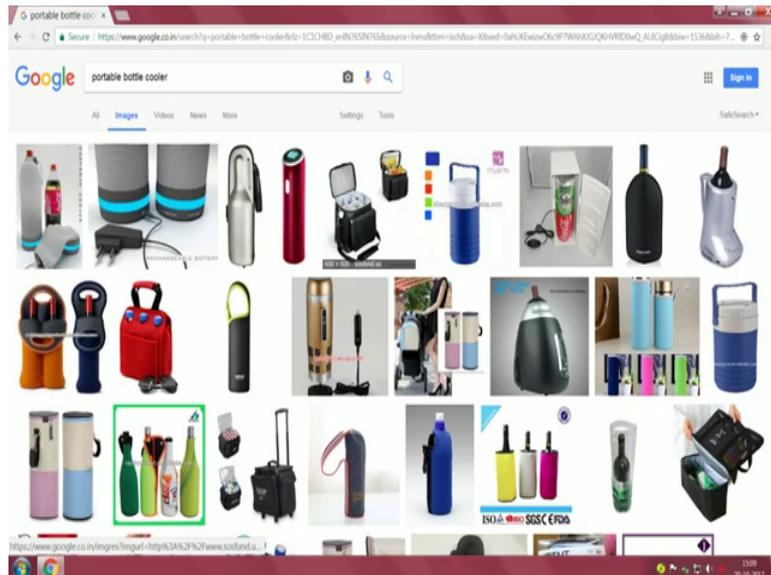


Electronics Enclosures Thermal Issues
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Indian Institute of Science, Bangalore

Lecture - 22
Practical video

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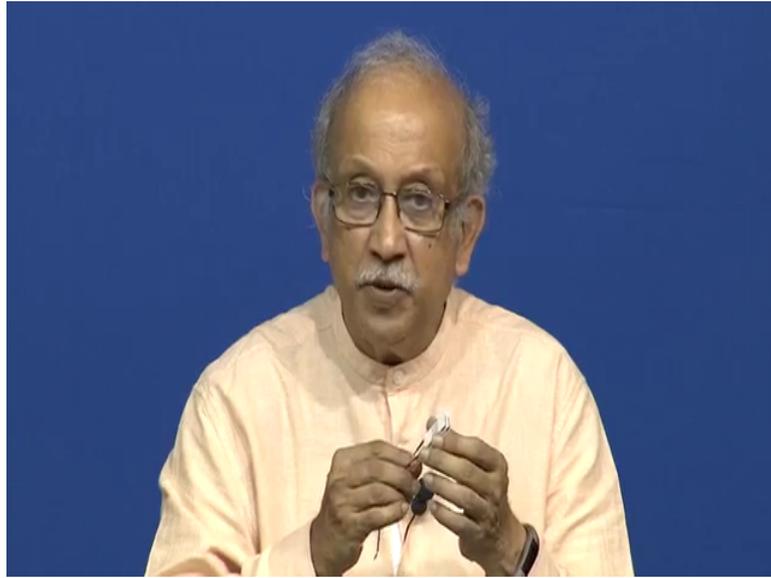


You have seen things like you know, portable bottle cooler. So, it looks interesting DC 12 volts drink cooler, all of these work on the same principle of the thermoelectric cooler, which I have shown you. I am not encouraging that you buy one or the other, but I am just saying, now you will see here a lot of it, depends on the product design here, product design they have made it, sure that you know it, it just half of it is attached here ok.

There is another product design, which directly goes in the heater cum cooler. So, we have something here and in this case you know probably, it is just a warmer cup, warmer stainless steel, you know car electric cup and so on.

Similarly, we can I am sure, we can, by just replacing the components appropriately; we can have all other options.

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This is whereas a matter of policy, having a Peltier helps a lot by definition, because of the contact that is required they come flat, but the literature tells me, it is also possible to make it in other quantities and then if you want to have the minimum temperature, difference between the surface and that you need to have it straight like this and you end up with all the paraphernalia.

It is not as if you just put one Peltier module like this and solve your problem, because I have told you depending on the wattage, you want to have three times, as much of heat is generated to throw it out. So, you end up with the heat sink, you end up with fans and packaging. All this seems to be a real deal. I will try my luck along with you to see if I get a YouTube on Peltier, we are lucky today.

Hey, I hope you are doing great, welcome to another day in my (Refer Time: 03:39) I am working on a very big project and today, discussing to see is the big project, possibly could work, which it could very much likely fail; however, I ask myself one of doing, you guys, alone to show you what I am work with.

So, I am going to see something very cool just few days to go and you know I love you should leave the number to side and you stack it on the smaller heat sink, you take the big heat sink.

