```
%PDF-1.4
%
3 0 obj <<
/Length 156
>>
stream
BT
/F51 9.9626 Tf 91.9253 759.9271
Td[(W)80(elcome)-250(to)-250(pdfT)]TJ
67.8181 -2.2416 Td[(E)]TJ 4.8418 2.2416
Td[(X!)]TJ 138.9241 -654.7472 Td[(1)]TJ
ET
endstream
endobj
2 0 obj <<
/Type /Page
/Contents 3 0 R
/Resources 1 0 R
/MediaBox [0 0 595.2756 841.8898]
/Parent 5 0 R
>> endobj
1 0 obj <<
/Font << /F51 4 0 R >>
/ProcSet [ /PDF /Text ]
>> endobj
6 0 obj <<
/Type /Encoding
/Differences[0/.notdef1/dotaccent
/fi/fl/fraction/hungarumlaut/Lslash
/lslash/ogonek/ring10/.notdef11
/breve/minus13/.notdef14/Zcaron
/zcaron/caron/dotlessi/dotlessj/ff
/ffi/ffl/notequal/infinity/lessequal
/greaterequal/partialdiff/summation
/product/pi/grave/quotesingle/space
/exclam/quotedbl/numbersign/dollar
/percent/ampersand/quoteright/parenleft
/parenright/asterisk/plus/comma/hyphen
/period/slash/zero/one/two/three
/four/five/six/seven/eight/nine/colon
/semicolon/less/equal/greater/question
/at/A/B/C/D/E/F/G/H/I/J/K/L
/M/N/O/P/Q/R/S/T/U/V/W/X/Y
/Z/bracketleft/backslash/bracketright
/asciicircum/underscore/quoteleft
/a/b/c/d/e/f/g/h/i/j/k/l/m
/n/o/p/q/r/s/t/u/v/w/x/y/z
/braceleft/bar/braceright/asciitilde
127/.notdef128/Euro/integral
/quotesinglbase/florin/quotedblbase
/ellipsis/dagger/daggerdbl/circumflex
/perthousand/Scaron/guilsinglleft/OE
/Omega/radical/approxequal144/.notdef
147/quotedblleft/quotedblright/bullet
/endash/emdash/tilde/trademark/scaron
/guilsinglright/oe/Delta/lozenge
/Ydieresis160/.notdef161/exclamdown
/cent/sterling/currency/yen/brokenbar
/section/dieresis/copyright/ordfeminine
/guillemotleft/logicalnot/hyphen
/registered/macron/degree/plusminus
/twosuperior/threesuperior/acute
/mu/paragraph/periodcentered/cedilla
/onesuperior/ordmasculine/guillemotright
/onequarter/onehalf/threequarters
/questiondown/Agrave/Aacute/Acircumflex
/Atilde/Adieresis/Aring/AE/Ccedilla
/Egrave/Eacute/Ecircumflex/Edieresis
/Igrave/Iacute/Icircumflex/Idieresis
/Eth/Ntilde/Ograve/Oacute/Ocircumflex
/Otilde/Odieresis/multiply/Oslash
/Ugrave/Uacute/Ucircumflex/Udieresis
/Yacute/Thorn/germandbls/agrave/aacute
/acircumflex/atilde/adieresis/aring/ae
/ccedilla/egrave/eacute/ecircumflex
/edieresis/igrave/iacute/icircumflex
/idieresis/eth/ntilde/ograve/oacute
/ocircumflex/otilde/odieresis/divide
/oslash/ugrave/uacute/ucircumflex
/udieresis/yacute/thorn/ydieresis]
>>endobj
4 0 obj <<
/Type /Font
/Subtype /Type1
/Encoding 6 0 R
/BaseFont /Times-Roman
>> endobj
5 0 obj <<
/Type /Pages
/Count 1
/Kids [2 0 R]
>> endobj
7 0 obj <<
/Type /Catalog
/Pages 5 0 R
>> endobj
8 0 obj <<
/Producer (pdfeTeX-1.30.4)
/Creator (TeX)
/CreationDate (D:20051017140613+02'00')
/PTEX.Fullbanner (This is pdfeTeX, Version
3.141592-1.30.4-2.2 (Web2C 7.5.5) kpathsea
version 3.5.5)
>> endobj
xref
0 9
0000000000 65535 f
0000000342 00000 n
0000000228 00000 n
0000000015 00000 n
0000002296 00000 n
0000002384 00000 n
0000000410 00000 n
0000002441 00000 n
0000002490 00000 n
trailer
<< /Size 9
/Root 7 0 R
/Info 8 0 R
/ID [<AA8E76D24E8056A065DC5D0A3435EE30>
<AA8E76D24E8056A065DC5D0A3435EE30>] >>
startxref
2694
%%EOF
```

The pdfTEX user manual

The pdfTeX user manual

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October 17, 2005

Rev. 1.622

The title page of this manual represents the plain TeX coded text "Welcome to pdfTeX!"

```
\pdfoutput=1
\pdfcompresslevel=0
\font\tenrm=ptmr8r
\tenrm
Welcome to pdf\TeX!
\bye
```

Contents

1 Introduction

The main purpose of the pdfTeX project is to create and maintain an extension of TeX that can produce pdf directly from TeX source files and improve/enhance the result of TeX typesetting with the help of pdf. When pdf output is not selected, pdfTeX produces normal dvi output, otherwise it generates pdf output that looks identical to the dvi output. An important aspect of this project is to investigate alternative justification algorithms (e. g. a font expansion algorithm akin to the hz micro–typography algorithm by Prof. Hermann Zapf), optionally making use of multiple master fonts.

pdfTeX is based on the original TeX sources and Web2c, and has been successfully compiled on Unix, Win32 and MSDos systems. It is under active development, with new features trickling in. Great care is taken to keep new pdfTeX versions backward compatible with earlier ones.

For some years there has been a 'moderate' successor to TeX available, called ε-TeX. Because mainstream macro packages such as LaTeX have started supporting this welcome extension, pdfTeX also is available as pdfeTeX. Although in this document we will speak of pdfTeX, we advise users to use pdfeTeX when available. That way they get the best of all worlds and are ready for the future. Starting with TeX Live 2004, that future has arrived: pdfeTeX is now the primary TeX engine.

Other extensions to pdfTeX are MLTeX and encTeX; recent pdfTeX engines have these often included.

pdfTeX is maintained by Hàn Thế Thành, Martin Schröder, Hans Hagen, Hartmut Henkel, and others. The pdfTeX homepage is `http://www.pdftex.org`. Please send pdfTeX comments and bug reports to the mailing list pdftex@tug.org.

We thank all readers who send us corrections and suggestions. We also wish to express the hope that pdfTeX will be of as much use to you as it is to us. Since pdfTeX is still being improved and extended, we suggest you to keep track of updates.

1.1 About this manual

This manual revision (1.622) tries to keep track with the recent pdfTeX development up to version 1.30.4. Main text updates were done regarding the new configuration scheme, font mapping, and new or updated primitives. The primary repository for the manual and its sources is at `http://sarovar.org/projects/pdftex/`. Copies in pdf format can also be found at the CTAN network in directory `ctan:systems/pdftex`.

Thanks to Karl Berry for proof reading and submitting a long changes list. New errors might have slipped in afterwards by the editor. Please send questions or suggestions by email to pdftex@tug.org.

1.2 Legal Notice

2 About PDF

The cover of this manual lists an almost minimal pdf file generated by pdfTEX, with the corresponding source file on the next page. Unless compression is enabled, such a pdf file is rather verbose and readable. The first line specifies the version used; currently pdfTEX produces level 1.4 output by default. pdf viewers are supposed to silently skip over all elements they cannot handle.

A pdf file consist of objects. These objects can be recognized by their number and keywords:

```
7 0 obj << /Type /Catalog /Pages 5 0 R >> endobj
```

Here `7 0 obj ... endobj` is the object capsule. The first number is the object number. Later we will see that pdfTEX gives access to this number. One can for instance create an object by using `\pdfobj` after which `\pdflastobj` returns the number. So

```
\pdfobj{/Type /Catalog /Pages 5 0 R}
```

inserts an object into the file, while `\pdflastobj` returns the number pdfTEX assigned to this object. The sequence `5 0 R` is an object reference, a pointer to another object (no. 5). The second number (here a zero) is currently not used in pdfTEX; it is the version number of the object. It is for instance used by pdf editors, when they replace objects by new ones. The version numbers permit a roll–back. (An example of a graphic editor that uses pdf as storage format is the Adobe Illustrator.)

In general this rather direct way of pushing objects in the files is not very useful, and only makes sense when implementing, say, fill–in field support or annotation content reuse. We will come to that later. Unless such direct objects are part of something larger, they will end up as isolated entities, not doing any harm but not doing any good either.

When a viewer opens a pdf file, it first goes to the end of the file. There it finds the keyword `startxref`, the signal where to look for the so called 'object cross reference table'. This table provides fast access to the objects that make up the file. The actual starting point of the file is defined after the `trailer`. The `/Root` entry points to the catalog. In this catalog the viewer can find the page list. In our example we have only one page. The trailer also holds an `/Info` entry, which tells a bit more about the document. Just follow the thread:

`/Root` ⟶ object 7 ⟶ `/Pages` ⟶ object 5 ⟶ `/Kids` ⟶ object 2 ⟶ `/Contents` ⟶ object 3

As soon as we add annotations, a fancy word for hyperlinks and the like, some more entries are present in the catalog. We invite users to take a look at the pdf code of this file to get an impression of that.

The page content is a stream of drawing operations. Such a stream can be compressed, where the level of compression can be set with `\pdfcompresslevel`. Let's take a closer look at this stream in object 3. Often there is a transformation matrix, six numbers followed by `cm`. As in PostScript, the operator comes after the operands. Between `BT` and `ET` comes the text. A font is selected by a `Tf` operator, which is given a resource name `/F..` and the font size. The actual text goes into `()` bracket pairs so that it creates a PostScript string. The numbers inbetween bracket pairs provide fine glyph positioning (kerning). When one analyzes a file produced by a less sophisticated typesetting engine, whole sequences of words can be recognized. In pdf

files generated by pdfTEX however, the words comes out rather fragmented, mainly because a lot of kerning takes place. pdf viewers in search mode simply ignore the kerning information in these text streams. When a document is searched, the search engine reconstructs the text from these (string) snippets.

This one page example uses an Adobe Times–Roman font. This is one of the 14 so–called standard fonts that are always present in the viewer application, and therefore need not be embedded in the pdf file. However, when we use for instance Computer Modern Roman, we have to make sure that this font is available, and the best way to do this is to embed it. Just let your eyes follow the object thread and see how a font is described. The only thing removed from this example is the (partially) embedded glyph description file, which for the 14 standard fonts is not needed.

In this simple file, we don't specify in what way the file should be opened, for instance full screen or clipped. A closer look at the page object no. 2 (`/Type /Page`) shows that a mediabox (`/MediaBox`) is part of the page description. A mediabox acts like the (high-resolution) bounding box in a PostScript file. pdfTEX users can add dictionary stuff to page objects by the `\pdfpageattr` primitive.

Although in most cases macro packages will shield users from these internals, pdfTEX provides access to many of the entries described here, either automatically by translating the TEX data structures into pdf ones, or manually by pushing entries to the catalog, page, info or self created objects. Those who, after this introduction, feel unsure how to proceed, are advised to read on but skip section 7. Before we come to that section, we will describe how to get started with pdfTEX.

3 Getting started

This section describes the steps needed to get pdfTEX running on a system where pdfTEX is not yet installed. Nowadays virtually all TEX distributions have pdfTEX as a component, such as TEX Live, teTEX, fpTEX, MikTeX, and CMacTEX. The ready to run TEX Live distribution comes with pdfTEX versions for many Unix, Win32, and Mac OS X systems; more information can be found at `http://www.tug.org/tex-live/`. teTEX by Thomas Esser is a source distribution with an automated compilation process for Unix systems; see `http://www.tug.org/teTeX/`. For Win32 systems there are also two separate distributions that contain pdfTEX, both in `ctan:systems/win32`: fpTEX by Fabrice Popineau and MikTeX by Christian Schenk. So when you use any of these distributions, you don't need to bother with the pdfTEX installation procedure in the next sections.

If there is no precompiled binary of pdfTEX for your system, or the version coming with a distribution is not the current one and you would like to try out a fresh pdfTEX immediately, you will need to build pdfTEX from sources; read on. You should already have a working TEX system, e. g. teTEX, into which the freshly compiled pdfTEX will be integrated. Note that the installation description in this manual is Web2c–specific.

3.1 Getting sources and binaries

The latest sources of pdfTEX are currently distributed for compilation on Unix systems (including Linux), and Win32 systems (Windows 95, 98, NT, 2000, XP). The primary location where one can fetch the latest released code is at the developers' homepage `http://sarovar.org/projects/pdftex/`, where you also find bug tracking information, and the manual sources. Download the pdfTEX archive from there.

The pdfTEX sources can also be found at their canonical place in the CTAN network, `ctan:systems/pdftex`. Separate pdfTEX binaries for various systems might also be available, check out the subdirectories below `ctan:systems`.

3.2 Compiling

The compilation is expected to be easy on Unix–like systems and can be described best by example. Assuming that the file `pdftex.zip` is downloaded to some working directory, e. g. `$HOME/pdftex`, on a Unix system the following steps are needed to compile pdfTeX:

```
cd $HOME/pdftex
unzip pdftex-1.30.4.zip
cd pdftex-1.30.4
./Build
```

The binaries `pdftex` and `pdfetex` are then built in the subdirectory `build/texk/web2c`. In the same directory also the corresponding pool files `pdftex.pool` and `pdfetex.pool` are generated, that are needed for creating formats.

3.3 Placing files

The next step is to put the freshly compiled binaries and pool files into their proper places within the tds structure of the TeX system. Put the files `pdftex` and `pdfetex` into the directory (e. g. for a typical teTeX system) `/usr/local/teTeX/bin/i686-pc-linux-gnu`, and the pool files into `/usr/local/teTeX/share/texmf/web2c`.

Don't forget to do a `texconfig-sys init` afterwards, so that all formats are regenerated system-wide with the fresh binaries.

3.4 Setting search paths

Web2c–based programs, including pdfTeX, use the Web2c run–time configuration file called `texmf.cnf`. The location of this file is the appropriate position within the tds tree relative to the place of the pdfTeX binary; on a teTeX system, file `texmf.cnf` typically is located either in directory `texmf/web2c` or `texmf-local/web2c`. The path to file `texmf.cnf` can also be set up by the environment variable `TEXMFCNF`.

