# HEAT TRANSFER DURING BOILING OF HELIUM IN VARIOUSLY ORIENTED NARROW CHANNELS

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Results are shown of an experimental study concerning the heat transfer during bubble boiling and film boiling of helium in narrow channels of various widths and orientations.

In our study of stabilized magnetic systems there arose the questions concerning the effect which their orientation with respect to the direction of gravity has on their performance characteristics. In order to answer this question, we built a device (Fig. 1) for testing the heat transfer to liquid helium in narrow channels variously oriented.

The heat transfer was measured in the channel between two discs of electrolytic copper with polished surfaces and with a constantan-wire heater cemented on one of them. Both the lateral and the back surface of this disc were insulated with foam-plastic, and its temperature was measured with an Allen–Bradley resistor. Stray heat losses through the foam-plastic insulation did not exceed 5% of the heater power near critical thermal flux levels. In each orientation they were measured in a control test and were accounted for in determining the thermal fluxes.

The results of measurements are represented in Fig. 1 by curves of maximum thermal flux (corresponding to transition from bubble to film boiling) and minimum thermal flux (corresponding to the reverse transition) as functions of 1/d (d denoting the channel width in meters).

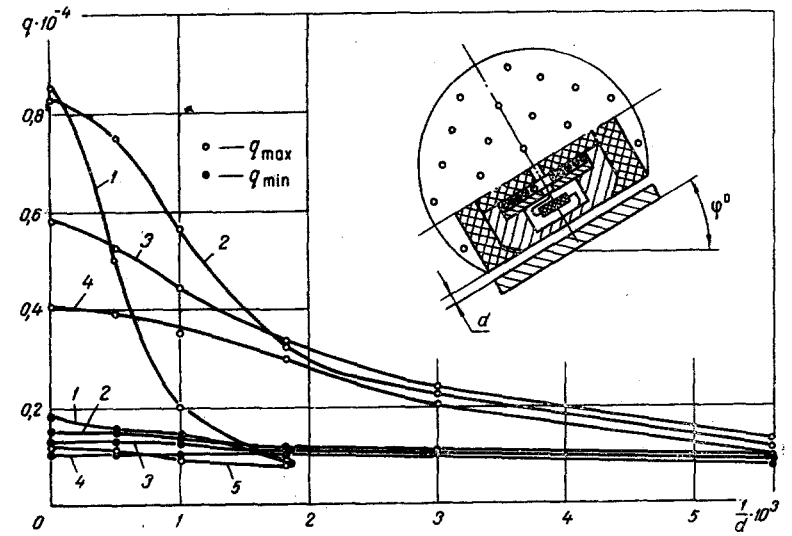


Fig. 1. Critical thermal fluxes q (W/m²) at various orientations of the channel ($\varphi^0$ denoting the inclination angle of the channel from the horizontal position), as a function of 1/d: $\varphi = 180°$ (1), 135° (2), 90° (3), 45° (4), 0° (5).

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Our results agree qualitatively with the results in [1, 2]. In [1] boiling was studied in a channel 0.22 m long and 0.002 m wide, with the maximum thermal flux there amounting to 50-60% of the thermal flux obtained for a channel of the same width in our study. In [2] the maximum thermal flux in shorter channels was of the same magnitude as in our study, while the minimum thermal flux during film boiling in our study was smaller than in [2] and less dependent on the channel orientation as well as on the channel width: it varied here from 1000 to 1500 $W/m^2$ over a wide range of the test parameters. The latter circumstance suggests, in the authors' opinion, that a stabilized superconductor designed so as to hold the thermal flux leaving its surface at a level not exceeding the critical thermal flux corresponding to transition from film to bubble boiling will also remain operative at any magnet orientation. The minimum critical flux in our tests was 1000 $W/m^2$. According to [3], it can be increased by a factor of 3-4 with the aid of special surface coatings.

## LITERATURE CITED


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