

Earth resistance measurement and the 62% rule



Everybody, who is familiar with the earth resistance measurements knows the 62 % rule:



The rule (recommendation) is defined in IEEE 81-2012 in Annex C. It is based on simplified model of rods and some additional preconditions:

- Current trough both rods (E and H) is the same: $I_E = I_H$
- Uniform soil
- Hemispherical electrodes

If the distance between E and H rode is big enough, then the rods can be treated as hemispherical electrodes. If the soil can be treated as uniform soil then the following equations are valid:

The distance between the E and S is calculated out of the following equation (C.9 in IEEE 81):

$$\frac{1}{(D-x)} - \frac{1}{D} - \frac{1}{x} = 0 \quad \{\text{Eq.1}\}$$

The positive root of equation is the location of the S probe

$$x_0 = d_{E,S} = 0.618 D$$

The S probe must be located on the straight line between E and H probe.

When performing the earth resistance measurement with the Fall of Potential (FoP) method you have to put the measurement S probe on a distance of 61,8% of the distance between the centre E of the tested earthing system and the auxiliary test probe H.

During the measurement both probes E and H conduct a current therefore the potential around the electrodes raises (GPR – ground potential raise). The graphical presentation of this potential raise around the probe has a form of a funnel (Figure 2).

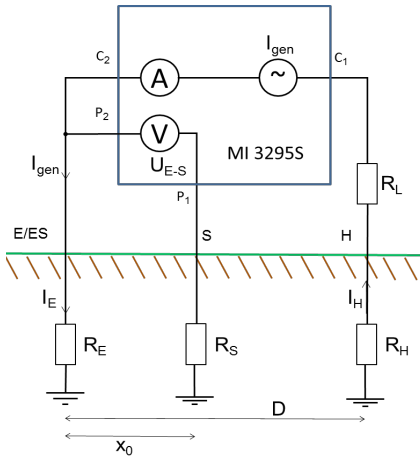


Figure 1: Fall of Potential method

In practice the distance between probes is finite (at least 5 times the diameter of the earthing system on the E side) and therefore the GPR of one probe

is influenced by the GPR of the other probe. When performing the measurements of the potential raise around the probe only the summary of both GRP can be measured. Therefore simple measurement of the voltage between E probe and zero ground results in an error and one of the possible solution is to use the 62% method. Within this method and the above described preconditions the voltage between E and S (62%) is equal to the GPR of the E probe without the influence of the GPR around the H probe.

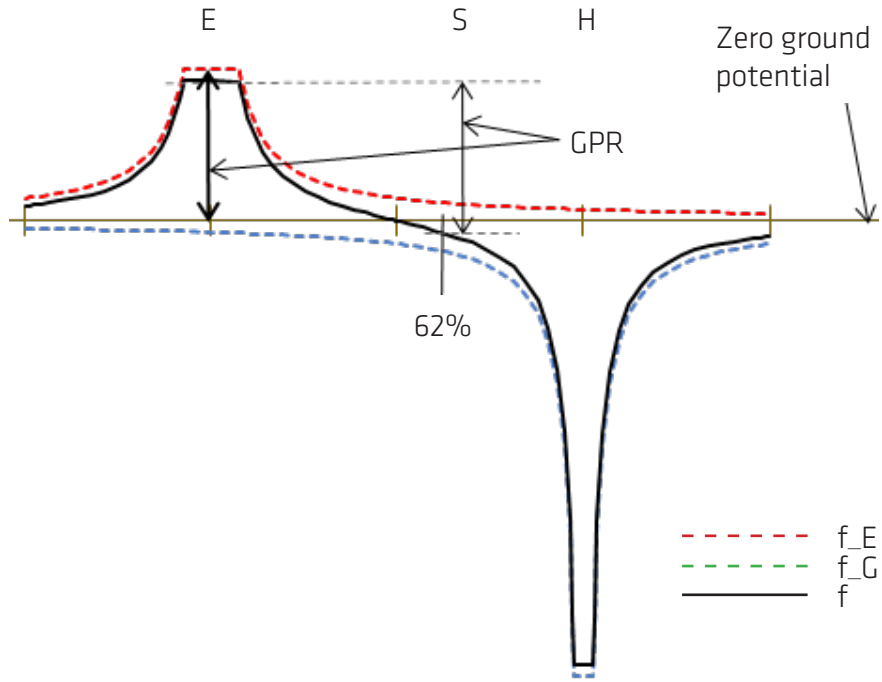


Figure 2: Graphical presentation of the voltage funnels

Earth resistance measurement on object with remote earth

If earth resistance measurements on objects with auxiliary grounding are performed (for example transmission tower with overhead grounding wire) the condition $I_E = I_H$ is not fulfilled. In such case the earthing current I_E has to be measured separately with the method as described in IEEE 81-2012 Ch. 8.2.2.6 and implemented in **MI 3290 Earth Analyser** where measurements with multiple flex clamps are supported. In this case the generated test current is not the equal to I_E (Figure 3 and 4):

