



Writing Numbers in Technical Documents

Perhaps you think these comments are pedantic. Some may be. But scientific reports, written or spoken, should reflect the precision of the experiments. Numbers and values submitted to editors or presented at meetings are sometimes hardly better than “umpteen zillion” or “every so often.”

—Vernon Booth

Communicating in Science

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Let's define our terms

A *number* (872) is an artificial construct to describe the size of something that has been measured, calculated, or counted

The special characters that represent numbers are *numerals* (8, 7, and 2)

87.2 is a *quantity**

unless it appears in a table, where it is a *value



Follow two fundamental rules for expressing numerical values

Use a number style that conveys information unambiguously

A realistic quantum simulator involving a hundred-thousand interacting spins that could be constructed in a few years has the potential to explore out-standing theoretical issues in condensed matter physics.

Maintain the style consistently throughout the text



Numbers <10 are usually written as words

Spell out cardinal numbers *one* to *nine* for things that are *counted*

two-state quantum system

nine separate experimental runs

three-body problem

Spell out ordinal numbers *first* to *ninth*

first occurrence

second question

seventh data run

“Zero” is usually written as a numeral
the x and y axes intersect at 0



Numbers >9 are written in numerals

Use numerals for quantities >9
for things that have been *counted*

18 months

128-processor Paragon[®] supercomputer

\$2.1 million

write out *million, billion, trillion* in words

Use numerals for ordinal numbers
greater than *ninth*

50th anniversary

21st century



Always express numbers that have been *measured* or *calculated* in numerals, even if they're <10

830 MHz

6 μg

77 K

213.5 Å

4 cm \times 4 cm



If an exact number is followed by a unit of measure, abbreviate the unit and write the number in numerals

Note the use of the “times” sign (\times), not a letter “x”

Units of measure are set in Roman type; they are not italicized



A space is usually inserted between a number and the unit of measure

Examples:

77 K, 250 kJ, 10 μm , 4 T

Use a non-breaking space to keep the number and the unit on the same line

Word—123Ctrl+Shift+Spaceunit or 

TeX—123~unit

Do not use an intermediate space in a few exceptions:

70% , \$100k, 15°, 45°C



A controversy is emerging between U.S. and European style in breaking 000s

According to IUPAP, a comma (,) should no longer be used to separate numbers having more than four digits into groups of three digits

12 578 896 *NOT* 12,578,896

Ideally, narrow or half spaces should be used

Be sure to use non-breaking spaces to avoid having part of the number marooned on a separate line



Approximate numbers follow the same rules as exact numbers

Same guidelines as exact numbers

Approximately **50 000** discrete events were recorded.

Approximately **one** sample in **seven** had to be discarded because of poor adherence of the thin film to the silicon substrate.

Do not abbreviate a unit that follows an approximate number

tens of kilohertz

thousands of volts

several millimeters



Very large approximate numbers are written as numerals followed by the word *million*, *billion*, or *trillion*

The renovation of the microanalysis laboratory will cost \$3.7 million and take nearly four years.

Overall, NSF funding increased by \$372.5* million to \$4.789 billion, **an** 8.4-percent increase over the previous year.

***Avoid awkward line breaks like this one**

The indefinite article preceding a number is chosen based on what the number sounds like when it is spoken



Mathematical operations are expressed in numerals

a factor of 4

a probability approaching 0

3×3 matrix

6 orders of magnitude

Fractional numbers written as decimals *must* have a zero preceding the decimal point

~~.3~~ cm 0.3 cm



A sentence may not begin with a number expressed in numerals

~~35~~ experimental runs were made.

Thirty-five experimental runs were made.

~~75~~-mm holes were drilled in the sample.

~~Seventy five~~-mm holes were drilled

Holes 75 mm in diameter were drilled...

Double penalties attach for beginning a paragraph, a figure caption, or a title with a number expressed in numerals



Qualifiers should not be used with exact numbers*

~~Approximately~~ 17 samples were contaminated with aluminum oxide.

Seventeen samples were contaminated with aluminum oxide.

****They sound ridiculous***



Numerals for quantities <10 are used in special cases

Names of parts of anything printed

Chapter 2, Vol. 3, No. 7, Fig. 4, Eq. 8
Table IV, Section 6.3.7, 2nd ed.

