

Moving Iron Based Pressure Wave Generators: Preparing Air Liquide's New Generation Pulse Tube Cryocoolers

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Pressure wave generator is the most determining component in the Pulse Tube cryocoolers performances. Key performances are cryogenic efficiency, micro-vibration levels and magnetic field levels. Since five years, Air Liquide has developed different pressure wave generator prototypes, with the support of French Space Agency CNES, and in cooperation with CEDRAT Technologies who brings its expertise related to linear actuators for space application. The consortium studied and tested several actuator topologies and sizes. Electromagnetic linear actuators driving opposed piston is the most typical architecture. CEDRAT technologies develops compact moving iron actuators (the MICA™) exhibiting excellent efficiency. Air Liquide has integrated MICAs into a TRL4 compressor which has been used to test and develop technological blocks and assembly architectures. This dismountable compressor multiplies the possible test configurations and assess: • Actuator and CPA assembling and alignment strategies • Piston alignment method • Clearance gap adjustment and design • Management of the moving part guidance Test results exhibit excellent cryogenic efficiency when coupled with AirLiquide LPTC pulse tube cold fingers. Moreover, the compressor shows low heat generation and encouraging EMC level. The presentation will first show the different pressure wave prototypes and the breadboard compressor developments. Then the breadboard cryogenic performances and EMC level will be presented.