TECHNICAL NEWS
from
THE OKONITE COMPANY

Engineering Information for the Professional Engineer

September, 2011 Edition: 030

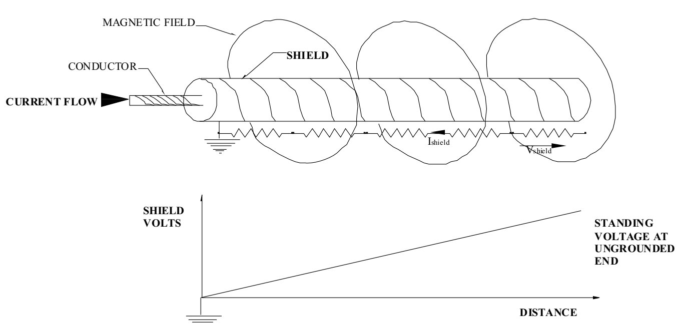
Single or Multi-point Grounding of Medium Voltage Shielded Cables

The primary purpose of a shield on a medium voltage is to contain and control electrical voltage stress within the cable. Without it, voltage would build up on the insulation surface and sporadically discharge. For this reason, these cables must be grounded at a minimum of one point.

BACKGROUND

Single point grounded cables are often referred to as "open-circuited" (OC) operation and multi-point grounded cables are referred to as "short-circuited" (SC). The advantage to OC operation is a higher Ampacity rating (for certain configurations) due to the absence of circulating current in the shield. The disadvantage is that a standing voltage will be present on the shield at the ungrounded end of the run.

The following depicts a shielded cable using a single point ground.



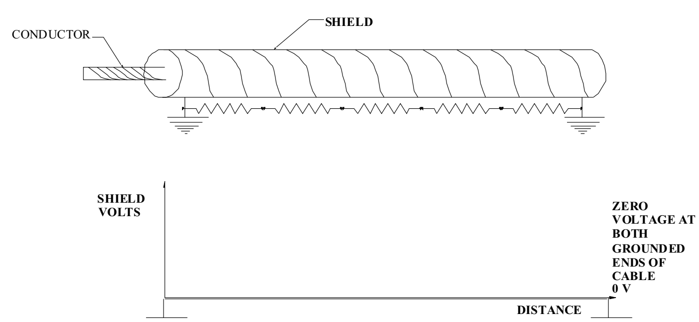
a.k.a - OPEN CIRCUITED SHIELD

Current flowing through the conductor builds a field around the cable, inducing voltage on the shield. Since the shield has a certain resistance, a small amount of current flows back to the grounded end. The farther the distance from the grounded point, the greater the shield resistance, thus the greater the shield voltage.

The amount of shield voltage present at the ungrounded end is dependent on:

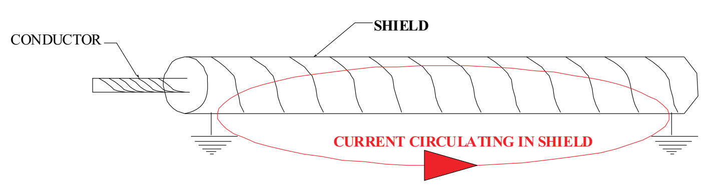
- the spacing between conductors
- the circuit length
- phasing
- load current

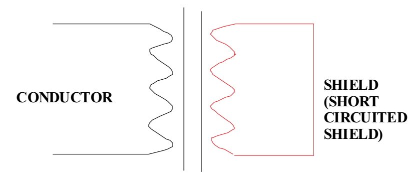
For a multi-point grounded system, the graphics look like:



a.k.a - SHORT CIRCUITED SHIELD

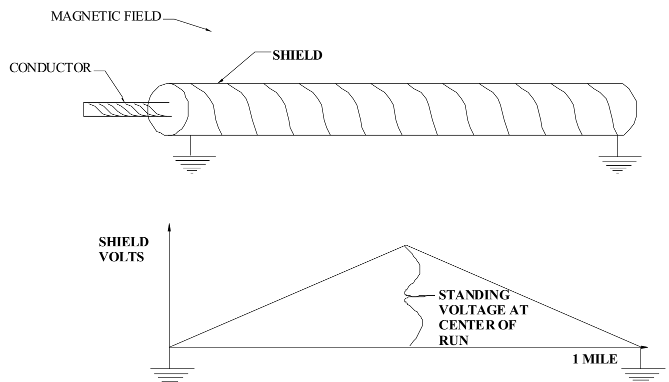
With the shield grounded at both ends over a normal distance, no standing voltage appears. However, assuming a good earth ground path, this configuration is subject to circulating current as it replicates a trans-





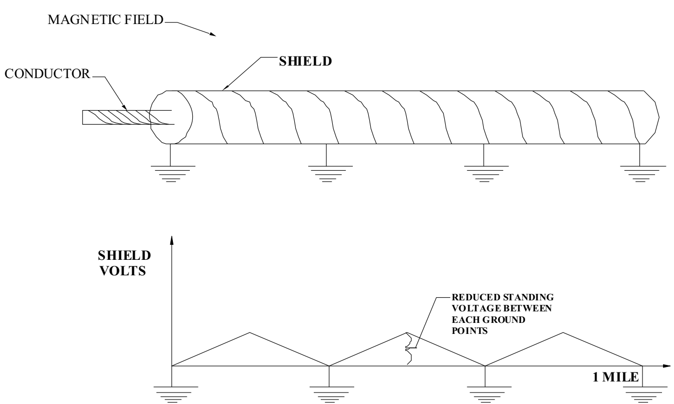
former and thus the basis for the term "short circuited" shields.

On multi-point grounded systems of long lengths, the NESC requires 4 grounds per mile. Again, if the distance is great enough, a standing voltage will appear in the middle of the run as shown below.



2 GROUNDS/MILE

However, when grounded 4 times per mile, the same graph now appears:



4 GROUNDS/MILE

SELECTION OF GROUNDING

Cable manufacturers recommend multi-point grounding for safety reasons. If a single point grounded system is not maintained and identified properly, the loss of the only ground (via corrosion or accidental disconnection) could result in the full system voltage being induced on the shield.

The only time single point grounded systems are considered is when large conductor (high current) applications are involved and the cables are installed in separate conduits (1 cable per conduit).

When cables are installed in the same duct or are triplexed, the close proximity to each other helps cancel the fields and results in less circulating current. For more information and formulas on shielding and grounding see Okonite's Engineering Handbook (EHB) pages 16 - 20.

HIGHLIGHTS

1. Every shielded cable must have at least one ground connection.
2. Use multi-point grounding whenever possible.
3. If a single point grounded system is warranted, it must be engineered to ensure the standing voltage at ungrounded end is within reason.
4. The greater the amount of copper used on the shield of a cable, the lower the shield resistance, which could result in higher circulating current.
5. Closer spacing of cables results in reduced circulating currents.
6. Three conductor cable, where the individual shields are in contact with each other, results in almost no circulating current.
7. Long runs of single conductor cables requires 4 grounds per mile or a semiconducting jacket (which effectively grounds the cable at every point along its length) per the NESC.
8. Ground leads should be sized to meet or exceed the circular mil area of the cables shield.

Listed below are industry references for grounding of shields.

A) Okonite's Engineering Handbook (EHB)

B) IEEE Standard 141 (Red Book)

C) National Electrical Safety Code C-2 (NESC)

D) Power and Communication Cables, Theory and Applications; Bartrikas and Srivastava, IEEE Press

Joe Zimnoch, Jr.

ISO 9000-1994 CERTIFIED

THE OKONITE COMPANY

Ramsey, New Jersey 07446