

The following example illustrates the use of the hanging indent feature of variable-item lists {5.1.1.6}. In this example, a user-defined macro is defined to accept four arguments that make up the *mark*. In the output, each argument is to be separated from the

previous one by a tab; tab settings are defined later. Since the first argument may begin with a period or apostrophe, the “\&” is used so that the formatter will not interpret such a line as a formatter request or macro call.

Note: The 2-character sequence “\&” is understood by formatters to be a “zero-width” space. It causes no output characters to appear, but it removes the special meaning of a leading period or apostrophe.

The “\t” is translated by the formatter into a tab. The “\c” is used to concatenate the input text that follows the macro call to the line built by the macro. The user-defined macro and an example of its use are:

```
.de aX
.LI
\&\$1\t\\$2\t\\$3\t\\$4\t\c
..
.
.
.ta 8 14 20 24
.VL 24
.aX .nh off \- no
No hyphenation.
Automatic hyphenation is turned off.
Words containing hyphens
(e.g., mother-in-law) may still be split across lines.
.aX .hy on \- no
Hyphenate.
Automatic hyphenation is turned on.
.aX .hc\<sp>c none none no
Hyphenation indicator character is set to “c” or removed.
During text processing, the indicator is suppressed
and will not appear in the output.
Prepending the indicator to a word has the effect
of preventing hyphenation of that word.
.LE
```

where <sp> stands for a space.

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The resulting output is:

.nh	off	-	no	No hyphenation. Automatic hyphenation is turned off. Words containing hyphens (e.g., mother-in-law) may still be split across lines.
.hy	on	-	no	Hyphenate. Automatic hyphenation is turned on.
.hc c	none	none	no	Hyphenation indicator character is set to "c" or removed. During text processing, the indicator is suppressed and will not appear in the output. Prepending the indicator to a word has the effect of preventing hyphenation of that word.

15. Summary

The following are qualities of MM that have been emphasized in its design in approximate order of importance:

- *Robustness in the face of error* — A user need not be an **nroff/troff** expert to use MM macros. When the input is incorrect, either the macros attempt to make a reasonable interpretation of the error or an error message describing the error is produced. An effort has been made to minimize the possibility that a user would get cryptic system messages or strange output as a result of simple errors.
- *Ease of use for simple documents* — It is not necessary to write complex sequences of commands to produce documents. Reasonable macro argument default values are provided where possible.
- *Parameterization* — There are many different preferences in the area of document styling. Many parameters are provided so that users can adapt input text files to produce output documents to their respective needs over a wide range of styles.
- *Extension by moderately expert users* — A strong effort has been made to use mnemonic naming conventions and consistent techniques in construction of macros. Naming conventions are given so that a user can add new macros or redefine existing ones if necessary.
- *Device independence* — A common use of MM is to produce documents on hard copy via teletypewriter terminals using the **nroff** formatter. Macros can be used conveniently with both 10- and 12-pitch terminals. In addition, output can be displayed on an appropriate CRT terminal. Macros have been constructed to allow compatibility with the **troff** formatter so that output can be produced on both a phototypesetter and a teletypewriter/CRT terminal.
- *Minimization of input* — The design of macros attempts to minimize repetitive typing. For example, if a user wants to have a blank line after all first- or second-level headings, the user need only set a specific parameter once at the beginning of a document rather than type a blank line after each such heading.

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- *Decoupling of input format from output style* — There is but one way to prepare the input text although the user may obtain a number of output styles by setting a few global flags. For example, the .H macro is used for all numbered headings, yet the actual output style of these headings may be made to vary from document to document or within a single document.

16. MM Macro Name Summary

The following listing shows all the MM macros and their usage. Each item in the list gives a definition of the macro followed by its normal format and arguments. The numbers enclosed in braces {} indicate the paragraph or section in the first part of this chapter where a complete explanation of each macro may be found.

Note: Macros marked with an asterisk are not, in general, called (invoked) directly by the user. They are “user exits” defined by the user and called by the MM macros from inside header, footer, or other macros.

1C	1-column processing {12.4} .1C
2C	2-column processing {12.4} .2C
AE	Abstract end {6.5} .AE
AF	Alternate format of “Subject/Date/From” block {6.9} .AF [company-name]
AL	Automatically incremented list start {5.1.1.1} .AL [type] [text-indent] [1]
AS	Abstract start {6.5} .AS [arg] [indent]
AT	Author’s title {6.3} .AT [title] ...
AU	Author information {6.3} .AU name [initials] [loc] [dept] [ext] [room] [arg] [arg] [arg]
AV	Approval signature {6.11.3} .AV [name] [1]

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- B** **Bold** {12.1}
.B [bold-arg] [previous-font-arg] [bold] [prev] [bold]
[prev]
- BE** **Bottom block end** {9.7}
.BE
- BI** **Bold/Italic** {12.1}
.BI [bold-arg] [italic-arg] [bold] [italic] [bold] [italic]
- BL** **Bullet list start** {5.1.1.2}
.BL [text-indent] [1]
- BR** **Bold/Roman** {12.1}
.BR [bold-arg] [Roman-arg] [bold] [Roman] [bold]
[Roman]
- BS** **Bottom block start** {9.7}
.BS
- CS** **Cover sheet** {10.2}
.CS [pages] [other] [total] [figs] [tbls] [refs]
- DE** **Display end** {7.1}
.DE
- DF** **Display floating start** {7.2}
.DF [format] [fill] [right-indent]
- DL** **Dash list start** {5.1.1.3}
.DL [text-indent] [1]
- DS** **Display static start** {7.1}
.DS [format] [fill] [right-indent]
- EC** **Equation caption** {7.5}
.EC [title] [override] [flag]
- EF** **Even-page footer** {9.2.5}
.EF [arg]

EH	Even-page header {9.2.2} .EH [arg]
EN	End equation display {7.4} .EN
EQ	Equation display start {7.4} .EQ [label]
EX	Exhibit caption {7.5} .EX [title] [override] [flag]
FC	Formal closing {6.11.1} .FC [closing]
FD	Footnote default format {8.3} .FD [arg] [1]
FE	Footnote end {8.2} .FE
FG	Figure title {7.5} .FG [title] [override] [flag]
FS	Footnote start {8.2} .FS [label]
H	Heading—numbered {4.2} .H level [heading-text] [heading-suffix]
HC	Hyphenation character {3.4} .HC [hyphenation-indicator]
HM	Heading mark style (Arabic or Roman numerals, or letters) {4.2.2.5} .HM [arg1] ... [arg7]
HU	Heading—unnumbered {4.3} .HU heading-text

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- HX* Heading user exit X (before printing heading) {4.6}
 .HX dlevel rlevel heading-text
- HY* Heading user exit Y (before printing heading) {4.6}
 .HY dlevel rlevel heading-text
- HZ* Heading user exit Z (after printing heading) {4.6}
 .HZ dlevel rlevel heading-text
- I Italic (underline in the **nroff** formatter) {12.1}
 .I [italic-arg] [previous-font-arg] [italic] [prev] [italic]
 [prev]
- IB Italic/Bold {12.1}
 .IB [italic-arg] [bold-arg] [italic] [bold] [italic] [bold]
- IR Italic/Roman {12.1}
 .IR [italic-arg] [Roman-arg] [italic] [Roman] [italic]
 [Roman]
- LB List begin {5.2}
 .LB text-indent mark-indent pad type [mark] [LI-space]
 [LB-space]
- LC List-status clear {5.3}
 .LC [list-level]
- LE List end {5.1.3}
 .LE [1]
- LI List item {5.1.2}
 .LI [mark] [1]
- ML Marked list start {5.1.1.4}
 .ML mark [text-indent] [1]
- MT Memorandum type {6.7}
 .MT [type] [addressee] *or* .MT [4] [1]
- ND New date {6.8}
 .ND new-date

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NE	Notation end {6.11.2} .NE
NS	Notation start {6.11.2} .NS [arg] [1] nP" Double-line indented paragraphs {4.1.2} .nP
OF	Odd-page footer {9.2.6} .OF [arg]
OH	Odd-page header {9.2.3} .OH [arg]
OK	Other keywords for the Technical Memorandum cover sheet {6.6} .OK [keyword] ...
OP	Odd page {12.9} .OP
P	Paragraph {4.1} .P [type]
PF	Page footer {9.2.4} .PF [arg]
PH	Page header {9.2.1} .PH [arg]
PM	Proprietary marking {9.9} .PM [code]
PX*	Page-header user exit {9.6} .PX
R	Return to regular (Roman) font {12.1} .R
RB	Roman/Bold {12.1} .RB [Roman-arg] [bold-arg] [Roman] [bold] [Roman] [bold]

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- RD Read insertion from terminal {12.13}
 .RD [prompt] [diversion] [string]
- RF Reference end {11.2}
 .RF
- RI Roman/Italic {12.1}
 .RI [Roman-arg] [italic-arg] [Roman] [italic] [Roman]
 [italic]
- RL Reference list start {5.1.1.5}
 .RL [text-indent] [1]
- RP Produce reference page {11.4}
 .RP [arg] [arg]
- RS Reference start {11.2}
 .RS [string-name]
- S Set **troff** formatter point size and vertical spacing {12.10}
 .S [size] [spacing]
- SA Set adjustment (right-margin justification) default {12.2}
 .SA [arg]
- SG Signature line {6.11.1}
 .SG [arg] [1]
- SK Skip pages {12.8}
 .SK [pages]
- SM Make a string smaller {12.10}
 .SM string1 [string2] [string3]
- SP Space vertically {12.7}
 .SP [lines]
- TB Table title {7.5}
 .TB [title] [override] [flag]
- TC Table of contents {10.1}
 .TC [slevel] [spacing] [tlevel] [tab] [h1] [h2] [h3] [h4] [h5]

TE	Table end {7.3} .TE
TH	Table header {7.3} .TH [N]
TL	Title of memorandum {6.2} .TL [charging-case] [filing-case]
TM	Technical Memorandum number(s) {6.4} .TM [number] ...
TP*	Top-of-page macro {9.6} .TP
TS	Table start {7.3} .TS [H]
TX*	Table of contents user exit {10.1} .TX
TY*	Table of contents user exit (suppresses "CONTENTS") {10.1} .TY
VL	Variable-item list start {5.1.1.6} .VL text-indent [mark-indent] [1]
VM	Vertical margins {9.8} .VM [top] [bottom]
WC	Footnote and display width control {12.5} .WC [format]

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17. MM String Name Summary

The following list shows the predefined string names used by the MM macro package. The numbers in braces {} indicate the paragraph or section number in the first part of this chapter where more information about the string can be found.

- BU Bullet {3.7}
 NROFF: ⊕
 TROFF: ●
- Ci Table of contents indent list {10.1}
 Up to seven scaled arguments for heading levels
- DT Date {6.8}
 Current date, unless overridden
 Month, day, year (e.g., May 31, 1979)
- EM Em dash string {3.8}
 Produces an em dash in the **troff** formatter and a double
 hyphen in **nroff**
- F Footnote number generator {8.1}
 NROFF: \u\\n+(:p\d
 TROFF: \v'-.4m'\s-3\\n+(:p\s0\v'.4m'
- HF Heading font list {4.2.2.4.1}
 Up to seven codes for heading levels 1 through 7
 2 2 2 2 2 2 2 (all levels underlined by **nroff** and italicized by
 troff)
- HP Heading point size list {4.2.2.4.3}
 Up to seven codes for heading levels 1 through 7
- Le Title for LIST OF EQUATIONS {7.6}
- Lf Title for LIST OF FIGURES {7.6}
- Lt Title for LIST OF TABLES {7.6}
- Lx Title for LIST OF EXHIBITS {7.6}

- RE SCCS Release and Level of MM {12.3}
 Release.Level (e.g., 15.129)
- Rf Reference number generator {11.1}
- Rp Title for References {11.4}
- Tm Trademark string {3.9}
 Places the letters “TM” one-half line above the text that it
 follows

Seven accent strings are also available. {12.12}

Note 1: If the released-paper style is used, then (in addition to the above strings) certain BTL location codes are defined as strings. These location strings are needed only until the .MT macro is called {6.7}. Currently, the following codes are recognized:

AK, AL, ALF, CB, CH, CP, DR, FJ, HL, HO, HOH, HP, IH, IN, INH, IW, MH, MV, PY, RD, RR, WB, WH, and WV.

Note 2: Paragraph 1.6 has notes on setting and referencing strings.

18. MM Number Register Summary

The list that follows contains a description of all the predefined number registers used by MM. Numbers enclosed in braces {} indicate the paragraph or section number in the first part of this chapter where more information about the register can be found. After each description is the normal value of the register followed by the range of allowable values, enclosed in brackets []. The lower and upper limit of values are separated by a colon (:).

Note 1: An asterisk attached to a register name indicates that this register can be set *only* from the command line or before the MM macro definitions are read by the formatter {2.4, 2.5}.

Note 2: Paragraph 1.6 has notes on setting and referencing registers. Any register having a single-character name can be set from the command line {2.4, 2.5}. These are indicated by a dagger (†) in the following list.

