Impressed-Current CP: Groundbed Resistance and Rectifier Rating

Vertical anode groundbed resistance (Dwight single, Sunde group) and the transformer-rectifier voltage and current for impressed-current CP.

Method: Dwight (1936) single vertical anode and Sunde (1968) multiple anodes in line (Peabody, Control of Pipeline Corrosion, 2nd ed., NACE, ch. 9)

Input parameters

Unit system: SI

Parameter	Value	Unit
Protection current	20.000	A
Soil resistivity	3.0000e+07	Ω·mm²/m
Anode (backfill column) length	2.0000	m
Anode (backfill column) diameter	250.00	mm
Number of anodes in line	5.0000	
Anode spacing	5.0000	m
Cable and structure-to-earth resistance	0.30000	Ω
Back e.m.f.	2.0000	V
Design margin on current and voltage	25.000	%

Calculated results

Parameter	Value	Unit
Single anode resistance	7.5413	Ω
Groundbed resistance	1.9620	Ω
Required voltage	47.240	V
Rectifier voltage rating	59.049	V
Rectifier current rating	25.000	A
Rectifier d.c. output	1.4762	kW

Notes for this case

- Anode length is less than about ten diameters: Dwight's formula is meant for slender anodes, so treat the resistance as approximate.
- Dwight's formula for one vertical rod and Sunde's for n rods in a line at spacing S. Use the backfill column as the anode size. Keep groundbeds remote from foreign structures to avoid interference.

Formula and method

$$R_1 = \frac{\rho}{2\pi L}\left(\ln\frac{8L}{d} - 1\right), \quad R_n = \frac{\rho}{2\pi nL}\left(\ln\frac{8L}{d} - 1 + \frac{2L}{S}\ln(0.656n)\right), \quad V = I(R_n + R_c) + E_b$$

Variables

I	Protection current	A
ρ	Soil resistivity	Ω·m
L	Anode (backfill column) length	m
d	Anode (backfill column) diameter	m
n	Number of anodes in line	-
S	Anode spacing	m

R_c	Cable and structure-to-earth resistance	Ω
E_b	Back e.m.f.	V
f_m	Design margin on current and voltage	-
R_1	Single anode resistance	Ω
R_n	Groundbed resistance	Ω
V	Required voltage	V
V_r	Rectifier voltage rating	V
I_r	Rectifier current rating	A
P	Rectifier d.c. output	W

Method and standards

Dwight and Sunde.

Assumptions and limits

- Uniform soil; vertical anodes in line.
- Dwight's formula assumes a slender anode: anodes too short for the formula to give a positive resistance are rejected, and a note appears below about ten diameters of length.

References

• Dwight (1936) single vertical anode and Sunde (1968) multiple anodes in line (Peabody, Control of Pipeline Corrosion, 2nd ed., NACE, ch. 9)

Report details

Report reference	FCC-T4ZW-A1RF (the same inputs always give the same reference)
Generated	17 November 2026, 19:44 UTC
Calculator	Impressed-Current CP: Groundbed Resistance and Rectifier Rating
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/materials/corrosion/iccp-rectifier-groundbed

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.