$\mathcal{AMS}$-LaTeX Version 1.0
User's Guide

American Mathematical Society

August 1990

Contents

Part I
General

1 Introduction

The necessary documentation for using the $\mathcal{AMS}$-LaTeX package has two parts: this *User's Guide*, and some sample files illustrating the features available in the $\mathcal{AMS}$-LaTeX package. The file used to produce this *User's Guide* is `amslatex.tex`; the sample files are named `testart.tex` and `testbook.tex`. Installation instructions for the $\mathcal{AMS}$-LaTeX package are found in a separate file, `amltinst.tex`. As explained in the `amltinst.tex` file, installation requires making a new LaTeX format file. This *User's Guide*, however, can be typeset without the new format file, so that users can read it before proceeding further if they wish. As a consequence, though, it was impractical in many cases to show sample output for commands from the `amstex` option; this is done instead in the sample file `testart.tex`. In the *User's Guide* approximate output has been shown for the purposes of illustration when it was practical to do so in ordinary LaTeX.

For best understanding, you should be reasonably familiar with the LaTeX manual: *LaTeX: A document preparation system*, by Leslie Lamport [2]. Reading the *Joy of TeX* [4] (the manual for $\mathcal{AMS}$-TeX) will help you get the most out of the $\mathcal{AMS}$-LaTeX software, but is not mandatory. For users whose background is in $\mathcal{AMS}$-TeX rather than LaTeX, there is an appendix describing the ways in which the LaTeX `amstex` option differs from $\mathcal{AMS}$-TeX 2.0.

1.1 Notes

The notation ⟨*dimension*⟩, ⟨*number*⟩, and the like will be used to indicate that an arbitrary dimension or number or whatever is to be substituted by the user. By *dimension* we mean a number followed by one of TeX's standard units `pt`, `pc`, `in`, `mm`, `cm`, and so forth.

It is important in this *User's Guide* that we distinguish between the original, non-LaTeX implementation of $\mathcal{AMS}$-TeX and the modified form of it that constitutes the LaTeX option `amstex`. Typewriter type will be used for the LaTeX option `amstex`, and the standard logo $\mathcal{AMS}$-TeX will be used for the original

non-LaTeX version.

2 The $\mathcal{AMS}$-LaTeX project

$\mathcal{AMS}$-TeX was originally released for general use in 1982. Its main strength is that it makes it easy for the user to typeset mathematics, while taking care of the many details necessary to make the output satisfy the high standards of mathematical publishing. It provides a predefined set of natural commands such as `\matrix` and `\text` that make complicated mathematics reasonably convenient to type. These commands incorporate the typesetting experience and standards of the American Mathematical Society, to handle problematic possibilities without burdening the user: matrices within matrices, or a word of text within a subscript, and so on.

$\mathcal{AMS}$-TeX, unlike LaTeX does not have certain features that are very convenient for authors—automatic numbering that adjusts to addition or deletion of material being the primary one. There are also labor-saving ways provided in LaTeX for preparing such items as indexes, bibliographies, tables, and simple diagrams. These features are such a convenience for authors that the use of LaTeX spread rapidly in the mid-80s (a reasonably mature version of LaTeX was available by the end of 1983), and the American Mathematical Society began to be asked by its authors to accept electronic submissions in LaTeX.

The obvious question to ask was whether the strengths of $\mathcal{AMS}$-TeX could be combined with the strengths of LaTeX, and in 1987 the American Mathematical Society began to investigate the possibility of doing just that. Work on the $\mathcal{AMS}$-LaTeX project was carried out over the next three years by Romesh Kumar, a TeX consultant in the Chicago area, and by West German LaTeX experts Frank Mittelbach and Rainer Schöpf, with assistance from Michael Downes of the American Mathematical Society Technical Support staff.

The overall philosophy was to provide $\mathcal{AMS}$-TeX commands to the LaTeX user without deviating from standard LaTeX syntax whenever possible. Thus, to make their syntax more like normal LaTeX syntax, $\mathcal{AMS}$-TeX commands having the form `\something...\endsomething` were converted to LaTeX environments, so that they now have the form `\begin{something}...\end{something}`. For example, a matrix is typed as `\begin{matrix}...\end{matrix}` instead of `\matrix...\endmatrix`. Also, some commands that have top and bottom options were changed so that the option is specified using `[t]` or `[b]`

instead of by a prefix `top` or `bot` in the command name. See Appendix B for more details.

A good part of the original $\mathcal{AMS}$-TEX was whittled off in the creation of the `amstex` option. Many commands were redundant and were simply dropped; others seemed only marginally useful and were omitted in order to conserve control sequence memory. Some internal control sequences were eliminated by restructuring the code.

$\mathcal{AMS}$-LATEX is different enough from the original $\mathcal{AMS}$-TEX that using the *Joy of TEX* as documentation would be unsatisfactory. Instead, this *User's Guide* aims to be more or less self-sufficient. The *Joy of TEX* is still recommended reading because it provides background information that helps explain why some things are handled the way they are.

3 Major components of the $\mathcal{AMS}$-LATEX package

The first major part of the $\mathcal{AMS}$-LATEX package is an extensive modification of $\mathcal{AMS}$-TEX 2.0 that allows it to be used in LATEX as a documentstyle option. In other words, if you are writing an article, your documentstyle declaration should look like this:

```
\documentstyle[amstex]{article}
```

The second major part of the $\mathcal{AMS}$-LATEX package is a pair of documentstyles called `amsart` and `amsbook`, parallel to LATEX's `article` and `book`, which are designed to be used in preparing manuscripts for submission to the AMS. As alternatives to the standard LATEX article and book styles, the AMS style files also offer the general LATEX user style files which match the style of AMS publications. When the `amsart` and `amsbook` style files are used the `amstex` option will be automatically included, so that the documentstyle declarations would simply be `\documentstyle{amsart}` or `\documentstyle{amsbook}`.

The analog in $\mathcal{AMS}$-TEX of the `amsart` documentstyle is the documentstyle `amsppt` ("AMS preprint"). In `amsart` and `amsbook` the document structure commands of the `amsppt` style described in Appendix A of the *Joy of TEX* have been superseded by their LATEX equivalents, where equivalents existed, and otherwise have been reimplemented in LATEX form. In order to save a significant amount of memory, the bibliography commands described in Appendix C of the *Joy of TEX* have been dropped in favor of BibTEX.

Part II
Font considerations

4 The font selection scheme of Mittelbach and Schöpf

In order to provide not only access to the AMSFonts currently available but a general, reliable mechanism for making new math fonts accessible to the user, the Society enlisted Frank Mittelbach and Rainer Schöpf to adapt their new LaTeX font selection scheme to accommodate the needs of the $\mathcal{AMS}$-LaTeX project. This new scheme has a couple of distinctive features: (1) fonts (even math fonts) need not be preloaded but can be loaded on demand; (2) font switches work a bit differently—attributes are independent, and only one is changed at a time. In LaTeX terms this means that, for example, `\bf\Large` has the same effect as `\Large\bf`.

At the present time the files for the new font selection scheme are being distributed along with the $\mathcal{AMS}$-LaTeX package, with the permission of Mittelbach and Schöpf; in the future the new scheme will become part of LaTeX, in place of the current scheme. A detailed description of the workings of the font selection scheme can be found in an article by Mittelbach and Schöpf that appeared in *TUGboat*, June 1990 (vol. 11, no. 2): *The new font family selection—user interface to standard LaTeX* [3]. If you don't have access to that article, contact the TeX User's Group (see Appendix D for the address).

5 Basic concepts

In normal use, the ordinary LaTeX commands `\rm`, `\it`, `\tt`, `\bf` are defined in terms of more primitive commands `\family` etc., and still function in much the same way as before. Knowledge of the more primitive commands will not be essential except in documentstyle design or similar tasks.

The Mittelbach–Schöpf font selection scheme classifies fonts based on the attributes *shape*, *series*, *size*, and *family*. Each attribute can be changed independently using the commands `\shape`, `\series`, `\size`, and `\family`. For example, to change the family attribute to `cmr` (Computer Modern roman), the command would be `\family{cmr}`. Note that these commands do not actually select the new font, because it's not uncommon for you to want to change several attributes at a time before actually switching to the new font. The command for putting the new attributes into effect is `\selectfont`. For example, if the current font is family `cmr`, size 10/12 (10-point type with 12-point baselineskip), series `m` (medium weight and width), and shape `it` (italic), then the command

```
\family{cmtt}\shape{n}\selectfont
```

would switch to a Computer Modern typewriter font in the "normal," i.e., upright, shape. The current size and series values would be used in the selection of the new font.

5.1 Shape

The *shape* attribute is one of normal (`n`), italic (`it`), small caps (`sc`), slanted (or "sloped") (`sl`), and upright italic (u). The first three of these are the shapes that were typically found together in the same font case, in the days of manual typesetting. The latter two are somewhat unusual variant shapes that are present in the Computer Modern fonts.

The command to switch to a particular shape, say `sc`, without changing other font attributes would be

```
\shape{sc}\selectfont
```

but there are abbreviations for the most common shape changes: `\sc`, `\it`, `\sl`, and `\normalshape`. These are the same as in the previous font selection scheme, except for `\normalshape`, which may be understood as a replacement for `\rm`. In the new font selection scheme `\rm` is a family-changing command, not a shape-changing command. If you are dismayed at the prospect of typing many instances of `\normalshape`, which is obviously much longer than `\rm`, don't be. As you shall see, many former uses of `\rm`, especially in mathematics, are better handled by other means. With astute use of grouping, most documents can be done without using `\normalshape` at all.

5.2 Series

The series attribute is actually a combination of two related attributes, weight and width. The font charts of type manufacturers typically show weights of light, medium, and bold, and widths of condensed, medium, and expanded, with intermediate and extreme variations such as semibold, extra bold, and ultra bold. The full list of the weights and widths allowed for in the Mittelbach–Schöpf scheme are as shown in Table 1 (adapted from Table 1 in [3]), along with their corresponding abbreviations for use with the `\series` command. Examples:

`\series{ux}\selectfont` Switches to an ultra expanded version of the current font.

`\series{sbc}\selectfont` Switches to a semibold condensed version of the current font.

`\series{m}\selectfont` Switches to a medium weight, medium width version of the current font.

