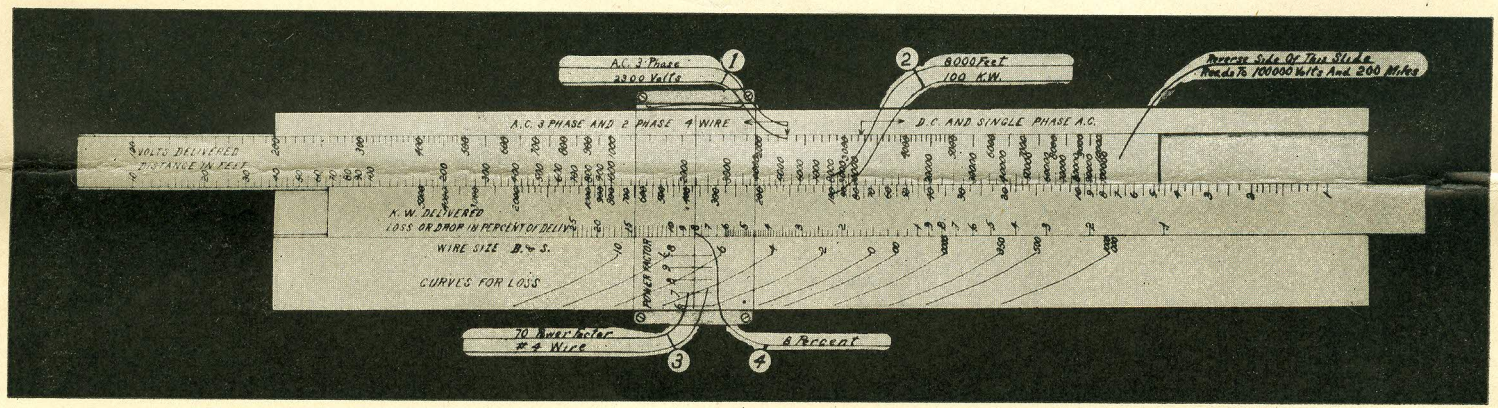
The Moler Line Loss and Voltage Drop Calculator



INSTRUCTIONS

This rule is intended for the direct calculation of electrical distribution line loss and voltage drop without the use of pencil, constants, tables or charts.

The operation is as follows:—Refer to the illustration and the rule. On the narrow margin are two arrows. The arrow to the left is for use in three phase and two phase problems. The arrow to the right is for use in D. C. and single phase problems. On the slide adjacent to these two arrows is a scale of VOLTS DELIVERED. (See the terms of each scale at the left.) The reverse side of this slide can be used uppermost also and is scaled to 100,000 volts and 200 miles.

Opposite the correct arrow, as the case may be, adjust the given VOLTS DELIVERED. This is adjustment No. 1. The thumb should now be placed on this slide so that it does not move during the remainder of the operation.

Now adjust the second slide so that the given K. W. DELIVERED coincides with the given DISTANCE IN FEET on the first slide. This is adjustment No. 2.

Now adjust the indicator so that the point of intersection of the main hair-line and the hair-line for the given POWER FACTOR intersects the CURVE FOR LOSS for the given WIRE SIZE. This is adjustment No. 3.

Now read LOSS IN PERCENT OF DELIVERED power directly under the main hair-line. This is adjustment or reading No. 4.

See adjustments 1, 2, 3 and 4 in the illustration where the rule is set for the following problem. At three phase 2300 volts and a distance of 8000 ft. 100 K. W. at 70% power factor is delivered over No. 4 wire. What is the loss in percent of delivered power? Answer 8. percent.

For VOLTAGE DROP the operation is the same except using the CURVES FOR VOLTAGE DROP on the back of the rule. These curves are for 60 cycle, unity or lagging power factor. Three SPACINGS in inches between wires are shown on the indicator. Select the nearest to the given SPACING and adjust the indicator for POWER FACTOR and WIRE SIZE. Now read the DROP IN PERCENT OF DELIVERED voltage under the hair-line on the face of the rule.

