"CONCISE"

CIRCULAR SLIDE RULES
AND
CONVERSION TABLES

CONCISE

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CONCISE

Manufacturers of Circular Slide Rule

PREFACE

The "Concise" Circular Slide Rule may best described as a useful instrument which saves time and labor when applied to solve many of the calculations that daily occur in practice.

By means of this ingenious little instrument one can easily solve with a sufficient degree of accuracy all manner of problems involving multiplication and division such as proportion, squares, square roots, cubes, cube roots, logarithms, trigonometric functions, etc.

The Merits of "Concise" Circular Slide Rule:

1) this slide rule helps facilitate the working out of multiple computation without error and without allowing the pointers to go off.

2) All the scales are divided by means of special deep cut graduations thus ensuring a life time of accurate calculation.

Slide Rule Diagram:

The slide rule diagram is provided for your convenience.

The symbols in the diagram are explained hereunder.

↗····· Set the graduation like th's.

↑ ····· Put the indicator line here.

*····· The sequence can be read off here.

The "Concise" Circular Slide Rule makes an ideal gift and is recommended as a "Give-away" item for friends and business associates. The name of your company or trade mark may be imprinted thereon, in the course of manufacture to meet your needs.

Contents:

1. Arrangement of scales and usage:

"Concise" Circular Slide Rules

Size mm	Cat. No.	Scale: Front face	Scale: Rear face	Character-istics
80	28	D. C. CI. A. K	Convers on Table	For small business use
95	320	D. C. CI. A. K	〃 and Calenda:	
〃	260	D. C. CI. A. K	D. S. T. S&T. L	
100	270	L. D. C. CI. A. K	DI.D.S.T$_1$.T$_2$. ST DI. D. SI. TI$_1$.	For general engi-neering and business use.
〃	271	〃	TI$_2$. SITI	
〃	280	A. D. C. CI. B. K	L.D.S.T$_1$.T$_2$.S&T	
110	300	K. A. D.C.CI.B.L	LL$_3$.LL$_2$.D.C.S. T$_1$. T$_2$. ST	For expert engineering use.
100		D. sin cos. cos^2	D. C. S. S&T. L	"Stadia" Computer

Usage of Scales:

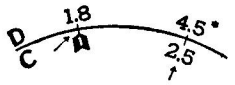
Scale	Remarks:
C, D	These are the fundamental scales of the "Concise" Circular Slide Rule. Multiplication and divison may be done freely.
CI	This scale is a supplement to C and D.
A, B	These are used for computation of squares and square roots conjointly with C and D scales.
K	This is used for computing cubes and cube roots conjointly with C and D scale.
L	This is the scale used to find logarithms in "reference scale" with D scale.
S, SI	These are used for Sin θ computation.
T,TI	These are used for Tan θ computation.
S&T	These are used to compute small angles by Sin θ and Tan θ.
LL$_2$, LL$_3$	These are the scales used to find the form of A^x in joint use with C scale.

2. Multiplication:

Of two given numbers:

Rule: Set 1 on scale C to multiply on scale D, against the multiplier on scale C read the product on scale D.

Example 1. $1.8 \times 2.5 = 4.5$ (Fig. 1)



set 1 on C to 1.8 on D, against 2.5 on C read 4.5 on D.

Fig. 1

Example 2. $3 \times 2 = 6$, $3 \times 5 = 15$, $3 \times 7 = 21$ (Fig. 2)

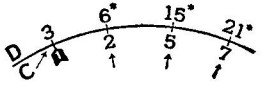


Fig. 2

Set 1 on C to 3 on D, against 2, 5, 7 on C and the answers 6, 15, 21 can be obtained on D respectively.

By means of "Concise" Circular Slide Rule you can accomplish many computations by single setting of the slide.

No instrument isneeded other than a circular slide rule.

Of three given numbers:

Example 3. $3 \times 4 \times 5 = 60$ (Fig. 3)

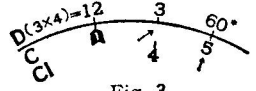


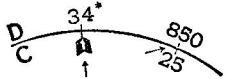
Fig. 3

Set 4 on CI to 3 on D, against 5 on C read 60 on D.

3. Division:

Of two given numbers:

Rule: Set the divisor on C to the dividend on D, against the index ⓐ of C read the quotient on D.