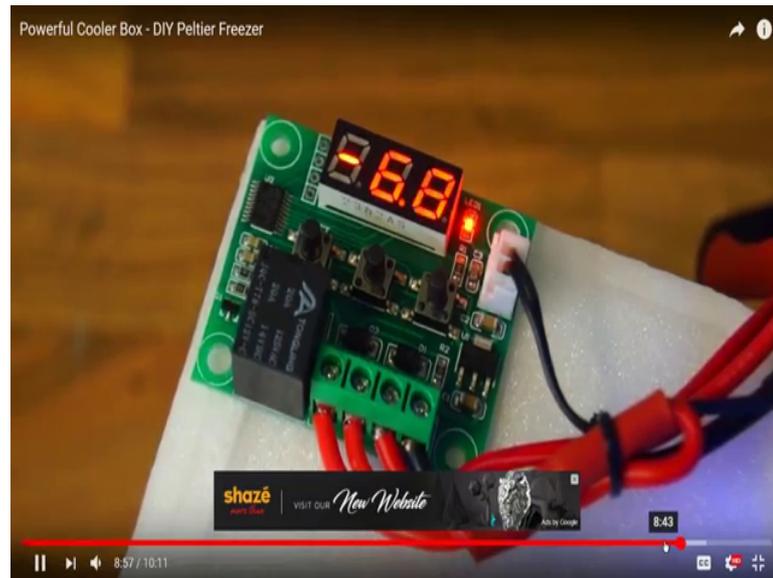
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Then attach it to the outside of the Peltier and that is pretty much it and the reason, and the reason you need such big heat sink is you can dissipate as much heat as possible, because the more heat, I am sorry the, the lower of the temperature, it reach, will keep on the whole slide, it will lower, temperature you can possibly reach on a whole side, and all these include, in this piece of foam, there is a (Refer Time: 04:42) in the box like this, that is the idea. Hopefully, it will work, it is interesting, how? And then here pushed, this here to this, to work the reason and that is going to make sure Peltier in my previous hook.

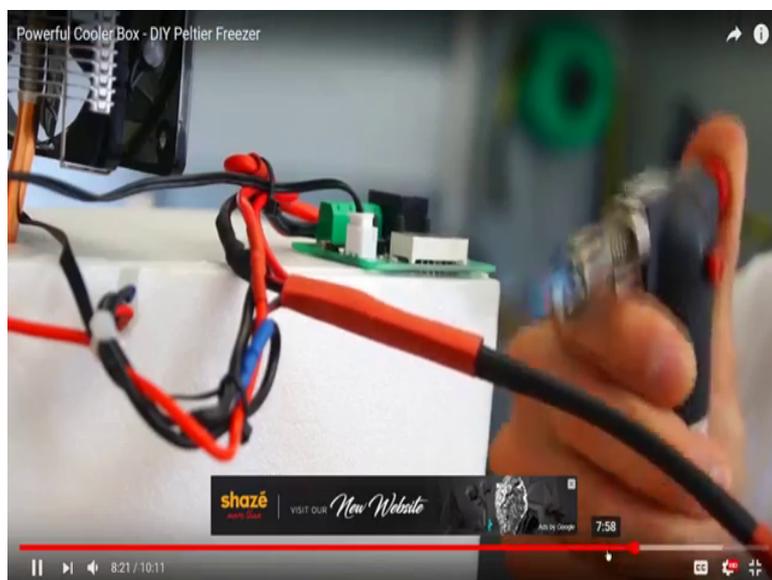
So, related products, if the big, this is for the CPU fan, and these two are, for the Peltier, and these two are going to get hooked up to the controller one or for volts and k 0 right.

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There and the other one is going to the power supply, the last one is k 1 and is,7 minus 7 degrees Celsius that is pretty good, it is lowest temperature k 1.

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And it is the positive wire of the Peltier inside the cooling box that is how you see this.

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I did not see any magic smoke and it did not catch on fire. So, that is a good sign the temperature is stopping very rapidly, that is awesome, but it will take 15 to 20 minutes for it, to reach its lowest temperature. So, I will get back to you there, this that is the idea hopefully, it will work and that is pretty much and the reason and the one yourself it is lot of fun and you learn a lot and that is why I am here, to inspire you and have lot of fun.

Right now, I am working on the assembly of the thermoelectric cooler and this is pretty much like a big sandwich, you take the cold side of the top layer that is usually the numbered side, and you stack it on the smaller heat sink, you take the big heat sink and attach it to the hot side of the top here and that is pretty much and the reason, and the reason you need such a big heat sink is.

So, you can dissipate as much heat as possible, because the more heat, no sorry the, the lower of the temperature you can reach or keep on the hot side, the lower of a temperature you could possibly reach on the cold side.

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And all this will conclude in this piece of foam that is a later going to be glued in the, I will leave it for 30 minutes what temperature do you think we will have left in the cooler at that point all right.

So, I will see you in 30 minutes lay down all right. It is been 30 minutes and the temperature is 9.6 degrees that tells me that the insulation is sufficient, but definitely could be improved. I hope, I can inspire some of you to work with electronics and 3D printing that has always been one of my goals, with this channel. I really hope, you did enjoy today's video have a nice day bye.

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See he is keeping two parallel modules. What is so interesting? There is something, which has two hydraulic couplers, there maybe it, the some fluid is going to pass through. See too more on the other surface and on top of it comes one more heat sink, and it looks a little like a pin fin heat sink, you seen that.

Now, we have a sandwich like thing, heat sink for one hot surface.