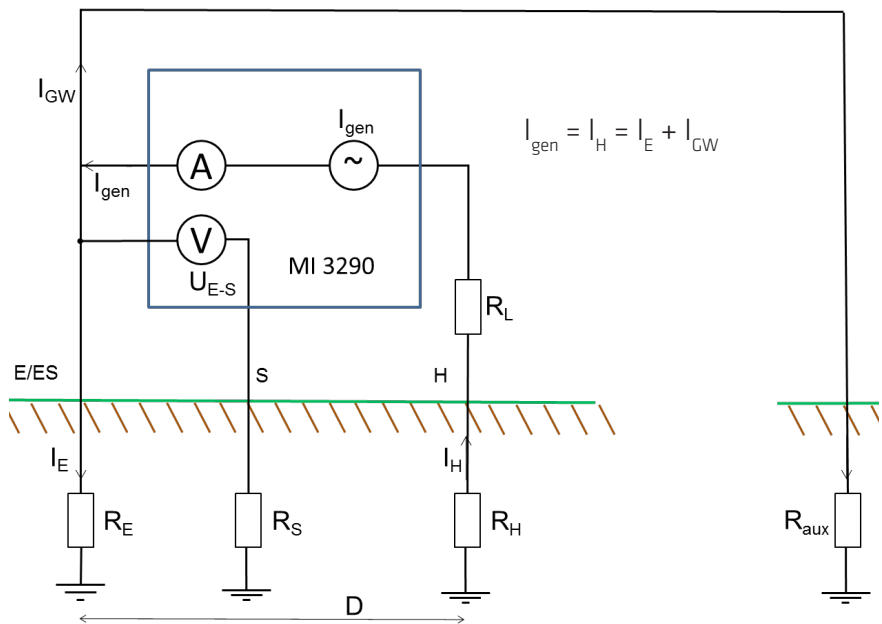


Figure 3: System with auxiliary earthing

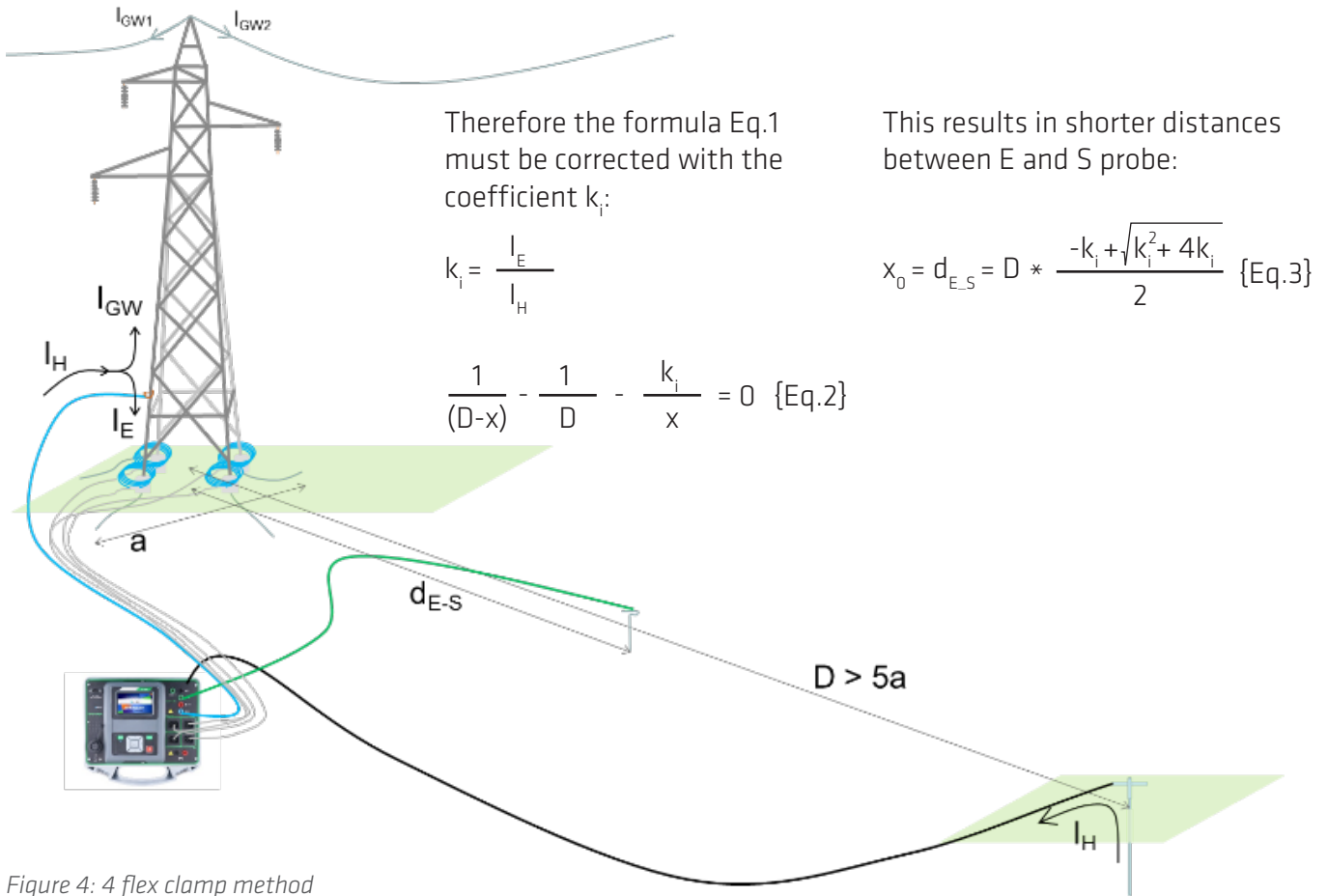


Figure 4: 4 flex clamp method

Some typical values of k_i and corresponding distances $d_{E,S}$ between E and S are listed in the table below:

