

Make an Iron Man Arc Reactor

by **Honus** on November 6, 2008

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Author: Honus Multi-Bot

I'm a former bicycle industry designer turned professional jeweler.

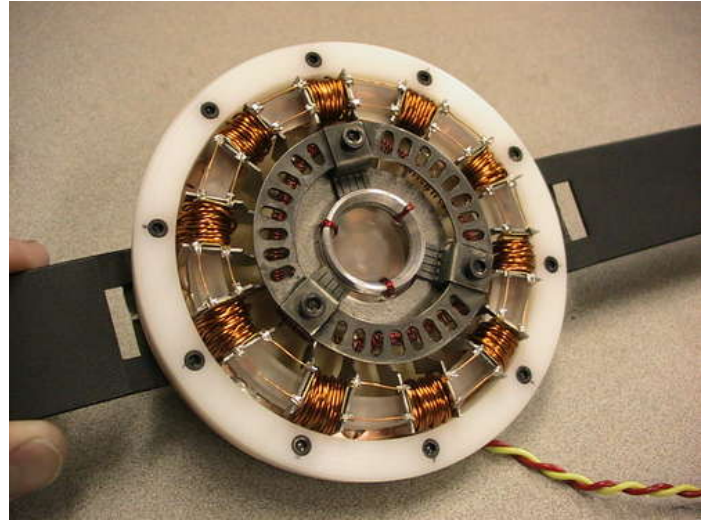
Intro: Make an Iron Man Arc Reactor

I didn't have a lot of time to make a great Halloween costume this year so I figured I'd do something relatively simple that was still eye catching and cool. I wanted my Arc Reactor to look pretty realistic, but not necessarily 100% movie accurate, so it's kind of a cross between a MkI and MkII version. There are some things I'd change on the next version (and I'll point them out) but overall I'm pretty pleased with it.

The reactor is attached to an old heart rate monitor strap and it's powered by a 3 volt battery pack that just slips in my jeans pocket. It's light weight and is comfortable to wear for several hours at a time. In the photos below you can see how bright it is- it easily shines through my t-shirt under normal office lighting conditions and is very bright at night.

Follow along and see how it's made.....

Update: see page six for the new style reactor!





Step 1: Tools and materials

There are a few necessary tools:

- soldering iron
- dremel tool
- drill bits
- metal snips/shears
- jeweler's saw (or some kind of saw to cut metal and plastic)
- needle nose pliers
- wire cutters
- files/sandpaper
- glue gun

And for materials:

- thin brass sheet
- plastic sheet (I used Delrin- you can buy Delrin and acrylic sheet from Colorado Plastics)
- clear acrylic sheet
- copper wire- 22ga and 24ga thickness solid wire
- sheet metal- 22ga thickness (.025in or about .5mm thickness)
- PCB (printed circuit board)- at least 4" square (Radio Shack sells some that measures around 4.5" x 6")
- several small bolts - I used 10ea 2.5mm bolts and 3ea 3mm bolts w/nuts
- 3 volt battery
- 11 ea NTE30027 surface mount LED's - I bought them from a local supplier but you can order them here: <http://www.cablesandconnectors.com/30000-30.HTM>
- battery hook up wire

As an option for LEDs and making a circuit board you could use these instead-
http://www.sparkfun.com/commerce/product_info.php?products_id=8735

I'll make specific notes about the materials used and possible substitutes/workarounds on the specific construction pages.

Please note: be careful cutting sheet metal as the edges can be very sharp and it's pretty easy to cut yourself.

Step 2: Start with the backplate

The first thing I did was draw up a general plan so I could figure out how everything would fit together. The outer diameter of the Arc Reactor is 4", so if you print the plan photo to that scale it will give you a good guide and help you get everything lined up correctly. All the measurements used in the drawings are in inches and they are really just to be used as a guide- I really just eyeballed everything as I was making it. By no means are they meant to be exact measurements. The most important thing is getting the proportions correct so everything will fit together during the final assembly.

The easiest way I found to cut out all the parts is to draw the patterns on paper and then glue the patterns to my sheet plastic or sheet metal using rubber cement and cut the patterns out with a jeweler's saw. Then file all the edges and smooth them with sandpaper.

So let's start by making the outer ring/backplate assembly. Begin by cutting a 4" diameter disc from PCB material. There are two copper traces cut (or etched) into this as well as a couple of solder pads on the center so you can solder down the LED's. There are 11 LED's- 10 for the clear ring and one for the center lens. The LED's I used are a surface mount type part# NTE 30027. Even though they are a surface mount component they are pretty easy to solder to the copper traces. The LED's sit directly under a clear acrylic ring and they are spaced 36 degrees apart- just make sure they are all facing the same direction! I simply connected the LED copper traces to the center solder pads and then drilled two small holes and soldered some wires from the back of the board to go to my 3v battery.

UPDATE!

Instead of having to make a circuit board and solder all the tiny LEDs you can just get some of these little guys and wire them in parallel-
http://www.sparkfun.com/commerce/product_info.php?products_id=8735

Just glue them down to a back plate and you're good to go!

