

Earth electrodes

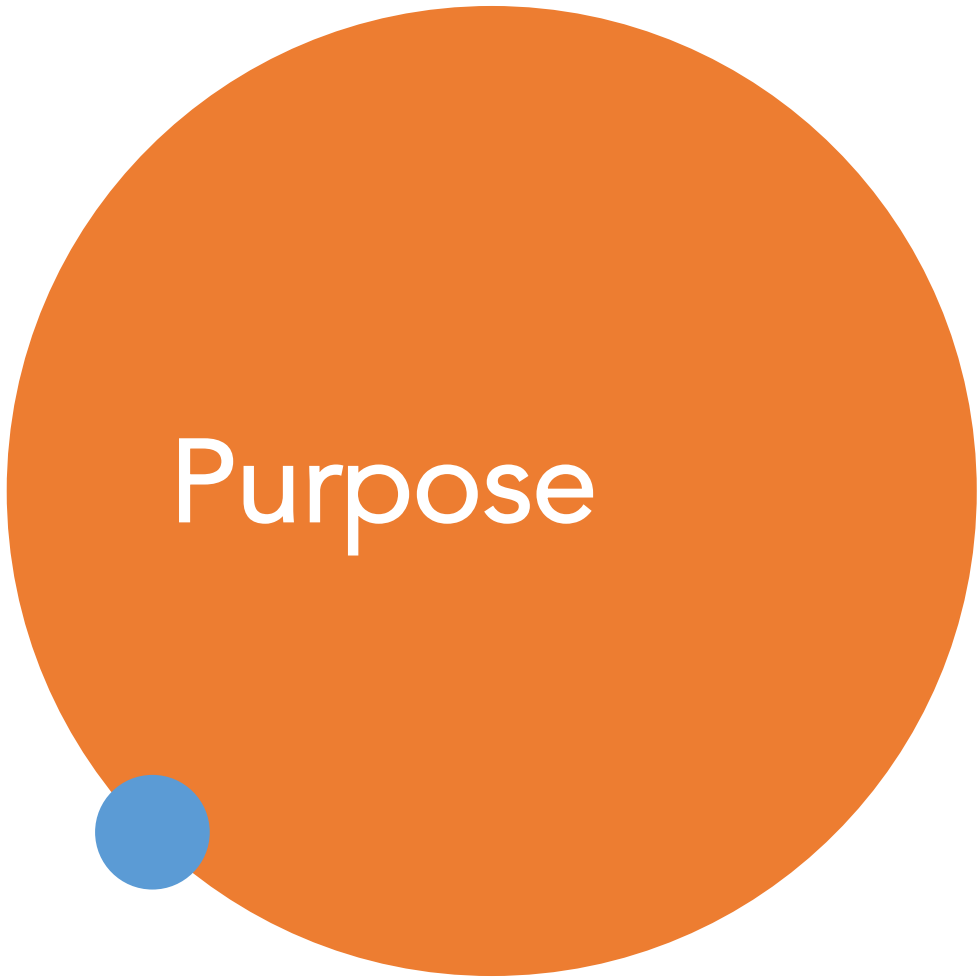
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What is an earth electrode?



