FLUKE®

Lightning protection and power quality

Application Note

Lightning protection plays a vital part in the overall power quality of an installation. Lightning occurrence varies by geography, with Florida being the lightning capital of the U.S. Lightning does not have to score a direct hit to be disruptive. It has so much energy that it couples surges into conductors, both those exposed to air and those buried in the ground. Basic lightning protection has two main requirements:

1. Effective grounding

A low impedance of the grounding electrode system to earth is important. But, equally important is that all parts of the grounding system be bonded together: all ground electrodes are bonded (and extraneous ground rods removed), structural steel is tied to service entrance ground, all grounding connections are tight and free of corrosion, etc. This minimizes the phenomenon called "transferred earth potential," where large surge currents create large voltage differences between two ground points with different impedances to earth. This same grounding practice is important for performance reasons, as it tends to minimize ground loop currents that circulate in an attempt to equalize ground potentials.

2. Surge arrestors

A surge arrestor "is a protective device for limiting surge voltages by discharging or bypassing surge current..." (NEC 280). Since the surge current is bypassed to ground, surge arrestors are only as effective as the grounding system.

Surge arrestors are sized for the location where they are installed. Three categories are defined (ANSI/IEEE C62.41-1991). A surge arrestor at an outside installation is closest to the lightning event and must absorb the most energy. This is considered a Category C location (corresponding to CAT IV in IEC 61010). Category B refers to feeders and distribution panels (equivalent to CAT III in IEC 61010), and Category A refers to receptacle connected surge arrestors (equivalent to CAT II).

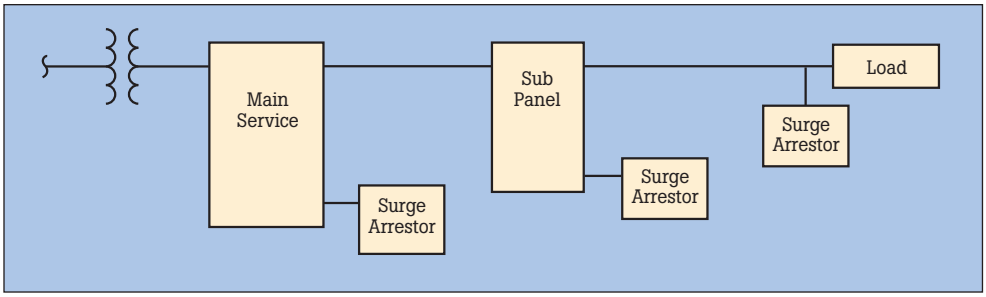
Inspection of lightning protection system

Check	Look for	Reason
Surge arrestors	• Installed at main service panel, subpanels and critical equipment. • To minimize high frequency impedance, leads should be short, with no bends.	• Lightning is high energy and needs multilevel protection. • Lightning has high ***f*** components. Shorter leads have less XL and less impedance at high ***f***.
Grounding electrode conductors at service entrance or at SDS	• Grounding electrode connections are not loose or corroded. • Grounding conductor should not be coiled or have unnecessary bends.	• Ensure low impedance ground to minimize potential to ground with lightning induced surges. • Minimize impedance to high frequency components of lightning.
Grounding electrode bonding	All grounding electrodes should be effectively bonded together ($< 0.1\ \Omega$).	Prevent difference in earth potential between electrodes in event of lightning.
Separately driven ("isolated") electrode	Electrode and equipment ground should both be tied to building steel, and thereby to the service entrance ground.	Same as above—entire grounding system should be an equipotential ground plane for lightning.
Datacom cabling that runs between buildings	Surge arrestors on datacom cabling or use of fiber optic cables.	Datacom cabling run between buildings can be a path for surge currents, due to differences between building earth potentials.

Lightning protection is covered in a number of standards and codes, including:
NEC: Articles 250 and 280
National Fire Protection Association: NFPA 780
Lightning Protection Institute: LPI-175
UL-96 and UL-96A

Surge arrestor or TVSS

A surge arrestor is there to protect the insulation and, ultimately, prevent failures that could lead to fires. It is not necessarily designed to protect sensitive equipment. That's the job of the TVSS (transient voltage surge suppressor).



Surge arrestors installed at service, panel, load.

Fluke. *Keeping your world up and running.*

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