

ICS 03.120.30

A 41

**GB**

中华人民共和国国家标准

**The National standard of the People's Republic of China**

GB/T 8170-2008

Replaces GB/T 1250-1989, GB/T 8170-1987

---

## 数值修约规则与极限数值的表示和判定

Rules of rounding off for numerical values &

expression and judgment of limiting values

Issued on: Jul-16-2008

Implemented on: Jan-01-2009

Jointly issued by: General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization administration of the People's Republic of China

## Content

Preface .....	2
1. Scope.....	3
2. Terminology and definition.....	3
3 Rules of rounding off for numerical values .....	3
4. Expression and judgment of limiting values .....	6
Reference document.....	11

## Preface

The standard is formed based on GB/T 8170—1987 *Rules of Rounding Off for Numerical Values* and GB/T 1250—1989 *Expression and Judgment of Limiting Values* through integration and revision.

This standard substitutes GB/T 8170—1987 and GB/T 1250—1989.

Compared with GB/T 8170—1987 and GB/T 1250—1989, main change of technical content for this standard includes following:

-Revise format of the standard according to requirements of GB/T 1.1-2000 *Directives for Standardization-Part 1: Rules for the Structure and Drafting of Standards*;

-Add terminology "Rounding Off for Numerical Values" and "Limiting values", revise definition of "rounding interval", delete terminology of "effective number of digit", "Rounding off of 0.5 unit" and "rounding off of 0.2 unit";

-Delete relative contents such as "Designate that numerical values is rounded off into n effective number of digit " in Rules of rounding off for numerical values in Chapter 3 and reserve "Designate situation of digit";

- Add symbol "+" or "-" at upper right corner of numerical value rounded off but not behind numerical value when necessary, showing the value has been "rounded down" or "rounded up";

-Add "when one of comparison methods is regulated in the standard or relative documents, it cannot be revised as soon as confirmed " in two judgment methods of comparison on measured value or the calculated value and limiting values"; delete relative contents of absolute limiting values;

-When the method of rounding-off is adopted for comparison, it is emphasized that "when test or calculation precision is allowed, firstly indicate additionally one or more than one on obtained numerical value according to designated number of digit rounded off and round off to regulated number of digit according to procedure of 3.2."

The standard is put forward by China National Institute of Standardization.

The standard is under the jurisdiction of National Technical Committee on Application of Statistical Methods of Standardization.

Drafting unit of this standard: China National Institute of Standardization, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Guangzhou Product Quality Supervision and Testing Institute, Wuxi Product Quality Supervision, Testing Institute and Fuzhou Chunlun Tea Co., Ltd.

Drafter of the standard: Chen Yuzhong, Yu Zhenfan, Feng Shiyong, Deng Huixing, Ding Wenxing, Dang Hua, Cheng Huaying and Fu Tianlong.

## **Rules of rounding off for numerical values & expression and judgment of limiting values**

### **1. Scope**

The standard regulates rules of rounding off for numerical value, expression and judgment method of numerical limiting values, relative term and the symbol and the method of comparison on measured value or the calculated value and limiting values regulated by the standard.

The standard is suitable for each numerical value tested and calculated from scientific technology and production activity. When obtained numerical value needs to be rounded off, it should be implemented according to rules regulated by the standard.

The standard is suitable for compiling each standard or other technical specifications and judging testing result.

### **2. Terminology and definition**

Following terminology and definition are suitable for the standard.

#### **2.1 Rounding off for numerical value**

It is the process omitting some final digits of former numerical value, adjusting the reserved final digit and making the finally obtained value most approximate former numerical value.

Note: numerical value rounded off is called as value for rounding-off (of former numerical value).

#### **2.2 Rounding interval**

It is minimum numerical unit for value for rounding-off.

As soon as numerical value for rounding interval is confirmed, value for rounding-off is integral multiples of the numerical value.

Case 1: if rounding interval is designated as 0.1, value for rounding-off should be selected from integral multiples of 0.1, which is equal to round off numerical values to one decimal.

Case 2: if rounding interval is designated as 100, value for rounding-off should be selected from integral multiples of 100, which is equal to round off numerical values to "Hundred" digits.

#### **2.3 Limiting values**

It is Limiting value of numerical value range of indicator which is regulated to be examined in the standard (or technical specification), given as number form and is in accordance with requirement of the standard (or technical specification).