A * †	Handles preprinted forms and logo {2.4} 0, [0:2]
Au	Inhibits printing of author information {6.3} 1, [0:1]
C * †	Copy type (original, DRAFT, etc.) {2.4} 0 (Original), [0:4]
Cl	Level of headings saved for table of contents {4.4} 2, [0:7]
Cp	Placement of list of figures, etc. {10.1} 1 (on separate pages), [0:1]
D * †	Debug flag {2.4} 0, [0:1]
De	Display eject register for floating displays {7.2} 0, [0:1]

- Df Display format register for floating displays
{7.2} 5, [0:5]
- Ds Static display pre- and post-space
{7.1} 1, [0:1]
- E * † Controls font of the Subject/Date/From fields
{2.4} 1 (**nroff**) 0 (**troff**), [0:1]
- Ec Equation counter, used by .EC macro
{7.5} 0, [0:?
Incremented by one for each .EC call.
- Ej Page-ejection flag for headings
{4.2.2.1} 0 (no eject), [0:7]
- Eq Equation label placement
{7.4} 0 (right-adjusted), [0:1]
- Ex Exhibit counter, used by .EX macro
{7.5} 0, [0:?
Incremented by one for each .EX call.
- Fg Figure counter, used by .FG macro
{7.5} 0, [0:?
Incremented by one for each .FG call.
- Fs Footnote space (i.e., spacing between footnotes)
{8.4} 1, [0:?
- H1-H7 Heading counters for levels 1 through 7
{4.2.2.5} 0, [0:?
Incremented by the .H macro of corresponding. level
or the .HU macro if at level given by the **Hu** register.
The H2 through H7 registers are reset to 0 by any .H
(.HU) macro at a lower-numbered level.
- Hb Heading break level (after .H and .HU)
{4.2.2.2} 2, [0:7]
- Hc Heading centering level for .H and .HU
{4.2.2.3} 0 (no centered headings), [0:7]

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Hi	Heading temporary indent (after .H and .HU) {4.2.2.2} 1 (indent as paragraph), [0:2]
Hs	Heading space level (after .H and .HU) {4.2.2.2} 2 (space only after .H 1 and .H 2), [0:7]
Ht	Heading type (for .H: single or concatenated numbers) {4.2.2.5} 0 (concatenated numbers: 1.1.1, etc.), [0:1]
Hu	Heading level for unnumbered heading (.HU) {4.3} 2 (.HU at the same level as.H 2), [0:7]
Hy	Hyphenation control for body of document {3.4} 0 (automatic hyphenation off), [0:1]
L * †	Length of page {2.4} 66, [20:? (11i, [2i:?] in troff formatter)
Le	List of equations {7.6} 0 (list not produced) [0:1]
Lf	List of figures {7.6} 1 (list produced) [0:1]
Li	List indent {5.1.1.1} 6 (nroff) 5 (troff), [0:?)
Ls	List spacing between items by level {5.1.1.1} 6 (spacing between all levels) [0:6]
Lt	List of tables {7.6} 1 (list produced) [0:1]
Lx	List of exhibits {7.6} 1 (list produced) [0:1]
N * †	Numbering style {2.4} 0, [0:5]
Np	Numbering style for paragraphs {4.1.2} 0 (unnumbered) [0:1]

- O * † Offset of page
 {2.4} .75i, [0:?
 (0.5i, [0i:?) in **troff** formatter)
 For **nroff** formatter, these values are unscaled
 numbers representing lines or character positions. For
 troff formatter, these values must be scaled.
- Oc Table of contents page numbering style
 {10.1} 0 (lowercase Roman), [0:1]
- Of Figure caption style
 {7.5} 0 (period separator), [0:1]
- P † Page number managed by MM
 {2.4} 0, [0:?
- Pi Paragraph indent
 {4.1.1} 5 (**nroff**) 3 (**troff**), [0:?
- Ps Paragraph spacing
 {4.1.3} 1 (one blank space between paragraphs), [0:?
- Pt Paragraph type
 {4.1.1} 0 (paragraphs always left justified), [0:2]
- Pv “PRIVATE” header
 {9.10} 0 (not printed), [0:2]
- Rf Reference counter, used by .RS macro
 {11.1} 0, [0:?
 Incremented by one for each .RS call.
- S * † The **troff** formatter default point size
 {2.4} 10, [6:36]
- Si Standard indent for displays
 {7.1} 5 (**nroff**) 3 (**troff**), [0:?
- T * † Type of **nroff** output device
 {2.4} 0, [0:2]

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- Tb Table counter, used by .TB macro
 {7.5} 0, [0:?]
 Incremented by one for each .TB call.
- U * † Underlining style (**nroff**) for .H and .HU
 {2.4} 0 (continuous underline when possible), [0:1]
- W * † Width of page (line and title length)
 {2.4} 6i, [10:1365]
 (6i, [2i:7.54i] in the **troff** formatter)

19. MM and Formatter Error Messages

When processing text using the MM macro package, MM will report any errors it can detect. Since the macros are written in the basic formatter primitives, other errors may be found and reported by the formatter (**nroff**, **troff/otroff**). The next two sections contain descriptions of the error messages which may be received from MM or the formatter.

19.1 MM Error Messages

An MM error message has a standard part followed by a variable part. The standard part has the form:

ERROR:(*filename*)input line *n*:

Variable parts consist of a descriptive message usually beginning with a macro name. They are listed below in alphabetical order by macro name, each with a more complete explanation.

Check TL, AU, AS, AE, MT sequence

The correct order of macros at the start of a memorandum is shown in paragraph 6.1. Something has disturbed this order.

Check TL, AU, AS, AE, NS, NE, MT sequence

The correct order of macros at the start of a memorandum is shown in paragraph 6.1. Something has disturbed this order. (Occurs if the .AS 2 {6.5} macro was used.)

CS:cover sheet too long

Text of the cover sheet is too long to fit on one page. The abstract should be reduced or the indent of the abstract should be decreased {6.5}.

MM MACROS

DE:no DS or DF active

A .DE macro has been encountered, but there has not been a previous .DS or .DF macro to match it.

DF:illegal inside TL or AS

Displays are not allowed in the title or abstract.

DF:missing DE

A .DF macro occurs within a display, i.e., a .DE macro has been omitted or mistyped.

DF:missing FE

A display starts inside a footnote. The likely cause is the omission (or misspelling) of a .FE macro to end a previous footnote.

DF:too many displays

More than 26 floating displays are active at once, i.e., have been accumulated but not yet output.

DS:illegal inside TL or AS

Displays are not allowed in the title or abstract.

DS:missing DE

A .DS macro occurs within a display, i.e., a .DE has been omitted or mistyped.

DS:missing FE

A display starts inside a footnote. The likely cause is the omission (or misspelling) of a .FE to end a previous footnote.

FE:no FS active

A .FE macro has been encountered with no previous .FS to match it.

FS:missing DE

A footnote starts inside a display, i.e., a .DS or .DF occurs without a matching .DE.

FS:missing FE

A previous .FS macro was not matched by a closing .FE, i.e., an attempt is being made to begin a footnote inside another one.

H:bad arg:value

The first argument to the .H macro must be a single digit from one to seven, but *value* has been supplied instead.

H:missing arg

The .H macro needs at least one argument.

H:missing DE

A heading macro (.H or .HU) occurs inside a display.

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H:missing FE

A heading macro (.H or .HU) occurs inside a footnote.

HU:missing arg

The .HU macro needs one argument.

LB:missing arg(s)

The .LB macro requires at least four arguments.

LB:too many nested lists

Another list was started when there were already six active lists.

LE:mismatched

The .LE macro has occurred without a previous .LB or other list-initialization macro {5.1.1}. This is not a fatal error. The message is issued because there exists some problem in the preceding text.

LI:no lists active

The .LI macro occurred without a preceding list-initialization macro. The latter probably has been omitted or entered incorrectly.

ML:missing arg

The .ML macro requires at least one argument.

ND:missing arg

The .ND macro requires one argument.

RF:no RS active

The .RF macro has been encountered with no previous .RS to match it.

RP:missing RF

A previous .RS macro was not matched by a closing .RF.

RS:missing RF

A previous .RS macro was not matched by a closing .RF.

S:bad arg:value

The incorrect argument *value* has been given for the .S macro {12.10}.

SA:bad arg:value

The argument to the .SA macro (if any) must be either 0 or 1. The incorrect argument is shown as *value*.

SG:missing DE

The .SG macro occurred inside a display.

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SG:missing FE

The .SG macro occurred inside a footnote.

SG:no authors

The .SG macro occurred without any previous .AU macro(s).

VL:missing arg

The .VL macro requires at least one argument.

WC:unknown option

An incorrect argument has been given to the .WC macro {12.5}.

19.2 Formatter Error Messages

Most messages issued by the formatter are self-explanatory. Those error messages over which the user has some control are listed below. Any other error messages should be reported to the local system support group.

Cannot do ev

Caused by:

1. Setting a page width that is negative or extremely short
2. Setting a page length that is negative or extremely short
3. Reprocessing a macro package (e.g., performing a **.so** request on a macro package that was already requested on the command line)
4. Requesting the **troff** formatter **-s1** option on a document that is longer than ten pages.

Cannot execute *filename*

Given by the **!** request if the *filename* is not found.

Cannot open *filename*

Indicates one of the files in the list of files to be processed cannot be opened.

Exception word list full

Indicates too many words have been specified in the hyphenation exception list (via **.hw** requests).

Line overflow

Indicates output line being generated was too long for the formatter line buffer capacity. The excess was discarded. Likely causes for this message are very long lines or words generated through the misuse of **\c** of the **.cu** request, or very long equations produced by **eqn/neqn**.

Nonexistent font type

Indicates a request has been made to mount an unknown font.

Nonexistent macro file

Indicates the requested macro package does not exist.

Nonexistent terminal type

Indicates the terminal options refer to an unknown terminal type.

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Out of temp file space

Indicates additional temporary space for macro definitions, diversions, etc. cannot be allocated. This message often occurs because of unclosed diversions (missing .FE or .DE), unclosed macro definitions (e.g., missing ". "), or a huge table of contents.

Too many page numbers

Indicates the list of pages specified to the `-o` formatter option is too long.

Too many number registers

Indicates the pool of number register names is full. Unneeded registers can be deleted by using the `.rr` request.

Too many string/macro names

Indicates the pool of string and macro names is full. Unneeded strings and macros can be deleted using the `.rm` request.

Word overflow

Indicates a word being generated exceeded the formatter word buffer capacity. Excess characters were discarded. Likely causes for this message are very long lines, words generated through the misuse of `\c` of the `.cu` request, or very long equations produced by `eqn/neqn`.

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Chapter 3

SROFF/MM USER GUIDE

INTRODUCTION

This chapter is a user's guide for preparing documents with **sroff**/MM, a macro package for use with the **sroff** text formatter.

Styled after the Memorandum Macros (Chapter 2) for **nroff** and **troff**, the **sroff**/MM package offers a practical subset of the larger **nroff**/MM package plus a few formatting commands of its own.

Although not as extensive as the **nroff** version of MM, this **sroff** version provides enough macrocommands for most formatting applications. Naturally, this package includes macros for standard Bell Laboratories documentation styles, such as internal memoranda, released paper, and external letter. And there are the usual macros for the main body of text: paragraphs, section headings, itemized lists, footnotes, displays, etc. **Sroff**/MM does not provide facilities for automatic reference and table of contents processing. In return for its lack of capability vis-a-vis **nroff**, **sroff** will reward you tenfold in efficiency and response time.

In most cases, an **sroff**/MM macro shares the same name and argument list with its **nroff**/MM counterpart. Macros for paragraphs, headings, itemized lists, and document formats behave in much the same way as with **nroff**/MM. In addition, there are a few specialized macros (e.g. multiple column output) that are not available with **nroff**/MM.

Users should not be misled by intended similarities between the two macro packages; the text formatters (**sroff**, **nroff**, and **troff/otroff**) that use them are different in many respects. **Sroff** does not share the escape conventions and macro definition facilities of **nroff** and **troff**, nor does it have the luxury of **if-else** conditional requests or trap mechanisms. Furthermore, **sroff** cannot be used with the **tbl** table preprocessor or the **neqn/eqn** equation formatter.

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With the UNIX operating system, users can use the **checkmm** command to scan the contents of input file(s) for errors in the use of Memorandum Macros. **Checkmm** was originally designed for use with **nroff**/MM, but works just as well with **sroff**/MM. This error-checking program checks for missing or unbalanced macro pairs (**.DS/.DE**, **.FS/.FE**), and improper usage of other MM macros; appropriate error messages are printed at the user's terminal.

For the occasions when you wish to convert a **nroff**/MM source file into a **sroff**/MM file, or vice versa, there is a command called **mmlint**. **MMLint** reads the source file(s) of the input document and reports the document changes required to convert the document into the specified text formatter.

Users who are familiar with **nroff**/MM may use the section at the end of this chapter (*SYNOPSIS OF SROFF/MM MACROS*) as a guide in preparing their documents. Be sure to check the argument list and default values for possible incompatibilities. At the very least, experienced **nroff**/MM users should read the next section before using **sroff**/MM.

The *SROFF/MM NUMBER REGISTERS* section contains a list of number registers used to control formatting styles. Users may change the values in these registers if the default values are not acceptable.

In Sections 3 through 12, macros are presented, more or less, in the order that they would be used. Macros used to produce Bell Laboratories document formats are discussed in Section 13. The discussion of each macrocommand begins with a synopsis of the macro call. Each macro is displayed with a generic list of arguments; optional arguments are enclosed in square brackets.

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1. Introduction to Macros

What is a macro? In **sroff**, a macro is a call to an executable text register containing a set of instructions to perform a specific formatting task. The text register has a one- or two-character name and is invoked as a request followed by an optional list of arguments. The instructions consist of **sroff** formatting requests intermixed with text fragments and parameters for argument substitution.

2. Macro Usage

2.1 Arguments and Quoting

Macros sometimes collect information by means of arguments. A list of one or more arguments is entered on the same line as the macro; each argument is separated by a space. For example,

```
.EX first second third fourth fifth
```

invokes a macro, **.EX**, with five arguments; each argument is an additional piece of information. Each macro may accept up to nine arguments.

If the text of an argument contains a space, the entire string must be enclosed in quotes (e.g. "string of text"). In this case, quoting is necessary to ensure that the text string is treated as a single argument.

A null argument is a pair of quotes with no text between them (""). The null argument is used to skip or blank out an argument field.

To include a quote as part of the argument text, use two quotes. If the printable quote is the first character in the string, then the entire string must be enclosed in quotes.

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2.2 Unpaddable Space Character

Sroff regards a space in the input text as a likely place to break an output line or to add extra space to fill an output line. An unpaddable space character may be used instead of a space to suppress breaking or padding at a given point.

In **sroff/MM**, the tilde (~) is defined as the unpaddable space character. On input, the tilde may be used instead of a space to ensure that two words are kept together on a line. On output, the tilde is translated into a single space.

To obtain a printable tilde on output, the **sroff** request

```
.tr~~
```

must be used before the tilde is to appear. This translates the tilde character into itself. After the line containing the tilde has been printed,

```
.tr~
```

restores the tilde as the unpaddable space character.