k_i	$d_{E,S}$ (% of D)
0,25	39,0%
0,30	41,8%
0,35	44,2%
0,40	46,3%
0,45	48,3%
0,50	50,0%
0,55	51,6%
0,60	53,1%
0,65	54,4%
0,70	55,7%
0,75	56,9%
0,80	58,0%
0,85	59,0%
0,90	60,0%
0,95	60,9%
1,00	61,8%

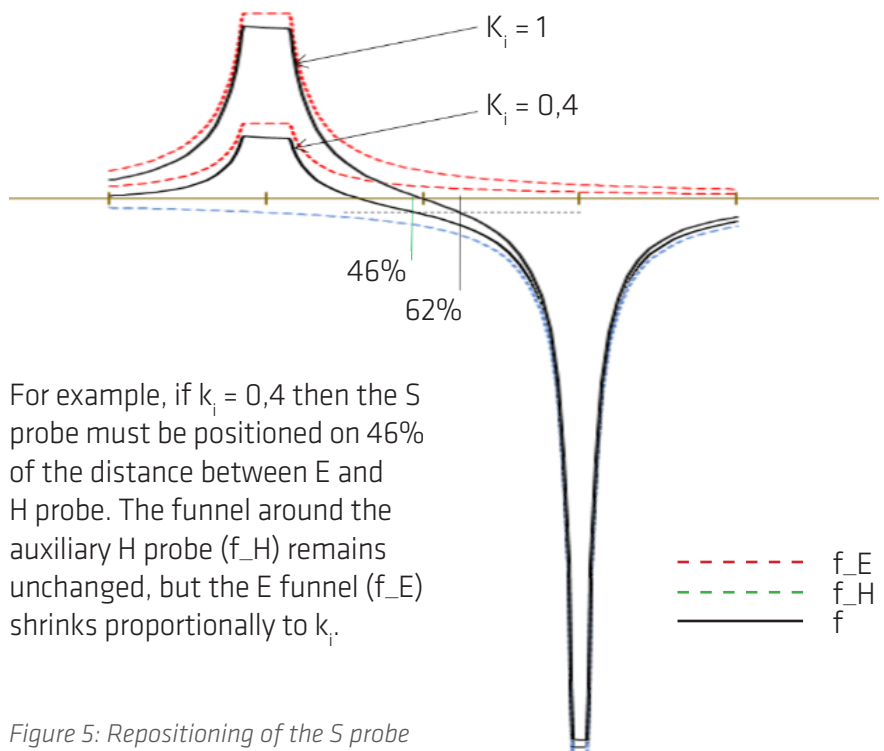


Figure 5: Repositioning of the S probe