

# DIY Vacuum Tubes How Hard Could It Be?

Nick Poole

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@North@chaos.social

Nick@signal ditch.com



Supercon<sup>®</sup>



**Nick Poole**

@NorthAllenPoole



...can you put a bunch of thermionic devices in the same envelope? If they're separated by plates and stuff... can you make an integrated thermionic circuit? I'm imagining a rectangular envelope like a modern VFD, but instead of a display it's like... a 555.

12:33 PM · Mar 14, 2022 · Twitter Web App

||| [View Tweet analytics](#)

**24** Likes



You and this Tweeter share some mutual follows

**stephencass** @stephencass · Mar 14

Replying to @NorthAllenPoole

A 555 in a bottle? Should be possible, I mean some late-stage thermionics got pretty crazy in terms of envelope size and the complexity within. Look at this 24-cm long, 256-bit, memory! [lampes-et-tubes.info/sp/sp136.php?](http://lampes-et-tubes.info/sp/sp136.php)

**Bleats** (18) (commissions OPEN) @blackcorvo · Mar 14

Replying to @NorthAllenPoole

Yes! There's been many examples of combined thermionic components:

Dual-triodes, diode-triodes, triode-pentodes, dual pentodes, even 2 triodes and a pentode all in the same enclosure!

Highly recommend looking at subminiature tubes and Nuvistors for reference on miniaturization.

**Nick Poole** @NorthAllenPoole · Mar 14



Some of your mutual follows often like this Tweeter

**ElectroLycan** @ElectroLycan · Mar 14

Replying to @NorthAllenPoole

Yes, and it gets wierd

[junkbox.com/electronics/Co...](http://junkbox.com/electronics/Co...)

**Nick Poole** @NorthAllenPoole · Mar 14

I'm going to spend so much time reading about tubes today

Show replies

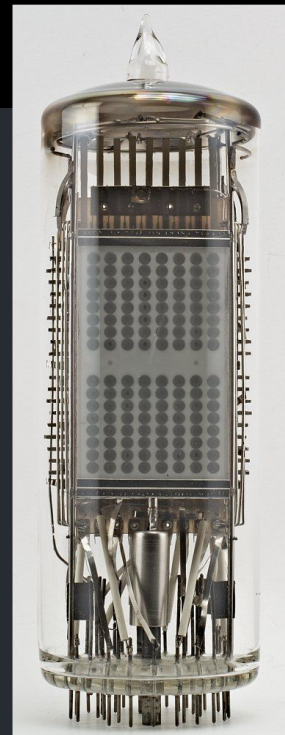
**Tom Barnes** @bom\_tarnes · Mar 14

Replying to @NorthAllenPoole and @NanoRaptor  
nutube but more?



[korgnutube.com](http://korgnutube.com)

**KORG Nutube** | A new vacuum tube which puts vacuum fluorescent di...  
Nutube, similar to a conventional vacuum tube, has an anode grid filament structure, and operates exactly as a triode vacuum tube. Also...





**Nick Poole** @NorthAllenPoole · Mar 14

Replying to @NorthAllenPoole

Currently wasting my time pulling a @NanoRaptor about this... renders incoming...



1

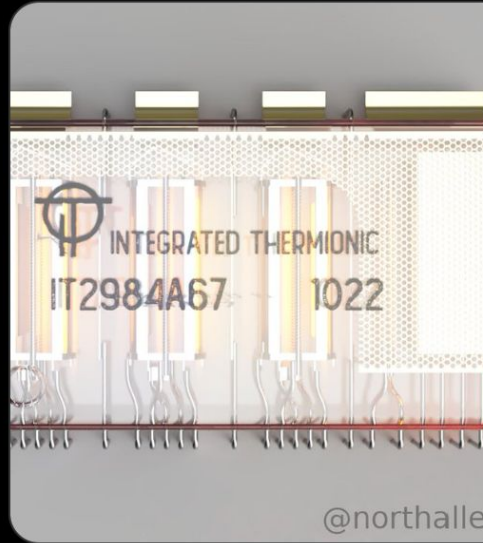


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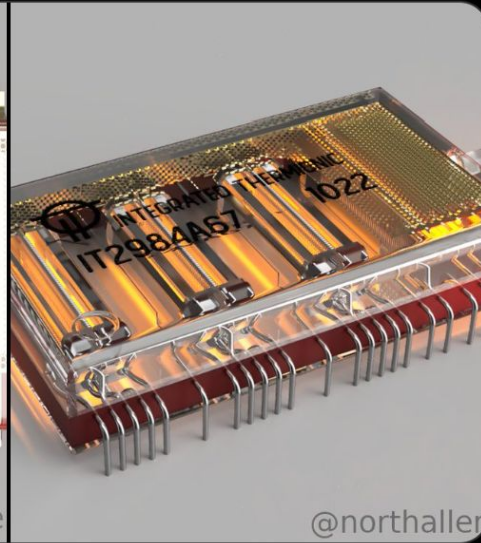


**Nick Poole** @NorthAllenPoole · Mar 14

Integrated Thermionics IT2984a67



@northalle



@northalle



10



41

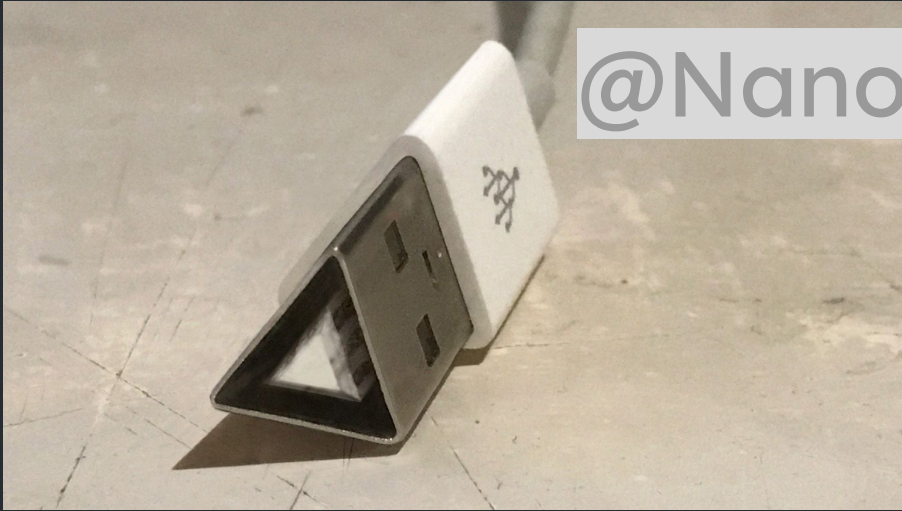


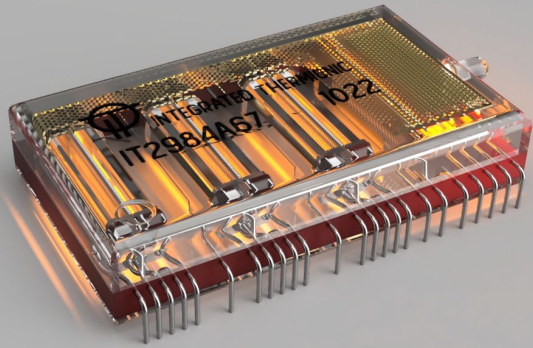
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@NanoRaptor