2.3 The Insertion Character and Predefined Registers

Information about the current date, time, and page number are available as predefined registers in **sroff**. These register names and their corresponding values are:

<i>Register</i>	<i>Contains</i>
%	current page number on output
(amon)	name of current month (e.g. January, February, March)
(mon)	number of current month of year (1-12)
(day)	date of current day of month (1-31)
(year)	last two digits of current year
(hour)	hour (0-23)
(min)	minute (0-59)
(sec)	second (0-59)

The contents of a register may be inserted in text by preceding the register name with an insertion character. **Sroff**/MM uses the circumflex (^) as the insertion character. For example,

Today is ^(amon) ^(day), 19^(year).

produces

Today is November 15, 1982.

The page number register (%) should not be preceded by the insertion character if used as part of the page header or page footer. For example, the macrocommand

.PF "'^(mon)/^(day)/^(year)"Page %"

prints the current date and page number on the bottom of every page as shown below.

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(The page footer macro, **.PF**, is discussed in Section 5.2.)

To obtain a printable circumflex, the **sroff** request

```
.ic
```

must be used before the circumflex is to appear. After the line containing the circumflex has been printed,

```
.ic^
```

reinstates the circumflex as the insertion character. Each call to an **sroff/MM** macro automatically restores the circumflex as the insertion character.

2.4 Safe Sroff Requests

Sroff/MM provides the most commonly used formatting facilities. Additional tasks, like arranging tabular data (**.ta**) or changing pagination (**.bp**, **.pa**, **.sk**) can be performed with **sroff** formatting requests. Not all **sroff** requests should be used with *mm*, and only some requests can be used interchangeably with the **nroff/troff** formatters.

The following **sroff** requests are safe to use with *mm* and are compatible with **nroff/troff**:

<i>Request</i>	<i>Action</i>
.af <i>R F</i>	assign format <i>F</i> to number register <i>R</i>
.br	break output line
.bp	begin new page
.ce <i>N</i>	center next <i>N</i> lines
.fi	fill output lines
.hy <i>N</i>	turn hyphenation on (<i>N</i> =1) and off (<i>N</i> =0)
.in % <i>N</i>	indent <i>N</i> spaces

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<i>Request</i>	<i>Action</i>
.ls <i>N</i>	<i>N</i> line spacing
.ne <i>N</i>	need <i>N</i> lines on page
.nf	do not fill output lines
.so <i>file</i>	insert source <i>file</i>
.sp <i>N</i>	space <i>N</i> lines
.ta <i>NN</i> ...	set tabs at <i>N</i>
.ti % <i>N</i>	indent only next line <i>N</i> spaces
.tr <i>abcd</i> ...	translate <i>a</i> into <i>b</i> , <i>c</i> into <i>d</i> , etc.

The following **sroff** requests are not compatible with **nroff/troff**, but may be a useful addition to **sroff/MM**:

<i>Request</i>	<i>Action</i>
.li <i>N</i>	take next <i>N</i> lines literally
.lv <i>N</i>	leave <i>N</i> consecutive blank lines
.oc <i>C</i>	overstrike character is <i>C</i>
.pa <i>N</i>	begin new page with page number <i>N</i>
.sk <i>N</i>	skip at next page to page number <i>N</i>
.uc <i>C</i>	underline character is <i>C</i>
.us <i>N</i>	underscore all characters in next <i>N</i> lines
.ws <i>N</i>	suppress <i>N</i> -line leading widows

For additional information on these and other **sroff** requests, see *Text Formatters Reference*.

Warning: Other sroff requests should be used with care, as they may conflict with the mm macros. Undefined requests will be printed as plain text.

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3. Number Registers

`.nr name [value]`

The `.nr` macro assigns a value to a register that is used to control formatting style. The first argument to `.nr` is the name of the register and is traditionally one or two characters in length. The second argument to `.nr` is the integer value assigned to the register. If no value is given, that number register is set to zero.

Number registers are used internally by the macros to flag information and to do basic arithmetic such as incrementing and resetting counters. For example, section headings are automatically numbered through the use of such registers.

Some number registers are preset by `sroff/MM` to provide default formatting information, but the user may change a default value with the `.nr` macro. For example, the number register *Pi* contains the number of spaces used to indent the first line of an indented paragraph. Initially, *mm* sets *Pi* to 5, so the first line of all indented paragraphs is indented 5 spaces. If the user prefers an indentation of 3 spaces, the command

```
.nr Pi 3
```

changes the amount of paragraph indentation to 3 spaces.

Register values are usually set in the beginning of the document but may be changed anywhere in the document. The new values are used from that point on or until the register is changed again.

Actually, `.nr` is an `sroff` command and is synonymous with the `.an` command to set number register values. However, `sroff` syntax requires that register names consisting of more than one character be enclosed in parentheses. Therefore, `.nr` has been redefined as a

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macro in *mm* to allow for compatibility with the **nroff** and **troff** text formatters. To increment or decrement the value in a number register, use the **sroff** request

.an (name) oN

The *SROFF/MM NUMBER REGISTERS* section contains a list of useful number registers. Users may change the value of these registers if the default values are not acceptable.

Two-letter register names of the form *aA*, where *a* and *A* are any lower- and upper-case alphabet, respectively, may be used freely without conflicting with **sroff/MM**.

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4. Overall Text Format

4.1 Right Margin Justification

`.SA [mode]`

The `.SA` macro changes the right margin justification for the main body of text. By default, filled output lines are adjusted to produce an even right margin by filling extra blanks between words.

The justification *mode* (0 or 1) is given as an argument to `.SA`. If *mode* is 0, justification is turned off, producing a ragged right margin. If *mode* is 1 (or if `.SA` is invoked without an argument), justification is turned on, producing an even right margin.

4.2 Line Length, Page Length, and Page Offset

To change the default line length, page length, or page offset, reset the appropriate number register *and* invoke the corresponding `sroff` request:

	Default Values		
Format	Terminal	Register	Request
line length	65	W	.ll
page length	66	L	.pl
page offset	10	O	.po

For example,

```
.nr W 96
.ll 96
```

produces a 96-character line length.

5. Page Headers and Footers

Each page of straight text has a seven-line margin at the top and bottom. The margin at the top of the page consists of three initial blank lines, two header lines, and two more blank lines before the page text begins. The margin at the bottom of the page consists of two blank lines, two footer lines, and three remaining blank lines.

The header and footer lines may be blank or they may contain text, which is defined as a three-part title in the following format:

A delimiter is used to separate the parts of the title. Normally, the apostrophe (') is used as the delimiter, although any character will do, as long as it does not appear in the title text. Text between the first and second delimiter is printed at the left margin, text between the second and third delimiter is centered on the line, and text between the third and fourth delimiter is aligned at the right margin. Any or all of the three parts of the header or footer title may be blank.

The percent character (%) may be used in header and footer titles to obtain the current page number on output (see Section 2.3, *The Insertion Character and Predefined Registers*).

5.1 Page Headers

```
.PH ['left'center'right']
.OH ['left'center'right']
.EH ['left'center'right']
```

The **.PH** macro specifies the header that is to appear at the top of every page. The header text is given as an argument to **.PH** and is printed on the fourth line of the top-of-page margin.

The **.OH** macro specifies the header that is to appear at the top of every odd-numbered page. The **.EH** macro specifies the header that is to appear at the top of every even-numbered page. Text for the

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odd-page header or the even-page header is given as an argument to **.OH** or **.EH**, respectively. Odd- and even-page headers are printed on the fifth line of the top-of-page margin, below the regular page header (if any).

By default, the current page number (centered and surrounded by dashes) is used as the header for every page; odd- and even-page headers are blank. All page headers are suppressed on the title page of internal memoranda, released papers, and external letters.

If **.PH**, **.OH**, or **.EH** are invoked without an argument, the respective header line is left blank.

5.2 Page Footers

```
.PF ['left'center'right']  
.OF ['left'center'right']  
.EF ['left'center'right']
```

The **.PF** macro specifies the footer that is to appear at the bottom of every page. The footer text is given as an argument to **.PF** and is printed on the fourth line of the bottom-of-page margin.

The **.OF** macro specifies the footer that is to appear at the bottom of every odd-numbered page. The **.EF** macro specifies the footer that is to appear at the bottom of every even-numbered page. Text for the odd-page footer or the even-page footer is given as an argument to **.OF** or **.EF**, respectively. Odd- and even-page footers are printed on the third line of the bottom-of-page margin, above the regular page footer (if any).

If **.PF**, **.OF**, or **.EF** are invoked without an argument, the respective footer line is left blank. By default, all page footers are blank.

6. Paragraphs

`.P [type]`

The `.P` macro marks the beginning of a paragraph. There are two types of paragraphs: left-adjusted paragraphs and indented paragraphs. In a left-adjusted paragraph, the text is blocked at the left margin; in an indented paragraph, the first line of text is indented from the left margin.

By default, paragraphs are left-adjusted. The number register *Pt* contains the default paragraph type. Legal values for *Pt* are 0 and 1: if *Pt* is set to 0, paragraphs are left-adjusted; if *Pt* is set to 1, paragraphs are indented.

The style of a single paragraph may be changed by specifying the desired paragraph type as the first argument to `.P`. This overrides the default paragraph type for that paragraph only. The command "`.P 1`" may be used to force a paragraph to be indented.

The number register *Pi* contains the amount of indentation used for indented paragraphs. By default, paragraphs are indented 5 spaces. The command

```
.nr Pi 10
```

changes the amount of paragraph indentation to 10 spaces.

The number register *Ps* contains the amount of space preceding paragraphs. By default, *Ps* is set to 1, producing one blank line before each paragraph. For example, in double space mode,

```
.nr Ps 0
```

could be used to suppress the extra blank space between paragraphs.

7. Section Headings

There are three kinds of section headings: sequentially numbered headings, unnumbered headings, and centered headings.

7.1 Numbered Headings

.H level [heading_text]

The **.H** macro can be used to obtain up to seven levels (sub-sections) of automatically numbered section headings. The first argument to **.H** specifies the heading level (1-7) and the second argument is the heading text. **.H** increments the counter for the specified heading level and generates current section numbers up to and including that level. The number registers *H1* through *H7* contain the current section numbers for heading levels 1 through 7, respectively.

.H produces the following format (spacing and print type) for heading levels 1, 2, and 3 through 7:

<i>Macro call</i>	<i>Format</i>
<i>.H 1 "HEADING TEXT"</i>	[2 blank lines] #. HEADING TEXT [break]
<i>.H 2 "Heading Text"</i>	[1 blank line] ##. Heading Text [break]
<i>.H 3 "Heading Text"</i>	[1 blank line] ###. Heading Text [No break occurs. Heading is immediately followed by text on the same line.]

The **.H** macro does not generate a blank line after headings. Therefore, **.sp** or any macro that normally generates a space (like **.P**) should follow first- and second-level headings; this is unnecessary (and often undesirable) in double space mode.

Warning: A .P macro must follow third- through seventh-level headings but will not cause a break after the heading text.

7.2 Unnumbered Headings

.HU [*heading_text*]

The **.HU** macro produces an unnumbered section heading. The heading text is supplied as an argument to **.HU**. Unnumbered headings are in the same format as major first-level headings: the heading is preceded by two blank lines and followed by a break, and heading text is set in bold type.

The **.HU** macro does not generate a blank line after the heading. Therefore, **.sp** or any macro that normally generates a space (like **.P**) should follow **.HU**. This is unnecessary (and often undesirable) in double space mode.

7.3 Centered Headings

Centered headings may be obtained by changing the value in the number register *Hc*. By default, *Hc* is set to 0, producing no centered headings. If *Hc* is set to 1, only major first-level headings are centered. If *Hc* is set to 2, both first- and second-level headings as well as unnumbered headings are centered. If *Hc* is set to 3, only unnumbered headings are centered.

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8. Itemized Lists

An itemized list is a set of one or more blocked paragraphs which are indented from the left margin with a label to the left of each text block. There are six kinds of itemized lists: automatic lists, reference lists, dash lists, bullet lists, marked lists, and variable lists.

Three different macros must be used, in the following order, to generate an itemized list:

1. A list-initialization macro (**.AL**, **.RL**, **.DL**, **.BL**, **.ML**, or **.VL**) which specifies the desired list type and the overall appearance of the list.
2. One or more list-item macros (**.LI**) which mark the beginning of each item in the list.
3. A list-end macro (**.LE**) which marks the end of the list.

(The above numbered list of three items is an example of an automatic list.)

8.1 List Initialization

A list-initialization macro is used to begin a list and to specify the type of list being generated. All lists share the same basic format, but each list type serves a different purpose and has a different labeling style.

Each type of list has its own default indentation. The amount of indentation can be changed by specifying the desired number of spaces as the *text_indent* argument to the list-initialization macro.

Normally, one blank line separates the items in a list. This can be suppressed by specifying the number '1' as the last argument to the list-initialization macro.

8.1.1 Automatic List

.AL [*format_type*] [*text_indent*] [1]

The **.AL** macro begins an automatically numbered or alphabetized list. By default, list items are sequentially labeled with an arabic numeral followed by a dot (.). A different sequence format may be obtained by specifying one of the following format types as the first argument to **.AL**.

<i>Type</i>	<i>Sequence Format</i>
A	upper-case alphabet
a	lower-case alphabet
I	upper-case roman numerals
i	lower-case roman numerals
1	arabic numerals (default)
01,001,...	arabic numerals with corresponding number of leading zeros

Text blocks are indented 5 spaces unless otherwise specified.

8.1.2 Reference List

.RL [*text_indent*] [1]

The **.RL** macro begins an automatically numbered reference list. Each item in the list is sequentially labeled with an arabic numeral enclosed in square brackets.

Text blocks are indented 6 spaces unless otherwise specified.

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8.1.3 Dash and Bullet Lists

.DL [*text_indent*] [1]

.BL [*text_indent*] [1]

The **.DL** and **.BL** macros begin dash and bullet lists, respectively. With the **.DL** macro, each item in the list is labeled with a dash (-); with the **.BL** macro, each item in the list is labeled with a bullet. On teletypewriter terminals, the bullet is simulated by overstriking the characters 'O' and '+'. .