Only two series changes are common enough to require abbreviations: `\bf` and `\mediumseries` are abbreviations for, respectively,

```
\series{bx}\selectfont    \series{m}\selectfont
```

or, in other words, “bold” and “not bold”.

5.3 Size

Because a change in font size is usually accompanied by a change in baselineskip, the `\size` command is designed to take two arguments, the new size and the new baselineskip. To switch to 14-point type with a baselineskip of 18 points, the command would be

```
\size{14}{18pt}\selectfont
```

All the usual LaTeX size-changing commands from `\tiny` to `\Huge` have suitable definitions based on the `\size` command.

Note. In the specification for the baselineskip, it is necessary to give the units, because in some situations a unit other than `pt` may be desirable.

Table 1: Font weights and widths, and their abbreviations. For use in the `\series` command, combine the weight and width abbreviations, dropping any `m`'s (for "medium"), except in the case where both weight and width are medium: then use a single `m`. Examples: Ultra Bold Condensed: `ubc`; Medium Condensed: `c`.

Weight		Width	
Ultra Light	`ul`	Ultra Condensed	`uc`
Extra Light	`el`	Extra Condensed	`ec`
Light	`l`	Condensed	`c`
Semilight	`sl`	Semicondensed	`sc`
Medium (normal)	`m`	Medium	`m`
Semibold	`sb`	Semiexpanded	`sx`
Bold	`b`	Expanded	`x`
Extra Bold	`eb`	Extra Expanded	`ex`
Ultra Bold	`ub`	Ultra Expanded	`ux`

5.4 Family

We define a font *family* as a group of fonts of various shapes, widths, and weights, that share distinctive design features, such as x-height, the relative thickness of horizontal and vertical strokes, distinctive shapes of particular letters, and so forth. In other words, fonts in the same family share a resemblance that fonts from different families don't share (though in some cases the resemblance is obvious only to an experienced eye). Table 2 gives a classification of some of the Computer Modern fonts according to family.

The abbreviations `\rm`, `\tt`, and `\sf` are provided for switching to the Computer Modern roman, typewriter, and sans serif families. (The definition of `\sf`, for example, is `\family{cmss}\selectfont`.)

Table 2: Computer Modern font families

Font file name	Family (and abbreviation)
`cmr10, cmti10, cmsl10, cmcsc10, cmu10, cmbx10, cmbxti, cmbxsl, cmb10`	Computer modern roman (`cmr`)
`cmss10, cmssi10, cmssbx10, cmssdc10`	Computer modern sans serif (`cmss`)
`cmtt10, cmitt10, cmsltt, cmtcsc10`	Computer modern typewriter (`cmtt`)

5.5 Using other font families

If the base family of a document is Computer Modern roman, with other families used only sporadically, the other families would be selected using the `\family` command as described in §5.4. If you want to change the *base family* of the document, however, say to Times Roman or Baskerville, then the best way is to change the default family settings. In a canonical setup with all Computer Modern fonts, the following definitions are in effect:

```
\newcommand\rmdefault{cmr}
\newcommand\sfdefault{cmss}
\newcommand\ttdefault{cmtt}
```

Some or all of these default settings can be changed using `\renewcommand`. For example, if you have families `pstr`, `pshel`, and `pstt` for respectively PostScript Times Roman, PostScript Helvetica, and Postscript Typewriter fonts, then you could make them the default via the commands

```
\renewcommand{\rmdefault}{pstr}
\renewcommand{\sfdefault}{pshel}
\renewcommand{\ttdefault}{pstt}
```

either in the preamble of an individual document, or in an option file (which then could be used by more than one document). After these changes, the commands `\rm`, `\sf`, and `\tt` will select the PostScript families rather than Computer Modern families. Computer Modern families would still be accessible through explicit use of the `\family` command, e.g.,

```
\family{cmtt}\selectfont
```

Note that in order to use such alternate families you must have on your computer system a fontdef file that defines which fonts belong to the families `pstr`, `pshel`, and `pstt`, as well as what sizes, shapes, and weights are available on your particular system; see the file `fontdef.max` for more details.

In addition to the family defaults, there are defaults for some other font attributes: `\bfdefault`, `\itdefault`, `\scdefault`, and `\sldefault`. These give further control over fonts. I.e., if you wanted to have all the slanted fonts in a document come out in italic, it could be done like this:

```
\renewcommand{\sldefault}{it}
```

The normal values for these defaults are

```
\bfdefault      bx
\itdefault      it
\scdefault      sc
\sldefault      sl
```

Notice that by default bold fonts come from the Bold Expanded series rather than the Bold series. A comparison of the bold Computer Modern fonts provided in standard distributions of TEX shows why:

Bold	Bold Expanded	
cmb10	cmbx5	cmbxsl8
	cmbx6	cmbxsl10
	cmbx7	cmbxti7
	cmbx8	cmbxti10
	cmbx9	
	cmbx10	
	cmbx12	

5.6 The `oldlfont` option

When the Mittelbach–Schöpf font selection scheme is in use, emulation of the old font selection scheme can be obtained by adding the option `oldlfont` to the documentstyle options list. When the `oldlfont` option is used, size-changing commands return to normal shape and medium series in addition to changing the font size; `\rm` gives normal shape and medium series; `\tt` gives the normal shape and medium series of the typewriter font; and `\sf` gives the normal shape and medium series of sans serif.

5.7 Warnings

When using the Mittelbach–Schöpf scheme, the font names listed in an "overfull hbox" message won't look the same as before. Each font name will have the family, series, shape, and size, separated by slashes. For example, 10-point Computer Modern bold extended will appear as `\cmr/bx/n/10`. Formerly it would have appeared as `\tenbf`.

Many combinations of font attributes are not available at the present time because the corresponding fonts do not exist. The combination

```
\family{cmr}\series{bx}\shape{sl}
```

happens to be available, because the corresponding font file, `cmbxsl10`, is part of the standard TEX distribution. However, for the combination

```
\family{cmss}\series{sbux}\shape{sc}
```

"Computer Modern sans serif semibold ultra expanded small caps," no font file currently exists.

When a combination of font attributes is selected that is not available, the nearest available font will be substituted, and a warning message—not an error message, just a warning message—will appear on-screen during the processing of the document file. The warning message will indicate which font was substituted.

Once in a while, you may find surprising results from a few commands in standard LaTeX because they do not reset all the font attributes in the new font selection scheme. For example, if the `\footnote` command appears within italic text (e.g., in a theorem), then the text of the footnote will also be italic, because the standard definition of `\footnote` resets only the *size* attribute, not the *shape* or *family* or *series* attributes. Problems of this nature will be rectified in the next version of LaTeX (version 2.10); in the meantime, you can add explicit font commands where needed: to get a normal footnote in italic text, type

```
\footnote{\normalshape ...}
```

instead of just `\footnote`.

6 Names of math font commands

The single biggest issue in the integration of $\mathcal{AMS}$-TeX and LaTeX font usage was that in $\mathcal{AMS}$-TeX math font commands work differently than text font commands and have different names. Instead of being a simple switch, whose scope is bounded by curly braces, a math font command in $\mathcal{AMS}$-TeX is a command with one argument. This means that in $\mathcal{AMS}$-LaTeX, to obtain a single bold letter in math you type `\bold{A}` rather than `{\bf A}`, and two bold letters would be typed `\bold{A}\bold{B}` instead of `{\bf AB}`. (A similar distinction between text accents and math accents already existed in LaTeX.) Having the font command apply only to a single letter in this way is more natural in math formulas, because letters are usually single variables rather than components of a word, and different fonts are mixed in all combinations; four consecutive letters might be from four different fonts.

The full list of math font commands in the `amstex` option is `\mathrm`, `\bold`, `\cal`, with the addition of `\frak` (Fraktur) and `\Bbb` (blackboard bold) if AMSFonts are available. Math italic, the default font for letters in math, also has a name, `\mit`, but this is never needed in ordinary use. Tables 3 and 4 give a comprehensive listing of font change commands for convenient reference.

To gain access to a new math alphabet, you use the `\newmathalphabet` command in the preamble of your document. If you have the AMSFonts 2.0 package, for example, and you want to use Russian letters in math, taking them

Table 3: Font commands used in text

Font command	Equivalent	Font selected
`\normalshape`	`\shape{n}`	normal, upright, “roman”
`\it`	`\shape{it}`	italic
`\em`	`\shape{it}`*	emphasis
`\sl`	`\shape{sl}`	slanted
`\sc`	`\shape{sc}`	small caps
`\mediumseries`	`\series{m}`	medium weight
`\bf`	`\series{bx}`	bold extended weight
`\tt`	`\family{cmtt}`	typewriter style
`\sf`	`\family{cmss}`	sans serif
`\rm`	`\family{cmr}`	roman
*The command `\em` selects shape `it` if the current font is upright, otherwise it selects shape `n` (normal).		

Table 4: Font commands used in math

`\bold`	Used to obtain bold letters from the English alphabet.
`\boldsymbol`	Used to obtain bold numbers and other nonalphabetic symbols, as well as bold Greek letters.
`\pmb`	“Poor man’s bold,” used for math symbols when bold versions don’t exist in the currently available fonts.
`\cal`	Calligraphic letters. Only uppercase is available.
`\mit`	Math italic. This font is automatically selected in math mode, so the command `\mit` is not needed in normal use.
`\mathrm`	Roman, normal shape. Note: most of the time, `\text` or `\operatorname` should be used instead of `\mathrm` to produce this font in math.
`\frak`	Euler Fraktur alphabet.
`\Bbb`	Blackboard bold alphabet. Only uppercase is available.

from the University of Washington Cyrillic fonts, then you need to find out the family name assigned to the fonts and the shapes and weights available. See Table 5 to see what family names are included in the standard font definition file `fontdef.max`. If you made a custom fontdef file to match your available fonts, look in that file to find the information. If you are running LaTeX at a larger institution where some technical person has been assigned to handle arcane font matters, you may need to consult that person.

Suppose, then, that the family name for the University of Washington fonts is `UWCyr`. Decide on the name of the command you'd like to use for Cyrillic, let's say `\cy`. In the preamble area of your document, add the line

```
\newmathalphabet*{\cy}{UWCyr}{m}{n}
```

Thenceforth `\cy{A}`, `\cy{d}`, and so on will give you a Russian A, d, or whatever in math. Since there is not a one-to-one correspondence between the Russian alphabet and the English alphabet, you may need to refer to your documentation to find out how to obtain certain letters. The *AMSFonts User's Guide* [1] gives a complete table.