In D. C. percents POWER LOSS and VOLTAGE DROP are the same, therefore, use CURVES FOR LOSS, 100% POWER FACTOR in both cases.

Special Attention A. In the CURVES FOR VOLTAGE DROP certain sections of certain curves are expanded or widened. This is caused by the varying relationship between Loss and DROP at different percentages. Some tables and charts do not take this into account but it is given here for use if desired. In adjusting on these curves, if the loss is low (one percent or less) adjust at the bottom of the width, if the loss is high (twenty percent or more) adjust at the top. Intermediate points can be adjusted accordingly. The supplemental indicator is useful in making this adjustment, particularly on intermediate power factors.

Special Attention B. In the CURVES FOR VOLTAGE DROP (not in curves for loss) wire sizes 350,000 C. M. and larger are marked with a star (*). These sizes are seldom used in alternating current practice because of their high reactance as compared to their resistance, thereby causing poorer voltage regulation than a larger number of circuits of smaller wire. The curves are given here for use if desired but they are not in their true relative position as they would overlap to such an extent as to be complicated.

To use these curves it will be noticed that each size has an arrow extended around to the face of the rule. When the rule has been set for the particular problem and the Loss read as usual (all curves for loss are in true psoition) again read the loss at 100% power factor and then adjust this reading to the arrow for the curve for voltage drop, then use the curve for voltage drop in the same manner as in the smaller wire sizes.

The method of finding other factors when the loss or drop is given is obvious. However if it is an existing line and the wire size, percent loss or drop and power factor are known, and it is required to find other corresponding wire sizes, percents or power factors, it is not necessary to know the load, distance or voltage. Simply set the indicator on the loss or drop curve, as the case may be, for the present wire size and power factor, then set the present percent under the hair-line. Now all other wire sizes, percentages and power factors correspond and can be read by use of the indicator.

The main hair-line on this rule is based on resistance of 10.8 ohms per mil foot and reactance of solid wire up to No. O, stranded wire No. O and larger. Some tables are based on higher or lower values and this should be taken into account when making comparisons. The above values have been used as covering the average installation where economy is taken into consideration.

A short hair-line will be noticed on the indicator, over the percentage scale and above the main hair-line. This mark is for reading for aluminum wire. (The main hair-line is for copper).

The rule is intended primarily for distribution work because many more problems are handled than in the higher voltages, however, the reverse side of the voltage slide can be turned up and is scaled to 100,000 volts and 200 miles, making the rule useful in transmission work not taking into account charging current which is usually negligible up th 45,000 volts and 50 miles.

The following percentages of voltage increase, due to charging current and based on distance are given for use if desired and are satisfactory for most practical purposes. The percentage is to be subtracted directly from the percent voltage drop (lagging or unity power factor) as taken from the rule. In some cases this will give a negative percentage which of course means a supply end voltage lower than the receiver end.

APPROXIMATE INCREASE IN DELIVERED VOLTAGE DUE TO CHARGING CURRENT, 60 CYCLE

DISTANCE	PERCENT	DISTANCE	PERCENT	DISTANCE	PERCENT
30 miles	.19	70 miles	1.06	120 miles	3.11
35 miles	.26	75 miles	1.22	130 miles	3.65
40 miles	.35	80 miles	1.38	140 miles	4.23
45 miles	.44	85 miles	1.56	150 miles	4.86
50 miles	.54	90 miles	1.75	160 miles	5.53
55 miles	.65	95 miles	1.95	170 miles	6.24
60 miles	.78	100 miles	2.16	180 miles	7.00
65 miles	.91	110 miles	2.61	190 miles	7.80
				200 miles	8.64

For example, if the voltage drop is found to be 8.8% and the distance is 60 miles, then .78 is subtracted from 8.8 giving 8.02%.

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