

Review of MHD Effects on Liquid Metal Boiling

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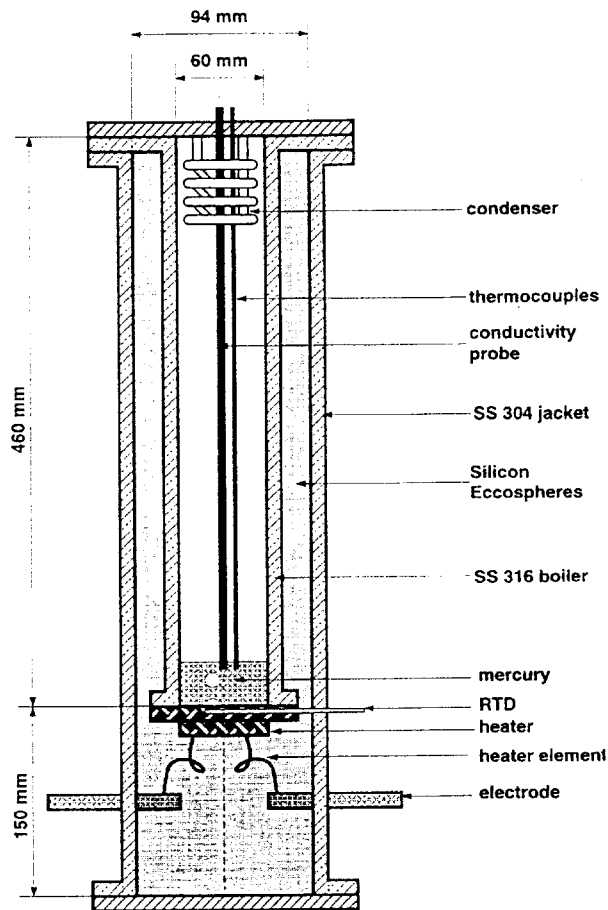
Outline

- Issues
- Summary of past work
- Application to EOLVE
- Summary

Issues

- Magnetic field will retard thermal convection.
- Magnetic field will affect bubble movement and shape.
- Magnetic field will influence nucleation of bubbles
- Net result is a reduction in heat transfer

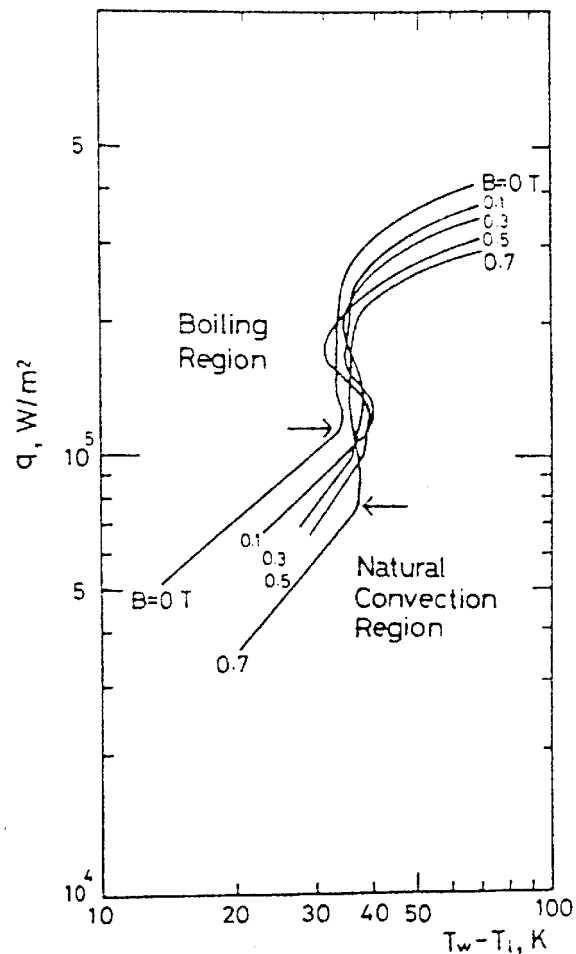
Test Equipment



Schematic of MHD boiling test section.