Text blocks in both dash and bullet lists are indented 2 spaces unless otherwise specified.

8.1.4 Marked List

.ML *label* [*text_indent*] [1]

The **.ML** macro begins a marked list. The marked list is similar to the dash and bullet lists in that the same label is used to mark each item in the list. However, in a marked list the user *must* supply the label. A label may consist of a single character or a string of characters. If no label is given, the list items will be unmarked.

Initially, text blocks are indented 5 spaces. Because the label may be of arbitrary length, a more appropriate indent should probably be specified.

8.1.5 Variable List

.VL [*text_indent*] [*mark_indent*] [1]

The **.VL** macro begins a variable list. This type of list is used when each list item is to be marked with a different label (as in a glossary of terms). In this case, the label is supplied as an argument to each list-item macro (**.LI**), and may consist of characters, words, or phrases.

If no label is given, the first line of the text block begins at the current margin, thereby producing a hanging indent as seen here.

Text blocks are indented 8 spaces unless otherwise specified.

In a variable list, the label itself may be indented by specifying the number of spaces as the *mark_indent* argument to **.VL**; otherwise, the label is printed at the current margin as in the other list types.

8.2 List Item

.LI [*label*]

The **.LI** macro marks the beginning of each item in a list, followed by the text for that list item. By default, **.LI** generates one blank line before each item; this can be suppressed by specifying the number '1' as the last argument to the list-initialization macro.

With the exception of variable lists, each item in a list is automatically marked with the label supplied by the list-initialization macro. In a variable list, the label must be supplied as the first argument to **.LI** for each item in the list. If no argument is given, a hanging indent will be generated for that item.

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8.3 List End

.LE [1]

The **.LE** macro marks the end of an itemized list. List indentation is turned off and the left margin is reset to where it was before that list began. Normally, **.LE** does not generate a blank line at the end of a list; it is assumed that most lists will be followed by a macro that generates its own space (such as **.P** or **.H**). If a list is followed by running text, a blank line between the list and text can be obtained by specifying the number '1' as an argument to **.LE**.

8.4 Nested Lists

It is possible to produce a list within a list (nested list) or even a list with several levels of nested lists (multiple nested list). The basic structure of an ordinary list applies to nested lists as well: each list must begin with one of the list-initialization macros, must contain at least one list item (marked by **.LI**), and must end with the list-end macro (**.LE**). A sub-list may begin anywhere after the first item in the current list, and must end before either the next item or the end of the current list. Each sub-list begins at the current list indent, and reverts to the previous indent when ended. The left margin is shifted to the right with each list-initialization macro, and shifted to the left with each **.LE**.

The sample input in Figure 3-1 was used to generate the multiple nested list in Figure 3-2.

Although there is no limit to the depth of a nested list, anything beyond a fourth nested level may be unreasonable. In fact, depending on the types of lists used, a sixth nested level may fall off the page. The more levels used, the more complicated the input will be. Users should be careful in organizing complex lists and should make certain that there is a **.LE** for every list-initialization macro used. (**Checkmm** would be extremely helpful here.)

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The following multiple nested list begins at the current left margin:

```
.AL
.LI
First item in automatically numbered list.
.LI
Second item in automatically numbered list.
.AL a
.LI
First item in alphabetized sub-list.
Notice how the left margin is indented to the right.
.BL
.LI
Item in a bullet-type sub-list.
Again, the left margin is reset.
.LI
Another item in the same sub-list.
.LI
Yet another item in this sub-list.
.LE
.LI
Second item in the alphabetized sub-list.
Notice how the left margin was reset to the
previous indent.
.DL
.LI
Item in a dash-type sub-list.
Again, the left margin is reset to the right.
.LI
Another item in the same sub-list.
.LE
.LE
.LI
Third (and last) item in automatically numbered list.
Notice how the left margin was reset to the proper
list level.
.LE 1
Now the left margin is restored to its original
state before the outermost list began.
```

Figure 3-1. Sample Input For a Multiple Nested List

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The following multiple nested list begins at the current left margin:

1. First item in automatically numbered list.
2. Second item in automatically numbered list.
 - a. First item in alphabetized sub-list. Notice how the left margin is indented to the right.
 - Item in a bullet-type sub-list. Again, the left margin is reset.
 - Another item in the same sub-list.
 - Yet another item in this sub-list.
 - b. Second item in the alphabetized sub-list. Notice how the left margin was reset to the previous indent.
 - Item in a dash-type sub-list. Again, the left margin is reset to the right.
 - Another item in the same sub-list.
3. Third (and last) item in automatically numbered list. Notice how the left margin was reset to the proper list level.

Now the left margin is restored to its original state before the outermost list began.

Figure 3-2. Sample Output For a Multiple Nested List

9. Footnotes

```
.FS label [text_indent]  
.FE
```

The **.FS** and **.FE** macros mark the beginning and end of the footnote text.

The footnote macros and text should be typed on the next line following the word being footnoted. The footnote label should be typed at the end of the footnoted word and given as an argument to **.FS**. The following example shows the input used to produce the rest of this sentence and the footnote* at the bottom of this page.

```
and the footnote*  
.FS *  
Sroff collects the footnote text and saves it  
for the bottom of the current page.  
A one-inch line separates the footnote from  
the main body of text.  
.FE  
at the bottom of this page.
```

By default, the footnote text is indented 2 spaces from the left margin. The amount of indentation can be changed by specifying the desired number of spaces as the second argument to **.FS**.

* **Sroff** collects the footnote text and saves it for the bottom of the current page. A one-inch line separates the footnote from the main body of text.

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10. Displays

```
.DS [format] [mode] [r_indent]  
.DE [1]
```

The **.DS** and **.DE** macros delimit text that is to be kept together on a page. The text between **.DS** and **.DE** may consist of one or more lines of text and may contain simple **sroff** formatting commands (such as **.sp**, **.ce**, and **.ul**). The text is formatted and displayed as a single block; on output, one blank line precedes and follows the display.

If possible, a display is printed where it is invoked. If a display does not fit on the current page, then the *remainder of the page is left blank* and the display is printed at the top of the next page.

If **.DS** is invoked with no arguments, the text lines are neither filled nor adjusted, and the entire display is blocked at the current left margin. The *format*, *mode*, and *r_indent* arguments to **.DS** may be used to alter the appearance of a display. For historical reasons, *format* and *mode* may be an integer or letter.

The first argument to **.DS** controls the format of the display. If *format* is 0 or L, the entire display is printed at the current left margin. (This is the default format.) If *format* is 1 or I, the entire display is indented from the current left margin. If *format* is 2 or C, each line of the display is centered individually. (Unfortunately, there is no way to automatically center an entire display as a single block.)

The number register *Si* contains the amount of indentation used for indented displays. Unless otherwise specified, displays with format 1 or I are indented 5 spaces from the current left margin.

The second argument to **.DS** controls line filling and adjustment. If *mode* is 0 or N, the display is processed in no-fill mode and each text line is printed exactly as typed. If *mode* is 1 or F, the display is processed in fill mode and output lines are filled to current available line length. By default, displays are processed in no-fill mode.

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Note: The **sroff** requests **.nf** and **.fi** have no effect in displays with *mode* 1 or F.

The third argument to **.DS** specifies the amount of indentation from the right margin. By default, text is not indented from the right margin.

To display a block of text with matching left- and right-hand indents, use

```
.nr Si n
.DS I F n
```

where *n* is the desired amount of indentation. For example,

```
.nr Si 4
.DS I 1 4
.ti +3
" To retire is not to flee, and there is no wisdom
waiting when danger outweighs hope, and it is
the part of wise men to preserve themselves
today for tomorrow, and not risk all in one day."
.sp
.ti +20
- Cervantes
.ul
(Don Quixote)
.DE
```

produces the following quotation format:

```
"To retire is not to flee, and there is
no wisdom waiting when danger outweighs hope,
and it is the part of wise men to preserve
themselves today for tomorrow, and not risk
all in one day."
```

```
- Cervantes (Don Quixote)
```

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Normally, **.DE** generates a blank line at the end of the display; it is assumed that most displays will be followed by running text. If a display is followed by a macro that generates its own spaces (such as **.P** or **.H**), the extra blank line following the display can be suppressed by specifying the number '1' as an argument to **.DE**.

Warning: Displays cannot be used in multiple column format, and footnotes cannot be used within displays.

11. Multiple Columns

Text format can change from single-column (default) to double- or multi-column. Double and multiple (3 to 10) columns of text are automatically balanced on partially filled pages; a change in column format also produces even columns of text. Switching back and forth between column formats does not cause page breaks.

11.1 Double- and Single-Column Format

.2C
.1C

The **.2C** macro generates double-column output. All lines of text following **.2C** are processed in two-column mode. The columns are balanced, producing two even columns of text.

The **.1C** macro generates single-column output, and is used to turn off the effects of **.2C**. Double-column text is balanced before **.1C** reverts to single-column processing.

11.2 Multi-Column Format

.MC [*columns*]

The **.MC** macro generates multi-column output. The number of columns is given as an argument to **.MC**; output may be from 1 to 10 columns wide. If **.MC** is invoked without an argument, text is processed in single-column mode. (**.1C** and **.2C** are merely extensions of the **.MC** macro.)

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Multi-column format is helpful in displaying a blocked list of data or word items. For example,

```
.MC 5
.nf
one
two
three
...
nineteen
.fi
.MC 1
```

prints each item separately (**.nf**) and successively lists the items in five columns:

one	five	nine	thirteen	seventeen
two	six	ten	fourteen	eighteen
three	seven	eleven	fifteen	nineteen
four	eight	twelve	sixteen	

Notice how the columns are balanced. To display the same information row-wise, use tabs to separate the items on each line.

12. Emboldening and Italics

.B [*word*]

.I [*word*]

.R

Words or lines of text are emphasized by using a different font (or print) type. The **.B** macro emboldens text by overstriking each character once. The **.I** macro emphasizes text with italics or underscores. All characters are underscored on teletypewriter terminals.

If a word or phrase is given as an argument to **.B**, only that word is emboldened. If **.B** is invoked without an argument, all following lines of text are emboldened until a **.R** or **.I** macro is used.

Similarly, if a word or phrase is given as an argument to **.I**, only that word is italicized (or underscored). If **.I** is invoked without an argument, all following lines of text are italicized until a **.R** or **.B** macro is used.

For example,

Only this

.B word

is emboldened.

.B

But all of this text is
set in bold type.

.I

And all of this text is set
in italic type.

.R

Now text is back to the
regular type, except
for this

.I italicized

word.

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produces

Only this word is emboldened. **But all of this text is set in bold type.** And all of this text is set in italic type. Now text is back to the regular type, except for this italicized word.

The **.R** macro turns off the effect of **.B** and **.I** and restores the regular print type.

13. Documentation Styles

Sample input and output for available documentation styles is included in the *EXAMPLES OF INPUT AND OUTPUT* section at the end of this chapter.

13.1 Macros for the Beginning

This section deals with a set of macros used to format the title page of standard Bell Laboratories documents such as internal memoranda, released papers, and external letters. These macros may also be used by companies other than Bell Laboratories.

Title page information (for title, author, abstract, etc.) is typed in the same way for all document styles. The information collected by each title page macro is then used by the **.MT** macro to generate the proper format.

The title page macros (each of which will be discussed separately in the sections that follow) are used in the beginning of a document before the main body of text. The macros must be invoked in the following order:

date	.ND [<i>date</i>]
title	.TL [<i>charging</i>] [<i>filing</i>] [<i>#_lines</i>] one or more lines of title text
author	.AU <i>name</i> [<i>init</i>] [<i>loc</i>] [<i>dept</i>] [<i>ext</i>] [<i>room</i>]
affiliation	.AA [<i>name and address</i>] ...
TM or MF number	.TM [<i>number</i>] or .MF [<i>number</i>]
abstract start	.AS [<i>mode</i>] [<i>indent</i>] [<i>heading</i>] one or more lines of abstract text
abstract end	.AE
document style	.MT [<i>type</i>] [<i>addressee</i>]

The use of **.TL**, **.AU**, and **.MT** is mandatory in order to produce the proper document format; use of the other title page macros is optional. Other macros should not be used within this block.

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13.1.1 Date

.ND [*date*]

The **.ND** macro changes the publication date normally printed on memoranda, released paper cover sheets, and external letters. If **.ND** is not used, **sroff/MM** prints the current date in the format **August 15, 1983**.

A fixed date may be specified as an argument to **.ND**. The new date will be printed as typed. If **.ND** is invoked without an argument, no date will be used and the date field will be left blank.

In memorandum-type documents, the date is printed on the title page after the word "date:". In released paper format, the date appears only on the cover sheet (if any), and is printed at the left margin below the abstract. Since external letters are usually printed on company letterhead, the date appears directly below where the letterhead block would be.

13.1.2 Title

.TL [*charging_case*] [*filing_case*] [*#_of_lines*]

The **.TL** macro collects information for title processing. The title itself begins on the line after **.TL** and may consist of one or more lines of text.

The charging case number and filing case number (if any) are given as the first and second argument to **.TL**, respectively. Multiple case numbers should be separated by a comma and a space (,) and treated as a single argument, as in

.TL " 82100-100, 82108-200" " 39199-11, 39400-02"

Case numbers are used only for internal memoranda and are ignored in released papers and external letters. These may be left out for

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documents outside Bell Laboratories (BTL) or documents that don't require them.

The third argument to **.TL** is the number of lines the title should have *on output*. This is only used for memorandum-style documents and can be omitted for released paper and external letter formats. By default, **.TL** assumes that the title for an internal memorandum will take up one line. If the user suspects that the "subject" information may consist of two or more output lines, it may be necessary to test-print the first page to get the right number.