Next you might need to edit `texmf.cnf` so that pdfTeX can find all necessary files, but the `texmf.cnf` files coming with the major TeX distributions should already be set up for normal use. You might check into the file `texmf.cnf` to see where the various bits and pieces are going.

pdfTeX uses the search path variables shown in table 1.

used for	**texmf.cnf**
output files	TEXMFOUTPUT
input files, images	TEXINPUTS
format files	TEXFORMATS
text pool files	TEXPOOL
encoding files	ENCFONTS
font map files	TEXFONTMAPS
tfm files	TFMFONTS
virtual fonts	VFFONTS
type1 fonts	T1FONTS
TrueType fonts	TTFONTS
pixel fonts	PKFONTS

Table 1 The Web2c variables.

TEXMFOUTPUT	Normally, pdfTEX puts its output files in the current directory. If any output file cannot be opened there, it tries to open it in the directory specified in the environment variable TEXMFOUTPUT. There is no default value for that variable. For example, if you type pdfetex paper and the current directory is not writable, if TEXMFOUTPUT has the value /tmp, pdfTEX attempts to create /tmp/paper.log (and /tmp/paper.pdf, if any output is produced.)
TEXINPUTS	This variable specifies where pdfTEX finds its input files. Image files are considered input files and searched for along this path.
TEXFORMATS	Search path for format (.fmt) files.
TEXPOOL	Search path for pool (.pool) files.
ENCFONTS	Search path for encoding (.enc) files.
TEXFONTMAPS	Search path for font map (.map) files.
TFMFONTS	Search path for font metric (.tfm) files.
VFFONTS	Search path for virtual font (.vf) files. Virtual fonts are fonts made up of other fonts. Because pdfTEX produces the final output code, it must consult those files.
T1FONTS	Search path for Type 1 font files (.pfa and .pfb). These outline (vector) fonts are to be preferred over bitmap pk fonts. In most cases Type 1 fonts are used and this variable tells pdfTEX where to find them.
TTFFONTS	Search path for TrueType font (.ttf) files. Like Type 1 fonts, TrueType fonts are also outlines.
PKFONTS	Search path for packed (bitmap) font (.pk) files. Unfortunately bitmap fonts are still displayed poorly by some pdf viewers, so when possible one should use outline fonts. When no outline is available, pdfTEX tries to locate a suitable pk font (or invoke a process that generates it).

3.5 The PDFTEX configuration

One has to keep in mind that, as opposed to TEX with its dvi output, the pdfTEX program does not require a separate postprocessing stage to transform the TEX input into a pdf file. As a consequence, all data needed for building a ready pdf page must be available during the pdfTEX run, in particular information on media dimensions and offsets, graphics files for embedding, and font information (font files, encodings).

When TEX builds a page, it places items relative to the top left page corner (the dvi reference point). Separate dvi postprocessors allow specifying the paper size (e. g. 'A4' or 'letter'), so that this reference point is moved to the correct position on the paper, and the text ends up at the right place.

In pdf, the paper dimensions are part of the page definition, and pdfTEX therefore requires that they be defined at the beginning of the pdfTEX run. As with pages described by PostScript, the pdf reference point is in the lower–left corner.

Formerly, these dimensions and other pdfTEX parameters were read in from a configuration file named pdftex.cfg, which had a special (non-TEX) format, at the start of processing. Nowadays such a file is ignored by pdfTEX. Instead, the page dimensions and offsets, as well as many other parameters, can be set by pdfTEX primitives during the pdfTEX format building process, so that the settings are dumped into the fresh format and consequently will be used when pdfTEX is later called with that format. All settings from

the format can still be overridden during a pdfTeX run by using the same primitives. This new configuration concept is a more unified approach, as it avoids the configuration file with a special format.

A list of pdfTeX primitives relevant for setting up the pdfTeX engine is given in table 2. All primitives are described in detail within later sections. Figure 1 shows a recent configuration file (`pdftexconfig.tex`) in TeX format, using the primitives from table 2, which typically is read in during the format building process. It enables pdf output, sets paper dimensions and the default pixel density for pk font inclusion. The default values are chosen so that pdfTeX often can be used (e. g. in `-ini` mode) even without setting any parameters.

internal name	**type**	**default**	**comment**
`\pdfoutput`	integer	0	dvi
`\pdfadjustspacing`	integer	0	off
`\pdfcompresslevel`	integer	9	best
`\pdfdecimaldigits`	integer	4	max.
`\pdfimageresolution`	integer	72	dpi
`\pdfpkresolution`	integer	0	72 dpi
`\pdfpkmode`	token reg.	empty	mode set in `mktex.cnf`
`\pdfuniqueresname`	integer	0	
`\pdfprotrudechars`	integer	0	
`\pdfminorversion`	integer	4	pdf 1.4
`\pdfforcepagebox`	integer	0	
`\pdfinclusionerrorlevel`	integer	0	
`\pdfhorigin`	dimension	1 in	
`\pdfvorigin`	dimension	1 in	
`\pdfpagewidth`	dimension	0 pt	
`\pdfpageheight`	dimension	0 pt	
`\pdflinkmargin`	dimension	0 pt	
`\pdfdestmargin`	dimension	0 pt	
`\pdfthreadmargin`	dimension	0 pt	
`\pdfmapfile`	text	`pdftex.map`	not dumped

Table 2 The set of pdfTeX configuration parameters.

```
% Set pdfTeX parameters for pdf mode (replacing pdftex.cfg file).
% Thomas Esser, 2004. public domain.
\pdfoutput=1
\pdfpagewidth=210 true mm
\pdfpageheight=297 true mm
\pdfpkresolution=600
\endinput
```

Figure 1 A typical configuration file (`pdftexconfig.tex`).

Independent of whether such a configuration file is read or not, the first action in a pdfTeX run is that the program reads the global Web2c configuration file (`texmf.cnf`), which is common to all programs in the web2C system. This file mainly defines file search paths, the memory layout (e. g. pool and hash size), and other general parameters.

3.6 Creating format files

```
% Thomas Esser, 1998, 2004. public domain.
\ifx\pdfoutput\undefined
\else
  \ifx\pdfoutput\relax
  \else
    \input pdftexconfig
    \pdfoutput=0
  \fi
\fi
\input etex.src
\dump
\endinput
```

Figure 2 File `etex.ini` for ε-TEX format with dvi output.

```
\ifx\pdfoutput\undefined
\else
  \ifx\pdfoutput\relax
  \else
    \input pdftexconfig
    \pdfoutput=1
  \fi
\fi
\scrollmode
\input latex.ltx
\endinput
```

Figure 3 File `pdflatex.ini` for LATEX format with pdf output.

Both pdfTEX and pdfeTEX engines allow building formats for dvi and pdf output in the same way as the classical TEX engine does for dvi. Format generation is enabled by the `-ini` option. The default mode (dvi or pdf) can be chosen either on the command line by setting the option `-output-format` to `dvi` or `pdf`, or by setting the `\pdfoutput` parameter. The format file then inherits this setting, so that a later call to pdfTEX with this format starts in the preselected mode (which still can be overrun then). A format file can be read in only by the engine that has generated it; a format incompatible with an engine leads to a fatal error. Often the pdfTEX program is a mere link to the pdfeTEX engine; then also a pdfTEX call generates an extended format.

It is customary to package the configuration and macro file input into a `.ini` file. E. g., the file `etex.ini` in figure 2 is for generating an ε-TEX format with dvi output (it contains a few comparisons to be safe also for TEX engines). A similar file `pdflatex.ini` can be used for generating a LATEX format with pdf output; refer to figure 3. One can see how the primitive `\pdfoutput` is used to override the output mode set by file `pdftexconfig.tex`. The corresponding pdfTEX calls for format generation are:

```
pdfetex -ini *etex.ini
pdftex -ini pdflatex.ini
```

These calls produce format files `etex.fmt` and `pdflatex.fmt`, as the default format file name is taken from the input file name. You can overrule this with the `-jobname` option. The asterisk `*` in the first example line tells the pdfeTEX engine to go into extended `-ini` mode; otherwise it stays in non–extended mode. The pdfTEX engine can't be brought into extended mode at all; it interprets an asterisk `*` in front of a file name as part of the file name. So, if you want a pdfLATEX format with pdf output and ε-TEX extensions available (format file `pdfelatex.fmt`), you would need to type e. g.:

```
pdfetex -ini -jobname=pdfelatex *pdflatex.ini
```

In ConTEXt the generation depends on the interface used. A format using the English user interface is generated with

```
pdfetex -ini cont-en
```

When properly set up, one can also use the ConTEXt command line interface TEXexec to generate one or more formats, like:

```
texexec --make en
```

for an English format, or

```
texexec --make en de
```

for an English and German one. Most users will simply say:

```
texexec --make --all [--alone]
```

and so generate the TEX and METAPOST related formats that ConTEXt needs. Whatever macro package used, the formats should be placed in the TEXFORMATS path.

3.7 Testing the installation

When everything is set up, you can test the installation. In the distribution there is a plain TEX test file example.tex. Process this file by typing:

```
pdftex example
```

If the installation is ok, this run should produce a file called example.pdf. The file example.tex is also a good place to look for how to use pdfTEX's primitives.

3.8 Common problems

The most common problem with installations is that pdfTEX complains that something cannot be found. In such cases make sure that TEXMFCNF is set correctly, so pdfTEX can find texmf.cnf. The next best place to look/edit is the file texmf.cnf. When still in deep trouble, set KPATHSEA_DEBUG=255 before running pdfTEX or run pdfTEX with option -k 255. This will cause pdfTEX to write a lot of debugging information that can be useful to trace problems. More options can be found in the Web2c documentation.

Variables in texmf.cnf can be overwritten by environment variables. Here are some of the most common problems you can encounter when getting started:

- I can't read pdftex.pool; bad path?

  TEXMFCNF is not set correctly and so pdfTEX cannot find texmf.cnf, or TEXPOOL in texmf.cnf doesn't contain a path to the pool file pdftex.pool or pdfetex.pool when you use pdfeTEX.

- You have to increase POOLSIZE.

  pdfTEX cannot find texmf.cnf, or the value of pool_size specified in texmf.cnf is not large enough and must be increased. If pool_size is not specified in texmf.cnf then you can add something like

  ```
  pool_size=500000
  ```

- I can't find the format file 'pdftex.fmt'!
  I can't find the format file 'pdflatex.fmt'!

  The format file is not created (see above how to do that) or is not properly placed. Make sure that TEXFORMATS in texmf.cnf contains the path to pdftex.fmt or pdflatex.fmt.

- `---! xx.fmt was written by tex`
  `Fatal format file error; I'm stymied`

  This appears e. g. if you forgot to regenerate the `.fmt` files after installing a new version of the pdfTeX binary and `pdftex.pool`. The first line tells by which engine the offending format was generated.

- `TEX.POOL doesn't match; TANGLE me again!`
  `TEX.POOL doesn't match; TANGLE me again (or fix the path).`

  This might appear if you forgot to install the proper `pdftex.pool` when installing a new version of the pdfTeX binary. E. g. under teTeX then run `texconfig-sys init`.

- `! I can't find file '*pdftex.ini'.`
  `<*> *pdftex.ini`

  This typically appears when you try to generate an extended format with the pdfTeX engine (it does not know about the special asterisk `*` notation). Use the pdfeTeX engine instead.

- pdfTeX cannot find one or more map files (`*.map`), encoding vectors (`*.enc`), virtual fonts, Type 1 fonts, TrueType fonts or some image file.

  Make sure that the required file exists and the corresponding variable in `texmf.cnf` contains a path to the file. See above which variables pdfTeX needs apart from the ones TeX uses.

  When you have installed new fonts, and your pdf viewer complains about missing fonts, you should take a look at the log file produced by pdfTeX. Missing fonts, map files, encoding vectors as well as missing characters (glyphs) are reported there.

Normally the page content takes one object. This means that one seldom finds more than a few hundred objects in a simple file. This document for instance uses about 900 objects. In demanding applications this number can grow quite rapidly, especially when one uses a lot of widget annotations, shared annotations or other shared things. In these situations in `texmf.cnf` one can enlarge pdfTeX's internal object table by adding a line in `texmf.cnf`, for instance:

```
obj_tab_size=400000
```

4 Macro packages supporting PDFTeX

As pdfTeX generates the final pdf output without help of a postprocessor, macro packages that take care of these pdf features have to be set up properly. Typical tasks are handling color, graphics, hyperlink support, threading, font–inclusion, as well as page imposition and manipulation. All these pdf–specific tasks can be commanded by pdfTeX's own primitives (a few also by a pdfTeX–specific `\special{pdf: ...}` primitive). Any other `\special{}` commands, like the ones defined for various dvi postprocessors, are simply ignored by pdfTeX when in pdf output mode; a warning is given only for non–empty `\special{}` commands.

When a macro package already written for classical TeX with dvi output is to be modified for use with pdfTeX, it is very helpful to get some insight to what extent pdfTeX–specific support is needed. This info can be gathered e. g. by outputting the various `\special` commands as `\message`. Simply type

```
\pdfoutput=1 \let\special\message
```

or, if this leads to confusion,

```
\pdfoutput=1 \def\special#1{\write16{special: #1}}
```

and see what happens. As soon as one 'special' message turns up, one knows for sure that some kind of pdfTeX specific support is needed, and often the message itself gives a indication of what is needed.

Currently all mainstream macro packages offer pdfTeX support, with automatic detection of pdfTeX as engine. So there is normally no need to turn on pdfTeX support explicitly.

- For LaTeX users, Sebastian Rahtz' and Heiko Oberdiek's `hyperref` package has substantial support for pdfTeX and provides access to most of its features. In the simplest and most common case, the user merely needs to load `hyperref`, and all cross–references will be converted to pdf hypertext links. pdf output is automatically selected, compression is turned on, and the page size is set up correctly. Bookmarks are created to match the table of contents.
- The standard LaTeX `graphics`, `graphicx`, and `color` packages also have automatic pdfTeX support, which allow use of color, text rotation, and graphics inclusion commands.
- The ConTeXt macro package by Hans Hagen has very full support for pdfTeX in its generalized hypertext features. Support for pdfTeX is implemented as a special driver, and is invoked by typing `\setupoutput[pdftex]` or feeding TeXexec with the `--pdf` option.
- pdf from Texinfo documents can be created by running pdfTeX on the Texinfo file, instead of TeX. Alternatively, run the shell command `texi2pdf` instead of `texi2dvi`.
- A small modification of `webmac.tex`, called `pdfwebmac.tex`, allows production of hyperlinked pdf versions of the program code written in web.

