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IEEE P1003.2 Draft 11.2 – September 1991 namespace are cooperating on the use of files after they have been created.

4.48 pax — Portable archive interchange

4.48.1 Synopsis

`pax [−cdnv][−f` *archive* `][−s` *replstr* `]...[`*pattern* `...]` 1

`pax −r[−cdiknuv][−f` *archive* `][−o` *options* `]...[−p` *string* `]...[−s` *replstr* `]` 1
`...[`*pattern* `...]` 1

`pax −w[−dituvX][−b` *blocksize* `][[−a][−f` *archive* `]][−o` *options* `]...` 1
`[−s` *replstr* `]...[−x` *format* `][`*file* `...]`

`pax −r −w[−diklntuvX][−p` *string* `]...[−s` *replstr* `]...[`*file* `...]` *directory*

4.48.2 Description

The `pax` utility shall read, write, and write lists of the members of archive files and copy directory hierarchies. A variety of archive formats shall be supported; see the `−x` *format* option description under 4.48.3.

The action to be taken depends on the presence of the `−r` and `−w` options:

(1) When neither the `−r` option nor the `−w` option is specified, `pax` shall write the names of the members of the archive file read from the standard input, with pathnames matching the specified patterns, to standard output. If a named file is of type directory, the file hierarchy rooted at that file shall be written out as well.

(2) When the `−r` option is specified, but the `−w` option is not, `pax` shall extract the members of the archive file read from the standard input, with pathnames matching the specified patterns. If an extracted file is of type directory, the file hierarchy rooted at that file shall be extracted as well. The extracted files shall be created relative to the current file hierarchy.

The ownership, access and modification times, and file mode of the 1
restored files are discussed under the `−p` option. 1

(3) When the `−w` option is specified and the `−r` option is not, `pax` shall write the contents of the file operands to the standard output in an archive format. If no *file* operands are specified, a list of files to copy, one per line, shall be read from the standard input. A file of type directory shall include all of the files in the file hierarchy rooted at the file.

(4) When both the `−r` and `−w` options are specified, `pax` shall copy the file operands to the destination directory.

If no *file* operands are specified, a list of files to copy, one per line, shall be read from the standard input. A file of type directory shall include all of the files in the file hierarchy rooted at the file.

The effect of the copy shall be as if the copied files were written to an archive file and then subsequently extracted, except that there may be hard links between the original and the copied files. If the destination directory is a subdirectory of one of the files to be copied, the results are unspecified. If the destination directory is a file of a type not defined by POSIX.1 {8}, the results are implementation defined; otherwise it shall be an error for the file named by the directory operand not to exist, not be writable by the user, or not be a file of type directory.

If, when the `-r` option is specified, intermediate directories are necessary to extract an archive member, `pax` shall perform actions equivalent to the POSIX.1 {8}*mkdir*() function, called with the following arguments:

— The intermediate directory used as the *path* argument.

— The value of the bitwise inclusive OR of S_IRWXU, S_IRWXG, and S_IRWXO as the *mode* argument.

If any specified *pattern* or *file* operands are not matched by at least one file or archive member, `pax` shall write a diagnostic message to standard error for each one that did not match and exit with a nonzero exit status.

The supported archive formats shall be automatically detected on input. The default output archive format shall be implementation defined.

A single archive can span multiple files. The `pax` utility shall determine, in an implementation-defined manner, what file to read or write as the next file.

If the selected archive format supports the specification of linked files, it shall be
an error if these files cannot be linked when the archive is extracted. Any of the 1
various names in the archive that represent a file can be used to select the file for 1
extraction. 1

4.48.3 Options

The `pax` utility shall conform to the utility argument syntax guidelines described in 2.10.2, except that the order of presentation of the `-s` options is significant.

The following options shall be supported by the implementation:

`-r` Read an archive file from standard input.

`-w` Write files to the standard output in the specified archive format.

`-a` Append files to the end of the archive. It is implementation 1
defined which devices on the system support appending. Addi- 1
tional file formats unspecified by this standard may impose res- 1
trictions on appending. 1

`-b` *blocksize*
: Block the output at a positive decimal integer number of bytes per write to the archive file. Devices and archive formats may impose restrictions on blocking. Blocking shall be automatically determined on input. Conforming POSIX.2 applications shall not specify a *blocksize* value larger than 32 256. Default blocking when creating archives depends on the archive format. (See the `-x` option below.)

