Temperature is one of the most important parameters in polymer processing since it has a large influence on the final properties of the product. However, its measurement is extremely difficult, especially in the thickness direction. One of the difficulties is the nature of polymer processes in which the polymer solidifies to form the product. As such, invasive techniques such as thermocouple insertion are not applicable. Another difficulty is the lack of information on the initial temperature distribution. In this work, an inversion technique is developed to reconstruct the initial temperature distribution over the thickness of a part during polymer processing using the surface temperature measurement. The heat transfer coefficient at the surface is also estimated. One of the issues in estimating the initial profile and the heat transfer simultaneously is the choice of the amount of data used in the inversion algorithm. Insufficient data lead to error in the solution while too much data give rise to correlation between the two effects. This is dealt with using the sensitivity analysis. The algorithm is validated using surface temperature data generated numerically from a number of theoretical temperature profiles developed during polymer flows. The technique is then applied to experimental data obtained by infrared thermography on the injection stretch blow molding process.