Fabrication of Wave Guide Run by Forming and Welding Technique Developed Innovatively for Space Use Programme

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ABSTRACT

Waveguide plumbing components are one of the most important and critical flight model (FM) hardware, are being used for propagation of Radio frequency (RF) waves, between two electronic packages. Moreover, these hardwares are also very essential while acting as a waveguide plumbing members as a part of whole Thermovac Setup to be established for carrying out Thermovac test activity on Flight Model subsystems. Basically, the waveguide is rolled semi-finished tubes of very thin walled (0.635 mm) having rectangular cross section in shape, made out of Al- alloy 6061- T6 material. In-house fabrication techniques are developed innovatively to form these above referred delicate straight tubes, into various complicated shapes called as Waveguide Runs, to be used in waveguide plumbing setup, to cater requirement of satellite panels. Primary requirement during fabrication of these waveguide runs is that, while forming it into various complicated shapes, the cross sectional dimensions and inside surface finish along the length of wave guide runs should change only up to defined stringent tolerance limits. During initiation of the fabrication task of said Waveguide plumbing hardwares, the challenges like; Annealing of Semi-finished tubes, precise mathematical calculations, Forming force analysis, Filler metal needed for forming and Filler alloy rods for GTAW have been addressed & optimised in a scientific way, after rigorous and precise iterations. Moreover, both the ends of the formed waveguide runs are to be joined with highly precise flanges through very sophisticated and Space Qualified Gas Tungsten Arc Welding (GTAW) to achieve leak proof permanent joints in Ultra high vacuum conditions. Since, the tubes are very thinned wall, internally having mirror finish and made with highly precise cross sectional dimensions, makes the whole fabrication process very challenging. However, through above briefed innovative space qualified fabrication technique developed In-house, a very significant progressive impact has achieved on aspects like; Assurance of quick delivery, enhancement of productivity, quick adaptability to the panel layout changes, high reliability and also substitution to the imports.

KEY WORDS

RF Propagation through waveguides, Annealing, Sheet metal forming, GTAW welding, Space Qualified processes, ASME Standards, Aluminum alloys, Electromagnetic Interference / Electromagnetic compatibility