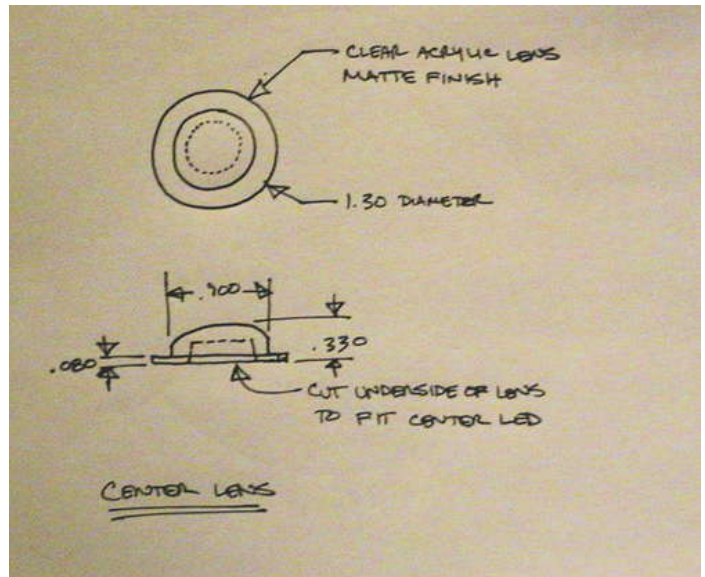
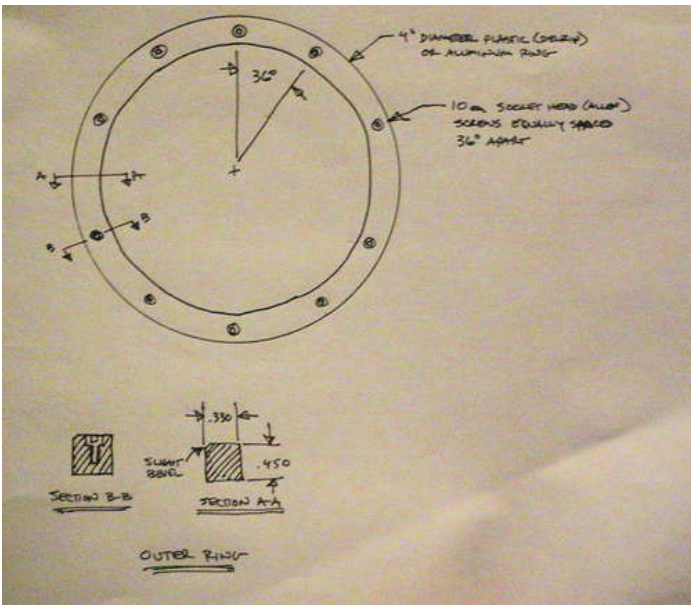
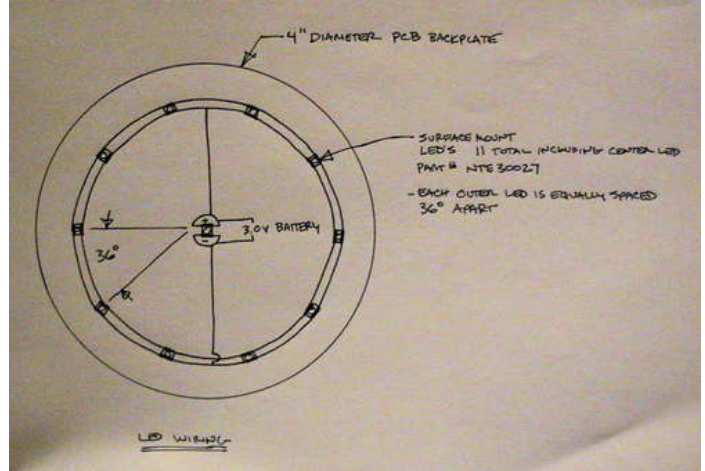
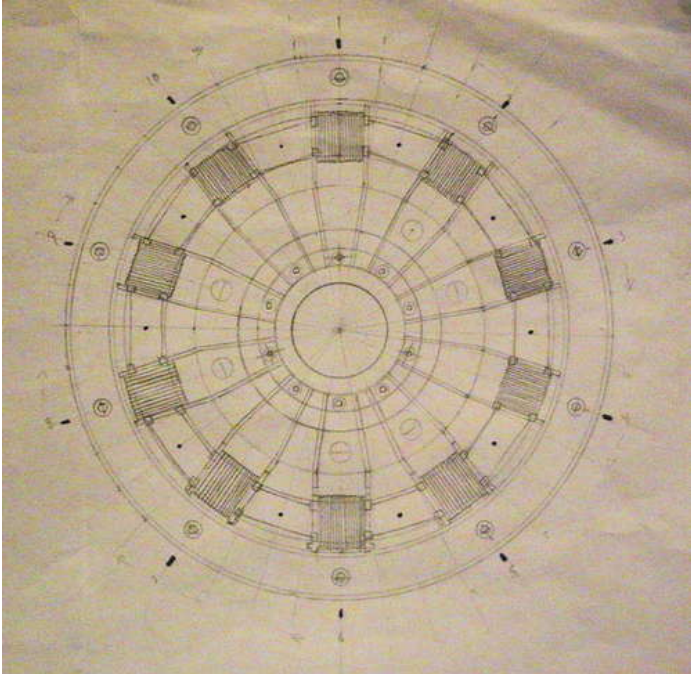
The outer ring was cut from some thick plastic sheet- I used Delrin because it cuts well and is pretty durable. A good substitute would be 1/2" MDF sheet. I should have painted the ring silver but I ran out of time.....maybe I'll make a machined aluminum ring in the future. There are 10 2.5mm allen head bolts evenly spaced at 36 degree intervals around the ring. I just drilled a pilot hole, then drilled a countersink for the bolt head so it would sit just below the surface of the ring. I actually threaded the holes for the bolts but you could probably just shove them in there with a bit of glue.

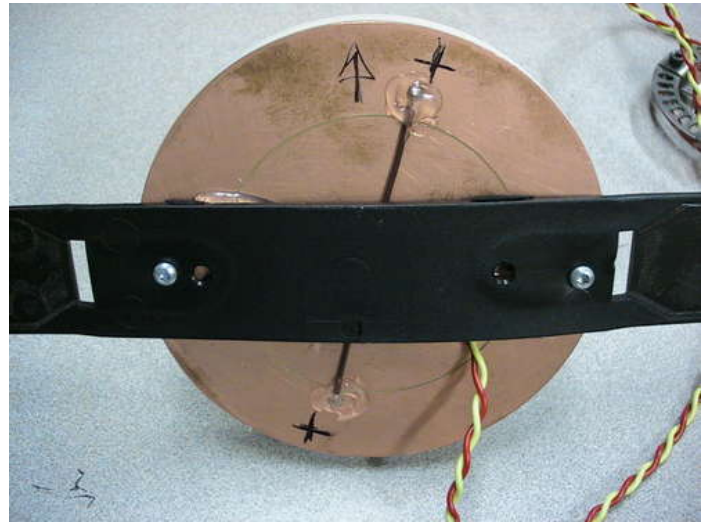
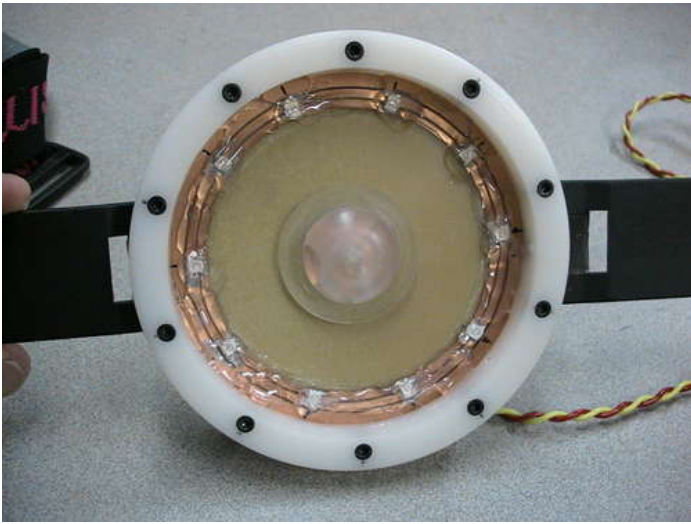
The outer ring is glued to the PCB backplate with a hot glue gun. Then run a bead of hot glue over the LED's and the copper traces. This will protect the LED's, help diffuse the light and keep the circuit from being shorted out when the remaining parts are installed.

