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A New Method for Testing Peltier Modules

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GOAL OF THE STUDY

The aim of this work is to apply a new approach to testing the quality of thermoelectric components. A non-destructive ultrasonic method is used to measure thicknesses of ceramic plates of Peltier modules at many points of their surfaces. Additional reliability factor is introduced to estimate the temperature variation as a function of thickness.

METHODOLOGY OF THE INVESTIGATION

- Six single-stage Peltier modules, models TEC1-12706 and TEC1-12706SR, were measured. Thickness of each ceramic plate (A and B) was measured at 17 points (Fig. 1).
- Krautkrämer USM 35XS flaw detector was used for ultrasonic measurements (Fig. 2).
  A pulse-echo contact ultrasonic method was applied. High frequency 10 MHz transducer, model DA312, was selected as transmitter and receiver of the echoes. Velocity was programmed (v = 10 600 m/s) and the apparatus calculates the thickness *d* by measuring the travel time *t* of the propagated and reflected ultrasonic pulse in the specimen: $d = v \times t / 2$.

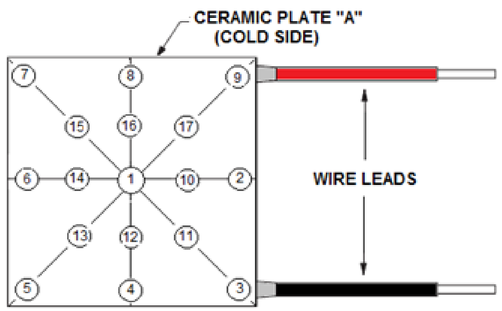

Fig. 1. Points of ultrasonic measurement

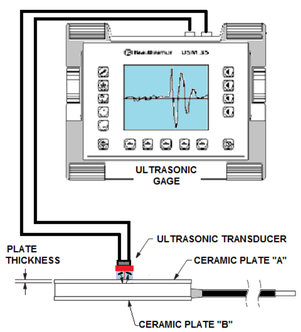

Fig. 2. Experimental set-up

MAIN RESULTS FROM THE STUDY

The comparison between the results shows that thicknesses vary at the indicated points of each plate and are different for studied modules (Fig. 3).
Reliability factor K_δ (Fig. 4) evaluates the temperature differences on the surface of the plates in respect to the reference point 1 in the center:

$$K_\delta = \frac{T_i}{T_1} = \frac{d_i}{d_1}$$

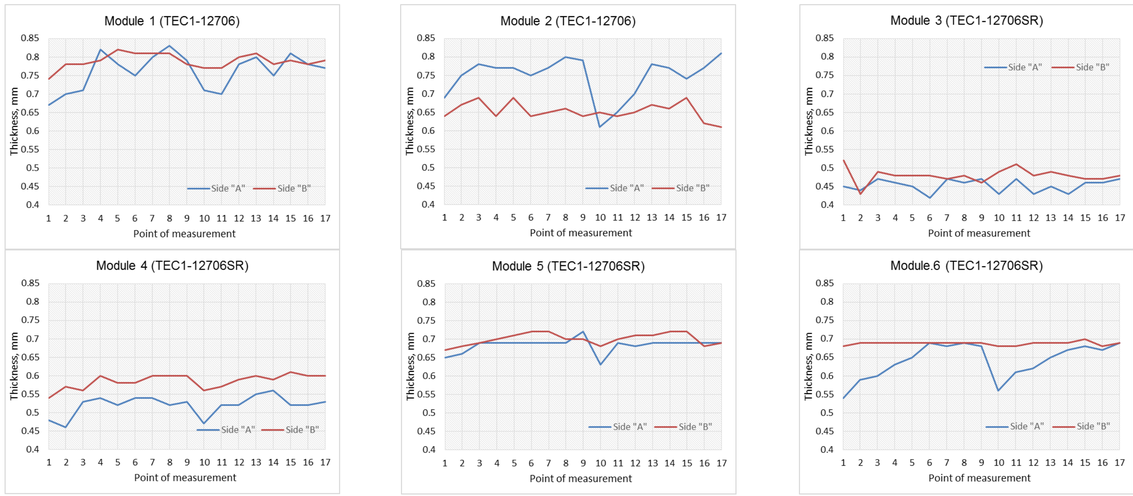

Fig. 3. Ultrasonically measured thicknesses of both plates of the modules

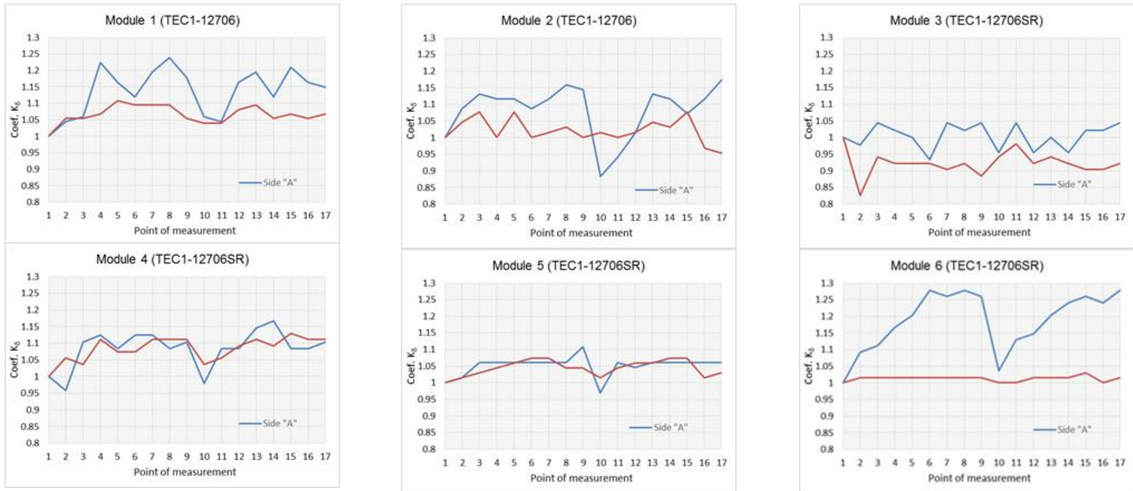

Fig. 4. Variation of K_δ for different modules

Temperature difference between the hot side and the cold side:

$$\Delta T_K = \frac{T_H}{\overline{K}_{\delta B}} - \frac{T_C}{\overline{K}_{\delta A}}$$

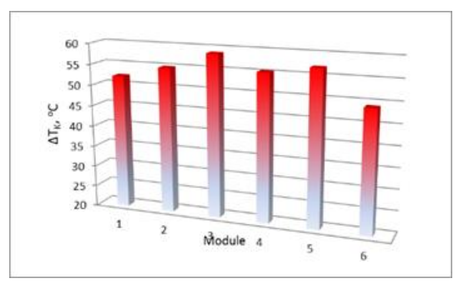

Fig. 5. Temperature deviation across the module at ΔT = 60 °C

CONCLUSIONS

- Conducted ultrasonic measurements of several thermoelectric modules show that thicknesses of the plates and modules may vary considerably.
- Comparative results of the introduced K_δ factor could be used as an additional criteria for selection of the Peltier modules.
- The proposed method is useful for qualification and selection of Peltier modules in combination with other known methods.