

# How to Use “jcej.cls” Class File for the Journal of Chemical Engineering of Japan

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**Keywords:** Commands and Environments Provided by jcej.cls, \figref, \tabref, \Hline, Long Formulas

The Society of Chemical Engineers, Japan (SCE) provides a L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> class file, named jcej.cls, for the Journal of Chemical Engineering of Japan (JCEJ). This document describes how to use the class file, and also makes some remarks about typesetting a document by using L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>.

## Introduction

This document describes how to handle the jcej.cls for the Journal of Chemical Engineering of Japan (JCEJ). Section 1.1 explains how to typeset according to the template. Section 1.2 describes a special feature of jcej.cls, which is different to the article.cls provided by the standard L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> and which points may be aware of on writing a paper and so on. Section 2 is about typographic notes, which explains how to typeset, how to prevent typographic errors and how to handle long formulas. For information about printing on A4 paper and making pdf file, refer to Appendix (p.7).

## 1. How to Typeset Papers

### 1.1 Template

Here is the template. template.tex which is distributed with the jcej.cls can be used.

```
\documentclass[ResearchPaper]{jcej}
%\documentclass[SC]{jcej}
%\documentclass[letter]{jcej}
%\documentclass[journal]{jcej}
%\documentclass[editorial]{jcej}
\usepackage{graphicx}
%\usepackage[fleqn]{amsmath}
\usepackage{varg}{txfonts}
\usepackage{soul}
\begin{document}
\Year{2011}
\Vol{44}
\No{1}
\title{title}
\authorlist{%
```

```
\authorentry{name}{label}
\authorentry{name}{label}[label]
}
%\breakauthorline{1,2,3}
\affiliate[label]{affiliate}
%\paffiliate[label]{Present address}
\received{2010}{11}{26}
\accepted{2011}{1}{31}
\correspondence{name (E-mail address)}
%\presented{Presented at ...}
\begin{keywords}
keywords
\end{keywords}
\begin{abstract}
summary
\end{abstract}
\maketitle
\section*{Introduction}
...
\begin{Acknowledgments}
acknowledgments
\end{Acknowledgments}

\begin{Nomenclature}
...
\end{Nomenclature}

\lastpagebalanced{40mm}

%\bibliographystyle{jcej}
%\bibliography{myrefs}
\begin{thebibliography}{}
\bibitem[]{}
...
\end{thebibliography}
%\appendix
\end{document}
```

Received on November 26, 2010; accepted on January 31, 2011

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Motoaki Sato (E-mail: teppei@uls.co.jp)

**Table 1** Options of \documentclass.

options	types of contribution
ResearchPaper	<i>Research Paper</i>
SC	<i>Short Communication</i>
letter	<i>Letter to the Editor</i>
journal	<i>Journal Review</i>
editorial	<i>Editorial Note</i>

jcej.cls should be specified as a document class, not as an option. The layout is influenced with the following formatting request, twocolumn, twoside and fleqn, which are declared inside jcej.cls. There is no need to specify them as an option and other options changing the layout or all style parameters should not be specified.

- The types of contribution are specified as an option of \documentclass as shown in **Table 1**. Without optional arguments, jcej.cls will be formatted in “Research Paper” type.
- txfonts package is required because of a typeface for a manuscript is Times Roman.  
`\usepackage[varg]{txfonts}`  
 Note that if you require amsmath packages, it must be specified before txfonts package.
- soul package is required to underline the number and headings of \subsubsection. The *underline depth/thickness* of \setul are changed from .65ex/.15ex to .15ex/.3pt.
- The \Year, \Vol and \No commands are used for the header and footer.  
 For example, the year of publication is assigned as \Year{2011}. Also, the \Vol and \No commands are assigned as \Vol{44} and \No{1}.
- The title of a paper is assigned in \title. You may use \\ to start a new line in a long title.
- The outputs of authors’ names and marks of affiliates are automatically generated by using the \authorlist, \authoreentry and \affiliate commands.

The \authoreentry command must be described as an argument of the \authorlist command.

For example, they could be described as follows.

```
\authorlist{%
  \authoreentry{Author_First}{SCE}
  \authoreentry{Author_Second}{UU}
  \authoreentry{Author_Third}{SCE}[CEJ]
}
```

The \authoreentry command has two arguments.

