STERLING

SLIDE RULE

A QUALITY INSTRUMENT FOR STUDENT OR PROFESSIONAL

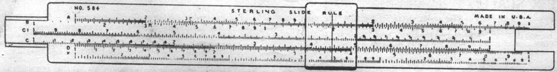
OPERATING INSTRUCTIONS

A complete course in use and operation of slide rule

The Sterling Student Slide Rule is an accurate and convenient instrument for use in computing multiplication, division, proportion, square and cube root problems, as well as sine, tangent and logarithm solutions.

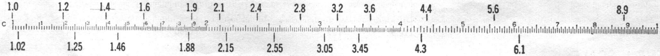
The reading of any slide rule is accurate to the second place in decimal work, therefore, approximation of the third place number can be done by mental calculation, by multiplying the last two numbers together and using the last figure as third number in these calculations. Accurate figures beyond this must be done by actual multiplication on paper.

The Sterling Slide Rule has standard A, B, C, C_1, D, and K scales. The A, D, and K scales are on the **body**, the B, C_1 and C scales on the **slide.** The **cursor** travels the full length of the body, and the hairline crosses these scales for direct comparison. On the reverse side of the slide, the S, L, and T scales appear, and the slide may be removed and reversed for use in calculating these factors for trigonometry problems.



MULTIPLICATION AND DIVISION

For this work, we use only the C and D scales, and in some cases the C_1 scale. The C and D scale are logarithmic, and start with the unit 1 at the left, thru the unit 10 (or 1) at the right. The space between 1 and 2 has small numbers indicating the "teens" following the left hand 1 or 10. The lines between the figures divide each segment into 10ths. The markings between 2 and 4 again represent individual numbers following 2 or 20, but the markings between unit numbers are in 5ths, or 2/10ths. From 4 to the right hand 1 or 10, each unit space is divided in halves, or 5/10ths. As you read the rule, therefore, these variations of the unit measures must be observed. The diagram below shows these as they appear on the rule, and gives readings as they appear:



MULTIPLICATION:

On a logarithmic scale, the progression of numbers is constant, therefore, the multiple of any unit or number of units can be read only if we place the factor 1 on the line of one of the factors in the problem. **The problem of 2 × 2 is therefore solved as follows:**

1—move the slide until the figure 1 at the **left** is over the 2 on the D scale. (Move the slide to the **right.**)

2—move the cursor until the hairline is over the 2 on the C scale on the slide.

3—the hair line will be over 4 on the D scale.

Similarly you will note 3 × 2 = 6, 4 × 2 = 8, 5 × 2 = 1 or 10 as you read across the scale.

Bear in mind that this 2 or the 2 on the C scale can represent, 2, 20 or 200. This must be remembered in writing down answers. Also remember that the answer to the problem **always** appears on the same scale from which you **started,** usually the D scale.

DIVISION:

Since division is the reverse of **multiplication,** we reverse the procedure shown in multiplication, as follows: **Problem:** divide 4 by 2. Start with 4 on the D scale. Move slide to **right** until 2 is over the 4. Against 1 to the **left,** read 2.

NOW	5 × 2 (1 of C over 5 of D—read 1 or 10 against 2 of C)
TRY	3 × 3 (1 of C over 3 of D—read 9 against 3 of C)
THESE	8 ÷ 2 (2 of C over 8 of D—read 4 against 1 of C)
PROBLEMS	5 ÷ 4 (4 of C over 5 of D—read 1.25 against 1 of C) (SEE BELOW)

For numbers which when multiplied are more than 10, it is necessary to achieve the same effect by using the **right** hand 1 (or ten) as the factor. For instance, 2 × 6 = 12. By placing the **right** hand 1 over 6 and reading against the 2 on the C scale, the cursor will indicate the 12 on the D scale. (**Left** hand 1 or 10 plus the small 2 equals 12)

Similarly, for division, 12 on D divided by 2 on C will read 6 under the **right** hand 1 of the slide.

	7 × 4 (**right** hand 1 on C over 7 on D. Read 28 on D below the 4 on C)
NOW	8 × 9 (**right** hand 1 on C over 9 on D. Read 72 on D below the
TRY	8 on C)
THESE	64 ÷ 8 (over 64 on D, place 8 on C. Against **right** hand 1 on C,
PROBLEMS	read 8)
	72 ÷ 9 (over 72 on D, place 9 on C. Against **right** hand 1 on C, read 8)

Some division or multiplication problems will "run off the rule." In this case, reverse the slide, using the **right** hand or **left** hand 1, and read the answer as shown.