### **3 Rules of rounding off for numerical values**

#### **3.1 Confirming rounding interval**

a) Designate rounding interval as  $10^{-n}$  (n is positive integer), or indicate rounding off numerical values to n decimals;

b) Designate rounding interval as 1, or indicate rounding off for numerical values to "individual" digit;

c) Designate rounding interval as  $10^n$  (n is positive integer), or indicate rounding off numerical values to  $10^n$  digit, or indicate rounding off numerical values to "Ten", "Hundred", "Thousand"..... digit.

#### **3.2 Rule for rounding up or down**

**3.2.1** If one leftmost number of numbers to be rounded down is less than 5, which will be rounded down when other numbers are kept.

E.g.: 12.149 8 is rounded off to the position of unit, to get 12; 12.149 8 is rounded off to one decimal, to get 12.1.

**3.2.2** If one leftmost number of numbers to be rounded down is more than 5, one will be rounded up, namely, keep final number through adding 1.

E.g.: 1 268 is rounded off to "hundred" digit, to get  $13 \times 10^2$  (it can be written as 1 300 on special occasion).

Remark: in examples of the standard, "special occasion" means when rounding interval is clear.

**3.2.3** If one leftmost number of numbers to be rounded down is 5 and non-zero digit exists behind it, 1 will be rounded up, namely, keep final digit through adding one.

E.g.: 10. 500 2 is rounded off to position of unit to get 11.

**3.2.4** When one leftmost digit to be rounded down is 5; and there is no digit or all digits are zero behind it, if reserved final digit is odd number (1, 3, 5, 7, 9), then 1 is rounded up, namely, keep final digit through adding 1; if reserved final digit is even number (0, 2, 4, 6, 8), it will be rounded down.

Case 1: rounding interval is 0.1 (or  $10^{-1}$ )

Value to be rounded off      Value for rounding-off

1.050       $10 \times 10^{-1}$ , it can be written into 1.0 on special occasion)

0.35 4  $\times 10^{-1}$ , it can be written into 0.4 on special occasion)

Case 2: rounding interval is 1000 (or  $10^3$ ).

Value to be rounded off      Value for rounding-off

2 500       $2 \times 10^3$  (it can be written into 2 000 on special occasion)

3 500       $4 \times 10^3$  (it can be written into 4 000 on special occasion)

**3.2.5** When negative number is rounded off, its absolute value is firstly rounded off according to regulations of 3.2.1~3.2.4 and then minus sign is added before obtained value.

Case 1: following digits are rounded off to "ten" digit-

Value to be rounded off      Value for rounding-off

-355       $36 \times 10$  (it can be written into -360 on special occasion)

-325       $32 \times 10$  (it can be written into -320 on special occasion)

Case 2: following digits are rounded off to three decimals, namely, rounding interval is  $10^{-3}$ :

Value to be rounded off      Value for rounding-off

-0.036 5       $-36 \times 10^{-3}$  (it can be written into -0.036 on special occasion)

### **3.3 Continuously rounding off is not allowed**

**3.3.1** For digit to be rounded off, result can be obtained through once rounding off after rounding interval or designated rounding-off digit is confirmed; continuously rounding off can not be made for many times according to regulations of 3.2.

Case 1: round off 97.46 with rounding interval is 1.

Correct method: 97.46  $\rightarrow$  97;

Un-correct method: 97.46  $\rightarrow$  97.5  $\rightarrow$  98.

Case 2: round off 15.454 6 with rounding interval is 1.

Correct method: 15.454 6  $\rightarrow$  15;

Un-correct method: 15.454 6  $\rightarrow$  15.455  $\rightarrow$  15. 46  $\rightarrow$  15.5  $\rightarrow$  16.

**3.3.2** In specific implementation, sometimes test and calculation department firstly indicates additionally one or more than one digit on obtained numerical value according to designated rounding-off digit, which is then judged by other departments. Following steps should be made

according to following steps to avoid producing error of continuously rounding off.

**3.3.2.1** When rightmost non-zero digit of indicated numerical value is 5, add "+" or add "-" at upper right corner of numerical value or not add symbol, which respectively shows that it is rounded up, down or not being rounded up or down.

E.g.: 16.50<sup>+</sup> shows that actual value is more than 16.50, which is rounded down as 16.50 through rounding off; 16.50<sup>-</sup> shows that actual value is less than 16.50, which is rounded up as 16.50 through rounding off.

