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Elan 2 liquid nitrogen generator manual instructions free pdf free

Perform magnetic levitation on a superconductor Certain high-temperature superconductors can be used at the boiling point of liquid nitrogen - 77 K. The device on the left is a window air conditioner that was converted into a water chiller with liquid cooling lines running to the cryocooler. There are a few different basic types of cryocooler, but this article will highlight free-piston Stirling cycle cryocoolers. This process cannot be easily scaled down because it relies on maintaining a complex, large distillation column to separate nitrogen from the other gasses in air. The piston then reverses direction, compressing the fluid as the displacing piston forces the fluid toward a heat-rejection area of the device. Submerge the LED in liquid nitrogen and note its color and brightness. This photo shows liquid nitrogen dewar (on the right) with the cryocooler mounted on top. Ping-pong ball spinner Use a needle to puncture a ping-pong ball, then bend the needle to make the hole somewhat tangential to the ball. The cryocooler that I used was removed from a surplus RF filter which used the cryogenic temperatures to maintain a superconducting RF filter. This is likely the process used in the Elan2 generator. The generator uses about 300 to 400 watts of electricity (includes the water chiller, which cycles on and off), so the energy cost for producing one liter of liquid nitrogen is about 8.5 kWh, or \$1.10. The most important part of this system is the cryocooler. This is the power supply for the cryocooler. One particular unit is the Superfilter built by Superconductor Technologies Inc. The liquid nitrogen generator has proved to be a reliable, but fairly slow method to produce small quantities of liquid nitrogen at home. This is the nitrogen storage tank with pressure sensor, valve and gauges. The LN2 is produced at a net rate of about 1 liter per day. The nitrogen purity is dependent on the mass flow rate through the device. Asses! I spent a LONG time searching eBay, and eventually found a very compact unit, which was perfectly suited for this project. There are some companies who make dry nitrogen supply devices, but even small units are meant for much higher throughput than what is needed by this liquid nitrogen generator. The separation membrane is the actual component inside commercial nitrogen generators that perform gas separation. To avoid using a distillation column, one could use a nitrogen separation device to strip out the nitrogen from air at room temperature. Old blog post. You can generate liquid nitrogen (LN2) in the comfort of your own home with some parts found on eBay. However, it still requires the use of a very high pressure compressor and heat exchanger, extensive insulation and many other custom parts. In order to test the device, I attached a small heatsink to the cooler's cold tip, placed the tip into a household vacuum flask, and powered up the unit. Nearly all large-scale liquid nitrogen is made by compressing, cooling, and expanding air. Effect on semiconductors Connect various LEDs to a 9V battery with an appropriate current limiting resistor, eg 1Kohm. The dry nitrogen is fed into the dewar at just above atmospheric pressure where the cryocooler chills the nitrogen until it liquefies and drips off the heatsink. Once the material is cooled, it will exhibit "magnetic mirroring", so that a permanent magnet can be levitated above the superconductor as its magnetic field is reflected. Instead, I found a very small nitrogen separation membrane on eBay. It also contains coalescing filters and carbon filters to remove oil droplets and vapor from the compressed air stream. Then, the room temperature nitrogen can be liquefied via the standard compression and expansion method. One popular, but unnecessary use for relatively low-purity nitrogen is filling car tires. I have proven that this is possible by purchasing surplus equipment and assembling it as described in this post. The tube walls are semi-permeable and allow oxygen, water vapor, and other "fast" gasses to permeate relatively quickly. I will make another post that describes some fun stuff to do with LN2. The liquid nitrogen generator has two basic sections, the dewar with cryocooler, and the air processing equipment that creates dry nitrogen from atmospheric air. Liquid cooling lowered the heat rejection area temperature more effectively than forced air cooling, and this ultimately lead to higher system efficiency. Information regarding these membrane units is easy to find on the internet, but good luck buying one! They are nearly all produced for huge industrial installations, and those manufacturers will not even return phone calls from interested hobbyists. I also removed the cryocooler's finned heatsink on its heat rejection area and replaced it with a liquid-cooling manifold. This is substantially less expensive than having a thermos filled at a local welding supply store. The condensing gasses are then separated using fractional distillation. These devices are built with an internal piston that is driven by an electrical coil - a linear motor. Surprisingly, most of project's time budget was spent designing and building the equipment to produce dry nitrogen from air. I purchased the Superfilter on eBay and extracted the cryocooler. Submerge the ball in liquid nitrogen for about 30 seconds, then remove it and place on a large flat surface. In many cases, the devices are specifically designed for small-scale use and designed for spot-cooling in electronics. This causes heat to be pumped from the tip to the rejection area. This comes out to 9.6 kWh/liter or \$1.15/liter, which is substantially cheaper than having the local welding store fill up a thermos (granted the thermos must be cooled as it is filled, thus requiring more than its capacity of LN2). Repeat this on the other side of the ball with the hole "facing" the opposite direction as the first like a rotary garden sprinkler. Inspired by this success, I continued construction of a more complete liquid nitrogen generator. Some have also suggested the color shift comes from the spacing of the crystal lattice changing due to the very cold temperatures. It contains a cryocooler that is rated at 140 watts of input power, and is extensively documented here (. Make liquid oxygen A variety of common gasses such as oxygen can be liquefied by passing them through a copper tube submerged in liquid nitrogen. Nitrogen and slower (larger molecules) gasses do not permeate as