`\authoreentry{name}{label}`

- The first argument of \authoreentry is filled with the author’s name in a capital letter and small letters. jcej.cls makes small letters of the family name small caps automatically. This command makes words after a first space small caps. If you have a middle name, it is necessary to combine a first name and a middle name with “~”.

- The second argument is assigned by the label of the author’s affiliate, corresponding to the label of the \affiliate command (see below). For example, an abbreviation for a department, institute or company can be given.  
 No extra spaces must be added between a letter and a brace. {SCE} and {SCE\_} are regarded as different.
- If you need to inform a present affiliate or address, the optional third argument which is described in brackets can be used as follows.  
`\authoreentry{name}{label_1}[label_2]`  
 The third argument is corresponding to the label of the \paffiliate command (see below).
- The \breakauthorline command is provided, if you would like to break a line of author’s lists at any point.  
`\breakauthorline{num,num,num,...}`  
*num* must be a positive integer. If “3” is specified, the line-break will be occurred after the third author. If “3,6” is specified, line-breaks will be occurred after the third and sixth authors.
- Author’s affiliate is described in the \affiliate command as follows.  
`\affiliate[label]{affiliate}`
  - The first argument *label* must be the same as the 2nd argument of the \authoreentry command. If the labels of affiliate are different from those of \authoreentry, there will come a warning message on your terminal.  
 The order of \affiliate generates a number on the right side of the author’s name corresponding to the label of the \authoreentry. This number will not generate when all of authors’ affiliates is same.  
 No extra spaces may be added between a letter and a bracket.
  - The second argument is filled with the author’s affiliate.  
 You may use \\ to start a new line in a long affiliate, and must not use \par or a blank line.
- The author’s present affiliate or address is described in the \paffiliate command as follows.  
`\paffiliate[label]{affiliate}`  
 The first argument must be the same as the third argument of the \authoreentry command.
- The \received command is required to generate the date of receipt of a manuscript. Those descriptions is in the order of *year/month/day*. For example, the date of receipt is assigned as follows.  
`\received{2010}{11}{26}`  
 The \accepted command is required to generate the date of acceptance.  
`\accepted{2011}{1}{31}`
- The \correspondence command is to inform where to make contact as follows for example.  
`\correspondence{name}`

(E-mail: xxx.yyy.zz).}

It generates “Correspondence concerning this article should be addressed to name (E-mail: xxx.yyy.zz).”

- If you need to describe a notation when a manuscript was first presented, the `\presented` command can be used.

```
\presented{Presented at  
the 2010 meeting at Tokyo.}
```

- The text of the keywords and the abstract are described in the `keywords` environment and `abstract` environment respectively.

The further information about them may refer to “Preparing and Submitting Manuscript” of SCE.

- The `\maketitle` command must come after those commands before the main text begins.
- The headings of “Introduction” and “Conclusions” does not require sectional number.

```
\section*{Introduction}
```

- If you might express your gratitude, the following description is recommended.

```
\begin{Acknowledgments}  
This work was financially supported  
by the SCE. etc.  
\end{Acknowledgments}
```

It generates “**Acknowledgments**” in bold face with an one line vertical space.

- For describing Nomenclature, refer to Section 1.2.6 and see also “Preparing and Submitting Manuscript” of SCE.
- For describing references (Literature Cited), refer to Section 1.2.7.

- The `\appendix` command is a declaration that changes the way that units with counter are numbered.

Equations are numbered “(A1)”, “(A2)”, ... captions of figures are numbered “Fig. A1”, “Fig. A2”, and so on.

The headings of `\section` is changed to be typeset in roman face with no extra vertical space.

- The balancing of left and right columns of the last page is required. You can use the `\lastpagebalanced` command on the left column.

```
\lastpagebalanced{40pt}
```

40pt is the height of a space at the bottom of the page.

The definition of this command is simple as follows.

```
\def\lastpagebalanced#1{%  
  \begin{figure}[b]  
    \vspace{#1}  
  \end{figure}  
}
```

## 1.2 Special Feature of jcej.cls

**1.2.1 Formula** A displayed formula is aligned on the left, a fixed distance (10pt) from the left margin, instead of being centered. A formula number is put on the right side.

Although a width of one column might be felt too

narrow to compose displayed formulas, equations should be composed with the proper length, paying attention to the message “Overfull \hbox”.

Section 2.2 describes several solutions and hints to handle a long formula.

**1.2.2 Numbers of Figures and Tables** When you refer to a figure or table number, it should be typed in bold face on the first reference.