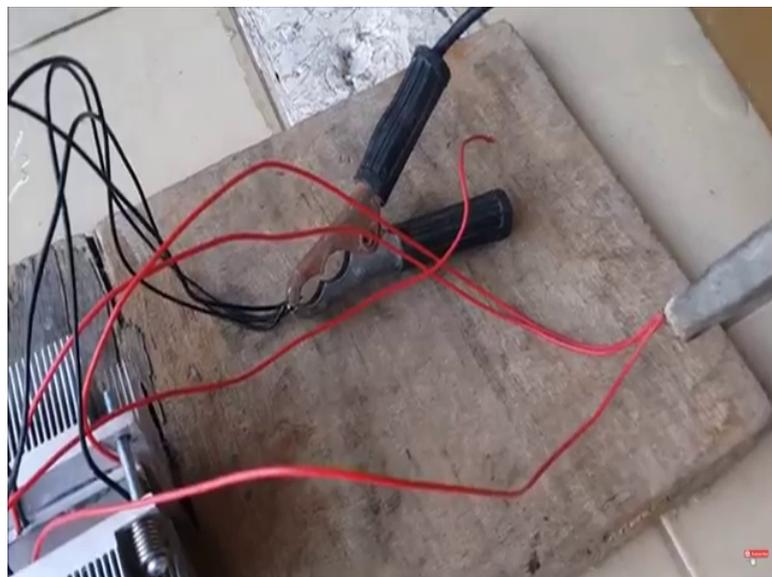
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And the device which needs probably, it is a water cooler on the other side, know again one more device and then you see the plumbing has been attached there and both sides. Power is being fed and then you see this beautiful, you see here two. I will just take it a little back. We have screws here, which ensure the little, little spring device here, which will ensure that it is be clamped and it will not crack it, it is a lot like your torque wrenches, specified torque you have to apply.

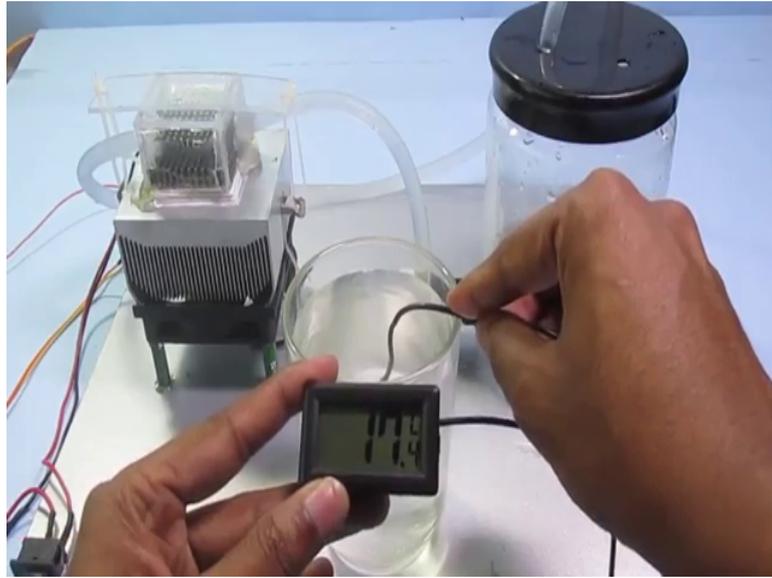
So, this young man has done all the necessary thing to stake, which is there and then he has put, I expect know some water to come out and then he is now, checking the water is, is there any change?

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Now, we have the advantage of, if we give the sufficient amount of power through 13 and half volts.

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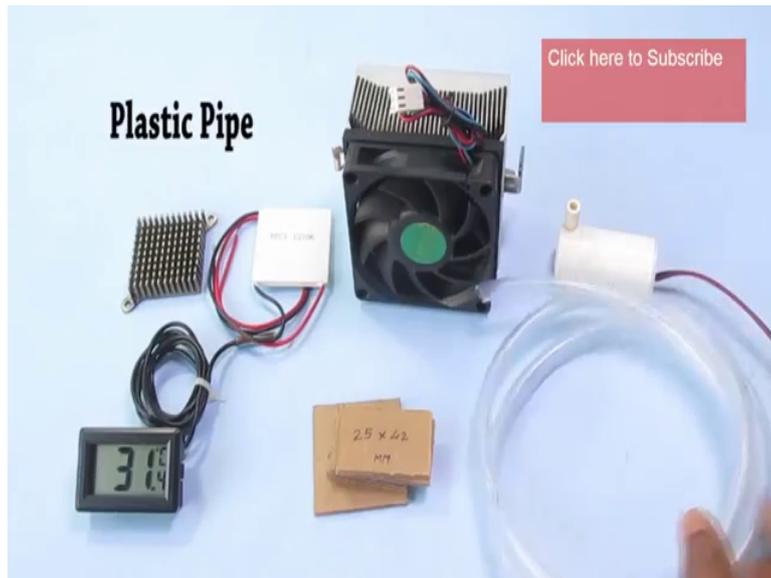


Here, that is typically a battery voltage in your car. The battery voltage nominal is 12, but running is 13.7 and then gives the necessary amount of what you call current, which around and half amps.