If you also want to use bold Russian letters, you could define another math alphabet and name it, say, `\boldcy`. Alternatively, you could set things up so that bold Russian letters are accessible through the commands `\boldsymbol` and `\boldmath`. If you add the line

```
\addtoversion{bold}{\cy}{UWCyr}{b}{n}
```

in your document's preamble, then `\cy{A}` would produce a normal-weight Russian A and

```
{\boldmath  $ ... \cy{A} ... $ }
```

would produce a bold Russian A (with the rest of the formula being made bold as well). Furthermore, you could then obtain a bold Russian A in the midst of normal math using `\boldsymbol`:

```
$ ... \boldsymbol{\cy{A}} ... $
```

In the `amstex` option `\boldsymbol` is to be used for individual bold math symbols and bold Greek letters—everything in math except for letters (where you would use `\bold`). For example, to obtain a bold ∞, $+$, π, or 0, you would use the commands `\boldsymbol{\infty}`, `\boldsymbol{+}`, `\boldsymbol{\pi}`,

Table 5: Font name assignments made in `fontdef.max`

Family	Series	Shape	
cmr	m	n	Computer Modern Roman
cmr	m	sl	CM slanted
cmr	m	it	CM italic
cmr	m	sc	CM small caps
cmr	m	u	CM upright italic
cmr	b	n	CM bold
cmr	bx	n	CM bold extended
cmr	bx	sl	CM bold extended slanted
cmr	bx	it	CM bold extended italic
cmss	m	n	CM sans serif
cmss	m	sl	CM sans serif slanted
cmss	sbc	n	CM sans serif semibold condensed
cmss	bx	n	CM sans serif bold extended
cmtt	m	n	CM typewriter
cmtt	m	it	CM typewriter italic
cmtt	m	sl	CM typewriter slanted
cmtt	m	sc	CM typewriter small caps
cmm	m	it	CM math italic
cmm	b	it	CM bold math italic
cmsy	m	n	CM math symbols
cmsy	b	n	CM bold math symbols
lasy	m	n	LaTeX extra symbols
lasy	b	n	LaTeX bold extra symbols
msa	m	n	AMS extra symbols A
msb	m	n	AMS extra symbols B
euf	m	n	Euler fraktur
euf	b	n	Euler fraktur bold
eur	m	n	Euler roman
eur	b	n	Euler bold roman
eus	m	n	Euler script
eus	b	n	Euler bold script
euex	m	n	Euler math extension symbols
UWCyr	m	n	University of Washington Cyrillic
UWCyr	m	it	UW Cyrillic italic
UWCyr	m	sc	UW Cyrillic small caps
UWCyr	b	n	UW Cyrillic bold
UWCyss	m	n	UW Cyrillic sans serif
ccr	m	n	Concrete Roman
ccr	m	it	Concrete italic
ccr	m	sc	Concrete small caps
ccr	c	sl	Concrete condensed slanted
ccm	m	it	Concrete math italic

or `\boldsymbol{0}`. Because they are not included in the standard distribution of TEX fonts, sizes other than 10-point of bold fonts for math symbols, Greek, and math italic (CMBSY and CMMIB) are provided in the AMSFonts 2.0 distribution.

Since `\boldsymbol` takes rather a lot of typing, you would usually put some definitions in the preamble of the form

```
\newcommand{\bpi}{\boldsymbol{\pi}}
\newcommand{\binfty}{\boldsymbol{\infty}}
```

for any bold symbols you're going to use frequently.

For some math symbols `\boldsymbol` will not have any effect because bold versions of those symbols do not exist in the currently available fonts. These include extension symbols and large operator symbols from the font CMEX, as well as the AMS extra math symbols from the fonts MSAM and MSBM. "Poor man's bold" (`\pmb`) can be used for some of the things that aren't handled properly by `\boldsymbol`. It works by typesetting three copies of the symbol with slight offsets. With large operators and extension symbols, however, `\pmb` does not currently work very well because the proper spacing and treatment of limits is not preserved.

To make an entire math formula bold (or as much of it as possible, depending on the available fonts), use `\boldmath` preceding the formula, as described in the LATEX manual.

The sequence `{\bf\hat{a}}` (in ordinary LATEX) or `\bold{\hat{a}}` (in the `amstex` option) produces a bold accent character over the **a**, as you would expect. However, combinations like `{\cal\hat{a}}` will not work because the `\cal` font does not have its own accents. In the `amstex` option the font change commands are defined in such a way that accent characters will be taken from the `\rm` font if they are not available in the current font (in addition to the `\cal` font, the `\Bbb` and `\frak` fonts don't contain accents).

In ordinary LATEX uppercase Greek can be made bold by, e.g., `{\bf\Gamma}`. In the `amstex` option uppercase Greek can be made bold only by using `\boldsymbol` (in other words, uppercase Greek is handled the same as lowercase Greek).

7 The command \newsymbol

The command \newsymbol is presently used only for symbols from the AMS extra symbol fonts, MSAM and MSBM. \newsymbol allows you to create a control sequence that will properly produce a symbol from the extra symbol fonts. The use of \newsymbol is explained in the *AMSFonts User's Guide*. In a LaTeX document there is one main difference in usage, which is only applicable if you want to use AMSFonts without using the amstex option: instead of using the additional setting-up commands \loadmsam and \loadmsbm, you should put "amsfonts" in the documentstyle options list. Otherwise \newsymbol commands can be used exactly as shown in the *AMSFonts User's Guide*. Like \newcommand's, they should be placed in the preamble.

The amsfonts option is geared to the current release of AMSFonts (version 2.0). In this version, some rearranging has been done and some font names are different than in earlier versions. If you have an earlier version, you would need to contact the AMS for an upgrade to version 2.0 in order to use the amsfonts option successfully. See Appendix D for how to obtain AMSFonts.

8 The amssymb option

If you are running a version of LaTeX with extra memory available for control sequence names, and you use quite a few of the extra math symbols from the AMSFonts, it may be more convenient for you to use the amssymb documentstyle option, which will define all the symbol names (about 200), so you won't have to include an individual \newsymbol command in your document for each one. You may prefer to include it in the construction of a format file (see the installation instructions) to save processing time; it is a stand-alone option, so it can be included in the format file without including the amstex option.

Part III
Features of the `amstex` option

9 Math spacing commands

Both the spelled-out and abbreviated forms of these commands are robust, and in addition they can also be used outside of math. The primary math spacing commands are:

Abbrev.	Spelled out	Abbrev.	Spelled out
`\,`	`\thinspace`	`\!`	`\negthinspace`
`\:`	`\medspace`		`\negmedspace`
`\;`	`\thickspace`		`\negthickspace`
`@,`		`@!`	
	`\quad`		
	`\qquad`		

`@,` and `@!` give one-tenth the space of `\,` and `\!` respectively, for extra fine tuning where necessary.

10 Multiple integral signs

`\iint`, `\iiint`, and `\iiiint` give multiple integral signs with the spacing between them nicely adjusted, in both text and display style. `\idotsint` is an extension of the same idea that gives two integral signs with dots between them.

11 Over and under arrows

There are some additional over and under arrow operations provided in the `amstex` option:

```
\underleftarrow        \underrightarrow
```

```
\overleftrightarrow     \underleftrightarrow
```

All over and under operations, including the previously available ones, have been modified to scale properly in subscript sizes. (After you have installed $\mathcal{AMS}$-LaTeX, you can process and print the sample file `testart.tex` to see examples of the arrows.)

12 Dots

In the `amstex` option dots should be typed as `\dots`; placement (on the baseline or centered) is selected according to whatever follows after the `\dots`. If the next thing is a plus sign, the dots will be centered; if it's a comma, they will be on the baseline—that is, if you are using the `amsart` documentstyle. Dot placement can be changed in other documentstyles if different conventions are wanted.

If the dots fall at the end of a math formula, the next thing is something like `\end` or `\)` or `$`, which does not give any information about how to place the dots. Then you must help by using `\dotsc` for "dots with commas," or `\dotsb` for "dots with binary operators/relations," or `\dotsm` for "multiplication dots," or `\dotsi` for "dots with integrals." For example, the input

```
Then we have the series $A_1,A_2,\dotsc$,
the regional sum $A_1+A_2+\dotsb$,
the orthogonal product $A_1A_2\dotsm$,
and the infinite integral
\[\int_{A_1}\int_{A_2}\dotsi\].
```

will produce low dots in the first instance and centered dots in the others, with the spacing on either side of the dots nicely adjusted.

Then we have the series $A_1, A_2, \dots$, the regional sum $A_1 + A_2 + \cdots$, the orthogonal product $A_1 A_2 \cdots$, and the infinite integral

$$\int_{A_1}\int_{A_2} \cdots .$$

Specifying dots this way, in terms of their meaning rather than in terms of their visual placement, is in keeping with the general philosophy of LaTeX and makes documents more portable between places where different conventions prevail. The control sequences `\ldots` and `\cdots` are still available, however, for compatibility.

13 Accents in math

The following accent commands automatically give good positioning of double accents:

```
\Hat    \Check  \Tilde  \Acute  \Grave  \Dot    \Ddot
\Breve  \Bar    \Vec
```

In ordinary LaTeX the second accent will usually be askew: $\hat{\hat{A}}$ (`\hat{\hat A}`). In the `amstex` option, if you type `\Hat{\Hat A}` (using the capitalized form for both accents) the second accent will be properly positioned (see `testart.tex` for examples).

As explained in the *Joy of TEX*, this double accent operation is complicated and tends to slow down the processing of a TeX file. If your document contains many double accents, you can use `\accentedsymbol` in the preamble of your document to help speed things up. It stores the result of the double accent command in a box register, for quick retrieval. `\accentedsymbol` is used like `\newcommand`:

```
\accentedsymbol{\Ahathat}{\Hat{\Hat A}}
```

Some accents have a wide form: typing `$\widehat{xy},\widetilde{xy}$` produces $\widehat{xy},\widetilde{xy}$. Because these wide accents have a certain maximum size, extremely long expressions are better handled by a different notation: $(AmBD)\widehat{\ }$ instead of $A\widehat{mBD}$. But getting an accent into a superscript is a little tricky (try it), so `amstex` has the following control sequences to make it easier:

```
\sphat     \spcheck   \sptilde   \spdot
\spddot    \spdddot   \spbreve
```

The example above would be typed `(AmBD)\sphat`.