- Fields ~ 1T
- Power input to plate at bottom of tank.
- Mercury is typically the working fluid

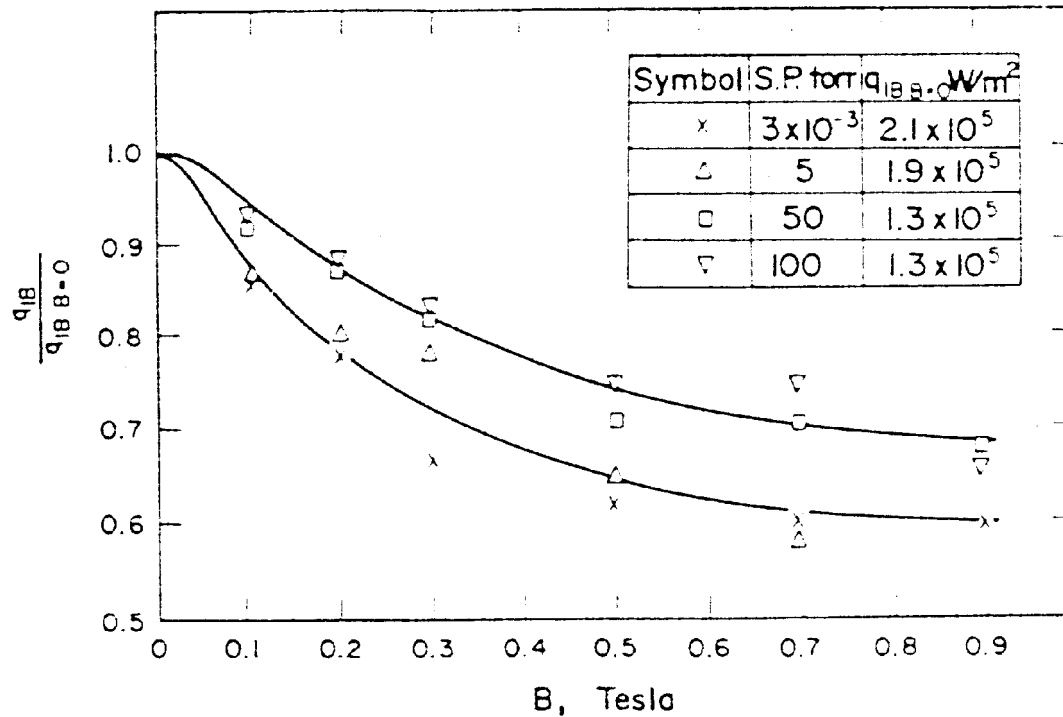
Typical Heat Transfer Data



Boiling curve of mercury under magnetic field for 35 mm liquid level and 50 torr system pressure. Incipient boiling is generated at point marked with arrow.