F.g. 4

Example 4. 850÷25=34 (Fig. 4)
Set 25 on C to 850 on D, against ⓐ on C read 34 on D.

Of three Given Numbers:

Example 5. 850÷25÷8=4.25 (Fig. 5)

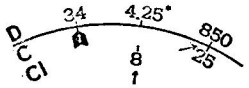


Fig. 5

Set 25 on C to 850 on D, against 8 on CI read 4.25 on D.

4. Mixture of Multiplication and Division:

When multiplication and division are mixed together, you can of course do them one by one in continuation; but for the sake of speed there is a simpler method. You may do both at once. Such instances occur very often and you must keep the method at your finger tips.

Example 6. $\frac{3\times6}{5}=3.6$ (Fig. 6)

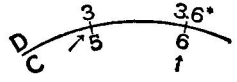


Fig. 6

Set 5 on C to 3 on D, against 6 on C read 3.6 on D.

5. Proportion:

As an example of the mixture of multipltication and division we shall deal with proportion.

Proportion can be found by the use of *"refernce scale method"* with reference to C and D scale. This method is widely applied for conversion, indexes, proportional division, percentage and also sale and purchase of commodities.

Rule. In order to solve $a:b=c:x$, set a on C to b on D, against c on C read x on D.

Example 7. $5:2.4=8:x$ Ans. 3.84 (Fig. 7)

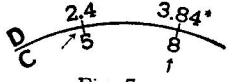


Fig. 7

Set 5 on C to 2.4 on D. against 8 on C read 3.84 on D.

Example 8. —Conversion:—

Fill the following blanks, given 1 lb=0.4536kg

lbs	45	63	(50.7)	(150)	180
kg	(20.4)	(28.6)	23	68	(81.6)

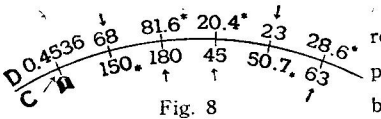


Fig. 8

For calculation reference to proportion relation between any concrete number or quantity and scale should be fixed until the operat on is finished.

Above example indicating "lb" is set on C scale and "kg" on D scale with fixed relationship.

Example 9. —Percentage:—

Fill up the blank columns in the following table:-

A	$ 350	(18.4)
B	450	(23.7)
C	500	(26.3)
D	600	(31.6)
sum	1900	(100.0)

Make the total sum of parts.

350+450+500+600=1900

set 100 on C to 1900 on D, against 350, 450, 500, 600, on C and the answers 18.4, 23.7, 26.3, 31.6 can be obtained on D.

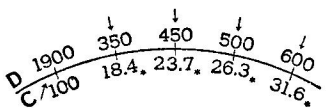


Fig. 9

Example 10. — Sale and pu chase: —

How much is 30 pcs. of a commodity @ 15 dollars per dozen; how many pcs. can be purchased at 40 dollars ?

Ans. $ 37.50,
32 Pcs.

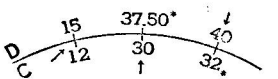


Fig. 10

6. Inverse Proportion:

With this circular slide rule, inverse proportion should be done invariably between D and CI.

Example 11.

There is a job 6 men complete in 14 days:
How many days will it take for 8 men to finish the job?

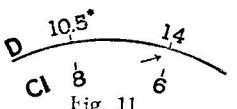


Fig. 11

Ans. 10.5 days (Fig. 11)

Set 6 on CI to 14 on D, against 8 on CI read 10.5 on D.

7. Squares and Square Root:

To extract squares, square roots, answer may be secured with A and C scales in the reference relation.

Example. 12

$3^2=9$ $3.52^2=12.4$

$\sqrt{25}=5$ $\sqrt{225}=15$

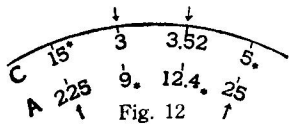


Fig. 12

Method of placing the decimal point for squares is the same as for that of multiplication.

In case of square roots, the given number is divided into several groups with two digits per group, counting from the decimal point in the direction of the first significant figure of a given number.

If the value in the top g oup is less than 10, the given number is set between 1−10 on A scale. If it is over 10, it is set between 10−100.

Place the decimal point of the answer, taking one digit per group.