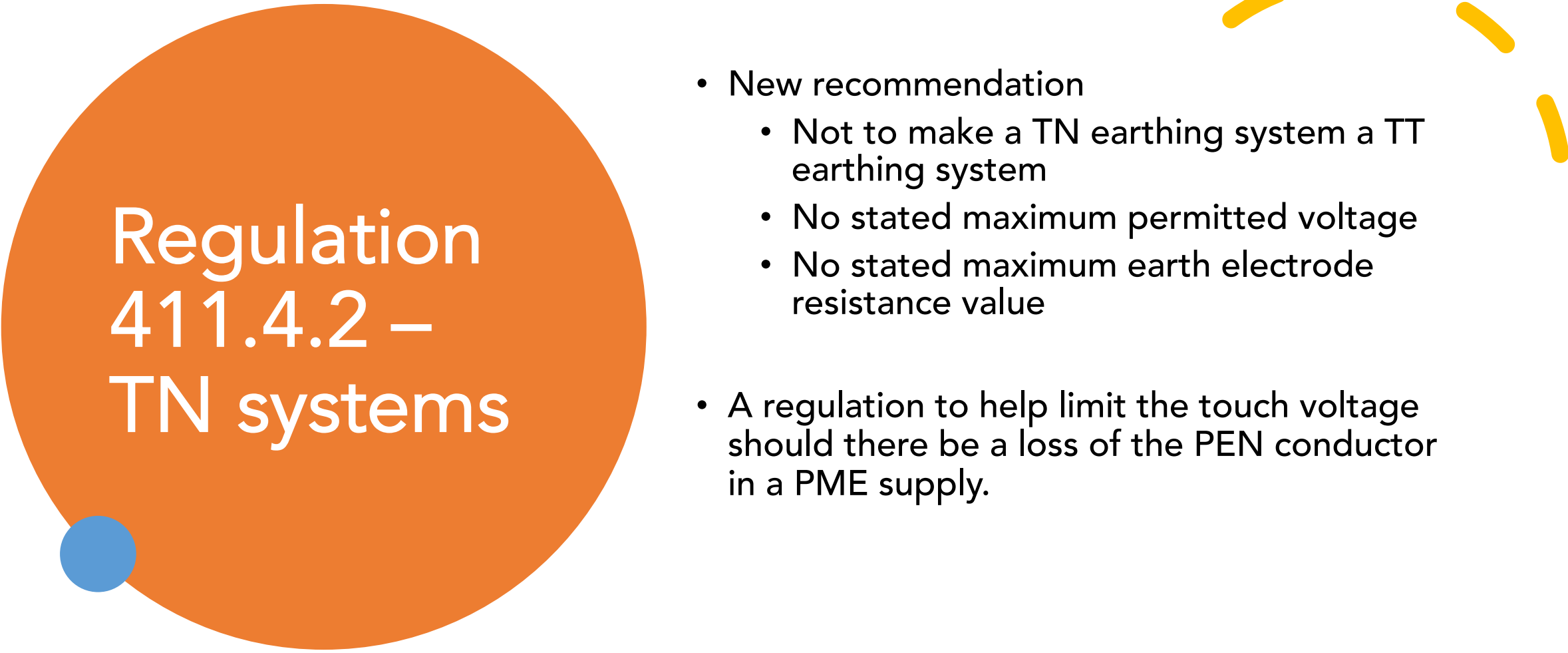
Part 2 definition:

Conductive part, which may be embedded in the soil or in a specific conductive medium, for example, concrete or coke, in electrical contact with the Earth



Purpose

- To create a TT earthing system – 411.5.1
- Part of a lightning protection system – BS EN 62305-1
- Foundation earthing – 542.2.3
- To support TN earthing systems – 411.4.2
- Earth generating sets – clause 2 BS 7430



Regulation 411.4.2 – TN systems

- New recommendation
 - Not to make a TN earthing system a TT earthing system
 - No stated maximum permitted voltage
 - No stated maximum earth electrode resistance value
- A regulation to help limit the touch voltage should there be a loss of the PEN conductor in a PME supply.