<http://www.instructables.com/id/Make-an-Iron-Man-Arc-Reactor/>

Now you need a lens for the center. I made mine from acrylic sheet, but you could use just about any kind of lens or clear plastic part that would fit. The thing to remember is that if it is too tall then it will come into contact with other parts later on so watch the height. I used a scotchbrite pad on the lens to help diffuse the LED light.

Next an old heart rate monitor strap was glued and screwed to the backside of the backplate. The two screws went through the PCB and into the outer ring, helping to hold everything together.





Step 3: Make the inner ring assembly

Now we have to make the inner ring. This is a clear ring that is held by a frame (which I call the lower spider frame.)

First cut the inner ring from clear acrylic sheet and rub it with a scotchbrite pad (steel wool would also work.)

Now comes the tedious part- there are 20 arms that need to be cut out, bent and then placed around a central ring to form the lower spider frame. The dimensions on this are not critical, but you have to constantly check the fit so that it will fit into your previously constructed backplate assembly. You also have to make sure that the clear ring will fit into the slots cut into the spider arms.

The distance from the outer edge to the opening of where the large notch is approximately .08 inches. The trick is that you will have to adjust the fit of this to your acrylic ring as well as the outer ring. You want the spider to essentially press fit snug into the outer ring. Then fit the acrylic ring to the spider. I can guarantee that you will probably have to do some trimming because the spider is so difficult/frustrating to make so that everything is aligned properly. I had to trim probably every opening to get everything to fit properly.

The easiest way to trim the opening in the spider is to use a small sanding disk with a Dremel tool to carefully trim the opening to fit the acrylic ring. The acrylic ring doesn't have to be a perfect fit as it's held in place by the copper wire wrapped around it.

I cut both the central ring and spider arms from 22 ga sheet steel using sheet metal shears and a jeweler's saw. A dremel tool would also work and will come in handy cleaning up all the rough edges. The finished arms were then welded to the central ring. Then the center bottom ring was cut from steel sheet and welded to the spider frame assembly- note how it is positioned. I was short on time so I left out the additional slots. The bolt holes were threaded for 3mm bolts.

As a substitute for sheet steel you could make the parts from brass or copper sheet and then solder the arms to the central ring and then solder the central bottom ring to the spider frame assembly. The parts could also be made from thin plastic sheet as well and just glued together, but they wouldn't be as durable.

Now you have to make 10 little brass tab thingsies. These sit on top of the clear ring after it has been placed into the spider frame assembly and then they are then wrapped with 22ga copper wire. Make sure when you wrap the wire it doesn't stick out too far outside the spider frame arms- make sure to check the fit with the backplate assembly- mine is just a light friction fit. The brass tab thingsies should be about the same width as your clear ring and the four little tabs should just stick out over the edges of the spider arms. The last bit is to solder some short 24ga copper wires to the tabs.