Ref. 6

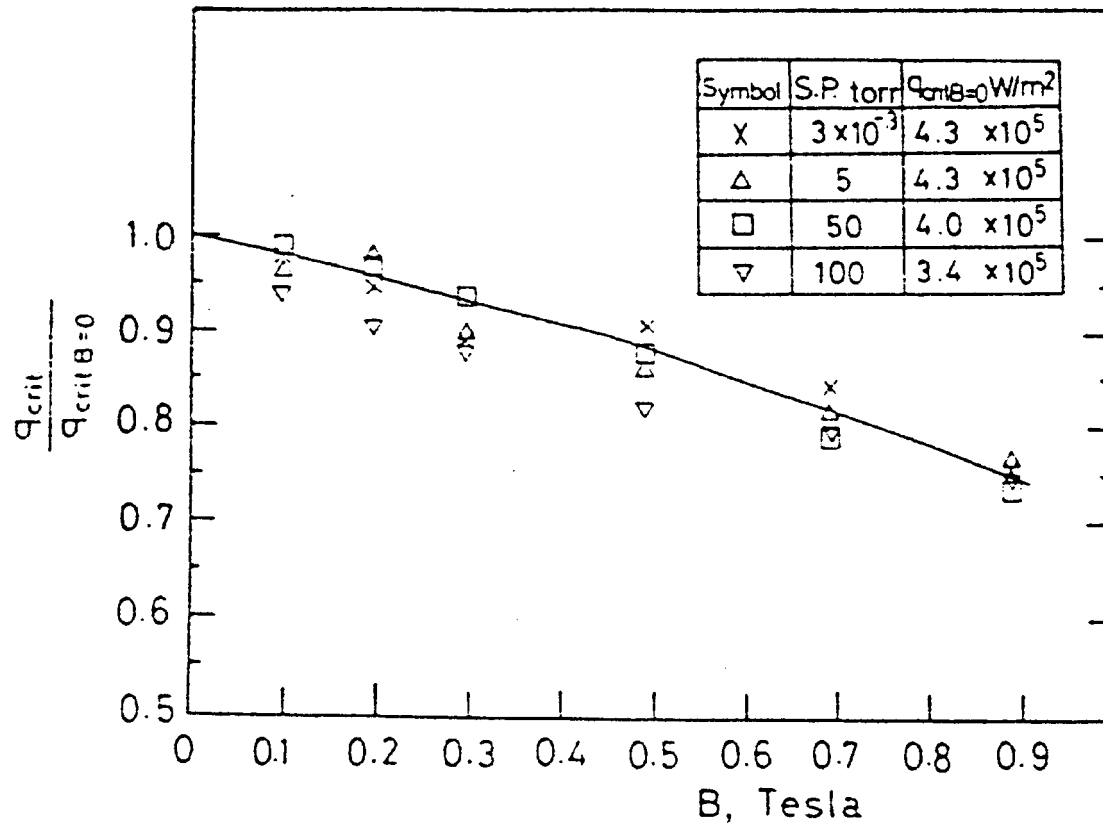
B Field Effect in Incipient Boiling



Effect of magnetic field on incipient boiling heat flux for 35 mm liquid level.