In memorandum-style documents, the title is printed as a filled block of text in bold type and is indented after the word "subject". If one or both case numbers are used, they will be printed on separate lines following the title. For example, as part of the input for an internal memorandum

```
.ND " February 22, 1982"  
.TL 82108-200 39199-11 2  
The Title of this Memorandum  
is " An MM-Like Macro Package  
for Sroff"
```

produces

```
subject: The Title of this Memorandum is                date: February 22, 1982  
         " An MM-Like Macro Package for Sroff "  
         Charging Case 82108-200                          from:  
         Filing Case 39199-11
```

(Notice the third argument to **.TL** reflects the number of lines used for the title *on output*, not on input, and does not include lines used for the charging and filing case.)

In a released paper, the title is centered and emboldened.

Normally, a title does not appear on an external letter and can be suppressed by omitting the title text altogether. If given, the title is printed as a filled block of text in the upper left side of the page.

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13.1.3 Author

.AU name [initials] [location] [department] [extension] [room]

The **.AU** macro collects information about the author(s). Since **.AU** is also used to mark the end of the title text, it *must* be the first command after the title. If the document has more than one author, a separate **.AU** must be used to describe each author. Up to six authors are allowed in a document.

The **.AU** macro accepts up to six arguments. The first argument is the author's name, and is used on the title page and in the signature block at the end of the document. The author's initials are given as the second argument and are usually typed in upper-case letters for use in the signature block's reference line.

The author's location, department number, telephone extension, and room number are given as the third, fourth, fifth, and sixth arguments, respectively. They are used on the title page of internal memoranda; the location and department number are also used in the reference line.

The information collected by **.AU** is used in different ways depending on the document type. For example, in a memorandum-type document, the macro call

```
.AU " S. P. LeName" CL MH 12345 6789 1A-000
```

produces

```
from: S. P. LeName  
MH 12345  
1A-000 x6789
```

(Notice that **sroff**/MM automatically prefixes the extension number with **x**.) In addition, the name, initials, location, and department number are used by the **.SG** macro (see Section 13.2.2) to generate the signature block at the end of the memorandum.

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In released paper format, only the author's name and location code are used and any other arguments to **.AU** are ignored. The author's name is centered and underscored below the title. The location code is used to select the corresponding BTL address, which is centered below the author's name. For example, the macro calls for a released paper with multiple authors

```
.TL  
A Short Title  
.AU " S. P. LeName" CL MH 12345 6789 1A-000  
.AU " H. O. Employee" HOE HO
```

produce

A Short Title

S. P. LeName

**Bell Laboratories
Murray Hill, New Jersey 07974**

H. O. Employee

**Bell Laboratories
Holmdel, New Jersey 07733**

Addresses are provided for the following BTL location codes: AK, AL, CB, DR, HL, HO, HP, IH, IN, MH, MV, PY, RD, WB, and WH. (The company addresses for other BTL locations and for non-BTL authors are discussed in Section 13.1.4, *Author's Affiliation*.)

In external letter format, only the author's name and initials are used and the remaining arguments to **.AU** are ignored. The name and initials are used by the **.SG** macro (see Section 13.2.2) to generate the signature block at the end of the letter.

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13.1.4 Author's Affiliation

`.AA [1st_line] [2nd_line] [3rd_line]`

The `.AA` macro, used only for released paper format, specifies the institution's name and address for non-BTL authors. It may also be used for authors from BTL locations for which an address is not automatically provided (i.e. ALF, FJ, NP, etc.).

`.AA` accepts up to three arguments, one for each line of the institution's address. For example,

```
.TL
A Physical Phenomenon
.AU "I. M. Here" IMH NP 11312
.AA "Bell Laboratories" "Neptune, New Jersey 07753"
.AU "U. R. There" URT
.AA "Department of Physics" "Princeton University" "Princeton, New Jersey 08540"
```

produces

A Physical Phenomenon

I. M. Here

Bell Laboratories
Neptune, New Jersey 07753

U. R. There

Department of Physics
Princeton University
Princeton, New Jersey 08540

Each `.AA` must follow the corresponding `.AU` for that author.

13.1.5 TM and MF Numbers

.TM [*number*]

.MF [*number*]

Filing numbers are usually assigned to Technical Memoranda and Memoranda for File by the department secretary. For Technical Memoranda, the TM number is given as an argument to **.TM**; for Memoranda for File, the MF number is given as an argument to **.MF**. If used, the TM or MF number is printed below the author information on the title page and cover sheet. Multiple TM or MF numbers should be separated by a space and treated as a single argument.

13.1.6 Abstract and Cover Sheet

.AS [*mode*] [*indent*] [*heading*]

.AE

The **.AS** macro marks the beginning of the abstract and the **.AE** macro marks its end. The abstract, which is sandwiched between **.AS** and **.AE**, may consist of one or more lines of text and may contain simple **sroff** formatting commands (such as **.sp**, **.ce**, and **.ul**).

The first argument to **.AS** determines whether the abstract appears on the cover sheet or on the title page or both. By default, *mode* is 0 and the abstract is printed only on the cover sheet. If *mode* is 1, the abstract appears only on the title page. If *mode* is 2, the abstract appears on both the cover sheet and the title page.

By default, the abstract text is printed with ordinary text margins. The abstract may be indented from both margins by specifying the number of spaces as the second argument to **.AS**. For example,

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.AS 0 4

This is the text for a very short abstract.
It really doesn't say anything since it is only
.ul
filler
used for this "you type" /"you get" example.

.sp

What you get here is just an abstract.
Normally, because the first argument to .AS is 0,
the abstract would appear only on the cover sheet,
rather than in the middle of the document as seen here.
.AE

produces

ABSTRACT

This is the text for a very short
abstract. It really doesn't say anything
since it is only filler used for this "you
type"/"you get" example.

What you get here is just an abstract.
Normally, because the first argument to
.AS is 0, the abstract would appear only
on the cover sheet, rather than in the
middle of the document as seen here.

If the .AS and .AE macros are used, a centered heading (*ABSTRACT*) followed by a blank line and the abstract text is printed after the title/author information. On the title page, three blank lines separate the abstract from the main body of the document. An alternate heading may be given as the third argument to .AS, replacing the word "ABSTRACT".

The abstract macros are used in memorandum-type documents and released papers, and are ignored in external letter format. To obtain an abstract on a separate cover sheet, .AS must be invoked with *mode 0* or *2*.

13.1.7 Document Type

.MT [*type*] [*addressee*]

The **.MT** macro generates standard Bell Laboratories format for the cover sheet and title page of both internal and external correspondence. Available documentation styles include internal memoranda, released paper, and external letter formats.

The document type is given as the first argument to **.MT**. For internal correspondence, the following values for *type* generate memorandum format with the corresponding heading:

<i>type</i>	<i>memorandum heading</i>
0	
1	<i>MEMORANDUM FOR FILE</i>
2	<i>PROGRAMMER'S NOTES</i>
3	<i>ENGINEER'S NOTES</i>
" <i>string</i> "	<i>string</i>

The memorandum heading (if any) is centered four spaces below the "subject/date/from" block on the title page. If **.MT** is invoked without an argument (or if *type* is 0), a simple memorandum is generated. If *type* is a text string (e.g., "CONFERENCE NOTES", "MEMORANDUM FOR RECORD"), then that string is used as the memorandum heading.

For external correspondence, values for *type* and the corresponding document formats are:

<i>type</i>	<i>document format</i>
4	released paper
5	external letter

Sample input and output for available documentation styles is included in the *EXAMPLES OF INPUT AND OUTPUT* section at the end of this chapter.

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Information used on the cover sheet and title page is supplied as arguments to the title page macros (.ND, .TL, .AU, etc.) and is used by .MT to generate the proper document format. .MT uses only the information needed for the specified document type; any irrelevant information is ignored. This can be used to your advantage: by including all information you need only change .MT *type* to obtain a different style.

Page header information is suppressed on the cover sheet and title page of all document styles. Unless otherwise specified, the default page header is used on the second and succeeding pages of the document.

For addressed memoranda and external letters, the name of the addressee may be given as the second argument to .MT. The addressee's name, followed by a dash and the current page number, will replace the page header for the second and succeeding pages of the document. The *addressee* argument is ignored in the released paper format.

13.2 Macros for the End

13.2.1 Formal Closing

.FC [*closing*]

The .FC macro generates the formal closing normally used in an external letter. If .FC is invoked without an argument, the closing

Yours very truly,

is used. A different closing (e.g. "Sincerely," , "Yours truly,") may be given as a quoted argument to .FC.

The formal closing is ignored in memorandum and released paper formats.

13.2.2 Signature Block

.SG [*typist's_initials*]

The **.SG** macro produces the signature block at the end of memorandum-type documents and external letters. One signature line is produced for each author. The author's name is printed on the right side of the page and is preceded by three blank lines for the author's signature. The reference data, taken from the first **.AU**, is printed at the left margin on the same line as the name of the last author.

The typist's initials are given as an argument to **.SG** and are appended to the reference data. In memorandum-type documents, the reference data includes the first author's location, department number, and initials, and the typist's initials. For example, given this author information at the beginning of the document

```
.AU " A. D. Strauss" ADS MH 37842  
.AU " C. G. Bellows" CGB HO 37635
```

the command

```
.SG cyd
```

at the end of the document produces

A. D. Strauss

MH-37842-ADS-cyd

C. G. Bellows

In external letter format, the reference data includes the author's initials and the typist's initials separated by a colon (i.e. ADS:cyd).

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If **.SG** is invoked without an argument, the reference data is omitted from the signature block.

The signature block is not used in released paper format, and the **.SG** macro is ignored.

13.2.3 Notations

.NS [*type*]
.NE

The **.NS** and **.NE** macros may be used to generate several types of notation lists at the end of a memorandum or letter. Typically, notations (i.e. "Copy to", "Att.") appear after the signature block and before the approval block (if any).

The first argument to **.NS** specifies the type of notation. If no argument is given, a "Copy to" notation is generated. The following table shows the notation types that are available:

<i>type</i>	<i>notation</i>
0	Copy to
1	Copy (with att.) to
2	Copy (without att.) to
3	Att.
4	Atts.
5	Enc.
6	Encs.
7	Under Separate Cover
8	Letter to
9	Memorandum to
" <i>string</i> "	Copy (<i>string</i>) to

A separate **.NS** is used for each notation type. The notation list, if any (i.e. list of names, attachments, enclosures), follows the corresponding **.NS**. One **.NE** is used after the last notation to mark the end of the entire notation block.

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Notations are printed at the current left margin. Each notation is preceded by one blank line and the notation list (if any) is printed exactly as typed. For example,

.NS 4
As above
.NS 1
C. V. Klein
J. P. Peters
A. G. Sellem
.NS " with att. 1 only"
J. D. Murphy
.NS 2
All Members Department 12345
.NE

produces

Atts.
As above

Copy (with att.) to
C. V. Klein
J. P. Peters
A. G. Sellem

Copy (with att. 1 only) to
J. D. Murphy

Copy (without att.) to
All Members Department 12345

The notation macros are used in memorandum-type documents and external letters, and are ignored in the released paper format.

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13.2.4 Approval Block

.AV *name*

The **.AV** macro generates an approval block with lined space for the approver's signature and the date. The name of the approver is given as an argument to **.AV** and is printed below the signature line. For example,

.AV " O. K. Withme"

produces

APPROVED:

O. K. Withme

Date

Typically, approvals appear after the author's signature and notation list (if any). The approval block is used in external letters and memorandum-type documents; the **.AV** macro is ignored in released paper format.

14. Usage

With the UNIX operating system, users can use the **checkmm** command to scan the contents of the input file(s) for errors in the use of Memorandum Macros. This error-checking program checks for missing or unbalanced macro pairs (**.DS/.DE**, **.FS/.FE**), and improper usage of other MM macros; appropriate error messages are printed at the user's terminal.

Documents prepared with **sroff/MM** may be printed on any computer terminal or line printer. The command

sroff -mm files

generates output at the user's terminal. Documents may be printed at a remote line printer by piping the output through the appropriate filter.

SROFF/MM MACROS

15. Sroff vs. Nroff

With the *mm* macro package, the performance ratio of **sroff** vs. **nroff** is almost 3 to 1; without any macros, the ratio is more like 10 to 1. Since **sroff** (and **nroff**) must process all the text that is part of the macro package, the size of the package directly affects the speed of the process. For this reason, many formatting luxuries like table of contents processing and automatic referencing were not implemented in **sroff**/MM.

Remember, the command **mmlint** may be used to run compatibility checks on **nroff**/MM and **sroff**/MM source files. If you wish to see what changes are necessary to convert a **nroff**/MM source file into a form usable with **sroff**/MM text formatter requests, you enter:

```
mmlint -s files
```

If you wish to see what changes are necessary to convert a **sroff**/MM source file into a form usable with **nroff**/MM text formatter requests, you enter:

```
mmlint -n files
```

In either case, appropriate error messages are printed at the user's terminal indicating the action required for the specified conversion.

SYNOPSIS OF SROFF/MM MACROS

The following listing shows all the **sroff**/MM macros and their usage. Macro commands are listed, more or less, in the order that they would be used. Each macro is followed by its argument list. Optional arguments are enclosed in square brackets and default values are enclosed in parentheses. Legal parameter values are listed below the argument list.