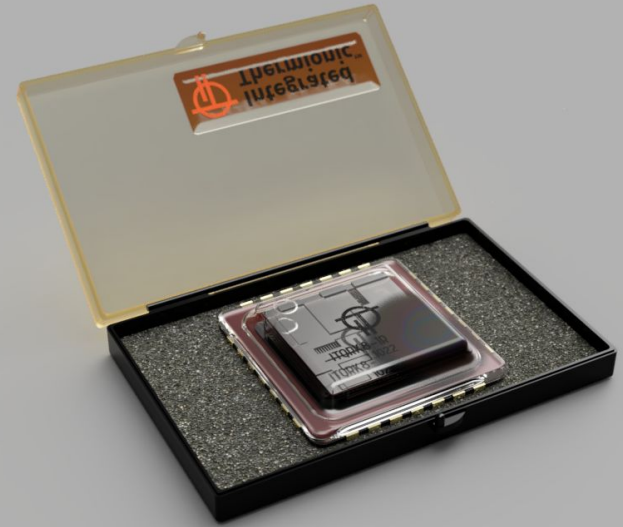




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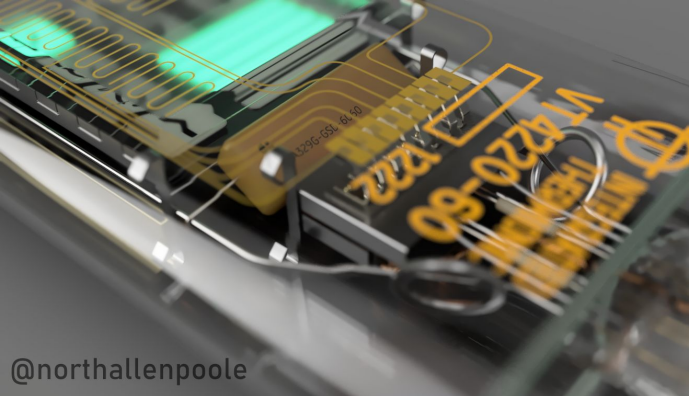
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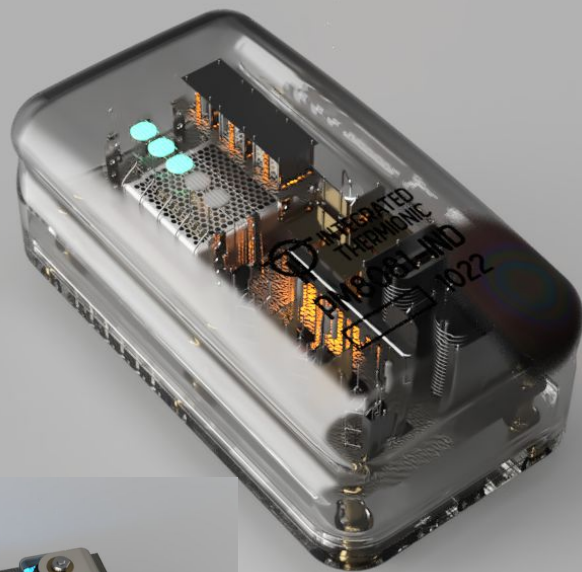
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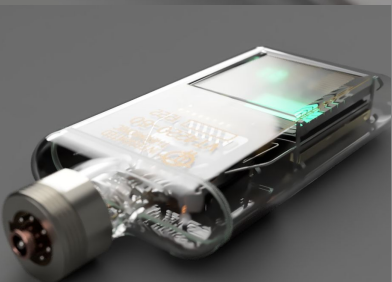
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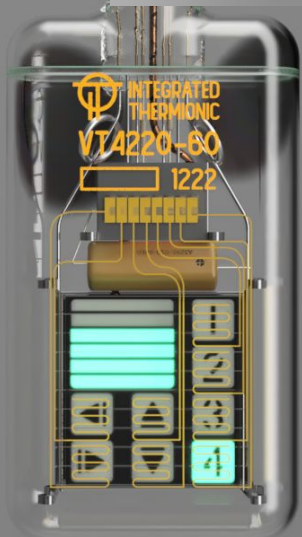
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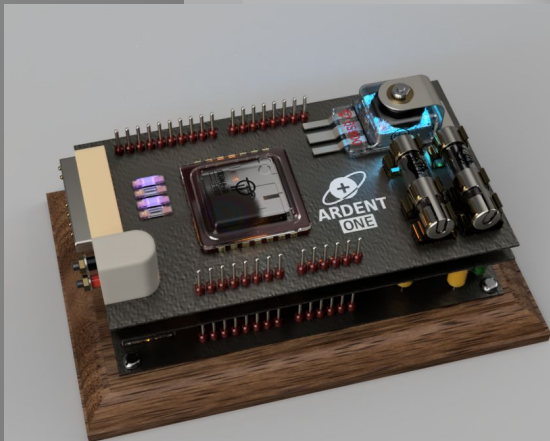
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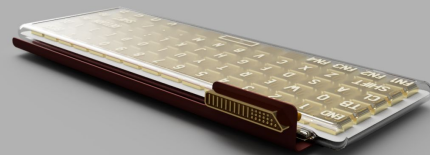
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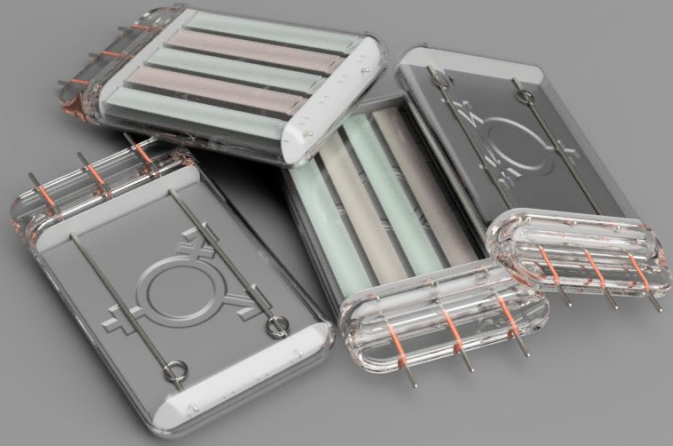
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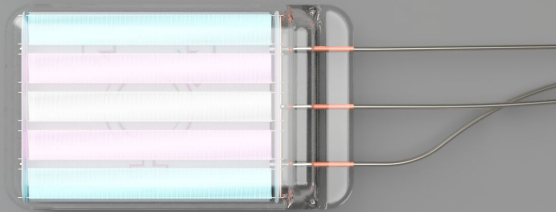
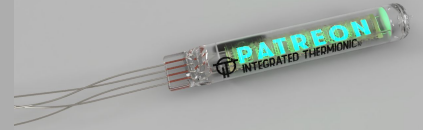
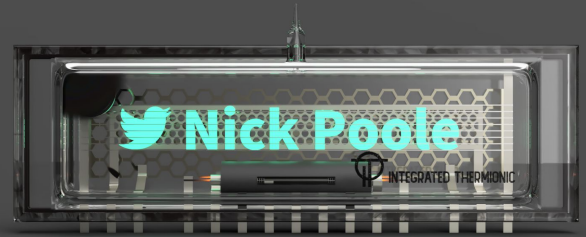
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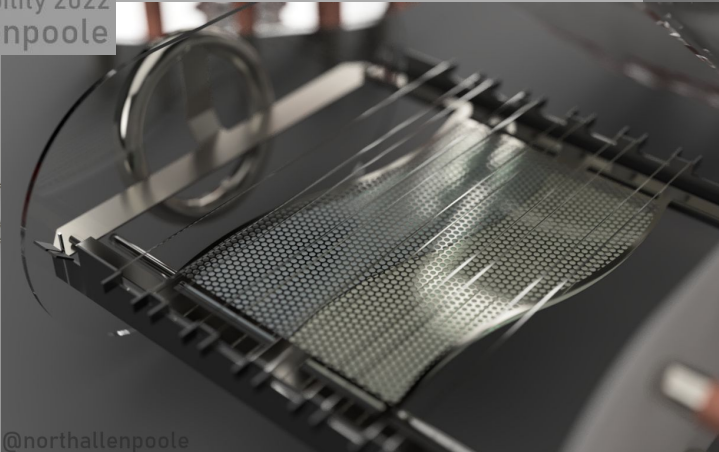
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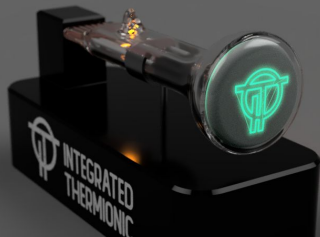
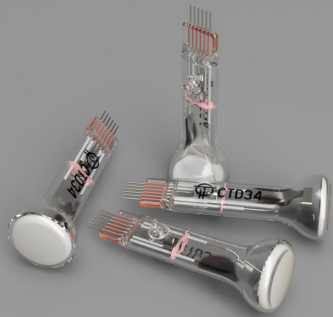
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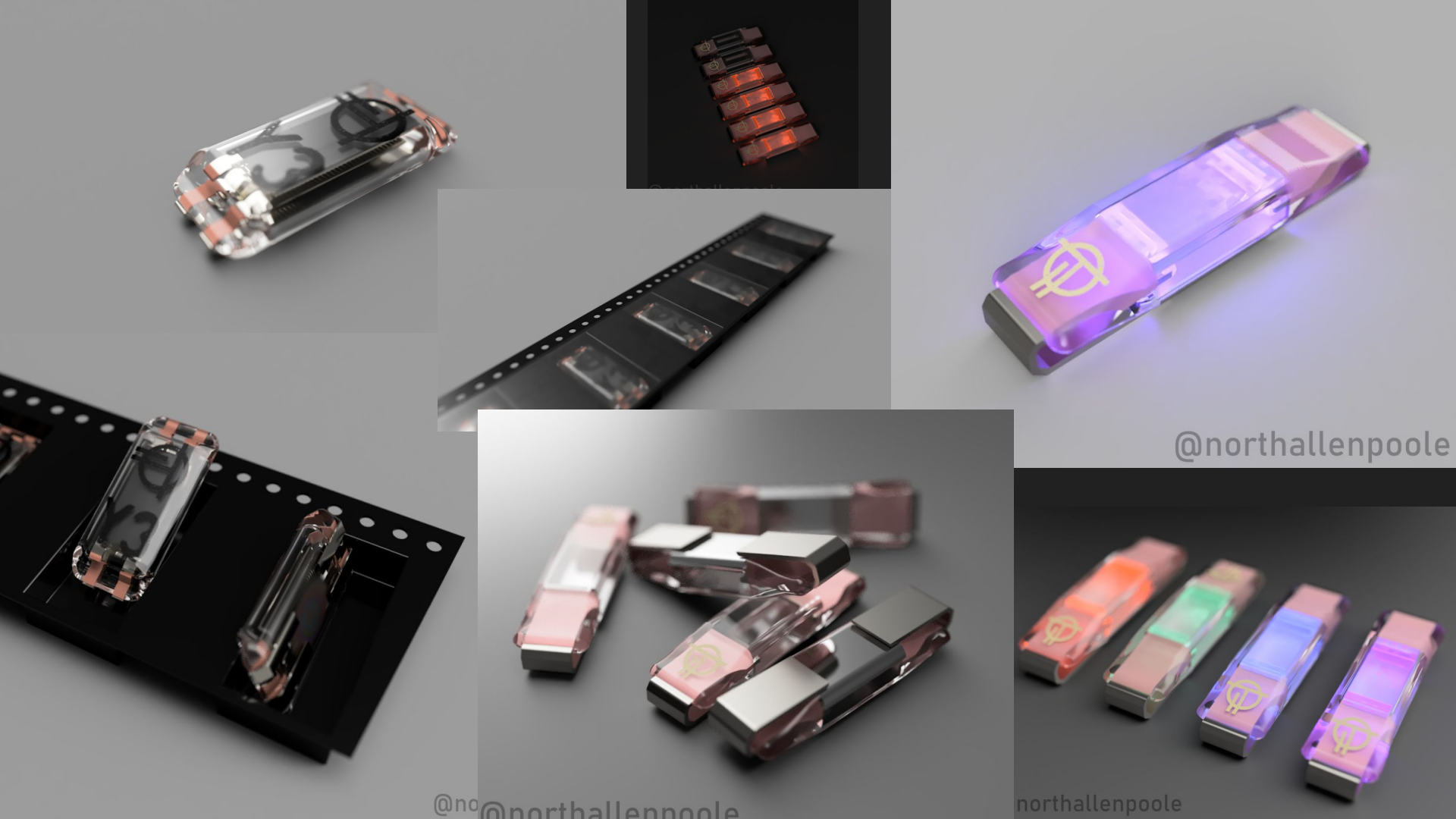
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1942-1959

1960-1981

1982-2001



INTEGRATED THERMIONIC®



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ToOoooOobTime @TubeTimeUS · Mar 22

Replying to @NorthAllenPoole

I think you've found your new calling. you're now the @NanoRaptor of vacuum tubes.



