

A Precision Fluid Charging Station for 3D-Printed, Embeddable Vapor Chamber Heat Spreaders

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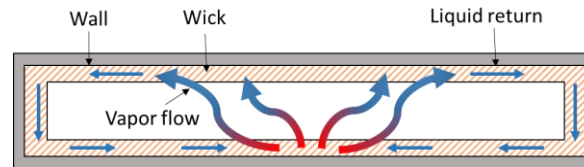
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Background

- A **vapor chamber** is a flat heat pipe with rectangular cross-section employed for heat spreading, and is widely used in electronics cooling.
- **3D printing** enables the vapor chambers to be directly embedded with components of the same materials to drastically improve conductivity.
- **Charging the chamber with degassed liquid of precise volume** is of vital significance to the performance of vapor chambers because:
 - i. insufficiently liquid leads to the dry-out condition;
 - ii. too much liquid inhibits heat transfer and increases vapor pressure;
 - iii. non-condensable gases form an insulating layer.



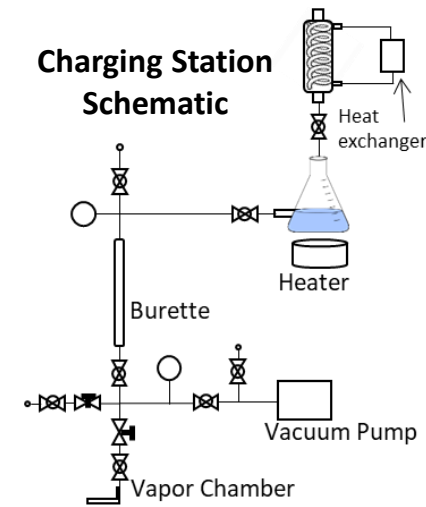
Schematic of a Vapor Chamber

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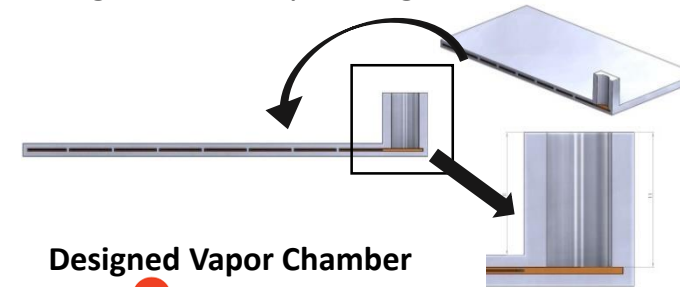
Approach

- Design and build a charging station which evacuates the chamber and fills it with the desired volume of fluid with very high accuracy.
- Test the station for vacuum leakage as well as the filling accuracy by differential weighing of the vapor chamber.
- Design a vapor chamber with compatible connections with the charging station.



Key Results

- A charging station that can evacuate and back fill a vapor chamber with an accuracy of 0.01 mL was constructed.
- A standard operating procedures manual is written for operation and troubleshooting of the charging facility.
- A vapor chamber with compatible connections is designed for 3D printing.



Designed Vapor Chamber



Fabricated Charging Station

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Objective: Design and fabricate a charging station for vapor chambers that evacuates and fills the chamber with degassed liquid of precisely-controlled volume (0.1-1 mL).