

# The flushend package

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## 1 Introduction

The package is used to balance columns on any page in twocolumn mode. By default it is switched on at the end of document. It is expected to work with footnotes, top floats and column break before one line section title.

## 2 Usage

Just load the package to balance the last page: that's all. To balance some page in middle of document use command `\flushcolsend` at that page.

<code>\flushend</code>	This macro switches on column balancing on the last page. It is used by default.
<code>\raggedend</code>	This macro switches off column balancing on the last page.
<code>\flushcolsend</code>	This macro switches on column balancing on the current page.
<code>\raggedcolsend</code>	This macro switches off column balancing on the current page.
<code>\atColsBreak</code>	<code>{\tokens}</code> Adds <code>\tokens</code> in place of the original column break (made without balancing). <i>Example:</i> <code>\atColsBreak{\vskip-2pt}</code>
<code>\atColsEnd</code>	<code>{\tokens}</code> Adds <code>\tokens</code> at the end of right column. <i>Example:</i> <code>\atColsEnd{\vfil}</code>
<code>\showcolsendrule</code>	It can be used just for debugging: adds rule to the bottom of columns.

## 2.1 Package options

<code>autobase</code>	It is used to guess <code>\baselineskip</code> value on original columns break.
<code>noauto</code>	It is used to switch off the previous option behaviour.
<code>debug</code>	Adds rules to the bottom of columns (just for debugging) and leftcolumn break place. Adds some additional log info.

## 3 Implementation

```

1 \newif\if@auto@baselineskip \@auto@baselineskiptrue
2 \newif\if@balance@debug \@balance@debugfalse
3 \DeclareOption{autobase}{\global\@auto@baselineskiptrue}
4 \DeclareOption{noauto}{\global\@auto@baselineskipfalse}
5 \DeclareOption{debug}{\global\@balance@debugtrue}
6 \DeclareOption{nodebug}{\global\@balance@debugfalse}
7 \ProcessOptions

8 \newskip\flushend@@lastskip@a
9 \newskip\flushend@@lastskip@b
10 \newskip\flushend@@lastskip@c
11 \newcount\flushend@@penalty@a
12 \newdimen\flushend@@lastkern@a
13 \newdimen\var@@temp@spread
14 \newdimen\var@@temp@a
15 \newdimen\flushend@@page@rule \flushend@@page@rule\z@
16 \def\showcolsendrule{\global\flushend@@page@rule=.4pt}

\top@@floatbox@min {(float size)} This value is used to catch possible float on right column top.
17 \gdef\top@@floatbox@min{4\topskip}

18 \newbox\flushend@@varbox@a
19 \newbox\flushend@@varbox@c
20 \newbox\flushend@@tempbox@a
21 \newbox\flushend@@tempbox@c
22 \@ifundefined{@viper}{\newbox\@viper}{}
23 \@ifundefined{hold@viper}{\newbox\hold@viper}{}

24 \newtoks\atColsBreak \atColsBreak={}
25 \newtoks\atColsEnd \atColsEnd={}

26 \@ifundefined{fmt@box@adds}{\def\fmt@box@adds#1{#1}}{}
27 \@ifundefined{fmt@vbox@adds}{\def\fmt@vbox@adds[#1]#2{#2}}{}

\remove@lastbox@at@balancing It is used to remove empty box at the right column end.
28 \def\unskip@three@kern@penalty{%
29 \unskip\unkern\unpenalty
30 \unskip\unkern\unpenalty
31 \unskip\unkern\unpenalty
32 }

```

```

33 \gdef\remove@lastbox@at@balancing{%
34   \unskip@three@kern@penalty
35   \bgroup
36     \setbox\z@\lastbox
37     \ifdim\wd\z@>\z@
38       \box\z@
39     \else
40       \aftergroup\unskip@three@kern@penalty
41     \fi
42   \egroup
43 }

