

# 26th National Symposium on Cryogenics and Superconductivity

Contribution ID : 110

## Design, Development, Installation and Commissioning of Long distance Cryogenic transfer lines

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### Content :

Space simulation chambers are vital in simulating the space conditions (i.e., Vacuum and Cold background) for performance verification of integrated spacecraft and its subsystems. In order to simulate the cold background of  $-100^{\circ}\text{C}$  to  $-180^{\circ}\text{C}$ , liquid nitrogen is circulated inside the thermal shroud which is placed inside the chamber. Therefore, it is necessary to ensure availability of liquid nitrogen for uninterrupted space simulation tests. As we are sourcing LN<sub>2</sub> exclusively from external vendors, its supply may get affected due to various issues such as production and logistics. Hence, to mitigate the possibility of LN<sub>2</sub> shortage for operation of space simulation chambers, a long distance cryogenic transfer line of 100m length interconnecting six distantly located Liquid Nitrogen (LN<sub>2</sub>) storage Dewars at ISRO Satellite Centre, Bangalore was designed and commissioned with a view to utilise the liquid nitrogen from any of these dewars. Super insulated pipe lines were chosen and various technical aspects such as pressure drop, cool down time, and cool down mass were studied in detail for realisation of this transfer line. Haaland and Darcy-Weisbach equations were used for estimating friction factor and pressure drop respectively. A novel approach was adopted for theoretical calculation of cool down time. The same was also determined experimentally and compared. Vent valves were installed along the line at appropriate locations to relieve excess pressure and facilitate free flow of LN<sub>2</sub> during initial cool down. Safety measures like pressure relief valves and rupture disks were provided to avoid excess pressure build up in closed sections. After commissioning, 2, 50,000 litres of LN<sub>2</sub> has been transferred successfully with about 84% transfer effectiveness and the performance of transfer line was found to be in-line with our analysis.

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