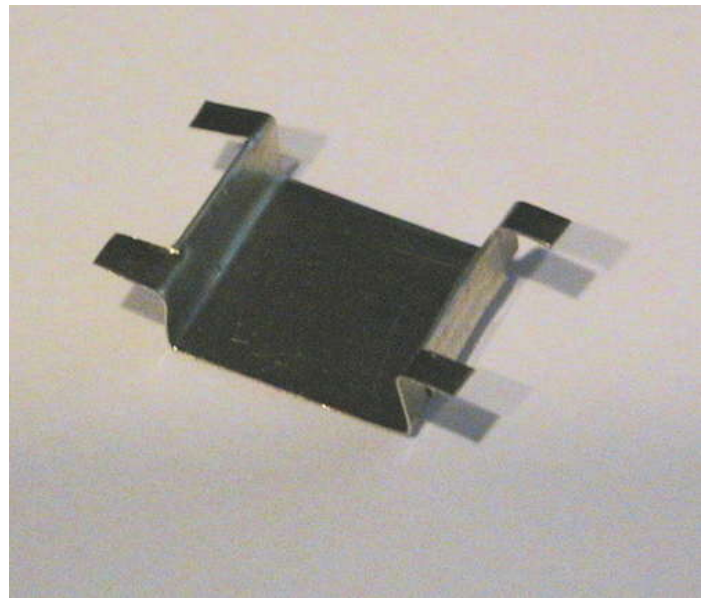
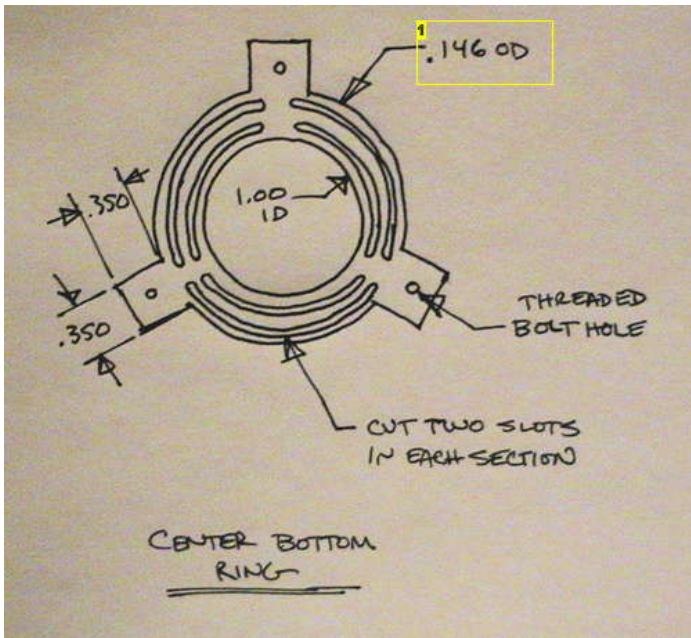
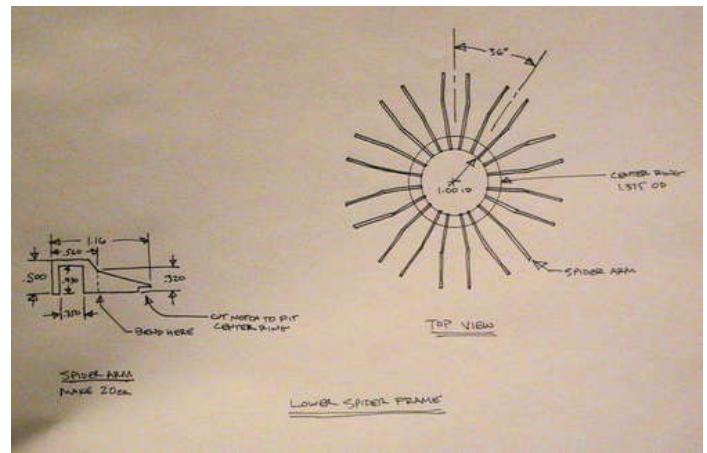
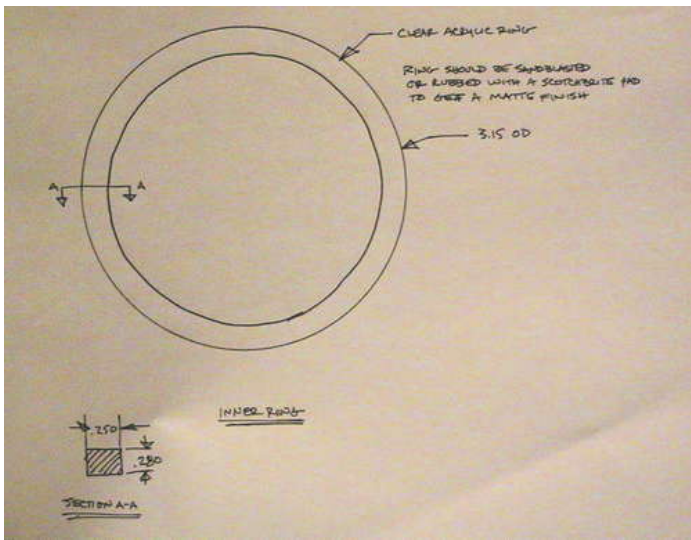
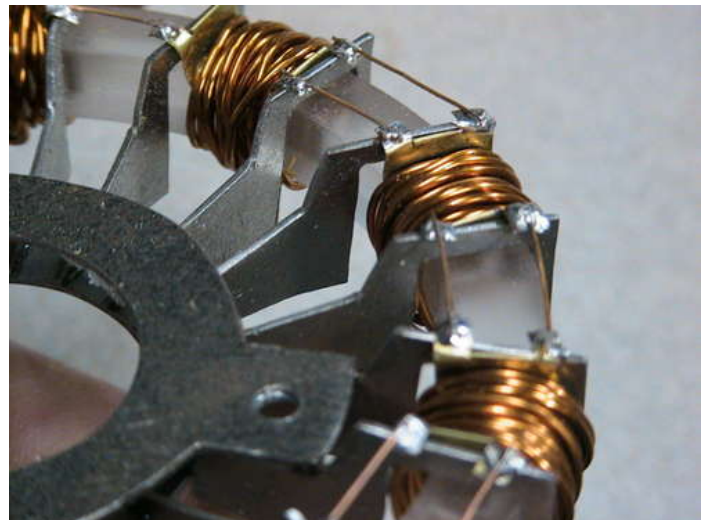
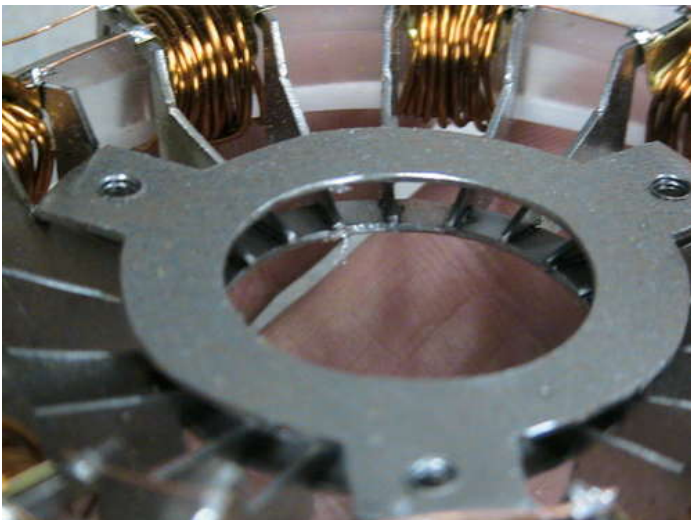
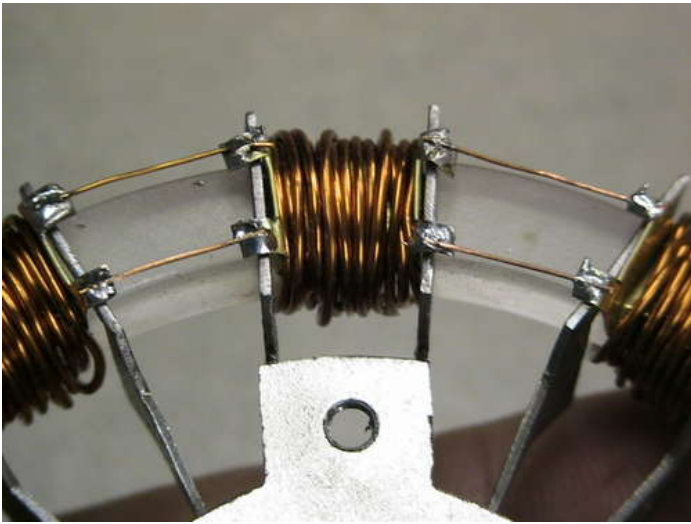