MACRO FUNCTION	NAME	ARGUMENT LIST
set number register	.nr	<i>name</i> [<i>value</i> (0)]
margin justification	.SA	[<i>flag</i> (1)] <i>flag</i> : 1 = on 0 = off
page header	.PH	[<i>'left'center'right'</i>]
odd page header	.OH	[<i>'left'center'right'</i>]
even page header	.EH	[<i>'left'center'right'</i>]
page footer	.PF	[<i>'left'center'right'</i>]
odd page footer	.OF	[<i>'left'center'right'</i>]
even page footer	.EF	[<i>'left'center'right'</i>]
date	.ND	[<i>date</i>]
title	.TL	[<i>charging_case</i>] [<i>filing_case</i>] [<i>#_lines</i> (1)]
author	.AU	<i>name</i> [<i>initials</i>] [<i>loc.</i>] [<i>dept.</i>] [<i>ext.</i>] [<i>room</i>]
author's affiliation	.AA	[<i>1st_line_address</i>] [<i>2nd_line</i>] [<i>3rd_line</i>]
TM number	.TM	[<i>number</i>]
MF number	.MF	[<i>number</i>]

SROFF/MM MACROS

abstract start	.AS [<i>flag</i> (0)] [<i>indent</i> (0)] [<i>heading</i> (ABSTRACT)]
	<i>flag:</i> 0 = cover sheet only 1 = title page only 2 = cover sheet and title page
abstract end	.AE
document type	.MT [<i>type</i> (0)] [<i>addressee</i>]
	<i>type:</i> 0 = no memo type printed 1 = MEMORANDUM FOR FILE 2 = PROGRAMMER'S NOTES 3 = ENGINEER'S NOTES 4 = released paper 5 = external letter " <i>string</i> " = <i>string</i> printed
paragraph	.P [<i>type</i> (0)]
	<i>type:</i> 0 = blocked 1 = indented
numbered heading	.H <i>level</i> [<i>heading_text</i>]
	<i>level:</i> 1 through 7
unnumbered heading	.HU [<i>heading_text</i>]
automatic list	.AL [<i>format</i> (1)] [<i>indent</i> (5)] [1]
	<i>format:</i> 1 = arabic A = upper-case alphabet a = lower-case alphabet I = upper-case roman i = lower-case roman 01,001,... = arabic with leading zeroes
reference list	.RL [<i>indent</i> (6)] [1]
dash list	.DL [<i>indent</i> (2)] [1]
bullet list	.BL [<i>indent</i> (2)] [1]

SROFF/MM MACROS

marked list	.ML <i>mark</i> [<i>indent</i> (5)] [1]
variable list	.VL [<i>text indent</i> (8)] [<i>mark indent</i> (0)] [1]
list item	.LI [<i>mark</i>]
list end	.LE [1]
footnote start	.FS <i>label</i> [<i>text_indent</i>]
footnote end	.FE
display start	.DS [<i>format</i> (0,L)] [<i>fill</i> (0,N)] [<i>right indent</i> (0)] <i>format:</i> 0 or L = left-adjusted 1 or I = indented 2 or C = centered <i>fill:</i> 0 or N = no fill 1 or F = fill
display end	.DE [1]
single column	.1C
double column	.2C
multiple column	.MC [<i>columns</i> (1)] <i>columns:</i> 1 thru 10
boldface type	.B [<i>string</i>]
italic type	.I [<i>string</i>]
regular type	.R
formal closing	.FC [<i>closing</i> (Sincerely,)]
signature	.SG [<i>typist's_initials</i>]

SROFF/MM MACROS

notation start

.NS [*type*(0)]

type: 0 = Copy to

1 = Copy (with att.) to

2 = Copy (without att.) to

3 = Att.

4 = Atts.

5 = Enc.

6 = Encs.

7 = Under Separate Cover

8 = Letter to

9 = Memorandum to

" *string*" = Copy (*string*) to

notation end

.NE

approval line

.AV *name*

SROFF/MM NUMBER REGISTERS

The following number registers may be reset with the `.nr` command. Default values are initially set by `sroff/MM`.

Register Name	Default Value	Usage
H1	0	Level 1 heading number
H2	0	Level 2 heading number
H3	0	Level 3 heading number
H4	0	Level 4 heading number
H5	0	Level 5 heading number
H6	0	Level 6 heading number
H7	0	Level 7 heading number
Hc	0	Centered heading level
L	66	Page length*
O	10	Page offset*
Pi	5	Paragraph indent
Ps	1	Paragraph spacing
Pt	0	Paragraph type
Si	5	Display indent
W	65	Line length*

Note: Two-letter register names of the form `aA`, where `a` and `A` are any lower- and upper-case alphabet, respectively, may be used freely without conflicting with `sroff/MM`.

* Must invoke the corresponding `sroff` request for the change to take effect.

SROFF/MM MACROS

EXAMPLES OF INPUT AND OUTPUT

The following input was used to produce both the sample Memorandum for File (using **.MT 1**) and the sample Released Paper (using **.MT 4**) shown in the next two sections.

Sample Input:

```
.ND "December 7, 1981"
.TL 12345 54321
Preparing Documents with Sroff/MM
.AU "S. P. LeName" SPL MH 45231 6351 2F-120
.AU "C. Walker" CW MH 45231 3732 2F-122
.AA "University of Wisconsin" "Madison, Wisconsin 53701"
.MF 81-45231-09
.AS 0 5
This is the text for an abstract which will appear
only on the cover sheet, and will be indented five
spaces from both left and right margins.
.AE
.MT type
.H 1 "FIRST-LEVEL HEADING"
.P
The .P macro marks the beginning of a paragraph.
By default, paragraphs are blocked at the
left margin and preceded by a blank line.
.H 2 "Second-Level Heading"
.P
Both first- and second-level headings, as well as unnumbered
headings, are set apart from the text; section numbers and
heading text are emboldened.
.H 3 "Third-Level Heading"
.P
This is the first paragraph under the third-level heading.
The section number and heading text are italicized,
and the text of this paragraph immediately follows the
heading text.
.H 1 "DOCUMENTATION STYLES"
.P
The .MT macro controls the documentation style.
The same input was used to produce
both memorandum and released paper formats.
The macro call, .MT 1, was used to produce the sample
Memorandum for File; the macro call, .MT 4,
was used to produce the sample released paper.
.SG cl
.NS 4
Appendices 1-5
.NE
```

SROFF/MM MACROS

Sample Output: Memorandum for File (.MT 1)

subject: **Preparing Documents with Sroff/MM**
Charging Case 12345
Filing Case 54321

date: **December 7, 1981**

from: **S. P. LeName**
MH 45231
2F-120 x6351

C. Walker
MH 45231
2F-122 x3732

MF 81-45231-09

ABSTRACT

This is the text for an abstract which will appear only on the cover sheet, and will be indented five spaces from both left and right margins.

SROFF/MM MACROS

Sample Output: Memorandum For File (Contd)

subject: **Preparing Documents with Sroff/MM**
Charging Case 12345
Filing Case 54321

date: **December 7, 1981**

from: **S. P. LeName**
MH 45231
2F-120 x6351

C. Walker
MH 45231
2F-122 x3732

MF 81-45231-09

MEMORANDUM FOR FILE

1. FIRST-LEVEL HEADING

The .P macro marks the beginning of a paragraph. By default, paragraphs are blocked at the left margin and preceded by a blank line.

1.1 Second-Level Heading

Both the first- and second-level headings, as well as unnumbered headings, are set apart from the text; section numbers and heading text are emboldened.

1.1.1. Third-Level Heading This is the first paragraph under the third-level heading. The section number and heading text are italicized, and the text of this paragraph immediately follows the heading text.

2. DOCUMENTATION STYLES

The .MT macro controls the documentation style. The same input was used to produce both memorandum and released paper formats. The macro call, .MT 1, was used to produce the sample Memorandum for File; the macro call, .MT 4, was used to produce the sample released paper.

S. P. LeName

MH-12345-SPL-c1

C. Walker

Atts.
Appendices 1-5

SROFF/MM MACROS

Sample Output: Released Paper (.MT 4)

Preparing Documents with Sroff/MM

S. P. LeName

Bell Laboratories
Murray Hill, New Jersey 07974

C. Walker

University of Wisconsin
Madison, Wisconsin 53701

ABSTRACT

This is the text for an abstract which will appear only on the cover sheet, and will be indented five spaces from both left and right margins.

December 7, 1981

SROFF/MM MACROS

Sample Output: Released Paper (Contd)

Preparing Documents with Sroff/MM

S. P. LeName

Bell Laboratories
Murray Hill, New Jersey 07974

C. Walker

University of Wisconsin
Madison, Wisconsin 53701

1. FIRST-LEVEL HEADING

The .P macro marks the beginning of a paragraph. By default, paragraphs are blocked at the left margin and preceded by a blank line.

1.1 Second-Level Heading

Both the first- and second-level headings, as well as unnumbered headings, are set apart from the text; section numbers and heading text are emboldened.

1.1.1. Third-Level Heading This is the first paragraph under the third-level heading. The section number and heading text are italicized, and the text of this paragraph immediately follows the heading text.

2. DOCUMENTATION STYLES

The .MT macro controls the documentation style. The same input was used to produce both memorandum and released paper formats. The macro call, .MT 1, was used to produce the sample Memorandum for File; the macro call, .MT 4, was used to produce the sample released paper.

S. P. LeName

MH-12345-SPL-c1

C. Walker

SROFF/MM MACROS

Sample Input: External Letter (.MT 5)

The following input was used to produce the sample External Letter (using **.MT 5**) shown in the next section.

```
.ND "December 7, 1981"  
.TL  
.nf  
.bf 2  
.AU "S. P. LeName" SPL MH 12345 6789 1A-100  
.MT 5 "B. I. Andover"  
.DS  
Ms. B. I. Andover  
TypeKing, Incorporated  
563 Whitman Avenue  
Orange, Connecticut 06477  
.DE  
Dear Ms. Andover:  
.P  
Please send me the technical information package  
for product SPA-V.  
.P  
Since my company is considering applying for an  
exclusive license to redevelop your font digitization  
procedure, I would also appreciate the following  
information:  
.BL  
.LI  
What is the patent status of your procedure?  
.LI  
Can the license be awarded for five years?  
.LI  
What royalties would be required on sales?  
.LE  
.P  
Thank you.  
.FC  
.SG c1
```

SROFF/MM MACROS

Sample Output: External Letter (.MT 5)

December 7, 1981

Ms. B. I. Andover
TypeKing, Incorporated
563 Whitman Avenue
Orange, Connecticut 06477

Dear Ms. Andover:

Please send me the technical information package for product SPA-V.

Since my company is considering applying for an exclusive license to redevelop your font digitization procedure, I would also appreciate the following information:

- What is the patent status of your procedure?
- Can the license be awarded for five years?
- What royalties would be required on sales?

Thank you.

Yours very truly,

SPL:c1

S. P. LeName

COVER SHEET INSTRUCTIONS

The following input can be used as a template for generating a true TM cover sheet:

.ND *date*
.TL *charging_case filing_case*
one or more lines
of title text
.AU *name initials location department extension room*
.TM *number*
.AS 1
one or more lines
of abstract text
.AE
.OK *keyword1 keyword2 keyword3 ...*
.MT
.CS *pgs_text pgs_other pgs_total #_figs #_tabs #_refs*

The input file for the cover sheet should then be processed using **troff** and the **-mm** macros; output should be sent to the phototypesetter.

SROFF/MM MACROS

NOTES

Chapter 4

VIEWGRAPH MACROS USER GUIDE

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Chapter 4

VIEWGRAPH MACROS USER GUIDE

1. Introduction

This chapter describes a package of UNIX system **troff** formatter macros called **MV** designed for typesetting viewgraphs and slides. It is assumed that the reader has a basic knowledge of the UNIX operating system, the text editor **ed**, and the **troff** formatter.

Note 1: The following list contains the commands identified in this guide. In addition, the list categorizes the commands by the reference manual in which they can be found.

1. *UNIX System User Reference Manual* — **ed** and **spell**.
2. *Introduction and Reference Manual* — **eqn**, **mv**, **mvt**, **ocw**, **otroff**, **tbl**, and **troff**.

Note 2: Throughout this chapter, a reference to **troff** (device independent) also means **otroff** (old troff) unless otherwise indicated.

With the **MV** macros, viewgraphs can be prepared in a variety of dimensions, as well as 35-mm slides and 2- by 2-inch “super-slides”. These transparencies can be made in a variety of styles, in different fonts, with oversize titles, and with highlighted subordination levels. Because text from which the foils are typeset is stored on the UNIX system, the contents of a foil can be readily changed to include new data or can be incorporated into a new presentation. Text of the foils can be passed through **spell**, or preprocessed by **eqn**, **tbl**, **ocw**, etc.

Note: The **ocw** preprocessor can only be used with **otroff**. It is not necessary with **troff** (device independent).

VIEWGRAPH MACROS

It is not possible to include artwork, graphics, or multicolored text in foils made with this macro package except by manual cut-and-paste methods.

Numbers enclosed in braces ({ }) refer to paragraph numbers within this section. For example, this is paragraph {1}.

2. Examples

Before explaining the macros in detail, the formatting process is illustrated with some examples.

2.1 Trivial Example

The following text file is given the file name of *trivial*:

```
.Sw
Six stages of a project:
.B
Wild enthusiasm
.B
Disillusionment
.B
Total confusion
.B
Search for the guilty
.B
Punishment of the innocent
.B
Promotion of the nonparticipants
```

The **.Sw** is a foil-start macro and is defined in paragraph 3.1. The following UNIX operating system command generates the viewgraph illustrated in Figure 4-1:

```
mvt trivial
```

2.2 Less Trivial Example

The foil that results from typesetting the following input is illustrated in Figure 4-2:

```
.Vw 2 " Less Trivial" " June 29, 1980"
.T " What the Walrus Said"
"The time has come," the Walrus said,
.BR
"To talk of many things:
.I .5
.B
Of shoes\(\em and ships\(\em and sealing wax\(\em
.B
Of cabbages\(\em and kings\(\em
.B
And why the sea is boiling hot\(\em
.B
And whether pigs have wings."
```

The `.Vw` {3.1} is another foil-start macro. Other macros (`.T`, `.BR`, and `.I`) in this example will be explained later. The “`\(em`” string is the **troff** formatter name for the “em dash” (long dash).

2.3 Other Examples

The inputs that produced Figures 4-3 through 4-7 are shown in this section. These foils illustrate the effect of macros that are discussed in the next section {3}.