`-c`
: Match all file or archive members except those specified by the *pattern* or *file* operands.

`-d`
: Cause files of type directory being copied or archived or archive members of type directory being extracted to match only the file or archive member itself and not the file hierarchy rooted at the file.

`-f` *archive*
: Specify the pathname of the input or output archive, overriding the default standard input (when neither the `-r` option nor the `-w` option is specified, or the `-r` option is specified and the `-w` option is not) or standard output (when the `-w` option is specified and the `-r` option is not).

`-i`
: Interactively rename files or archive members. For each archive member matching a *pattern* operand or file matching a *file* operand, a prompt shall be written to the file `/dev/tty`. The prompt shall contain the name of the file or archive member, but the format is otherwise unspecified. A line shall then be read from `/dev/tty`. If this line is blank, the file or archive member shall be skipped. If this line consists of a single period, the file or archive member shall be processed with no modification to its name. Otherwise, its name shall be replaced with the contents of the line. The `pax` utility shall immediately exit with a nonzero exit status if end-of-file is encountered when reading a response or if `/dev/tty` cannot be opened for reading and writing.

`-k`
: Prevent the overwriting of existing files.

`-l`
: (The letter ell.) Link files. When both the `-r` and `-w` options are specified, hard links shall be made between the source and destination file hierarchies whenever possible.

`-n`
: Select the first archive member that matches each *pattern* operand. No more than one archive member shall be matched for each pattern (although members of type directory shall still match the file hierarchy rooted at that file).

`-o` *options*
: Provide information to the implementation to modify the algorithm for extracting or writing files that is specific to the file format specified by `-x`. This version of this standard does not specify any such options and a Strictly Conforming POSIX.2 Application shall not use the `-o` option.

NOTE: It is expected that future versions of POSIX.2 will offer additional file formats and this option will be used by POSIX.2 and other POSIX standards to specify such features as international file-name and file codeset translations, security, accounting, etc., related to each additional format.

`−p` *string* Specify one or more file characteristic options (privileges). The *string* option-argument shall be a string specifying file characteristics to be retained or discarded on extraction. The string shall consist of the specification characters `a`, `e`, `m`, `o`, and `p`, and/or other, implementation-defined, characters. Multiple characteristics can be concatenated within the same string and multiple `−p` options can be specified. The meaning of the specification characters are as follows:

- `a` Do not preserve file access times.
- `e` Preserve the user ID, group ID, file mode bits (see 2.2.2.60), access time, modification time, and any other, implementation-defined, file characteristics.
- `m` Do not preserve file modification times.
- `o` Preserve the user ID and group ID.
- `p` Preserve the file mode bits. Other, implementation-defined file-mode attributes may be preserved.

In the preceding list, ''preserve'' indicates that an attribute stored in the archive shall be given to the extracted file, subject to the permissions of the invoking process; otherwise, the attribute shall be determined as part of the normal file creation action (see 2.9.1.4).

If neither the `e` nor the `o` specification character is specified, or the user ID and group ID are not preserved for any reason, `pax` shall not set the S_ISUID and S_ISGID bits of the file mode.

If the preservation of any of these items fails for any reason, `pax` shall write a diagnostic message to standard error. Failure to preserve these items shall affect the final exit status, but shall not cause the extracted file to be deleted.

If file-characteristic letters in any of the *string* option-arguments are duplicated or conflict with each other, the one(s) given last shall take precedence. For example, if `-p eme` is specified, file modification times shall be preserved.

`−s` *replstr* Modify file or archive member names named by *pattern* or *file* operands according to the substitution expression *replstr*, using the syntax of the `ed` utility (see 4.20). The concepts of ''address'' and ''line'' are meaningless in the context of the `pax` utility, and shall not be supplied. The format shall be:

`-s /`*old*`/`*new*`/[gp]`

where as in `ed`, *old* is a basic regular expression and *new* can contain an ampersand, `\`*n* (where *n* is a digit) backreferences, or subexpression matching. The *old* string shall also be permitted to contain `<newline>` characters.

Any nonnull character can be used as a delimiter (`/` shown here). Multiple `-s` expressions can be specified; the expressions shall be applied in the order specified, terminating with the first successful substitution. The optional trailing `g` shall be as defined in the `ed` utility. The optional trailing `p` shall cause successful substitutions to be written to standard error. File or archive member names that substitute to the empty string shall be ignored when reading and writing archives.

