

# INSTRUCTIONS

FOR THE USE OF

## A. W. FABER'S

IMPROVED



# PRECISION CALCULATING RULES

No. **360** (10 in. scale length)

„ **363** (10 „ „ „ )

„ **369** ( 5 „ „ „ )

„ **389** ( 4 „ „ „ )

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## A. W. FABER

**STEIN** near Nuremberg

MANUFACTORY ESTABLISHED 1761.

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LONDON AGENCY:

13/14, Camomile Street, E. C. 3.

# BRIEF INSTRUCTIONS FOR THE USE OF THE RULE.

**Introduction.** By the aid of the Calculating Rule, multiplication and division can be effected with a sufficient degree of accuracy for most cases occurring in practice, while various other, and frequently rather complicated calculations, can be made quickly and with certainty. In addition, an entire series of algebraic, trigonometric and technical calculations can be carried out with the aid of the instrument, so that the Calculating Rule has now become indispensable to the student, engineer and the practical man.

The following brief instructions only indicate the fundamental calculations which can be carried out with the Calculating Rule. For special study the guide issued in book form is recommended; this contains numerous examples, with figures, furnishing the student with an excellent introduction to the practical application of the Calculating Rule.

**Definitions.** In the following instructions, the several parts of the Calculating Rule will be briefly referred to as follows: The two parts firmly connected with each other is the "rule"; the part movable in the rule is the "slide", and the sliding aluminium frame, carrying a glass plate with a line across it, is the "cursor". The graduations on the rule and slide from 1 to 100 are called the "upper scales", and those from 1 to 10, on the lower part of the rule, the "lower scales". The upper scale on the rule is called the A scale and the lower scale is the D scale. The upper scale on the slide is the B scale and the lower scale is the C scale. The graduations marked S and T, on the back of the slide are intended for reading the sines and tangents of angles to 90°, and 45° respectively. The graduations marked L on the same side of the slide, enable the logarithms of numbers of from 1 to 10 to be read off. At the back of the rule at the right and left ends, slots with special marks or "Indices" are formed, which are used when employing the S, T or L graduations.

The graduations on the rule represent graphically the logarithms of the numbers from 1 to 10 and from 1 to 100, as well as the logarithms of the trigonometrical functions. Multiplication and division can be carried out on the upper, as well as on the lower scales. In the upper scale, the distance, 1 to 10, is equal to that of 10 to 100, and the entire length of 1 to 100, is equal to the length of 1 to 10 on the lower scale. In consequence, the accuracy of the readings is greater by one decimal on the lower scale than on the upper one. The upper scale should be used chiefly where great accuracy is not important or for combined multiplication and division, which, however, can be executed also on the lower scales.

**Multiplication.** Two numbers are multiplied together by adding the distances corresponding to the numbers on the rule and slide.

Example, Fig. 1:  $2.45 \times 3.0 = 7.35$ .

Set 1 on the slide (B 1) under 2.45 on the upper scale (A 2.45), place the line on the cursor over 3 on the slide (B 3), and read off the product, 7.35, on the upper scale (A 7.35) of the rule under the line on the cursor.

If the calculation is to be made on the lower scale, place 1 on the slide (C 1) above 2.45 on the lower scale (D 2.45), move the cursor until its line is above 3 on the lower scale (C 3) on the slide, and read off the product, 7.35, on the lower scale (D 7.35) of the rule.

Example, Fig. 2:  $7.5 \times 2.5 = 18.75$ .

In using the upper scale proceed exactly as in Example, Fig. 1. When using the lower scale, however, it will be found that the second factor 2.5

no longer falls within the rule, and reading as before is consequently not possible. In this case, set C 10 above D 7.5, move the cursor line over C 2.5, and read under the cursor line D 18.75.

As will be evident from these examples, it is immaterial whether the setting is made with the right or the left end of the slide; this only affects the number of places in the result. It also follows from these examples, that continued multiplication, that is to say, when more than two factors are involved, can be carried out very easily, as the intermediate results need not be read off, it being only necessary to set the cursor to the second factor as before and to bring one end of the slide under the cursor, when the multiplication by the third factor can at once be made and read off, or further multiplications made.

Two numbers are divided, one by the other, by subtracting from one another the distances corresponding to the numbers; the divisor being always subtracted from the dividend.

Example. Fig. 3:  $8.25 \div 5.5 = 1.5$ .

Set the cursor to D 8.25, bring C 5.5 under the cursor line and read 1.5 under C 1.

If the calculation is to be made with the upper scale, set the cursor to 8.25 on A, bring B 5.5 under the cursor line and read 1.5 on A above B 1.

Compound calculations, that is to say, multiplications and divisions in immediate sequence can easily be made with the Calculating Rule. The intermediate results need not be read off if it is not necessary to know them, and after the last setting the correct final result will appear. It is best to begin such calculations with a division, then follow with a multiplication, then another division and again a multiplication and so on.