Some nice samples of pdfTeX output can be found at `http://www.pdftex.org`, `http://www.pragma-ade.com`, and `http://www.tug.org/texshowcase`.

5 Setting up fonts

pdfTeX can work with Type 1 and TrueType fonts, but a source must be available for all fonts used in the document, except for the 14 standard fonts supplied by the pdf reader (Times, Helvetica, Courier, Symbol and Dingbats). It is possible to use METAFONT–generated fonts in pdfTeX — but it is strongly recommended not to use these fonts if an equivalent is available in Type 1 or TrueType format, if only because bitmap Type 3 fonts render very poorly in (older versions of) Adobe Reader. Given the free availability of Type 1 versions of all the Computer Modern fonts, and the ability to use standard PostScript fonts, there is rarely a need to use bitmap fonts in pdfTeX.

5.1 Map files

Font map files provide the connection between TeX tfm font files and the outline font file names. They contain also information about re–encoding arrays, partial downloading, and character transformation parameters (like SlantFont and ExtendFont). Those map files were first created for dvi postprocessors. But, as pdfTeX in pdf output mode includes all pdf processing steps, it also needs to know about font mapping, and therefore reads in one or more map files. Map files are not read in when pdfTeX is in dvi mode. Pixel fonts can be used without being listed in the map file.

By default, pdfTeX reads the map file `pdftex.map`. In Web2c, map files are searched for using the `TEXFONTMAPS` config file value and environment variable. By default, the current directory and various system directories are searched.

Within the map file, each font is listed on an individual line. The syntax of each line is upward–compatible with `dvips` map files and can contain the following fields (some are optional; explanations follow):

tfmname basename fontflags special encodingfile fontfile

It is mandatory that *tfmname* is the first field. If a *basename* is given, it must be the second field. Similarly if *fontflags* is given it must be the third field (if *basename* is present) or the second field (if *basename* is left out). It is possible to mix the positions of *special*, *encodingfile*, and *fontfile*, however the first three fields must be given in fixed order.

tfmname sets the name of the tfm file for a font — the name TeX sees. This name must always be given.

basename sets the base (PostScript) font name. The *basename* field is checked against the BaseName entry of fonts coming with embedded pdf files. If there is a match, the font will be removed from the embedded file, and a local font is opened, which will contain the glyphs from the embedded file. This collecting mechanism helps keeping the resulting pdf file size small, if many files with similar fonts are to be embedded. Therefore it is recommended always to set the *basename* field.

If a *basename* field is given, also a *fontfile* field must be there, unless the *basename* matches one of the 14 standard font names; then the *fontfile* field is optional. If the *fontfile* name is given, this font will be embedded (depending on flags, see below). If the *fontfile* name for a standard font is missing, the font will be quietly left out, which is fine, as pdf viewers will later render the text with their own versions of the font.

fontflags specify some characteristics of the font. The following description of these flags is taken, with slight modification, from the pdf Reference Manual (the section on font descriptor flags). Viewers can adapt their rendering to these flags, especially when they substitute a replacements for not embedded fonts.

The value of the flags key in a font descriptor is a 32–bit integer that contains a collection of boolean attributes. These attributes are true if the corresponding bit is set to 1. Table 3 specifies the meanings of the bits, with bit 1 being the least significant. Reserved bits must be set to zero.

bit position	**semantics**
1	Fixed–width font
2	Serif font
3	Symbolic font
4	Script font
5	Reserved
6	Uses the Adobe Standard Roman Character Set
7	Italic
8–16	Reserved
17	All–cap font
18	Small–cap font
19	Force bold at small text sizes
20–32	Reserved

Table 3 The meaning of flags in the font descriptor.

All characters in a *fixed–width* font have the same width, while characters in a proportional font have different widths. Characters in a *serif font* have short strokes drawn at an angle on the top and bottom of character stems, while sans serif fonts do not have such strokes. A *symbolic font* contains symbols rather than letters and numbers. Characters in a *script font* resemble cursive handwriting. An *all–cap* font, which is typically used for display purposes such as titles or headlines, contains no lowercase letters. It differs from a *small–cap* font in that characters in the latter, while also capital letters, have been sized and their proportions adjusted so that they have the same size and stroke weight as lowercase characters in the same typeface family.

Bit 6 in the flags field indicates that the font's character set conforms to the Adobe Standard Roman Character Set, or a subset of that, and that it uses the standard names for those characters.

Finally, bit 19 is used to determine whether or not bold characters are drawn with extra pixels even at very small text sizes. Typically, when characters are drawn at small sizes on very low resolution devices such as display screens, features of bold characters may appear only one pixel wide. Because this is the minimum feature width on a pixel–based device, ordinary non–bold characters also appear with one–pixel wide features, and thus cannot be distinguished from bold characters. If bit 19 is set, features of bold characters may be thickened at small text sizes.

If the font flags are not given, pdfTeX treats it as being 4, a symbolic font. If you do not know the correct value, it is best not to specify it at all, as specifying a bad value of font flags may cause troubles in viewers. On the other hand this option is not absolutely useless because it provides backward compatibility with older map files (see the *fontfile* description below).

special instructions can be used to manipulate fonts similar to the way `dvips` does. Currently only the keywords `SlantFont` and `ExtendFont` are interpreted, other instructions (as `ReEncodeFont` with parameters, see *encoding* below) are just ignored. The permitted `SlantFont` range is −1..1; for `ExtendFont` it's −2..2. The block of *special* instruction must be enclosed by double quotes `"`.

encoding specifies the name of the file containing the external encoding vector to be used for the font. The file name may be preceded by a `<`, but the effect is the same. The format of the encoding vector is identical to that used by `dvips`. If no encoding is specified, the font's built–in default encoding is used. It may be omitted if you are sure that the font resource has the correct built–in encoding. In general this option is highly preferred and is *required* when subsetting a TrueType font.

fontfile sets the name of the font source file. This must be a Type 1 or TrueType font file. The font file name can be preceded by one or two special characters, which says how the font file should be handled.

- If the font file name is preceded by a `<` the font file will be partially downloaded, meaning that only used glyphs (characters) are embedded to the font. This is the most common use and is *strongly recommended* for any font, as it ensures the portability and reduces the size of the pdf output. Partial fonts are included in such a way that name and cache clashes are minimized.
- If the font file name is preceded by a double `<<`, the font file will be included entirely — all glyphs of the font are embedded, including the ones that are not used in the document. Apart from causing large size pdf output, this option may cause troubles with TrueType fonts, so it is not recommended. It might be useful in case the font is atypical and can not be subsetted well by pdfTeX. *Beware: some font vendors forbid full font inclusion.*
- If nothing precedes the font file name, the font file is read but nothing is embedded, only the font parameters are extracted to generate the so–called font descriptor, which is used by the pdf reader to simulate the font if needed. This option is useful only when you do not want to embed the font (i. e. to reduce the output size), but wish to use the font metrics and let the pdf reader generate instances that look close to the used font in case the font resource is not installed on the system where the pdf output will be viewed or printed. To use this feature the font flags *must* be specified, and it must have the bit 6 set on, which means that only fonts with the Adobe Standard Roman Character Set can be simulated. The only exception is the case of a Symbolic font, which is not very useful.

When one suffers from invalid lookups, for instance when pdfTeX tries to open a `.pfa` file instead of a `.pfb` one, one can add the suffix to the filename. In this respect, pdfTeX completely relies on the `kpathsea` libraries.

If a used font is not present in the map files, first pdfTEX will look for a source with suffix `.pgc`, which is a so–called pgc source (pdf Glyph Container)[1]. If no pgc source is available, pdfTEX will try to use pk fonts as dvi drivers do, creating pk fonts on–the–fly if needed.

Lines containing nothing apart from *tfmname* stand for scalable Type 3 fonts. For scalable fonts as Type 1, TrueType and scalable Type 3 font, all the fonts loaded from a tfm at various sizes will be included only once in the pdf output. Thus if a font, let's say `csr10`, is described in one of the map files, then it will be treated as scalable. As a result the font source for csr10 will be included only once for `csr10`, `csr10 at 12pt` etc. So pdfTEX tries to do its best to avoid multiple downloading of identical font sources. Thus vector pgc fonts should be specified as scalable Type 3 in map files like:

```
csr10
```

It doesn't hurt much if a scalable Type 3 font is not given in map files, except that the font source will be downloaded multiple times for various sizes, which causes a much larger pdf output. On the other hand if a font in the map files is defined as scalable Type 3 font and its pgc source is not scalable or not available, pdfTEX will use pk fonts instead; the pdf output is still valid but some fonts may look ugly because of the scaled bitmap.

To summarize this rather confusing story, we include a some example lines. First we use two fonts from the 14 standard fonts with font–specific encoding, i. e. no external encoding is given. In the first line, the fontfile is missing, so viewers will use their own font. The ZapfDingbats font is taken from the given font file.

```
psyr Symbol
pzdr ZapfDingbats <pzdr.pfb
```

Similarly, two standard fonts with an external encoding. The < preceding the encoding file name may be left out.

```
ptmr8r  Times-Roman  <8r.enc
ptmri8r Times-Italic <8r.enc <ptmri8a.pfb
```

A SlantFont is specified similarly as for `dvips`. The `SlantFont` or `ExtendFont` entries work only with embedded font files.

```
psyro           ".167 SlantFont"         <usyr.pfb
pcrr8rn Courier ".85 ExtendFont" <8r.enc <pcrr8a.pfb
```

Partially download a font without re–encoding:

```
pgsr8a GillSans <pgsr8a.pfb
```

Download a font entirely without re–encoding:

```
pgsr8a GillSans <<pgsr8a.pfb
```

Partially download a font with re–encoding:

```
pgsr8r GillSans <8r.enc <pgsr8a.pfb
```

Entirely download a font with re–encoding:

```
pgsr8r GillSans <8r.enc <<pgsr8a.pfb
```

[1] This is a text file containing a pdf Type 3 font, created by METAPOST using some utilities by Hans Hagen. In general pgc files can contain whatever is allowed in a pdf page description, which may be used to support fonts that are not available in METAFONT. pgc fonts are not widely useful, as vector Type 3 fonts are not displayed very well in older versions of Acrobat Reader, but may be more useful when better Type 3 font handling is more common.

Sometimes we do not want to include a font, but need to extract parameters from the font file and re–encode the font as well. This only works for fonts with Adobe Standard Encoding. The font flags specify how such a font looks like, so e. g. the Adobe Reader can generate a similar instance if the font resource is not available on the target system.

```
pgsr8r GillSans 32 <8r.enc pgsr8a.pfb
```

Do not embed the font — only extract the font parameters:

```
pgsr8a GillSans pgsr8a.pfb
```

A TrueType font can be used in the same way as a Type 1 font:

```
verdana8r Verdana <8r.enc <verdana.ttf
```

5.2 TrueType fonts

As mentioned above, pdfTEX can work with TrueType fonts. Defining TrueType fonts is similar to Type 1. The only extra thing to do with TrueType is to create a tfm file. There is a program called `ttf2afm` in the pdfTEX distribution which can be used to extract afm from TrueType fonts (another conversion program is `ttf2pt1`). Usage of `ttf2afm` is simple:

```
ttf2afm -e <encoding vector> -o <afm outputfile> <ttf input file>
```

A TrueType file can be recognized by its suffix `ttf`. The optional *encoding* specifies the encoding, which is the same as the encoding vector used in map files for pdfTEX and `dvips`. If the encoding is not given, all the glyphs of the afm output will be mapped to `/.notdef`. `ttf2afm` writes the output afm to standard output. If we need to know which glyphs are available in the font, we can run `ttf2afm` without encoding to get all glyph names. The resulting afm file can be used to generate a tfm one by applying `afm2tfm`.

To use a new TrueType font the minimal steps may look like below. We suppose that `test.map` is used.

```
ttf2afm -e 8r.enc -o times.afm times.ttf
afm2tfm times.afm -T 8r.enc
echo "times TimesNewRomanPSMT <8r.enc <times.ttf" >>test.map
```

There are a few limitations with TrueType fonts in comparison with Type 1 fonts:

a. The special effects SlantFont/ExtendFont cannot be used.
b. To subset a TrueType font, the font must be specified as re–encoded, therefore an encoding vector must be given.
c. TrueType fonts coming with embedded pdf files are kept untouched; they are not replaced by local ones.

6 Formal syntax specification

This section formally specifies the pdfTEX specific extensions to the TEX macro programming language. All primitives are prefixed by `pdf` except for `\efcode`, `\lpcode`, `\rpcode`, `\leftmarginkern`, and `\rightmarginkern`. The general definitions and syntax rules follow after the list of primitives.