`-t` Cause the access times of the archived files to be the same as they were before being read by `pax`.

`-u` Ignore files that are older (having a less recent file modification time) than a pre-existing file or archive member with the same name. If the `-r` option is specified and the `-w` option is not specified, an archive member with the same name as a file in the file system shall be extracted if the archive member is newer than the file. If the `-w` option is specified and the `-r` option is not specified, an archive file member with the same name as a file in the file system shall be superseded if the file is newer than the archive member. It is unspecified if this is accomplished by actual replacement in the archive or by appending to the archive. If both the `-r` and `-w` options are specified, the file in the destination hierarchy shall be replaced by the file in the source hierarchy or by a link to the file in the source hierarchy if the file in the source hierarchy is newer.

`-v` Produce a verbose table of contents (see 4.48.6.1) if neither the `-r` option nor the `-w` option is specified. Otherwise, list archive member pathnames to standard error (see 4.48.6.2).

`-x` *format* Specify the output archive format. The `pax` utility shall recognize the following formats:

`cpio` The extended `cpio` interchange format specified in POSIX.1 {8} 10.1.2. The default *blocksize* for this format for character special archive files shall be 5120. Implementations shall support all *blocksize* values less than or equal to 32 256 that are multiples of 512.

`ustar` The extended `tar` interchange format specified in POSIX.1 {8} 10.1.1. The default *blocksize* for this format for character special archive files shall be 10 240. Implementations shall support all *blocksize* values less than or equal to 32 256 that are multiples of 512.

Implementation-defined formats shall specify a default block size as well as any other block sizes supported for character special archive files.

Any attempt to append to an archive file in a format different from the existing archive format shall cause `pax` to exit immediately with a nonzero exit status.

`−X` When traversing the file hierarchy specified by a pathname, `pax` shall not descend into directories that have a different device ID [*st_dev* , see POSIX.1 {8}*stat* ()].

The options that operate on the names of files or archive members (`−c`, `−i`, `−n`, `−s`, `−u`, and `−v`) shall interact as follows. When the `−r` option is specified and the `−w` option is not (archive members are being extracted), the archive members shall be ‘‘selected,’’ based on the user-specified *pattern* operands as modified by the `−c`, `−n`, and `−u` options. Then, any `−s` and `−i` options shall modify, in that order, the names of the selected files. The `−v` option shall write names resulting from these modifications.

When the `−w` option is specified (files are being archived), the files shall be selected based on the user-specified pathnames as modified by the `−n` and `−u` options. Then, any `−s` and `−i` options shall, in that order, modify the names of these selected files. The `−v` option shall write names resulting from these modifications.

If both the `−u` and `−n` options are specified, `pax` shall not consider a file selected unless it is newer than the file to which it is compared.

4.48.4 Operands

The following operands shall be supported by the implementation:

directory The destination directory pathname for copies when both the `−r` and `−w` options are specified.

file A pathname of a file to be copied or archived.

pattern A pattern matching one or more pathnames of archive members. A pattern shall be given in the name-generating notation of the pattern matching notation in 3.13, including the filename expansion rules in 3.13.3. The default, if no *pattern* is specified, is to select all members in the archive.

4.48.5 External Influences

4.48.5.1 Standard Input

If the `-w` option is specified, the standard input shall be used only if no *file* operands are specified. It shall be a text file containing a list of pathnames, one per line, without leading or trailing `<blank>`s.

If neither the `-f` nor `-w` options are specified, the standard input shall be an archive file. (See 4.48.5.2.)

Otherwise, the standard input shall not be used.

4.48.5.2 Input Files

The input file named by the *archive* option-argument, or standard input when the archive is read from there, shall be a file formatted according to one of the specifications in POSIX.1 {8} 10.1, or some other, implementation-defined, format.

The file `/dev/tty` shall be used to write prompts and read responses.

4.48.5.3 Environment Variables

The following environment variables shall affect the execution of `pax`:

LANG This variable shall determine the locale to use for the locale categories when both **LC_ALL** and the corresponding environment variable (beginning with **LC_**) do not specify a locale. See 2.6.

LC_ALL This variable shall determine the locale to be used to override any values for locale categories specified by the settings of **LANG** or any environment variables beginning with **LC_**.