How to use Gauge mark "*c*"

There is a gauge mark "*c*" at point 1.128 …… on D scale, which is used for relation of circle diameter and area. It is derived from the following formula,

area of circle $a=\frac{\pi}{4}d^2$ d=diameter of circle

Changing the form, $a=\left(\sqrt{\frac{\pi}{4}}\,d\right)^2=\left(d/\sqrt{\frac{4}{\pi}}\right)^2$

Denominator $\sqrt{\frac{4}{\pi}}$ in parenthesis corresponds to the value of c.

Example 13. Find the area of a circle with diameter of 2.3m.

Ans. 4.15m²

Reference scale:

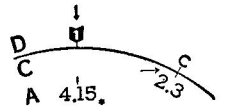


Fig. 13

A and D scales may be used as the "reference scale" Calculation of circle areas from many given diameters by the use of the guage mark *c* at the same time is shown in the following example

Example. 14.

Find circle area, given diameters of 2m, 2.3m, and 2.5m respectively.

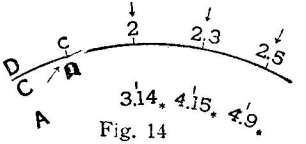


Fig. 14

(By the use of A and B scales)

— No. 280 No. 300 —

There is a gauge mark "*c*" at point 1.128……on C scale If the alue of a cylinder with 2.3m in diameter and 8m in length is required, set the gauge mark "*c*" on C scale to 2.3 on D scale, and then after the cursor is set to 8 on B scale, the volume 33.2m² is read on A scale under the hairline.

8. Cubes and Cube Roots:

These are to be done between C and K scales.

Example 15. $2^3=8$, $\sqrt[3]{125}=5$

In the case of calculating cube roots, given number is divided into several groups with 3 digits per group, counting from decimal point in the direction of the first significant figure. According to the significant figure in the first group being one, two or three, the given number is set in the section 1～10, 10～100, and 100～1000 of K scale respectively.

The method of placing the decimal point is determined on the basis of one digit per group.

9. Logarithms:

This work is done between D and L scales.

Common Logarithm:

A common logarithm with base of 10 includes integer (characteristic) and decimal fraction (mantissa). Equally graduated scale L is provided in order to find mantissa of a common logarithm.

Characteristic is mentally calculated from the following formula:

(number of places above decimal point of given number) -1

i, e. one less than the number of figures at the left of decimal point.

If given number is of m places under decimal point, characterisitic is $\overline{m}$ and simply put at the left of decimal point. $\overline{m}$ may be considered as the symbolic expression of $-m$.

Example 16. $\log_{10} 387.5 = 2.588$ $\log_{10} 0.02 = \overline{2}.301$

As shown by the above example, $\overline{2}.301$ of $\log_{10} 0.02$

means that characteristic is negative and mantissa is positive, and not permissible to multiply or divide as it is. In this case $0.301 - 2 = -1.699$ should be first computed. If given number is set on CI scale you can directly find out the complementary number of 0.301 *i. e.* 0.699 on L scale.

Anti-logarithms:

Form of $\log_{10}{}^{-1}x=a$ is given by the perfect reverse procedure of the preceding example.

Take mantissa only out of a given number x and set on L scale. Significant figure of number of logarithm a is given on the scale D, opposite this point.

One is added up to characteristic of logarithm x to place decimal point.

Example 17. $\log_{10}{}^{-1}\ 1.356=22.7$

Fxponent: —No. 300—

This (No. 300) slide rule provides LL_2, LL_3 scales which are two portions of folded scaels of a log scale in the range of 1.11～20,000 folped at the value of **e**.

In case of exponential computation A^n which is frequently used in an empirical formula, if n is positive, it is simply computed by the use of LL scale.

Example 18. $3.2^{6.5}=1910$

Set 1 on C to 3.2 on LL_3,

against 6.2 on C read 1910 on LL_3.

10. Trigonometrical Function:

(By the use of S and T scales)

— No. 260 *No.* 270 *No.* 280 *No.* 300—

Arrangement of trigonometric scales of these slide rules are adopted S (6°～90°), T(6°～45°), T_1(6°～45°), T_2 (45°～84°) and S&T.

The angle is graduated at degree and minute system. S&T scale is used for computation of sin θ and tan θ of small angle below 6°

Trigonometric Funciton and its multiplicaton & divison

(a) If it is requested to find only sin θ, tan θ and so on, set 90° on S to the index of on D, and set indicator on S or T and read answer on D scale under the hairline.