Integer registers

`\pdfoutput` (integer)
`\pdfminorversion` (integer)
`\pdfcompresslevel` (integer)

\pdfdecimaldigits (integer)
\pdfimageresolution (integer)
\pdfpkresolution (integer)
\pdftracingfonts (integer)
\pdfuniqueresname (integer)
\pdfadjustspacing (integer)
\pdfprotrudechars (integer)
\efcode ⟨font⟩ ⟨8-bit number⟩ (integer)
\lpcode ⟨font⟩ ⟨8-bit number⟩ (integer)
\rpcode ⟨font⟩ ⟨8-bit number⟩ (integer)
\pdfforcepagebox (integer)
\pdfoptionalwaysusepdfpagebox (integer)
\pdfinclusionerrorlevel (integer)
\pdfoptionpdfinclusionerrorlevel (integer)
\pdfimagehicolor (integer)
\pdfimageapplygamma (integer)
\pdfgamma (integer)
\pdfimagegamma (integer)

Dimen registers

\pdfhorigin (dimen)
\pdfvorigin (dimen)
\pdfpagewidth (dimen)
\pdfpageheight (dimen)
\pdflinkmargin (dimen)
\pdfdestmargin (dimen)
\pdfthreadmargin (dimen)

Token registers

\pdfpagesattr (tokens)
\pdfpageattr (tokens)
\pdfpageresources (tokens)
\pdfpkmode (tokens)

Expandable commands

\pdftexrevision (expandable)
\pdftexbanner (expandable)
\pdfcreationdate (expandable)
\pdfpageref ⟨page number⟩ (expandable)
\pdfxformname ⟨object number⟩ (expandable)
\pdffontname ⟨font⟩ (expandable)
\pdffontobjnum ⟨font⟩ (expandable)
\pdffontsize ⟨font⟩ (expandable)
\pdfincludechars ⟨font⟩ ⟨general text⟩ (expandable)

\leftmarginkern ⟨box number⟩ (expandable)
\rightmarginkern ⟨box number⟩ (expandable)
\pdfescapestring ⟨general text⟩ (expandable)
\pdfescapename ⟨general text⟩ (expandable)
\pdfescapehex ⟨general text⟩ (expandable)
\pdfunescapehex ⟨general text⟩ (expandable)
\pdfuniformdeviate ⟨number⟩ (expandable)
\pdfnormaldeviate (expandable)
\pdfmdfivesum [file] ⟨general text⟩ (expandable)
\pdffilemoddate ⟨general text⟩ (expandable)
\pdffilesize ⟨general text⟩ (expandable)
\pdffiledump [offset ⟨number⟩] [length ⟨number⟩] ⟨general text⟩ (expandable)

Read–only integers

\pdftexversion (read–only integer)
\pdflastobj (read–only integer)
\pdflastxform (read–only integer)
\pdflastximage (read–only integer)
\pdflastximagepages (read–only integer)
\pdflastannot (read–only integer)
\pdflastxpos (read–only integer)
\pdflastypos (read–only integer)
\pdflastdemerits (read–only integer)
\pdfelapsedtime (read–only integer)
\pdfrandomseed (read–only integer)
\pdfshellescape (read–only integer)

General commands

\pdfobj ⟨object type spec⟩ (h, v, m)
\pdfrefobj ⟨object number⟩ (h, v, m)
\pdfxform [⟨xform attr spec⟩] ⟨box number⟩ (h, v, m)
\pdfrefxform ⟨object number⟩ (h, v, m)
\pdfximage [⟨image attr spec⟩] ⟨general text⟩ (h, v, m)
\pdfrefximage ⟨object number⟩ (h, v, m)
\pdfannot ⟨annot type spec⟩ (h, v, m)
\pdfstartlink [⟨rule spec⟩] [⟨attr spec⟩] ⟨action spec⟩ (h, m)
\pdfendlink (h, m)
\pdfoutline ⟨outline spec⟩ (h, v, m)
\pdfdest ⟨dest spec⟩ (h, v, m)
\pdfthread ⟨thread spec⟩ (h, v, m)
\pdfstartthread ⟨thread spec⟩ (v, m)
\pdfendthread (v, m)
\pdfsavepos (h, v, m)
\pdfinfo ⟨general text⟩
\pdfcatalog ⟨general text⟩ [⟨open-action spec⟩]

`\pdfnames` ⟨general text⟩
`\pdfmapfile` ⟨map spec⟩
`\pdfmapline` ⟨map spec⟩
`\pdffontattr` ⟨font⟩ ⟨general text⟩
`\pdftrailer` ⟨general text⟩
`\pdffontexpand` ⟨font⟩ ⟨expand spec⟩
`\vadjust` [⟨pre spec⟩] ⟨filler⟩ `{` ⟨vertical mode material⟩ `}` (h, m)
`\pdfliteral` [`direct`] ⟨general text⟩ (h, v, m)
`\special` ⟨pdfspecial spec⟩
`\pdfresettimer`
`\pdfsetrandomseed` ⟨number⟩
`\pdfnoligatures` ⟨font⟩

General definitions and syntax rules

⟨general text⟩ → `{` ⟨balanced text⟩ `}`
⟨attr spec⟩ → `attr` ⟨general text⟩
⟨resources spec⟩ → `resources` ⟨general text⟩
⟨rule spec⟩ → (`width` | `height` | `depth`) ⟨dimension⟩ [⟨rule spec⟩]
⟨object type spec⟩ → `reserveobjnum` |
    [`useobjnum` ⟨number⟩]
    [`stream` [⟨attr spec⟩]] ⟨object contents⟩
⟨annot type spec⟩ → `reserveobjnum` |
    [`useobjnum` ⟨number⟩] [⟨rule spec⟩] ⟨general text⟩
⟨object contents⟩ → ⟨file spec⟩ | ⟨general text⟩
⟨xform attr spec⟩ → [⟨attr spec⟩] [⟨resources spec⟩]
⟨image attr spec⟩ → [⟨rule spec⟩] [⟨attr spec⟩] [⟨page spec⟩] [⟨colorspace spec⟩] [⟨pdf box spec⟩]
⟨outline spec⟩ → [⟨attr spec⟩] ⟨action spec⟩ [`count` ⟨number⟩] ⟨general text⟩
⟨action spec⟩ → `user` ⟨user-action spec⟩ | `goto` ⟨goto-action spec⟩ |
    `thread` ⟨thread-action spec⟩
⟨user-action spec⟩ → ⟨general text⟩
⟨goto-action spec⟩ → ⟨numid⟩ |
    [⟨file spec⟩] ⟨nameid⟩ |
    [⟨file spec⟩] [⟨page spec⟩] ⟨general text⟩ |
    ⟨file spec⟩ ⟨nameid⟩ ⟨newwindow spec⟩ |
    ⟨file spec⟩ [⟨page spec⟩] ⟨general text⟩ ⟨newwindow spec⟩
⟨thread-action spec⟩ → [⟨file spec⟩] ⟨numid⟩ | [⟨file spec⟩] ⟨nameid⟩
⟨open-action spec⟩ → `openaction` ⟨action spec⟩
⟨colorspace spec⟩ → `colorspace` ⟨number⟩
⟨pdf box spec⟩ → `mediabox` | `cropbox` | `bleedbox` | `trimbox` | `artbox`
⟨map spec⟩ → `{` [⟨map modifier⟩] ⟨balanced text⟩ `}`
⟨map modifier⟩ → `+` | `=` | `-`
⟨numid⟩ → `num` ⟨number⟩
⟨nameid⟩ → `name` ⟨general text⟩
⟨newwindow spec⟩ → `newwindow` | `nonewwindow`
⟨dest spec⟩ → ⟨numid⟩ ⟨dest type⟩ | ⟨nameid⟩ ⟨dest type⟩

⟨dest type⟩ → `xyz` [`zoom` ⟨number⟩] | `fitr` ⟨rule spec⟩ |
`fitbh` | `fitbv` | `fitb` | `fith` | `fitv` | `fit`
⟨thread spec⟩ → [⟨rule spec⟩] [⟨attr spec⟩] ⟨id spec⟩
⟨id spec⟩ → ⟨numid⟩ | ⟨nameid⟩
⟨file spec⟩ → `file` ⟨general text⟩
⟨page spec⟩ → `page` ⟨number⟩
⟨expand spec⟩ → ⟨stretch⟩ ⟨shrink⟩ ⟨step⟩ [`autoexpand`]
⟨stretch⟩ → ⟨number⟩
⟨shrink⟩ → ⟨number⟩
⟨step⟩ → ⟨number⟩
⟨pre spec⟩ → `pre`
⟨pdfspecial spec⟩ → `{` [⟨pdfspecial id⟩ [⟨pdfspecial modifier⟩]] ⟨balanced text⟩ `}`
⟨pdfspecial id⟩ → `pdf:` | `PDF:`
⟨pdfspecial modifier⟩ → `direct:`

A ⟨general text⟩ is expanded immediately, like `\special` in traditional TeX, unless explicitly mentioned otherwise.

Some of the object and image related primitives can be prefixed by `\immediate`. More about that in the next sections.

7 PDFTeX primitives

Here follows a short description of the primitives added by pdfTeX to the original TeX engine (other extensions by MLTeX and encTeX are not listed). One way to learn more about how to use these new primitives is to have a look at the file `samplepdf.tex` in the pdfTeX distribution.

Note that if the output is dvi then the pdfTeX specific dimension parameters are not used at all. However some pdfTeX integer parameters can affect the dvi as well as pdf output (currently `\pdfoutput` and `\pdfadjustspacing`).

General warning: many of these new primitives, for example `\pdfdest` and `\pdfoutline`, write their arguments directly to the pdf output file (when producing pdf), as pdf string constants. This means that *you* (or, more likely, the macros you write) must escape characters as necessary (namely `\`, `(`, and `)`. Otherwise, an invalid pdf file may result. The `hyperref` and Texinfo packages have code which may serve as a starting point for implementing this, although it will certainly need to be adapted to any particular situation.

7.1 Document setup

- `\pdfoutput` (integer)

  This parameter specifies whether the output format should be dvi or pdf. A positive value means pdf output, otherwise (default 0) one gets dvi output. This primitive is the only one that must be set to produce pdf output (unless the commandline option `-output-format=pdf` is used); all other primitives are optional. This parameter cannot be specified *after* shipping out the first page. In other words, if we want pdf output, we have to set `\pdfoutput` before pdfTeX ships out the first page.

  When pdfTeX starts complaining about specials, one can be rather sure that a macro package is not aware of the pdf mode. A simple way of making macros aware of pdfTeX in pdf or dvi mode is:

```
\ifx\pdfoutput\undefined \csname newcount\endcsname\pdfoutput \fi
\ifcase\pdfoutput DVI CODE \else PDF CODE \fi
```

Using the `ifpdf.sty` file, which works with both LaTeX and plain TeX, is a cleaner way of doing this. Historically, the simple test `\ifx\pdfoutput\undefined` was defined; but nowadays, the pdfTeX engine is used in distributions also for non-pdf formats (e. g. LaTeX), so `\pdfoutput` may be defined even when the output format is dvi.

- `\pdfminorversion` (integer)

  This primitive sets the pdf version of the generated file and the latest allowed pdf version of included pdfs. E. g., `\pdfminorversion=3` tells pdfTeX to set the pdf version to 1.3 and allows only included pdf files with versions numbers up to 1.3. The default for `\pdfminorversion` is 4, producing files with pdf version 1.4. If specified, this primitive must appear before any data is to be written to the generated pdf file, so you should put it at the very start of your files. The command has been introduced in pdfTeX 1.30.0 as a shortened synonym of `\pdfoptionpdfminorversion` command, that is obsolete by now.

- `\pdfcompresslevel` (integer)

  This integer parameter specifies the level of stream compression (text, in–line graphics, and embedded png images (only if they are un- and re–compressed during the embedding process); all done by the `zlib` library). Zero means no compression, 1 means fastest, 9 means best, 2..8 means something in between. A value outside this range will be adjusted to the nearest meaningful value. This parameter is read each time pdfTeX starts a stream. Setting `\pdfcompresslevel=0` is great for pdf stream debugging.

- `\pdfdecimaldigits` (integer)

  This integer parameter specifies the numeric accuracy of real coordinates as written to the pdf file. It gives the maximal number of decimal digits after the decimal point. Valid values are in range 0..4. A higher value means more precise output, but also results in a larger file size and more time to display or print. In most cases the optimal value is 2. This parameter does not influence the precision of numbers used in raw pdf code, like that used in `\pdfliteral` and annotation action specifications; also multiplication items (e. g. scaling factors) are not affected and are always output with best precision. This parameter is read when pdfTeX writes a real number to the pdf output.

  When including huge METAPOST images using `supp-pdf.tex`, one can limit the accuracy to two digits by typing: `\twodigitMPoutput`.

- `\pdfhorigin` (dimension)

  This parameter can be used to set the horizontal offset the output box from the top left corner of the page. A value of 1 inch corresponds to the normal TeX offset. This parameter is read when pdfTeX starts shipping out a page to the pdf output.

  For standard purposes, this parameter should always be kept at 1 true inch. If you want to shift text on the page, use TeX's own `\hoffset` primitive. To avoid surprises, after global magnification has been changed by the `\mag` primitive, the `\pdfhorigin` parameter should still be 1 true inch, e. g. by typing `\pdfhorigin=1 true in` after issuing the `\mag` command. Or, you can preadjust the `\pdfhorigin` value before typing `\mag`, so that its value after the `\mag` command ends up at 1 true inch again.

- `\pdfvorigin` (dimension)

  This parameter is the vertical companion of `\pdfhorigin`, and the notes above regarding `\mag` and true dimensions apply. Also keep in mind that the TeX coordinate system starts in the top left corner (downward), while pdf coordinates start at the bottom left corner (upward).

- `\pdfpagewidth` (dimension)

  This dimension parameter specifies the page width of the pdf output (the screen, the paper, etc.). pdfTeX reads this parameter when it starts shipping out a page. After magnification has been changed by the `\mag` primitive, check that this parameter reflects the wished true page width.

  If the value is set to zero, the page width is calculated as $w_{\text{box being shipped out}} + 2 \times (\text{horigin} + \texttt{\textbackslash hoffset})$. When part of the page falls off the paper or screen, you can be rather sure that this parameter is set wrong.

- `\pdfpageheight` (dimension)

  Similar to the previous item, this dimension parameter specifies the page height of the pdf output. If set to zero, the page height will be calculated analogously to the above. After magnification has been changed by the `\mag` primitive, check that this parameter reflects the wished true page height.

7.2 The document info and catalog

- `\pdfinfo` ⟨general text⟩

  This primitive allows the user to add information to the document info section; if this information is provided, it can be extracted, e. g. by the pdfinfo program, or by the Adobe Reader (version 7.0: menu option *File* ⟶ *Document Properties*). The ⟨general text⟩ is a collection of key–value–pairs. The key names are preceded by a `/`, and the values, being strings, are given between parentheses. All keys are optional. Possible keys are `/Author`, `/CreationDate` (defaults to current date including time zone info), `/ModDate`, `/Creator` (defaults to `TeX`), `/Producer` (defaults to `pdfTeX-1.30.4` or `pdfeTeX-1.30.4`), `/Title`, `/Subject`, and `/Keywords`.

  `/CreationDate` and `/ModDate` are expressed in the form `D:YYYYMMDDhhmmssTZ..`, where `YYYY` is the year, `MM` is the month, `DD` is the day, hh is the hour, `mm` is the minutes, `ss` is the seconds, and `TZ..` is an optional string denoting the time zone. An example of this format is shown below. For details please refer to the pdf Reference.