LC_COLLATE This variable shall determine the locale for the behavior of ranges, equivalence classes, and multicharacter collating elements used in the pattern matching expressions for the *pattern* operand, the basic regular expression for the `-s` option, and the extended regular expression defined for the `yesexpr` locale keyword in the LC_MESSAGES category.

LC_CTYPE This variable shall determine the locale for the interpretation of sequences of bytes of text data as characters (e.g., single- versus multibyte characters in arguments and input files) and the behavior of character classes within regular expressions and pattern matching.

LC_MESSAGES This variable shall determine the processing of affirmative responses and the language in which messages should be written.

LC_TIME This variable shall determine the format and contents of date and time strings when the `−v` option is specified.

4.48.5.4 Asynchronous Events

Default.

4.48.6 External Effects

4.48.6.1 Standard Output

If the `−w` option is specified and neither the `−f` nor `−r` options are specified, the standard output shall be the archive formatted according to one of the specifications in POSIX.1 {8} 10.1, or some other implementation-defined format. (See `−x` *format* under 4.48.3.)

If neither the `−r` option nor the `−w` option is specified, the table of contents of the selected archive members shall be written to standard output using the following format: 1

`"%s\n"`, *<pathname>*

If neither the `−r` option nor the `−w` option is specified, but the `−v` option is specified, the table of contents of the selected archive members shall be written to standard output using the following formats:

For pathnames representing hard links to previous members of the archive:

`"%s△==△%s\n"`, *<ls −l listing>* , *<linkname>*

For all other pathnames:

`"%s\n"`, *<ls −l listing>*

where *<ls −l listing>* shall be the format specified by the `ls` utility (see 4.39) with the `−l` option. When writing pathnames in this format, it is unspecified what is written for fields for which the underlying archive format does not have the correct information, although the correct number of `<blank>`-separated fields shall be written.

When writing a table of contents of selected archive members, standard output shall not be buffered more than a line at a time.

4.48.6.2 Standard Error

If either or both of the `−r` option and the `−w` option are specified as well as the `−v` option, `pax` shall write the pathnames it processes to the standard error output using the following format: 1

`"%s\n"`, *<pathname>*

These pathnames shall be written as soon as processing is begun on the file or archive member, and shall be flushed to standard error. The trailing `<newline>`, which shall not be buffered, shall be written when the file has been read or written.

If the `−s` option is specified, and the replacement string has a trailing `p`, substitutions shall be written to standard error in the following format:

`"%s∆>>∆%s\n"`, *<original pathname>* , *<new pathname>* 2

In all operating modes of `pax` (see 4.48.2), optional messages of unspecified format concerning the input archive format and volume number, the number of files, blocks, volumes, and media parts as well as other diagnostic messages may be written to standard error.

In all formats, for both standard output and standard error, it is unspecified how nonprintable characters in pathnames or linknames are written.

4.48.6.3 Output Files

If the `−r` option is specified, the extracted or copied output files shall be of the archived file type.

If the `−w` option is specified, but the `−r` option is not, the output file named by the `−f` option argument shall be a file formatted according to one of the specifications in POSIX.1 {8}10.1, or some other, implementation-defined, format.

4.48.7 Extended Description

None.

4.48.8 Exit Status

The `pax` utility shall exit with one of the following values:

- 0 All files were processed successfully.
- >0 An error occurred.

4.48.9 Consequences of Errors

If `pax` cannot create a file or a link when reading an archive or cannot find a file when writing an archive, or cannot preserve the user ID, group ID, or file mode when the `−p` option is specified, a diagnostic message shall be written to standard error and a nonzero exit status shall be returned, but processing shall continue. In the case where `pax` cannot create a link to a file, `pax` shall not, by default, create a second copy of the file.

If the extraction of a file from an archive is prematurely terminated by a signal or error, `pax` may have only partially extracted the file or (if the −`n` option was not specified) may have extracted a file of the same name as that specified by the user, but which is not the file the user wanted. Additionally, the file modes of extracted directories may have additional bits from the S_IRWXU mask set as well as incorrect modification and access times.

4.48.10 Rationale. *(This subclause is not a part of P1003.2)*

Examples, Usage

The following command:

```
pax -w -f /dev/rmt/1m .
```

copies the contents of the current directory to tape drive 1, medium density (assuming historical System V device naming procedures. The historical BSD device name would be `/dev/rmt9`).

