INTRODUCTION

1. McWade Productions (Pty) Ltd manufactures and markets a comprehensive range of both aluminium and copper alloy clamps for use in all electrical conductor and/or tubular busbar applications. This range varies from small conductor termination clamps used at less than 500 volts up to large diameter tubular busbar clamps suitable for use on 250mm diameter busbars at 765kV and rated in excess of 6 500 amps. The clamps are manufactured to the company's own designs and/or to meet specific customer requirements.

2. When designing substations and, particularly when determining the type of current carrying clamp to be utilised, the maximum continuous load rating and short circuit currents are critical factors to take into account. This is particularly important with the high load factors now occurring in some power systems. Internationally, substation design now tends towards the use of tubular bus systems as opposed to overhead strung conductor type busbars where with current ratings in excess of 3 000 amps, strung busbars require more than 3 conductors per bus phase with the resultant complications arising in the connection of these bundle conductors. Bundle conductor bus systems are subject to bundle collapse under short circuit conditions which generate serious shock forces at attachment points. At voltages in excess of 88/132kV tubular bus arrangements lend themselves more towards a superior corona free design than do bundle conductor bus systems. Furthermore, the use of tubular bus systems provides for a lower profile and more aesthetically acceptable substation design. When utilising tubular busbars, short circuit forces between phases with relative small phase spacings, do present a problem and these forces must be allowed for in the mechanical strength in the clamps and the post insulators used.

3. The clamps, as detailed in this catalogue, are manufactured to comply with the requirements of the National Electrical Utility of South Africa being Eskom as well as international specifications.

   a.) Aluminium Clamps
   Aluminium alloy clamps are predominantly used for the connection of stranded aluminium conductors and/or tubular aluminium busbars to each other and to hot dip tinned copper equipment studs and terminals. Where corrosion is a prime factor, and the terminals not tinned, bi-metallic washers and/or sleeves should be fitted to the copper terminals. All aluminium alloy clamps are supplied pre-greased if required.

   b.) Copper Clamps
   Copper alloy clamps, which are hot dip tinned, are predominantly used in copper to copper applications. Where corrosion is a factor to be considered, they are also used in copper to aluminium applications. Copper clamps are supplied un-greased.

CORROSION OF INTER-CONNECTOR CLAMPS

Two factors are associated with corrosion:

1. Atmospheric action

2. Galvanic action

For atmospheric action to result in corrosion there must be moisture and oxygen present.

Galvanic action results in corrosion when two dissimilar metals in the electrolytic series e.g. aluminium and copper are in physical contact. In this case moisture acts as an electrolyte.

In such an instance the copper becomes the cathode and receives a positive charge. The aluminium becomes the anode and receives a negative charge.

The resultant current flow attacks the aluminium leaving the copper unharmed.

Both factors described above are influenced by environmental conditions.

This occurs in rural areas to a lesser extent than in urban centres and more so in heavy industry locations - steelworks, chemical plants, refineries etc.

The problem of the mechanical jointing of two dissimilar metals in physical contact with each other, such as aluminium and copper stems from their difference in electrolytic potential.

The extent, or severity, of the corrosive action is proportional to distance or separation of the metals in the list i.e. the magnitude of the difference in electrolytic potential of the two metals which, in the case of aluminium and copper is quite considerable.

Aluminium to Aluminium Connections

No problem exists in the jointing of these conductors as electrolytic action is non existent. Nevertheless, care must be taken to prevent crevice corrosion and to select an aluminium alloy connector body not liable to stress corrosion cracking.

Aluminium to Copper Conductor Connections

The best choice is an aluminium bodied connector since it is not subject to the galvanic attack of the more vulnerable element - the aluminium conductor.

Nevertheless, it is good practice to use an inhibitor grease, on the aluminium connector body or on the aluminium conductors and additionally where-ever possible to install the aluminium conductor above the copper to prevent pitting from the galvanic action of copper salts washing over the aluminium connector and conductor when in a lower position, alternatively a hot tin dipped copper alloy connector is to be utilised or an aluminium connector with a bi-metallic sleeve placed over the copper conductor.

Electrical Jointing of Aluminium

A particular phenomenon associated with jointing of aluminium conductors concerns the oxide film that forms rapidly on the surface of freshly extruded or cleaned aluminium exposed to air.

This oxide film acts as an insulating medium and must be removed with a scratch steel brush or abrasive paper in order to achieve a satisfactory and reliable electrical joint.

This problem with aluminium is that the freshly cleaned surface is liable to fast oxide formation, hence it is important to coat the surface with an oxide inhibitor immediately after cleaning.

The function of a contact/compression compound is:

a) Firstly to act as an oxide inhibitor by preventing the ingress of moisture and air and to provide for continuing protection against further corrosion of the electrical joint in its working environment.

b) Secondly, with certain compression greases under compressive force, its high content of sharp metallic particles penetrates through any remaining oxide film to provide multi contact current carrying bridges.

Inter-strand resistance

The high contact resistance due to aluminium oxide on the strands of aluminium conductors may be responsible for the poor distribution of current throughout the conductor strands. Thus some strands may carry much more than their share of the current, with consequent overheating of the conductor.

The most effective way to overcome inter-strand resistance in aluminium conductors is by the use of compression connectors filled with a compression-jointing compound.

Note: While oxide films on copper are conducting mediums, and more easily broken by contact pressure, it is a recommended practice to clean badly tarnished old copper surfaces with a scratch brush.