Image Notes

1. This should read 1.46 OD Oops!



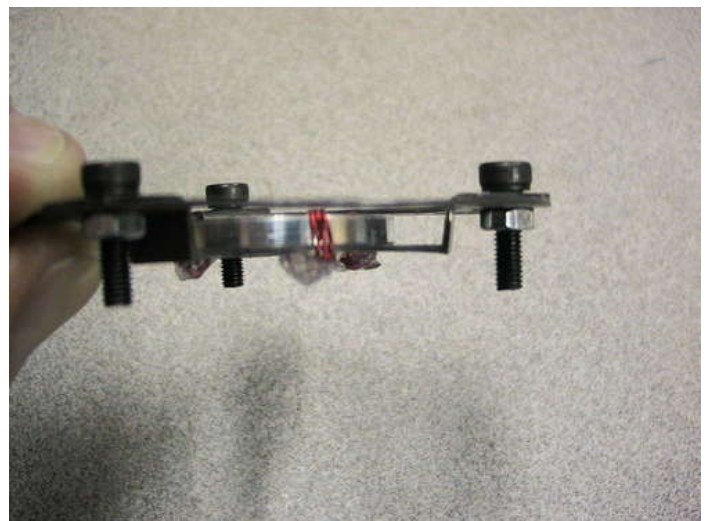


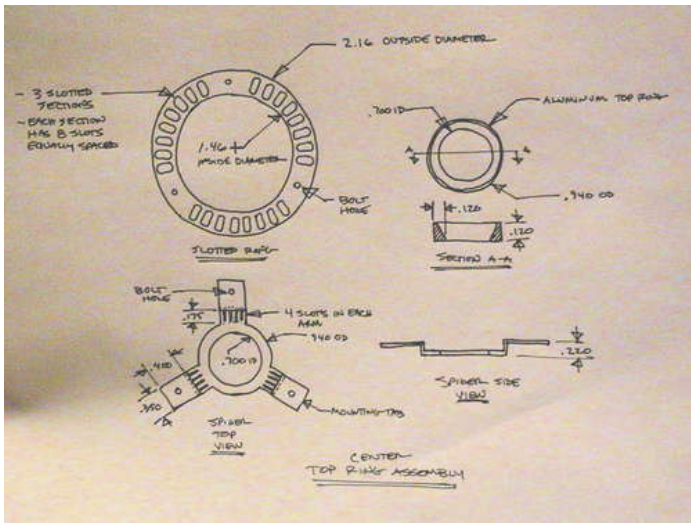
Step 4: Make the top ring assembly

The top ring assembly is made just like the spider frame assembly- it's cut from 22ga steel sheet but you could also use brass sheet or plastic. I oxidized my steel assembly to get the black finish but a sharpie pen or black paint would also work. There are three 3mm bolts that go through the spider and slotted ring- there is a nut on the backside so the assembly stays put when everything is put together in the final assembly.

There is a central ring that is made from aluminum but it could also be made from plastic and painted silver. It's held on with some thin copper wire and a few dabs of glue from a glue gun.

The last bit is a coil of copper wire that has been formed into a ring. I used wire that was coated red- you could use a marker to color the wire. The wire was wound around a drill bit, formed into a circle and then glued together with a glue gun. The coil ring is then placed around the bolts.



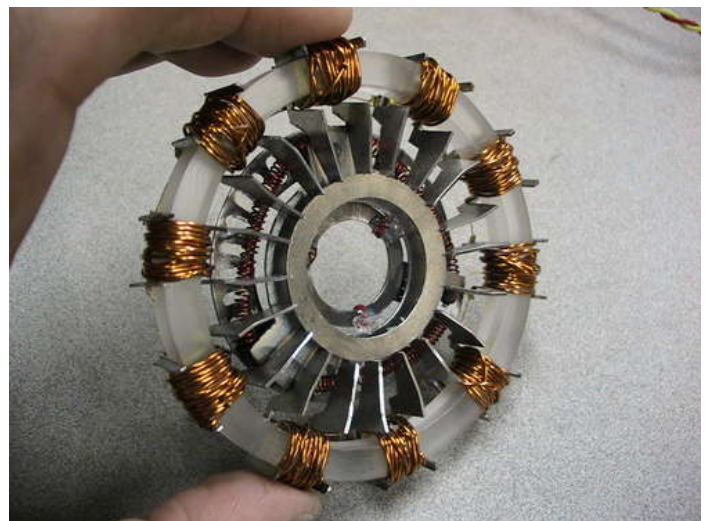


Step 5: Testing and final assembly

Plug in your battery and make sure all your LED's light up. Then mount the center top ring assembly to the inner ring assembly by lining up the three bolts and tightening them until the bottom of the top ring assembly sits just above the inner ring assembly. You can add a dab of glue if you want to the bolts to make sure they don't come loose.

Now press the entire assembly into the backplate assembly- note the orientation, making sure everything is aligned correctly. If the fit is really loose, you can put a couple dabs of glue between the wrapped copper wire sections and the backplate to hold everything together.

That's it! Now go finish your Iron Man armor suit..... :)





Step 6: New style reactor

So here is a new reactor based on what I believed the Iron Man 2 movie reactor would look like based on early screen shots. Notice that it now has eight segments instead of ten. It is constructed in a similar manner to the original reactor except that it is made from stainless steel and aluminum instead of plastic. This particular pair of reactors were built for a custom Iron Man theme motorcycle so they had to be able to withstand heat and vibration. They measure four inches in diameter and one inch deep.

The first thing I did was make a simple model in Sketchup to get an idea what the finished reactor would look like. Note that there are slight changes from the Sketchup model and the finished reactors.

The first thing I made were separate circuit boards for the LEDs. These are different from my original reactor in that they have 100 Ohm resistors connected to one side of the LED to protect the LED from burning out. The circuit boards get wires soldered to them and are then bolted to the stainless back plate with small hex head brass screws.

The spider is made from stainless steel that is welded together. There are four small brass hex head bolts that are threaded into each section of the spider and then they are soldered together to keep them from coming loose. The lenses were turned from clear acrylic and then the outer lens was inserted into the spider and the wire wrapping began. The wire wrapping takes forever since it's pretty hard to keep it straight. There's about 50 feet of wire in each reactor.

The outer ring is turned from thick wall aluminum tubing using a lathe and there are four holes drilled and threaded into the back side so it can be mounted to the stainless steel back plate. There is also a thin lip machined into the front of the ring- this will hold a clear protective lens on the finished piece.

The center piece is also turned from aluminum. There is a lip machined into the back side to fit the small brass screen. The back side is also drilled and threaded for two allen head screws so it can be bolted to the stainless back plate- the screws go through the center lens to hold it in place and the center aluminum piece fits into the stainless spider. There are also several small brass hex head screws that hold the stainless spider to the back plate.

Next the outer ring and clear lens are bolted in place. The clear lens slides into the outer ring from the back and gets a bead of clear silicone to seal it to the outer ring. This assembly is then fitted to the back plate.

Since these reactors were built for a motorcycle they needed to be able to take 12v input power and output no more than 4v. To accomplish this I used a power supply circuit from Adafruit www.adafruit.com/index.php. The power supply is adjustable and can accept up to 20v input- it's a really easy to build kit that works great.

These reactors were a lot more work to make than my original reactors but I think they really came out nice. All in all there's 26 stainless steel parts, 32 laser welded joints, 40 soldered joints, 3 acrylic lenses, 2 machined aluminum parts, 50 micro sized brass hex head bolts, 6 allen head bolts, 50ft. of copper wire, 9 surface mount LEDs, 9 surface mount resistors, 2 circuit boards and 1 brass mesh piece in each reactor- whew!

