

Evaporative Cooling Plant

Descriptive.

The Evaporative Cooling Plant (ECP) is a custom-built refrigeration plant capable of providing up to 500W of cooling. It is designed to pump compressed, pre-chilled liquid C3F8 refrigerant into a capillary installed in an experimental stave. The pressure drop introduced post capillary causes evaporation of the C3F8 and hence cooling along the stave. The cooling plant can provide cooling on up to 3 staves each of which can be individually isolated or tuned to a desired input pressure. See pic1

The ECP differs from traditional refrigerators in having "sub-cooling". This chills the liquid C3F8 down to -35°C prior to entering the capillary. In practice this reduces the enthalpy of the C3F8 and allows the liquid to absorb up to twice as much heat during evaporation.

The experimental staves typically consist of arrangements of ATLAS detector modules or replicas equipped with heaters, interfaced with a Cupro-Nickel (CuNi) cooling pipe structure (cooling loop), which carries the pressurized refrigerant. Aluminium blocks are soldered onto these pipes and provide a thermal interface between a module and the cooling system.

The ECP is equipped several key controls, these include:

- A PID controller adjusts the compressor frequency to maintain a constant input pressure. This controller will also accept manual commands if a fixed rate is required.
- The stave outlets can be manually regulated to tune the pressure at the capillary in the range 2-8 bar.
- The water supply temperature to the condenser can be adjusted to increase the above pressure even further.

Instrumentation systems provides a means to monitor the ECPs operation. These include:

- Pressure gauges on outlets 1-3, buffer tank and high-pressure line.
- Pressure transducers have been installed in parallel to these gauges to allow real-time PC monitoring and data-logging of operation.
- Operating temperatures are measured using 3 wire PT100 sensors on the sub-cooling coil, main exhaust and the high-pressure side of the system.
- A meter measures volumetric gas flow on the main exhaust.

This data is processed and displayed graphically by a Labview interface.