Integrated Thermionic™

digital art about vacuum tube technology

## Select a membership level

Diode



**\$3**

PER MONTH

Join

This is the "General Support" Tier. All patrons get early access to video content. If you don't need a lot of special benefits but just want to throw a few bucks my way, this is the way to do it.

Triode



**\$10**

PER MONTH

Join

This is the "behind-the-scenes" tier-level. You'll have access to pre-render screencaps of devices I'm working on as well as info-dumps on interesting bits of tube tech that I come across in my research. You'll also get early access to video content and a thank you at the end of each video. This is a good way to get

[Show more](#)

Private

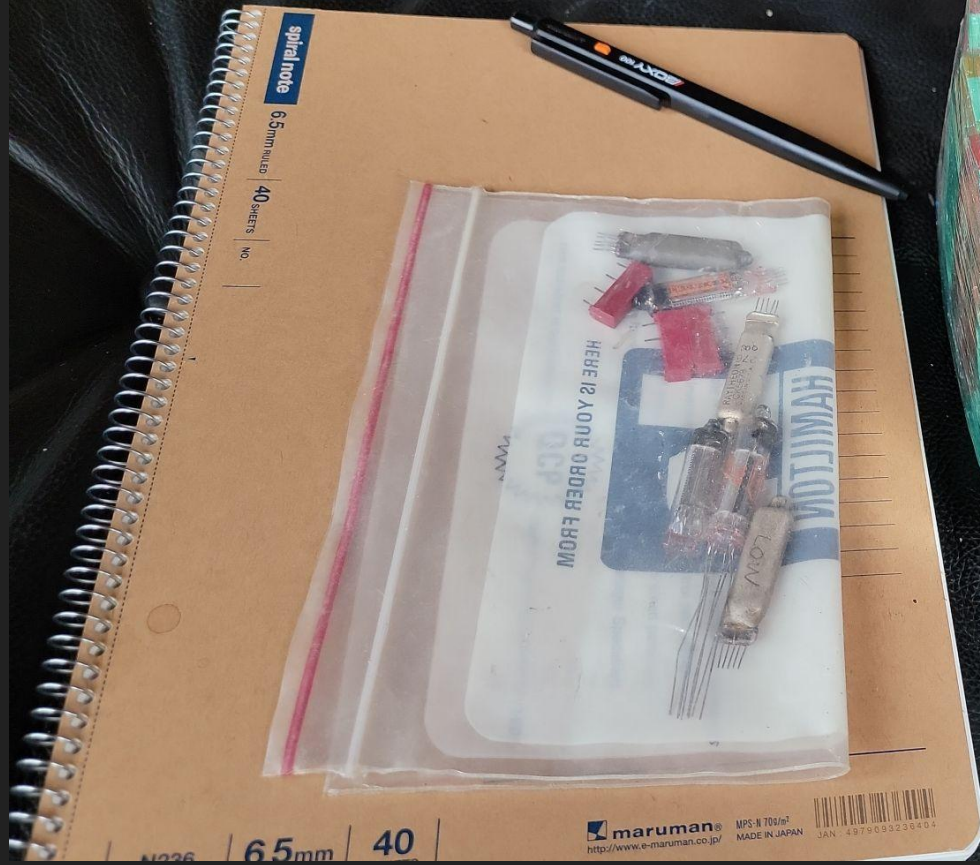
**21**

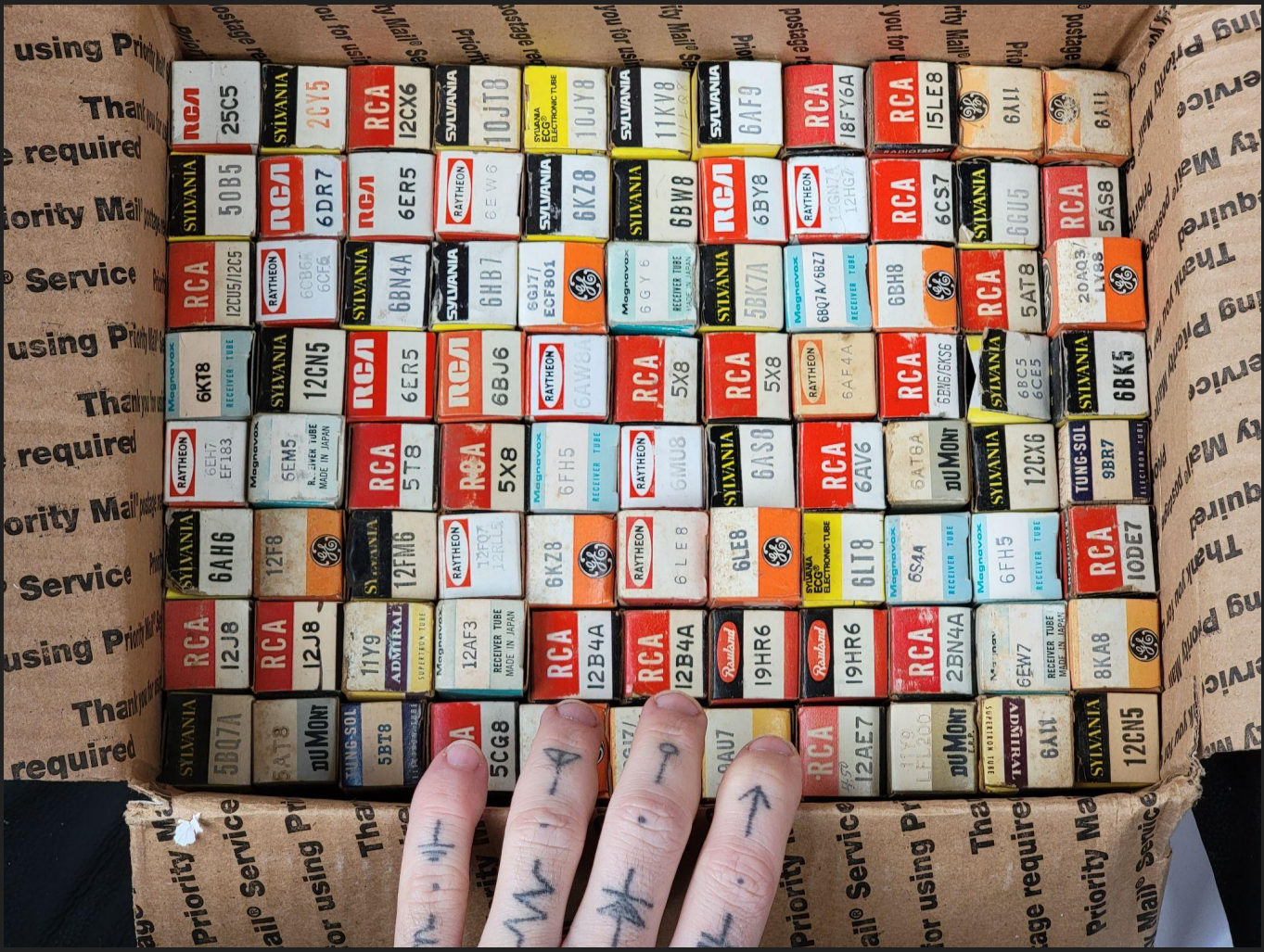
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RCA 6FH5