Limiting touch voltage

$$\bullet R_A = R_L \times \frac{U_P}{(U_S - U_P)}$$

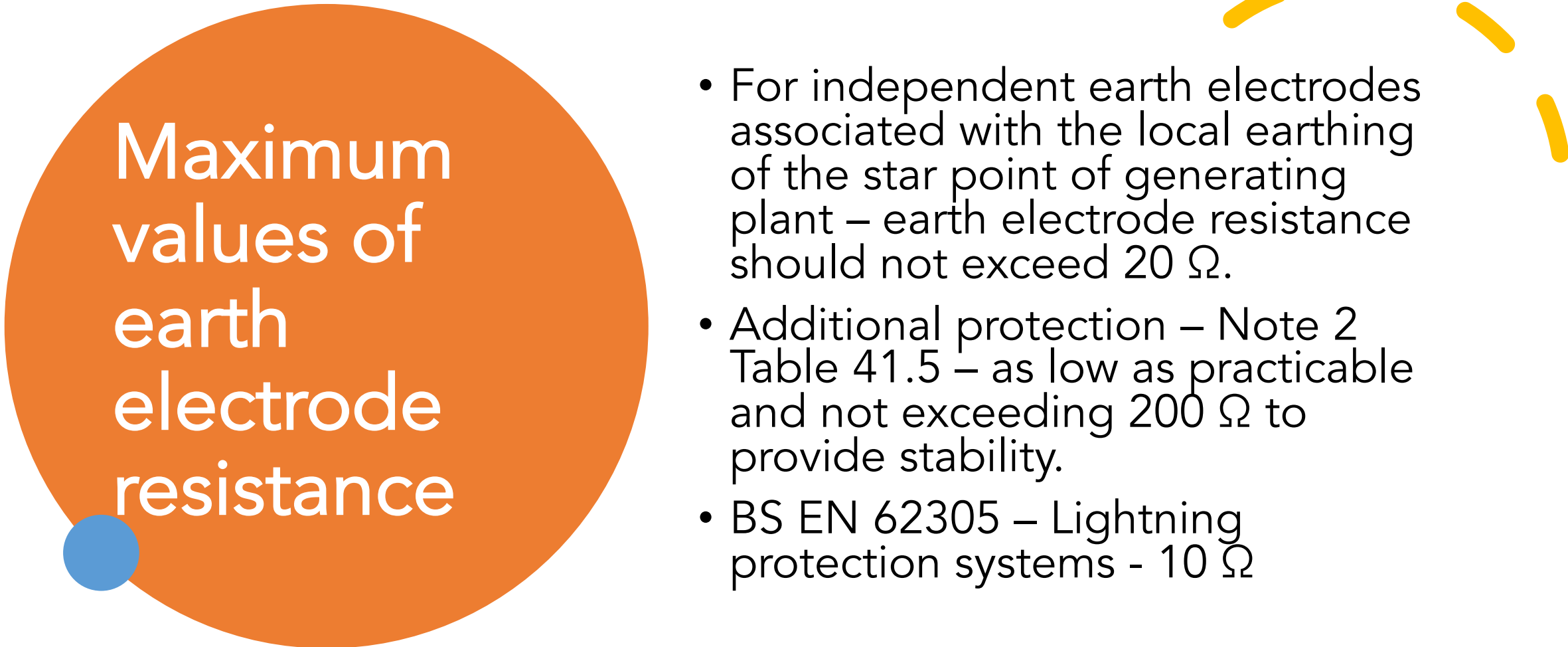
Load (kW)	$R_L \Omega$	$R_A \Omega$	
		$U_P = 50 V$	$U_P = 100 V$
11	4.8	1.1	3.1
7	7.6	1.8	4.9
3	17.6	4.3	11.5

Based on Table 14.1 Guidance Note 5 published by the IET



BS 7430: 2011+ A1:2015

- Code of practice for protective earthing of electrical installations
 - provides recommendations and guidance on meeting the requirements for the earthing of electrical installations