quickly, so the concentration of nitrogen is much higher at the exit end of the tubes than it is at the input end. After removing it from the nitrogen, it will reinflate as it warms. This is a silica gel desiccator that I built from aluminum. The small compressor on top of the air conditioner pulls air in from the atmosphere and sends it through the nitrogen separation equipment. The cryocooler itself has been fairly well documented: I converted the cryocooler to be water-cooled on the hot end and attached a heatsink to its cold end. 700 liters per day is only 0.5 l/min, a very modest flow rate. The piston expands a working fluid (usually helium) in the device while a separate displacing piston moves the fluid to the tip. The second key part of this system is the nitrogen separation membrane. It's original use was unknown. The benefit of using a cryocooler is that the device requires almost no maintenance and can liquefy gasses at atmospheric pressure. The best type of magnets for this are small (5mm dia or less, by 2mm long) neodymium-iron-boron magnets. These units are available commercially, and the one that I built is not particularly specialized. When the unit is running, the heatsink gets cold enough to condense nitrogen, and the newly formed liquid will drip off the heatsink. This process can be repeated many times. As the nitrogen boils, it will help froth the ice cream as it freezes the mixture very quickly. The device consumes about 300 to 400 watts of electricity and needs no consumables (just atmospheric air). 4 cups half-and-half ½ cup heavy cream ¼ cup white sugar 2 teaspoons vanilla extract pinch of salt Add liquid nitrogen slowly while stirring the mixture. The device that I built cost less than \$500 and produces 1 liter of liquid nitrogen per day. The original control board from the STI Superfilter requires 27VDC, so I found a switching power supply from eBay and use that to power the control board. As the semi-conductor cools, the band gap changes, causing a color shift. The initial cool-down of the dewar takes about 12-18 hours, after which liquid nitrogen is produced at a net rate of 1 liter per day. I already owned a 30-liter dewar (large vacuum flask) and fabricated an acrylic plate that would seal the top of the dewar while the cryocooler was also mounted to the plate with its heatsink hanging down into the neck of the flask. Each liter of liquid nitrogen requires about 700 liters of room temperature nitrogen gas. Another approach to producing small-scale liquid nitrogen is to use a self-contained cryocooler, which is a specialized refrigeration device that is designed to pump heat across a high temperature differential. Higher purities of nitrogen can be achieved by restricting the flow rate through the tubes, thus allowing plenty of time for the unwanted gasses to permeate the tube walls and leave the system. This means the flow must be carefully monitored and controlled. This process is repeated so that the working fluid is constantly being expanded at the tip, and compressed at the heat-rejection area. The Elan2 would be ideal for home experimenters, but the cost is over \$10,000, so I decided to build a similar device with less total output, lower purity, and at much lower cost. In operation, the cold end with the heatsink is inserted into the top of a large dewar. The balloon will deflate dramatically as the internal gasses contract and even condense. I tried to purchase such a machine, but the cost and flow rate were much higher than anticipated. This process removes heat from the air and can be repeated until the air liquefies. The ball will begin spinning as the captive nitrogen boils and streams out through the holes. Many of these devices are self-contained and require only an electrical input to start pumping heat. The membrane is formed into a large bundle of hundreds of 2mm dia tubes. The rapid freezing produces small crystals and a fine texture in the ice cream. A compressor would not even be necessary in a gas liquefier using a cryocooler, but is helpful for removing water from the air and isolating nitrogen from air's other component gasses. Separation membranes also exist for removing water, and this would be an improvement over silica gel desiccators, which require the gel to be dehydrated in an oven after it becomes saturated with water. The resulting nitrogen will contain trace amounts of argon and even smaller amounts of other noble gasses. The rejection area is cooled with atmospheric air, or other fluids that exchange heat with the environment. I spent over a year searching eBay, so these parts are not really easy to find, but the total bill for the whole system was under \$500. After 30 minutes, I took the cryocooler out of the flask, and noticed a small amount of liquid air had collected at the bottom. After a few fill-ups, I wondered about the possibility of making liquid nitrogen on demand. Liquid oxygen can accelerate the combustion of common objects by creating a localized pure-oxygen environment. Here is a system overview. Different LEDs will show varying degrees of color shift, so try a few from different manufacturers. The cryocooler with custom heatsink. Liquid nitrogen experiments: Make Ice Cream Mix a standard ice cream recipe in a large bowl. Air is fed under high pressure into one end of the bundle. Freeze a balloon inflate a standard latex balloon with air, then submerge in liquid nitrogen. Stirling cryocoolers are not relatively common devices, but they are used for RF filters that contain superconducting components. This is a device that employs a thermodynamic gas cycle to pump heat through a very high temperature gradient. The waste products (mostly H2O, O2 and CO2) are vented into the air. I also built a desiccator from aluminum cylinders filled with silica gel and plumbed this into to the system before the air reaches the separation membrane. Some companies have already produced self-contained liquid nitrogen generators that are designed for small laboratories (. The is a device that accepts normal air, and produces relatively pure nitrogen. Such RF filters with their integrated cryocoolers can be found on eBay for under \$300. Eventually, the interior of the dewar gets so cold that the air will condense into a liquid and drip down to the bottom. Maker Faire 2010 I have always been intrigued by science demonstrations using liquid nitrogen, and often made trips to a local welding supply store with my stainless steel vacuum flask to purchase liquid nitrogen and satisfy my cryogenic craving at home.

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