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Experimental study on helium heat transfer in a small natural circulation loop above the supercritical pressure

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We present here the first results on helium heat transfer in a small natural circulation loop above the supercritical pressure. The circulation loop is composed of a condenser, a uniformly heated test section and a return loop. The inner diameter of the tubes constituting the loop is 4 mm and the height of the test section is 23 cm. The condenser is thermally coupled to the second-stage of a Gifford-McMahon type cryocooler (1.5 W at 4.2 K) and is basically a phase separator with a heat exchanger. With this set-up, the helium heated in the test tube can be re-cooled in the condenser, where the pressure is held above the critical pressure and constant during the experiment. Thus, it is a self-sustaining cooling system. Data presented here correspond to the steady-state regime of the loop and gather the evolutions of the wall temperature at various heights of the test section. The temperature in the condenser was not controlled and increased as the heat flux on the test section was raised. The measurement covers a wall temperature from below the critical temperature up to 30 K for a constant pressure of 2.3 bars. The heat transfer coefficients are also presented and compared to ad-hoc correlations.

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