```

Macros used in debug mode.

```

44 \def\show@@box#1{%
45   \bgroup
46     \showboxbreadth=2000\showboxdepth=2000%
47     \showbox#1\relax
48   \egroup
49 }
50 \def\wlog@balance@debug#1{\if@balance@debug \wlog{#1}\fi}
51 \def\log@box@info#1{<box\the#1>(\the\ht#1+\the\dp#1)x\the\wd#1}
52 \let\show@@box@next@gobble

```

To get more or less proper result we need to know about footnotes at the left column end, top floats at the right column top, skips and so on. This part of the package is responsible for such analysis.

```

53 \gdef\analyze@lastbox@box#1{%
54   \setbox\flushend@@varbox@a\vbox{%
55     \unvbox#1%
56     \global\flushend@@lastskip@a\lastskip
57     \unskip
58     \global\var@@temp@a\lastkern
59     \unkern
60     \global\flushend@@penalty@a\lastpenalty
61     \unpenalty
62     \ifdim\lastskip>\z@
63       \global\flushend@@lastskip@a\lastskip
64     \fi
65     \unskip
66     \ifdim\lastkern>\z@
67       \global\var@@temp@a\lastkern
68     \fi
69     \unkern
70     \ifnum\lastpenalty>\z@
71       \global\flushend@@penalty@a\lastpenalty
72     \fi
73     \unpenalty
74     \global\setbox\flushend@@tempbox@a\lastbox
75   }%

```

```

76 \wlog@balance@debug{^^J::analyze@lastbox@box::\log@box@info{#1}%
77   ^^J::unvbox: \log@box@info{\flushend@@varbox@a}%
78   ^^J::lastbox: \log@box@info{\flushend@@tempbox@a}%
79   ^^J::lastskip: \the\flushend@@lastskip@a;
80     lastkern: \the\var@@temp@a;
81     lastpenalty: \the\flushend@@penalty@a
82   }%
83 }

\analyze@leftcolumn@box {({box})}
84 \gdef\analyze@leftcolumn@box#1{%
85   \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
86   \flushend@@lastskip@b\ht#1%
87   \wlog@balance@debug{^^Jmainbox: \log@box@info{#1}}%
88   \setbox\flushend@@varbox@a\vbox{%
89     \unvbox#1%
90     \global\flushend@@lastskip@a\lastskip
91     \unskip
92     \global\flushend@@lastkern@a\lastkern
93     \unkern
94     \global\flushend@@penalty@a\lastpenalty
95     \unpenalty
96     \global\setbox\flushend@@tempbox@a\lastbox
97   }%
98   \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
99   \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@a
100  \wlog@balance@debug{.-box: \log@box@info{\flushend@@varbox@a}%
101    ^^J.-lastbox: \log@box@info{\flushend@@tempbox@a}%
102    ^^J.-lastskip: \the\flushend@@lastskip@a;
103      lastkern: \the\flushend@@lastkern@a;
104      lastpenalty: \the\flushend@@penalty@a
105    ^^J.-diff: \the\flushend@@lastskip@b
106  }%
107  \check@@footnoterule@@box\flushend@@tempbox@a\flushend@@lastskip@b\flushend@@varbox@a
108  \check@@baselineskip@@skip\flushend@@lastskip@a\flushend@@lastskip@b\flushend@@lastskip@c
109  \ifvoid\flushend@@tempbox@a
110    \ifdim\ht\flushend@@varbox@a>\topskip
111      \flushend@@lastskip@b\ht\flushend@@varbox@a
112      \var@@temp@a\ht\flushend@@varbox@a
113    \loop
114      \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
115      \ifvoid\flushend@@varbox@a
116        \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
117        \advance \var@@temp@a -3\p@
118      \else
119        \var@@temp@a=-1\p@
120      \fi
121    \ifdim \var@@temp@a>\z@
122    \repeat
123    \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@varbox@a}%