Finally, `\dddot` and `\ddddot` are available to produce triple and quadruple dot accents in addition to the `\dot` and `\ddot` accents already available in LaTeX.

14 Roots

In ordinary LaTeX the placement of root indices is sometimes not so good: $\sqrt[\beta]{k}$ (`\sqrt[\beta]{k}`). In the `amstex` option `\leftroot` and `\uproot` allow you to adjust the position of the root: `\sqrt[\leftroot{-2}\uproot{2}`

`\beta]{k}` will move the beta up and to the right. (See the sample file `testart.tex`.) The negative argument used with `\leftroot` moves the β to the right. The units are a small dimension that is a useful size for such adjustments.

15 Boxed formulas

The command `\boxed` puts a box around its argument, like `\fbox` except that the contents are in math mode.

16 Extensible arrows

`@>>>` and `@<<<` produce arrows that extend automatically to accommodate unusually wide subscripts or superscripts. The text of a superscript is typed in between the first and second `>` or `<` symbols, and for a subscript, it's typed between the second and third symbols. For example, `@>\xi F_k\Gamma_k\alpha>>` would have a superscript $\xi F_k \Gamma_k \alpha$ placed above the arrow. These arrows were originally developed for use in commutative diagrams but can be used elsewhere also. However, the `amscd` option must be loaded for extensible arrows to function. (See section 24.4 for more information about the `amscd` option.)

17 `\overset`, `\underset` and `\sideset`

LaTeX provides `\stackrel` for placing a superscript above a binary relation. In `amstex` there are somewhat more general commands, `\overset` and `\underset`, that can be used to place one symbol above or below another symbol, whether it's a relation or something else. The input `\overset{*}{X}` will place a superscript-size $*$ above the X; `\underset` performs the parallel operation that you'd expect.

There's also a command called `\sideset`, for a rather special purpose: putting symbols at the subscript and superscript corners of a large operator symbol such as $\sum$ or $\prod$. The prime example is the case when you want to put a prime on a sum symbol. If there are no limits above or below the sum, you

could just use `\nolimits`: here's `\sum\nolimits' E_n` in display mode:

$$\sum\nolimits' E_n. \tag{1}$$

But if you want not only the prime but also something below or above the sum symbol, it's not so easy. If you have

$$\sum_{n<k,\ n\ odd} nE_n \tag{2}$$

and you want to add a prime on the sum symbol, use `\sideset` like this:

```
\sideset{}{'}\sum_{...}nE_n
```

The extra pair of empty braces is explained by the fact that `\sideset` has the capability of putting an extra symbol or symbols at each corner of a large operator; to put an asterisk at each corner of a product symbol, you would type

```
\sideset{_*^*}{_*^*}\prod
```

(After you have installed $\mathcal{A}\mathcal{M}\mathcal{S}$-LaTeX, you can typeset and print the sample file `testart.tex` to see examples of the output.)

18 The `\text` command

The main use of the command `\text` is for words or phrases in a display. It is very similar to the LaTeX command `\mbox` in its effects, but has a couple of advantages. If you want a word or phrase of text in a subscript, you can type `..._{\text{word or phrase}}`, which is slightly easier than the `\mbox` equivalent: `..._{\mbox{\scriptsize word or phrase}}`. The other advantage is the more descriptive name.

19 Operator names

Math functions such as $\log$, $\sin$, and $\lim$ are traditionally typeset in roman type to help avoid confusion with single math variables, set in math italic. The more common ones have predefined names, `\log`, `\sin`, `\lim`, and so forth, but new ones come up all the time in mathematical papers, so `amstex` provides a general

mechanism for producing such names: `\operatorname{xxx}` produces xxx in the proper font and automatically adds proper spacing on either side when necessary, so that you get $A\,xxx\,B$ instead of $Axxx B$.

Since `\operatorname` takes rather a lot of typing, you would usually put some definitions in the preamble of the form

```
\newcommand{\xxx}{\operatorname{xxx}}
\newcommand{\yyy}{\operatorname{yyy}}
```

for any operator names you're going to use frequently.

Something like `\lim` has been defined as an `\operatornamewithlimits` rather than an `\operatorname`, because in displayed formulas if there is a subscript on `\lim` it is conventionally placed underneath, like the limits on sums:

$$C_+ f(x) = \lim_{t\to 0} C(f)(x+it) \tag{3}$$

You can use `\operatornamewithlimits` just like `\operatorname`; the only difference is the placement of subscripts and superscripts. A few special operator names with limits are defined for you in the `amstex` option: `\varinjlim`, `\varprojlim`, `\varliminf`, and `\varlimsup`; there are some examples in the sample file `testart.tex`.

20 \mod and its relatives

Commands `\mod`, `\bmod`, `\pmod`, `\pod` are provided to deal with the rather special spacing conventions of "mod" notation. `\bmod` and `\pmod` are available in LaTeX, but in the `amstex` option the spacing of `\pmod` will adjust to a smaller value if it's used in a non-display-mode formula. `\mod` and `\pod` are variants of `\pmod` preferred by some authors; `\mod` omits the parentheses, whereas `\pod` omits the "mod" and retains the parentheses.

21 Fractions and related constructions

In addition to `\frac` (which was already available in LaTeX), `amstex` provides `\dfrac` and `\tfrac` as convenient abbreviations for `{\displaystyle\frac ... }` and `{\textstyle\frac ... }`. Furthermore, the thickness of the

fraction line can be varied, using a new square-bracket option of the `\frac` command. `\frac[`⟨*dimension*⟩`]{...}{...}` makes a fraction where the thickness of the horizontal rule is determined by the given dimension. The sample file `testart.tex` shows an example using a thickness of `1.5pt`.

`\fracwithdelims`⟨*left delimiter*⟩⟨*right delimiter*⟩`[`⟨*dimension*⟩`]` is an extension of the same idea, with delimiters on either side specified by the user.[1]

For binomial expressions such as $\binom{n}{k}$ `amstex` has `\binom`, `\dbinom` and `\tbinom`. `\binom` is an abbreviation for `\fracwithdelims()[0pt]`.

After you have installed $\mathcal{AMS}$-LaTeX, you can typeset and print the sample file `testart.tex` to see examples of `\frac` and `\binom`.

22 Continued fractions

The continued fraction

$$\cfrac{1}{\sqrt{2}+\cfrac{1}{\sqrt{2}+\cfrac{1}{\sqrt{2}+\cfrac{1}{\sqrt{2}+\cfrac{1}{\sqrt{2}+\cdots}}}}} \tag{4}$$

can be obtained by typing

```
\cfrac{1}{\sqrt{2}+
 \cfrac{1}{\sqrt{2}+
  \cfrac{1}{\sqrt{2}+
   \cfrac{1}{\sqrt{2}+
    \cfrac{1}{\sqrt{2}+\dotsb
}}}}}
```

Left or right placement of any of the numerators is accomplished by using `\lcfrac` or `\rcfrac` instead of `\cfrac`.

[1] The perceptive reader may wonder why this command is necessary when you can type things like `\left(\frac{...}{...}\right)`. The answer is that `\fracwithdelims` provides slightly better spacing.

23 Smash options

The plain TEX command `\smash` is used to typeset a subformula and give it an effective height and depth of zero, which is sometimes useful in adjusting the subformula's position with respect to adjacent symbols. In `amstex` there are optional arguments `t` and `b` for `\smash`, because sometimes it is advantageous to be able to "smash" only the top or only the bottom of something while retaining the natural depth or height. For example, to smash only the part of a subformula that extends below the baseline, you would type `\smash[b]{`⟨*whatever*⟩`}`.

24 New LATEX environments

24.1 The "cases" environment

"Cases" constructions like the following are common in mathematics:

$$P_{r-j} = \begin{cases} 0 & \text{if } r-j \text{ is odd,} \\ r!\,(-1)^{(r-j)/2} & \text{if } r-j \text{ is even.} \end{cases} \tag{5}$$

and in the `amstex` option there is a `cases` environment:

```
\begin{equation} P_{r-j}=
  \begin{cases}
    0&  \text{if $r-j$ is odd},\\
    r!\,(-1)^{(r-j)/2}&  \text{if $r-j$ is even}.
  \end{cases}
\end{equation}
```

Notice the use of `\text` and the embedded math.

24.2 Matrix

In the creation of the `amstex` option, $\mathcal{AMS}$-TEX's `\matrix` could have been discarded, since LATEX's `array` environment has the same function. But we wanted to keep $\mathcal{AMS}$-TEX's `\pmatrix`, `\bmatrix`, `\vmatrix` and `\Vmatrix` commands, with delimiters built in; for consistency, the basic `\matrix` has been retained also. It and the other matrix commands have been changed into LATEX environments that work like `array`, except that they don't have an argument specifying the format of the columns. Instead a default format is provided: up to 10 centered columns. The maximum number of columns is determined by the counter `MaxMatrixCols`, which you can change if necessary using LATEX's `\setcounter` or `\addtocounter` commands. I.e., suppose you have a big matrix with 19 or 20 columns. Then you'd do something like this:

```
\begin{equation}
\setcounter{MaxMatrixCols}{20}
A=\begin{pmatrix}
...&...&...&...&...&...&...&...&...&...&...&  ... \\
  ...  \\
  ...
\end{pmatrix}
\end{equation}
```

To produce a small matrix suitable for use in text, use the `smallmatrix` environment.

```
\begin{math}
  \bigl( \begin{smallmatrix}
      a&b\\ c&d
    \end{smallmatrix} \bigr)
\end{math}
```

`\hdotsfor{`⟨*number*⟩`}` produces a row of dots in a matrix spanning the given number of columns.

```
\begin{matrix} a&b&c&d\\
e&\hdotsfor{3} \end{matrix}
```

would give dots spanning the last three columns in the second row. The spacing of the dots can be varied through use of a square-bracket option, for example, `\hdotsfor[1.5]{3}`. The number in square brackets will be used as a multiplier; the normal value is 1.