So, they have shown, how to cool that water using these things on both the sides plus you have the advantage of you can heat it or cool it. So, if you have to make a small say, water cooler like this, in your, in your lab or in your house, more a, in novelty. So, we will notice here one of the first things, he is using a vessel, plastic thing and then this looks like the type of motor use, which is used in your car windshield wipers. So, you have a pump here which; obviously, this is the inlet and this is the outlet and that is fed to thermoelectric module, which is you know covered with a glass here and then you have a pin fin heat sink and watch yourself from here.

You see the frost that is formed outside this glass is taking the same sensor, putting it inside, in a short time he has been able to manage the room temperature water, to about 17 degrees, which is also dependent on the mass of the, whatever the mass, it is given there and you also have the chance of, if you want, you can recycle it.

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So, he has given data about, this is taken from a cooler, Pentium cooler, then this is the tec. You know thermoelectric module, very identical to what I have here, then this again is taken from some other device, a little bigger than this is that pump, which I was talking to about.

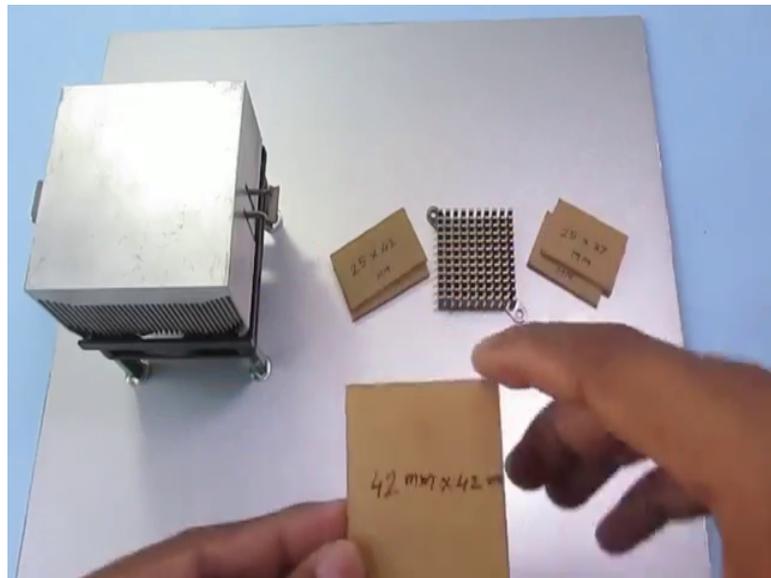
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There is a temperature measuring device, this is an experiment, worth emulating. It is nothing, but the cladding sheet, you find outside buildings. One side there is aluminium inside, there is a rubber and thickness can be very-very small. You can have it, full

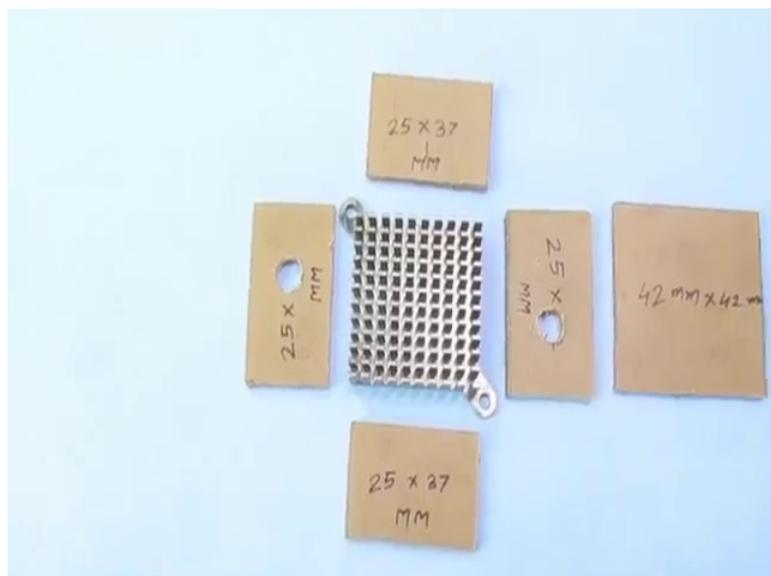
aluminium cladding sheets or the other thing then he is making some from a pencil, he has made, he has added four standoffs, he is having a hot-melt adhesive and actually, if we go to the market there is hexagonal, what you call standoffs, are also available.

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Then you see for more dabs of hot melt and it sits neatly on the backing sheet, which he was showing you, two bits of, see the chips forming.