**3.3.2.2** If indicated value need to be rounded off, when one leftmost digit of digit to be rounded down is 5 and there is no digit behind it or all are zero, one will be rounded up for those with "+" on upper right corner of numerical value, those with "-" will be rounded down. Other should be made according to regulations of 3.2.

Case 1: following digits are rounded off to position of unit (another one position will be kept for indicated value to one decimal).

Measured value	Indicated value	Value for rounding-off
15.454 6	15. 5 <sup>-</sup>	15
-15.454 6	—15. 5 <sup>-</sup>	-15
16.520 3	16.5 <sup>+</sup>	17
-16.520 3	-16. 5 <sup>+</sup>	-17
17.500 0	17.5	18

### 3.4 Rounding off of 0.5 unit and rounding off of 0.2 unit

When numerical value is rounded off, the method rounding off of 0.5 unit or rounding off of 0.2 unit also can be adopted if necessary.

#### 3.4.1 Rounding off of 0.5 unit (rounding off of 0.5 unit)

Rounding off of 0.5 unit means that: make rounding off on numerical value of 0.5 unit to be rounded off according to designated rounding interval.

The method for rounding off of 0.5 unit is as below: value X to be rounded of is multiplied by 2. Make rounding off on 2X according to designated rounding interval and according to regulations of 3.2. Obtained numerical value (2X value for rounding-off) is divided by 2.

E.g.: following digits are rounded off to rounding off of 0.5 unit at "Individual" digit.

Value to be rounded off X	2X	2X value for rounding off	X value for rounding off
60.25	120.50	120	60.0
60.38	120.76	121	60.5
60.28	120.56	121	60.5
-60.75	-121.50	-122	-61.0

#### 3.4.2 Rounding off of 0.2 unit

Rounding off of 0.2 unit means that: make rounding off on numerical value of 0.2 unit to be rounded off according to designated rounding interval.

The method of rounding off of 0.2 unit is as below: value X to be rounded off is multiplied by 5, make rounding off on 5X according to designated rounding interval and according to regulations

of 3.2. Obtained numerical value (5X value for rounding-off) is divided by 5.  
 E.g.: following value are rounded off to rounding off of 0.2 unit of "Hundred" digit

Value for rounding-off X	5X	5X value for rounding off	X value for rounding off
830	4 150	4 200	840
842	4 210	4 200	840
832	4 160	4 200	840
-930	-4650	-4 600	-920

#### 4. Expression and judgment of limiting values

##### 4.1 General rule for writing limiting values

**4.1.1** For index or parameter etc given in quantity mode which is regulated to be examined in the standard (or other technical specification), limiting values should be regulated. Limiting values express boundary value within scope of numerical value conforming requirements of the standard. It can be expressed through giving minimum limiting value and (or) maximum limiting value or giving basic numerical value and limit deviation value etc.

**4.1.2** Expression mode of limiting values and written number of digit in the standard should be proper and its effective digit should be written out. Precision degree expressed by written number of digit can guarantee due performance and quality of products or other standardized object.

##### 4.2. Term expressing limiting values

###### 4.2.1 Basic terminology

**4.2.1.1.** See table 1 for basic terminology and symbol expressing limiting values.

Table 1 Basic terminology and symbol expressing limiting values

Basic terminology	Symbol	Basic term under specific situation			Remark
Be more than A	$>A$		Be more than A	Higher than A	Being not in accordance with requirements when measured value or calculated value is exactly A.
Be less than A	$<A$		Be less than A	Lower than A	Being not in accordance with requirements when measured value or calculated value is exactly A.
Be more than or equal to A	$\geq A$	Not less than A	Not less than A	Not lower than A	Being in accordance with requirements when measured value or calculated value is exactly A.
Be less than or equal to A	$\leq A$	Not more than A	Not more than A	Not higher than A	Being in accordance with requirements when measured value or calculated value is exactly A.

Remark 1: A is limiting values.

Remark 2: following idioms are allowed to be used for expressing limiting values:

- a) "Exceeding A" means that: numerical value is more than A ( $>A$ );
- b) "Less than A" means that: numerical value is less than A ( $<A$ );
- c) "A and above " or "at least A" means that: numerical value is more than or equal to A ( $\geq A$ );
- d) " A and below " or "at most A " means that numerical value is less than or equal to A ( $\leq A$ ).