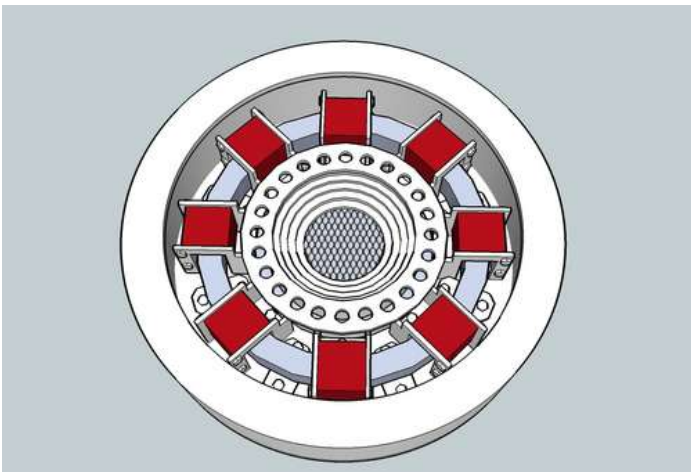


Image Notes

1. NTE30027 LED
2. 100 Ohm surface mount resistor

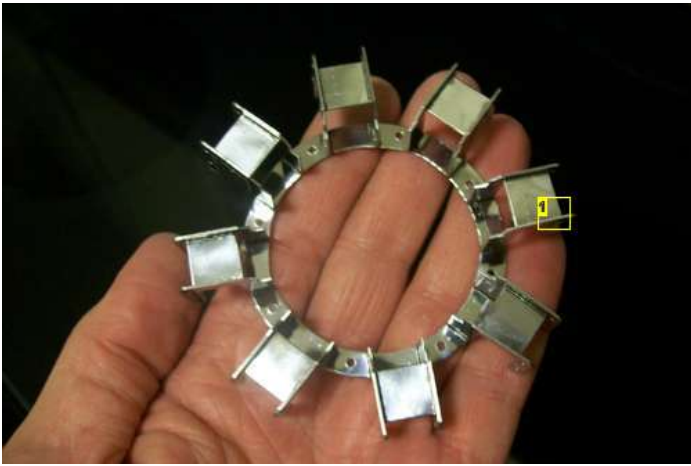


Image Notes
1. stainless steel spider

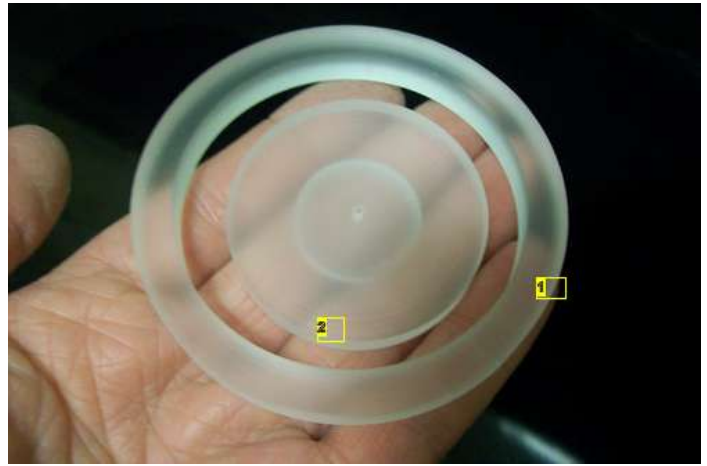


Image Notes
1. outer lens
2. center lens

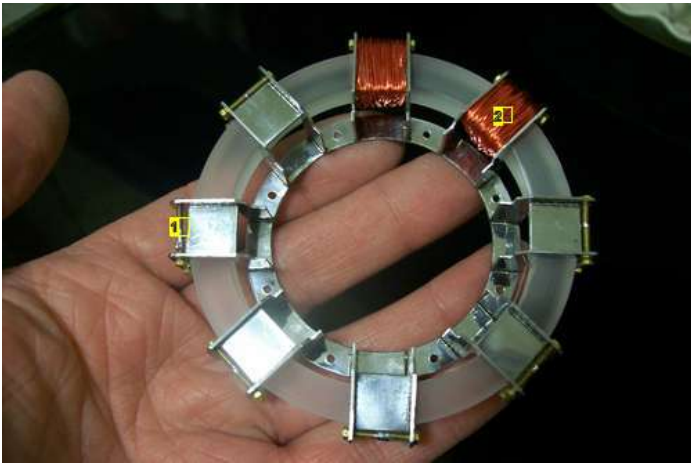


Image Notes
1. brass hex head screws
2. copper wiring- I needed to re wrap these two sections as they weren't straight enough



Image Notes
1. I test fit all the pieces to make sure everything fit perfectly



Image Notes
1. finished reactor

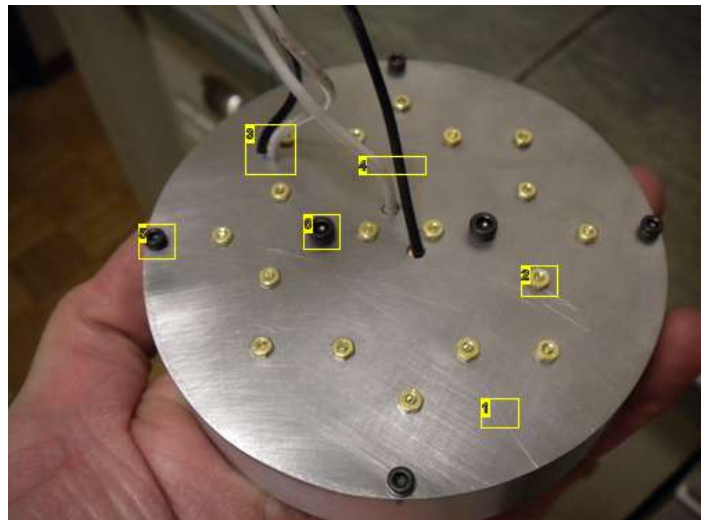


Image Notes
1. stainless steel back plate
2. all the brass screws/nuts get loctite on the threads

3. wires to the outer PCB
4. wires to the center PCB
5. these four bolts hold the outer ring in place
6. these two center bolts go through the center lens and hold the aluminum center piece

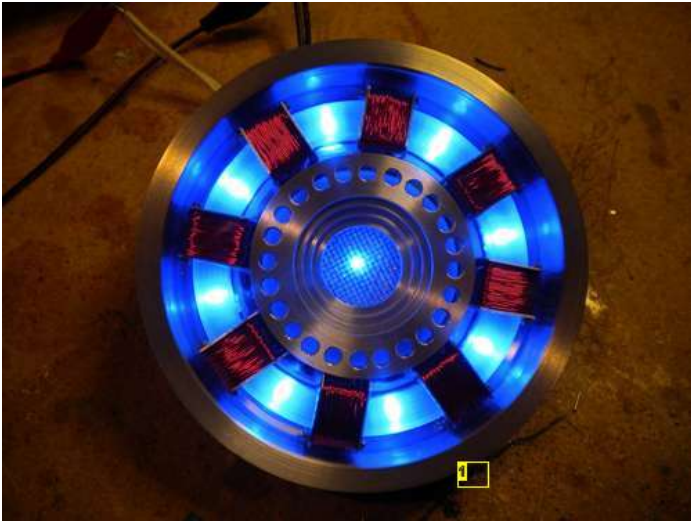


Image Notes

1. here it is all lit up!