RCA 12J8

RCA 12J8

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12AF3

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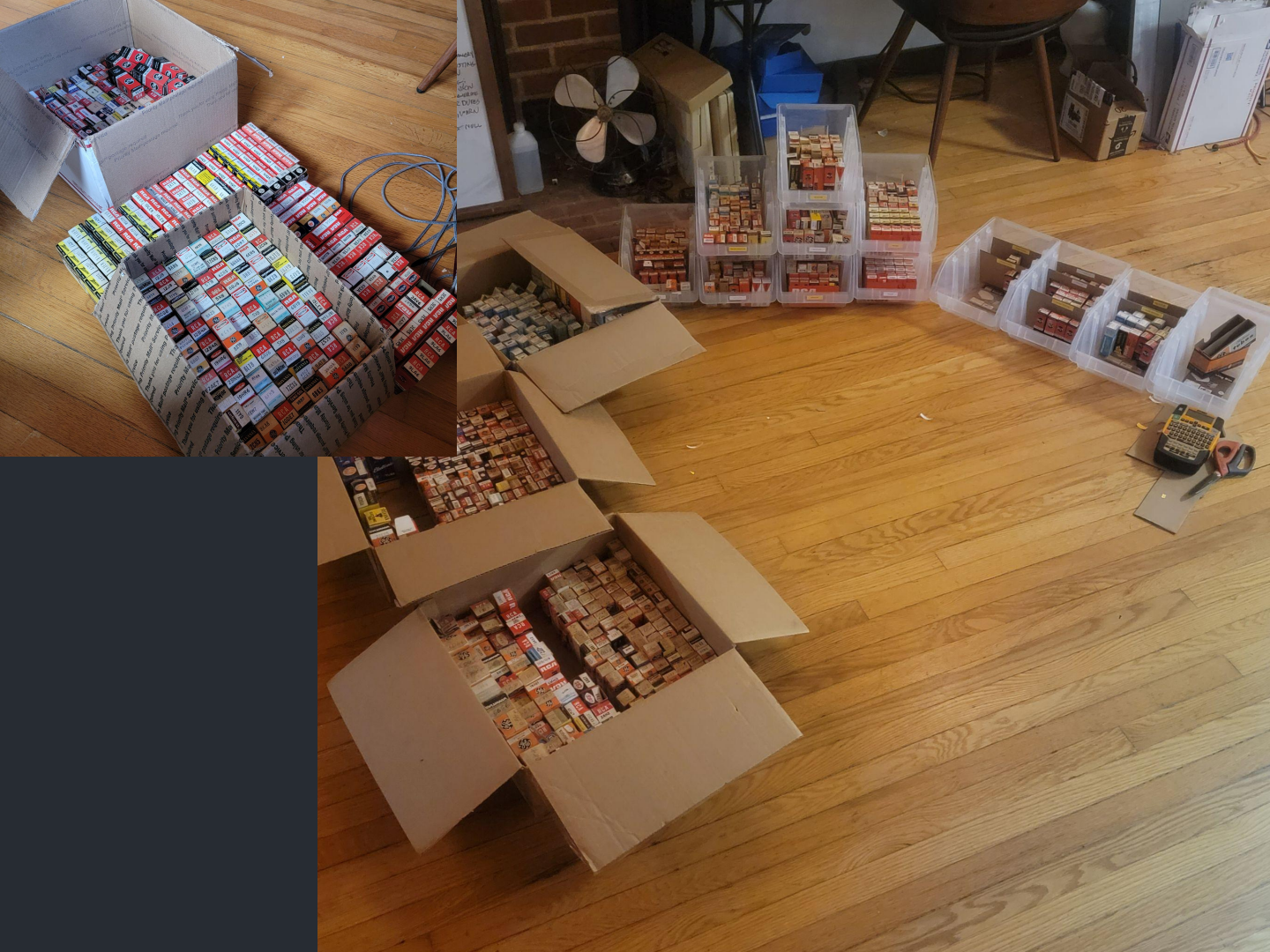
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Nick Poole

@NorthAllenPoole



## Integrated Thermionic™ CTD34 Photonette® Sub-Miniature CRT Display



[ Everyone liked that ]



**Raveyote** @raveyote · Apr 5  
 Replying to @NorthAllenPoole  
 I want it XD



**tonkussssssss** @TheMajorTech  
 Replying to @NorthAllenPoole  
 🙄🙄🙄🙄🙄



**Ben Krasnow** @BenKrasnow · Apr 5  
 Replying to @NorthAllenPoole and @TubeTimeUS  
 I know that I'm not the first person to start searching the web for more product info ;)



**Sebastian F4GRX** @f4grx@mastodon.social @f4grx · Apr 5  
 Replying to @NorthAllenPoole



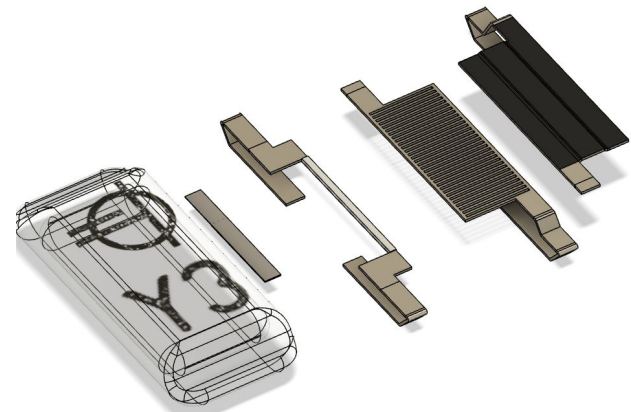
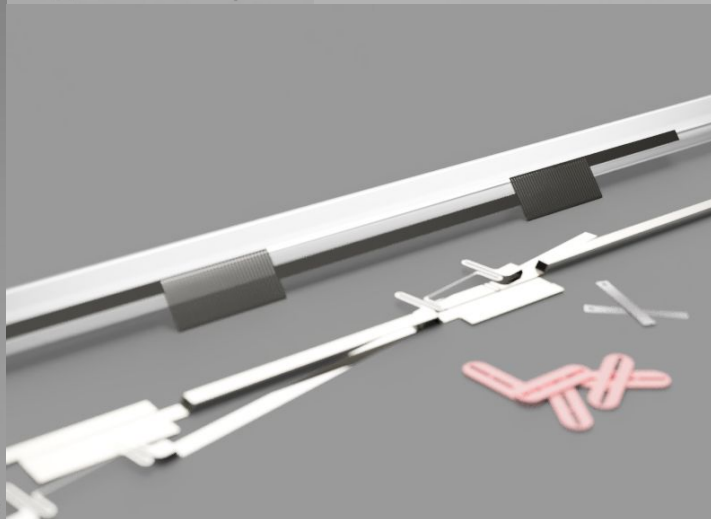
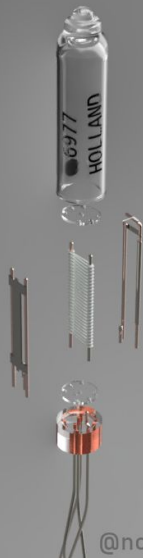
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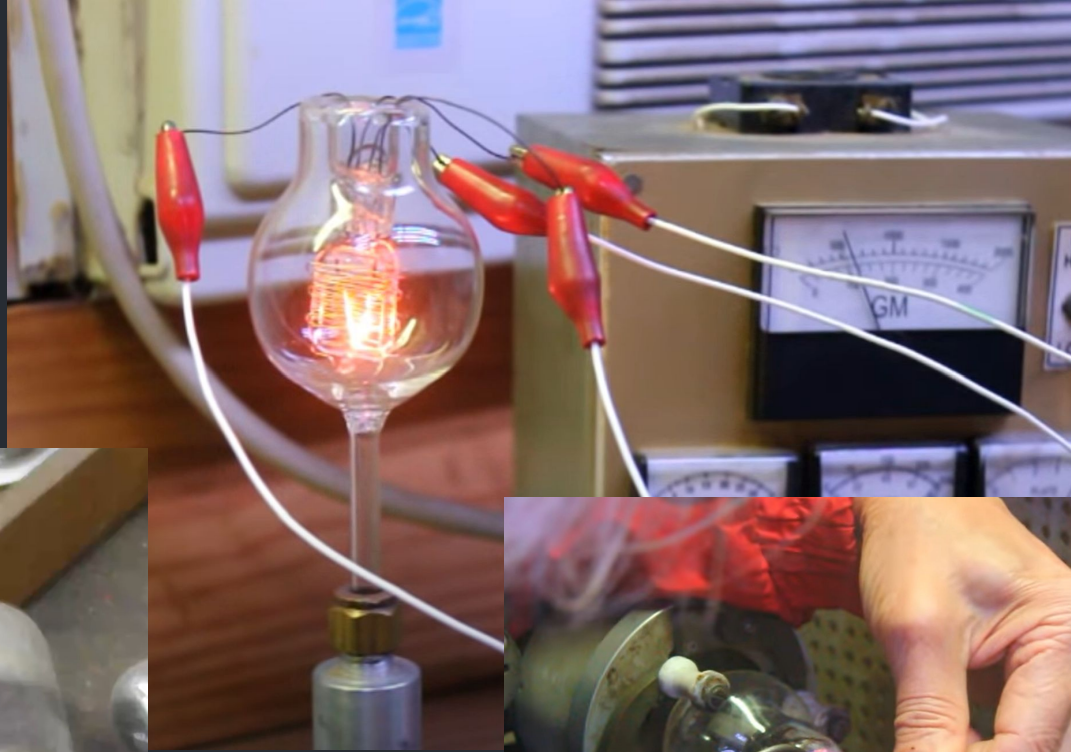
**Huxley Dunsany** @Huxley\_D · Apr 6  
 Replying to @NorthAllenPoole  
 My god I want this to be real, very very badly



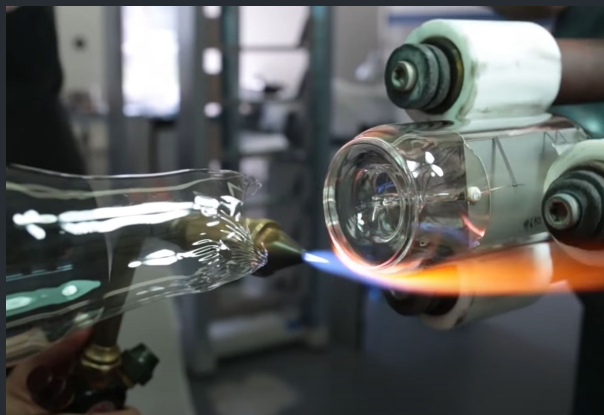
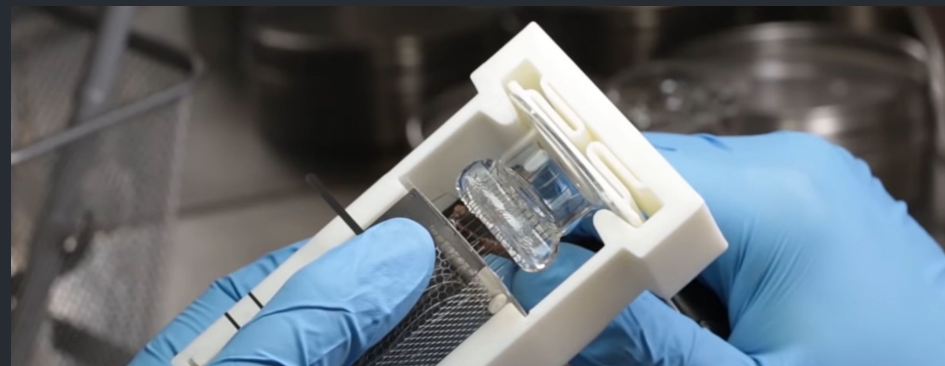
**jgeorge** @jgeorge · Apr 5  
 Replying to @NorthAllenPoole and @TubeTimeUS  
 I legitimately think I have never needed a physical object more in my life than this.