Read on DI scale, when its reciprocal is required.

If cos θ is required, the slide rule has no scale on directly for a cosine ; but taking advantage of

$$\cos\theta = \sin(90°-\theta)$$

have the sine of the complement angle of θ, and it is cos θ.

Note: $\theta > 45°$ (No. 260)

$$\tan\theta = \cot(90°-\theta) = \frac{1}{\tan(90°-\theta)}$$

(b) Multiplication and division, including trigonometric function is determined by combination of operation of S or T and D, DI scales.

Example 19. $\sin 32° = 0.53$ (Fig. 15)

$5.6 \times \sin 35° = 3.21$ (Fig. 16)

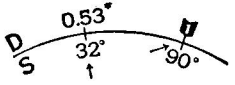


Fig. 15

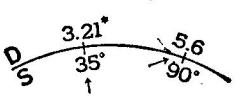


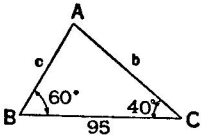
Fig. 16

Explanation referred to sin θ has been made in the previous paragraph. And also that of cos θ or tan θ is the same, except that complementary angle of S scale should be used to cos θ.

Sine Proportion:

Sine Proportion is performed through the use of *"reference scale method"* of S and D scales.

Example 20. Find b and c, in Fig. 17.



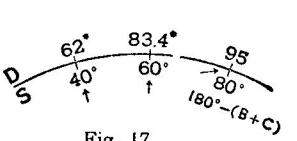


Fig. 17

Find angle A from $A = 180° - (B+C)$ and follow the procedure shown in the above Fig. 17.

Solution of Right Triangle:

Solution of right triangle and also to solve the vector and complex number by No. 270 slide rule efficiently may be carried out by joint use of S, T scales and DI scale. (Detailed explanation is indicated in the instruction of No. 271 slide rule.)

11. Trigonometric Function

(By the use of SI and TI scale.)

—No. 271—

This slide rule has trigonometric function scale such as SI (6°～90°) for sine, TI_1 (6°～45°) and TI_2 (45°～84°) for Tangent.

These scale are graduated with degree and minute system and so called inversed scale.

SI & TI scale is used for computation of sin θ and tan θ of small angle below 6°.

Trigonometric Function and its multiplication

Location of value of each trigonometric function is

shown by Fig. 18, when index of D scale is set on θ of SI scale Example 21.

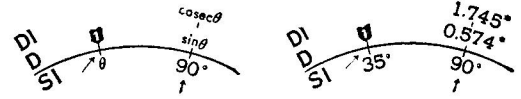


Fig. 18

Multiplicatiton and division are worked out with joint use of D. Calculation of sine is explained in the following example and tangent is also givgn in same way. except that TI scale is used instead of SI scale.

Example 22.

5.6 sin 35° = 3.21

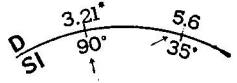


Fig. 19

Sine Proportion:

Sine Proportion is performed through the use of "*reference scale method*" of SI and DI scales.

(Detailed explanation is indicated on No. 270 slide rule.)

Solution of Right Triangles:

By the use of SI and TI scales, solution of right triangles is greatly simplified.

Fig. 20 indicates relation of base angle θ and side a, b, c,

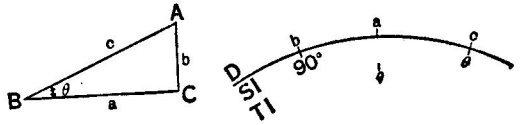


Fig 20

Example 23. Find θ and c, given a=5.4 b=3.2 in right triargle.

Answer

$\theta = 30°45'$

$c = 6.25$

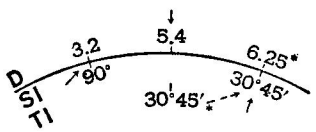


Fig. 21

This calculation is also applied to the form of $c=\sqrt{a^2 \pm b^2}$, which is called "Pythagorean theorem."

Example 24.

$\sqrt{1.8^2+3.5^2}=3.93$

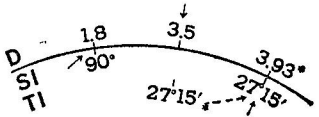


Fig. 22

Solution of Oblique Triangle:

By dividing the triangle into two right ones, we can finish the whole job by one setting of the slider.