Locations

Row 3, Area 6

Time

17 ms, 5 s, 3 min (except days, months, and years—they're counted—and centuries, which are always spelled out)

Money

\$0.26 per unit, \$1.3 billion



Capitalization depends on position

When the noun comes before the number, capitalize it

Figure 7, Equation 21

Section 5

Model No. 34001x

When the noun lags behind the number, leave it in lower case

the seventh figure

the 5th edition

the 34001x model



Percentages and decimals require numerals

Write out the word “percent” in text

98.5 percent

3 percent

Use the percent symbol (%) only in headlines, tables, or graphics to save space

Decimals also require numerals (the quantities *had* to be calculated or measured, not counted)

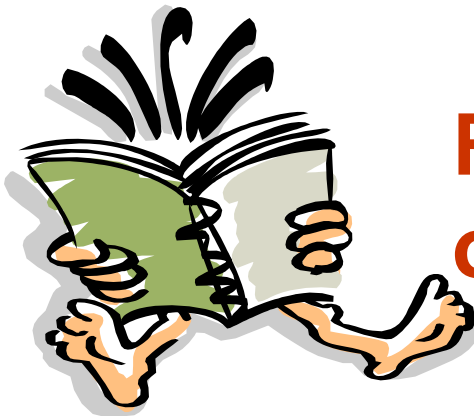
4.39 eV, 1.5 cm, 0.22 Å vs. 0.16 Å



Use numerals to express ratios

The ratio of epoxy to pigment should be 15 to 2.

“1:4” is read “one to four” and *means* “one out of five”



Read Vernon Booth’s chapter on “Dubious Ratios”



Avoid ambiguous ratios

“three times more than” =
“four times as much as”

Many readers interpret “times more than”
to mean “times as many as”—
avoid this ambiguity!

The footprint of our device is *one-fourth smaller* because of our integrated heating and cooling system.—????

The results are *10 times smaller* than expected.



Forming the plural of a number written in numerals

Plurals of single-digit numbers are formed by adding an apostrophe plus an s

“Binary code comprises 1’s and 0’s.”

Plurals of numbers >9 are formed by adding only the *s*—*no apostrophe*

Boeing 767s

expressed in 100s



Hyphenating numbers

Hyphenate numbers and units of measure *only* when they form a modifier that describes something else

The beam diameter is 25 μm .

The 25- μm beam provides excellent resolution.

Hyphenate numbers 21 through 99 when they are written as words

Forty-five days is the maximum the unit should be used without replacing the J17 filter.



Fractions and —*fold* numbers

Mixed integers and fractions are always written in numerals

2½ years, 3¼ percent

Hyphenate fractions written as words

two-thirds, three-quarters, one-fourth as many

Hyphenate “fold” numbers when written in numerals (numbers >9)

20-fold

100-fold

Do not use hyphens when written as words

threefold

sevenfold



Writing ranges of numbers requires special rules

Use an en dash (–), not a hyphen (-)

1985–1993; pp. 11–18; 4.38 eV–4.54 eV

Include all numerals to ensure accuracy

1348–1458, not 1348–458

**Include the units of measure for both
quantities in the range**

\$400–\$600; 10 μm \times 20 μm

The electron-beam sculpting technique was used to fabricate superconducting nanowires having widths of <8 nm and lengths of 30 nm–50 nm.



**A dash means “to” or “through,”
not “between”**

**Use *to* or *through* instead of a dash with
negative numbers to avoid confusion**

with temperatures of $-5-25^{\circ}\text{C}$

(is the latter number “ $+25^{\circ}\text{C}$ ” or “ -25°C ”?)

**Do not use *from* or *between* before a
range; it’s meaningless**

from 1993 to 1997, ***not*** from 1993–1997

between 11 and 17, ***not*** between 11–17



Express adjacent numbers in a combination of words and numerals to avoid confusion

15 4-mg doses

fifteen 4-mg doses

30 20-mm samples

thirty 20-mm samples

18 6-hour runs

eighteen 6-hour runs

In these examples, the numbers that express quantities that have been counted (doses, samples, runs) are expressed in words



Use correct descriptors

For quantities that are *measured*
less than, *more* than, *amount* of

“Less than 10 percent of the solution ...”

For quantities that are *counted*
fewer than, *greater* than, *number* of

“Fewer than half of the samples ...”

For *dimensions*

smaller than, *larger* than

Use “more than”—not “over”—to
indicate the larger of two quantities



Keep the number and the unit or the thing it is describing on the same line of text

“Joseph Lykken attempted to lower the string scale to the vicinity of 10^{-17} cm, the TeV scale.”

“In a 1995 paper, James Hurrell noted the marked similarity between the spatial patterns in surface air temperature trends during the previous 30 years and the winter-to-winter . . .”



Recommended References

The Chicago Manual of Style, 15th ed.
(University of Chicago Press, Chicago, 2003).

Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers, 6th ed. (Cambridge University Press, New York, 1994).

Microsoft Manual of Style for Technical Publications, 2nd ed. (Microsoft Press, 1998).

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