The following commands:

`mkdir` *newdir*
`pax -rw` *olddir newdir*

copy the *olddir* directory hierarchy to *newdir* .

```
pax -r -s ',^//*usr//*,,' -f a.pax
```

reads the archive `a.pax`, with all files rooted in ‘‘`/usr`’’ in the archive extracted relative to the current directory.

The −`p` (privileges) option was invented to reconcile differences between historical 1
`tar` and `cpio` implementations. In particular, the two utilities used −`m` in 1
diametrically opposed ways. The −`p` option also provides a consistent means of 1
extending the ways in which future file attributes can be addressed, such as for 1
enhanced security systems or high-performance files. Although it may seem com- 1
plex, there are really two modes that will be most commonly used: 1

`-p e` ‘‘Preserve everything.’’ This would be used by the historical super- 1
user, someone with all the appropriate privileges, to preserve all 1
aspects of the files as they are recorded in the archive. The `e` flag is 1
the sum of `o` and `p`, and other implementation-defined attributes. 1

`-p p` ‘‘Preserve’’ the file mode bits. This would be used by the user with 1
regular privileges who wished to preserve aspects of the file other 1
than the ownership. The file times are preserved by default, but two 1
other flags are offered to disable these and use the time of extraction. 1

History of Decisions Made

The description of `pax` was adopted from a command written by Glenn Fowler of AT&T. It is a new utility, commissioned for this standard.

The table of contents output is written to standard output to facilitate pipeline processing.

The output archive formats required are those defined in POSIX.1 {8}; others, such as the historical `tar` format, may be added as an extension.

The one pathname per line format of standard input precludes pathnames containing `<newline>`s. Although such pathnames violate the portable filename guidelines, they may exist and their presence may inhibit usage of `pax` within shell scripts. This problem is inherited from historical archive programs. The problem can be avoided by listing filename arguments on the command line instead of on standard input.

An earlier draft had hard links displaying for all pathnames. This was removed because it complicates the output of the non `−v` case and does not match historical `cpio` usage. The hard-link information is available in the `−v` display.

The working group realizes that the presence of symbolic links will affect certain `pax` operations. Historical practice, in both System V and BSD-based systems, is that the physical traversal of the file hierarchy shall be the default, and an option is provided to cause the utility to do a logical traversal, that is, follow symbolic links. Historical practice has not been so consistent as to what option is used to cause the logical traversal; BSD systems have used `−h` (`cp` and `tar`) and `−L` (`ls`), while the *SVID* specifies `−L` (`cpio` and `ls`). Given this inconsistency, the `−L` option is recommended.

The archive formats described in POSIX.1 {8} have certain restrictions that have been brought along from historical usage. For example, there are restrictions on the length of pathnames stored in the archive. When `pax` is used in `−rw` mode, copying directory hierarchies, there is no stated dependency on these archive formats. Therefore, such restrictions should not apply.

The POSIX.2 working group is currently devising a new archive format to be published in a revision or amendment to this standard. It is expected that the `ustar` and `cpio` formats then will be retired from a future version of POSIX.1 {8}. This new format will address all restrictions and new requirements for security labeling, etc. The `pax` utility should be upward-compatible enough to handle any such changes. The reason that the default `−x` *format* output format is implementation defined is to reserve the default format for this new standard interface. The `−o` option was devised to provide means of controlling the many aspects of international and security concerns without expending the entire alphabet of option letters for this, and possibly other, file formats. The `−o` string is meant to be specific for each `−x` format. Control of various file permissions and attributes that can be expressed in a binary way will continue to use the `−p` (permissions) option; the `−o` will be reserved for more involved requirements and will probably take a

```
pax -o name=value,name=value -o name=value
```

approach.

The fundamental difference in how `cpio` and `tar` viewed the world was in the way directories were treated. The `cpio` utility did not treat directories differently from other files, and to select a directory and its contents required that each file in the hierarchy be explicitly specified. For `tar`, a directory matched every file in the file hierarchy it rooted.

The `pax` utility offers both interfaces; by default, directories map into the file hierarchy they root. The `−d` option causes `pax` to skip any file not explicitly referenced, as `cpio` traditionally did. The `tar`-style behavior was chosen as the default because it was believed that this was the more common usage, and because `tar` is the more commonly available interface, as it was historically provided on both System V and BSD implementations. Because a file may be matched more than once without causing it to be selected multiple times, the traditional usage of piping an `ls` or `find` to the archive command works as always.