```

```

124     \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
125     \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
126     \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
127     \wlog@balance@debug{...--box: \log@box@info{\flushend@@tempbox@c}%
128         ^^J...--lastbox: \log@box@info{\flushend@@varbox@a}%
129         ^^J...--diff: \the\flushend@@lastskip@b}%
130     \check@@footnoterule@@box\flushend@@varbox@a\flushend@@lastskip@b
131     \flushend@@tempbox@c
132     \check@@baselineskip@@skip\flushend@@lastskip@a\flushend@@lastskip@b
133     \flushend@@lastskip@c
134     \ifdim\ht\flushend@@varbox@a>.5\topskip
135         \analyze@lastbox@box\flushend@@varbox@a
136     \fi
137     \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
138 \else
139     \wlog@balance@debug{lastbox: \log@box@info{\flushend@@varbox@a}}%
140 \fi
141 \fi
142 \ifdim\ht\flushend@@varbox@a>\topskip
143     \expandafter\analyze@leftcolumn@box\expandafter\flushend@@varbox@a
144 \fi
145 }

```

\get@@footnoterule@@box

```

146 \def\get@@footnoterule@@box{%
147     \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
148     \setbox\flushend@@varbox@a\vbox{\strut
149         \vskip\z@
150         \footnoterule
151         \unskip\unkern\unpenalty
152         \unskip\unkern\unpenalty
153     }%
154     \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\ht\strutbox
155     \xdef\footnoterule@@box@@ht{\the\ht\flushend@@varbox@a}%
156     \xdef\footnoterule@@box@@dp{\the\dp\flushend@@varbox@a}%
157     \xdef\footnoterule@@box@@wd{\the\wd\flushend@@varbox@a}%
158     \wlog@balance@debug{:footnoterule: \log@box@info{\flushend@@varbox@a}}%
159 }

```

\check@@footnoterule@@box  $\langle box \rangle$   $\langle skip \rangle$   $\langle box \rangle$

```

160 \def\check@@footnoterule@@box#1#2#3{%
161     \ifdim\ht#1=\footnoterule@@box@@ht
162     \ifdim\dp#1=\footnoterule@@box@@dp
163     \ifdim\wd#1=\footnoterule@@box@@wd
164         \ifdim#2>\topskip
165             \xdef\main@box@height{\the\ht#3}%
166             \xdef\main@box@skip{\the#2}%
167         \fi
168     \fi
169 \fi

```

```

170     \fi
171   }

\check@@baselineskip@@skip  {<dimension>}{<dimension>}{<var>}
172 \def\check@@baselineskip@@skip#1#2#3{%
173     \ifdim#1>\z@
174         \ifdim#2>\z@
175             \global#3=\the#1%
176         \gdef\check@@baselineskip@@skip##1##2##3{%
177             \fi
178         \fi
179     }

\analyze@rightcolumn@box  {<box>}
180 \def\analyze@rightcolumn@box#1{%
181     \bgroup
182     \xdef\top@@floatbox@ht{\z@}%
183     \xdef\top@@floatbox@skip{\z@}%
184     \xdef\top@@section@skip{\z@}%
185     \splittopskip\z@ \vfuzz\maxdimen \vbadness\maxdimen
186     \wlog@balance@debug{^~J(R)mainbox: \log@box@info{#1}}%
187     \var@@temp@a3\p@
188     \setbox\flushend@@varbox@a\vbox{\strut
189         \vskip\z@
190         \unvcopy#1%
191     }%
192     \splittopskip\z@
193     \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\ht\strutbox
194     \flushend@@lastskip@a\ht\flushend@@varbox@a
195     \loop
196         \flushend@@lastskip@b\ht\flushend@@varbox@a
197         \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
198         \ifvoid\flushend@@tempbox@c
199             \advance \var@@temp@a 3\p@
200             \ifdim\var@@temp@a>\flushend@@lastskip@b
201                 \var@@temp@a=-1\p@
202             \fi
203         \else
204             \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
205             \ifdim\ht\flushend@@tempbox@c>\top@@floatbox@min
206                 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c
207                 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
208                 \xdef\top@@floatbox@skip{\the\flushend@@lastskip@b}%
209                 \flushend@@lastskip@b\flushend@@lastskip@a
210                 \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
211                 \advance\flushend@@lastskip@b -\top@@floatbox@skip
212                 \xdef\top@@floatbox@ht{\the\flushend@@lastskip@b}%
213                 \var@@temp@a=3\p@
214             \else
215                 \advance\flushend@@lastskip@b -\ht\flushend@@tempbox@c

