



A.8: Development of Metal Forming Tooling for 1.3 GHz SRF Cavity

We report here the design and development of forming and machining tooling for 1.3 GHz superconducting radio frequency (SRF) cavity by Industrial and Medical Accelerator Section (IMAS) and Accelerator Component Engineering & Fabrication Division (ACEFD). In the present day technology the cavity structure is manufactured by following a number of steps beginning with deep drawing pristine RRR 300 grade Niobium half cells. These half cells are then precisely machined and electron beam welded using carefully qualified parameters to produce single cell or 9-cell accelerating structure. The design involved trial forming with initial profile, generating measurement reference of the formed profile, recreating the formed profile on computer and then making required corrections in the profile in an iterative fashion. Spring back and thickness reduction during deep drawing were included in the design. The dies were machined to a high accuracy from a strong aluminum alloy AA 7075-T6 on CNC turn mill center SPINNER in controlled environment. A procedure and reference was developed to ensure repeatability in 3-D profile inspection on CMM and proper tweaking of the dies. This procedure was repeated for the three types of cells needed for a 9-cell cavity. Niobium being very expensive, trials during the development phase were done in aluminum and OFE copper (which behave like Niobium under deep drawing). We have formed more than 60 half cells including niobium half cells and these cells are now being used for EB welding trials and qualification by RRCAT team. The required profile tolerances on the formed parts were achieved and the tooling was qualified for cavity cell production. After the qualification, a complete set of forming tooling, for the three types of cells, was sent to Fermilab, USA.

at 1.3GHz for SRF cavity R&D and qualification of the industry for SRF cavity manufacturing. In the words of Bob Laxdal, Head of the SRF/RF Department at TRIUMF “Your dies have been tremendously useful as they enable us to get an early start on the program. PAVAC has used the dies to produce a copper single cell cavity as well as to form niobium half cells. The goal is to produce a niobium single cell cavity for testing in the coming months.”

This work is done under Addendum-1 to the MOU between Indian and US Universities and Accelerator Laboratories for development of Superconducting RF Cavities and Cryomodules.



Fig. A.8.2: Forming tooling for centre cell of the Cavity



Fig. A.8.1: Niobium half cell formed at RRCAT

After receipt at Fermilab the dies have been used at TRIUMF. TRIUMF is collaborating with PAVAC Industries, Canada on the production of single cell and multi-cell cavities



Fig. A.8.3: Single cell copper cavity formed at TRIUMF using the tooling developed at RRCAT.

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