Bus Joints: Dissimilar Metals and Corrosion

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Corrosion of an electrical connection is a serious concern for equipment users. The concerns are primarily associated with the power bus and assembly hardware.

For galvanic corrosion to occur, three conditions must be met:

1. Two electrically dissimilar metals must be present
2. There must be an electrically conductive path between the two metals
3. There must be a conductive path (electrolyte) for metal ion to movement.

If any one of the three is not present, galvanic corrosion is not possible.

Finishing and plating can prevent the dissimilar metals from coming in contact and prevent base metal corrosion. The choice of plating metals for copper bus and hardware should be from metals which are similar in electronegativity; found by using the following equation:

$$Electronegativity = X_m = \frac{(IE+EA)}{2}$$

Where, ***IE*** is Ionization Energy
EA is Electron Affinity

The unit for ***Electronegativity*** is **Pauling**

The ion path is typically surface condensation droplets, which are not visually detectable, acting as an electrolyte with the presence of ionic contamination. This is categorized by three environment levels:

1. Harsh Environments – Outdoors, high humidity, and high salt environments are included. The difference in the electronegativity should not exceed 0.15 in this application.
2. Normal Environments – Indoors, but not in temperature or humidity controlled areas. The difference in the electronegativity should not exceed 0.25 in this application.
3. Controlled Environments – Indoors with both temperature and humidity controlled. The difference in the electronegativity should not exceed 0.5 in this application.

The bus found in indoor switchgear is normally copper with silver plating at the connection points that are assembled with steel hardware, typically plated with zinc and a dichromate sealant. Silver and zinc have electronegativity values of 2.2 and 1.81 respectively. The difference between them is 0.39; well within the guidelines for Controlled Environments. Switchgear constructed in accordance with IEEE C37.20.2 includes design requirements to control humidity within the switchgear and provides normal operating conditions that include temperature limits.

The combination of silver-plated copper and zinc-coated carbon steel hardware does not promote an increase in corrosion on the base metal (copper). The fastener (zinc-coated steel) may see higher potential because of the base metal, but the speed and extent of the corrosion is significantly affected by

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the environment and the addition of the silver plating. Which is to say the required environmental controls imposed by IEEE C37.20.2 greatly reduce the chance for galvanic corrosion between the copper bus and the fasteners by removing humidity and maintaining a temperature range. It should be noted that indoor equipment shows a marked increase in galvanic corrosion when it is not properly stored or placed in an environmental condition beyond the design constraints.

There is no issue between the steel hardware and copper bus when the switchgear is properly applied and maintained.

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