  Multiple appearances of `\pdfinfo` will be concatenated. In general, if a key is given more than once, one may expect that the first appearance will be used. Be aware however, that this behaviour is viewer dependent. Except expansion, pdfTeX does not perform any further operations on ⟨general text⟩ provided by the user.

  An example of the use of `\pdfinfo` is:

```
\pdfinfo
  { /Title        (example.pdf)
    /Creator      (TeX)
    /Producer     (pdfeTeX 1.30.4)
    /Author       (Tom and Jerry)
    /CreationDate (D:20050428154343+01'00')
    /ModDate      (D:20050428155343+01'00')
    /Subject      (Example)
    /Keywords     (mouse, cat) }
```

- `\pdfcatalog` ⟨general text⟩ [⟨open-action spec⟩]

  Similar to the document info section is the document catalog, where keys are `/URI`, which provides the base url of the document, and `/PageMode`, which determines how the pdf viewer displays the document on startup. The possibilities for the latter are explained in Table 4:

value	meaning
/UseNone	neither outline nor thumbnails visible
/UseOutlines	outline visible
/UseThumbs	thumbnails visible
/FullScreen	full–screen mode

Table 4 Supported /PageMode values.

In full–screen mode, there is no menu bar, window controls, nor any other window present. The default setting is /UseNone.

The ⟨openaction⟩ is the action provided when opening the document and is specified in the same way as internal links, see section 7.9. Instead of using this method, one can also write the open action directly into the catalog.

- \pdfnames ⟨general text⟩

  This primitive inserts the ⟨general text⟩ to the /Names array. The text must conform to the specifications as laid down in the pdf Reference Manual, otherwise the document can be invalid.

- \pdftrailer ⟨general text⟩

  This command puts its argument text verbatim into the file trailer dictionary. The primitive has been introduced in pdfTeX 1.11a.

7.3 Fonts

- \pdfpkresolution (integer)

  This integer parameter specifies the default resolution of embedded pk fonts and is read when pdfTeX downloads a pk font during finishing the pdf output. As bitmap fonts are still rendered poorly by some pdf viewers, it is best to use Type 1 fonts when available.

- \pdffontexpand ⟨font⟩ ⟨stretch⟩ ⟨shrink⟩ ⟨step⟩ [autoexpand]

  This extension to TeX's font definitions controls a pdfTeX automatism called *font expansion*. We describe this by an example:

```
\font\somefont=sometfm at 10pt
\pdffontexpand\somefont 30 20 10 autoexpand
\pdfadjustspacing=2
```

  The 30 20 10 means this: "hey TeX, when line breaking is going badly, you may stretch the glyphs in this font as much as 3 % or shrink them by 2 %". Because pdfTeX uses internal data structures with fixed widths, each additional width also means an additional font. For practical reasons pdfTeX uses discrete steps, in this example, 1 %. This means that for font sometfm up to 6 differently scaled alternatives may be used. When no step is specified, 0.5 % steps are used.

  Roughly spoken, the trick is as follows. Consider a text typeset in triple column mode. When TeX cannot break a line in the appropriate way, the unbreakable parts of the word will stick into the margin. When pdfTeX notes this, it will try to scale (shrink) the glyphs in that line using fixed steps, until the line fits. When lines are too spacy, the opposite happens: pdfTeX starts scaling (stretching) the glyphs until the white space gaps is acceptable. This glyph stretching and shrinking is called *font expansion*.

The additional expanded fonts get artificial names by adding the font expansion value to the tfmname of the base font, e. g. `sometfm+10` for 1 % stretch or `sometfm-15` for 1.5 % shrink. If the `autoexpand` option is not given, tfm files with these names and appropriate dimensions must be available. So, each expanded variant of a font must have its own tfm file! Expanded tfm names like `sometfm+10` must not be mentioned in the map file (but the tfm name of the base font without expansion must be there). When no tfm file can be found, pdfTeX will try to generate it by executing the script `mktextfm`, where available and supported.

The font expansion is greatly simplified, if the `autoexpand` option is there. Then no expanded tfm file versions are needed; instead, pdfTeX generates expanded copies of the unexpanded tfm data structures and keeps them in its memory.

pdfTeX requires only unexpanded Type 1 font files for font expansion, from which all expanded font versions are internally generated and included (subsetted) into the pdf output file. To enable font expansion, don't forget to set `\pdfadjustspacing` to a value greater than zero.

The font expansion mechanism is inspired by an optimization first introduced by Prof. Hermann Zapf, which in itself goes back to optimizations used in the early days of typesetting: use different glyphs to optimize the grayness of a page. So, there are many, slightly different a's, e's, etc. For practical reasons pdfTeX does not use such huge glyph collections; it uses horizontal scaling instead. This is sub–optimal, and for many fonts, possibly offensive to the design. But, when using pdf, it's not illogical: pdf viewers use so–called Multiple Master fonts when no fonts are embedded and/or can be found on the target system. Such fonts are designed to adapt their design to the different scaling parameters. It is up to the user to determine to what extent mixing slightly remastered fonts can be used without violating the design. Think of an O: when geometrically stretched, the vertical part of the glyph becomes thicker, and looks incompatible with an unscaled original. With a multiple master situation, one can stretch while keeping this thickness compatible.

► `\pdfadjustspacing` (integer)

This primitive provides a switch for enabling font expansion. By default, `\pdfadjustspacing` is set to 0; then font expansion is disabled, so that the pdfTeX output is identical to that from the original TeX engine.

Font expansion can be activated in two modes. When `\pdfadjustspacing` is set to 1, font expansion is applied *after* TeX's normal paragraph breaking routines have broken the paragraph into lines. In this case, line breaks are identical to standard TeX behaviour.

When set to 2, the width changes that are the result of stretching and shrinking are taken into account *while* the paragraph is broken into lines. In this case, line breaks are likely to be different from those of standard TeX. In fact, paragraphs may even become longer or shorter.

Both alternatives require a collection of tfm files that are related to the ⟨stretch⟩ and ⟨shrink⟩ settings for the `\pdffontexpand` primitive, unless this is given with the `autoexpand` option.

► `\efcode` ⟨font⟩ (integer)

We didn't yet tell the whole story. One can imagine that some glyphs are visually more sensitive to stretching or shrinking than others. Then the `\efcode` primitive can be used to influence the expandability of individual glyphs within a given font, as a factor to the expansion setting from the `\pdffontexpand` primitive. The syntax is similar to `\sfcode` (but with the ⟨font⟩ required), and it defaults to 1000, meaning 100 % expandability. The given integer value is clipped to the range 0..1000, corresponding to a usable expandability range of 0..100 %. Example:

```
\efcode\somefont`A=800
\efcode\somefont`O=0
```

Here an A may stretch or shrink only by 80 % of the current expansion value for that font, and expansion for the O is disabled. The actual expansion is still bound to the steps as defined by `\pdffontexpand` primitive, otherwise one would end up with more possible font inclusions than would be comfortable.

- `\pdfprotrudechars` (integer)

  Yet another way of optimizing paragraph breaking is to let certain characters move into the margin ('character protrusion'). When `\pdfprotrudechars=1`, the glyphs qualified as such will make this move when applicable, without changing the line-breaking. When `\pdfprotrudechars=2` (or greater), character protrusion will be taken into account while considering breakpoints, so line-breaking might be changed. This qualification and the amount of shift are set by the primitives `\rpcode` and `\lpcode`. Character protrusion is disabled when `\pdfprotrudechars=0` (or negative).

  If you want to protrude some item other than a character (e. g. a `\hbox`), you can do so by padding the item with an invisible zero–width character, for which protrusion is activated.

- `\rpcode` ⟨font⟩ (integer)

  The amount that a character from a given font may shift into the right margin ('character protrusion') is set by the primitive `\rpcode`. The protrusion distance is the integer value given to `\rpcode`, multiplied with 0.001 em from the current font. The given integer value is clipped to the range −1000..1000, corresponding to a usable protrusion range of −1 em..1 em. Example:

  ```
  \rpcode\somefont`,=200
  \rpcode\somefont`-=150
  ```

  Here the comma may shift by 0.2 em into the margin and the hyphen by 0.15 em. All these small bits and pieces will help pdfTEX to give you better paragraphs (use `\rpcode` judiciously; don't overdo it).

  Remark: old versions of pdfTEX use the character width as measure. This was changed to a proportion of the em-width after Hàn Thế Thành finished his master's thesis.

- `\lpcode` ⟨font⟩ (integer)

  This is similar to `\rpcode`, but affects the amount by which characters may protrude into the left margin. Also here the given integer value is clipped to the range −1000..1000.

- `\leftmarginkern` ⟨box number⟩ (expandable)

  The `\leftmarginkern` ⟨box number⟩ primitive expands to the width of the margin kern at the left side of the horizontal list stored in `\box` ⟨box number⟩ . The expansion string includes the unit `pt`. E. g., when the left margin kern of `\box0` amounts to −10 pt, `\leftmarginkern0` will expand to `-10pt`. A similar primitive `\rightmarginkern` exists for the right margin. The primitive has been introduced in pdfTEX 1.30.0.

  These are auxiliary primitives to make character protrusion more versatile. When using the TEX primitive `\unhbox` or `\unhcopy`, the margin kerns at either end of the unpackaged hbox will be removed (e. g. to avoid weird effects if several hboxes are unpackaged behind each other into the same horizontal list). These `\unhbox` or `\unhcopy` are often used together with `\vsplit` for dis- and re–assembling of paragraphs, e. g. to add line numbers. Paragraphs treated like this do not show character protrusion by default, as the margin kerns have been removed during the unpackaging process.

  The `\leftmarginkern` and `\rightmarginkern` primitives allow to access the margin kerns and store them away before unpackaging the hbox. E. g. the following code snipplet restores margin kerning of a horizontal list stored in `\box\testline`, resulting in a hbox with proper margin kerning (which is then done by ordinary kerns).

```
\dimen0=\leftmarginkern\testline
\dimen1=\rightmarginkern\testline
\hbox to\hsize{\kern\dimen0\unhcopy\testline\kern\dimen1}
```

- `\rightmarginkern` ⟨box number⟩ (expandable)

  The `\rightmarginkern` ⟨box number⟩ primitive expands to the width of the margin kern at the right side of the horizontal list stored in `\box` ⟨box number⟩ . See `\leftmarginkern` for more details. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdffontattr` ⟨font⟩ ⟨general text⟩

  This primitive inserts the ⟨general text⟩ to the `/Font` dictionary. The text must conform to the specifications as laid down in the pdf Reference Manual, otherwise the document can be invalid.

- `\pdffontname` ⟨font⟩ (expandable)

  In pdf files produced by pdfTeX one can recognize a font resource by the prefix `/F` followed by a number, for instance `/F12` or `/F54`. For a given TeX ⟨font⟩ , this primitive expands to the number from the corresponding font resource name. E. g., if `/F12` corresponds to some TeX font `\foo`, the `\pdffontname\foo` expands to the number `12`.

  In the current implementation, when `\pdfuniqueresname` (see below) is set to a positive value, the `\pdffontname` still returns only the number from the font resource name, but not the appended random string.

- `\pdffontobjnum` ⟨font⟩ (expandable)

  This command is similar to `\pdffontname`, but it returns the pdf object number of the font dictionary instead of the number from the font resource name. E. g., if the font dictionary (`/Type /Font`) in pdf object 3 corresponds to some TeX font `\foo`, the `\pdffontobjnum\foo` gives the number `3`.

  Use of `\pdffontname` and `\pdffontobjnum` allows users full access to all the font resources used in the document.

- `\pdffontsize` ⟨font⟩ (expandable)

  This primitive expands to the font size of the given font, with unit `pt`. E. g., when using the plain TeX macro package, the call `\pdffontsize\tenrm` expands to `10.0pt`.

- `\pdfincludechars` ⟨font⟩ ⟨general text⟩

  This command causes pdfTeX to treat the characters in ⟨general text⟩ as if they were used with ⟨font⟩, which means that the corresponding glyphs will be embedded into the font resources in the pdf output. Nothing is appended to the list being built.

- `\pdfuniqueresname` (integer)

  When this primitive is assigned a positive number, pdf resource names will be made reasonably unique by appending a random string consisting of six ascii characters.

- `\pdfmapfile` ⟨map spec⟩

  This primitive is used for managing font map files, to make them known to pdfTeX so that they can be read in. If no `\pdfmapfile` primitive is given, the default map file `pdftex.map` will be read in by pdfTeX.

  Normally there is no need for the pdfTeX user to bother about the `\pdfmapfile` primitive, as the main TeX distributions provide nice helper tools that automatically assemble the default font map file. One prominent tool example is the script `updmap` coming with teTeX.

The operation mode of the \pdfmapfile primitive is selected by a flag letter (+, =, -, or omitted). This flag defines how a map file is going to be handled, and how a collision between an existing map entry and a newer one is resolved; either ignoring a later entry, or replacing or deleting an existing entry. But in any case, map entries of fonts already in use are kept untouched. The companion primitive \pdfmapline allows something similar, only that a single map line for one font (instead of a map file name) is given as argument. Here are two examples:

```
\pdfmapfile{+myfont.map}
\pdfmapline{+ptmri8r Times-Italic <8r.enc <ptmri8a.pfb}
```

The general map handling function is that map items, which are either map file names or single font map lines (in case of the \pdfmapline primitive) are put into an auxiliary list of pending map items. During the next page shipout, this list is processed and all pending map items are sequentially scanned for their map entries, and an internal map entry database is updated, using one of the modes described below. Then the list of pending map items is cleared. All \pdfmapfile and \pdfmapline commands can also be given after shipout of the first page.

If your map file isn't in the current directory (or a standard system directory), you will need to set the TEXFONTMAPS variable (in Web2c) or give an explicit path so that it will be found.

\pdfmapfile{foo.map} (+/=/- flags omitted) clears the list of pending map items and starts a new list with the only pending file foo.map. When the file foo.map is scanned, duplicate map entries are ignored and a warning is issued. When this command is given at the beginning of a TeX run, the default map file pdftex.map will *not* be read in. This is compatible with the former behaviour.

If you want to add support for a new font through an additional font map file while keeping all the existing mappings, don't use this version of command, but instead type either \pdfmapfile{+myfont.map} or \pdfmapfile{=myfont.map}, as described below.

\pdfmapfile {+foo.map} puts the file foo.map into the list of pending map items. When the file foo.map is scanned, duplicate map entries are ignored and a warning is issued. This is compatible with the former behaviour.

