

Automatic Thermal Conductivity Measuring System HWM-15

(in conformity with JIS R 2616, JIS R 2251-1, R 2251-2, ISO 8894-1, 8894-2)

The system is based on the principle of the transient hot wire method. This is composed of an electric heating circuit of thin metallic wire (Hot wire) and a measuring circuit of the temperature of the hot wire sandwiched between two specimens as shown in Fig.1.

When The constant energy(Q) is applied to the hot wire, the wire temperature(θ) rises in proportion to log-time ($\ln t$) in accordance with Eq.(1).

$$\theta = \frac{Q}{4\pi\lambda} \left(\ln \frac{4at}{r^2} - C \right) \dots\dots\dots(1)$$

where, a:thermal diffusivity, r:distance between a heat source and a point of temperature measurement in a specimen.

When the wire temperature (θ) is plotted against log-time ($\ln t$), the first portion is curved due to the influence of heat capacity of the hot wire. Then the plot becomes linear for a considerable period of time, and finally curves again as the specimen size becomes a factor as shown in Fig.2. By limiting the data points to the linear part of the curve showed by green lines (t_1 and t_2 in Fig.2), the thermal conductivity (λ) is obtained using the equation:

$$\lambda = \frac{Q}{4\pi} \cdot \frac{\ln(t_2 / t_1)}{\theta_2 - \theta_1} \dots\dots\dots(2)$$

where , θ_1 and θ_2 are the wire temperatures at elapsed times t_1 and t_2 .

To obtain the exact thermal conductivity, the stability of specimen temperature ($\pm 0.05^\circ\text{C} / 5 \text{ min}$) before starting measurements, is required. Fig.3 showed the graph that the hot wire temperature converges to $\pm 0.05^\circ\text{C}$ in proportion to time elapsed.

This system produces automatically the complete result such as Fig.4 after the computed the most suitable period of start for measurements, the most suitable powers for applying the hot wire, by the inputting the fixed temperatures and the number of times for measurements. The results obtained are saved as the Word and the Excel files.

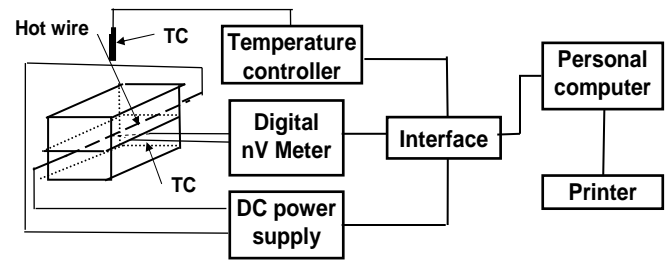


Fig.1. Schematic diagram of the system.

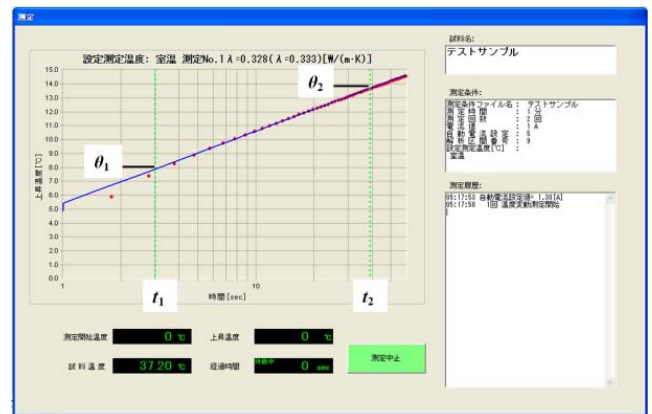


Fig.2. Hot wire temperature vs. time.

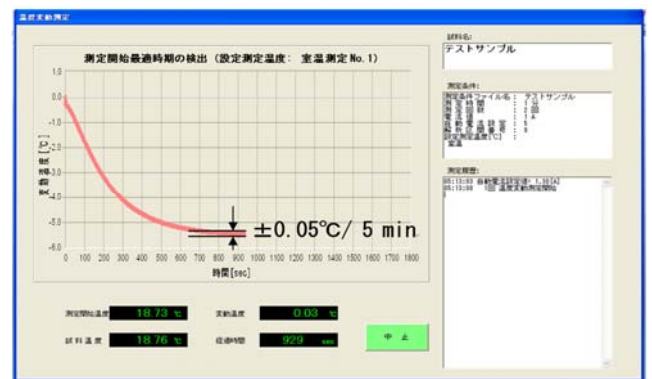


Fig.3. Check of specimen temperature.

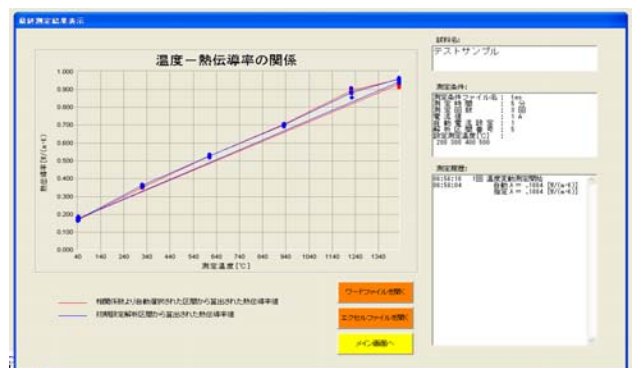


Fig. 4. Thermal conductivity measured automatically by the system HWM-15.

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