The `\figref`, `\tabref` commands are provided. `\figref{fig1}` generates “**Figure 1**” for example when appears for the first time.

The `\figref` command decides to be typeset in bold or roman face, and also collapses a list of three or more consecutive numbers into a range, and sorts the numbers before collapsing them.

```
\figref{fig1,fig2} and \figref{fig3,fig2,fig1}
```

generates “**Figures 1 and 2**” and **Figures 1–3**.

There is a limit for their commands. The label of figure or table in appendix should not be referred, if referred, an error will occur.

**1.2.3 Including Graphics** Although there are many ways to include pictures and figures in L<sup>A</sup>T<sub>E</sub>X, the Encapsulated PostScript format (EPS) is recommended for publishing.

Here is a simple explanation to insert graphics into the text.

The `graphics` or `graphicx` package must be loaded. `dvips` is a device driver’s option and it might be changed according to a device driver you use or might be omitted.

```
\usepackage[dvips]{graphicx}
```

A graphics file (EPS file) produced by some tools can be included with the `\includegraphics` command.

```
\begin{figure}[tb]  
\begin{center}  
  \includegraphics{file.eps}  
\end{center}  
\caption{...}  
\label{fig:1}  
\end{figure}
```

If the option “`scale=0.5`” is given, the graphics will be scaled by half.

```
\includegraphics[scale=0.5]{file.eps}
```

You can get the same result as above by using the `\scalebox` command.

```
\scalebox{0.5}{\includegraphics{file.eps}}
```

If the option “`width=30mm`” is given, the width of graphics will be 30 mm (with the height proportionally scaled).

```
\includegraphics[width=30mm]{file.eps}
```

The next is another example using `\resizebox`.

```
\resizebox{30mm}{!}  
{\includegraphics{file.eps}}
```

Both dimension of width and height can be specified as follows.

```
\includegraphics[width=30mm,height=40mm]  
{file.eps}
```

**Table 2** caption

A	B	C
D	E	F

or

```
\resizebox{30mm}{40mm}
{\includegraphics{file.eps}}
```

For further information about the graphics package, see reference book (Lamport, 1994), (Goossens *et al.*, 1997).

**1.2.4 Table** The font size inside the table environments is set `\small` (9 pt) (see **Table 2**).

`\Hline` generates a thick line for the top and bottom rules.

```
\begin{table}[tb]
\caption{caption}
\label{table:1}
\begin{center}
\begin{tabular}{c|c|c}
\Hline
A & B & C \\
\hline
D & E & F \\
\Hline
\end{tabular}
\end{center}
\end{table}
```

#### 1.2.5 Captions of Floating Environment

- If you would like to break a line, you can use a `\\` command.
- `\label` must be located after `\caption`.

**1.2.6 Nomenclature** If you list symbols with their definition and SI units, the following description is recommended by using `tabular` or `tabbing` environment.

##### Input:

```
\begin{Nomenclature}
\tabcolsep0pt
\begin{tabular}{p{44pt}l}
$C_D$
&= drag coefficient [---]\\
$C_D$
&= drag coefficient for a group
of particles [---]\\
$D$
&= diameter of a particle orbit [m]\\
$d$
&= annular gap [m]\\
$d_p$
&= mean particle diameter [m]\\
\multicolumn{2}{l}{\langle Subscripts \rangle}
c
&= continuous phase (fluid)\\
d
&= dispersed phase (particles)
\end{tabular}
\end{Nomenclature}
```

```
\end{tabular}
\end{Nomenclature}
```

```
\begin{Nomenclature}
\begin{tabbing}
\hbox to 42pt{$C_D$}\hss
\> = drag coefficient [---]\\
$C_D$
\> = drag coefficient for a group
of particles [---]\\
$D$
\> = diameter of a particle orbit [m]\\
$d$
\> = annular gap [m]\\
$d_p$
\> = mean particle diameter [m]\\
$\langle$Subscripts$\rangle$ \> \\
c
\> = continuous phase (fluid)\\
d
\> = dispersed phase (particles)
\end{tabbing}
\end{Nomenclature}
```

##### Output:

###### Nomenclature

$C_D$  = drag coefficient [—]  
 $C_D$  = drag coefficient for a group of particles [—]  
 $D$  = diameter of a particle orbit [m]  
 $d$  = annular gap [m]  
 $d_p$  = mean particle diameter [m]  
 $\langle$ Subscripts $\rangle$   
 $c$  = continuous phase (fluid)  
 $d$  = dispersed phase (particles)

