

1003型



双面计算尺 说明书

Instruction for the use of duplex Slide Rule

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TYPE 1003

1 → 1
1 → 10
1 → 10
10 → 100
100 → 1000
1 → 10
1 → 1
1 → 10
10 → 100
1 → 1 主尺的零
01 → 1

10 → 100

ARC

Instruction for The Use of 1003 Type Duplex Slide Rule

Preface

In order to simplify the procedure of calculations with greater ease and rapidity for the scientific and technological personnel, our company has designed and manufactured 1003 Type Duplex Slide Rule. As compared with any other

kind of slide rule, this new designed type evidently has many advantages, such as the enlargement of the scales, which enables it to widen the range of their calculations etc. This kind of slide rule proves to be most convenient for calculations in the field of common dynamics, mechanics, civil architecture and electrical engineering; besides, it can also be employed for calculations related to rate of change in chemical reaction, dampening of radiant isotope, temperaturational change and electrization in turbines and automatic control etc. Subsequently, it is an advanced computing instrument for the broad masses of the scientific and technological personnel.

I. Scales

Front face: there are 17 scales, namely (red) $\ln I_{-2}$, (red) $\ln I_{-1}$, (red) $\ln I_0$, (red) $\ln I_1$, DF, CF, (red) CIF, H_0 , H_1 , (red) H'_0 , (red) CI, C, D, \ln_1 , \ln_0 , \ln_{-1} , \ln_{-2} .

Rear face: there are also 17 scales, namely sh_0 , sh_1 , cu_1 , cu_2 , cu_3 , lg_1^{-1} , tg_0 (red ctg_0), tg_1 (red ctg_1), tg_2 (red ctg_2), \sin_0 (red \cos_0), srt_{-1} (red \cos_{-1} red ctg_{-1}), C, D, sq_2 , sq_1 , th_0 , ch_1 .

II. Multiplication and Division by Use of Scales

C, D and (Red) CI for Reciprocals

C and D are scales for the general multiplication and division, and at the same time they are in relation with other scales, specially for this reason in point, they are also known as the fundamental scales. CI is the inverted scale of C. D, which is used to determine the reciprocal of a given number, for successive operations, it is quite possible to convert multiplication into division and vice versa only by making use of (red) CI scale with the result that the pro-

cedure of calculation is to be simplified.

Example 1: $\frac{7.36 \times 8.44}{92} = (0.675),$ [estimated $\frac{7.2 \times 8}{90} = 0.64]$

Set the hairline directly over 7.36 on D scales, set 92 on C scale under the hairline, opposite 8.44 on C scale, read 0.675 on D scale.

Example 2; $18.5 \times 6.2 \times 4.75 = 18.5 \div \frac{1}{6.2} \times 4.75 = (545),$ [estimated $20 \times 6 \times 5 = 600]$

Set the hairline directly over 18.5 on D scale, set 6.2 on CI scale under the hairline, opposite 4.75 on C scale, read 545 on D scale.

III. Multiplication and Division by Employment of Scales CF, DF, (Red) CIF

CF and DF are the folded scales of C, D with the folding point at $\sqrt{10}$. Red CIF is the inverted scale of CF. Undoubtedly the procedure of calculations will be furthermore simplified by the joint use of scales C, D, red CI, CF,

DF and red CIF.

Example 3: $248 \div 7.25 = (34.2)$

Set the hairline directly over 248 on D scale, set 7.25 on CF scale under the hairline, opposite $\sqrt{10}$ on CF scale, read 34.2 on DF scale. (This method could not be applied to the scale with the folding point at π .)

Example 4: $22.7 \times 6.45 = (146.4)$

Move the slide, Set 1 on C scale opposite 22.7 on D scale, set the hairline directly over 6.45 on CF scale, read 146.4 on DF scale.

IV. How to Use Scales sq and cu

1. Set the hairline directly over any number x on D scale, then read \sqrt{x} under the hairline on sq scale and read $\sqrt[3]{x}$ on cu scale.

Example: $\sqrt{4} = (2)$, $\sqrt[3]{4} = (1.587)$

2. Set the hairline directly over any number x on sq scale, then read x^2 under the hairline on D scale. Example: $3^2 = (9)$.

3. Set the hairline directly over any number x on cu scale, then read x^3 under the hairline on D scale. Example: $4^3 = (64)$.

V. Scales of Trigonometric Function

There are many classifications for the trigonometric functional scales, such as tg_0 (red ctg_0) tg_1 (red ctg_1), \sin_0 (red \cos_0) etc. It should be noted that figures in black color represent computations for the positive functional angles, while figures in red color represent computations for the complementary functional angles.

Set the hairline directly over any angle with degree x on the scale of trigonometric function, read answer on C scale under the hairline, this is precisely the functional value of that angle which you would ascertain. In case of reverse operation, the angle with degree x could be found by means of the known functional value.

Example: $\sin 30^\circ = \cos 60^\circ = (0.5)$ $\operatorname{tg} 30^\circ = \operatorname{ctg} 60^\circ = (0.577)$, $\sin^{-1}.53 = (32^\circ)$

When $.573^\circ < x < 5.73^\circ$, it is necessary to use tg_2 (red ctg_2) scale and srt_1 (red \cos_{-1} red ctg_{-1}) scale.

Example 5: $\sin 2.5^\circ = (.0436)$, $\operatorname{ctg} 2^\circ = (28.6)$.