Case 1: residual phosphor in steel is less than 0.035%,  $A=0.035\%$ .

Case 2: tensile strength of steel wire rope is more than ore equal to 22 X102 (MPa),  $A=22X102$  (MPa).

**4.2.1.2.** Basic term can be combined for using, expressing scope of limiting value.

Following terms and symbol can be allowed to be adopted for specific checking indicator X (see table 2). Only one symbol expression mode can be used in same standard.

Table 2 Combination term and symbol expressing limiting values which are allowed to be used for specific checking indicator X.

Comprehensive basic term	Combined allowable expression	Symbol		
		Express ion mode I	Expression mode II	Expression mode III
Be more than or equal to $A$ and less than or equal to $B$	From $A$ to $B$	$A \leq X \leq B$	$A \leq . \leq B$	$A \sim B$
Be more than $A$ and less than or equal to $B$	Exceeding $A$ and be equal to $B$	$A < X \leq B$	$A < . \leq B$	$>A \sim B$
Be more than or equal to $A$ and less than $B$	Be more than or equal to $A$ and less than $B$	$A \leq X < B$	$A \leq . < B$	$A \sim < B$
Be more than $A$ and less than $B$	Exceeding $A$ and be less than $B$	$A < X < B$	$A < . < B$	

#### 4.2.2 Numerical value with limit deviation value

**4.2.2.1** Basic numerical value with absolute upper limiting deviation value  $+b_1$  and absolute lower limiting deviation value  $-b_2$ , ranges from  $A-b_2$  to  $A+b_1$ , which conforms requirements and is denoted as  $A_{-b_2}^{+b_1}$ .

Remark: when  $b_1 = b_2 = b$ ,  $A_{-b_2}^{+b_1}$  can be abridged as  $A \pm b$ .

E.g.:  $80_{-1}^{+2}$  ranges from 79mm to 82mm, which conforms to requirements.

**4.2.2.2** Basic numerical value  $X$  with relative upper limiting deviation value  $+b_1\%$  and relative lower limiting deviation value  $-b_2\%$ , means that: relative deviation value  $[(R-A)/A]$  that measured value or the calculated value  $R$  in relation to  $A$  ranges from  $-b_2\%$  to  $+b_1\%$ , which conforms requirements and is denoted as  $A_{-b_2}^{+b_1} \%$ .

Remark: when  $b_1 = b_2 = b$ ,  $A_{-b_2}^{+b_1} \%$  can be abridged as  $A (1 \pm b\%)$ .

E.g.,:  $510 \Omega (1 \pm 5\%)$ , means that: relative deviation value  $[(R - 510)/510]$  of measured value or the calculated value  $R(\Omega)$  in relations to  $510 \Omega$  ranges from  $-5\%$  to  $+5\%$ , which is in

accordance with requirements.

**4.2.2.3** For basic numerical value A, if upper limiting deviation value  $+b_1$  and (or) lower limiting deviation value  $-b_2$  makes  $A+b_1$  and (or)  $A-b_2$  not conform requirements, brackets should be added and it should be written as  $A_{-b_2}^{+b_1}$  (not including  $b_1$  and  $b_2$ ) or  $A_{-b_2}^{+b_1}$  (not including  $b_1$ ) and  $A_{-b_2}^{+b_1}$  (not including  $b_2$ ).

Case 1:  $80_{-1}^{+2}$  (not including 2) mm, means that: range from 79mm to approximating but not more than 82 mm, which conforms to requirements.

Case 2:  $510 \Omega (1\pm 5\%)$  (not including 5%), means that: relative deviation value  $[(R-510)/510]$  of measured value or its calculated value  $R(\Omega)$  in relation to  $510\Omega$  ranges from -5% to approximating but not more than +5%, which conforms to requirements.

### **4.3 Method of comparison between measured value or the calculated value and regulated limiting values in the standard.**

#### **4.3.1 General rules**

**4.3.1.1** When judge whether measured value or the calculated value is in accordance with requirements of the standard or not, comparison should be made between obtained measured value through testing or the calculated value and regulated limiting values in the standard, comparison method can be adopted as below:

- a) Comparison method for full numerical value;
- b) Comparison method for value for rounding-off.