24.3 The Sb and Sp environments

The `Sb` and `Sp` environments can be used to typeset several lines as a subscript or superscript: for example

```
\begin{equation}
  \sum\begin{Sb}
        0\le i\le m\\ 0<j<n
      \end{Sb}
    P(i,j)
\end{equation}
```

produces a two-line subscript underneath the sum:

$$\sum_{\substack{0\le i\le m\\ 0<j<n}} P(i,j) \tag{6}$$

`Sb` and `Sp` can be used anywhere that an ordinary subscript or superscript can be used.

24.4 Commutative diagrams

To save memory, the commutative diagram commands of $\mathcal{A}_{\mathcal{M}}\mathcal{S}$-TEX are not included in the `amstex` option, but are available as a separate option, `amscd`. The `picture` environment can be used for complex commutative diagrams but for simple diagrams without diagonal arrows the `amscd` commands are more convenient.

The commutative diagram

$$\begin{array}{ccc} S^{\mathcal{W}_\Delta}\otimes T & \xrightarrow{j} & T \\ \big\downarrow & & \big\downarrow{\scriptstyle EndP} \\ (S\otimes T)/I & = & (Z\otimes T)/J \end{array} \tag{7}$$

can be produced in ordinary LATEX by

```
\begin{array}{ccc}
S^{{\cal W}_\Lambda}\otimes T&
    \stackrel{j}{\longrightarrow}&  T\\
\Big\downarrow&
        &\Big\downarrow\vcenter{%
          \rlap{$\scriptstyle{\rm End}\,P$}}\\
(S\otimes T)/I& =&  (Z\otimes T)/J
\end{array}
```

When the `amscd` option is used you would type instead

```
\begin{CD}
S^{{\cal W}_\Lambda}\otimes T   @>j>>   T\\
@VVV                                    @VV{\End P}V\\
(S\otimes T)/I                  @=      (Z\otimes T)/J
\end{CD}
```

(with `\End` defined as `\operatorname{End}`; see §19). This would give longer horizontal arrows than in (7) and improved spacing between elements of the diagram (see `testart.tex`). In the `CD` environment the commands `@>>>`, `@<<<`, `@VVV`, and `@AAA` give respectively right, left, down, and up arrows.For the horizontal arrows, material between the first and second `>` or `<` symbols will be typeset as a superscript, and material between the second and third will be typeset as a subscript. Similarly, material between the first and second or second and third `A`s or `V`s of vertical arrows will be typeset as left or right "sidescripts".

25 Alignment structures for equations

In the `amstex` option several environments exist for creating multi-line displayed equations. They are similar in function to LaTeX's `equation` and `eqnarray` environments. These environments are:

```
align      gather     alignat    xalignat   xxalignat
multline   split
```

Each environment, except for `split`, has both starred and unstarred forms, where the unstarred forms have automatic numbering, using LaTeX's `equation` counter. You can suppress the number on any particular line by putting `\notag`

before the \\; you can also override it with a tag of your own using \tag{⟨*label*⟩}, where ⟨*label*⟩ means arbitrary text such as $*$ or ii used to "number" the equation. There is also a \tag* command that causes the tag to be typeset absolutely literally, without putting parentheses around it. \tag and \tag* can also be used in the starred versions of all the amstex alignment structures. See testart.tex, Appendix B, for examples of the use of \tag.

25.1 The align environment

The align environment is used for two or more equations when vertical alignment is desired (usually binary relations such as equal signs are aligned). The term "equation" is used rather loosely here to mean any math formula that is intended by the author as a self-contained subdivision of the larger display, usually, but not always, containing a binary relation.

25.2 The gather environment

Like the align environment, the gather environment is used for two or more equations, but when there is no alignment desired among them; each one is centered separately between the left and right margins.

25.3 The alignat environment

The alignat environment is for multiple "align" structures side by side. There is one required argument, to specify the number of "align" structures.[2] The xalignat and xxalignat environments are forms of the alignat environment with expanded spacing between the component align structures. If we consider each "align" structure to be a column, xalignat has equal spacing between columns and at the margins; xxalignat has equal spacing between columns and zero spacing at the margins.

[2]For an argument of n, the number of &'s per line is $2n - 1$ (one ampersand for alignment within each "align" structure, and ampersands to separate the "align" structures from one another).

25.4 The `multline` environment

The `multline` environment is a variation of the `equation` environment used for equations that don't fit on a single line. The first line of a `multline` will be at the left margin and the last line at the right margin, except for an indention on both sides whose amount is equal to `\multlinegap`. The value of `\multlinegap` can be changed using LaTeX's `\setlength` and `\addtolength` commands. If the `multline` contains more than two lines, any lines other than the first and last will be centered individually between the margins.

25.5 The `split` environment

The `split` environment is for *single* equations that are too long to fit on one line and hence must be split into multiple lines. Unlike the other `amstex` equation structures, it provides no numbering, because it is used only inside some other displayed equation structure, usually an `equation`, `align`, or `gather` environment, which provides the numbering. Unlike the `multline` environment, the `split` environment provides for alignment among the split lines, using & to mark alignment points, as usual.

25.6 Alignment environments that don't constitute an entire display

In addition to the `split` environment, there are some other equation alignment environments that do not constitute an entire display. They are self-contained units that can be used inside of other formulas, or set side-by-side. The environment names are `aligned`, `gathered`, and `alignedat`. These environments take an optional argument to specify their vertical positioning with respect to the material on either side. The default is `[c]`. A `gathered` environment with the first line level with the material on either side would be done like this.

```
\begin{gathered}[t]
...\\
...
\end{gathered}
```

25.7 Vertical spacing and page breaks in the `amstex` equation structures

You can use the `\\[`⟨*dimension*⟩`]` command to get extra vertical space between lines in all the `amstex` displayed equation environments, as is usual in LaTeX. Unlike `eqnarray`, the `amstex` environments don't allow page breaks between lines, unless `\displaybreak` or `\allowdisplaybreaks` is used. The philosophy is that page breaks in such situations should receive individual attention from the author. `\displaybreak` must go before the `\\` where it is supposed to take effect. Like LaTeX's `\pagebreak`, `\displaybreak` takes an optional argument between 0 and 4 denoting the desirability of the pagebreak. `\displaybreak[0]` means "it is permissible to break here" without encouraging a break; `\displaybreak` with no optional argument is the same as `\displaybreak[4]` and forces a break.

There is also an optional argument for `\allowdisplaybreaks`. `\allowdisplaybreaks` obeys the usual LaTeX scoping rules; the normal way of limiting its scope would be to put `{\allowdisplaybreaks` at the beginning and `}` at the end of the desired range. Within the scope of an `\allowdisplaybreaks` command, the `\\*` command can be used to prohibit a pagebreak, as usual.

25.8 The `\intertext` command

The command `\intertext` is used for a short interjection of a few lines in the middle of a display alignment. Its salient feature is preservation of the alignment, which would not be possible if you simply ended the display and then started it up again afterwards. `\intertext` may only appear right after a `\\` or `\\*` command.

25.9 Equation numbering

In LaTeX if you wanted to have equations numbered within sections—that is, have equation numbers (1.1), (1.2), ..., (2.1), (2.2), ..., in sections 1, 2, and so forth—you would probably redefine `\theequation`:

```
\renewcommand{\theequation}{\thesection.\arabic{equation}}
```

This works fine except that the equation counter won't be reset to zero at the beginning of a new section or chapter, unless you do it yourself using `\setcounter`. To make this a little more convenient, the `amstex` option provides a command `\numberwithin`. To have equation numbering tied to section numbering, with automatic reset of the equation counter, the command would be

```
\numberwithin{equation}{section}
```

As the name implies, `\numberwithin` can be applied to other counters besides the equation counter, but the results are not guaranteed because of potential complications. Normal LaTeX methods should be used where available, e.g., in `\newtheorem`.

To make cross-references to equations easier, an `\eqref` command is provided. This automatically supplies the parentheses around the equation number, and adds an italic correction if necessary (see Section 31.7.2). To refer to an equation that was labeled with the label `e:baset`, the usage would be `\eqref{e:baset}`.

25.10 Error messages

One kind of error message in particular should be mentioned, since it follows from a mistake that is easy to make.

```
Runaway argument?
 \left |\frac {\hat v(s)-\hat v(t)}{|\widetilde {D} \ETC.
! Paragraph ended before \multline* was complete.
<to be read again>
                   \par
l.17

? h
I suspect you've forgotten a '}', causing me to apply this
control sequence to too much text. How can we recover?
My plan is to forget the whole thing and hope for the best.

? e
```

This usually means one of two things: Either you have an equation alignment environment where the end doesn't match the beginning—perhaps something like

```
\begin{multline*}
...
\end{multline}
```

(as in this case)—or else you have a missing `}` or `\right` delimiter inside of the environment. A `}` is rather easy to leave off accidentally when using certain commands, such as `\frac`.

26 Miscellaneous

In the `amstex` option `~`, `\/`, and `\slash` will remove superfluous spaces on either side of them, as a convenience to the user (in the case of `\/`, only a space on the left will be removed). For example, if you have typed `p. 63` and then realize you should add a `~`, you can insert the `~` without deleting the space.

In ordinary LaTeX `\big`, `\bigg`, `\Big`, and `\Bigg` delimiters don't adjust properly over the full range of LaTeX font sizes. In the `amstex` option they do.

27 New documentstyle options available

Several new documentstyle options have been created. About half of them have to do with the positioning of "limits" or `\tag`s. The abbreviation of the names reflects the MS-DOS limitation of eight characters for file names,[3] which we need to allow for.

`nosumlim`	No limits on sums
`intlim`	Limits on integrals
`nonamelm`	No limits on operatornames
`ctagsplt`	Vertically centered tags on the `split` environment
`righttag`	Equation tags on the right

[3] Not including the file extension.

Some of the component parts of the `amstex` option are also available individually, that is, they can be used in the options list of the `\documentstyle` command:

`amstext`	defines `\text`
`amsbsy`	defines `\boldsymbol` and `\pmb`
`amsfonts`	defines `\frak` and `\Bbb` and sets up the fonts msam (extra math symbols A), msbm (extra math symbols B, and blackboard bold), eufm (Euler Fraktur), as well as extra sizes of cmmib (bold math italic and bold lowerCase Greek), and cmbsy (bold math symbols and bold script), for use in mathematics.