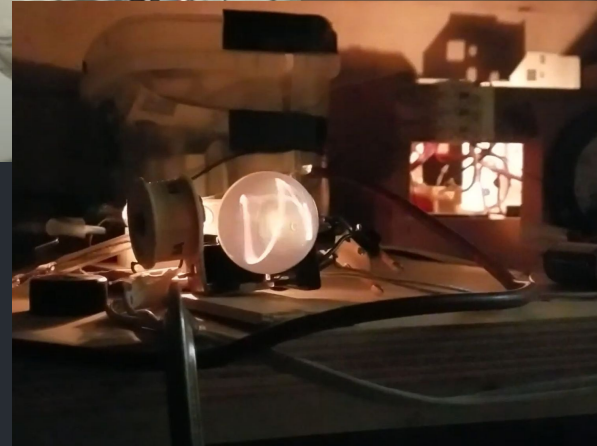
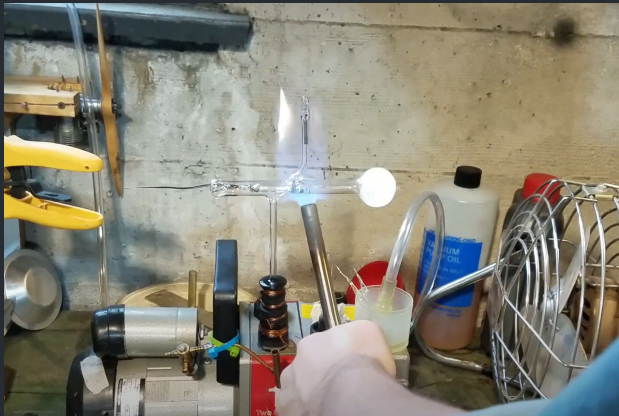
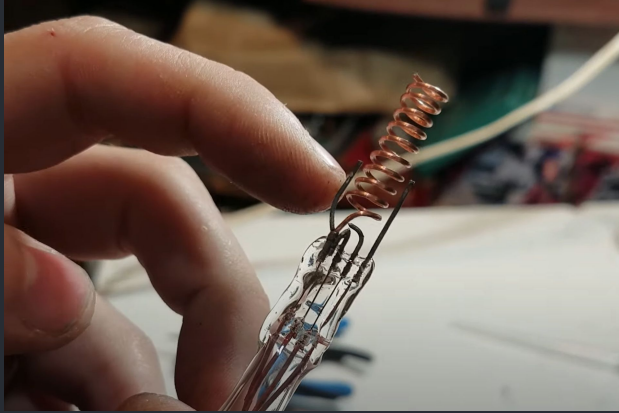
# Ron "Glasslinger" Soyland



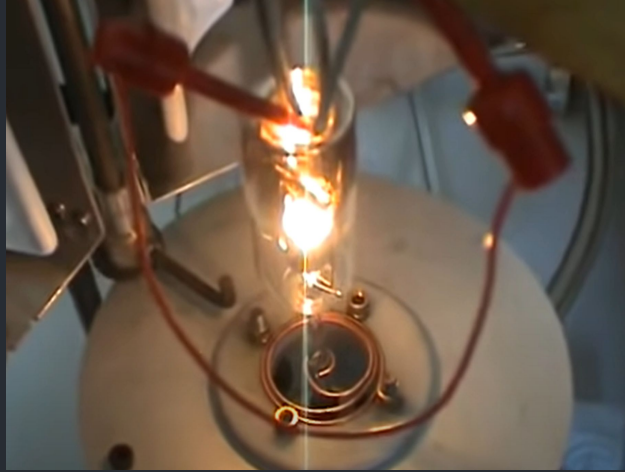
# Dalibor Farný



# JDFlyback



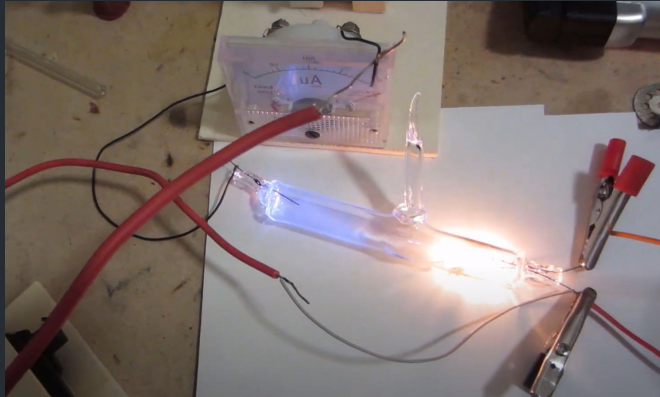
Claude Paillard



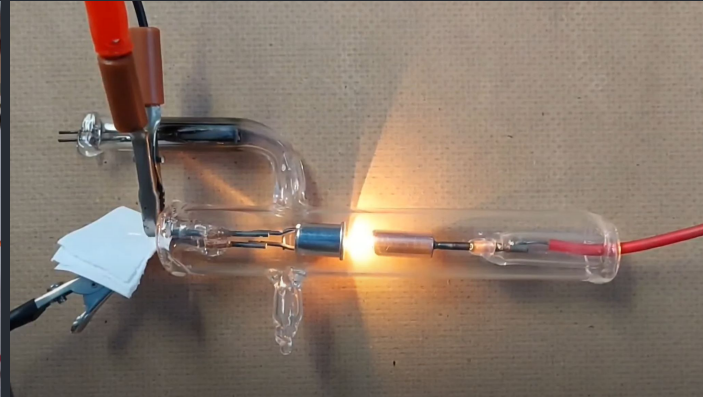
Lea Barker  
(Ottawa Vintage Radio Club)



The Science Furry



atominik





## New Duniway Stockroom glass ion gauge tube: iridium filament; 2.75" CF flange



Watchers: 2  
Quantity Remaining: 1

[Buy it now](#)



I found a version of  
to the specs you wa  
fit in a small flat rat  
PayPal or Venmo to

Apr 20, 2022, 10:56 AM

Awe  
mail



discord.com  
Discord - A New Way to Chat  
with Friends & Communities

Hey there!  
I saw your post about discord, which  
reminded me that I wanted to send you an  
invite to our vacuum hackers discord:

to nick

Hello Nick!  
For some sort of reason almost everything i post in the youtube comme  
might be interested in technical info and maybe some samples of vacu  
Anyway , i have phosphors, cathode modules, tube bottoms(stems) and  
About the cathodes and phosphors i can help you with samples if you need  
As i could not get this to you i try if this is a way to reach you. If you hav  
greetings from holland,

Nick, that range is indeed the weird Edward  
connection. I'm not sure what it is called.  
Luckily, it looks like the nut is included. You  
could probably get away with a lot of different  
style adapters, but yeah, I chose to machine  
an aluminum part that would fit into the nut.  
Let me know how it goes

Apr 14, 2022, 6:54 PM

My name is Aleksa [redacted] all the way from Serbia. I was fortunate  
enough to be a part of a commercial tube manufacturing factory called Ei  
Radio Cevi (Ei-RC) there is a 2 part video on YT, you may have seen it.  
Today, the factory doesn't exist, there are no leftovers. The machines  
were sold for scrap and what was saved went to WesternElectric, the



Jul 7, 2022, 4:24 AM

Hope you can get them downlo  
apologies if they're too much. I  
and I can pick out the highlights instead ;-)

hing your latest video, I went  
per I remember  
tems/bases. C  
e accumulated  
ocs on vacuum  
going through a  
ght might be us  
easier just to di  
know, you migl  
asonic welding

em up here in t  
3) zips:

[/temp/lrw\\_refe](#)  
[/temp/lrw\\_refe](#)

include Kohl's "N  
Techniques for Electron Tubes"  
and Roth's "Vacuum Sealing Te  
under Dalibor. It boggles the mi  
research has been done on just  
like that - when you see a nice  
produced tube, you never appr  
what went into it!

- # TOPICS
- # introductions\_and\_dire...
- # lessons-learned
- # general
- # show-and-tell
- # swap-meet
- # resources
- # machining
- # lasers\_and\_optics
- # semiconductor
- # radiation
- # off-topic-thats-someti...
- # sensitive
- # voiceposting
- # beeps-boops

Hi Nick, I really appreciate your electron  
device creativity and renderings and am glad  
ansferring it to the real world.  
[/itm/2241592889...](#) is a really  
ing triple carbonate cathode  
e later. Charles Osborne,  
region

54 AM

n an consulting engineer  
[ebeaminc.com](#)

ching your vacuum tube talk. Dr Jim  
d I were thinking about duplicating a  
ube similar to the CPI YU-176A for  
Q RF amplifiers.

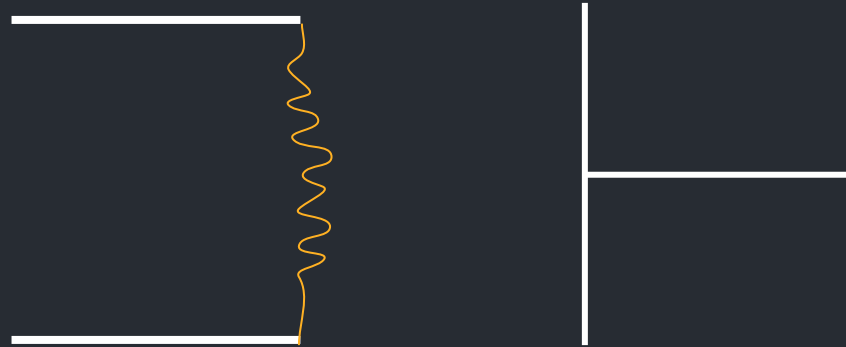
otter is still doing fun things, loves to  
knowledge and is just all around

a Los Alamos. Designed the  
; for ACCSYS, Bates, some govt  
and whatnot.