VI. The Scale of Common Logarithm \lg_1^{-1}

\lg_1^{-1} is a scale of common logarithm, which is used to determine the mantissa of the logarithm of any given number. For prefixing the characteristic to the mantissa for 1 and all numbers greater than 1, the characteristic is one less than the number of places to the left of the decimal point in the given number. For example: Here the characteristic is 1 and the mantissa is .398. $\lg 25 = (1.398)$.

For numbers smaller than 1, that is for numbers wholly decimal, the characteristic is negative and its numerical

value is one more than the number of ciphers between the decimal point and the first decimal which is not a cipher. For example, $\lg 0.25 = (\bar{1}.398)$.

Set the hairline directly over 25 on D scale, read the mantissa 0.398 under the hairline on \lg^{-1} scale, the characteristic of $\lg 0.25$ is -1 .

VII. How to Use Scales H_0 , H_1 and (Red) H'_0

Scales H_0 and H_1 are graduated according to $\sqrt{1 + (.1C)^2}$ and $\sqrt{1 + C^2}$ respectively, that is a sequent scale. Red

H'_0 scale is graduated according to $\sqrt{1-(.1C)^2}$. Since $\sin^2 x + \cos^2 x = 1$, $1 + \operatorname{tg}^2 x = \sec^2 x$, $1 + \operatorname{ctg}^2 x = \operatorname{csc}^2 x$, therefore, we could obtain the cosine, secant, and cosecant values of angles through the operation of these three scales. Examples:

$\cos 10^\circ = (.9848)$, set the hairline to 10° on sin scale, read .9848 on H'_0 scale.

$\sec 15^\circ = (1.0353)$, set the hairline to 15° on tg_0 scale, read 1.0353 on H_0 scale.

$\operatorname{csc} 17^\circ = (3.42)$, set the hairline to 17° on (red) ctg_1 scale, read 3.42 on H_1 scale.

H_0 , H_1 and (red) H'_0 are reading scales, they are impossible in calculation for continued multiplication and division in combination with any other scales, their chief purpose is destined for vectorization.

VIII. Four Black Scales of Natural Logarithm and Four Red Scales of Natural Logarithm

1. To ascertain reciprocals

The black scale of natural logarithm and its corresponding red scale are reciprocals mutually. Set the hairline directly over any number x on the black scale of natural logarithm, read $\frac{1}{x}$ value on the corresponding red scale of

natural logarithm. Set the hairline directly over any number x on the red scale of natural logarithm, read $\frac{1}{x}$ value on the corresponding black scale of natural logarithm. For example: the reciprocal of 10 is 0.1, the reciprocal of .8 is 1.25.

2. To find the natural logarithm for a real number which is greater than 1.

Set the hairline directly over any real number a on the black scale of natural logarithm, then read the value $\ln a$ under the hairline on D scale. For instance $\ln 20.1 = (3)$, $\ln 1.6 = (.47)$, $\ln 1.032 = (.0315)$, $\ln 1.00345 = (.00344)$.

3. To find the natural logarithm for a real number which is smaller than 1.

Set the hairline directly over any real number b on the red scale of natural logarithm, then read the value $\ln b$ under the hairline on D scale. For instance: $\ln .045 = (-3.1)$, $\ln .67 = (-.4)$, $\ln .9675 = (-.033)$, $\ln .9967 = (-.0033)$.

4. To find a^x

Set the hairline directly over any number a on the black (or red) scale of natural logarithm, move the slide, and meanwhile also set the hairline directly over 1 on C scale, then regulate the hairline to x on C scale, read the value a^x on the black (or red) scale of natural logarithm, and read the value a^{-x} on the corresponding red (or black) scale

of natural logarithm. For instance $1.15^{3.2}=(1.564)$, $1.15^{-3.2}=(.639)$, $.25^{-2}=(.0625)$, $.25^{-2}=(16)$.

5. To find $a^{\frac{1}{x}}$

Set the hairline directly over any real number a on the black (or red) scale of the natural logarithm, move the slide, and meanwhile also set the hairline directly over x on C scale, then regulate the hairline to 1 on C scale, read $a^{\frac{1}{x}}$ on the black (or red) scale of natural logarithm, and read $a^{-\frac{1}{x}}$ on the corresponding red (or black) scale of natural logarithm. For instance:

$$144^{\frac{1}{2}} = (12), \quad 144^{-\frac{1}{2}} = (.0833).$$

6. To find logarithm for any base

Example: To find $\log_9 729$ $\log_9 729 = \frac{\ln 729}{\ln 9} = \frac{6.57}{2.19} = 3.$

IX. How to Use the Scale of Hyperbolic Function

There are four major classifications of the scale of hyperbolic function sh_0 , sh_1 , th_0 , and ch_1 for the advanced 1003

Type Duplex Slide Rule. sh_0 and sh_1 are a sequent scale. Read θ radians on the scale of hyperbolic function, while read the value of hyperbolic function on D scale. For instance:

$$sh .39 = (.4), \quad sh 2.13 = (4.15), \quad th .424 = (.4), \quad ch .694 = (1.25).$$

X. Use of π -line, R-line, S-line and V-line

π (3.1416 on scales C, D, DF) ratio of circumference of circle to its diameter is used for operation of circle.

S ($\frac{\pi}{4}$ on CI scale)..... is used for computation of circle area in respect to its diameter. ($\frac{\pi}{4}d^2$)

V ($\frac{\pi}{6}$ on CI scale)..... is used for finding spherical volume of sphere in respect to its diameter. ($\frac{\pi}{6}d^3$)

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