VIEWGRAPH MACROS

The input for Figure 4-3 is:

```
.Vh 3 " Levels & Marks"
.T " Foil Levels & Level Marks"
This is the .A (left margin) level;
.B
this is the .B level,
.B
as is this;
.C
this is the .C level,
.C
as is this;
.D
and this is the .D level,
.D
as is this.
.A
The large bullet, the dash, and the small
bullet are the default "marks" for
levels .B, .C, and .D, respectively.
However, these three levels can also
be marked arbitrarily:
.B B.
Like this (this is the .B level);
.C 3.
like this (this is the .C level);
.D d.
like this (this is the .D level), or
.D iv.
like this, or even
\&.D\(\rh^\(bu +4
like this.
.A
The .A level cannot be marked.
.B
An arbitrary number of lines of text
can be included in any item at any level;
the text will be filled, but neither adjusted
nor hyphenated, just like this .B level item.
```

VIEWGRAPH MACROS

The input for Figure 4-4 is:

```
.DF 1 R
.VS 4 Complex
.T " Of Bits & Bytes & Words"
.S -4
.I 3 A x
.ft I
But let your communication be, Yea, yea;
Nay, nay: for whatsoever is more than these
cometh of evil.*
.ft
.I +1 a nospace
Matthew 5:37
.BR
.S
.I 0 .A
Binary notation has been around for a
.S +6
long
.S
time.
.B
The above verse tells us to use:
.C 1)
Binary notation,
.ft I
and
.ft
.C 2)
Redundancy
.D \(\rh
(in communicating)
.B
Binary notation is
.U not
suited for human use, above verse to
the contrary notwithstanding.
.SP
.S -2
.TS
box ;
c | c | c | c
```

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```
l l e l e .
SystemⓅBits/ByteⓅBytes/WordⓅBits/Word

-
IBM 7090/94Ⓟ6Ⓟ6Ⓟ36
IBM 360/370Ⓟ8Ⓟ4Ⓟ32
PDP 11/70Ⓟ8Ⓟ2Ⓟ16
.TE
.S
.S -4
.U -----
.BR
* The use of this verse in this context
is plagiarized from C. Shannon.
.S
```

The input for Figure 4-5 is:

```
.de CW
.I 5 a
.NF
.ft 3
..
.de CN
.FI
.I 0 a
.ft 1
..
.DF 1 R 2 I 3 CW
.VS 5 " CW & EQN"
.EQ
gsize 18
.EN
.S 100 5.5
Input:
.CW
.EQ
sum from k=1 to inf m sup k-1
~ =~ 1 over 1-m
.EN
.CN
```

VIEWGRAPH MACROS

Output:

```
.I 2 a
```

```
.EQ
```

sum from k=1 to inf m sup k-1

$\tilde{=} \tilde{=} 1 \text{ over } 1-m$

```
.EN
```

```
.I 0 a
```

Input:

```
.CW
```

The equation $\int f(t) \tilde{=} \tilde{=} 2 \pi$

$\int \sin(\omega t) dt$

is used here in running text,
rather than being displayed.

```
.CN
```

Output:

```
.I .5 a
```

```
.EQ
```

```
delim $$
```

```
.EN
```

```
.AD
```

The equation $\int f(t) \tilde{=} \tilde{=} 2 \pi$

$\int \sin(\omega t) dt$

is used here in running text,
rather than being displayed.

```
.EQ
```

```
delim off
```

```
gsize 10
```

```
.EN
```

The input for Figure 4-6 is:

```
.de CW
```

```
.I .5 a
```

```
.NF
```

```
.ft 3
```

```
..
```

```
.de CN
```

```
.I 0 a
```

```
.FI
```

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```
.ft 1
..
.DF 1 R 2 I 3 CW
.VS 6 " The Works: Input"
Input:
.S -4
.CW
.TS
center doublebox ;
Cip+4 | Cip+4 S S
^ | L L L
^ | C | C | C
^ | C | C | C
Li | C | C | N .
UsersⓅHardware
Ⓟ_Ⓟ_Ⓟ_
ⓅUNIX\*(TmⓅModelⓅSerial
ⓅSystemⓅ\^ⓅNumber
=
OS Dev.ⓅAⓅVAXⓅ54
SGS Dev.ⓅBⓅ11/70Ⓟ3275
Low-EndⓅCⓅ11/23Ⓟ221
-
And now ...ⓅT{
.NA
Some filled text and an equation:
T}ⓅT{
$ zeta (s) = prod
from k=1 to inf k sup -s $
.AD
T}Ⓟ1.2
.TE
.CN
```

VIEWGRAPH MACROS

The input for Figure 4-7 is:

```
.VS 7 " The Works: Output"
.EQ
delim $$
gsize 14
.EN
Output:
.I 0 a
.SP
.TS
center doublebox ;
Cip+4 | Cip+4 S S
^ | L L L
^ | C | C | C
^ | C | C | C
Li | C | C | N .
UsersⓅHardware
Ⓟ_Ⓟ_Ⓟ_
ⓅUNIX\*(TmⓅModelⓅSerial
ⓅSystemⓅ\^ⓅNumber
=
OS Dev.ⓅAⓅVAXⓅ54
SGS Dev.ⓅBⓅ11/70Ⓟ3275
Low-EndⓅCⓅ11/23Ⓟ221
-
And now ...ⓅT{
.NA
Some filled text and an equation:
T}ⓅT{
$ zeta (s) = prod
from k=1 to inf k sup -s $
.AD
T}Ⓟ1.2
.TE
.EQ
delim off
gsize 10
.EN
```

VIEWGRAPH MACROS

3. Macros

This section contains explanations of the MV macros which are summarized in **mv** of the *UNIX System User Reference Manual*.

3.1 Foil-Start Macros

Each foil must start with a foil-start macro. There are nine foil-start macros for generating nine different-sized foils; the names (and the corresponding mounting-frame sizes) of these macros are shown in Figure 4-8.

The naming convention for these nine macros is that the first character of the name (V or S) distinguishes between viewgraphs and slides, while the second character indicates whether the foil is square (S), small wide (w), small high (h), big wide (W), or big high (H). Slides are thinner than the corresponding viewgraphs; therefore, the ratio of the longer dimension to the shorter one is larger for slides than for viewgraphs. As a result, slide foils can be used for viewgraphs, but not vice versa. On the other hand, viewgraphs can accommodate a bit more text.

Note: The **.VW** and **.SW** macros produce foils that are 7 by 5.4 inches because commonly available typesetter paper is less than 9 inches wide. These foils must be enlarged by a factor of 9/7 before they can be used as 9-inch wide by 7-inch high viewgraphs.

Each foil-start macro causes the previous foil (if any) to be terminated, foil separators to be produced, and certain heading information to be generated. The default heading information consists of three lines of right-justified data:

- The current date in the form *mo/dy/yr*
- BTL
- FOIL *n*.

VIEWGRAPH MACROS

where *n* is the sequence number in the current “run”. As explained below, this heading information is replaced by the three arguments of the foil-start macro if those arguments are given.

The actual projection area is marked by “cross hairs” (plus signs) that fit into the corners of the viewgraph mount. This is an aid in positioning the foil for mounting.

All foils other than the square (.VS) foil also have a set of horizontal and vertical “crop marks”. These indicate how much of the foil will be seen if it is made into a slide, rather than into a viewgraph.

Default heading information can be changed by specifying three optional arguments to the foil-start macro. Square brackets ([]) indicate that the argument they enclose is optional.

```
.XX [ n ] [ id ] [ date ]
```

where:

- **XX** stands for one of the nine foil-start macros
- *n* is the foil identifier (typically a number)
- *id* is other identifying information (typically the initials of the person creating the foil)
- *date* is usually the date.

The resulting heading information consists of three lines of right-justified text:

- *id*
- *date*
- FOIL *n*.

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If *date* and *id* are omitted on a foil-start macro, then the corresponding values (if any) from the previous foil-start macro are used.

3.2 Level Macros

The MV macros provide four levels of indentation, called .A, .B, .C, and .D. Each of these level macros causes the text that follows it to be placed at the corresponding level of indentation.

The amount of vertical spacing done by each level macro can be changed with the .DV macro {3.7}. Figure 4.3 shows examples of the level macros.

3.2.1 The .A Level

```
.A [ x ]
```

The leftmost level (left margin) is obtained by the .A macro. The .A level is automatically invoked by each of the foil-start macros. Each .A macro spaces one half of a vertical space from the preceding text, unless the *x* argument is specified (*x* can be any character or string of characters); *x* suppresses the spacing.

The .A macro does not generate a mark of any sort; it is the “left-margin” macro. Repeated .A calls are ignored, but each successive call of any of the other three level macros generates the corresponding mark.

The .A macro can also be invoked through the .I macro {3.4}.

3.2.2 The .B Level

```
.B [ mark [ size ] ]
```

The .B level items are marked by a bullet (in slightly reduced point size). The text that follows the .B macro is spaced one half of a vertical space from the preceding text.

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The .B level *mark* may be changed by specifying the desired character string as the first argument.

Note: All character-string arguments that contain spaces must be quoted ("...").

Without the second argument (*size*), the point size of the *mark* is not reduced. Thus, the following will produce a numbered list:

```
.VS
This is a list of things:
.B 1.
This is thing number 1.
.B 2.
This is thing number 2.
.B 3.
This is the third and last thing on this foil.
```

It is possible to change the point size of the *mark* with the second argument (*size*). If given, it specifies the desired point-size change. An unsigned or positive (+) argument is taken as an increment; a negative (-) argument is a decrement. An argument greater than 99 causes the *mark* to be reduced in size just as if it were the default *mark*, namely, the bullet. After the *mark* is printed, the previous point size is restored. All these point-size changes are completely invisible to the user.

3.2.3 The .C Level

```
.C [ mark [ size ] ]
```

The .C level is like the .B level except that it is indented farther to the right and the default *mark* is a long dash (\(em)) in a slightly reduced point size.

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3.2.4 The .D Level

.D [mark [size]]

The **.D** level is indented farther to the right than the **.C** level and does not space from the previous text. It causes the text that follows to start on a new line. In other words, it causes a break {3.10}. Otherwise, it behaves like the **.B** and **.C** levels. The **.D** level default *mark* is a bullet smaller than that used for the **.B** level.

3.3 Titles

.T string

The **.T** macro creates a centered title from its argument (*string*). The argument must be enclosed within double quotes ("...") if it contains spaces. The size of the title is four points larger than the prevailing point size. Any indentation established by the **.I** macro {3.4} has no effect on titles; they are always centered within the foil horizontal dimension.

Figures 4-2, 4-3, and 4-4 illustrate the **.T** macro.

3.4 Global Indents

.I [indent] [a [x]]

The entire text (except titles) of the foil may be shifted right or left by the **.I** macro. The first argument (*indent*) is the amount of indentation that is to be used to establish a new left margin. This argument may be signed positive or negative, indicating right or left movement from the current margin. If unsigned, the argument specifies the new margin, relative to the initial default margin. If the argument is not dimensioned, it is assumed to be in inches (see *Text Formatters Reference* for legal **troff** formatter units). If the argument is null or omitted, 0i is assumed causing the margin to revert to the initial default margin.

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If a second argument is specified, the `.I` macro calls the `.A` macro {3.2.1} before exiting. The third argument, if present, is passed to the `.A` macro.

Figures 4-2, 4-4, 4-5, 4-6, and 4-7 illustrate the `.I` macro.

3.5 Point Sizes and Line Lengths

```
.S [ ps ] [ ll ]
```

Each foil-start macro begins the foil with an appropriate default point size and line length. Default point sizes for each type of foil and corresponding maximum number of lines are given in Figure 4-9. Prevailing point size and line length may be changed by invoking the `.S` macro. If the `ps` argument is null, the previous point size is restored. If `ps` is signed negative, the point size is decremented by the specified amount. If `ps` is signed positive, it is used as an increment; and if `ps` is unsigned, it is used as the new point size. If `ps` is greater than 99, the initial default point size is restored (Figure 4-9). Vertical spacing is always 1.25 times the current point size.

The second argument (`ll`), if given, specifies line length. It may be dimensioned. If it is not dimensioned and is less than 10, it is taken as inches. If it is not dimensioned and is greater than or equal to 10, it is taken as **troff** formatter units {7.3}.

Figures 4-4, 4-5, and 4-6 illustrate the `.S` macro.

3.6 Default Fonts

```
.DF n font [ n font ... ]
```

The `MV` macros assume that the Helvetica Regular (also known as Geneva) font, mounted in position 1, is the default font. Additional fonts can be mounted and the default font can be changed. The `.DF` macro informs the **troff** formatter that `font` is in position `n`. The first-named font is the default font. Up to four pairs of arguments may be specified.

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The `.DF` macro must immediately precede a foil-start macro; the initial setting is equivalent to

```
.DF 1 H 2 I 3 B 4 S
```

Figures 4-4, 4-5, and 4-6 illustrate the `.DF` macro.

3.7 Default Vertical Space

```
.DV [ a ] [ b ] [ c ] [ d ]
```

The default vertical space macro (`.DV`) allows changing the vertical spacing done by each of the four level macros {3.2}. The first argument (*a*) is the spacing for the `.A` macro, *b* is for the `.B` macro, *c* is for the `.C` macro, and *d* is for the `.D` macro. All nonnull arguments must be dimensioned. Null arguments leave the corresponding spacing unaffected. The initial setting is equivalent to

```
.DV .5v .5v .5v 0v
```

3.8 Underlining

```
.U string1 [ string2 ]
```

The underline macro (`.U`) takes one or two arguments. The first argument (*string1*) is the string of characters to be underlined. The second argument (*string2*), if present, is not underlined but concatenated to the first argument.

For example:

.U phototypesetter

produces

phototypesetter

while

.U under line

produces

underline

Figure 4-4 illustrates the .U macro.

3.9 Synonyms

The MV macro package recognizes the .AD, .BR, .CE, .FI, .HY, .NA, .NF, .NH, .NX, .SO, .SP, .TA, and .TI uppercase text synonyms for the corresponding lowercase **troff** formatter requests. The *NROFF and TROFF User Manual (In Text Formatters Reference)* contains definitions of these requests.

3.10 Breaks

The .S, .DF, .DV, and .U macros do not cause a break. The .I macro causes a break only if it is invoked with more than one argument. All other MV macros always cause a break. The **troff** formatter synonyms {3.9} .AD, .BR, .CE, .FI, .NA, .NF, .SP, and .TI also cause a break.

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3.11 Text Filling, Adjusting, and Hyphenation

By default, the MV macros fill, but neither adjust nor hyphenate text. This is an aesthetic judgement that seems correct for foils. These defaults can, of course, be changed by using the .AD, .FI, .HY, .NA, .NF, and .NH macros {3.9}.