```

```

216         \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
217         \ifdim\ht\flushend@@tempbox@c>\topskip
218         \else
219             \xdef\top@@section@skip{\the\flushend@@lastskip@b}%
220         \fi
221         \var@@temp@a=-1\p@
222     \fi
223 \fi
224 \ifdim \var@@temp@a>\z@
225 \repeat
226 \ifvoid\flushend@@tempbox@c
227 \else
228     \ifdim\top@@section@skip>\z@
229     \else
230         \ifdim\ht\flushend@@tempbox@c>\z@
231             \setbox\flushend@@varbox@a\vbox{\unvbox\flushend@@tempbox@c}%
232         \fi
233         \flushend@@lastskip@b\ht\flushend@@varbox@a
234         \var@@temp@a=3\p@
235     \loop
236         \setbox\flushend@@tempbox@c\vsplit\flushend@@varbox@a to\var@@temp@a
237         \ifvoid\flushend@@tempbox@c
238             \advance \var@@temp@a 3\p@
239             \ifdim\var@@temp@a>\flushend@@lastskip@b
240                 \var@@temp@a=-1\p@
241             \fi
242         \else
243             \ifdim\ht\flushend@@tempbox@c>\z@
244                 \var@@temp@a=-1\p@
245             \fi
246         \fi
247     \ifdim \var@@temp@a>\z@
248     \repeat
249     \loop
250         \setbox\flushend@@varbox@a\vbox{%
251             \unvbox\flushend@@tempbox@c
252             \unskip\unkern\unpenalty
253             \unskip\unkern\unpenalty
254             \unskip\unkern\unpenalty
255             \setbox\flushend@@tempbox@c\lastbox
256         }%
257     \flushend@@lastskip@b\ht\flushend@@varbox@a
258     \setbox\flushend@@varbox@a\vbox{%
259         \unvbox\flushend@@varbox@a
260         \unskip\unkern\unpenalty
261         \unskip\unkern\unpenalty
262         \unskip\unkern\unpenalty
263     }%
264     \advance\flushend@@lastskip@b -\ht\flushend@@varbox@a
265     \ifdim\flushend@@lastskip@b>\topskip

```

```

266             \xdef\top@@section@skip{\the\flushend@@lastskip@b}%
267         \fi
268     \ifdim\ht\flushend@@varbox@a>2\topskip
269         \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@varbox@a}%
270     \repeat
271 \fi
272 \fi
273 \egroup
274 }