EXAMPLE: 4 × 4—put **left** hand 1 on C against 4 on D. The 4 on C is "off the rule." Slide the slide to the **left** until the **right** hand 1 is over 4 on D. Against 4 on C, read 16 on D.

USING THE C_1 SCALE:

The C_1 scale is the same as the C scale, except that it reads from **right** to **left.** This scale is therefore the RECIPROCAL of the C scale, and can be used to avoid the necessity of moving the slide **left** or **right.**

EXAMPLE: 4 × 4—Reading from the RIGHT on C_1, place the 4 above the 4 on D—against the **left** hand 1 on C_1, read 16 on D. You are now using C_1, the reversed or reciprocal scale in place of the C scale, so read these two, C_1 and D against each other. (SEE BELOW)

24 ÷ 4—place **left** hand 1 on C_1 above 24 on D—Against 4 on C_1 read 6 on D.

By reading the C scale against the C_1 scale, you will note that the total of the two numbers always equals 1 or, 10 when multiplied together. Also, the C scale represents the fraction (decimal) of the C_1 scale.

EXAMPLE: 1/8 = .125—Against 8 on C_1 read .125 on C. (SEE BELOW)

USING THE A OR B SCALE:

The A and B scales are made up of 2 half size or half length logarithmic scales, therefore they are the SQUARE of the C and D scales. We can therefore square numbers shown on the C or D scale by reading the number times itself on the A or B scale. For practice, remove the slide. You now can clearly read the A against the D scale. Slide the cursor along, until the hairline is over 3 on D—you will read 9 on the **left** half of the scale. Slide it further along to 4 on D—you will read 16 on the **right** half of the A scale.

The square of 5 on D is 25 on the **right** scale of A. (SEE BELOW)

The square of 26 is 676 on the **left** scale of A.
The square of 19 is 361 on **left** scale of A.
The square of 55 is 3025 on the **right** scale of A.

Note that the products have **even** and **odd** numbers of digits. Example 1 and 4 have **even** numbers of digits. Examples 2 and 3 have **odd** numbers of digits. When square root is learned, this factor is most important in determining which scale to use.

SQUARE ROOT:

Since the A scale is the square of the numbers on D. in turn, the numbers on D are the square roots of the numbers on scale A. Of prime importance here is which half of the A scale to use when putting the number to be divided into its square root "into the rule." The rule for this is simple. If ODD number of digits, use the **left** scale. If EVEN number of digits, use the **right** scale:

The square root of 25 (even number of digits—**right** scale) is 5 on D
The square root of 250 (odd number of digits—**left** scale) is 15.81+ on D scale.
The square root of 2500 (even number of digits—**right** scale) is 50.

USING THE K SCALE:

The K scale, you will note, consists of 3 log scales instead of 2 as in A. The result is that these figures are the CUBE of the D scale figures. 3 × 3 × 3 = 27, or the cube of 3 can be read directly on K by placing the cursor over 3 on D and reading 27 on the MIDDLE part of K scale. Also, the CUBE ROOT of 64 read on K on MIDDLE scale, is 4 (4 × 4 × 4). Since there are 3 scales, left, middle, and right, the rule for use of them in determining the number to put "into the rule," the left scale is for numbers of 1 digit, the middle scale for 2 digit numbers, the right scale for 3 digit numbers.

The rule to be learned is as follows: FROM THE DECIMAL POINT, divide the **number into groups of 3 digits. Now. skip over the groups of 3 next to the decimal, and determine the number of digits in the "outside" numbers. If it is only 1 digit —use the left part of the K scale in your computation.** If 2 digits, the center part **of K, if 3 digits, the right side of K.** For instance:

1—125. has three digits **left** of decimal—use **right** K — 5 = CUBE ROOT
2—1.25 has 1 digit **left**—2 digits **right** of decimal. Since the number is more than 1 (by .25) the answer w'l be found in conjunction with the **left** scale (main number from 1 to 10) 12.5 would be read in the **middle scale,** since it has 2 digits in the whole number. 1250 has 1 digit **right** of the first set of 3 numbers, so answer would be found in **left** scale.
3—12,516 would be found in the **center** scale, because of 2 digits in second group away from the decimal point. Also, .125,160 would be found here, since there are 2 digits in the first "outside" group from the decimal point, having less than 3 digits (here 0 is discounted). If the figure were .125,164, the answer would be found in the **right** hand scale (3 digits in "outside" number).