4. The *troff* Preprocessors

It is possible to use the various **troff** formatter preprocessors to typeset foils that require more powerful formatting capabilities.

4.1 Tables

The **tbl** program can be used to set up columns of data within a viewgraph or slide. The **.TS** and **.TE** macros are not defined in the **MV** macro package, but are merely flags to **tbl**. Figures 4-4 and 4-7 illustrate the **tbl** program use.

4.2 Mathematical Expressions

The **eqn** program can be used to typeset mathematical expressions and formulas on foils provided care is taken to specify proper fonts and point sizes. The **.EQ** and **.EN** macros are not defined in the **MV** macro package. Figures 4-5 and 4-7 illustrate the **eqn** program.

4.3 Constant-Width Program Examples

The constant-width font simulates computer-terminal and line-printer output and can, at times, be effective in presenting computer-related topics. The **ocw** program (see manual page), as well as Figures 4-5 and 4-6 illustrate the constant-width font.

Note: The **ocw** preprocessor is not needed with device independent **troff**.

If you are using device independent **troff**, your typesetter may have a constant width font available. In that case, do not use the **ocw** preprocessor. Use the **.DF** macro to define the font position.

For example:

```
.DF 1 R 2 I 3 CW
```

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Then, define the .CW and .CN macros to include the font change, as shown below.

```
.de CW  
.NF  
.ft 3  
..  
.de CN  
.FI  
.ft 1  
..
```

5. Finished Product

5.1 Phototypesetter Output

```
mvt [ options ] file ...
```

Typeset output is obtained via the **mvt** command. The *file* argument contains text and macro invocations for the foils. The *options* argument can be one or more of the following:

- a preview output on a terminal (other than a
 TEKTRONIX 4014 {5.2})
- e invoke **eqn**
- t invoke **tbl**
- Term* direct output to *term*, where *term* can be one of the
 following:

st	STARE
4014	TEKTRONIX 4014
vp	Versatec printer

Using a hyphen (-) in place of *file* causes the **mvt** command to read the standard input (rather than a file), as in the following example using the **ocw** preprocessor {4.3}:

```
ocw [ options ] file ... | mvt [ options ] -
```

5.2 Output Approximation on a Terminal

```
mvt -a file_name ...
```

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An approximation of the typeset output can be obtained with the **mvt** command. The resulting output shows the formatted foils except that:

- Point-size changes are not visible.
- Font changes cannot be seen.
- Titles that are too long appear proper.
- All horizontal motions are reduced to one horizontal space to the right.
- All vertical motions are reduced to one vertical space down.

For example, it appears that lines of text following a **.B**, **.C**, or **.D** macro do not align properly (even though, in fact, they do).

Although alignment cannot be determined from this approximation, line breaks and the amount of vertical space used by the text can be observed. If the foil is not full, the macro package prints the number of blank lines (in the then current point size) that remain on the foil; if the foil is full, a warning is printed. If the text did overflow the foil, the text will be printed after the “cross hairs.”

5.3 Making Actual Viewgraphs and Slides

Output of the typesetter is so-called “mechanical paper,” which is white, opaque photographic paper with black letters. There are several simple processes (for example, Thermofax, Bruning) for making transparent foils from opaque paper. Because some of these processes involve heat and because mechanical paper is heat sensitive, one should first make copies of the typesetter output on a good-quality office copier and then use these copies for making transparencies.

Getting slides made is a much more complicated photographic process that is best left to professionals. It is possible to make both positive (opaque letters on transparent background) and negative (transparent letters on opaque background) slides, as well as colored-background slides, etc.

6. Suggestions For Use

The following suggestions have been derived from experience, from the examination of several other macro packages for making foils, and from some publications that discuss good and bad foil-making practices:

- The most useful foil sizes are .VS and .Vw (or .Sw). This is because most projection screens are either square or wider than they are tall and also because the resulting foils are smaller, easier to carry, and require no enlargement before use.
- Reducing point size below the default value should be avoided. Default point size for each type of foil (Figure 4-9) is the smallest point size that will result in a foil that is legible by an audience of more than a dozen people. If there is more text than fits onto a foil, two or more foils should be used instead of reducing the point size.
- Numerous font changes should be avoided. A foil with more than two typefaces looks cluttered and distracts the viewer.
- Underlined typeset text should be avoided. Even though this package contains a macro for underlining, it should not be used. Underlined typeset text almost always looks bad; instead use a different typeface.
- The Helvetica sans-serif font is thicker and easier to read than the Times Roman serif font normally used for typesetting. On the other hand, the Times Roman font permits more text to be squeezed onto a foil. If it is intended to use italic and/or bold typefaces, either the Helvetica regular, italic, and medium* :

.DF 1 H 2 HI 3 HM

* Helvetica medium is really a bold typeface.

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or the Times Roman regular, italic, and bold:

.DF 1 R 2 I 3 B

should be mounted via the .DF macro {3.6}. Bold typefaces tend to be a bit overwhelming. Choice of fonts is primarily a matter of personal choice. The following table identifies fonts used in the examples of Fig. 4-1 through 4-7.

<i>FIGURE</i>	<i>FONT</i>
4.1, 4.2, 4.3	H (default)
4.4, 4.7	R and I
4.5, 4.6	R and CW

- The .SP macro can be used to insert a bit of additional white space (for instance, .5v or 1v, where v means “vertical space”) at the top of each foil (that is, increase the top margin).
- Normal uppercase and lowercase text is more legible than uppercase text only.* Uppercase and lowercase alphabets have evolved and have been used for many years because they result in more legible text. Furthermore, such text is less bulky than uppercase text only, so more information can be put onto a foil without crowding.
- Foils for a presentation should be made as consistent as possible. Changing fonts, typefaces, point sizes, etc., from foil to foil tends to distract the viewer. While it is possible to introduce emphasis and draw the viewer’s attention to particular items with such changes, this works only if it is done purposefully and sparingly. Overuse of these techniques is almost always counter-productive.

* The only exceptions to this rule are foils set in a point size so small that lowercase characters simply can not be read. This is usually the case for foils produced on a normal typewriter.

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In summary, the dictum that “the medium is the message” does not apply to foil making. When in doubt:

- Do not change point sizes.
- Do not change fonts or typefaces.
- Do not underline.
- Use many “sparse” foils rather than a few “dense” ones.
- Use fewer words rather than more words.
- Use larger point sizes rather than smaller point sizes.
- Use larger top and bottom margins rather than smaller ones.
- Use normal uppercase and lowercase text rather than uppercase text only.

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7. Warnings

7.1 Use of *troff* Formatter Requests

In general, it is not advisable to intermix arbitrary **troff** formatter requests with the MV macros because this often leads to undesirable (and sometimes astonishing) results. The “safe” requests are ones for which uppercase text synonyms have been defined in the MV package {3.9}. Other **troff** formatter requests should be used sparingly (if at all) and with care and discipline. Be particularly careful when using requests that affect point size, indentation, page offset, line and title lengths, and vertical spacing between lines. The .I and .S macros should be used instead {3.4 and 3.5}.

7.2 Reserved Names

Certain names are used internally by this macro package. In particular, all 2-character names starting with either “)” or “]” are reserved. Names that are the same as names of the MV macros and strings described in this part or names that are the same as **troff** names cannot be used. Furthermore, if any of the preprocessors {4.1, 4.2, and 4.3} are used, their reserved names must also be avoided.

7.3 Miscellaneous

The .S macro changes the point size and vertical spacing immediately, but a line-length change requested with that macro does not take effect until the next-level macro call. Specifying a third argument to the .S macro usually results in a disaster.

The “*(Tm” string generates a trademark symbol.

The tilde (~) is defined by the MV macros as a “nonpaddable” space; that is, the tilde may be used wherever a fixed-size (non adjustable) space is desired. To override this condition, the following line should be included in the input file:

```
.tr ~~
```

8. Dimensional Details

For each style of viewgraph, Figure 4-9 shows the default point size; the maximum number of lines of text (at the default point size); and the height, width, and aspect ratio, both nominal and actual.

11/7/83
BTL
FOIL 1

Six stages of a project:

- Wild enthusiasm
- Disillusionment
- Total confusion
- Search for the guilty
- Punishment of the innocent
- Promotion of the non-participants

Figure 4-1. Trivial Example (Not Actual Size)

VIEWGRAPH MACROS

June 29, 1980
Less Trivial
FOIL 2

What the Walrus Said

"The time has come," the Walrus said,
"To talk of many things:

- Of shoes—and ships—and sealing wax—
- Of cabbages—and kings—
- And why the sea is boiling hot—
- And whether pigs have wings."

Figure 4-2. Less Trivial Example (Not Actual Size)

Foil Levels & Level Marks

This is the .A (left margin) level;

- this is the .B level,
- as is this;
 - this is the .C level,
 - as is this;
 - and this is the .D level,
 - as is this.

The large bullet, the dash, and the small bullet are the default "marks" for levels .B, .C, and .D, respectively. However, these three levels can also be marked arbitrarily:

- B. Like this (this is the .B level);
 - 3. like this (this is the .C level);
 - d. like this (this is the .D level), or
 - iv. like this, or even
 - like this.

The .A level cannot be marked.

- An arbitrary number of lines of text can be included in any item at any level; the text will be filled, but neither adjusted nor hyphenated, just like this .B level item.

Figure 4-3. Example of Foil Levels (Not Actual Size)

Of Bits & Bytes & Words

*But let your communication be, Yea,
yea; Nay, nay: for whatsoever is
more than these cometh of evil.**

Matthew 5:37

Binary notation has been around for a long time.

- The above verse tells us to use:
 - 1) Binary notation, *and*
 - 2) Redundancy
(in communicating)
- Binary notation is not suited for human use, above verse to the contrary notwithstanding.

System	Bits/Byte	Bytes/Word	Bits/Word
IBM 7090/94	6	6	36
IBM 360/370	8	4	32
PDP 11/70	8	2	16

* The use of this verse in this context is plagiarized from C. Shannon.

Figure 4-4. Example of a Square Foil (Not Actual Size)

VIEWGRAPH MACROS

11/4/83
CW & EQN
FOIL 5

Input:

```
.EQ
sum from k=1 to inf m sup k-1
= 1 over 1-m
.EN
```

Output:

$$\sum_{k=1}^{\infty} m^{k-1} = \frac{1}{1-m}$$

Input:

```
The equation $ f(t) = 2 pi
int sin ( omega t ) dt $
is used here in running text,
rather than being displayed.
```

Output:

The equation $f(t) = 2\pi f \sin(\omega t) dt$ is used here in running text, rather than being displayed.

Figure 4-5. Example of Indent (Not Actual Size)

VIEWGRAPH MACROS

11/4/83
The Works: Input
FOIL 6

Input:

```
.TS          (Ⓣ = tab)
center doublebox ;
Cip+4 | Cip+4 S S
^ | L L L
^ | C | C | C
^ | C | C | C
Li | C | C | N
Users Ⓣ Hardware
Ⓣ _ Ⓣ _ Ⓣ _
Ⓣ UNIX\*(Tm Ⓣ Model Ⓣ Serial
Ⓣ System Ⓣ Ⓣ Number
=
OS Dev. Ⓣ A Ⓣ VAX Ⓣ 54
SGS Dev. Ⓣ B Ⓣ 11/70 Ⓣ 3275
Low-End Ⓣ C Ⓣ 11/23 Ⓣ 221

And now ... Ⓣ T |
Some filled text and an equation:
T | Ⓣ T |
$ zeta (s) = prod
from k=1 to inf k sup -s $
T | Ⓣ 1.2
.TE
```

Figure 4-6. Example of Input of a Table Foil (Not Actual Size)

VIEWGRAPH MACROS

11/4/83
The Works: Output
FOIL. 7

delim \$\$ gsize 14 Output:

<i>Users</i>	<i>Hardware</i>		
	UNIX TM System	Model	Serial Number
<i>OS Dev.</i>	A	VAX	54
<i>SGS Dev.</i>	B	11/70	3275
<i>Low-End</i>	C	11/23	221
<i>And now ...</i>	Some filled text and an equation:	\$ zeta (s) = prod from k=1 to inf k sup -s \$	1.2

delim off gsize 10

Figure 4-7. Example of Output of a Table Foil (Not Actual Size)

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<i>MACRO NAME</i>	<i>SIZE* AND TYPE</i>
.VS	7X7 viewgraph or 2X2 super-slide
.Vw	7X5 viewgraph
.Vh	5X7 viewgraph
.VW	9X7 viewgraph
.VH	7X9 viewgraph
.Sw	7X5 35-mm slide
.Sh	5X7 35-mm slide
.SW	9X7 35-mm slide
.SH	7X9 35-mm slide

* Size of mounting frame opening (width and height) in inches.

Figure 4-8. Table of Foil-Start Macros

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MACRO (NOTE 1)	POINT SIZE	MAXIMUM LINES (NOTE 2)	NOMINAL				ACTUAL (TEXT)			
			W — (NOTE 3) —	H	AR	1/AR	W — (NOTE 3) —	H	AR	1/AR
.VS	18	21	7	7	1	1	6	6.8	1.13	.88
.Vw	14	19	7	5	.71	1.4	6	4.8	.8	1.25
.Vh	14	27	5	7	1.4	.71	4.2	6.8	1.6	.62
.VW	14	21	7	5.4	.77	1.3	6	5.2	.87	1.15
.VH	18	28	7	9	1.3	.77	6	8.8	1.5	.68
.Sw	14	18	7	4.6	.67	1.5	6	4.4	.73	1.4
.Sh	14	27	4.6	7	1.5	.67	3.8	6.8	1.8	.56
.SW	14	18	7	4.6	.67	1.5	6	4.4	.73	1.4
.SH	18	28	6	9	1.5	.67	5	8.8	1.76	.57

Note 1: If used as a viewgraph, the .SW macro and .VW macro generated foils must be enlarged by a factor of 9/7.

Note 2: Maximum number of lines of text at the default point size.

Note 3: W—Width in inches, H—Height in inches, AR—Aspect ratio (H/W).

Figure 4-9. Default Point Size, Dimensions, and Aspect Ratios

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NOTES

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