This paper offered a new method of obtaining the simultaneously true radial temperature profiles of PP melt during an isothermal flow. It was found that the use of unsheathed thermocouple network and the moving of temperature sensor past the stationary melt could eliminate the conduction and shear heating errors between the temperature sensor and the polymer melt respectively. The error of the melt-sensor friction was approximated to be 30% of the measured melt temperature. Under the test conditions in this work, the true maximum melt temperature was found to be in the range of 2-8°C. Increasing the piston speed with higher initial bulk temperature of the PP melt tended to increase the true $\Delta T_{\text{max}}$ to the optimum value, too high piston speed resulting in a decrease in the true $\Delta T_{\text{max}}$. The polymer melt-sensor friction was found to be independent of the sensor speed and initial bulk temperature of the PP melt.