Ref 6

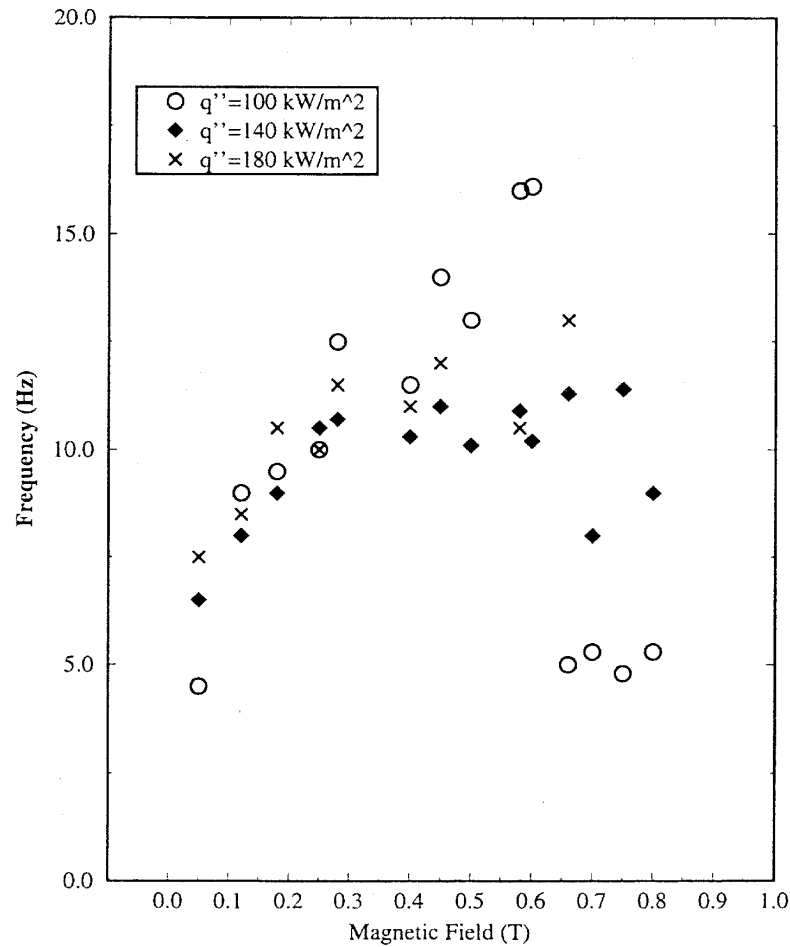
B Field Effect on Burnout Flux



Effect of magnetic field on burnout heat flux for 35 mm liquid level

Ref 6

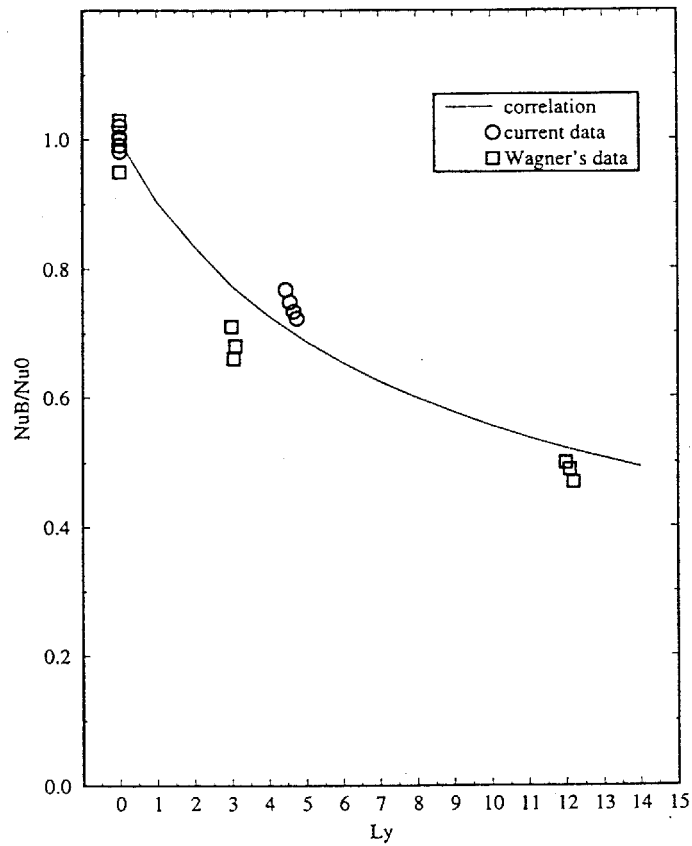
B Field Effect on Bubble Frequency



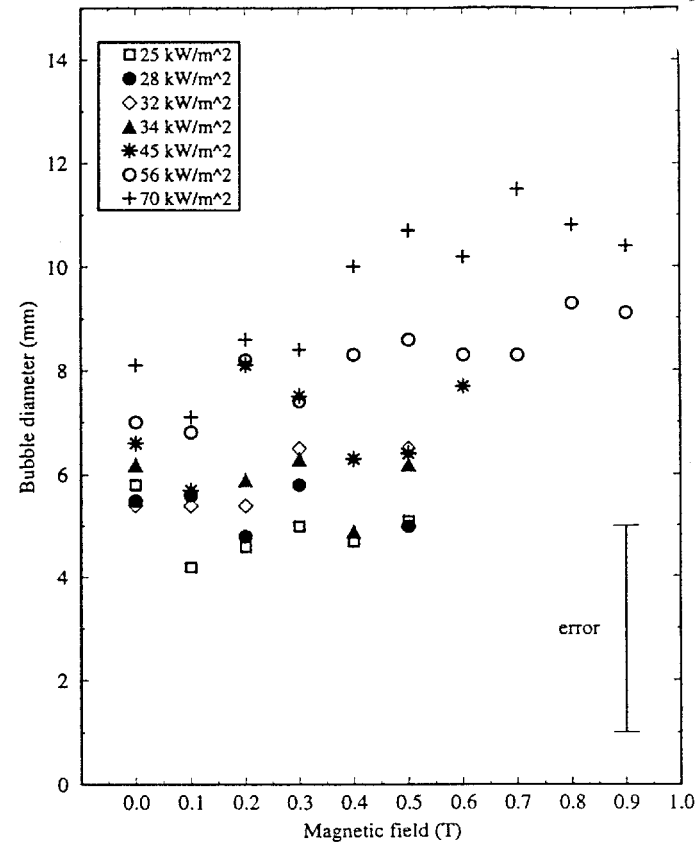
Bubble frequency data as a function of magnetic field strength.