\pdfmapfile {=foo.map} puts the file foo.map into the list of pending map items. When the file foo.map is scanned, matching map entries in the database are replaced by new entries from foo.map.

\pdfmapfile {-foo.map} puts the file foo.map into the list of pending map items. When the file foo.map is scanned, matching map entries are deleted from the database.

\pdfmapfile {} clears the list of pending map items. It does not affect map entries already registered into the database. This is compatible with the former behaviour. When this command is given at the beginning of a pdfTeX run, the default map file pdftex.map will *not* be read in. This may help with quick program startup, if no fonts are required.

If you want to use a base map file name other than pdftex.map, or change its processing options through a pdfTeX format, you can do this by appending the \pdfmapfile command to the \everyjob{} token list for the -ini run, e. g.:

```
\everyjob\expandafter{\the\everyjob\pdfmapfile{+myspecial.map}}
\dump
```

► \pdfmapline ⟨map spec⟩

Similar to \pdfmapfile, but here you can give a single map line (like the ones in map files) as an argument. The modifiers (+-=) have the same effect as with \pdfmapfile; see also the description above. Example:

```
\pdfmapline{+ptmri8r Times-Italic <8r.enc <ptmri8a.pfb}
```

This primitive (especially the `\pdfmapline{=...}` variant) allows quick checks of a new font map entry, before writing it into a map file.

`\pdfmapline {}` clears the list of pending map items a similar way as `\pdfmapfile{}` does. The primitive has been introduced in pdfTEX 1.20a.

► `\pdftracingfonts` (integer)

This integer parameter specifies the level of verbosity for info about expanded fonts given in the log, e. g. when `\tracingoutput=1`. If `\pdftracingfonts=0`, which is the default, the log shows the actual non-zero signed expansion value for each expanded letter within brackets, e. g.:

```
...\xivtt (+20) t
```

If `\pdftracingfonts=1`, also the name of the tfm file is listed, together with the font size, e. g.:

```
...\xivtt (cmtt10+20@14.0pt) t
```

Setting `\pdftracingfonts` to a value other than 0 or 1 is not recommended, to allow future extensions. The primitive has been introduced in pdfTEX 1.30.0.

► `\pdfmovechars` (integer)

Since pdfTEX version 1.30.0 the primitive `\pdfmovechars` is obsolete, and its use merely leads to a warning. (This primitive specified whether pdfTEX should try to move characters in range 0..31 to higher slots; its sole purpose was to remedy certain bugs of early pdf viewers.)

► `\pdfpkmode` (tokens)

The `\pdfpkmode` is a token register that sets the METAFONT mode for pixel font generation. The contents of this register is dumped into the format, so one can (optionally) preset it e. g. in `pdftexconfig.tex`. The primitive has been introduced in pdfTEX 1.30.0.

► `\pdfnoligatures` ⟨font⟩

This diables all ligatures in the loaded font ⟨font⟩ . The primitive has been introduced in pdfTEX 1.30.0.

7.4 PDF objects

► `\pdfobj` ⟨object type spec⟩

This command creates a raw pdf object that is written to the pdf file as `1 0 obj ... endobj`. The object is written to pdf output as provided by the user. When ⟨object type spec⟩ is not given, pdfTEX does not any longer create a dictionary object with contents ⟨general text⟩ , as it was in the past.

When however ⟨object type spec⟩ is given as ⟨attr spec⟩ `stream` , the object will be created as a stream with contents ⟨general text⟩ and additional attributes in ⟨attr spec⟩.

When ⟨object type spec⟩ is given as ⟨attr spec⟩ `file` , then the ⟨general text⟩ will be treated as a file name and its contents will be copied into the stream contents.

When ⟨object type spec⟩ is given as `reserveobjnum`, just a new object number is reserved. The number of the reserved object is accessible via `\pdflastobj`. The object can later be filled with contents by `\pdfobj useobjnum` ⟨number⟩ `{` ⟨balanced text⟩ `}`. But the reserved object number can already be be used before by other objects, which provides a forward–referencing mechanism.

The object is kept in memory and will be written to the pdf output only when its number is referred to by `\pdfrefobj` or when `\pdfobj` is preceded by `\immediate`. Nothing is appended to the list being built. The number of the most recently created object is accessible via `\pdflastobj`.

- `\pdflastobj` (read–only integer)

  This command returns the object number of the last object created by `\pdfobj`.

- `\pdfrefobj` ⟨object number⟩

  This command appends a whatsit node to the list being built. When the whatsit node is searched at shipout time, pdfTeX will write the object ⟨object number⟩ to the pdf output if it has not been written yet.

7.5 Page and pages objects

- `\pdfpagesattr` (tokens)

  pdfTeX expands this token list when it finishes the pdf output and adds the resulting character stream to the root `Pages` object. When defined, these are applied to all pages in the document. Some examples of attributes are `/MediaBox`, the rectangle specifying the natural size of the page, `/CropBox`, the rectangle specifying the region of the page being displayed and printed, and `/Rotate`, the number of degrees (in multiples of 90) the page should be rotated clockwise when it is displayed or printed.

```
\pdfpagesattr
  { /Rotate 90                % rotate all pages by 90 degrees
    /CropBox [0 0 612 792] }  % the crop size of all pages (in bp)
```

- `\pdfpageattr` (tokens)

  This is similar to `\pdfpagesattr`, but has priority over it. It can be used to override any attribute given by `\pdfpagesattr` for individual pages. The token list is expanded when pdfTeX ships out a page. The contents are added to the attributes of the current page.

- `\pdfpageref` ⟨page number⟩ (expandable)

  This primitive expands to the number of the page object that contains the dictionary for page ⟨page number⟩ . If the page ⟨page number⟩ does not exist, a warning will be issued, a fresh unused pdf object will be generated, and `\pdfpageref` will expand to that object number.

  E. g., if the dictionary for page 5 of the TeX document is contained in pdf object no. 18, `\pdfpageref5` expands to the number 18.

7.6 Form XObjects

The next three primitives support a pdf feature called 'object reuse' in pdfTeX. The idea is first to create a 'form XObject' in pdf. The content of this object corresponds to the content of a TeX box; it can contain pictures and references to other form XObjects as well. After creation, the form XObject can be used multiple times by simply referring to its object number. This feature can be useful for large documents with many similar elements, as it can reduce the duplication of identical objects.

These commands behave similarly to `\pdfobj`, `\pdfrefobj` and `\pdflastobj`, but instead of taking raw pdf code, they handle text typeset by TeX.

- `\pdfxform` [⟨attr spec⟩] [⟨resources spec⟩] ⟨box number⟩

  This command creates a form XObject corresponding to the contents of the box ⟨box number⟩ . The box can contain other raw objects, form XObjects, or images as well. It can however *not* contain annotations

because they are laid out on a separate layer, are positioned absolutely, and have dedicated housekeeping. `\pdfxform` makes the box void, as `\box` does.

When ⟨attr spec⟩ is given, the text will be written as additional attribute into the form XObject dictionary. The ⟨resources spec⟩ is similar, but the text will be added to the resources dictionary of the form XObject. The text given by ⟨attr spec⟩ or ⟨resources spec⟩ is written before other entries of the form dictionary and/or the resources dictionary and takes priority over later ones.

- `\pdfrefxform` ⟨object number⟩

  The form XObject is kept in memory and will be written to the pdf output only when its object number is referred to by `\pdfrefxform` or when `\pdfxform` is preceded by `\immediate`. Nothing is appended to the list being built. The number of the most recently created form XObject is accessible via `\pdflastxform`.

  When issued, `\pdfrefxform` appends a whatsit node to the list being built. When the whatsit node is searched at shipout time, pdfTeX will write the form ⟨object number⟩ to the pdf output if it is not written yet.

- `\pdflastxform` (read–only integer)

  The object number of the most recently created form XObject is accessible via `\pdflastxform`.

  As said, this feature can be used for reusing information. This mechanism also plays a role in typesetting fill–in forms. Such widgets sometimes depends on visuals that show up on user request, but are hidden otherwise.

- `\pdfxformname` ⟨object number⟩ (expandable)

  In pdf files produced by pdfTeX one can recognize a form Xobject by the prefix `/Fm` followed by a number, for instance `/Fm2`. For a given form XObject number, this primitive expands to the number in the corresponding form XObject name. E. g., if `/Fm2` corresponds to some form XObject with object number 7, the `\pdfxformname7` expands to the number 2. The primitive has been introduced in pdfTeX 1.30.0.

7.7 Graphics inclusion

pdf provides a mechanism for embedding graphic and textual objects: form XObjects. In pdfTeX this mechanism is accessed by means of `\pdfxform`, `\pdflastxform` and `\pdfrefxform`. A special kind of XObjects are bitmap graphics and for manipulating them similar commands are provided.

- `\pdfximage` [⟨rule spec⟩] [⟨attr spec⟩] [⟨page spec⟩] [⟨colorspace spec⟩] [⟨pdf box spec⟩] ⟨general text⟩

  This command creates an image object. The dimensions of the image can be controlled via ⟨rule spec⟩. The default values are zero for depth and 'running' for height and width. If all of them are given, the image will be scaled to fit the specified values. If some (but not all) are given, the rest will be set to a value corresponding to the remaining ones so as to make the image size to yield the same proportion of *width* : (*height* + *depth*) as the original image size, where depth is treated as zero. If none are given then the image will take its natural size.

  An image inserted at its natural size often has a resolution of `\pdfimageresolution` (see below) given in dots per inch in the output file, but some images may contain data specifying the image resolution, and in such a case the image will be scaled to the correct resolution. The dimensions of an image can be accessed by enclosing the `\pdfrefximage` command to a box and checking the dimensions of the box:

  ```
  \setbox0=\hbox{\pdfximage{somefile.png}\pdfrefximage\pdflastximage}
  ```

  Now we can use `\wd0` and `\ht0` to question the natural size of the image as determined by pdfTeX. When dimensions are specified before the `{somefile.png}`, the graphic is scaled to fit these. Note that, unlike the e. g. `\input` primitive, the filename is supplied between braces.

The image type is specified by the extension of the given file name: `.png` stands for png image, `.jpg` for jpeg, and `.pdf` for pdf file. But once pdfTEX has opened the file, it checks the file type first by looking to the magic number at the file start, which gets precedence over the file name extension. This gives a certain degree of fault tolerance, if the file name extension is stated wrongly.

Similarly to `\pdfxform`, the optional text given by ⟨attr spec⟩ will be written as additional attributes of the image before other keys of the image dictionary. One should be aware, that slightly different type of PDF object is created while including png or jpeg bitmaps and pdf images.

While working with pdf image, ⟨page spec⟩ allows to decide which page of the document is to be included. Starting from pdfTEX 1.11 one may also decide which pdf page box of the image is to be treated as a final bounding box. If ⟨pdf box spec⟩ is present, overrides default behaviour specified by `\pdfforcepagebox` parameter. Both options are irrelevant for non–pdf inclusions.

Starting from pdfTEX 1.21, `\pdfximage` command supports `colorspace` keyword followed by an object number (user–defined colorspace for the image being included). This feature works for jpeg images only. pngs are rgb palettes and pdf images have always self–contained color space information.

- `\pdfrefximage` ⟨integer⟩

  The image is kept in memory and will be written to the pdf output only when its number is referred to by `\pdfrefximage` or `\pdfximage` is preceded by `\immediate`. Nothing is appended to the list being built.

  `\pdfrefximage` appends a whatsit node to the list being built. When the whatsit node is searched at shipout time, pdfTEX will write the image with number ⟨integer⟩ to the pdf output if it has not been written yet.

- `\pdflastximage` (read–only integer)

  The number of the most recently created XObject image is accessible via `\pdflastximage`.

- `\pdflastximagepages` (read–only integer)

  This read–only register returns the highest page number from a file previously accessed via the `\pdfximage` command. This is useful only for pdf files; it always returns 1 for png or jpeg files.

- `\pdfimageresolution` (integer)

  The integer `\pdfimageresolution` parameter (unit: dots per inch, dpi) is a last resort value, used only for bitmap (jpeg, png) images, but not for pdfs. The priorities are as follows: Often one image dimension (`width` or `height`) is stated explicitely in the TEX file. Then the image is properly scaled so that the aspect ratio is kept. If both image dimensions are given, the image will be stretched accordingly, whereby the aspect ratio might get distorted. Only if no image dimension is given in the TEX file, the image size will be calculated from its width and height in pixels, using the x and y resolution values normally contained in the image file. If one of these resolution values is missing or weird (either < 0 or > 65535), the `\pdfimageresolution` value will be used for both x and y resolution, when calculating the image size. And if the `\pdfimageresolution` is zero, finally a default resolution of 72 dpi would be taken. The `\pdfimageresolution` is read when pdfTEX creates an image via `\pdfximage`. The given value is clipped to the range 0..65535 [dpi].

  Currently this parameter is used particularily for calculating the dimensions of jpeg images in exif format (unless at least one dimension is stated explicitely); the resolution values coming with exif files are currently ignored.

- `\pdfforcepagebox` (integer)

  When pdf files are included, the command `\pdfximage` allows the selection of which pdf page box to use in the optional field ⟨image attr spec⟩. The integer primitive `\pdfforcepagebox` allows to globally override this choice by giving them one of the following values: (1) media box, (2) crop box, (3) bleed box, (4) trim box,

and (5) artbox. The command is available starting from pdfTeX 1.30.0, as a shortened synonym of obsolete `\pdfoptionalwaysusepdfpagebox` instruction.

- `\pdfinclusionerrorlevel` (integer)

  This controls the behaviour of pdfTeX when a pdf file is included that has a newer version than the one specified by this primitive: If it is set to 0, pdfTeX gives only a warning; if it's 1, pdfTeX raises an error. The command has been introduced in pdfTeX 1.30.0 as a shortened synonym of `\pdfoptionpdfinclusionerrorlevel`, that is now obsolete.

