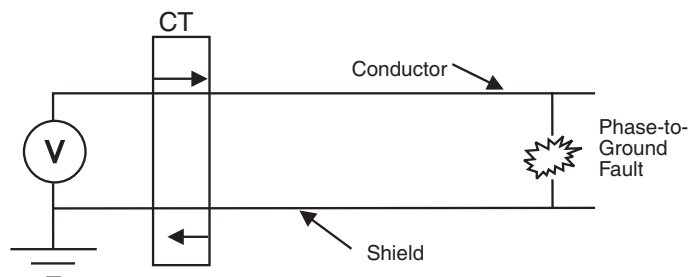


SHIELDED POWER CABLE AND WINDOW CURRENT TRANSFORMERS

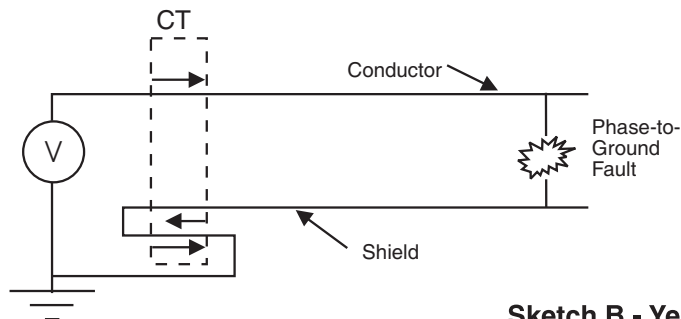
From time to time we get asked; what is the proper routing of the ground return conductor when a window (“donut”) type current transformer (CT) is used for protective relaying? Should the shield or concentric neutral be run through the CT or routed outside the CT? The following sketches should help to illustrate that **it is necessary to feed the grounding conductor on the cable shields back through the CT before connecting it to ground.**

Sketch A illustrates the case where a single phase-to-ground fault returns the fault current in the shield, and in a coaxial construction such as a medium voltage, shielded power cable, the magnetic fields produced by outgoing and return current will tend to cancel one another. This cancellation thus renders the CT ineffectual in detecting a phase-to-ground fault. This is particularly true for single point grounding at source end, or for multipoint grounding if the fault occurs near source end.



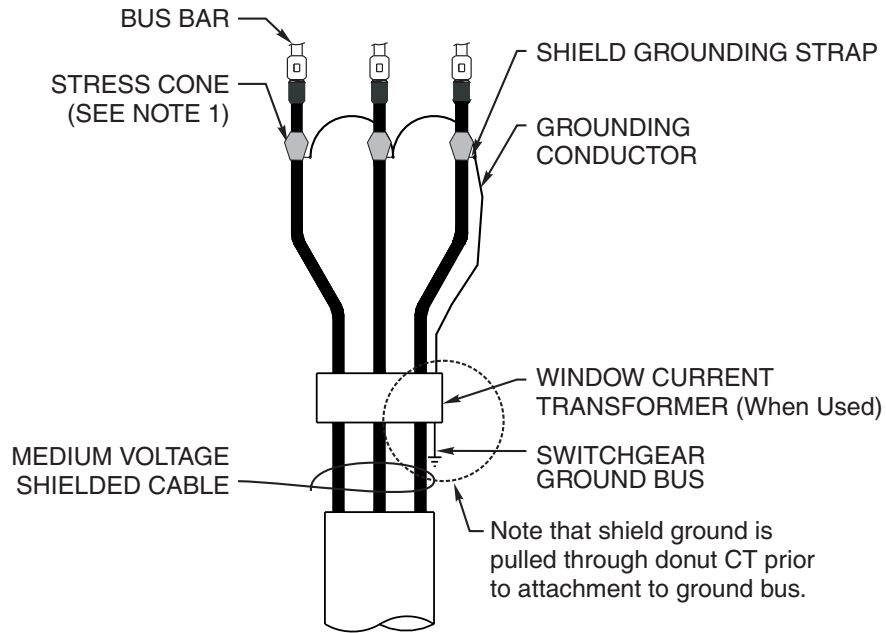
Sketch A - No

Sketch B diagrams the connection with the shield doubled back on itself in the CT so that the magnetic field produced by the shield current is canceled, and allows the CT to detect excessive current in the phase conductor .



Sketch B - Yes

The following illustration depicts a typical utility installation with the proper routing of the ground return conductor.



Another type of fault detecting device, an FCI Sensor, can be used on concentric neutral cables. The proper placement of this device is also important for correct operation in sensing a ground fault.

During a phase-to-ground fault, fault current flows through the conductor and a portion returns along the neutral. The resulting magnetic field of the neutral tends to cancel the magnetic field of the conductor. If an FCI is installed directly over the concentric neutral, it may not detect the fault current because the magnetic field is canceled or reduced. Correct placement can be done in one of two ways:

- (1) Train the concentric neutral wires back over themselves on the cable. The FCI is then installed over the portion of the cable where the neutral wires are overlaid.
- (2) Train the neutral wires to the outside of the FCI. The FCI is placed on the cable above the concentric neutral wires.

The following figure illustrates the proper placement as described above. This information comes from the Under-ground Systems Design and Installation Guide, published by the National Rural Electric Cooperative Association .

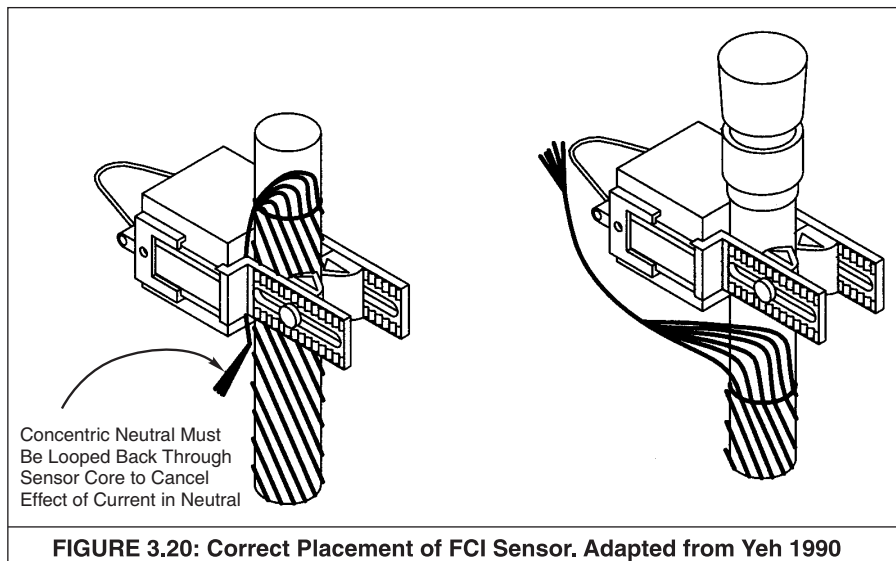


FIGURE 3.20: Correct Placement of FCI Sensor. Adapted from Yeh 1990