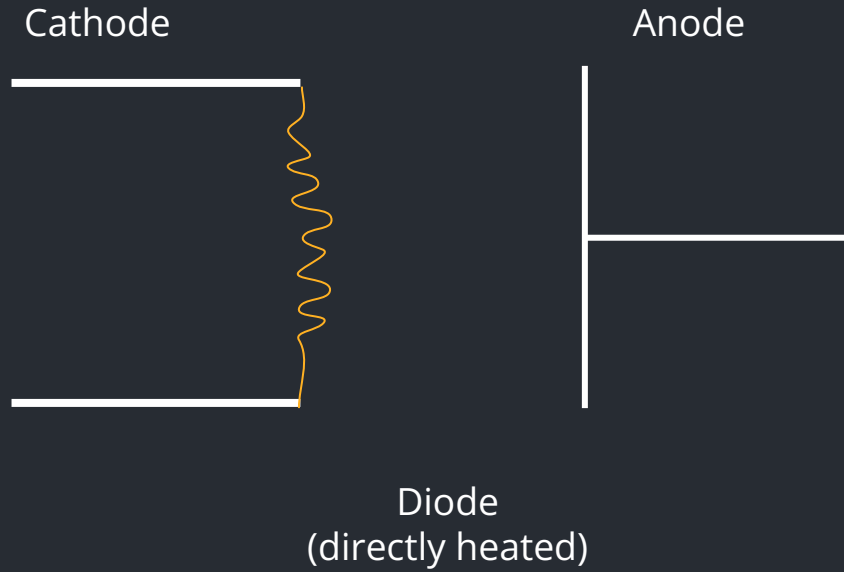
If you're serious about asking tube production  
questions, I'll give you his email address.

# How Work Tho?

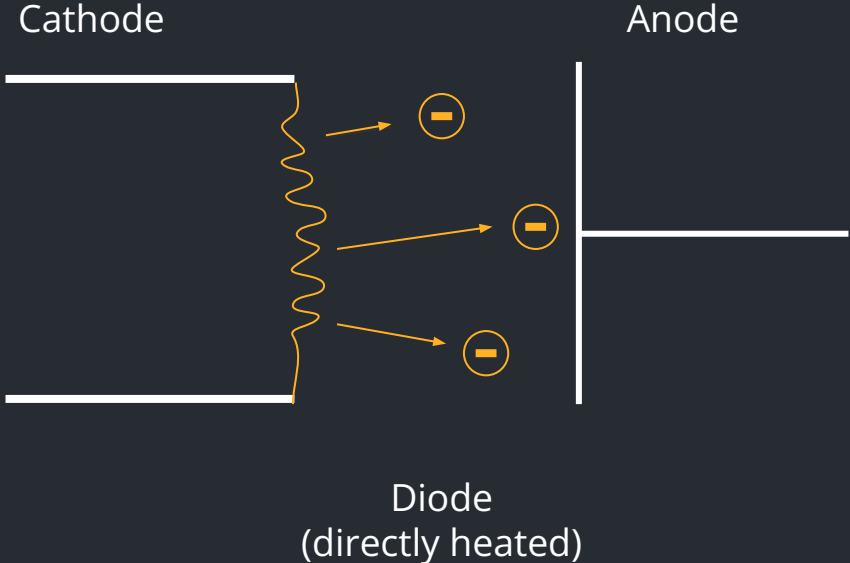


Diode  
(directly heated)

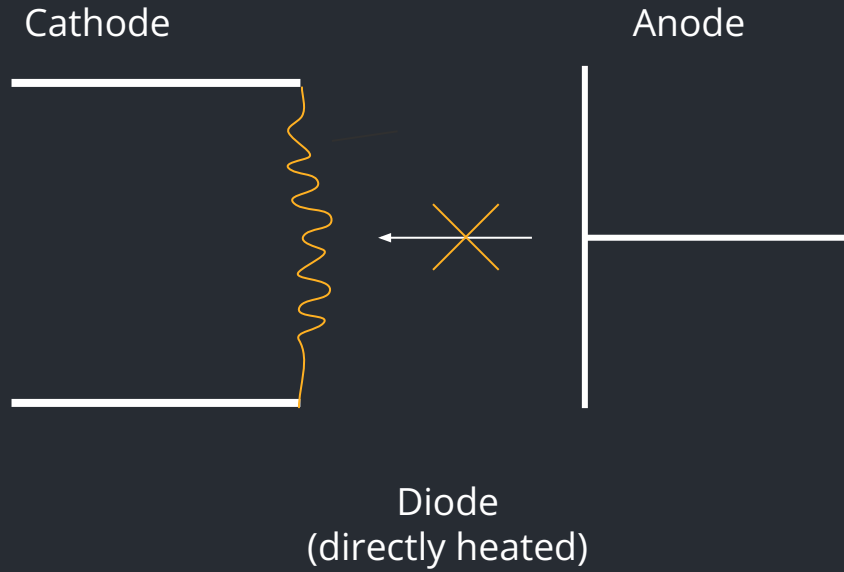
# How Work Tho?



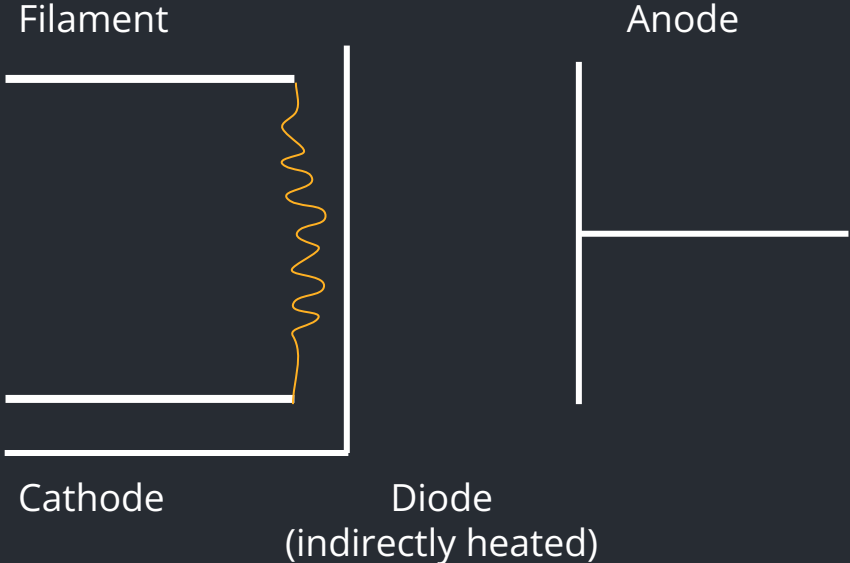
# How Work Tho?



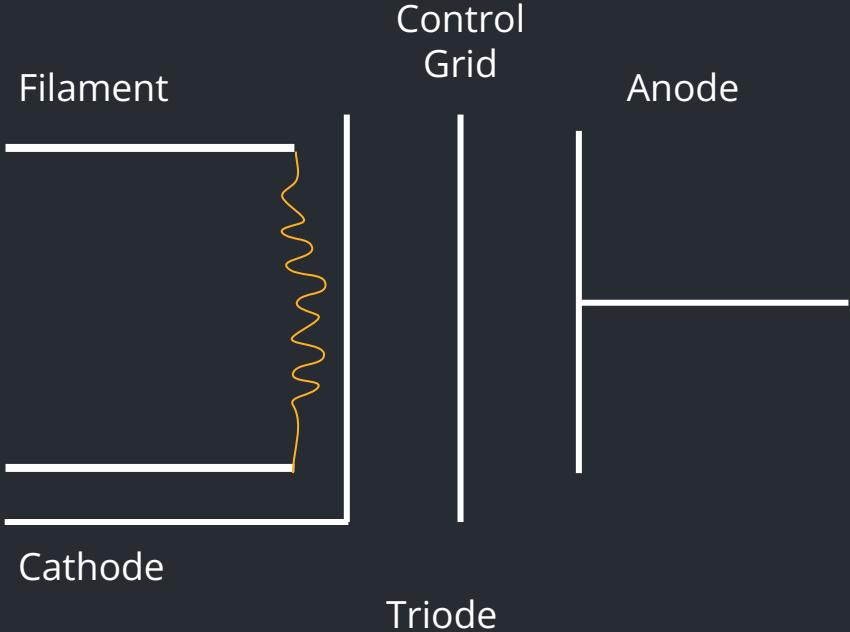
# How Work Tho?