```

\last@outputdblcol Columns balancing of the twocolumn mode page.

```

275 \def\last@outputdblcol{%
276 \if@firstcolumn
277     \global \@firstcolumnfalse
278     \global \setbox\@leftcolumn \box\@outputbox
279 \else
280     \global \@firstcolumntrue
281     \@tempdima\ht\@leftcolumn
282     \splittopskip\topskip \splitmaxdepth\maxdepth
283     \var@@temp@spread=\wd\@outputbox
284     \if@auto@baselineskip
285         %% Trying guess baselineskip value on column break
286         \get@@footnoterule@@box
287         \xdef\main@box@height{\the\ht\@leftcolumn}%
288         \xdef\main@box@skip{\z@}%
289         \global\flushend@@lastskip@c\z@
290         \setbox\flushend@@varbox@a\vbox{\unvcopy\@leftcolumn}%
291         \analyze@leftcolumn@box\flushend@@varbox@a
292         \setbox\flushend@@varbox@a\vbox{\unvcopy\@outputbox}%
293         \analyze@rightcolumn@box\flushend@@varbox@a
294         \ifdim\main@box@skip>\z@
295             \splittopskip\z@
296             \setbox\flushend@@varbox@a\vsplit\@leftcolumn to\main@box@height
297         \else
298             \setbox\flushend@@varbox@a\box\@leftcolumn
299         \fi
300     \ifdim\var@@temp@spread>\z@
301         \setbox\@outputbox\vbox{\strut
302             \vskip\z@
303             \unvbox\@outputbox
304             }%
305         \splittopskip\z@
306         \setbox\flushend@@tempbox@c\vsplit\@outputbox to\ht\strutbox
307     \ifdim\top@@floatbox@skip>\z@
308         \setbox\flushend@@tempbox@c\vsplit\@outputbox to\top@@floatbox@ht
309         \setbox\flushend@@tempbox@c\vbox{\unvbox\flushend@@tempbox@c}%
310     \fi
311     \setbox\@tempboxa\vbox{%
312         \unvbox\flushend@@varbox@a
313         \unskip\unkern\unpenalty

```



```

314         \vskip\flushend@@lastskip@c
315         \the\atColsBreak
316         \hrule\@height\flushend@@page@rule width\columnwidth
317         \ifdim\top@@section@skip>\topskip
318             \vskip\top@@section@skip
319         \fi
320         \unvbox\@outputbox
321         \remove@lastbox@at@balancing
322         \the\atColsEnd
323     }%
324     \ifdim\top@@floatbox@skip>\z@
325         \setbox\@outputbox\vbox{\unvbox\flushend@@tempbox@c}%
326     \fi
327 \else %% rightcolumn empty
328     \setbox\@tempboxa\vbox{%
329         \unvbox\flushend@@varbox@a
330         \remove@lastbox@at@balancing
331         \the\atColsEnd
332     }%
333 \fi
334 \else
335     %% Ignore baselineskip value on column break
336     \ifdim\var@@temp@spread>\z@
337         \setbox\@outputbox\vbox{\strut
338             \vskip\z@
339             \unvbox\@outputbox
340         }%
341         \splittopskip\z@
342         \setbox\flushend@@tempbox@c\vsplit\@outputbox to\ht\strutbox
343         \setbox\@tempboxa\vbox{%
344             \unvbox\@leftcolumn
345             \setbox\z@\lastbox
346             \unskip\unkern\unpenalty
347             \the\atColsBreak
348             \hrule\@height\flushend@@page@rule width\columnwidth
349             \unvbox\@outputbox
350             \remove@lastbox@at@balancing
351             \the\atColsEnd
352         }%
353     \else
354         \setbox\@tempboxa\vbox{%
355             \unvbox\@leftcolumn
356             \remove@lastbox@at@balancing
357             \the\atColsEnd
358         }%
359     \fi
360 \fi
361 \ifdim\main@box@skip>\z@
362     \@tempdimb\ht\@tempboxa
363     \advance\@tempdimb -\main@box@skip