###### Nomenclature

$C_D$  = drag coefficient [—]  
 $C_D$  = drag coefficient for a group of particles [—]  
 $D$  = diameter of a particle orbit [m]  
 $d$  = annular gap [m]  
 $d_p$  = mean particle diameter [m]  
 $\langle$ Subscripts $\rangle$   
 $c$  = continuous phase (fluid)  
 $d$  = dispersed phase (particles)

#### 1.2.7 “Literature Cited” and Citations

1. In “Literature Cited” which is described in thebibliography environment, place references in the right order according to the JCEJ editing style; e.g., authors’ names, initials, title of article, journal abbreviation, volume number, pages, and publication year.  
For further information about describing references, see “A Handbook for Contributors to the the Journal of Chemical Engineering of Japan”.
2. On the other hand, in case using  $\BibTeX$  the bibliography style “jcej.bst” (in alphabetical order) is recommended, which is distributed with jcej.cls. For further information about jcej.bst, see jcej.bst itself.

The following descriptions is required to generate a

**Table 3** Citation Commands

description	generated words
<code>\citeauthoryear{FMi1}</code>	Goossens <i>et al.</i> (1994)
<code>\citeauthor{FMi1}</code>	Goossens <i>et al.</i>
<code>\citeyear{FMi1}</code>	1994
<code>\pciteauthoryear{FMi1}</code>	(Goossens <i>et al.</i> , 1994)

list of references. And a bib file named `myrefs.bib` for example should be prepared.

```
\bibliographystyle{jcej}
```

```
\bibliography{myrefs}
```

For example, the following list is generated after the `bibtex` program produced a `bbl` file.

```
\begin{thebibliography}{}%
```

```
\bibitem[\protect\bibauthoryear{
Goossens \bgroup \em et al.\egroup}
{1994}]{FMi1}
```

```
Goossens, M., F.~Mittelbach and
A.~Samarin; The \LaTeX\ Companion,
Addison-Wesley (1994)
```

```
\end{thebibliography}
```

`jcej.cls` provides following commands for citing authors and years.

```
\citeauthoryear
```

```
\citeauthor
```

```
\citeyear
```

```
\pciteauthoryear
```

Their commands and generated words are shown in **Table 3**.

**1.2.8 Verbatim Environment** You can change the values of the parameters in the `verbatim` environment. The default settings are:

```
\verbatimleftmargin=0pt
```

```
\def\verbatimsize{\normalsize}
```

```
\verbatimbaselineskip=\baselineskip
```

The left margin of the `verbatim` environment is set `0pt`. The font size is set `\normalsize`. The baseline skip is set the same of normal texts.

For example, those parameters can be changed as follows.

```
\verbatimleftmargin=10pt
```

```
\def\verbatimsize{\small}
```

```
\verbatimbaselineskip=10pt
```

**1.2.9 Some Small Macros Defined in `jcej.cls`**

- `\halflinekip` and `\onelineskip` produce a vertical space, a half of a line skip and one line skip respectively.
- `\QED`: Produces “□” in the end of the proof and so on. You would get the same output by using `\hfill $\Box$`. But if the end of a paragraph goes to the right margin, the character □ is positioned at the start of a line. Using `\QED` will prevent such cases.

### 1.3 AMS Packages

The  $\mathcal{AMS}$ - $\text{\LaTeX}$  packages are provided to typeset complex equations or other mathematical constructions.

If you would like to use them, the `amsmath` package should be loaded with the `fleqn` option.

```
\usepackage[fleqn]{amsmath}
```

While the `amsmath` package presents many functions, the `\boldsymbol` command which is to be used for individual bold math symbols and bold Greek letters is needed, only the `ambsy` package might be loaded.

```
\usepackage{ambsy}
```

Once the `amssymb` package is loaded, many extra math symbols of the  $\mathcal{AMS}$ - $\text{\LaTeX}$  fonts will become available.

```
\usepackage[psamsfonts]{amssymb}
```

For further information about the  $\mathcal{AMS}$ - $\text{\LaTeX}$  package, see reference book (Goossens *et al.*, 1994).

