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C2Or3A-07: Experimental optimization of GM cryocooler operating horizontally in liquid helium temperature zone

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GM cryocooler is characterized by high refrigeration efficiency and high reliability. Its mature manufacturing line makes it widely used in the temperature zone below liquid helium, such as MRI and cryopump. However, the cooling performance of the cryocooler will be weakened by the secondary flow and the natural convection when the cryocooler is installed horizontally. The influence of secondary flow and natural convection on the cryocooler will be strengthened as the dimensions of the cryocooler increases and the operation frequency decreases. Moreover, the performance of the GM cryocooler with large cooling capacity at the liquid helium temperature zone will be seriously degraded after the installation direction is converted from vertical to horizontal. The cooling capacity of KDE420 GM cryocooler produced by CSIC Pride Cryogenic Technology is decreased from 2.1W@4.2K to 1.6W@4.2K with 23.8% attenuation after its operation direction turns horizontal. Therefore, in the present study, we were committed to carrying out effective process to reduce the influence of operation direction and improve the cryocooler's cooling performance. By adjusting the size and improving the manufacturing process, the cooling capacity of the KDE420 increases from 1.6W to 2.2W while its operation direction is horizontal. The performance of KDE420 was improved by 37.5% and showed no degradation after 320 hours of horizontal operation.

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