

## Conductor Size Considerations for Station Class Arresters



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### Conductor Size Considerations for Station Class Arresters

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#### The Basic Question

“Does the arrester line lead as shown in Figure 1 need to be the same diameter as the down conductor to the transformer?”

#### Answer

The diameter of a line lead connected to an arrester has a negligible effect on the protection offered by that arrester. In other words, the diameter of the conductor carrying a surge does not change the total discharge voltage or clamping voltage of the arrester.

What is important is the length of the lead in series with the arrester and electrically in parallel with the protected insulation, as this is what determines the inductance of the lead. Whereas the lead diameter has little effect on the inductance. A lead that is sized longer than required will result in a higher inductance which will have a negative effect on the protection provided by the arrester.

#### Other Related Considerations for the Line Connector

Therefore, when selecting the arrester lead on a station class arrester, there are several factors that need to be taken into consideration to ensure the arrester protection capabilities are not affected.

**Fault Current:** When an arrester fails, the fault current through the arrester can be quite substantial. If it is important that the lead not burn through or fail mechanically, the lead should be selected to meet these criteria,



Figure 1 Transformer showing arrester leads

keeping in mind that the diameter of the lead will have an effect on the corona.

**Corona:** For higher voltage systems the conductor diameter can determine the level of corona that it will be emitted. Therefore this may be the limiting factor in determining the conductor size.

**Voltage Reflections:** Voltage reflections that will occur because the bushing and arrester are separated by a finite distance are also affected by the conductor length but not the diameter.

**Mechanical Considerations:** The mechanical strength of the lead is a primary consideration when sizing any arrester lead in a substation. The mechanical stress generally dominates the decision after the electrical considerations have been made.

#### **Ground Conductor Considerations**

The size of the ground conductor (and the material) has little effect on the protection the arrester provides to the transformer. Again, the length has more effect and shorter is always better. If a neutral bushing is exposed externally, a conductor directly to that bushing from the arrester is always better than running both the arrester and the bushing down to the earth mat separately. Also as in the line lead, the conductor should be large enough to survive the rigors of a fault event otherwise; it might burn thorough or fail from stress. Sharp bends in leads also have no significant effect in the protection of the transformer.



**Figure 2** Arresters' with large diameter leads due to mechanical strength requirements

#### **Summary**

The optimum size of an arrester conductor that is mounted to a transformer in a substation is determined by the mechanical requirements. Fault current response needs to be considered; mechanical stress from wind and the configuration, and corona are the major factors in this consideration.