Ref 3

B Field Effect on Convection and Bubble Size (Ref 3)

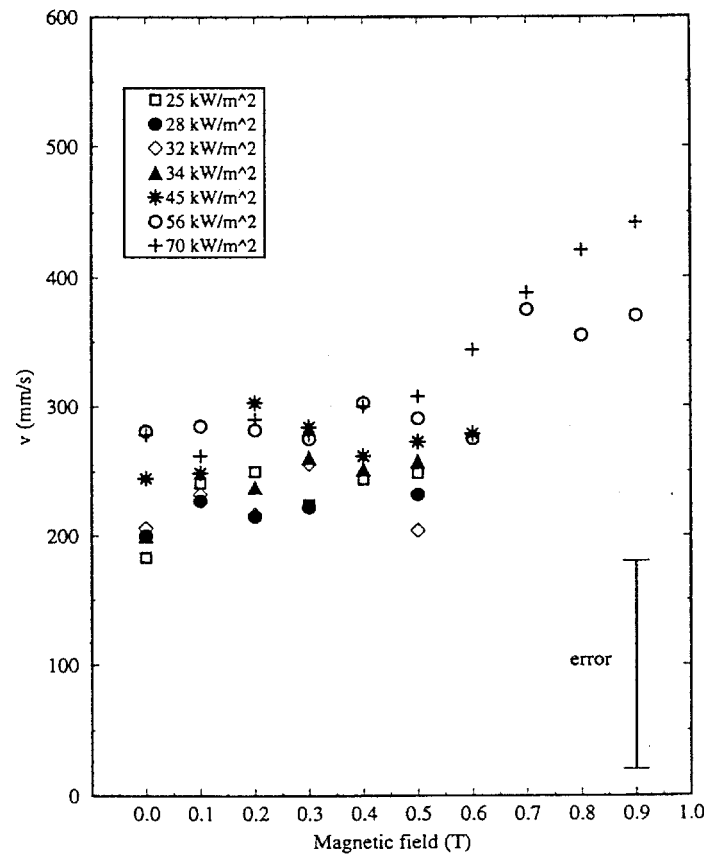


Natural convection data for single phase flow vs equation

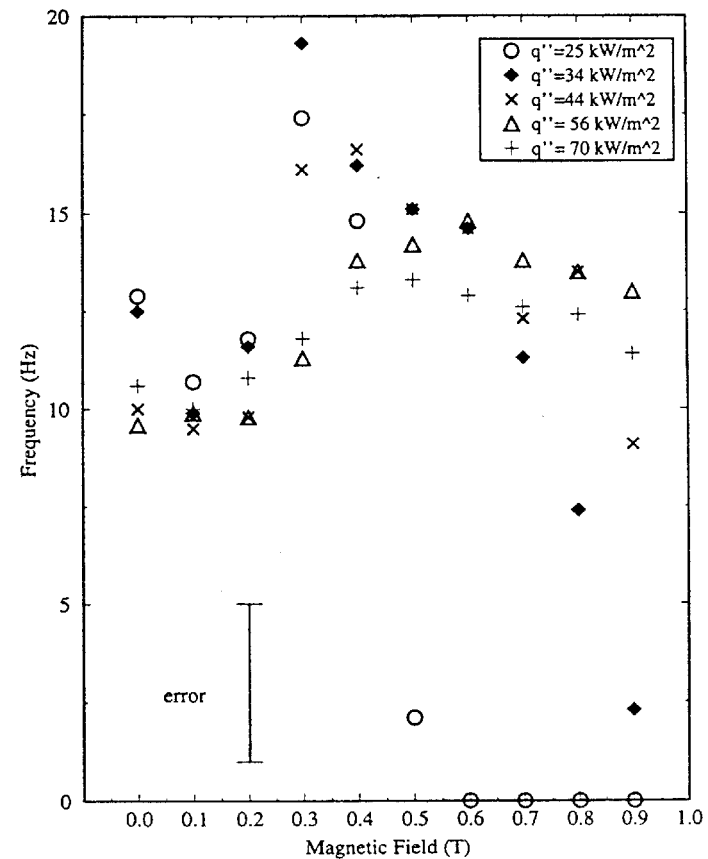


Effect of the magnetic field on the bubble size data.

B Field Effect on Bubble Rise Velocity and Frequency (Ref 3)

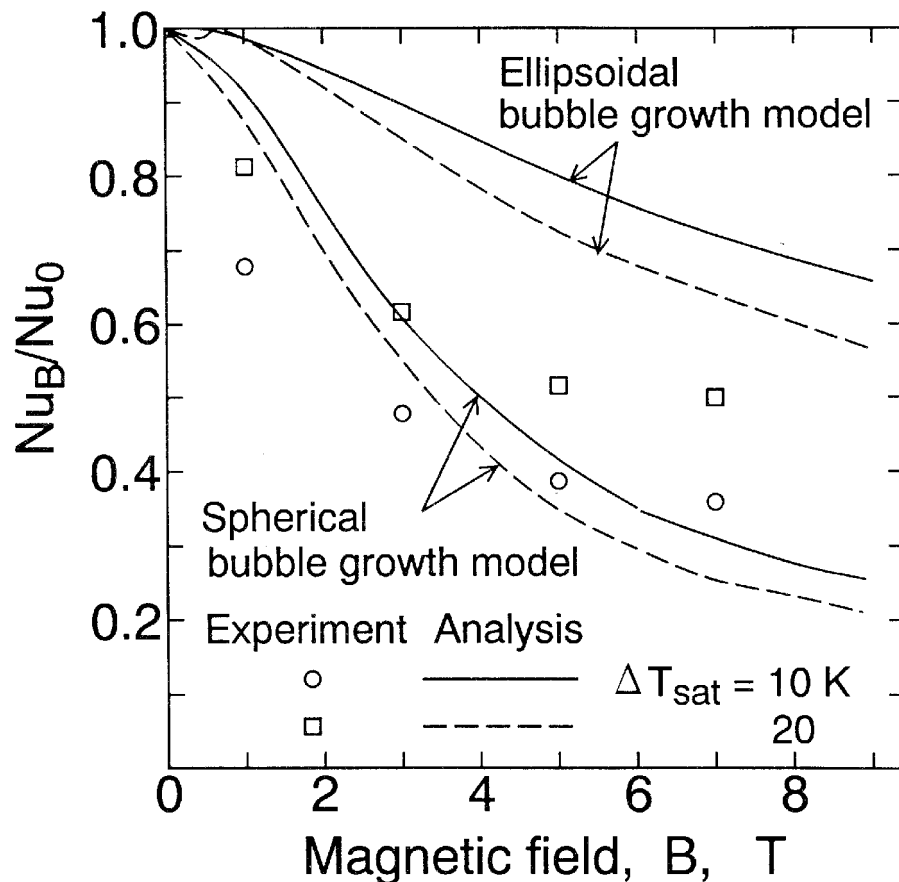


Effect of the magnetic field on the bubble rise velocity data.



Effect of the magnetic field on the bubble frequency data.

B Field Effect on Nu_B



Experimental and analytical results for Nu_B/Nu_0 calculated with original spherical and modified ellipsoidal bubble growth models.

Ref 1

Summary

- The magnetic field will significantly affect the boiling heat transfer, but will not likely affect the viability of the concept.
- The number of experimental studies is limited, and none adequately simulate the EVOLVE conditions.
- Future work includes applying experiments and models to the EVOLVE conditions and determining the needs for experimentation.