```

```

364 \advance\@tempdimb -\ht\@leftcolumn
365 \@tempdimb .5\@tempdimb
366 \splittopskip\topskip \splitmaxdepth\maxdepth
367 \loop
368 \setbox\flushend@@varbox@a\copy\@tempboxa
369 \setbox\flushend@@tempbox@a\vsplit\flushend@@varbox@a to\@tempdimb
370 \setbox\flushend@@tempbox@c\vbox{%
371 \unvcopy\flushend@@tempbox@a
372 \vskip\main@box@skip
373 \unvcopy\@leftcolumn
374 }%
375 \setbox\flushend@@varbox@c\vbox{\unvbox\flushend@@varbox@a}%
376 \var@@temp@spread=\ht\flushend@@tempbox@c
377 \advance\var@@temp@spread by-\ht\flushend@@varbox@c
378 \wlog@balance@debug{Left x: \the\ht\flushend@@tempbox@a
379 +\the\dp\flushend@@tempbox@a=\the\ht\flushend@@varbox@a
380 +\the\dp\flushend@@varbox@a::\the\@tempdimb
381 ^^JLeft 0: \the\ht\flushend@@tempbox@c
382 +\the\dp\flushend@@tempbox@c::\the\@tempdimb
383 ^^JRight x: \the\ht\flushend@@varbox@c
384 +\the\dp\flushend@@varbox@c=\the\ht\flushend@@varbox@a
385 +\the\dp\flushend@@varbox@a::\the\@tempdimb
386 ^^JExtra height:\the\var@@temp@spread\space when \the\@tempdimb
387 }%
388 \ifdim\var@@temp@spread<\z@ \advance\@tempdimb 1\p@ \repeat
389 \flushend@@lastskip@a\the\ht\flushend@@tempbox@c
390 \flushend@@lastskip@b\the\@tempdimb
391 \setbox\flushend@@tempbox@a\vsplit\@tempboxa to\@tempdimb
392 \setbox\@leftcolumn\vbox to\@tempdima{%
393 \vbox to \flushend@@lastskip@a{%
394 \unvbox\flushend@@tempbox@a
395 \vskip\main@box@skip
396 \unvbox\@leftcolumn
397 \vss
398 }%
399 \hrule\@height\flushend@@page@rule width\textwidth
400 \vss
401 }%
402 \global\ht\@leftcolumn=\the\@tempdima
403 \wlog{- LAST -%
404 ^^JExtra skip:\the\var@@temp@spread
405 ^^JLeft:\the\ht\@leftcolumn/\the\dp\@leftcolumn
406 ^^JRight:\the\ht\@tempboxa/\the\dp\@tempboxa
407 ^^JOutput:\the\@tempdimb
408 }%
409 \setbox\@outputbox\vbox to\@tempdima{%
410 \vbox spread\var@@temp@spread{\unvbox\@tempboxa}%
411 \vss
412 }%
413 \else

```

```

414 \@tempdimb \ht\@tempboxa
415 \ifdim\top@@floatbox@skip>\z@
416 \advance\@tempdimb \top@@floatbox@skip
417 \advance\@tempdimb \top@@floatbox@ht
418 \fi
419 \@tempdimb .5\@tempdimb
420 \splittopskip\topskip \splitmaxdepth\maxdepth
421 \loop
422 \setbox\flushend@@varbox@a\copy\@tempboxa
423 \setbox\flushend@@tempbox@a\vsplit\flushend@@varbox@a to\@tempdimb
424 \setbox\flushend@@tempbox@c\vbox{\unvcopy\flushend@@tempbox@a}%
425 \ifdim\top@@floatbox@skip>\z@
426 \setbox\flushend@@varbox@c\vbox{%
427 \unvcopy\@outputbox
428 \vskip\top@@floatbox@skip
429 \unvbox\flushend@@varbox@a
430 }%
431 \else
432 \setbox\flushend@@varbox@c\vbox{\unvbox\flushend@@varbox@a}%
433 \fi
434 \var@@temp@spread=\ht\flushend@@tempbox@c
435 \advance\var@@temp@spread by-\ht\flushend@@varbox@c
436 \wlog@balance@debug{Left x: \the\ht\flushend@@tempbox@a
437 +\the\dp\flushend@@tempbox@a=\the\ht\flushend@@varbox@a
438 +\the\dp\flushend@@varbox@a::\the\@tempdimb
439 ^^JLeft 0: \the\ht\flushend@@tempbox@c
440 +\the\dp\flushend@@tempbox@c::\the\@tempdimb
441 ^^JRight x: \the\ht\flushend@@varbox@c
442 +\the\dp\flushend@@varbox@c=\the\ht\flushend@@varbox@a
443 +\the\dp\flushend@@varbox@a::\the\@tempdimb
444 ^^JExtra height:\the\var@@temp@spread\space when \the\@tempdimb
445 }%
446 \ifdim\var@@temp@spread<\z@ \advance\@tempdimb 1\p@ \repeat
447 \@tempdimb\ht\flushend@@tempbox@c
448 \wlog{- LAST -%
449 ^^JExtra skip:\the\var@@temp@spread
450 ^^JLeft:\the\ht\flushend@@tempbox@c/\the\dp\flushend@@tempbox@c
451 ^^JRight:\the\ht\flushend@@varbox@c/\the\dp\flushend@@varbox@c
452 ^^JOutput:\the\@tempdimb
453 }%
454 \setbox\flushend@@tempbox@c\vsplit\@tempboxa to\@tempdimb
455 \setbox\flushend@@varbox@c\vbox{\unvbox\flushend@@tempbox@a}%
456 \setbox\@leftcolumn\vbox to\@tempdima{%
457 \vbox to\@tempdimb{\unvbox\flushend@@varbox@c\vss}%
458 \hrule\height\flushend@@page@rule width\textwidth
459 \vss
460 }%
461 \global\ht\@leftcolumn=\the\@tempdima
462 \ifdim\top@@floatbox@skip>\z@
463 \setbox\@outputbox\vbox to\@tempdima{%

