



Iranian Journal of Physics Research, Vol. 26, No. 2, 2026
DOI: 10.47176/ijpr.26.2.12282

Thermomechanical and optical analysis of electron gun of 6 MeV linear accelerator tube

A. Mahdian¹, E. Shiri^{1,2}, and D. Salehi^{1,2}

1. Faculty of Mechanic Engineering, Malek e Ashtar University of Technology, Shahinshahr, Iran
2. Behyaar Sanaat Sepahan Co, science & technology town, Isfahan, Iran

E-mail: asmahdian@chmail.ir

(Received 31 January 2026 ; in final form 05 June 2026)

Abstract

This research focuses on a comprehensive investigation of the thermal behavior and resulting mechanical effects in an electron gun utilized in a linear accelerator operating at an energy of 6 MeV. The test cathode was heated under near-operating vacuum conditions (10–5mbar) up to an operational temperature of 1050°C. The resulting temperature distribution was measured using both thermocouples and a non-contact pyrometer. The experimental results obtained at various power levels served as the basis for validating the numerical modeling conducted with COMSOL Multiphysics software; the accuracy of the thermal simulation was confirmed through close agreement between the simulation and experimental results. Subsequently, thermo-mechanical analyses were performed based on the thermal data, and the geometry of the components was optimized to reduce stresses induced by thermal deformation within the ceramic body. The most critical aspect of this work involved examining the thermal effects on the geometrical dimensions of the cathode and their influence on the characteristics of the output electron beam, which was modeled using CST software. By comparing the output beam in the cold state and the hot state, the cathode dimensions were adjusted such that the hot dimensions matched the cold dimensions. This dimensional optimization ensured that the resulting electron beam under various operating conditions remained consistent with the design specifications of the reference (cold) state. This empirically validated approach guarantees the high-power performance efficiency of the electron gun.

Keywords: Electron gun, Thermomechanical analysis, Comsol, CST, Optimization

For full article, refer to the Persian section