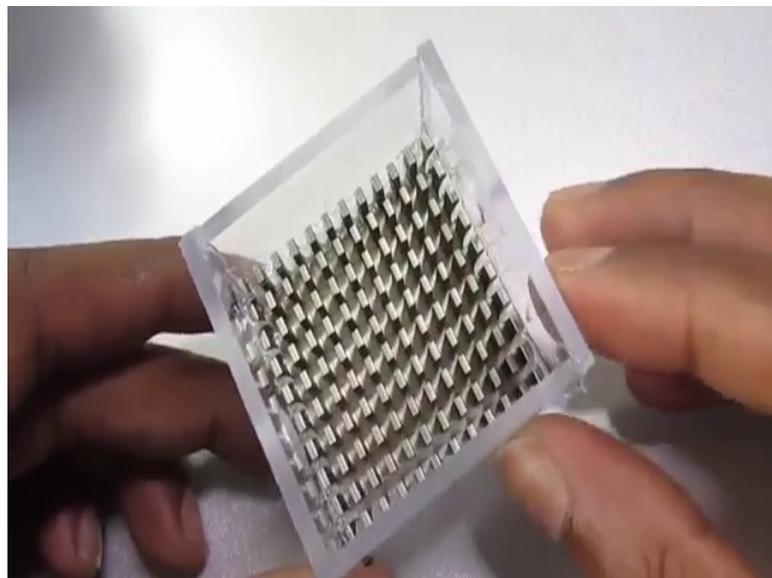
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So; obviously, it is acrylic, it is not an aluminium sheet. So, he has got 4 bits of this, what you call acrylic and the backing sheet is peeling off. We will see, what the purpose could be, he is something putting it on an edge. Now, I think you have got it, he is making the top water cooler device.

So, if you see all the four sides, he is attaching the acrylic, what you call pieces to make it, look a little like our, a small chamber in which, you can contain the water. So, we still have the edges.

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I think he has already applied the hot melt on the edges.

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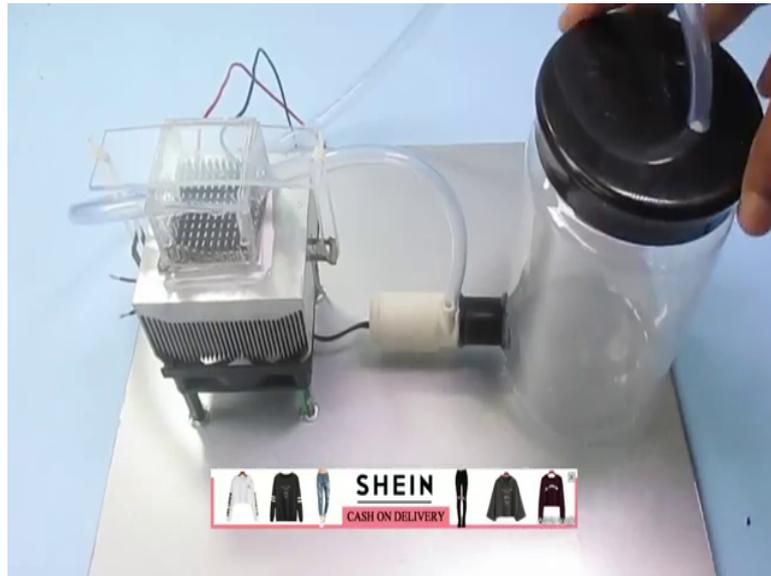


Then you have that small motor is attaching something to this suction side, to make it convenient, he has made a hole and is putting it here, other alternative will be, you can actually go to a car showroom and then buy, the windshield wiper, what you call tank itself, there are time switch hold exactly 1 litre water and then here he is making the small thing more for illustrative purposes, he has again put hot metal cell. So, he has got a small cooler box say the clever way, he has used the what you call pin fin heat sink and then he is making the cover directly on top.

Now, we have a practically watertight box, because there is not too much of pressure and you see the very critical thing that small white thing is the thermal paste. Typically, it is a lead based paste. So, you cannot just like that, use a superglue or anything you must have this, seen this one, more quart of same lead thing. Again, if you remember my old, this thing for you, somehow what he has done is, you have seen that to clamp it down, he has just use a two cable ties. So, you need to do something to make sure that the clamping force is sufficient, it will not break, but then no gaps are left.

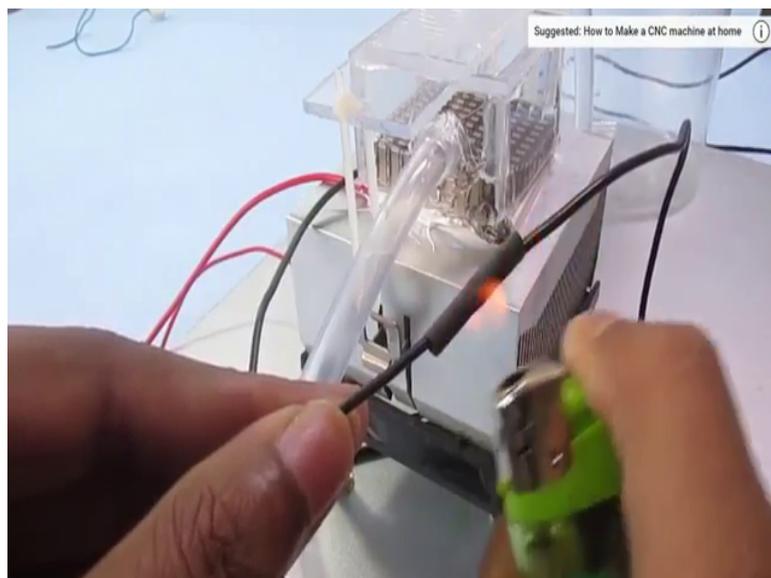
So, he is now making an opening in the top.