27.1 The `amssymb` option

The `amssymb` option defines names for all the symbols in the AMS math symbol fonts. (Note: The `amssymb` and `amsfonts` options aren't much use unless you have version 2.0 of the AMSFonts package.)

27.2 Comments

A new `verbatim` style option written by Rainer Schöpf (and distributed along with the $\mathcal{AMS}$-LaTeX package) provides a `comment` environment; anything you write between `\begin{comment}` and `\end{comment}` is totally ignored by LaTeX. The `\end{comment}` should be on a line by itself: any text after `\end{comment}` on the same line would be ignored (and you would receive a warning message that it was lost). Inside the `comment` environment LaTeX is in a special state that is ended by the first occurrence of the `\end{comment}` command; you cannot have one `comment` environment nested inside another. The `verbatim` option provides some other nice features; see `verbatim.doc` for further details.

27.3 Syntax checking

Another new style option is called `syntonly`; if you include this in your document options list, then you can put `\syntaxonly` in the document preamble

to run the file with syntax check only. No output will be produced, but any LaTeX errors will be uncovered. The advantage of this is that LaTeX will run significantly faster when `\syntaxonly` is in effect. How much faster depends on the particular computer being used and other variables but 30%–40% is typical.

28 Protecting fragile commands

Many of the commands added by the `amstex` option are fragile and will need to be `\protect`ed in commands with "moving arguments"—`\section` and other sectioning commands, `\caption`, `\addcontentsline`, `\addtocontents`, `\markboth`, `\markright`, `@`-expressions in an `array` or `tabular` environment, and others (see the LaTeX manual, Section C.1.3).

29 Differences the LaTeX user should note

In `amstex` the `@` character has a special use, in the extensible arrows `@>>>` and `@<<<` and in the math microspacing commands `@,` and `@!`. In order to get an ordinary printed @ character, type `@@` instead of `@`.

With the various alignment environments available in the `amstex` option, the `eqnarray` environment is no longer needed. Furthermore, since it does not prevent overlapping of the equation numbers with wide formulas, as most of the `amstex` alignments do, using the `amstex` alignments seems better.

`\nonumber` is interchangeable with `\notag`; the latter seems slightly preferable, for consistency with the name of `\tag`.

In math `\bf`, `\rm`, and other text font commands should not be used for single math variables; `\bold`, `\mathrm`, etc. should be used instead. (See section 6 for details.)

Part IV
The `amsart` and `amsbook` documentstyles

30 General remarks

Two considerations controlled the development of the `amsart` and `amsbook` documentstyles. First of all, their intended use is for articles and books submitted for publication to the American Mathematical Society (in addition to giving the LaTeX user some additional output styles). And second, because `amsart` and `amsbook` not only load the `amstex` option, but also add several features not found in the standard LaTeX styles, they don't have much spare memory to work with (if used with a "small" implementation of TeX).

Therefore some features of lesser usefulness found in the standard LaTeX styles have been omitted or minimized in an effort to conserve memory. No special provisions have been made for setting up marginal notes or two-column format, for example. And the 11pt and 12pt options have been reduced to a minimal kernel: they do nothing except reset the margins and a few font sizes. More sophisticated adjustments that are done in the standard LaTeX `article` and `book` styles are omitted.

The `fleqn` option and the `openbib` bibliography style are not used in AMS publications, and therefore the necessary work to make them available has not been done.

No provision is made for fonts in sizes larger than `\large`; the LaTeX commands `\Large`, `\LARGE`, `\huge`, and `\Huge` still function normally but the size they produce is the same as for `\large`. The design of `amsart` does not use internally anything larger than `\normalsize`.

The `amstex` option, which is part of the `amsart` and `amsbook` styles, does the necessary setting up to allow the use of fonts from the AMSFonts 2.0 collection, but it is perfectly possible to use `amsart` and `amsbook` without having AMSFonts.

31 The amsart documentstyle

31.1 Top matter

We use the term "top matter" for the information found at the beginning of an article, such as the title, author, addresses, and abstract. Compared to the standard `article` documentstyle, the `amsart` documentstyle has a significantly expanded top matter section. LaTeX's `article` style provides `\title`, `\author`, `\thanks`, `\date`, and an `abstract` environment. The complete list of top matter commands provided by the `amsart` style is:

```
\title      \keywords
\author     \subjclass
\address    \translator
\email      \dedicatory
\thanks     \date
```

All of these commands should precede the `\maketitle` command. If the `abstract` environment is used, it should follow immediately after `\maketitle`. The address, e-mail address, and translator information prints at the end of the document; the key words, subject classification, and thanks information print as footnotes at the bottom of the first page of the document.

An `\author` command should be used for each individual author, when a paper has multiple authors. Things like `\address`, `\email`, and `\thanks` that pertain only to one author should be placed after the `\author` command that they go with (and before any other `\author` commands). The AMS custom is to list author names in alphabetical order. (See **Author names and addresses** in section 31.7.1 for further details.)

In giving an e-mail address remember that `@` characters should be doubled in order for them to print.

31.2 Memory conservation measures

To free up valuable memory, commands that are needed only at the beginning of a document are undefined when they are no longer needed. This includes the top matter commands `\title`, `\author`, etc. and the `abstract` environment.

31.3 Running heads

Running heads on odd-numbered pages (right-hand pages) in the `amsart` style contain the text of the article title, and on even-numbered pages they contain the author's name. If the title is too long to fit within the page width, a shorter version for the running head text can be specified with a square-bracket option of the `\title` command:

```
\title[Short Version Here]{Long Version of the Title Here,\\
  Perhaps with Multiple Lines}
```

The `\author` command has also been given the same kind of square-bracket option.

31.4 Non-English versions of automatically generated text

If the base language of an article is some language other than English, the user may wish to change some pieces of text that are generated automatically. To change "Abstract" to "Résumé", use `\renewcommand` to redefine `\abstractname`:

```
\renewcommand{\abstractname}{R\'esum\'e}
```

The user can change the following in the same way:[4]

```
\abstractname   Abstract
\partname       Part
\indexname      Index
\figurename     Figure
\tablename      Table
\proofname      Proof
\refname        References
\appendixname   Appendix
\tocname        Contents
```

This also allows the user to substitute, e.g., "Diagram" instead of "Figure" for the labels of figure environments. In the `amsbook` style, there are some additional names available for changing:

[4]The names of the control sequences were chosen to match the names used in `babel.sty`.

```
\chaptername    Chapter
\listfigurename List of Figures
\listtablename  List of Tables
\bibname        Bibliography
```

(The environment `thebibliography` uses `\bibname` in the `amsbook` style, and `\refname` in the `amsart` style.)

31.5 Theorems, definitions, and similar structures

LaTeX provides `\newtheorem` to create theorem environments. The `amsart` and `amsbook` styles make use of the `theorem` documentstyle option to provide more flexibility in the design of theorems, definitions, proofs, remarks, and the like (for full details, see Frank Mittelbach's article in *TUGboat*, vol. 10, no. 3, November 1989, pp. 416–426). Three levels of theorem-type environments are provided through three `\theoremstyle`s: `plain`, `definition`, and `remark`. The different styles receive different typographical treatment that gives them visual emphasis corresponding to their relative importance in the author's exposition.

To create new theorem-type environments in the different styles, use the `\newtheorem` command in the normal way, but divide your `\newtheorem` commands into groups and preface each group with the appropriate `\theoremstyle`. If no `\theoremstyle` command is given, the style used will be `plain`. The `\theorembodyfont` and `\theoremheaderfont` commands described in Mittelbach's article are unnecessary in the AMS documentstyles.

Here is an example of a rather comprehensive `\newtheorem` section:

```
% theorem style plain --- default
\newtheorem{thm}{Theorem}[section]
\newtheorem{lem}{Lemma}[section]
\newtheorem{cor}{Corollary}[section]
\newtheorem{prop}{Proposition}[section]
\newtheorem{crit}{Criterion}[section]
\newtheorem{alg}{Algorithm}[section]

\theoremstyle{definition}
```

```
\newtheorem{defn}{Definition}[section]
\newtheorem{conj}{Conjecture}[section]
\newtheorem{exmp}{Example}[section]
\newtheorem{prob}{Problem}[section]

\theoremstyle{remark}

\newtheorem{rem}{Remark}          \renewcommand{\theremark}{}
\newtheorem{note}{Note}           \renewcommand{\thenote}{}
\newtheorem{claim}{Claim}
\newtheorem{summ}{Summary}        \renewcommand{\thesumm}{}
\newtheorem{case}{Case}
\newtheorem{ack}{Acknowledgment}  \renewcommand{\theack}{}
```

If you would like an unnumbered environment, use `\renewcommand` to undefine `\thexxxx` (where `xxxx` stands for the environment name), as shown in the "remark" section. If you have a theorem with a special name, such as "Klein's Theorem," use a separate `\newtheorem` command just for that theorem and make it unnumbered:

```
\newtheorem{kthm}{Klein's Theorem}
\renewcommand{\thekthm}{}
```

This will give the normal format for a theorem in all respects except the automatic numbering.

31.6 Proofs

A predefined `pf` environment and a starred form `pf*` are provided for proofs, and produce the heading "Proof" with appropriate spacing and punctuation. A "Q.E.D." symbol, □, is automatically appended at the end of a proof. To substitute a different end-of-proof symbol, use `\renewcommand` to redefine the command `\qedsymbol`. The proof environment is primarily intended for short proofs, less than a page in length; longer proofs should probably be done as a separate section or subsection in your document. For a long proof that doesn't use the `pf` environment, you can obtain the symbol and the usual amount of preceding space by using `\qed`.

The starred form, `pf*`, of the proof environment takes an argument in curly braces, which allows you to substitute a different name for the standard "Proof". If you want to substitute, say, "Proof (sufficiency)", then write

```
\begin{pf*}{Proof (sufficiency)}
```

and that's all there is to it.

31.7 Miscellaneous notes

31.7.1 Variations from standard LaTeX

Variations to LaTeX (like `\subjclass` for subject classification numbers) that are simple additions will not be specially pointed out. However, a couple of variations that involve contradictions of statements in the LaTeX manual need to be noted.

