Discoloration of Silver Electro Deposits
Background

Silver is a brilliantly white metal much prized for its ornamental electrical and thermal conduction properties. It has the highest thermal conduction and lowest contact resistance per unit of length of any metal. While the conductivity of the electro-deposit does not reach the theoretical for the wrought material, it is still higher than other metals. The principal drawback of silver for contact use is its tendency to tarnish (sulfide film formation) which increases its contact resistance. Silver sulfide films have a low shear strength, which make them easily removed.

Silver is inert in most reagents. However it does react with a few chemicals which can present problems in an industrial environment. The reactions of concern for silver are as follows:

- **Sulfur**
  Reacts with sulfur bearing gases of materials in a moist environment will produce a silver sulfide tarnish characterized by its brown to black appearance. Common sources of sulfur in the workplace are paper, polypropylene/polyethylene packaging material, cutting oil and combustion gases from natural gas heat sources.

- **Halogens**
  Reacts with all halogens (F, Br, Cl, ) at elevated temperatures. Chloride as HCl is common in the exhaust of most natural gas fueled heat sources.

- **Nitric Acid**
  The principal reaction of silver is with HNO3. It reacts as all concentrations and at any temperatures.

- **Cyanide**
  Silver is dissolved by cyanide solutions in the presence of air.

The latter two possible reactions are rare within the industrial workplace and thus are generally not an issue for silver corrosion.
Minimization Considerations

To minimize the silver tarnish problem, the following steps are recommended:

- Store product in a dry atmosphere
- Minimize thermal cycles of product, which could promote condensation on product.
- Store product in facilities not heated with natural gas and air conditioned.
- Do not place sulfur-bearing material in contact with silver plate. These are items such as newsprint, cardboard, cardboard laden with machining oils, plastic (polypropylene / polyethylene), unprotected human handling (direct contact with skin) etc.
- Store product protected by sulfur-free packaging material.
- Store product with desicants and sulfur scavengers.

With proper storage of silver plated product the prevention of silver sulfide can be prevented for extended periods of time.