Example 25. Find $\angle\theta$ and $\overline{AC}$ of triangle in Fig. 23.

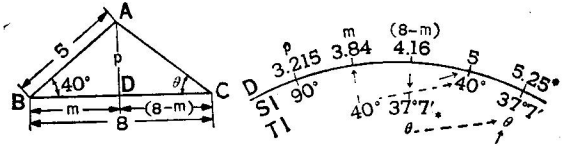


Fig. 23

You can solve rt. △ ABD of 5 and 40° to get $\overline{BD}$ (=m say) and $\overline{AD}$ (=p say); then rt. △ ADC of p and (8—m). One setting of the slider is sufficient to complete the task. Answer θ =37.7° $\overline{AC}$ =5.25

The sum of tow Vectors

Example 26. This is an applicat'on of Oblique Triangle, $\overline{OA}$ (8), $\overline{OB}$ (12), and $\angle AOB=40°$

Compute the sum of Vectors $\overline{OA}$ and $\overline{OB}$. It is similar to the solution of a triangle, having two sides 8 and 12 and an includ·d angle $180°-40°=140°$

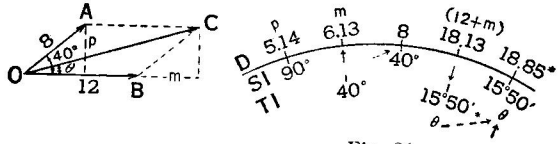


Fig. 24

m=6.13 12+m=12+6.13=18.13

θ=15° 50′ $\overline{OC}$=18.85

Gauge marks

ρ'' (20626 on D scale)
ρ' (3437.7 on D scale)
ρ° (57.29 on D scale)
} For conversion of small angle into Radian.

For small angle of $\theta < 6°$, unit of Radian which is converted from this degree is used, assuming $\tan\theta \fallingdotseq \sin\theta$, ρ'', ρ', and ρ° on D scale are conversion gauge marks respectively when θ is expressed in second, minute and degree.

Set θ on scale C, refers to these gauge marks.

Opposite index of D scale; read answer on C scale. Method of placing decimal point is estimated as follows; 1 second $\fallingdotseq$ 0.000005, 1 minute $\fallingdotseq$ 0.0003, 1 d gree $\fallingdotseq$ 0.02

12. "Concise" Stadia Computer:

The "sin cos" and "$\cos^2$" scales are given on this Slide Rule for the purpose of stadia calculations.

The "$\cos^2$" scale (red color) is used for direct calculation of horizontal distance and the "sin cos" scale (blak color) for vertical height. The graduations appearing in the middle of the slide are the extended portion of the "sin cos" scale.

Upon obtaining the angle α and reading "Kl" from the Stadia instrument, the horizontal distance "d" between the position of the instrument and the object of measurement, as well as the difference of veritical height "h" can be secured by means of the following:-

$d = Kl \cdot \cos^2\alpha$

$h = Kl \cdot \sin\alpha \cos\alpha$

K is the given factor of the Stadia instrument which is usually set at 100.

Example. Obtain "d" and "h" from the Stadia reading 538 feet and 12°30′, obtained from the Stadia instrument.

Ans. d=513 feet, h=113.7 feet.

Please note

1. Set the index (O) to 538 on scale D.
2. Against 12°30′ on Scale $\cos^2$ (red color) read 513 on scale D.……(horizontal distance.)
3. Against 12°30′ on scale sin cos (black color) read 113.7 on scale D.……(vertical height.)

13. How to use the "Conversion Tables"

Circular slide rule : D, C. CI, A, K.

Tables : Equivalents of Imperial, Metric and Japanese weights and measures.

Front face : Length, Weight.

Rear face : Square, Cubic & Capacity.

The following procedure should be taken to convert one unit to another one by the "Concise Weight and Measures Conversion Tables"

If you want to convert "one mile" to another unit, pull out the table till you find word " 1 " above "Mile" on the case.

And then you will get the line of figures.

1609.34 (meters), 1.60934 (kilometers), 63360 (inches), 5280 (feet), 1760 (yards), 5310.84 (shaku), 885.139 (ken), 0.40979 (ri).