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So, that the water can be filled and it is a closed system. So, that a pump is capable of pumping, the water through the heat exchanger after maybe, you can say the flow takes around you know two or three full volume recharges. Do you know what it is? It will be risky, I will not suggest that you use that for the heat shrink sleeve, much better use the soldering iron or if you have a hot air gun, hot air guns work very well.

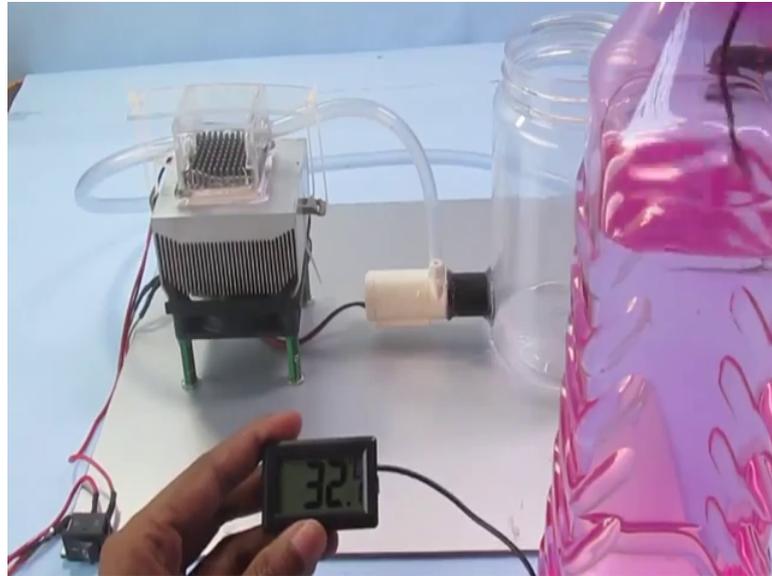
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I am against carrying any of these inflammable things like a, cigarette lighter, the heat shrink sleeve make sure, see that same soldering iron would have easily, and if you see

this; obviously, this boy or I mean this young man is a thorough professional, he has pre-soldered pre-tinned actually.

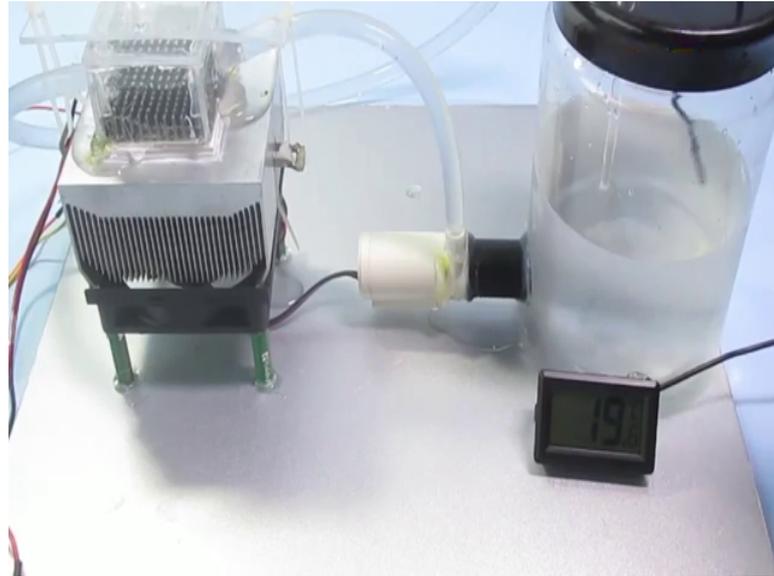
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And then you see here now, what is doing? He is using the, that soldering iron itself to insulate those things.

So, he is now stuck it to one side and then you see he has taken a normal power supply from a PC. This temperature reads 31 degrees here; I do not know it is 30, yeah. It should be 31 degrees correct yeah and he is filling the tank, a reasonable height such that the pump always stays in the, enough feed is there and this is the outlet depending on how you like it. If you wanted to make it now, you watch carefully here.

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The flow you may notice, you may notice the water being re-circulated here. Now, when he switches it on, he has switched it on. You see here. Now, the pump is running and the water is getting recycled, re-circulated here, you have a beautiful, the re-circulating system and after a very short time, you have a beautiful cold liquid and plus a demonstrate everything. So, there is no mumbo-jumbo about, how this thing can be cold?

So, in case you are thinking of setting up something it is a good experiment to start, instructables was about, cooling air, making a small refrigerator, and here, in 20 minutes and then I expect the volume to be about a litre, the temperature is now, he will now show you the temperature, have a look at it.

