# INSTRUCTIONS

FOR THE USE OF

# A. W. FABER'S CALCULATING RULE

**No. 378**

## FOR ELECTRICAL AND MECHANICAL ENGINEERS.

MANUFACTORY ESTABLISHED 1761.

MANUFACTORIES

in

GERMANY, FRANCE AND UNITED STATES.

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LONDON, PARIS, BERLIN AND NEWARK (N.J.) U.S.A.


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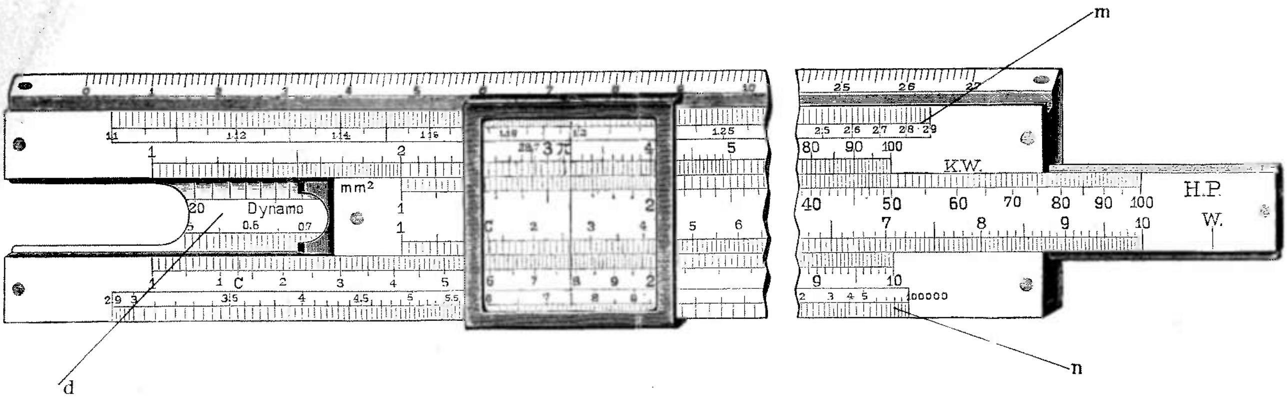
# Instructions.




The **A. W. FABER new Calculating Rule** differs from the ordinary calculating rule in that it is wider and is exclusively intended for **Electrical and Mechanical Engineers.** Nevertheless, it can be used for all such calculations as are possible with the ordinary calculating rule. By means of this new arrangement it is possible, however, to make three further important calculations which are shortly explained in the following instructions, with the aid of examples.

**Log-log Scales.**

On the upper face of the rule are two additional scales, **m** and **n** (see illustration). These are the so-called log-log scales. These two scales form a continuous log-log scale running from 1.1 to 100,000, divided into two parts on account of its great length. The first part runs from 1.1 to 2.9, and the second part from 2.9 to 100,000. With the aid of the cursor and the lower scale on the slide, powers and roots within the limits 1.1 and 100,000, and of the form $a^x$ or $\sqrt[x]{a}$ can be obtained, in which neither **a** nor **x** need be a whole number. The choice of the lower limit, 1.1, was determined by the most usually occurring values, and the length of the scale then determined the upper limit, 100,000. Both parts of the log-log scales extend somewhat beyond the limits of the ordinary log scales on the rule; while on the lower scale of the slide, to the right of 10, is a special index mark, **W**, the length 1-W being equal to the length from 1.1 to 2.9 on the log-log scale.

**Raising to Powers.**

Example 1: $1.124^{2.24} = 1.2993$.

Set the cursor to 1.124, on the log-log scale, and bring 1 on the lower scale on the slide under the line on the glass; then set the line on the glass to the exponent 2.24 on the lower scale of the slide, when the power, 1.2993 can be read off on the log-log scale **m**, under the line on the cursor.

As will be seen from the above example, the reading of results which do not exceed 2.9, is very simple. But if the number, when raised to the given power, exceeds 2.9, then the special index mark **W** is used in place of 1 and the result is found on the lower log-log scale **n**, **i.e** between 2.9 and 100,000.

Example 2: $1.665^{3.17} = 5.03$

As before, set the cursor to 1.665 on the log-log scale, bring **W** on the lower scale of the slide under the cursor line, set the cursor to the exponent 3.17 on the lower scale of the slide and read the power, 5.03, on the lower log-log scale, under the cursor.

**Extracting roots.**

Example 3: $\sqrt[2.8]{26.5} = 3.22$.

Set the cursor to 26.5 on the log-log scale, bring the exponent, 2.8 on the lower scale on the slide under the cursor line, and after setting the cursor to 1 on the lower scale on the slide, read off the root, 3.22, on the lower log-log scale.

If the root is less than 2.9, the special index mark **W** is used, and the result is found on the upper log-log scale **m**.

