VIII. WELDING OF KOVAR® ALLOY

Since welding involves a change in crystalline structure, with different expansion characteristics in the welding area, great precautions must be taken to avoid stresses which will lead to fractures. Additional thermal stresses are introduced by those heating methods which are applied progressively. Therefore, resistance welding is preferred for most high vacuum applications with Kovar® when conditions prevent the use of copper or other high temperature braze.

A) Resistance Welding

Resistance welding, with a projection on one of the matching flanged surfaces, has been found extremely satisfactory, especially for large production. For resistance welding of Kovar® alloy the following facts are pertinent:

1. The projection should be machined or coined. (Embossed projections, with a space underneath, are generally not sufficiently rigid.)

2. Kovar® to Kovar® is ideal. When welding Kovar® to other metals, however, the projection is preferably placed on the Kovar® part for thermal considerations.

3. The matching surfaces of the welding area are to be kept as flat as practical.

4. Surfaces must be smooth, clean and of as uniform thicknesses as practical. High or non-uniform electrical resistivity values will cause difficulties.

5. Welds should be made with minimum heat-input.

6. Due to initial set-up on timing, electrode design, jigging etc., resistance welding is not generally used for items of limited production.

VIII. WELDING OF KOVAR® ALLOY (Cont'd.)

B) Inert-Gas-Shielded Arc Welding

Arc-welding sets up severe thermal stresses due to the fact that, at the point of welding, Kovar® temperatures are above the melting temperature, while other portions may be as low as room temperature. Stress-corrosion effects are accentuated when Kovar® is arc welded to other metals, as well as from the resulting mixture of heterogeneous grains of differing expansivity.

Some designs of vacuum devices do not permit using more preferable types of joints. In these cases, sound arc-welded joints on Kovar® alloy are secured by employing extreme care and precaution as indicated by the following:

1. Kovar® to Kovar® is preferred.

2. Sections in weld area should be as thin as practical, down to about .020" minimum.

3. Preferred design is one in which two flanged sections are butted and a bead welded on the outer circumference. Before arc welding the butted surfaces should have continuous metal to metal contact.

4. When dissimilar thicknesses are joined the thicker material should be bevelled.

5. The joint should be designed to prevent undue stress concentration at the time of making the weld. This includes allowance of sufficient clearance. (See Section V)

6. Before welding, the parts are to be chemically cleaned and free of oxide film, as well as stress-relief annealed.

7. Either helium or argon are satisfactory for shielding, but the gas supply should be ample (30 to 50 cubic feet per hour) and protected from drafts.

8. Electrodes of 1% or 2% thoriated tungsten, ground to an extremely sharp point, are recommended.

VIII. WELDING OF KOVAR® ALLOY (Cont'd.)

B) Inert-Gas-Shielded Arc Welding

9. The electrode must be held very close to the work (preferably within .030"). To cut down turbulent flow, the electrode should be held at an angle of 10 to 15° pointed towards the direction of weld.

10. Copper-jigging rings are sometimes found helpful in keeping the assembly cool during the welding operation.

11. When welding Kovar® to steel or other alloy, the interposition of a thin nickel strip (or by nickel plating the Kovar®) will minimize the formation of the objectionable interface containing two phases (alpha and gamma).

IX. SUMMARY

The aim of this bulletin is to supplement existing literature on the brazing and welding metallurgy by giving practical hints on making the best applicable joints with Kovar® alloy. The field is so great that only most typical problems are covered. The Carborundum Company, Electronics Division, Latrobe, Pa. invites consultation of its engineering service on the more specific problems of application and processing of Kovar® alloy.