See this, we can see frost forming on the outside of the small case, to demonstrate it for us he has used this elaborate plumbing and now, you see after this thing, know from what is 13 30 degree, this has become to 13 degrees, which is a good reasonable achievement. I am, what you call, I am very happy about it, maybe whole thing can be improved dramatically by avoiding all this plumbing. Do you need all the plumbing, see the ambient is you know little down and then nicely, after you know taking it out and handling everything that 13 has come to 17 degrees. It is a very drinkable temperature.

So, if you have a fruit juice or something you can always pass it likely, if you were to make it probably, sir please show the, this. If you were to make it yourself, all this is a

little excess for convenience, he has done it. It is possible for us to fit the whole thing to one side here or I would prefer, even if you keep it at the bottom.

Imagine the bottom portion, the whole top of the cup sits somehow neatly here, you make all this and then on top directly, you can add the liquid, you want to cool on the top and then you can probably add a stirrer, you can even have a small, what you hand stirrer thing, you have for beverage mixer like thing and after a specified time probably this temperature can be mounted here. So, you have a neat cup, you pour, your fruit juice or anything or drinking water or if you are used to this new lemon, tested water you can build a whole thing in one thing and then all it requires is a power supply from your laptop.

So, there 12 volt power supplies are available and I am sure you have enough spoiled laptops with what you call power supplies and the other way and they are incompatible to that extent, you can always get a typically around 5 amps 12 volts to 10 amps 12 volts is you know, makes this whole thing work very well.

Let me get back to more things here, kindly put my thing on the screens here. So, if you go in search here, you will find. So, many of these small, you know things made with air conditioners, I am sorry with the small of a cooling and all that made with this Peltier thing, the only how to tell, caution or something is it is meant for a technical purpose of having a small volume, quickly cooling or heating up.

Any other option like this, you know it is meant for you more as a serious hobby, unlikely to cool large volumes of space, you cannot use it as a room cooler, though as I said one of the commercial entities, I am little upset, that, that they are trying to promote a, the small you know cooler as a answer to proper refrigerators, in India it is not. So, I am still for it.

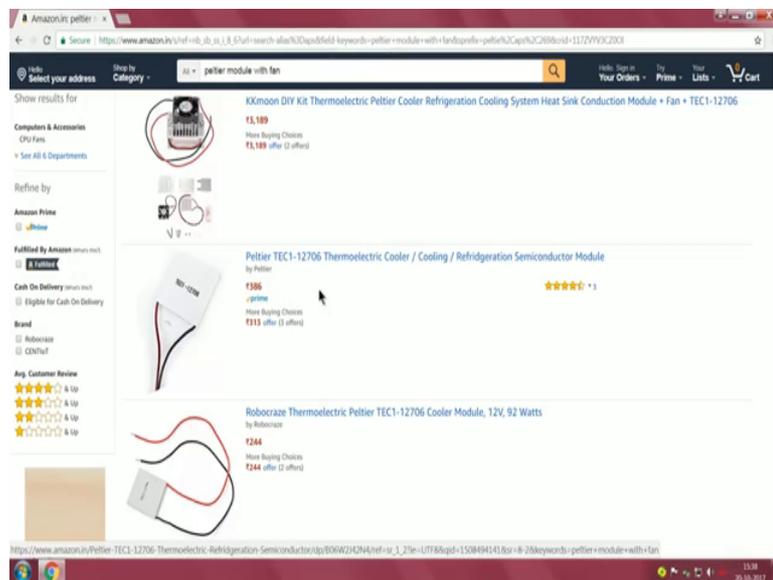
And; however, I will take back part of my statement back, saying imagine you are in the, in the field, you have to carry vaccines, which have to be kept in an unbroken cold chain, you want an unbroken cold chain vaccine, at that point generally, they have a pad which is a phase change gel, which has a high conductivity, well it is not fully phase change, it freezes very well from a gel state to, what you call frozen and during that freezing and during that unfreezing, that latent heated helps in keeping the temperature down.

So, if you have two of these gel pads and you have your vaccines inside and you put it all in a box, then adding a Peltier device like this, makes a lot of sense, you do not need to build a refrigerator and carry these things in a refrigerator, when all you require is a box, which has a outlet, which you can plug it to the car, cigarette lighter socket and travel as far as your like and if the pads are already pre-cooled and taken out, from your what you call deep freeze, you are in, you can be very sure that you are aiding in the cause of un-breaking the chain.

You can always take it and you feel the pad, if you feel that the pad is, you know slightly getting supple, you can always bring it back and what you call plug in the ever Peltier in the old box and then it will maintain the temperature at the cold thing, maybe 2 or 3 hours. You can carry it on a shoulder, dispense it and bring it back.

So, in all these cases the method is available. Now, these days, they do not cost much, if you, I will have one more go and check, you know the place where I am clicking from, I will go to the, we have only one and only device here and I will give, seen this the basic device costs around 300 rupees ok.

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That is the tc 1 type thing, we have and then if you want with a little bit of these, you know periphery and earlier saying there is a small heat sink, aluminium heat sink plus small fan and although.