Starred forms of sectioning commands In the `amsart` and `amsbook` documentstyles starred forms of the `\chapter` and `\section` commands produce a table of contents entry. This is a variation from standard LaTeX (see the LaTeX manual, §C.3.1), but more in keeping with usual publishing practice.

Author names and addresses The standard LaTeX format for specifying the names and addresses of a document's authors is this:

```
\author{First Author\\Address, Line 1\\Address, Line 2
        \and Second Author\\Address, Line 1\\Address, Line 2}
```

In the `amsart` and `amsbook` documentstyles there is a separate `\address` command for addresses, and the author names and addresses are specified individually like all the other elements of the top matter:

```
\author{First Author}
\address{Address, Line 1\\Address, Line 2}
...
\author{Second Author}
\address{Address, Line 1\\Address, Line 2}
```

Addresses and similar elements will be associated with the nearest preceding `\author` command to determine where they should be printed.

Author names and addresses typed in the standard LaTeX format will still print fine, without error messages, but the addresses may not fall in the proper place (at the end of the document, in the `amsart` style).

31.7.2 Numbers and punctuation in italic text

Mathematical typesetting poses a problem that rarely arises in nonmathematical typesetting. In mathematical publishing, for consistency, parentheses and other punctuation, as well as numbers, are always set in an upright font rather than varying with the surrounding text. But then when a math formula with non-italic numbers and punctuation occurs in the middle of italicized text—e.g., in a theorem—with italic numbers and punctuation nearby, the visual discrepancy rises up to smite the reader in the eye. Therefore it is conventional in mathematical publishing to use the same upright style for numbers and punctuation in italic text as is used in the mathematics.

At the present time, italic fonts with upright numbers and punctuation aren't available. The work of getting upright numbers and punctuation in italic text therefore must be done by the author. In order to help the author, the `amsart` and `amsbook` documentstyles take two steps. First, they do as much as possible automatically, behind the scenes. For example, `\ref` usually produces a number of some sort; the definition of `\ref` has been changed so that the number will never print in italic. Second, they provide a control sequence `\rom`, with one argument, that can be used by the author when necessary to make an individual punctuation mark or number nonitalic. For example:

```
... formal \rom{(} in the previous year, \rom{1989)} ...
```

Italic corrections are inserted automatically by `\rom`.

The use of `\rom` is unnecessary for punctuation marks that are not high enough to have a noticeable slant, such as commas and periods.

32 The `amsbook` documentstyle

The `amsbook` style has much in common with the `amsart` style; everything in the previous sections about `amsart` holds true for `amsbook`, excepting

some details such as the placement of author addresses and other top matter information.

32.1 Front matter

The "top matter" information for a book (more commonly called the front matter, when discussing a book) is usually specially made up on a title page, with the format varying widely from book to book. In the `amsbook` design `\maketitle` produces a simple title page with the title and author; subject classification numbers, abstract, or key words, if supplied, will print on the next page. The style is too plain for actual publication; it's purpose is to make it convenient for authors to provide the necessary information to a publisher.

For submissions to the American Mathematical Society, please provide as a minimum the following information: title, author, addresses, mathematics subject classification numbers, translator (if applicable), and acknowledgments of funding support (`\thanks`),

32.2 Running heads

Right-hand running heads in the `amsbook` style contain the text of the current section heading; left-hand running heads contain the current chapter title. For special chapters such as a preface or bibliography that don't have sections, the right running head will be the same as the left. Square-bracket options can be used, as normal, to change the text used for running heads.

33 Bibliography styles for use with BibTEX

The $\mathcal{AMS}$-LaTeX distribution includes two bibliography styles, `amsplain` and `amsalpha`, analogous to the standard LaTeX `plain` and `alpha` bibliography styles. In the AMS styles an extra field "language" is provided, for giving the original language of a reference, as an indication to the reader that the title, author name, and so on are translated. (Because that means locating the reference in a library will require a little extra care.)

Also included is a file `mrabbrev.bib` containing standardized abbreviations used by *Mathematical Reviews* for journal names in the mathematical sciences and related fields. Because the full list is too big to be handled by the

current version of BibTEX, individual users should use it as a resource, extracting abbreviations for the journals that they cite in their particular bibliography database and adding them to their database.

Part V
Appendixes

A Files included in the $\mathcal{AMS}$-LaTeX distribution

The total number of files in the $\mathcal{AMS}$-LaTeX package, including documentation and option files, is more than sixty. A majority of these files are for the Mittelbach–Schöpf font selection scheme and other LaTeX option files written and maintained by Mittelbach and Schöpf. They are used by various parts of the $\mathcal{AMS}$-LaTeX package but are not inherently part of the $\mathcal{AMS}$-LaTeX distribution; they are included at the present time because they have not yet become widely available in the United States.

A.1 Files maintained by the American Mathematical Society

`amltinst.tex`	Instructions on how to install the $\mathcal{AMS}$-LaTeX package.
`amslatex.tex` `amslatex.toc`	This *User's Guide*, describing the $\mathcal{AMS}$-LaTeX package, and the auxiliary file for the table of contents.

`testart.tex`
`test.bib`
`testart.bbl`
	A sample file illustrating the use of commands from the `amstex` option, as well as the `amsart` documentstyle.

`testbook.tex`
`pref.tex`
`chap1.tex`
`chap2.tex`
`app.tex`
`testbook.bbl`
	These files are sample files illustrating the use of the `amsbook` documentstyle.

`amstex.sty`	The `amstex` documentstyle option. Defines special $\mathcal{AMS}$-TEX structures (like multiline display alignments) with LATEX syntax. It is a copy of `amstex.tex`, version 2.0, modified as necessary to make it usable from within LATEX.

`amstext.sty`
`amsbsy.sty`
`amsfonts.sty`
`amssymb.sty`
	These are extra option files that can be used apart from the `amstex` option. The file `amsbsy.sty` defines the `\boldsymbol` command and the `\pmb` command ("poor man's bold"). The file `amstext.sty` defines the $\mathcal{AMS}$-TEX `\text` command. The files `amsfonts.sty` and `amssymb.sty` are for use with the AMSFonts package (version 2.0). `amsfonts.sty` defines commands, including `\newsymbol`, for using fonts in the AMSFonts collection, and `amssymb.sty` defines the names of all the math symbols available in the AMSFonts collection.

`amscd.sty`	Commutative diagrams The `amscd` option contains extra mathematical commands that can be used as add-ons with the `amstex` option. (It can also be used without the `amstex` option.)

`intlim.sty`
`nonamelm.sty`
`nosumlim.sty`
`righttag.sty`
`ctagsplt.sty`
	Extra math style options that affect, for example, left or right placement of equation numbers. They are for use only with the `amstex` option. The `intlim` option provides for integral subscripts to be placed above and below rather than on the side. The `nosumlim` option provides for sum subscripts to be placed on the side rather than above and below. The `nonamelm` option provides for "operator name" subscripts to be placed on the side rather than above and below. The `righttag` option puts equation numbers on the right instead of on the left. The `ctagsplt` option gives equation numbers vertically centered on the height of a displayed formula that uses the `split` environment.

`amsart.sty`
`amsbook.sty`
`amsart.doc`
`amsbook.doc`
	Primary documentstyles for submissions to the AMS, for articles and books respectively, and technical documentation files. Auxiliary files for 10-point, 11-point and 12-point options are also distributed: `amsart10.sty`, `amsart11.sty`, `amsart12.sty`, `amsbk10.sty`, `amsbk11.sty`, `amsbk12.sty`, `amsbk10.doc`, `amsart10.doc`.

`amsplain.bst`
`amsalpha.bst`
`mrabbrev.bib`
	Bibliography style files for use with BibTeX, and a file containing the *Mathematical Reviews* standard abbreviations for the names of mathematical journals.

A.2 Files maintained by Mittelbach and Schöpf

The official copies of the remaining files in this distribution are maintained by Frank Mittelbach and Rainer Schöpf, who have given permission for the American Mathematical Society to distribute them.

`theorem.sty`
`theorem.doc`
and related files
	Option for special treatment of theorems and similar structures, written by Frank Mittelbach, and auxiliary files; used by `amsart.sty` and `amsbook.sty`.

`verbatim.sty` `verbatim.doc`	Option file implementing an improved `verbatim` environment and a `comment` environment.

`lfonts.new`
`preload.min`
`fontdef.max`
`newlfont.sty`
and related files
	The files that implement the Mittelbach–Schöpf font selection scheme.

B Differences between $\mathcal{AMS}$-TEX (version 2.0) and the `amstex` option

This section describes the parts of $\mathcal{AMS}$-TEX that were removed during the creation of the `amstex` option. It will probably be of interest primarily to users with $\mathcal{AMS}$-TEX experience.

In general, $\mathcal{AMS}$-TEX commands that were redundant with LaTeX commands were simply dropped. Other commands were reimplemented as documentstyle options or otherwise changed in form.

B.1 Document structure commands

These commands have all been superseded by their LaTeX equivalents (some of which have the same name but function slightly differently):

$\mathcal{AMS}$-TEX	LATEX
\document	\begin{document}
\midspace	\beginfigure[htp]...\endfigure
\footnote	\footnote
\cite	\cite
\pagewidth	\textwidth
\pagebreak	\pagebreak

For more information on document structure commands refer to Part IV, which describes the amsart and amsbook documentstyles.

B.2 Math font commands

The names for $\mathcal{AMS}$-TEX math font commands couldn't simply be carried over to LATEX because there is a conflict with \roman, which is preempted by LATEX for another use. Therefore, in the amstex option, $\mathcal{AMS}$-TEX's \roman has been renamed \mathrm. In addition, the \italic and \slanted math font commands have been dropped in amstex, since their usefulness is in question and memory space for control sequence names is in short supply. It appears that \text{\it...} will serve everywhere that \italic might be used, and the same goes for \sl and \slanted.

In $\mathcal{AMS}$-TEX the text font commands \bf, \rm, \sl, etc., cause an error message if used in math mode, but in the amstex option this has been disabled. This is intended to make it easier for users who might want to add the amstex option to a LATEX document that has already been written or partially written. However, using these commands in math mode will have no effect on font changes.

In $\mathcal{AMS}$-TEX 2.0 there is a command \boldkey used to obtain bold versions of math symbols such as = and + that are present on keyboard keys. In the amstex option the use of the new font selection scheme made it possible to generalize \boldsymbol so that \boldkey is not needed.