The Data Interchange Format specification of POSIX.1 {8} requires that processes with ‘‘appropriate privileges’’ shall always restore the ownership and permissions of extracted files exactly as archived. If viewed from the historic equivalence between super-user and ‘‘appropriate privileges,’’ there are two problems with this requirement. First, users running as super-users may unknowingly set dangerous permissions on extracted files. Second, it is needlessly limiting in that super-users cannot extract files and own them as super-user unless the archive was created by the super-user. (It should be noted that restoration of ownerships and permissions for the super-user, by default, is historical practice in `cpio`, but not in `tar`.) In order to avoid these two problems, the `pax` specification has an additional ‘‘privilege’’ mechanism, the `−p` option. Only a `pax` invocation with the POSIX.1 {8} privileges needed, and which has the `−p` option set using the `e` specification character, has the ‘‘appropriate privilege’’ to restore full ownership and permission information.

Note also that POSIX.1 {8} 10.1 requires that the file ownership and access permissions shall be set, on extraction, in the same fashion as the POSIX.1 {8} *creat*() function when provided the mode stored in the archive. This means that the file creation mask of the user is applied to the file permissions.

The default *blocksize* value of 5120 for `cpio` was selected because it is one of the standard block-size values for `cpio`, set when the `−B` option is specified. (The other default block-size value for `cpio` is 512, and this was felt to be too small.) The default block value of 10 240 for `tar` was selected as that is the standard block-size value for BSD `tar`. The maximum block size of 32 256 (2^{15}−512) is the largest multiple of 512 that fits into a signed 16-bit tape controller transfer register. There are known limitations in some historic system that would prevent larger blocks from being accepted. Historic values were chosen to make compatibility with existing scripts using `dd` or similar utilities to manipulate archives more likely. Also, default block sizes for any file type other than character special has been deleted from the standard as unimportant and not likely to affect the structure of the resulting archive.

Implementations are permitted to modify the block-size value based on the archive format or the device to which the archive is being written. This is to provide implementations the opportunity to take advantage of special types of devices, and should not be used without a great deal of consideration as it will almost certainly decrease archive portability.

The −n option in early drafts had three effects; the first was to cause special characters in patterns to not be treated specially. The second was to cause only the first file that matched a pattern to be extracted. The third was to cause pax to write a diagnostic message to standard error when no file was found matching a specified pattern. Only the second behavior is retained by POSIX.2, for many reasons. First, it is in general a bad idea for a single option to have multiple effects. Second, the ability to make pattern matching characters act as normal characters is useful for other parts of pax than just file extraction. Third, a finer degree of control over the special characters is useful, because users may wish to normalize only a single special character in a single file name. Fourth, given a more general escape mechanism, the previous behavior of the −n option can be easily obtained using the −s option or a sed script. Finally, writing a diagnostic message when a pattern specified by the user is unmatched by any file is useful behavior in all cases.

There are two methods of copying subtrees in POSIX.2. The other method is described as part of the cp utility (see 4.13). Both methods are historical practice: cp provides a simpler, more intuitive interface, while pax offers a finer granularity of control. Each provides additional functionality to the other; in particular, pax maintains the hard-link structure of the hierarchy, while cp does not. It is the intention of the working group that the results be similar (using appropriate option combinations in both utilities). The results are not required to be identical; there seemed insufficient gain to applications to balance the difficulty of implementations having to guarantee that the results would be exactly identical.

A single archive may span more than one file. See POSIX.1 {8} 10.1.3. While POSIX.1 {8} only refers to reading the archive file, it is reasonable that the format utility may also determine, in an implementation-defined manner, the next file to write. It is suggested that implementations provide informative messages to the user on the standard error whenever the archive file is changed.

The −d option (do not create intermediate directories not listed in the archive) found in previous drafts of this standard was originally provided as a complement to the historic −d option of cpio. It has been deleted.

The −s option in earlier drafts specified a subset of the substitution command from the ed utility. As there was no reason for only a subset to be supported, the −s option is now compatible with the current ed specification. Since the delimiter can be any nonnull character, the following usage with single spaces is valid:

```
pax -s " foo bar " ...
```

The −t option (specify an implementation-defined identifier naming an input or output device) found in earlier drafts has been deleted because it is not historical practice and of limited utility. In particular, historic versions of neither cpio nor tar had the concept of devices that were not mapped into the file system; if the devices are mapped into the file system, the −f option is sufficient.