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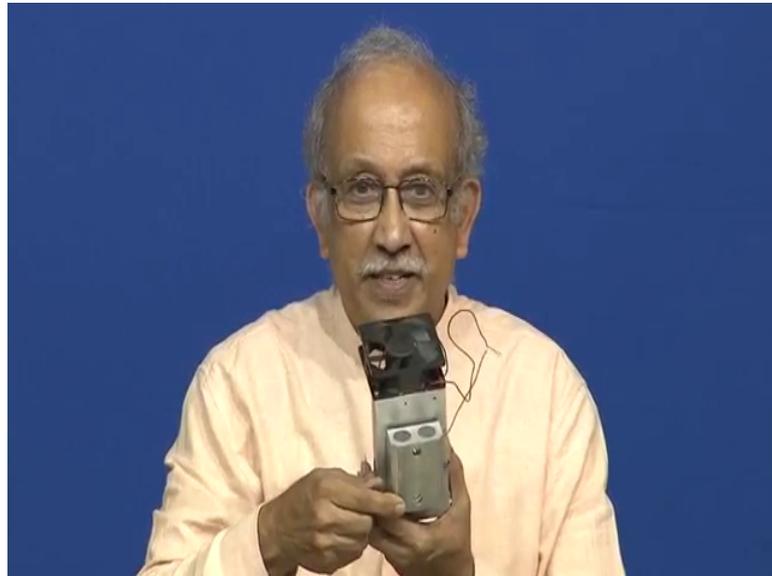


You can get it for under a 1000 rupees. So, I feel it is a very good place for you to start fan, then you have a small 40 by 40 mm heat sink, then I have a, what you call tape on one side, you put the whole thing and now, the other side you stick it to whatever device, you want and if you buy two of them, you can put it into a box and you can put them all together.

I feel for various professionals for students and first cut experimental people, this is a very good point to start it further, if you want I am sure, much more fully managed you see beautiful with heat sink.

kit comes here with this thing exposed here. So, you can use it; for you know controlling various small devices in your house and as I said for, in the case of unbroken cold chain, you can use it and I will, what you call stop the lecture.

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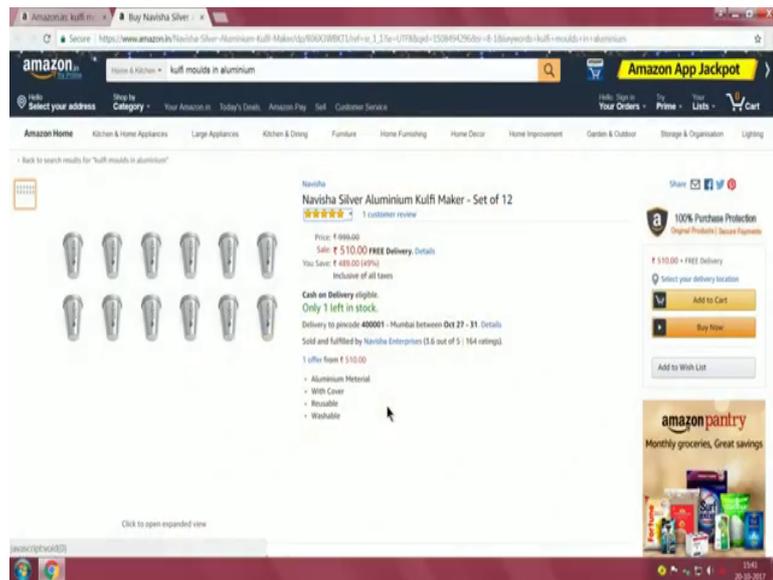


Now, at this point saying, you can maybe eventually make a kulfi maker, also like this, while you cannot make a kulfi maker, you can make something, which will keep the kulfi cold enough that is, you have the kulfi moulds, you have seen I think the aluminium kulfi moulds, which we have out here, I will tell you, I have made a box, somehow I have lost it somewhere, I will go back to Amazon.

They look a little like, your ice candy. You seen this kulfi moulds in aluminium. So, I have a box, in which all of these things are stacked, the stacking unit is not there, they come usually. There is a perforated, what you call stand, in which you keep all these and I am waiting to mount. You know two of these, you know Peltier things that is I take that buy, buy the kulfi, I put all the stuff in the refrigerator, after it has frozen, take it out and transfer it to my Peltier insulated, Peltier box.

They continue to be cold and I can take them on a picnic of course, the ants will be there before me, at the picnic and that apart I can have something, which maintains see a thing as a, this thing you see here, a set of 12 of course, base plate, he has not given. Usually, it will also come with a base plate.

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And in other ways, if you want to have these; So, many other things are there, you know push up frozen stick, ice cream pop, jelly lolly maker and all this stuff, you know even these things eventually, I am sure you will be probably able to freeze all of them.

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You see here, what they are doing you can see. The, what you call over is you know treating the child, pouring some, this various types of juice and the concentrates and then what you call.

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If you can make a stand for this, which will make this thing stand and add a Peltier element at the bottom, after freezing them you keep them here.

They can stay at this temperature for a very- very long time.

So, thank you have a nice, may be a cool time, next time is one of the things in this course, you know, you suggest, you tried. All the hardware is available, there is an element of novelty and, you will learn something.

So, thank you.