- `\pdfimagehicolor` (integer)

  This primitive, when set to 1, enables embedding of png images with 16 bit wide color channels at their full color resolution. As such an embedding mode is defined only from pdf version 1.5 onwards, the `\pdfimagehicolor` functionality is automatically disabled in pdfTeX if `\pdfminorversion` < 5; then each 16 bit color channel is reduced to a width of 8 bit by stripping the lower 8 bits before embedding. The same stripping happens when `\pdfimagehicolor` is set to 0. For `\pdfminorversion` ≥ 5 the default value of `\pdfimagehicolor` is 1. If specified, the parameter must appear before any data is written to the pdf output. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfimageapplygamma` (integer)

  This primitive, when set to 1, enables gamma correction while embedding png images, taking the values of the primitives `\pdfgamma` as well as the gamma value embedded in the png image into account. When `\pdfimageapplygamma` is set to 0, no gamma correction is performed. If specified, the parameter must appear before any data is written to the pdf output. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfgamma` (integer)

  This primitive defines the 'device gamma' for pdfTeX. Values are in promilles (same as for `\mag`). The default value of this primitive is 1000, defining a device gamma value of 1.0.

  When `\pdfimageapplygamma` is set to 1, then whenever a png image is included, pdfTeX applies a gamma correction. This correction is based on the value of the `\pdfgamma` primitive and the 'assumed device gamma' that is derived from the value embedded in the actual image. If no embedded value can be found in the png image, then the value of `\pdfimagegamma` is used instead. If specified, the parameter must appear before any data is written to the pdf output. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfimagegamma` (integer)

  This primitive gives a default 'assumed gamma' value for png images. Values are in promilles (same as for `\pdfamma`). The default value of this primitive is 2200, implying an assumed gamma value of 2.2.

  When pdfTeX is applying gamma corrections, images that do not have an embedded 'assumed gamma' value are assumed to have been created for a device with a gamma of 2.2. Experiments show that this default setting is correct for a large number of images; however, if your images come out too dark, you probably want to set `\pdfimagegamma` to a lower value, like 1000. If specified, the parameter must appear before any data is written to the pdf output. The primitive has been introduced in pdfTeX 1.30.0.

7.8 Annotations

pdf 1.4 provides four basic kinds of annotations:

- hyperlinks, general navigation
- text clips (notes)

- movies
- sound fragments

The first type differs from the other three in that there is a designated area involved on which one can click, or when moved over some action occurs. pdfTeX is able to calculate this area, as we will see later. All annotations can be supported using the next two general annotation primitives.

► `\pdfannot` ⟨annot type spec⟩

This command appends a whatsit node corresponding to an annotation to the list being built. The dimensions of the annotation can be controlled via the ⟨rule spec⟩ . The default values are running for all width, height and depth. When an annotation is written out, running dimensions will take the corresponding values from the box containing the whatsit node representing the annotation. The ⟨general text⟩ is inserted as raw pdf code to the contents of annotation. The annotation is written out only if the corresponding whatsit node is searched at shipout time.

► `\pdflastannot` (read–only integer)

This primitive returns the object number of the last annotation created by `\pdfannot`. These two primitives allow users to create any annotation that cannot be created by `\pdfstartlink` (see below).

7.9 Destinations and links

The first type of annotation, mentioned above, is implemented by three primitives. The first one is used to define a specific location as being referred to. This location is tied to the page, not the exact location on the page. The main reason for this is that pdf maintains a dedicated list of these annotations —and some more when optimized— for the sole purpose of speed.

► `\pdfdest` ⟨dest spec⟩

This primitive appends a whatsit node which establishes a destination for links and bookmark outlines; the link is identified by either a number or a symbolic name, and the way the viewer is to display the page must be specified in ⟨dest type⟩, which must be one of those mentioned in table 5.

keyword	meaning
`fit`	fit the page in the window
`fith`	fit the width of the page
`fitv`	fit the height of the page
`fitb`	fit the 'Bounding Box' of the page
`fitbh`	fit the width of 'Bounding Box' of the page
`fitbv`	fit the height of 'Bounding Box' of the page
`xyz`	goto the current position (see below)

Table 5 Options for display of outline and destinations.

The specification `xyz` can optionally be followed by `zoom` ⟨integer⟩ to provide a fixed zoom–in. The ⟨integer⟩ is processed like TeX magnification, i. e. 1000 is the normal page view. When `zoom` ⟨integer⟩ is given, the zoom factor changes to 0.001 of the ⟨integer⟩ value, otherwise the current zoom factor is kept unchanged.

The destination is written out only if the corresponding whatsit node is searched at shipout time.

- `\pdfstartlink` [⟨rule spec⟩] [⟨attr spec⟩] ⟨action spec⟩

  This primitive is used along with `\pdfendlink` and appends a whatsit node corresponding to the start of a hyperlink. The whatsit node representing the end of the hyperlink is created by `\pdfendlink`. The dimensions of the link are handled in the similar way as in `\pdfannot`. Both `\pdfstartlink` and `\pdfendlink` must be in the same level of box nesting. A hyperlink with running width can be multi–line or even multi–page, in which case all horizontal boxes with the same nesting level as the boxes containing `\pdfstartlink` and `\pdfendlink` will be treated as part of the hyperlink. The hyperlink is written out only if the corresponding whatsit node is searched at shipout time.

  Additional attributes, which are explained in great detail in the pdf Reference Manual, can be given via ⟨attr spec⟩. Typically, the attributes specify the color and thickness of any border around the link. Thus `/C [0.9 0 0] /Border [0 0 2]` specifies a color (in rgb) of dark red, and a border thickness of 2 points.

  While all graphics and text in a pdf document have relative positions, annotations have internally hard–coded absolute positions. Again this is for the sake of speed optimization. The main disadvantage is that these annotations do *not* obey transformations issued by `\pdfliteral`'s.

  The ⟨action spec⟩ specifies the action that should be performed when the hyperlink is activated while the ⟨user-action spec⟩ performs a user–defined action. A typical use of the latter is to specify a url, like `/S /URI /URI (http://www.tug.org/)`, or a named action like `/S /Named /N /NextPage`.

  A ⟨goto-action spec⟩ performs a GoTo action. Here ⟨numid⟩ and ⟨nameid⟩ specify the destination identifier (see below). The ⟨page spec⟩ specifies the page number of the destination, in this case the zoom factor is given by ⟨general text⟩. A destination can be performed in another pdf file by specifying ⟨file spec⟩, in which case ⟨newwindow spec⟩ specifies whether the file should be opened in a new window. A ⟨file spec⟩ can be either a `(string)` or a `dictionary`. The default behaviour of the ⟨newwindow spec⟩ depends on the browser setting.

  A ⟨thread-action spec⟩ performs an article thread reading. The thread identifier is similar to the destination identifier. A thread can be performed in another pdf file by specifying a ⟨file spec⟩.

- `\pdfendlink`

  This primitive ends a link started with `\pdfstartlink`. All text between `\pdfstartlink` and `\pdfendlink` will be treated as part of this link. pdfTEX may break the result across lines (or pages), in which case it will make several links with the same content.

- `\pdflinkmargin` (dimension)

  This dimension parameter specifies the margin of the box representing a hyperlink and is read when a page containing hyperlinks is shipped out.

- `\pdfdestmargin` (dimension)

  Margin added to the dimensions of the rectangle around the destinations.

7.10 Bookmarks

- `\pdfoutline` [⟨attr spec⟩] ⟨action spec⟩ [`count` ⟨integer⟩] ⟨general text⟩

  This primitive creates an outline (or bookmark) entry. The first parameter specifies the action to be taken, and is the same as that allowed for `\pdfstartlink`. The ⟨count⟩ specifies the number of direct subentries under this entry; specify 0 or omit it if this entry has no subentries. If the number is negative, then all subentries will be closed and the absolute value of this number specifies the number of subentries. The ⟨text⟩ is what

will be shown in the outline window. Note that this is limited to characters in the pdf Document Encoding vector. The outline is written to the pdf output immediately.

7.11 Article threads

- `\pdfthread` [⟨rule spec⟩] [⟨attr spec⟩] ⟨id spec⟩

  Defines a bead within an article thread. Thread beads with same identifiers (spread across the document) will be joined together.

- `\pdftstarthread` [⟨rule spec⟩] [⟨attr spec⟩] ⟨id spec⟩

  This uses the same syntax as `\pdfthread`, apart that it must be followed by a `\pdfendthread`. `\pdfstartthread` and the corresponding `\pdfendthread` must end up in vboxes with the same nesting level; all vboxes between them will be added into the thread. Note that during output runtime if there are other newly created boxes which have the same nesting level as the vbox/vboxes containing `\pdfstartthread` and `\pdfendthread`, they will be also added into the thread, which is probably not what you want. To avoid such unconsidered behaviour, it's often enough to wrap boxes that shouldn't belong to the thread by a box to change their box nesting level.

- `\pdfendthread`

  This ends an article thread started before by `\pdfstartthread`.

- `\pdfthreadmargin` (dimension)

  Specifies a margin to be added to the dimensions of a bead within an article thread.

7.12 Literals and specials

- `\pdfliteral` [`direct`] ⟨general text⟩

  Like `\special` in normal TeX, this command inserts raw pdf code into the output. This allows support of color and text transformation. This primitive is heavily used in the METAPOST inclusion macros. Normally pdfTeX ends a text section in the pdf output and resets the transformation matrix before inserting ⟨general text⟩, however this can be turned off by giving the optional keyword `direct` . This command appends a whatsit node to the list being built. ⟨general text⟩ is expanded when the whatsit node is created and not when it is shipped out, as with `\special`.

- `\special {pdf:` ⟨text⟩ `}`

  This is equivalent to `\pdfliteral {` ⟨text⟩ `}`.

- `\special {pdf:direct:` ⟨text⟩ `}`

  This is equivalent to `\pdfliteral direct {` ⟨text⟩ `}`.

7.13 Strings

- `\pdfescapestring` ⟨general text⟩

  Starting from version 1.30.0, pdfTeX provides a mechanism for converting a general text into pdf string. Many characters that may be needed inside such a text (especially parenthesis), have a special meaning inside a pdf string object and thus, can't be used literally. The primitive replaces each special pdf character by its literal representation by inserting a backslash before that character. Some characters (e. g.space) are

also converted into 3–digit octal number. In example, `\pdfescapestring{Text (1)}` will be expanded to `Text\040\(1\)`. This ensures a literal interpretation of the text by the pdf viewer. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfescapename` ⟨general text⟩

  In analogy to `\pdfescapestring`, `\pdfescapename` replaces each special pdf character inside the general text by its hexadecimal representation preceded by `#` character. This ensures the proper interpretation of the text if used as a pdf name object. In example, `Text (1)` will be replaced by `Text#20#281#29`. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfescapehex` ⟨general text⟩

  This command converts each character of ⟨general text⟩ into its hexadecimal representation. Each character of the argument becomes a pair of hexadecimal digits. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfunescapehex` ⟨general text⟩

  This command treats each character pair of ⟨general text⟩ as a hexadecimal number and returns an ascii character of this code. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfmdfivesum` ⟨general text⟩ (expandable)

  This command expands to the md5 of ⟨general text⟩ in uppercase hexadecimal format (same as `\pdfescapehex`). The primitive has been introduced in pdfTeX 1.30.0.

7.14 Timekeeping

- `\pdfelapsedtime` (read–only integer)

  The command expands to a number that represents the time elapsed from the moment of run start. The elapsed time is returned in 'scaled seconds', that means seconds divided by 65536, e. g. pdfTeX has run for 959623 'scaled seconds' when this paragraph was typeset. Obviously, the command will never return a value greater than the highest number available in TeX: if the time exceeds 32767 seconds, the constant value $2^{31} - 1$ will be returned. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfresettimer`

  The command resets the internal timer so that `\pdfelapsedtime` starts returning micro–time from 0 again. The primitive has been introduced in pdfTeX 1.30.0.

7.15 Random numbers

- `\pdfuniformdeviate` ⟨number⟩ (expandable)

  The commands generates a uniformly distributed random integer value between 0 (inclusive) and ⟨number⟩ (exclusive). This primitive expands to a list of tokens. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfnormaldeviate` (expandable)

  The commands generates a random integer value with a mean of 0 and a unit of 65 536, e. g. −16980. This primitive expands to a list of tokens. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfrandomseed` (read–only integer)

  You can use `\the\pdfrandomseed` to query the current seed value, so you can e. g. write the value to the log file. The initial value of the seed is derived from the system time, and is not more than 1 000 999 999

(this ensures that the value can be used with commands like `\count`). The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfsetrandomseed` ⟨number⟩

  This sets the random seed (`\pdfrandomseed`) to a specific value, allowing you to re-play sequences of semi-randoms at a later moment. The primitive has been introduced in pdfTeX 1.30.0.

7.16 Files

- `\pdffilemoddate` ⟨general text⟩ (expandable)

  Expands to the modification date of file ⟨general text⟩ in the same format as for `\pdfcreationdate`, e. g. it's `D:20051017182846+02'00'` for the source of this manual. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdffilesize` ⟨general text⟩ (expandable)

  Expands to the size of file ⟨general text⟩ , e. g. it's `191595` for the source of this manual. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdfmdfivesum` file ⟨general text⟩ (expandable)

  Expands to the md5 of file ⟨general text⟩ in uppercase hexadecimal format (same as `\pdfescapehex`), e. g. it's `39B9FA736576354E8A054344626D2C9B` for the source of this manual. The primitive has been introduced in pdfTeX 1.30.0.

- `\pdffiledump` [offset ⟨number⟩] [length ⟨number⟩] ⟨general text⟩ (expandable)

  Expands to the dump of the file ⟨general text⟩ in uppercase hexadecimal format (same as `\pdfescapehex`), starting at offset ⟨number⟩ or 0 with length ⟨number⟩ , if given. The first ten bytes of the source of this manual are `2520696E746572666163`. The primitive has been introduced in pdfTeX 1.30.0.

7.17 Miscellaneous

- `\vadjust` [⟨pre spec⟩] ⟨filler⟩ `{` ⟨vertical mode material⟩ `}`

  The `\vadjust` implementation of pdfTeX adds an optional qualifier ⟨pre spec⟩ (which is the string `pre`) to the original TeX primitive with the same name. As long as there is no `pre` given, `\vadjust` behaves exactly as the original (see the TeXbook, p. 281); it appends an adjustment item created from ⟨vertical mode material⟩ to the current list *after* the line in which `\vadjust` appears. However with the qualifier `pre`, the adjustment item is put *before* the line in which `\vadjust pre` appears.

- `\pdfsavepos`

  This primitive marks the current absolute (x, y) position on the media, with the reference point in the lower left corner. It is active only during page shipout, when the page is finally assembled. The position coordinates can then be retrieved by the `\pdflastxpos` and `\pdflastypos` primitives, and e. g. written out to some auxiliary file. The coordinates can be used only after the current `\shipout` has been finalized, therefore normally two pdfTeX runs are required to utilize these primitives.