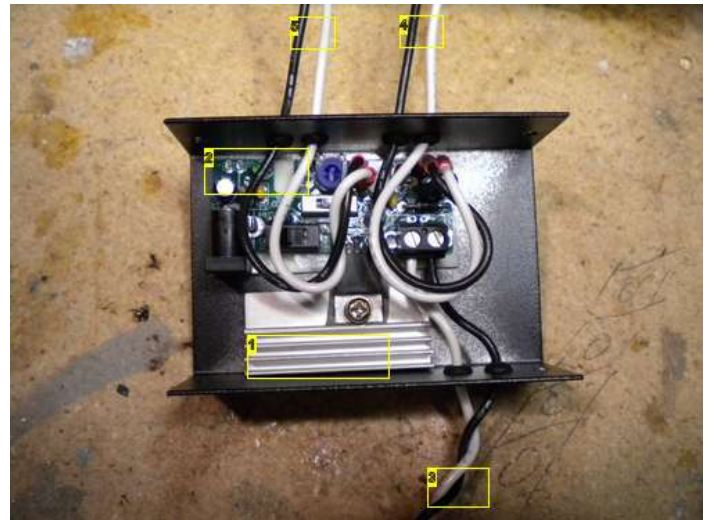


Image Notes

1. heat sink
2. Adafruit power supply
3. 12v input
4. 4v out to reactor
5. 4v out to reactor

Related Instructables



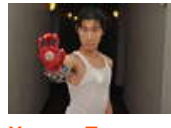
Iron Man Arc Reactor+ helmet (bucket)
(Photos) by mkamchin



How to make an Iron Man Arc Reactor
by msraynsford



The 15-dollar, 15-minute Arc Reactor.
by JustinBrown



You, as Tony Stark, as Iron Man
by Jamo_G



Easiest Arc Reactor.
by Cheeseduck




Iron Man Repulsor (bare) & Arc Reactor
by malcherms


Comments


50 comments [Add Comment](#)


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 **fugher** says: Mar 15, 2011. 1:15 PM [REPLY](#)
i really don't understand what is the OD for the center bottom ring. Is is 1.46 or .146???


and what is the diameter of the threaded belt holes??

 **Honus** says: Mar 15, 2011. 4:38 PM [REPLY](#)
If you look at the note it is supposed to be 1.46" OD. The bolt holes are threaded for whatever diameter bolts you want to use.


 **fugher** says: Mar 16, 2011. 5:56 AM [REPLY](#)
ok thank you. i am sorry i didn't notice it said 1.46. when i noticed it, it was too late.

 **fugher** says: Mar 5, 2011. 9:49 PM [REPLY](#)
how is it that you put the batteries on the arc reactor? where do they go and how do they go? what kind of wiring does it need?


 **Honus** says: Mar 6, 2011. 1:52 PM [REPLY](#)
I just had the batteries in my pants pocket with the wires running up directly to the reactor- simple.


 **fugher** says: Feb 22, 2011. 7:12 AM [REPLY](#)
hey i wanted to ask you the battery which kind is it. is it the flat 3 volt that is used on watches or is a different one?

 **Honus** says: Feb 22, 2011. 8:11 AM [REPLY](#)
I used two AA batteries.

 **fugher** says: Feb 21, 2011. 11:59 AM [REPLY](#)
some of the parts that are made can we order them from you? and we can pay you?


 **Honus** says: Feb 21, 2011. 1:23 PM [REPLY](#)
Sorry but I don't sell any of the parts right now.

 **fugher** says: Feb 22, 2011. 6:47 AM [REPLY](#)
yes i would understand. I asked you because I used to be in a machine shop you using lathes, mills, and CNC machines now i don't have that any more.


 **Honus** says: Feb 22, 2011. 6:57 AM [REPLY](#)
I have been working on a kit but it was just too expensive to have all the parts made commercially so I'm working at producing it myself using resin castings. Toward that end I've been building a 3D printer/CNC so I can more accurately make the patterns for molding. You can view my progress here- <http://multi-bot.blogspot.com>

 **fugher** says: Feb 22, 2011. 7:05 AM [REPLY](#)
Hey thats nice.


 **fugher** says: Feb 21, 2011. 11:56 AM [REPLY](#)
where did you get the strap to hold it in place?

 **Honus** says: Feb 21, 2011. 1:24 PM [REPLY](#)
It's from an old heart rate monitor. You could just use an elastic strap.


 **fugher** says: Feb 21, 2011. 10:01 AM [REPLY](#)
what is the diameter and length of the bolts i would need to get.


 **Honus** says: Feb 21, 2011. 11:08 AM [REPLY](#)
I think the ones I used were 3mm diameter. I don't remember the length as I used some long bolts I had on hand and cut them to length with a cut off wheel.

 **fugher** says: Feb 21, 2011. 12:00 PM [REPLY](#)
thanks. that is what i thought.

 **fugher** says: Feb 21, 2011. 9:45 AM [REPLY](#)
hey i wanted to ask about the pcb in radio shack i only found one with 2-1/16x6x1/16" but i don't know if i should get to make the ark. if not where can i find one

 **Honus** says: Feb 21, 2011. 11:03 AM [REPLY](#)
Here's the one you want-
<http://www.radioshack.com/product/index.jsp?productId=2102495>


 **DaPandaMan13** says: Feb 17, 2011. 8:09 PM [REPLY](#)
I am planning to do the original and new reactor, one of each.
After reading the design and looking at the pictures, I have a few questions:
How did you cut the metals (stainless steel, aluminum, etc) hence the spider legs, backplate, etc? Did you do it with a machine yourself or some one else from a workshop helped you with the exact specification cuts?
Did you cut the outer and center lense the same way?
Thank You!


