Liquid Nitrogen Cooled Cryopump
Model no. AGASTYA-400

Introduction

AGASTYA-400 is a Liquid Nitrogen Cooled Cryopump which produces vacuum by capturing gas molecules on cryo-panel surfaces cooled to liquid nitrogen temperature of around 80K. It has a central bath to which cryopanels are attached and gets cooled by conduction. The bath serves the purpose of cold head as in closed loop refrigeration system (Stirling Cryocoolers, GM cryocoolers etc). At 80 K temperature cryosorption cryopump is capable of pumping nitrogen, water vapor and most of the hydrocarbons. The present invention AGASTYA-400 is modular concept tested and accepted design and is in operation at ISRO, SAC, Ahmedabad to evacuate cryovac chambers. It provides ~4000 l/s pumping speed for nitrogen/air and >15000 l/s pumping speed for water vapor for a 400mm opening. The pumping speed can be scaled up based on the design methodology established. The system finds application in Space Research, Plasma devices and any large vacuum application.

Applications

Specific to DAE the applications are to evacuate the large volume vessels in fusion machines (SST-1 & Aditya Tokamak at IPR), Accelerator Driven Systems, Vacuum and cryostat of ITER and LIGO beam technologies.

Non-DAE application area includes

- Space research for evacuation of Satellite testing/simulation chambers, Thrusters testing
- Defence and Aerospace
- Semiconductor industries
- Thin Film Industries
- Pharmaceutical industries

The cryogenic pump market, as per a survey, went to USD 1.67 Billion in 2016 and was projected to reach USD 1.96 Billion by 2021. The compound annual growth rate (CAGR) is about 3.79%.

(Reference: https://www.researchnester.com/reports/cryogenic-pump-market/975)

Specifications

Sr.#	Items	Specification

1	Type of pump	Liquid Nitrogen based Cryosorption pump (400 mm opening)
2	Cryo liquid	Liquid nitrogen
3	Model	AGASTYA 400
4	Material of construction	Stainless Steel AISI 304L (chamber), OHFC copper (panels)
5	Pumping speed	4000 litres/second (for Air/N2), 15,000 liters/second (moisture)
6	Gas load	1 E-2 mbar-liters/second Base
7	Pressure	2 E-7 mbar
8	Capacity	> 6000 mbar-liter
9	Feedthrough for sensors	D type 25 Pin feedthrough for temperature sensors
10	Temperature sensor	4 wire Pt-100

The 'Agastya 400' system comprises of the following sub-systems:

- Mechanical assembly involving an SS vacuum chamber with flanged ends and ports for sensors & gauges, vacuum systems etc., a central hollow stainless steel bath with copper rings brazed on it, activated carbon coated copper cryo panels, pressure release valve for safety, regeneration heating system.
- Instrumentation & control system involving temperature monitoring sensors and controllers, pressure monitoring gauges and regeneration heater power source.

Infrastructure Required

A. Following are the test and quality check infrastructure (non-consumable)
   - Pumping system (Rotary Pump, roots pump) with pumping speed 5-20 m3/hr
   - Vacuum Gauge (Pirani/Penni/combination type gauge)
   - Liquid nitrogen dewar
   - Temperature monitoring device
   - Vacuum Leak detector
   - HV/UHV accessories

B. Other Infrastructure: Mechanical Fabrication Workshop with CNC/Conventional turning lathe machine, milling machine, TIG welding machine, Welding consumables, Table mounted mechanical vice, Tool grinding machine, Portable grinder, spanner tool kit, etc.

Test Facilities Space

The space required for testing the complete assembled Liquid Nitrogen Cooled Cryopump system of 400 mm opening is 5m x 5m.

Power Supply

Single phase power supply requirement during performance testing of the cryopump.

Material Availability

All the raw materials are available within the country. For fulfilling user's application specific requirements temperature sensors and feedthrough need to be imported through local agents.

Manpower

One mechanical engineer, and one trained technicians to operate the machineries related to fabrication will be required for the production of the system. One mechanical engineer with basic cryogenic knowledge is required for system operation. For initial short operational and testing duration, Electrical and Electronics Engineer with knowledge in temperature measurement, automation and control will be required to carry out the pressure and temperature measurements.

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