Practice is required in order to calculate quickly and with certainty by means of the Calculating Rule. The values of the separate graduations in the several scales must become impressed on the memory, more particularly those that are not marked with numbers. The estimation of all those numerical values which are not marked on the rule, must be practised, that is to say, the value of the spaces between adjacent graduations must be learnt. With some practice the requisite accuracy will be obtained, and it will be found that this estimating is not by any means as difficult as it appears at first sight.

The determination of the number of places in the result likewise requires some consideration. In nearly all cases the number of figures in the result will be known beforehand, and consequently only the numerical values come into question in these cases. It is only necessary to observe that the results will appear correctly on the rule if the factors can be set without changing the slide as explained in Exercise 2.

From the arrangement of the graduations on the upper scale, from 1 to 10 being equal to 10 to 100, and the whole, 1 to 100, being equal to 1 to 10 on the lower scale, it is evident that above any number on the lower scale its square can be read on the upper scale. Reversely, below each number on the upper scale is found its square root on the lower scale.

Example, Fig. 4:  $3^2 = 9$ .

Place the cursor line over D 3, and under the line, read square (9) on A.

Example, Fig. 4:  $\sqrt{81} = 9$ .

Place the cursor line over A 81, and read off under the cursor line, the square root (9) on D.

The raising of a number to its third power or the extraction of a cube root will be most easily shown by an example:

Example, Fig. 4:  $1.4^3 = 2.744$ .

Set C 1 to D 1.4, move the cursor line over B 1.4 and read 2.744 on A under the cursor line.

**Division.**

**Reading  
the Scales.**

**Number of  
Places in Result.**

**Squares and  
Square Roots.**

**Cubes and  
Cube Roots.**

Example, Fig. 5:  $\sqrt[3]{1.728} = 1.2$ .

Set the cursor to 1.728 on A, move the slide (in this case to the right) until the same number (1.2) appears simultaneously on the upper scale of the slide under the cursor line, and on D under C 1.

**Sines and Tangents.**

To determine the values of the sines and tangents of any angle, the scales marked S and T on the back of the slide are used with the index marks in the slots at the ends of the Calculating Rule.

Example, Fig. 6:  $\sin 32^\circ = 0.5299$ .

Set the angle  $32^\circ$  on the S scale either under the right hand or the left hand upper index in the slots, and read off the value of the sine (0.5299) on the upper scale of the slide, either under 100 or 1 of A.

Example, Fig. 7:  $\tan 7^\circ 20' = 0.1286$ .

Set the angle  $7^\circ 20'$  on the T scale above the left hand lower index and read off the value of the tangent (0.1286) on C above 1 on D.

It must be observed, that the values of the sines and tangents up to  $5^\circ 40'$ , are read as 0.01 . . . . those above  $5^\circ 50'$  being read as 0.1 . . . .

**Logarithms.**

As remarked above, the scale marked L on the back of the slide, enables the mantissa of a given number to be found.

Example, Fig. 8:  $\log 1.35 = 0.1303$ .

Set C 1 above D 1.35 and read off the mantissa of the log. (0.1303) on the L scale above the right hand lower index.

**Mark C and C<sup>1</sup>.**

Set C or C<sup>1</sup> on the slide over a given diameter (d) on D and then on B over 1, 10, or 100, will be found the area of a circle of the given diameter  $\left(\frac{\pi d^2}{4}\right)$  on A.

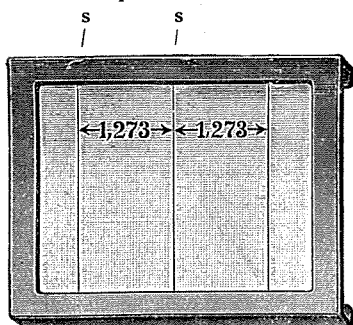
Example: Set C<sup>1</sup> over 7 c. m. on D and read on A 38.5 sq. c. m.

Keeping the slide in the same position, the contents of a cylinder can be found by looking along the slide to the value corresponding to the height of the cylinder, and then reading off the value on the scale A.

Example: Area of circle above = 38.5 sq. c. m. No. 1 on the slide is in line with this. Height of cylinder = 4 c. m. and on A, over this figure on the slide will be found 154 cubic c. m.

**Instructions for the Three-Line Cursor.**

**Cursor for 2 equal constants.**



The cursor is employed whenever methods of calculation have to be employed which frequently repeat themselves and which contain constant factors, as for example the calculation of a cross section from the diameter, or the contents of a cylinder from the diameter and height. This calculation is simplified by use of the side lines which are  $1.273 = \frac{4}{\pi}$  from the centre line and results can be read off straight away, with only one setting of the cursor.

Example: What is the content of a cylinder 1.24 meters in diameter and 3.24 meters long?

One sets the cursor line "d" on the diameter of the cylinder on the scale D (1.24), then above it on the scale A will be found the section of the cylinder

= 1.207 sq. m. Above B 3.24 will be found on A the cubic content 3.91 c. m.