**4.3.1.2** If there is no special regulations on limiting values (including numerical value with limit deviation value) in the standard or relative documents, comparison method for full numerical value should be used. If comparison method for value for rounding-off is regulated to be adopted, it should be explained in the standard.

**4.3.1.3** If one of the comparison methods is regulated by the standard or relative documents for using, it cannot be revised as soon as confirmed.

#### **4.3.2 Comparison method for full numerical value**

For obtained measured value through testing or calculated value which is not rounded off (or is rounded off, but should be marked that it is obtained through rounding up, down or not through rounding up or down.), compare the numerical value and regulated limiting values. Those exceeding regulated scope of limiting values (irrespective of exceeding degree) should be judged as not conforming requirements. See table 3 for examples.

#### **4.3.3 Comparison method for value for rounding-off**

**4.3.3.1** Rounding off is made on measured value or the calculated value, rounding-off digit should be consistent with regulated limiting values digit.

When test or calculation precision is allowed, firstly indicate additionally one or more than one on obtained numerical value according to designated rounding-off digit; and then round off to regulated digit according to procedure of 3.2.

**4.3.3.2** Compare numerical value which is rounded off and regulated limiting values, so long as it exceeds regulated scope of limiting values (irrespective of exceeding degree), it will be judged as not conforming requirements. See table 3 for examples.

**Table 3 Example and comparison for comparison method for full numerical value and comparison method for value for rounding-off**

Project	Limiting values	Measured value or the calculated value	Whether to be in accordance with requirements according to comparison of full numerical value	Value for rounding-off	Whether to be in accordance with requirements according to comparison of value for rounding-off
Tensile strength of medium carbon steel /MPa	$\geq 14 \times 100$	1 349	Not conforming	13×100	Not conforming
		1 351	Not conforming	14×100	Conforming
		1 400	Conforming	14×100	Conforming
		1 402	Conforming	14×100	Conforming
		97.01	Conforming	97.0	Conforming
Mass fraction of NaOH /%	$\geq 97.0$	97.00	Conforming	97.0	Conforming
		96.96	Not conforming	97.0	Conforming
		96.94	Not conforming	96, 9	Not conforming
Mass fraction of silicon in medium carbon steel /%	$\leq 0.5$	0.452	Conforming	0.5	Conforming
		0, 500	Conforming	0,5	Conforming
		0.549	Not conforming	0.5	Conforming
		0, 551	Not conforming	0.6	Not conforming
Mass fraction of manganese in medium carbon steel /%	1.2~1.6	1.151	Not conforming	1.2	Conforming
		1.200	Conforming	1.2	Conforming
		1.649	Not conforming	1.6	Conforming
		1.651	Not conforming	1.7	Not conforming
Diameter of coil rod/ mm	10.0±0, 1	9.89	Not conforming	9, 9	Conforming
		9.85	Not conforming	9.8	Not conforming
		10.10	Conforming	10.1	Conforming
		10.16	Not conforming	10.2	Not conforming
Diameter of coil rod/ mm	10.0±0, 1 (not including 0.1)	9, 94	Conforming	9, 9	Not conforming
		9.96	Conforming	10.0	Conforming
		10.06	Conforming	10.1	Not conforming
		10.05	Conforming	10.0	Conforming
Diameter of coil rod/ mm	10.0±0.1 (not including+0.1)	9.94	Conforming	9.9	Conforming
		9.86	Not conforming	9.9	Conforming
		10.06	Conforming	10.1	Not conforming
		10.05	Conforming	10.0	Conforming
Diameter of coil rod/ Mm	10.0 ± 0.1 (not including -0.1)	9.94	Conforming	9.9	Not conforming
		9.86	Not conforming	9.9	Not conforming
		10.06	Conforming	10.1	Conforming
		10.05	Conforming	10.0	Conforming

Remark: cases in the table do not mean that all such kind limiting values should adopt comparison method for full numerical value or comparison method for value for rounding-off.

#### **4.3.4 Comparison between two judgment methods**

For measured value or its calculated value and the regulated limiting values, see table 3 for comparison result using comparison method for full numerical value and comparison method for value for rounding-off under different situation. For same limiting values, if it is in accordance with requirements, comparison method for full numerical value is relatively stricter, compared with comparison method for value for rounding-off.

## **Reference document**

[1]GB/T 699—1999 high quality carbon structural steel

[2] JIS Z 8401 Rules for Rounding off of Number Value