# How Work Tho?

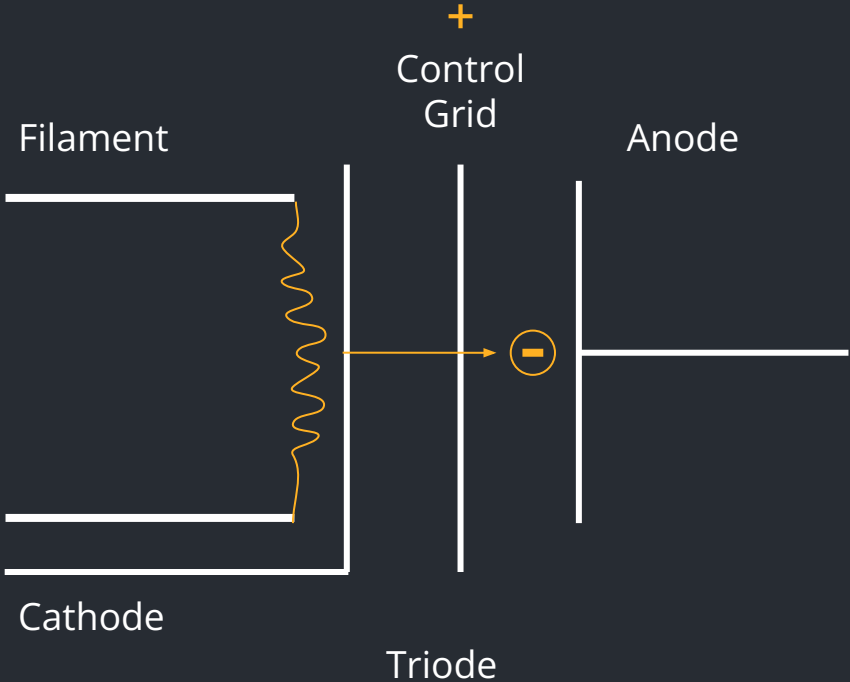


# How Work Tho?

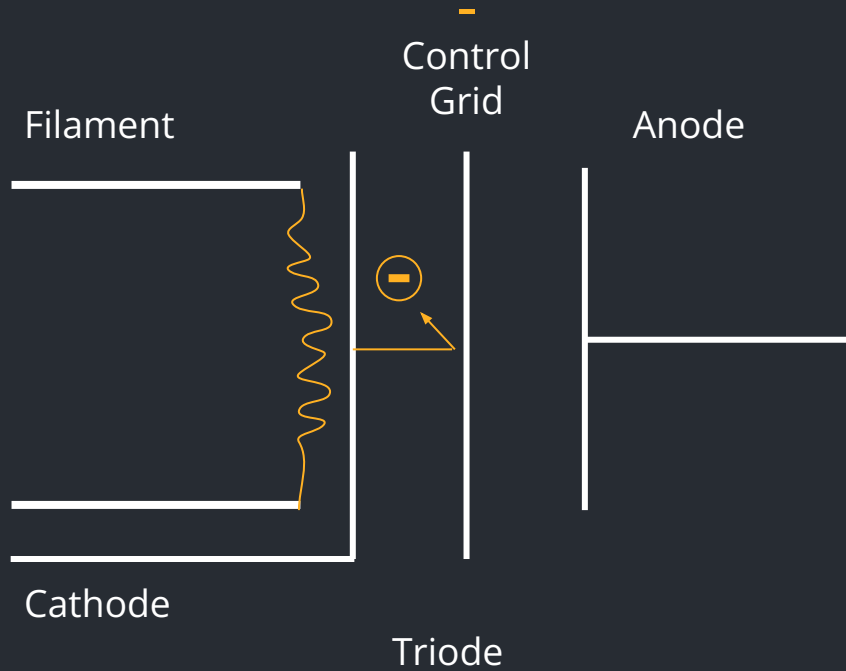




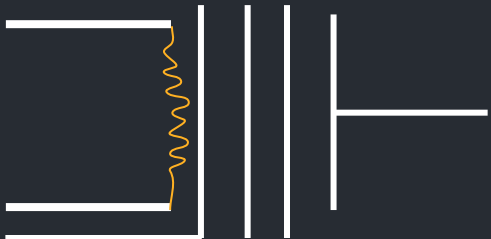
# How Work Tho?



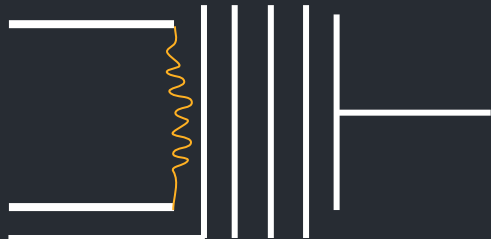
# How Work Tho?



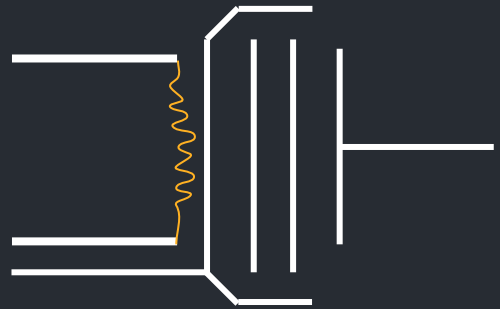
# How Work Tho?



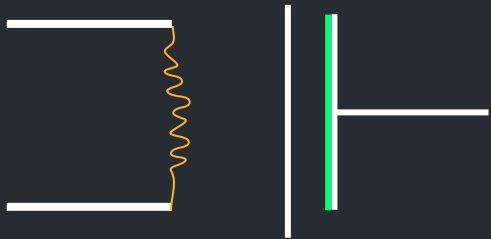
Tetrode



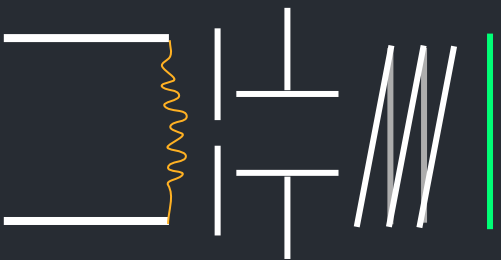
Pentode



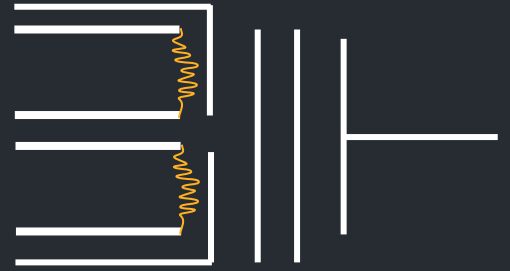
Beam  
Tetrode



VFD



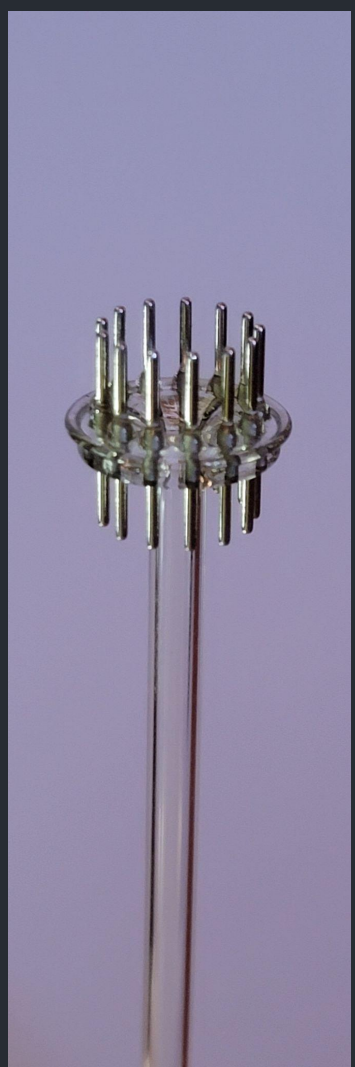
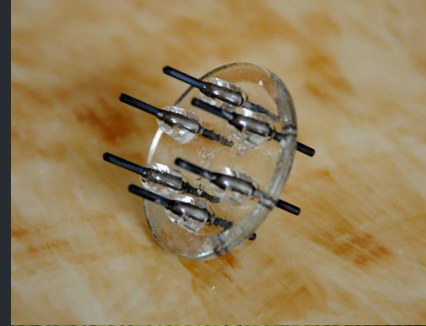
CRT



Dual  
Tetrode

# Multi-Pin Bases

- AKA Tube Base, Pin Base, Flat Stem, Button Stem
- Hard to find and impossible to buy in small quantities
- Usually made from either Schott 8250 + Kovar or Lead Glass + Dumet
- Can be had with or without evacuation stem
- I found suppliers:
  - Moore's Glassworks
  - Hebei pengxu Photoelectric Technology Co
- MOQ seems to be around 100pcs @ \$10-20/pc
- They look really nice and take the guesswork out of the glass-to-metal seal *however* you need to work with a compatible glass
- There is a cheap, available alternative (DIY)



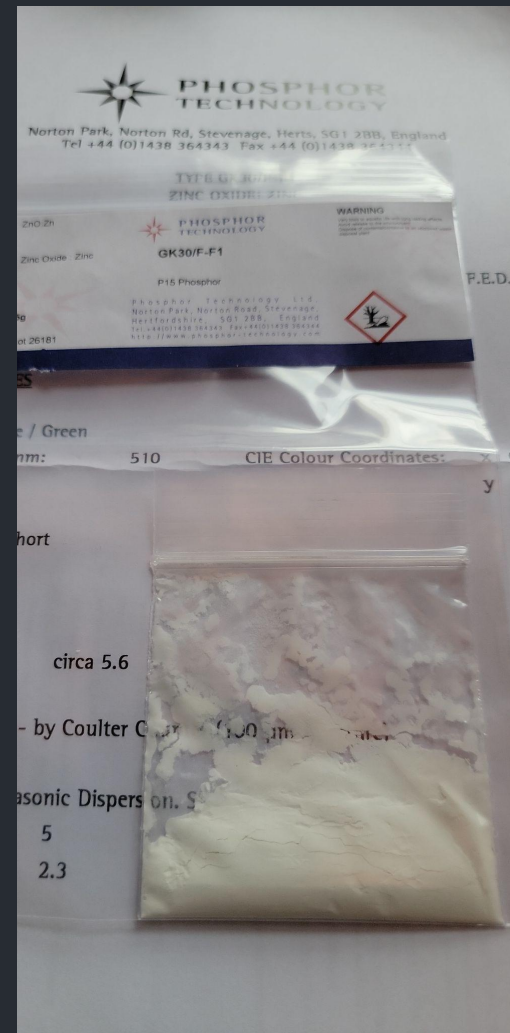
# Evaporable Getters

- Hard to find and impossible to buy in small quantities
- Big Supplier is SAES
  - Sign an NDA
  - Not for Resale
  - Nosey
- Alternate supplier is Nanjing Huadong Electronics Vacuum Material Co
  - MOQ 20000pcs @ \$0.38/pc
  - They'll sell you 1000 (@ \$4.50/pc)
  - Sent me a free sample of 150pcs
- Creates the pretty, mirrored finish you see on commercial tubes
- Need an induction heater to fire the getters in situ
- There is a cheap, available alternative (DIY)



