

The System Test Thermosyphon

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Purpose

- The thermosyphon cools all of the things which need to be brought to low temperatures that are located in vacuum.
- This includes things like the R&D vessel, purification tower components, Kr removal condenser, and the SRV cold cylinder.

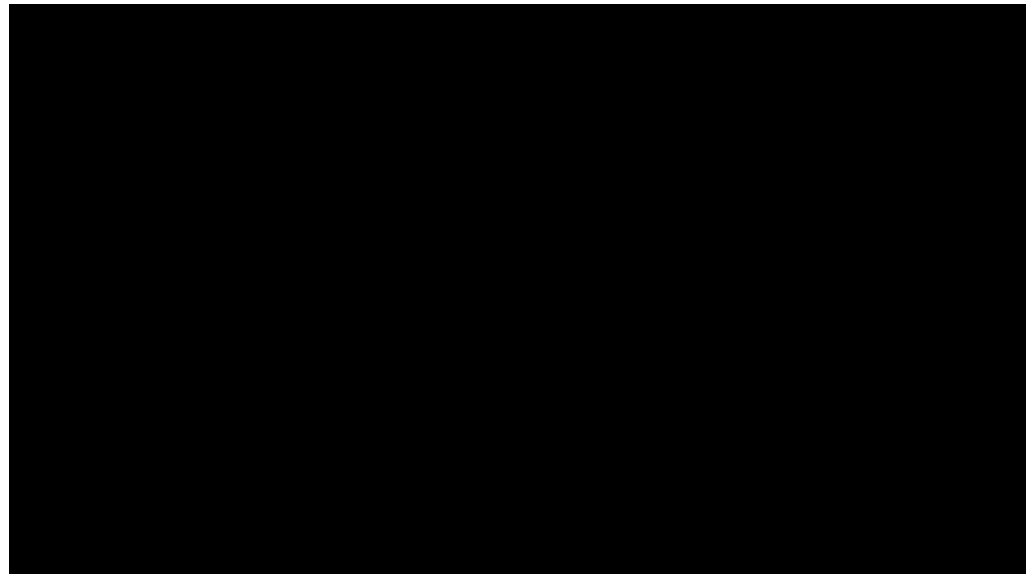
SLAC Set Up



- Thermosyphon dewar is mounted high above the deck of the Hut on a tall stand.
- 16 lines extend from the thermosyphon those that are currently in use extend through the floor to whatever they need to cool.
- Ten of these lines are so-called high power lines. Six are low power.

How it works

- The tubes which run between the LN reservoir and the object to be cooled contain a fixed amount of nitrogen (N_2) at pressure slightly over atmospheric so that it condenses when cooled by the reservoir.
- This nitrogen falls down the tube via gravity and exchanges heat at the bottom by boiling at which point it returns to gaseous form and returns to the top where it condenses once more.



<http://www.1-act.com/thermosyphons/>

Low power

How it works (continued)

- The tubes are insulated from the outer surface of the lines by a vacuum separate from that of the dewar.
- The surface off of which the nitrogen boils is a (typically copper) head.
- Heaters are also attached to the head in order to fine tune the amount of cooling to precisely the amount of heat loss in the system.



High Power, Low Power

- The Low power configuration is a single tube down which LN flows while simultaneously the gaseous nitrogen flows upward.
- The high power configuration consists of two tubes forming a loop. One in which the LN falls, and one in which the gaseous nitrogen rises.
- The high power configuration is advantageous because flow is always one direction instead of obstructing the flow from the opposite direction.
- This terminology is also used to describe two different flow regimes of nitrogen in the tubes.



Start-up Procedure

- Overfill lines with nitrogen. (Fill to 10ish bar, condense, repeat)
- Cool it to near the desired temperature using the high powered flow regime
- Activate heater to more finely control cooling power.
- Let out nitrogen until the heater is only slightly heating.

Nice Thermosyphon Features

- Cools more efficiently than simple convection because the latent heat of vaporization is so much higher than heat required to change the temperature by any reasonable amount.
 - N_2 Heat of Vaporization: $\sim 199 \text{ kJ/kg}$
 - N_2 Specific Heat $< 1.039 \text{ kJ/(kg K)}$
- No moving parts.
- Little maintenance.
- Keeps working in the event of a power failure.
- Works regardless of size provided it is oriented such that gravity draws liquid to the bottom.
- Huge range in possible cooling power.
- Can work on lines without stopping Thermosyphon.