## 2. How to Prevent Typographic Errors

### 2.1 General Note

1. You should pay attention to a space after a period. “ $\text{\TeX}$  simply assumes that a period ends a sentence unless it follows an uppercase letter. This works most of the time, but not always—abbreviations like ‘etc.’ being the most common exception. You tell  $\text{\TeX}$  that a period doesn’t end a sentence by using a `\_` command (a `\` character followed by a space or the end of a line) to make the space after the period.” “On the rare occasions that a sentence-ending period follows an uppercase letter, you will have to tell  $\text{\TeX}$  that the period ends the sentence. You do this by preceding the period with a `\@` command.” (Lamport, 1994)  
Beans (lima, etc.)\\_ have vitamin B\@.
2. “Line breaking should be prevented at certain interword spaces. ... Trying `\_` (a tilde character) produces an ordinary interword space at which  $\text{\TeX}$  will never break a line.” (Lamport, 1994)  
Mr.\\_ Jones, Section\\_\ref{label}, (1)\\_gnats.
3. There should be no space after opening or before closing parentheses, as in `(\_word\_)`.
4. There are many cases of an inappropriate application of a `\_` or `\newline` command except in the tabular environment etc., such as two `\_` commands in succession or `\_` command just before a blank line. They will often cause warning messages like `Underfull \hbox ...`, as a result it would often prevent you from finding important warning messages. The use of `\par\noindent` or `\hfil\break` commands is recommended and gives you the same effect without warning messages.
5. There are some cases of an inappropriate application of a `\_` in descriptions such as program lists. Use of the `tabbing` environment or `list` environment is recommended.
6. The difference in the use of the hyphen (`-`), en dash (`--`) and em dash (`---`) should be noted. A hyphen is used in connecting English-language words such as ‘well-known’, and an en dash is used when ex-

pressing a range such as ‘pp.298–301’. The em dash is even longer—it’s used as punctuation.

- The difference when hyphen and en dash are used in maths mode should also be noted. Some examples are given below.

$A^{\mathrm{b}}\mathrm{b}\mathrm{c}$

$A^{\mathrm{b}-\mathrm{c}}$  ⇒ hyphen

$A^{\mathrm{b}}\mathrm{b}\mathrm{c}$

$A^{\mathrm{b}-\mathrm{c}}$  ⇒ en dash

$A^{\mathrm{b}-\mathrm{c}}$

$A^{\mathrm{b}-\mathrm{c}}$  ⇒ minus sign

- The less-than sign “<” (<, a relation) should not be confused with “<” (<, a delimiter). The same is true for the greater-than sign “>” and “>”.

- A unary operator and a binary operator: “A + or – that begins a formula (or certain subformulas) is assumed to be a unary operator, so typing  $-x$  produces  $-x$  and typing  $\sum -x_i$  produces  $\sum -x_i$ , with no space between the “-” and “x”. If the formula is part of a larger one that is being split across lines, T<sub>E</sub>X must be told that the + or – is a binary operator. This is done by starting the formula with an invisible first term, produced by an  $\mbox{}$  command with a null argument.” (Lamport, 1994)

$$\begin{array}{l} y = a + b + c + \dots + e \\ \quad + f + \dots \end{array}$$

$$\quad + f + \dots$$

$$\quad + f + \dots$$

$$\quad + f + \dots$$

- $\allowbreak$  may be used within long maths formulas in paragraphs instead of using  $\allowbreak$ ,  $\hfil\break$  or  $\linebreak$ , since T<sub>E</sub>X is reluctant to break lines there.

## 2.2 How to Handle Long Formulas

Here are some explanations how to handle long formulas, for example, over hanged equations, equations overriding the equation number, and so forth.

### Example 1:

$$y = a + b + c + d + e + f + g + h + i + j + k + l + m \quad (1)$$

The equation is too long, and the space between the equation and the equation number are too narrow and sometimes the equation number moves to the right. In this case the  $\!$  command is useful.