```

```

464         \vbox spread\var@@temp@spread{%
465             \unvbox\@outputbox
466             \vskip\top@@floatbox@skip
467             \unvbox\@tempboxa
468         }%
469     \vss
470 }%
471 \else
472     \setbox\@outputbox\vbox to\@tempdima{%
473         \vbox spread\var@@temp@spread{\unvbox\@tempboxa}%
474         \vss
475     }%
476 \fi
477 \fi
478 \setbox\@outputbox \vbox {%
479     \hb@xt@\textwidth {%
480         \hb@xt@\columnwidth {%
481             \fmt@box@adds{\box\@leftcolumn}\hss}%
482             \hfil
483             \vrule \@width\columnseprule
484             \hfil
485             \hb@xt@\columnwidth {%
486                 \fmt@box@adds{\box\@outputbox}\hss}%
487             }%
488         }%
489     \global\let\@outputdblcol\saved@orig@@outputdblcol
490     \global\atColsEnd}%
491 \ifvoid\hold@viper
492 \else
493     \setbox\@outputbox\vbox{\box\hold@viper\box\@outputbox}%
494 \fi
495 \@combinedblfloats
496 \@outputpage
497 \begingroup
498     \@dblfloatplacement
499     \@startdblcolumn
500     \@whilesw\if@fcolmade\fi
501         {\@outputpage\@startdblcolumn}%
502     \ifvoid\@viper
503     \else
504         \global\setbox\@viper\vbox{%
505             \vskip-\stripsep
506             \unvbox\@viper
507         }%
508         \csname @viperoutput\endcsname
509     \fi
510 \endgroup
511 \fi
512 }

```

Adds default balancing of the last page at the end of document.

```
513 \usepackage{etoolbox}
514 \AtBeginDocument{%
515     \global\let\saved@orig@@outputdblcol\@outputdblcol
516     \global\let\balanced@@outputdblcol\last@outputdblcol
517     \preto\enddocument{\let\@outputdblcol\balanced@@outputdblcol}%
518     \appto\footnoterule{\vskip\z@}%
519 }
```

User interface commands for the balancing pages.

```
520 \def\flushcolsend{\global\let\@outputdblcol\last@outputdblcol}
521 \def\raggedcolsend{\global\let\@outputdblcol\saved@orig@@outputdblcol}
522 \def\flushend{\global\let\balanced@@outputdblcol\last@outputdblcol}
523 \def\raggedend{\global\let\balanced@@outputdblcol\saved@orig@@outputdblcol}

524 \if@balance@debug
525     \showcolsendrule
526 \fi
```