# Natural Convection and Heat Transfer in a Mini-SIGMA Experiment

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## Abstract

The experimental facility is of two-dimensional (2D) slice with the diameter, height, and thickness of the test section being 250mm, 125mm, and 50mm, respectively. The pool's sidewall, with a 23mm thick copper plate, was cooled by the regulated water loop A water-cooling system was used to maintain the temperature of water surrounding the test section nearly constant with time. Four (4) thin cable-type heaters, with a diameter of 2.4mm and a length of 85cm, were used to simulate internal heating in the pool. They were uniformly distributed in the semi-circular section to supply a maximum of 1kW power to the pool. From theses data we obtained the Rayleigh number on the order of $10^{10}$. The water loop temperatures were used to obtain the average heat flux on the sidewall and on the top of the pool. A total of 20 T-type thermocouples were fixed inside the copper wall at different angular locations in order to obtain local heat fluxes. Inside the pool, 27 T-type thermocouples were installed to measure the pool temperature distribution and variation. The thermocouple readings were all calibrated using the calibration box. The Mini-SIGMA experiment was conducted to test the performance of the water-cooling loop, cable-type heaters, thermocouples and the data acquisition system (DAS) against the available data on natural convection. We focused on the average heat transfer coefficients, angular heat flux, and peak values. The local heat fluxes were calculated from the temperature differences obtained from the thermocouple pair placed inside the wall and water pool. The maximum heat flux region corresponded to the upper part of the pool. The lowest heat transfer occurred at the bottom of the pool, which was the stagnation point. However, the highest value occurred at the upper corner of the pool.