“The  $\!$  acts like a backspace, removing the same space amount of space that  $\,$  adds.” (Lamport, 1994)

$$\begin{array}{l} y = a + b + c + d + e + f + g + h + i + j + k + l + m \\ \quad + f + \dots \end{array}$$

$$\quad + f + \dots$$

$$\quad + f + \dots$$

$$y = a + b + c + d + e + f + g + h + i + j + k + l + m \quad (2)$$

**Example 2:** Using eqnarray environment instead of equation environment.

$$\begin{array}{l} y = a + b + c + d + e + f + g + h + i + j + k + l + m + n + o \\ \quad + f + \dots \end{array}$$

$$\quad + f + \dots$$

$$\quad + f + \dots$$

$$\quad + f + \dots$$

To typeset above, you will get the following output.

$$y = a + b + c + d + e + f + g + h$$

$$+ i + j + k + l + m \quad (3)$$

**Example 3:** To change the length of  $\mathit{mathindent}$  is to change the position that the equation begins.

$\mathit{mathindent}=0pt$  % <-- [1]

$\begin{array}{l} y = a + b + c + d + e + f + g + h + i + j + k + l + m \\ \quad + f + \dots \end{array}$

$\end{array}$

$\mathit{mathindent}=10pt$  % <-- [2] default length

To typeset above (see [1]), you will get the following output.

$$y = a + b + c + d + e + f + g + h + i + j + k + l + m \quad (4)$$

The length of  $\mathit{mathindent}$  must be restored (see [2]).

### Example 4:

$$\iint_S \left( \frac{\partial V}{\partial x} - \frac{\partial U}{\partial y} \right) dx dy = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds \quad (5)$$

The equation is too long and overrides the equation number. In this case the  $\lefteqn$  command is useful. It can be used for splitting long formulas across lines as follows.

$$\begin{array}{l} \lefteqn{\iint_S \left( \frac{\partial V}{\partial x} - \frac{\partial U}{\partial y} \right) dx dy} \\ \quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds \end{array}$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

$$\quad = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds$$

To typeset above, you will get the following output.

$$\iint_S \left( \frac{\partial V}{\partial x} - \frac{\partial U}{\partial y} \right) dx dy = \oint_C \left( U \frac{dx}{ds} + V \frac{dy}{ds} \right) ds \quad (6)$$

**Example 5:** A matrix using the array environment.

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix} \quad (7)$$

The width of a matrix can be shrunk by changing the length of  $\arraycolsep$  or using an @-expression (@{}).

$$\begin{array}{l} A = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right) \end{array}$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

$$\quad = \left( \begin{array}{cccc} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{array} \right)$$

```

a_{21} & a_{22} & \ldots & a_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
a_{m1} & a_{m2} & \ldots & a_{mn} \\
\end{array}
\right)
\end{equation}

```

The `\arraycolsep` dimension is half the width of a horizontal space between columns in the `array` environment. A matrix using the `array` environment can be shrunk by changing the length of `\arraycolsep` (see [1]). And also it can be shrunk by using `@`-expression (see [2]).

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix} \quad (8)$$

Compare Eqs. (7) and (8).

**Example 6:** A matrix using a `\pmatrix`.

```

\begin{equation}
\def\quad{\hskip.75em\relax}% <-- [1]
%% default setting is \hskip1em
A = \pmatrix{
  a_{11} & a_{12} & \ldots & a_{1n} \cr
  a_{21} & a_{22} & \ldots & a_{2n} \cr
  \vdots & \vdots & \ddots & \vdots \cr
  a_{m1} & a_{m2} & \ldots & a_{mn} \cr
}
\end{equation}

```

In the case of the equation using `\pmatrix`, the definition of `\quad` can be changed (see [1]).

If `amsmath` packages is loaded, the `pmatrix` environment must be selected instead of `\pmatrix`. In that case the explanation on Example 5 is useful.

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## Appendix

Printing on A4 paper and making pdf file

- If you print a manuscript on A4 paper by using `dvips` printer driver, the following parameter might be set.  
`dvips -t a4 -O 0mm,0mm file.dvi`  
“`-t a4 -O 0mm,0mm`” option might be omitted.
- You can directly make a pdf file by using `pdflatex`, or convert a dvi file to a pdf file by using `dvips` and `Acrobat Distiller` or `dvipdfmx`.
- If you convert a dvi file to a pdf file, you must first convert a dvi file to a ps file (printer is your printer name):  
`dvips -Pprinter -t a4 -O 0in,0in`  
`-o file.ps file.dvi`  
“`-t a4 -O 0in,0in`” option might be omitted. then, convert a ps file to pdf file by using `Acrobat Distiller`.  
You may also convert a dvi file to a pdf file by using `dvipdfmx`.  
`dvipdfmx -p a4 -x 1in -y 1in -o file.pdf file.dvi`  
“`-p a4 -x 1in -y 1in`” option might be omitted.