B.3 Matrices

The \format option of $\mathcal{AMS}$-TEX's \matrix is not available for matrix, pmatrix and related environments; just use the array environment instead if you need an unusual format for the columns.

$\mathcal{AMS}$-TEX's `\smallmatrix` command has also been reimplemented as an environment:

```
\begin{math}
  \bigl( \begin{smallmatrix}
      a&b\\ c&d
    \end{smallmatrix} \bigr)
\end{math}
```

B.4 Displayed equation structures

In the LaTeX `amstex` option, commands for creating multiple-line displays have been converted to environments similar to LaTeX's `eqnarray` and `equation`—they use `\begin` and `\end`, and the `$$` that would have been used in $\mathcal{AMS}$-TEX should not be used. See Section 25 for more details.

B.5 Math style commands

As a matter of convenience, $\mathcal{AMS}$-TEX provided the abbreviations `\dsize`, `\tsize`, `\ssize`, and `\sssize` for `\displaystyle`, `\textstyle`, `\scriptstyle`, and `\scriptscriptstyle`. In order to conserve control sequence names, these have been dropped in `amstex`, since they are merely synonyms. If you need to use a math style command frequently because of the nature of your material, you can add an abbreviation using `\newcommand` in the preamble of your document, and call it whatever you choose:

```
\newcommand{\sst}{\scriptstyle}
```

B.6 `\thickfrac`

The `\thickfrac` and `\thickfracwithdelims` commands of $\mathcal{AMS}$-TEX have been replaced by square-bracket options on the `\frac` and `\fracwithdelims` commands. See Section 21.

B.7 Commenting out a large section of text

The `\comment` command of $\mathcal{AMS}$-TEX is replaced by the `comment` environment of the `verbatim` documentstyle option. See the description in Section 27.2.

B.8 Page breaks inside a display

In the `amstex` option, `\displaybreak` should *precede* the `\\` where it is supposed to take effect. In the original $\mathcal{AMS}$-TEX it follows immediately after the `\\`.

B.9 Special colons in math

LATEX and $\mathcal{AMS}$-TEX have different definitions for the `\:` command. In LATEX it is a medium math space, whereas in $\mathcal{AMS}$-TEX it is a colon with spacing appropriate in certain notation for mappings: $S : s \to s^t$ (`$S\:s\to s^t$`). The LATEX version is the one that has been retained, in order to avoid compatibility problems. `\colon` is available as a substitute for the $\mathcal{AMS}$-TEX `\:`.

B.10 Paragraphed text within a displayed equation

$\mathcal{AMS}$-TEX has a `\foldedtext` command for handling a piece of text within a display that needs to be typeset as a paragraph (perhaps to keep it from running over the right margin). In the `amstex` option this was dropped because it's redundant; LATEX's `\parbox` command can be used instead.

B.11 Commutative diagrams

In order to conserve memory, commutative diagram commands are a separate option, `amscd`, that must be loaded in the documentstyle options list if it is desired.

The `\pretend...\haswidth` command is not available in the `amscd` option. Approximately the same results can be gotten by inserting blank space using `\hspace` in the subscript or superscript fields of the extensible arrow commands (`@>>>` and `@<<<`).

B.12 Footnotes

The `\footnote` command of the `amsppt` documentstyle is superseded by LaTeX's command of the same name. Instead of the $\mathcal{AMS}$-TeX `\adjustfootnotemark` command use `\addtocounter{footnote}{`⟨*number*⟩`}`. The literal footnote mark feature of `amsppt` is not available.

B.13 Vertical spacing

The $\mathcal{AMS}$-TeX use of `\vspace` in alignment structures `\align`, `\split`, etc. is superfluous in LaTeX because the same function is available through the optional argument of the `\\` or `\\*` commands. Therefore $\mathcal{AMS}$-TeX's version of `\vspace` has been dropped.

B.14 Blank space for figures

$\mathcal{AMS}$-TeX's `\midspace`, `\topspace`, `\caption` and `\captionwidth` are superfluous in the `amstex` option and have been dropped; use LaTeX's `figure` environment and `\caption` command.

B.15 `\hdotsfor`

The original $\mathcal{AMS}$-TeX syntax of `\hdotsfor` has been simplified somewhat in the `amstex` option; $\mathcal{AMS}$-TeX's `\innerhdotsfor` is not needed. The spacing between dots is adjusted via a square-bracket option rather than through a separate command `\spacehdotsfor` or `\spaceinnerhdotsfor`.

B.16 `\topsmash` and `\botsmash`

These have been changed in the `amstex` option to square-bracket options of the `\smash` command.

B.17 `\spreadlines` and other display options

Some of the $\mathcal{AMS}$-TeX options used inside displays, such as `\spreadlines` and `\nopagebreak`, have been dropped. For the most part their effect can be obtained by other means available in standard LaTeX.

B.18 The \and command

There is a name conflict between $\mathcal{AMS}$-TEX's `\and` and LATEX's `\and`. The function of $\mathcal{AMS}$-TEX's `\and` can be obtained in the `amstex` option by using `\And`.

B.19 Global options

There are several $\mathcal{AMS}$-TEX commands that change the global setting of certain aspects of the document style. In the `amstex` option we've done the natural thing, which is to make them into LATEX documentstyle options (see Section 27). These commands are `\TagsOnRight`, `\CenteredTagsOnSplits`, `\LimitsOnInts`, `\NoLimitsOnNames`, and `\NoLimitsOnSums`. The corresponding opposites of these commands have been dropped because they describe the default conditions in the `amstex` option. Because it seems to be of only marginal usefulness, `\TagsAsMath` has been dropped.

C Memory statistics

Combining all of $\mathcal{AMS}$-TEX with all of LATEX, even after eliminating redundancies, produces a large macro package that strains the current limits of personal computer versions of TEX. After the zealous application of efficiency measures, the current version of $\mathcal{AMS}$-LATEX is probably more compact than anyone anticipated; nevertheless, for some documents and some implementations of TEX it will still be too big to run. Among other things, a large number of bibliography items, cross-references, or personal definitions will tend to cause an overrun in a particular area of TEX's memory: the maximum limit on the number of control sequence names. Also, you are more likely to run out of main memory if your document includes a large table or PicTEX diagram.

For those who might be interested in the details, Table 6 shows memory statistics from LATEX runs using various combinations of option files from the $\mathcal{AMS}$-LATEX distribution. For comparison purposes, the statistics in the first column are from a sample run using the current standard LATEX without the Mittelbach–Schöpf font scheme, with the `article` documentstyle, and the last column, "representative maxima", shows the available memory in each category in the implementation of TEX used for testing (VAX/VMS Version

Table 6: Memory statistics

	article*	[M--S fonts] article	[amstex]† article	[amstex, amscd, amssymb] article	[amsfonts, amsbsy] article	[amstex]† amsart	representative maxima
strings	286	386	942	1170	500	933	7032
string characters	2421	3183	8444	10505	4218	8419	20798
main memory	51376	50126	63506	63880	51059	65445	65501
control sequences	2234	2410	2938	3160	2498	2946	5000
font information	18941	12721	16842	16842	16842	11462	65504
number of fonts	72	50	70	70	70	47	220
hyphenation exceptions	14	14	14	14	14	14	307
input stack	12	16	16	16	16	19	200
nesting levels	9	9	14	14	9	14	40
parameter stack	25	25	25	25	25	25	60
input buffer	361	361	436	436	400	436	1500
save stack	233	173	192	192	187	264	2000

*This column is the control, using standard LaTeX with the standard `article` documentstyle, without the Mittelbach–Schöpf font selection scheme. The adjacent column is the same, except for the font selection scheme.

†Recall that the `amstex` option includes the `amsfonts`, `amsbsy`, and `amstext` options, and that the `amsart` and `amsbook` documentstyles automatically include the `amstex` option.

2.98a.0 (AMS)). The test document used in each case was a medium-size article with about 20 bibliography entries, 50 author-defined commands, and 50 cross-reference labels.

It can be seen that in all of the tests with the `amstex` option loaded the upper limit of 65536 words of main memory is nearly exceeded. And use of the `amssymb` option in the fourth test would cause control sequence memory to be exceeded for implementations of TEX that have a maximum of 3000 (currently true for many implementations on small computer systems).

The font base used in all the tests, except for the control, was `fontdef.max`, `preload.min`, and `newlfont.sty`. Obviously, preloading more fonts by using a different preload file would tend to increase font memory usage. The reason for the comparatively small number of fonts used by the `amsart` documentstyle is that no fonts larger than `\normalsize` are used in the title and section headings.

Memory statistics for the `amsbook` documentstyle are comparable to the statistics for `amsart`. But bear in mind that books will usually have larger bibliographies and more cross-references, which means greater usage of control sequence memory.

D Getting help

Comments or questions on the $\mathcal{AMS}$-LaTeX package should be sent to:

American Mathematical Society
Technical Support
P. O. Box 6248
Providence, RI 02940

Phone: 800-321-4AMS (321-4267) or 401-455-4080
Internet: `tech-support@Math.AMS.com`

If you are reporting a problem you should include the following information:

1. the source file—either in electronic form or printed—where the problem occurred, preferably with irrelevant material removed.

2. a LaTeX transcript (log) file showing the error message (if applicable) and the version numbers of the documentstyle and option files being used.

If you wish to obtain the article by Mittelbach and Schöpf that appeared in *TUGboat*, June 1990 (vol. 11, no. 2): *The new font family selection—user interface to standard LaTeX*, contact:

TeX User's Group
P. O. Box 9506
Providence, RI 02940

Phone: (401) 751-7760
Internet: `TUG@Math.AMS.com`

References

[1] *AMSFonts version 2.0—user's guide*, American Mathematical Society, Providence, R.I., 1990; distributed with the AMSFonts package.

[2] Leslie Lamport, *LaTeX: A document preparation system*, Addison-Wesley, 1985.

[3] Frank Mittelbach and Rainer Schöpf, *The new font family selection—user interface to standard LaTeX*, *TUGboat* **11**, no. 2 (June 1990), pp. 297–305.

[4] Michael Spivak, *The joy of TEX*, 2nd ed., American Mathematical Society, Providence, R.I., 1990.

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