

# Analytical Model and Experimental Evidence of Exponential Temperature Decay in Natural Convection Loop

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**Abstract.** Natural convection is a fundamental mechanism for heat dissipation in advanced cooling systems, ranging from nanofluid-enhanced transformers to liquid metal-cooled reactors. This work describes the design of a versatile experimental setup and an accompanying analytical model developed to characterize buoyancy-driven flow in both nanofluids and liquid metals. Building on our previous research (Zemanová Diešková *et al.*, 2024), we upgrade the analytical framework by incorporating a local heat transfer coefficient to account for environmental losses. This refinement predicts an exponential decay of the fluid temperature along the cooling segments of the loop. To validate this model, we employ infrared (IR) thermography to capture the continuous temperature field along the outer surface of the glass tube. Preliminary results show a good correlation between the measured spatial temperature distribution and the exponential profiles predicted by the model.