Maximum values of earth electrode resistance

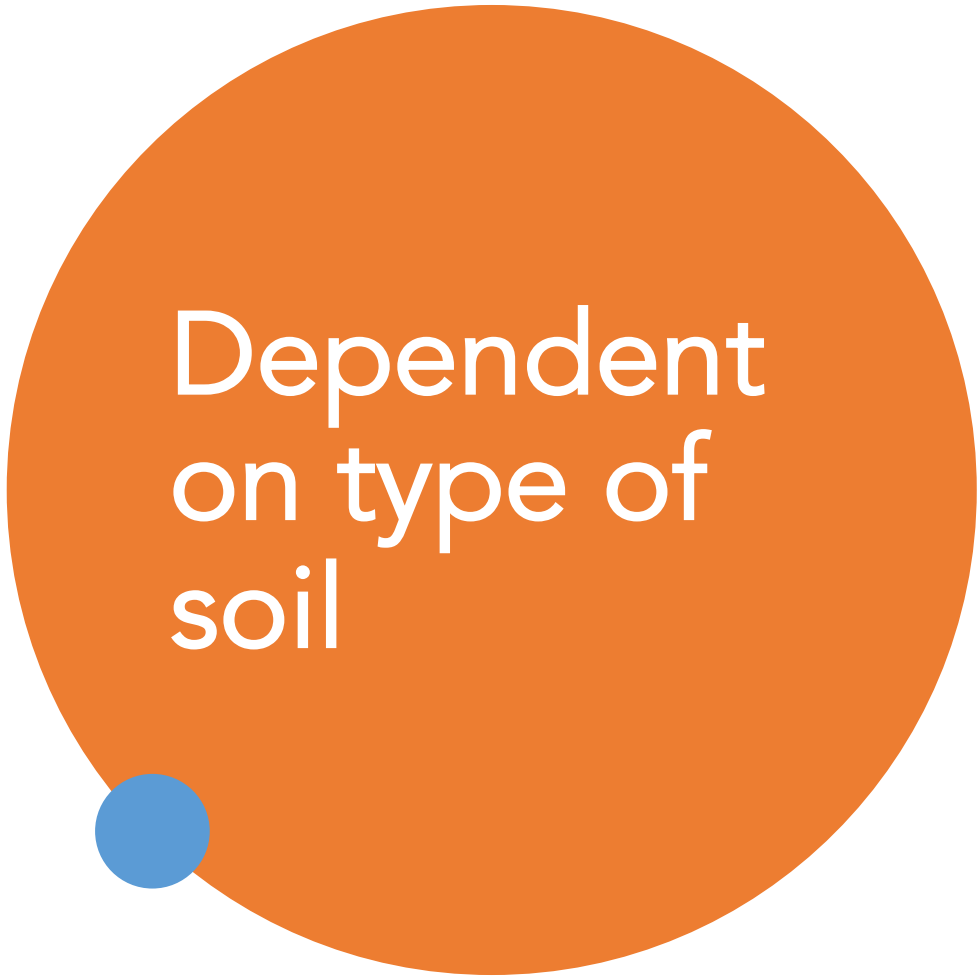
- For independent earth electrodes associated with the local earthing of the star point of generating plant – earth electrode resistance should not exceed $20\ \Omega$.
- Additional protection – Note 2 Table 41.5 – as low as practicable and not exceeding $200\ \Omega$ to provide stability.
- BS EN 62305 – Lightning protection systems - $10\ \Omega$

TT Earthing System Table 41.5

Rated residual operating current (mA)	Maximum earth fault loop impedance Z_s (ohms)
30	1667
100	500
300	167
500	100

Where earth electrode resistance requires to be reduced:

- Increase number of electrodes (resistors in parallel)
- Increase depth of earth rods
- Create foundation earth
- Alter soil resistance (not by adding water)



Dependent
on type of
soil

Examples of soil type	Mean value of resistivity in Ωm
Bogs	1 - 30
Soft clay	50
Stoney ground	1 500 – 3 000
Chalky soil	100 - 300
Granite and sandstone	1 500 – 10 000

Permitted types of earth electrode

- 542.2.1 – to be able to withstand damage and take account of possible increase in resistance due to corrosion
- 542.2.2
 - earth rods/pipes,
 - tapes or wires,
 - plates,
 - underground structural metalwork embedded in foundations,
 - welded metal reinforcement of concrete,
 - lead sheaths and other metal coverings of cables (except where precluded by 542.2.5),
 - other suitable underground metalwork.

Minimum cross-sectional area of buried earthing conductor

	Protected against mechanical damage	NOT protected against mechanical damage
Protected against corrosion by a sheath	2.5 mm ² copper 10 mm ² steel	16 mm ² copper 16 mm ² coated steel
Not protected against corrosion	25 mm ² copper 50 mm ² steel	

Do NOT use metallic pipes containing gases or flammable liquid or water utility pipework – 542.2.6

Conclusion

- New recommendation in Regulation 411.4.2 requires no minimum value of earth electrode resistance – yet!
- Check Regulation Group 542 for sizing of earthing conductor to connect to the earth electrode
- 542 also details permitted earth electrodes
- Where used with TT earthing system apply Table 41.5 but don't trust any earth electrode resistance readings above 200 Ω .
- Different soil types will affect the earth electrode resistance.