THE L SCALE:

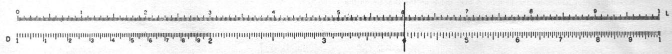
This scale is actually a graduated scale exactly 250 millimeters long. It is graduated into thousandths of this length since this length is the same as the log scale. Therefore, by reading a number on this scale, we can find the **logarithm** of any number on the D scale. Note that the numbers on the scale are preceded by a decimal point, reading therefore from 0 to 1.0. This is called base 10. The D and L scale should be matched for direct reading.

Be sure to include all decimal points, including the one on the scale in your answer. The logarithm is read directly on the D scale.

EXAMPLE: log. 4 (D scale) is .6025 (L scale)
log. 2 (D scale) is .301 (L scale)

Inversely, set the hairline over the number on the L scale, and you will **read the mantissa** of the logarithm on the D scale.

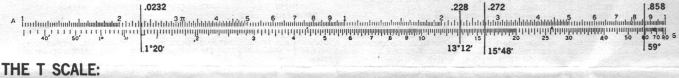
Mantissa—.6025 is 4.
Mantissa—.301 is 2.



THE S SCALE:

This scale is for direct reading of the sines of angles. The scale is divided in degrees, minutes and seconds. The scale is used in conjunction with the A scale to read the answer directly. It must be noted that sines above 60° must be carefully judged, since the scale decreases rapidly. The scale divisions are in minutes (60′ EQUAL 1°) with degree numbers in 10s.
To determine the Sine of an angle, follow this example:

Sin 15°48′—Set hairline over 15°48′ on S scale—read .272 on A. **(SEE BELOW)**
Sin 59°—Set hairline over 59 on S scale—read .858 on A.
Sin 1°20′—Set hairline over 1°20′ on S scale—read .0232 on A.
(Remember that the **left** scale on A is .1 of **right** scale, therefore an additional decimal is required.)
Sin 4°20′ is .0758.



THE T SCALE:

The tangent scale starts at 5.7° and increases up to 45° on the **right.** To find the tangent of 6°45′ or 6.75° place the hairline over 6°45′ on T and read .1185 on the D scale. **(SEE BELOW)**
It can be seen here also that multiplication of the sine or tangent is only a matter of finding the sine or tangent of the required angle. then transferring this to the D scale, by reversing the slide, and. putting the 1 of the C scale against the hair line; multiply as required, reading your answer on D.

EXAMPLE: With slide even with scale A, Sin 13.2° or 13°12′ reads 228 on A. **(SEE ABOVE)** Remove slide and turn over. Now transfer .228 to D and place left 1 of C on .228. To multiply this by, say 14.6, place cursor over 14.6 on C and read 3.33 on D at hair line.

In quick review, here is a problem in each of the scales: check your answers with these, and if any question, refer to the proper instruction:

24.5 × 13.7 (C & D scales) **Answer:** 335.65 (last 2 numbers approximated)
924 ÷ 16 (C & D scales) **Answer:** 57.75
42 × 42 (42²) (D & A scales) **Answer:** 1764 (end 2 of each number multiplied together gives last 4)
Square root of 2450. **Answer:** 49.5 (A scale—right half—answer on D)
9 × 9 × 9 (9³) D and K scale. **Answer:** 729 (approx. 730 on scale)
Cube root of 125 (D & K scales—right side of K because of 3 digits)
Answer is 5 on D scale.

Log 6—(REVERSE SLIDE—Use L and D scale)—.778
Sin 13.4° or 13°24′—S and A scale **Answer:** .232
Tangent 6.75° or 6°45′—T and D scale—.1185

Each of the functions may be used in conjunction with each of the other functions, if the problem is written out and each component is calculated in accordance with the functions of the rule.

ASK FOR AND USE STERLING ARCHITECT AND ENGINEERS SCALE RULES, PROTRACTORS AND TRIANGLES. Accurate and clearly marked for all problems in linear measurement, angle and radial computation. STERLING on the product is it's guarantee of QUALITY.

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