The −o and −p options found in previous versions of this standard have been renamed to be −p and −t, respectively, to correspond more closely with the historic tar and cp utilities.

The default behavior of pax with regard to file modification times is the same as historical implementations of tar. It is not the historical behavior of cpio.

Because the −i option uses /dev/tty, utilities without a controlling terminal will not be able to use this option.

The −y option, found in earlier drafts, has been deleted because a line containing a single period for the −i option has equivalent functionality. The special lines for the −i option (a single period and the empty line) are historical practice in cpio.

In earlier drafts, an −e *charmap* option was included to increase portability of 1
files between systems using different coded character sets. This option was omit- 1
ted because it was apparent that consensus could not be formed for it. It was an 1
interface without implementation experience and overloaded the charmap file 1
concept to provide additional uses its original authors had not intended. The 1
developers of POSIX.2 will consider other mechanisms for transporting files with 1
nonportable names as they develop the new interchange format, described earlier. 1

The −k option was added to address international concerns about the dangers involved in the character set transformations of −e (if the target character set were different than the source, the file names might be transformed into names matching existing files) and was made more general to also protect files transferred between file systems with different {NAME_MAX} values (truncating a filename on a smaller system might also inadvertently overwrite existing files). As stated, it prevents any overwriting, even if the target file is older than the source, which is seen as a generally useful feature anyway.

It is almost certain that appropriate privileges will be required for pax to accomplish parts of this specification. Specifically, creating files of type block special or character special, restoring file access times unless the files are owned by the user (the −t option), or preserving file owner, group, and mode (the −p option) will all probably require appropriate privileges.

Some of the file characteristics referenced in this specification may not be supported by some archive formats. For example, neither the tar nor cpio formats contain the file access time. For this reason, the e specification character has been provided, intended to cause all file characteristics specified in the archive to be retained.

It is required that extracted directories, by default, have their access and modification times and permissions set to the values specified in the archive. This has obvious problems in that the directories are almost certainly modified after being extracted and that directory permissions may not permit file creation. One possible solution is to create directories with the mode specified in the archive, as modified by the *umask* of the user, plus sufficient permissions to allow file creation. After all files have been extracted, pax would then reset the access and modification times and permissions as necessary.

When the −r option is specified, and the −w option is not, implementations are permitted to overwrite files when the archive has multiple members with the same name. This may fail, of course, if permissions on the first version of the file do not permit it to be overwritten.

4.49 `pr` — Print files

4.49.1 Synopsis

`pr` [`+`*page*] [`−`*column*] [`−adFmrt`] [`−e`[*char*][*gap*]] [`−h` *header*] [`−i`[*char*][*gap*]]
[`−l` *lines*] [`−n`[*char*][*width*]] [`−o` *offset*] [`−s`[*char*]] [`−w` *width*] [*file* . . .]

4.49.2 Description

The `pr` utility is a printing and pagination filter. If multiple input files are specified, each shall be read, formatted, and written to standard output. By default, the input shall be separated into 66-line pages, each with:

— A 5-line header that includes the page number, date, time, and the pathname of the file.

— A 5-line trailer consisting of blank lines.

If standard output is associated with a terminal, diagnostic messages shall be deferred until the `pr` utility has completed processing.

When options specifying multicolumn output are specified, output text columns shall be of equal width; input lines that do not fit into a text column shall be truncated. By default, text columns shall be separated with at least one `<blank>`.

4.49.3 Options

The `pr` utility shall conform to the utility argument syntax guidelines described in 2.10.2, except that: the *page* option has a `'+'` delimiter; *page* and *column* can be multidigit numbers; some of the option-arguments are optional; and some of the option-arguments cannot be specified as separate arguments from the preceding option letter. In particular, the `−s` option does not allow the option letter to be separated from its argument, and the options `−e`, `−i`, and `−n` require that both arguments, if present, not be separated from the option letter.

The following options shall be supported by the implementation. In the following option descriptions, *column*, *lines*, *offset*, *page*, and *width* are positive decimal integers; *gap* is a nonnegative decimal integer.

`+`*page* Begin output at page number *page* of the formatted input.

`−`*column* Produce output that is *columns* wide (default shall be 1) and is written down each column in the order in which the text is received from the input file. This option should not be used with `−m`. The options `−e` and `−i` shall be assumed for multiple text-column output. Whether or not text columns are balanced is