- `\pdflastxpos` (read–only integer)

  This primitive returns an integer number representing the absolute x coordinate of the last point marked by `\pdfsavepos`. The unit is 'scaled points' (sp).

- `\pdflastypos` (read–only integer)

  This primitive works similar to `\pdflastxpos`, only it returns the y coordinate.

- `\pdftexversion` (read–only integer)

  Returns the version of pdfTEX multiplied by 100, e. g. for pdfTEX version 1.30.4 used to produce this document, it returns `130`.

- `\pdftexrevision` (expandable)

  Returns the revision letter of pdfTEX, e. g. for pdfTEX version 1.30.4 used to produce this document, it returns the letter `4`.

- `\pdftexbanner` (expandable)

  Returns the pdfTEX banner message, e. g. for the version used here: `This is pdfeTeX, Version 3.141592-1.30.4-2.2 (Web2C 7.5.5) kpathsea version 3.5.5`. The primitive has been introduced in pdfTEX 1.20a.

- `\pdfcreationdate` (expandable)

  Expands to the date string pdfTEX uses in the info dictionary of the document, e. g. for this file `D:20051017183841+02'00'`. The primitive has been introduced in pdfTEX 1.30.0.

- `\pdfshellescape` (read–only integer)

  This primitive is 1 if `\write18` is enabled, 0 otherwise. `\write18` was not enabled when this manual was typeset. The primitive has been introduced in pdfTEX 1.30.0.

8 Graphics and color

pdfTEX supports inclusion of pictures in png, jpeg, and pdf format; a few differences between these are discussed below. The most common technique with TEX —the inclusion of eps figures— is replaced by pdf inclusion. eps files can be converted to pdf by Ghostscript, Adobe Distiller or other PostScript–to–pdf converters.

The pdf format is currently the most versatile source format for graphics embedding. pdfTEX allows to insert arbitrary pages from pdf files with their own fonts, graphics, and pixel images into a document. The cover page of this manual is an example of such an insert, being a one page document generated by pdfTEX.

By default pdfTEX takes the BoundingBox of a pdf file from its CropBox if available, otherwise from its MediaBox. This can be influenced by the ⟨pdf box spec⟩ option to the `\pdfximage` primitive, or by setting the `\pdfforcepagebox` primitive to a value corresponding to the wanted box type.

To get the right BoundingBox from a eps file, before converting to pdf, it is necessary to transform the eps file so that the start point is at the (0,0) coordinate and the page size is set exactly corresponding to the BoundingBox. A Perl script (epstopdf) for this purpose has been written. The TEXutil utility script and the PStoPDF program that comes with Ghostscript can so a similar job. (Concerning this conversion, they can handle complete directories, remove some garbage from files, takes precautions against duplicate conversion, etc.)

The lossless compressing png format is great for embedding crisp pixel graphics (e. g. line scans, screen shots). Since pdfTEX 1.30.0 also the alpha-channel of png images is processed if available; this allows embedding of images with simple transparency. The png format does not support the CMYK color model, which is sometimes required for print media (this often can be replaced by four component jpeg in high quality or

lossless compression mode). Photos in png format have a rather weak compression; here the jpeg format is preferable.

Embedding png images in the general case requires pdfTeX to uncompress the pixel array and to re–compress it to the pdf requirements; this process often takes a noticeable amount of time. Since pdfTeX 1.30.0 there is now a fast png embedding mode that goes without uncompressing; the image data are directly copied into the pdf stream, resulting in a much higher embedding speed. However this mode is only activated, if the image array structure of the png file is compatible with the pdf image structure (e. g. an interlaced png image requires uncompressing to re–arrange the image lines). Luckily it seems that the most common png files also allow fast copying. The use of gamma correction disables fast copying, as it requires calculations with individual pixels. Whether the fast copy mode is used for a png image can be seen from the log file, which then shows the string '(PNG copy)' after the png file name.

The jpeg format is normally used in lossy mode; then it's ideal for embedding photos; it's not recommended for crisp images from synthetic sources with a limited amount of colors.

Other options for graphics in pdfTeX are:

LaTeX **picture mode** Since this is implemented simply in terms of font characters, it works in exactly the same way as usual.

Xy–pic If the PostScript back–end is not requested, Xy–pic uses its own Type 1 fonts, and needs no special attention.

tpic The 'tpic' `\special` commands (used in some macro packages) can be redefined to produce literal pdf, using some macros written by Hans Hagen.

METAPOST Although the output of METAPOST is PostScript, it is in a highly simplified form, and a METAPOST to pdf conversion (mptopdf, written by Hans Hagen and Tanmoy Bhattacharya) is implemented as a set of macros which reads METAPOST output and supports all of its features.

For new work, the METAPOST route is highly recommended. For the future, Adobe has announced that they will define a specification for 'encapsulated pdf'.

The inclusion of raw PostScript commands —a technique utilized by for instance the `pstricks` package— cannot directly be supported. Although pdf is direct a descendant of PostScript, it lacks any programming language commands, and cannot deal with arbitrary PostScript.

9 Character translation

Characters that are input to pdfTeX are subject to optional TeX character translation (tcx) under control of a tcx file. The tcx maps the input character codes (e. g. from `\input` or `\read`) to the character codes as seen by pdfTeX. This mapping takes place before the characters enter pdfTeX's 'mouth'. If no tcx file is read, the input characters enter pdfTeX directly; no mapping is done.

tcx files consist of lines each containing one or two integer numbers in the range 0..255, either in decimal or hex notation. A comment sign % in a tcx line starts a comment until the end of line. The first number in each line is for matching the input character code, the second, optional number is the corresponding TeX character code. If a line contains only one number, characters with this code enter pdfTeX unchanged; no mapping is done.

tcx mapping also influences pdfTeX output streams for `\message` and `\write`. Without tcx mapping, only characters that are within the range 32..126 are flagged as 'printable', meaning that these characters are output directly by `\message` and `\write` primitives. Characters outside the range 32..126 are instead output

in escaped form, e. g. as `^^A` for a character with code `0x01`. When a character code is mentioned in the 2nd column of the tcx file, or as the only value in a line, it is flagged as 'printable'. During `\message` and `\write`, output characters are mapped in reverse direction: they are looked up in the 2nd column of the tcx file and the corresponding values from the 1st column are output. Again, if a pdfTeX character code is found as the only number in a line, no mapping is done. Mentioning a character code as the only number on a line has the sole purpose to flag this code 'printable'; remember that character within the range 32..126 are 'printable' anyway.

The characters output into the pdf file, e. g. by `\pdfliteral` or `\special` primitives, are not subject to tcx output remapping.

Beware: Character translation interferes with the encTeX primitives; to avoid surprises, don't use encTeX and tcx mapping at the same time. Further details about tcx file loading can be found in the teTeX manual.

10 Limitations of PDFTeX

pdfTeX currently lacks a colorstack. This can be overcome by the `pdfcolmk` package.

Abbreviations

In this document we used a few abbreviations. For convenience we mention their meaning here.

afm	Adobe Font Metrics
ascii	American Standard Code for Information Interchange
CMacTeX	Macintosh Web2c distribution
ConTeXt	general purpose macro package
dvi	native TeX Device Independent file format
encTeX	encTeX extension to TeX
eps	Encapsulated PostScript
epstopdf	eps to pdf conversion tool
ε-TeX	an extension to TeX
exif	Exchangeable Image File format (JPEG file variant)
fpTeX	Win32 Web2c distribution
Ghostscript	ps and pdf language interpreter
hz	Hermann Zapf optimization
jpeg	Joint Photographic Expert Group
LaTeX	general purpose macro package
Mac OS X	Macintosh operating system version 10
md5	MD5 message-digest algorithm
METAFONT	graphic programming environment, bitmap output
METAPOST	graphic programming environment, vector output
MikTeX	Win32 distribution
MLTeX	MLTeX extension to TeX
mptopdf	METAPOST to pdf conversion tool
MSDos	Microsoft DOS platform (Intel)
pdf	Portable Document Format
pdfeTeX	ε-TeX extension producing pdf output
pdfLaTeX	TeX extension producing pdf output (LaTeX format loaded)
pdfTeX	TeX extension producing pdf output

Perl	Perl programming environment
pgc	pdf Glyph Container
pk	Packed bitmap font
png	Portable Network Graphics
PostScript	PostScript
PStoPDF	PostScript to pdf converter (on top of GhostScript)
rgb	Red Green Blue color specification
tcx	TeX Character Translation
tds	TeX Directory Standard
teTeX	TeX distribution for Unix (based on Web2c)
TeX	typographic language and program
TeXexec	ConTeXt command line interface
Texinfo	generate typeset documentation from info pages
TeX Live	TeX-Live distribution (multiple platform)
TeXutil	ConTeXt utility tool
tfm	TeX Font Metrics
Unix	Unix platform
url	Uniform Resource Locator
web	literate programming environment
Web2c	official multi–platform web environment
Win32	Microsoft Windows platform

Examples of HZ and protruding

In the following sections we will demonstrate pdfTeX's protruding and hz features, using a text from E. Tufte. This sample text has a lot of punctuation and often needs hyphenation. Former pdfTeX versions had sometimes problems with combining these features, but from version 1.21a on it should be ok. If you still encounter problems, please try to prepare a small test file that demonstrates the problem and send it to one of the maintainers.

Normal

We thrive in information–thick worlds because of our marvelous and everyday capacity to select, edit, single out, structure, highlight, group, pair, merge, harmonize, synthesize, focus, organize, condense, reduce, boil down, choose, categorize, catalog, classify, list, abstract, scan, look into, idealize, isolate, discriminate, distinguish, screen, pigeonhole, pick over, sort, integrate, blend, inspect, filter, lump, skip, smooth, chunk, average, approximate, cluster, aggregate, outline, summarize, itemize, review, dip into, flip through, browse, glance into, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff and separate the sheep from the goats.

We thrive in information–thick worlds because of our marvelous and everyday capacity to select, edit, single out, structure, highlight, group, pair, merge, harmonize, synthesize, focus, organize, condense, reduce, boil down, choose, categorize, catalog, classify, list, abstract, scan, look into, idealize, isolate, discriminate, distinguish, screen, pigeonhole, pick over, sort, integrate, blend, inspect, filter, lump, skip, smooth, chunk, average, approximate, cluster, aggregate, outline, summarize, itemize, review, dip into, flip through, browse, glance into, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff and separate the sheep from the goats.

HZ

We thrive in information–thick worlds because of our marvelous and everyday capacity to select, edit, single out, structure, highlight, group, pair, merge, harmonize, synthesize, focus, organize, condense, reduce, boil down, choose, categorize, catalog, classify, list, abstract, scan, look into, idealize, isolate, discriminate, distinguish, screen, pigeonhole, pick over, sort, integrate, blend, inspect, filter, lump, skip, smooth, chunk, average, approximate, cluster, aggregate, outline, summarize, itemize, review, dip into, flip through, browse, glance into, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff and separate the sheep from the goats.

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Protruding

We thrive in information–thick worlds because of our marvelous and everyday capacity to select, edit, single out, structure, highlight, group, pair, merge, harmonize, synthesize, focus, organize, condense, reduce, boil down, choose, categorize, catalog, classify, list, abstract, scan, look into, idealize, isolate, discriminate, distinguish, screen, pigeonhole, pick over, sort, integrate, blend, inspect, filter, lump, skip, smooth, chunk, average, approximate, cluster, aggregate, outline, summarize, itemize, review, dip into, flip through, browse, glance into, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff and separate the sheep from the goats.

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Both

We thrive in information–thick worlds because of our marvelous and everyday capacity to select, edit, single out, structure, highlight, group, pair, merge, harmonize, synthesize, focus, organize, condense, reduce, boil down, choose, categorize, catalog, classify, list, abstract, scan, look into, idealize, isolate, discriminate, distinguish, screen, pigeonhole, pick over, sort, integrate, blend, inspect, filter, lump, skip, smooth, chunk, average, approximate, cluster, aggregate, outline, summarize, itemize, review, dip into, flip through, browse, glance into, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff and separate the sheep from the goats.

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into, flip through, browse, glance into, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff and separate the sheep from the goats.

Additional PDF keys

This section is based on the manual on keys written by Martin Schröder, one of the maintainers of pdfTEX.

A pdf document should contain only the structures and attributes defined in the pdf specification. However, the specification allows applications to insert additional keys, provided they follow certain rules.

The most important rule is that developers have to register with Adobe prefixes for the keys they want to insert. Hans Hagen has registered the prefix `PTEX` for pdfTEX.

pdfTEX generates an XObject for every included pdf. The dictionary of this object contains these additional keys:

`key`	**type**	meaning
`PTEX.FileName`	string	The name of the included file as seen by pdfTEX.
`PTEX.InfoDict`	dictionary	The document information dictionary of the included pdf (an indirect object).
`PTEX.PageNumber`	integer	The page number of the included file.

The pdf reference manual says: "Although viewer applications can store custom metadata in the document information dictionary, it is inappropriate to store private content or structural information there; such information should be stored in the document catalog instead."

Although it would seem more natural to put this infomation in the document information dictionary, we have to obey the rules laid down in the pdf reference. The following key ends up in the document catalog.

`key`	**type**	meaning
`PTEX.Fullbanner`	string	The full version of the binary that produced the file as displayed by `pdftex --version`, e. g. `This is pdfeTeX, Version 3.141592-1.30.4-2.2 (Web2C 7.5.5) kpathsea version 3.5.5`. This is necessary because the string in the `Producer` key in the info dictionary is rather short, e. g. `pdfeTeX-1.30.4`.

Colophon

This manual is typeset in ConTEXt. One can generate an A4 version from the source code by typing:

```
texexec --result=pdftex-a.pdf pdftex-t
```

Or in letter size:

```
texexec  --mode=letter --result=pdftex-l.pdf pdftex-t
```

Given that the A4 version is typeset, one can generate an A5 booklet by typing:

```
texexec --pdfarrange --paper=a5a4 --print=up --addempty=1,2
  --result=pdftex-b.pdf pdftex-a
```

Odd and even page sets for non-duplex printers can be generated using `--pages=odd` and `--pages=even` options (which might require some disciplined shuffling of sheet).

This also demonstrates that pdfTEX can be used for page imposition purposes (given that pdfTEX and the fonts are set up properly).

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