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Development of a test facility for measurement of performance of LN₂ cooled prototype plate fin heat exchanger

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Content :

The helium Refrigerator/Liquefier (HRL) needs LN₂ (liquid nitrogen) cooled heat exchanger to cool helium gas down to 80K. For this, a vacuum brazed aluminum plate fin heat exchanger was designed at IPR and a prototype of this has been fabricated by an Indian manufacturer. To measure the performance of this heat exchanger, a cryogenic test facility with closed loop helium circulation at higher operating pressure (between 1 and 14bar) is planned. This will need the design of a closed loop cryogenic piping, valves, temperature fixtures, interconnection with heat exchangers, layout of room temperature and cryogenic components with proper supports. Required insulation has been designed and made to minimize the external heat leaks to the cryogenic components, which, otherwise can lead to significant error in performance measurement. This prototype heat exchanger will be installed along with another plate fin heat exchanger(2stream type: helium to helium) which is expected to bring down the temperature of warm high pressure helium gas from 300K to about 120K by the use of cold helium gas coming out of LN₂ heat exchanger. This cold helium gas at the outlet from this heat exchanger will attain about 270K. A heater will be used to bring it to near to 300K before going to the helium circulator. It is planned that, the pressurized helium gas will be circulated using a circulator in the case of unavailability of helium compressor and oil removal system. For different operating pressure and helium flow rates, pressure drops through heat exchanger will be measured and that will be verified with the software developed by IPR. Similarly the thermal effectiveness and equivalent heat transfer will be calculated from the measured temperature of streams. This will be further verified using the software. It also includes the safety requirements for the reliable operation of the test facility.

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