Example 4: $\sqrt[7.15]{8.75} = 1.354$.

Set the cursor to 8.75 on the log-log scale; bring the exponent 7.15 on the lower scale on the slide under the cursor line, the cursor to the index mark **W**, and read off the root, 1.354, on the upper log-log scale.

If in extracting roots the result falls below 1.1, the calculation cannot be made with this slide rule; neither can numbers less than 1.1 be raised to powers.

**Graduations on the Bottom of the Calculating Rule.**

The measuring scale has been omitted from the bottom side **d** of the Calculating Rule and has been replaced by two new sets of logarithmic graduations, which are read by means of the metal indicator attached to the left end of the slide. The upper of the two scales enables the efficiency of dynamos and electric motors to be calculated, or the out-put in kilowatts, or the effective horse power, with a given degree of efficiency; and this with a single setting of the slide.

By the lower scale, and with only two settings of the slide, the loss of potential in an electric circuit can be calculated from the quantities: current strength, length of lead, and section of lead. Obviously any one of these four factors may be the unknown quantity. The scale is only applicable to direct current calculations, or for an alternating current free from induction.

For simplicity the upper scale will be called the "Efficiency Scale" and the lower graduations, the "Loss of Potential", or "Voltage Loss Scale".

The upper ordinary log. scale of the rule is marked "KW", signifying Kilowatts, on the right; the upper scale on the slide is marked "H.P.", signifying effective horse-power. The upper scale on the bottom of the rule, that is the efficiency scale, gives the efficiency of dynamos (from 100 to the left); and the efficiency of motors (from 100 to the right).

**Efficiency of Dynamos.**

Example 5: Determine the efficiency of a dynamo of 90 KW and 132 H.P.

Set 13.2 on the upper scale of the slide (corresponding to 132 H.P.) under 90 KW on the upper scale of the rule, and read off, at the left end of the slide, 91.3 % on the efficiency scale for dynamos.

From this example it is at once eviden[illegible] at with a given degree of efficiency all possible electrical and effective h[illegible] powers can be immediately read off with a single setting of the slide.

For this purpose, the left end of the slide [illegible] o the degree of efficiency, and the corresponding values are read off on [illegible] upper scales on the rule and slide respectively.

Example 6: Efficiency 90 %.

Set the left end of the slide to 90 on t[illegible] [illegible]mo" scale, and above H.P. = 20, read KW = 13.41; above H.[illegible], KW = 33.6; above H.P. = 100, KW = 67.1 etc.

**Efficiency of Motors.**

Example 7: Determine the eff[illegible] of a motor of 20 H.P. and 17.1 KW.

Set 2 on the H.P. scale to 17.1 on the KW scale and read off the efficiency (87.3 %) on the "Motor" scale. From this example it is also evident that for [illegible] given efficiency, the power in KW can be read immediately above any H[illegible]

**Scale of Loss of Potential — Voltage Loss Scale.**

The use of the "Voltage Loss Scale" is as simple as that of the sc[illegible] last described. The loss of potential in a simple copper lead with dir[illegible] current, or with alternating current free from induction, is determined by the formula $e = \frac{J \times L}{c \times q}$, in which **e** denotes the loss of potential in volts, **J**, the current strength in amperes, L the single length of lead in metres, **q**, the necessary sectional area of the copper, and **c**, a copper constant, which on the slide rule has been taken as 28.7. The voltage loss scale gives the loss of potential from 0.5 to 10 directly in volts.

**Example 8:** Determine the loss of potential for a copper lead of 70 sq. mm. section and 80 metres in length, with a current strength of 60 amperes.

Set 1 on the upper scale on the slide to 6 on the upper scale on the rule, bring the cursor line to 8 on the upper scale on the slide (obtaining the product $J \times L$); then bring 7 on the upper scale on the slide to the cursor line (obtaining the quotient $\frac{J \times L}{q}$, and read, at the left end of the slide on the voltage loss scale, 2.38 volts. The advantage afforded by the slide rule now becomes evident, for if the loss of potential found is too great, a further setting of the slide enables the sectional area to be found for any desired loss of potential. Thus, suppose for example, the loss of potential is to be only 1 volt. The cursor is kept unchanged in position, the left end of the slide set to 1 on the voltage loss scale, and 167 sq. mm. is read off under the line on the cursor, on the upper scale of the slide.

If the left end of the slide is set to a certain loss of potential and the cursor to a certain section, then by moving the slide, all values of the product "length of lead" and "strength of current" can be obtained, which are applicable to the known section and loss of potential.

Thus, by means of the voltage loss scale, any one of the factors in the above formula can be very easily ascertained, if the other factors are known.

The rule has the constants 28.7 and 746 marked on the upper scales of both rule and slide, while on the back of the rule is a collection of useful constants and other data.