 **Honus** says: Feb 17, 2011. 8:50 PM [REPLY](#)
I cut the PCB material and sheet metal by hand using both a jeweler's saw and a nibbler tool. The lenses were cut by hand, turned on a lathe and then sanded with sandpaper to smooth them. The outer aluminum ring and inner aluminum ring were machined using a lathe.


 **jamesbondd** says: Sep 26, 2010. 4:11 PM [REPLY](#)
Honus, how did you cut the ovals into the top ring?


 **Honus** says: Sep 26, 2010. 4:42 PM [REPLY](#)
I used a jeweler's saw.

 **royfang** says: Feb 3, 2011. 1:06 AM [REPLY](#)
dam must've taken ages.

 **grayseep189** says: Dec 31, 2010. 12:48 PM [REPLY](#)
I dont have any welding materials, and solder doesn't stick to the sheet metal. So how can I connect the spider arms to the center ring?

 **grayseep189** says: Dec 31, 2010. 6:12 PM [REPLY](#)
I may have solid core solder, should I buy solder with rosin core. Or would this not really change anything.

 **Honus** says: Dec 31, 2010. 6:28 PM [REPLY](#)
Do you have some soldering flux? I would try cleaning the metal using a scotchbrite pad and then apply some flux and then solder.

 **grayseep189** says: Jan 1, 2011. 3:31 AM [REPLY](#)
no I dont have a very versatile toolbox yet



Honus says:
I guess try using epoxy. What kind of sheet metal is it?

Dec 31, 2010. 4:10 PM [REPLY](#)



grayseep189 says:
I don't know for sure, I just got some sheet metal from lowes that said weldable

Dec 31, 2010. 5:52 PM [REPLY](#)



erictank says:
Hate to be a nag, but do you have any updates on kit availability yet, Honus?
Thanks in advance.

Dec 13, 2010. 8:29 PM [REPLY](#)



Honus says:
Still working on it!

Dec 13, 2010. 8:54 PM [REPLY](#)



MrOctober67 says:
Got another question, how did you apply power to this unit?
Just hook up a battery basically and route cable to your pocket?

Dec 6, 2010. 6:55 PM [REPLY](#)



Honus says:
Yep- that's exactly what I did.

Dec 6, 2010. 9:20 PM [REPLY](#)



MrOctober67 says:
I work at a machine shop with Wire Electrical Discharge Machines, I'll be able to make this perfectly everything exact, the hardest part probably will be using those machines because I'm not the one that programs them, another guy at our shop does that.
I have a niche for making things simpler to do. I'll let you know how it goes.
We also have a lathe too, I will make that outer ring out of aluminum like you said you wanted to do.
I am absolutely giddy about this project,

Dec 6, 2010. 6:15 PM [REPLY](#)



Honus says:
Cool- make sure to post pics!

Dec 6, 2010. 9:19 PM [REPLY](#)



TheRealDJ says:
This is fantastic but how many man hours did it take for you to build this? I'm trying to rush job building this in the next two days and I'm curious how to maximize the speed for creating it.

Oct 28, 2010. 11:01 AM [REPLY](#)



Honus says:
It took me about a week working mostly evenings. As far as how to build it faster? I don't really know- maybe make the spider assembly from plastic sheet. I would just either leave out details or try to simplify it as much as possible.

Oct 28, 2010. 7:24 PM [REPLY](#)



aaaaaaaaaaaaaaaa says:
I'm starting on this and had a tip for anyone trying to cut circles in the acrylic, I couldn't find a saw that worked without cracking the acrylic until i came across using hole saws with my power drill, worked great and got perfect circles the first time.

Oct 22, 2010. 11:34 AM [REPLY](#)



Honus says:
That's great to know- I honestly never even thought of using a hole saw. Did you use a standard bi metal hole saw?

Oct 22, 2010. 1:05 PM [REPLY](#)



aaaaaaaaaaaaaaaa says:
Yup, just have to keep the rev's high on the drill to keep it from cracking the acrylic. I just made all 20 of those spider legs and wow that took forever!

Oct 25, 2010. 10:57 AM [REPLY](#)



Honus says:
Cool- yep, the spider is the hardest part to make. Of course wrapping all the wire takes a while too! On the Mk II reactor I'm casting the spider arms in resin so it should go much faster.

Oct 25, 2010. 8:07 PM [REPLY](#)



xocdpdrummerx says:

Oct 17, 2010. 2:53 PM [REPLY](#)

HONUS HELP ME!!!! im a complete novice at this. i bought all the material, and tools, and have several different people with backgrounds in this stuff to help solder, wire, etc.

Here's my issue, im following your diagrams and sketching them out to make a stencil so i can cut the individual spider arms. the snag im running into, is that the measurements you gave, im following them exactly, but the entire length (1.16) seems to be short, and my spider arms seem to look stubby. where am i going wrong?



Honus says:

Oct 17, 2010. 3:30 PM [REPLY](#)

That length should be correct. Are they already attached to the spider center ring? is the center ring the correct dimension?



xocdpdrummerx says:

Oct 17, 2010. 4:11 PM [REPLY](#)

no, i havent even begun cutting yet, im drawing the designs on bigger paper, some of the numbers are REALLY hard to see on your diagrams. but for some reason, my sketch is coming out differently. i bought everything, and im already getting discouraged, lol



mr08kitt says:

Oct 24, 2010. 10:30 PM [REPLY](#)

Honus is right don't get discouraged its not that hard, if the decimals are throwing you off just convert them to fractions and use a ruler to roughly find your measurements. I was in a hurry to make mine since i started a couple weeks before i started managing my Spirit Halloween store. it still turned out great! still getting offers from people to buy it lol. thanks again honus



Honus says:

Oct 17, 2010. 6:56 PM [REPLY](#)

Have you downloaded the bigger views? Just click on the "i" in the upper left corner and you'll be able to see the large version.

Don't get discouraged- just hang in there, be patient and it'll all work out. Remember that none of these dimensions are super critical. What matters the most is how the pieces line up and fit together. If you need help just let me know and I'll help out as best as I can.



xocdpdrummerx says:

Oct 17, 2010. 10:09 PM [REPLY](#)

hey btw, when's this kit coming out? and what's going to be in it? just all the pieces already pre-cut with instructions on how to build it?



Honus says:

Oct 17, 2010. 10:18 PM [REPLY](#)

I don't yet know since it hasn't been finalized.



RelientOwl says:

Oct 21, 2010. 8:42 PM [REPLY](#)

Is that magnet wire you used?

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