Evaluation Temperature Stresses in Microrefrigerating Devices for Radio-Electronic Equipment

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Abstract - **The research paper reveals the method of reliability assessment of thermoregulation systems based on thermoelectric elements, allowing to take into account along with the electric strength of the elements material their mechanical stability in many cascade structures.**
Keywords - **Radio technical devices, thermoregulation systems, thermoelectric elements, mechanical stresses, Peltier elements, temperature oscillation.**

I. Introduction

Providing proper operation of devices and assemblies of electronic equipment is inextricably connected with the provision of necessary conditions of their work. It means, first of all, providing the temperature conditions under which the normal operation of components and assemblies of electronic equipment, protection from extremes of ambient pressure and mechanical stress (vibration, shaking, shocks, etc.). The tendency to microminimization of equipment, to the increase of its efficiency causes a rise in heat emission by some elements and nodes of radio electronic devices. Providing appropriate conditions for cooling is connected to the necessity of using a raw material intensive cooling devices (coolers, fans, etc.).

II. Instruction for Authors

In recent years microrefrigirators the construction of which is based on the Peltier effect become more and more widespread. Such thermoelectric modules enable to remotely measure the temperature stream, function as microrefrigirators, coolers of electronic circuits, provide the required operating temperature and normal operation of equipment. In turn, when the temperature drops at each stage of the device there is the emergence of strains in the material of thermoelements.

In the research paper the method of evaluation of temperature stresses is reveled depending on the possible fluctuation ranges, temperature values, physical and mechanical characteristics of materials that make up the structures, as well as consideration of tolerances for dimensions of various elements.

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Three possible cases are considered:

a) the size of thermoelement, and solder layers is in the nominal values of dimensions; b) prisms of thermoelements are made on the upper limit of tolerance for the dimension, and the thickness of each solder layer equals ½ of the distance difference between thermal transitions and is maximal within the tolerance of thermoelement’s length; c) the prism of thermoelement is made on the bottom limit of tolerance for its length, and thickness of the solder layers in this case is maximal and equals ½ of the distance difference between thermal transitions and the minimal length of thermoelement’s prism.

III. Conclusion

1. The value of mechanical stresses in the material thermoelements resulting from the influence of temperature drop and from the deformability of the whole system is insignificant and does not create a threat to the mechanical integrity of the product.
2. Range of values of tolerance modulus of thermoelectric material does not affect significantly the strength of the product as a whole.
3. The data received indicates that the magnitude of possible stresses is not a hazardous to the material for the product.

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