# Cathodoluminescent Phosphors

- AKA FED (Field Emission Device) phosphors
- Various compositions  
ZnO:Zn, Y<sub>2</sub>O<sub>3</sub>:Eu, Gd<sub>2</sub>O<sub>2</sub>S:Tb, etc.
- How do you apply it? I don't know!
- Found a supplier: Phosphor Technology Ltd
  - MOQ is 100g
  - \$300/kg+
  - Sent me a free 5g bag
- You only need these for Vacuum Fluorescent Displays
- Again, no idea how to apply



# Fancy Wire and Sheet

- 99+% purity wire is surprisingly available and affordable in a variety of materials: 316L Stainless, Nickel, Titanium, Tungsten, etc.
- Thank you #vapenation
- Thin nickel sheet is cheap because of battery-pack builders
- High purity (two 9s or better) or exotic materials (Barium, Molybdenum, etc) are available from chemical suppliers
- Check out [electrontubestore.com](http://electrontubestore.com) for the really fancy stuff (Inconel, Kovar, Dumet, Thoriated Tungsten)



# Glass Tubing

- Pyrex/Simax ("33 Expansion" Borosilicate)
  - Available all over the place
  - Used for test tubes, etc.
  - Also bongs, etc (thank you, weed)
  - Easy to work because of resistance to thermal shock
  - High melting point
- Soda Lime Glass
  - Cheap and cheerful
  - Low melting point (but...)
  - Needs to be carefully annealed after working so it doesn't crack
- Schott 8250, 8270, etc
  - The good shit
  - Well defined mechanical and optical properties
  - High electrical insulation value
  - Designed for sealing to Kovar and Molybdenum
  - Hard to buy (probably expensive?)



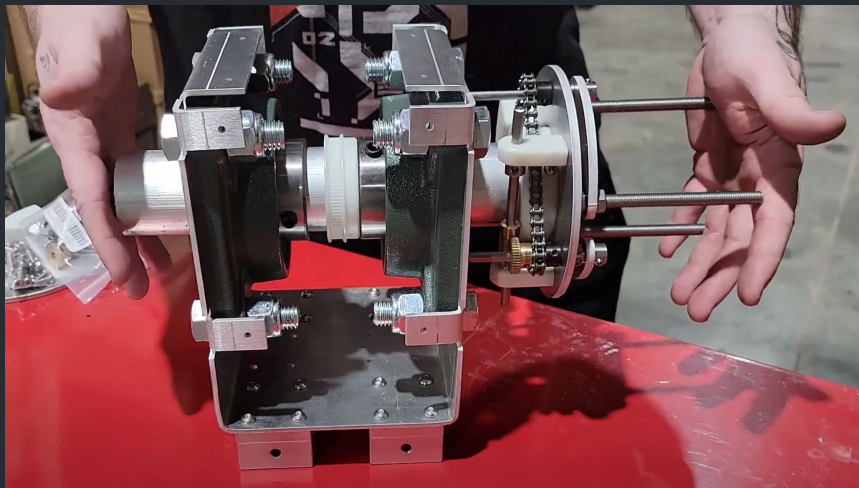
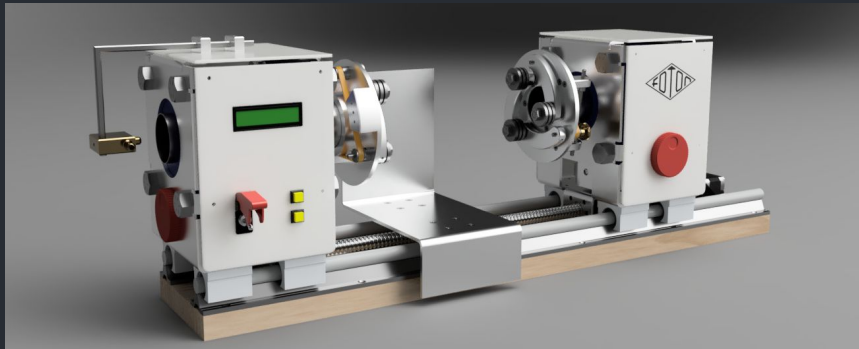


# Spot Welder



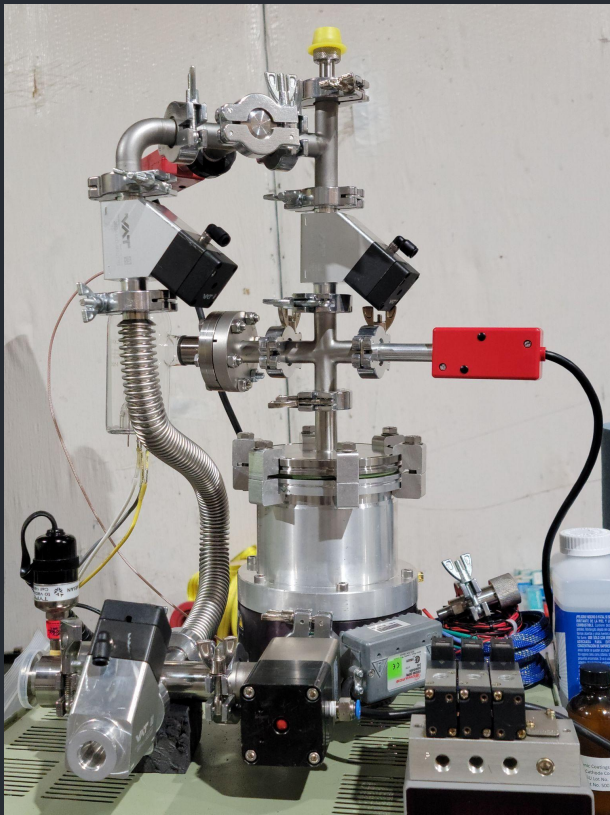
- Weird requirements:
  - Harbor Freight spot welder is unwieldy and over-juiced
  - Cheap battery-terminal welders are a little anemic for most tube materials and the electrodes are oriented for “butt welding”
  - Professional resistance welding machines are \$\$\$
  - Dentists and Jewelers seem like they might have something that would work, but I haven’t found it yet...
- Just build one... but BE CAREFUL
  - Tried to get fancy with eBay spot welder control board. It’s nice for delicate parts but...
  - Added a “melt everything” pedal that just triggers a SSR across the transformer, works great
  - There are a thousand YouTube videos that will show you how

# Glass Lathe

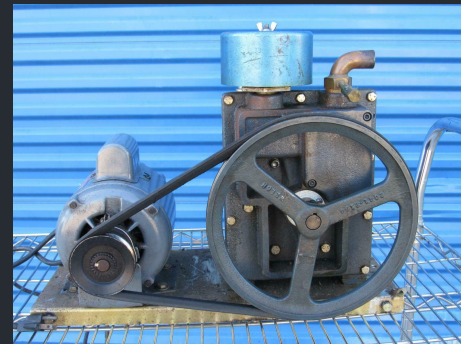


- Unlike a machine or wood lathe
  - Feed-through headstock
  - Headstock and tailstock rotate in sync
  - Slow and don't take a lot of axial load
- Evenly heat a piece of tubing and keep it from sagging while hot
- Melt two pieces and use the tail-feed to push them together while turning them in proper alignment
- Commercial machines are available, but mainly for scientific glassblowing. No "small" glass lathes.
  - Bethlehem, Litten, Heathway, SEAM
- Design/Build one?
  - "Foton" OSHW Glass Lathe
  - Stepper Motor Drive
  - No machining required
  - Specifically for very small work
  - First one is still in progress
- Not *strictly* necessary, you could do some work by hand, with a bench roller, or even a cordless drill

# High Vacuum System

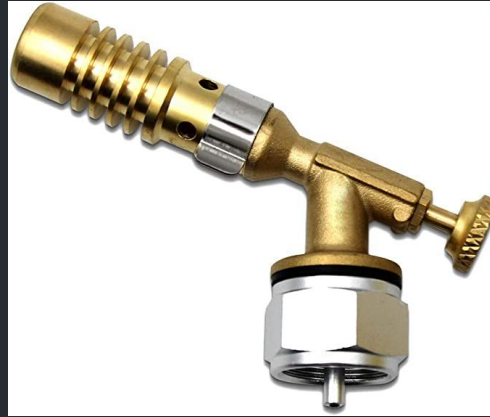


- Extremely in-depth topic, no time to get into it today.
  - This pains me, because I like to talk about it.
- University surplus auctions and eBay
- Careful with contamination in used equipment.
  - Rough vacuum pumps are often used in chem labs
  - High vacuum pumps are used in semiconductor manufacturing
- You'll probably need to design your own system from components
- Seek out material science nerds, fusor builders, etc.
- Beware inherited wisdom. Large, expensive systems foster superstition because gremlins are difficult to diagnose



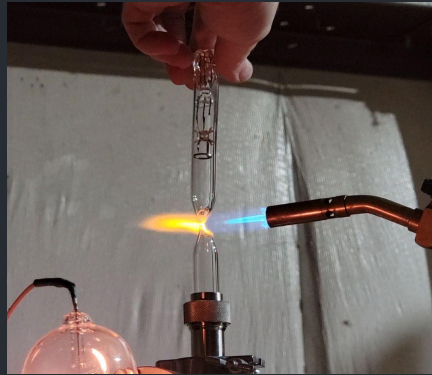
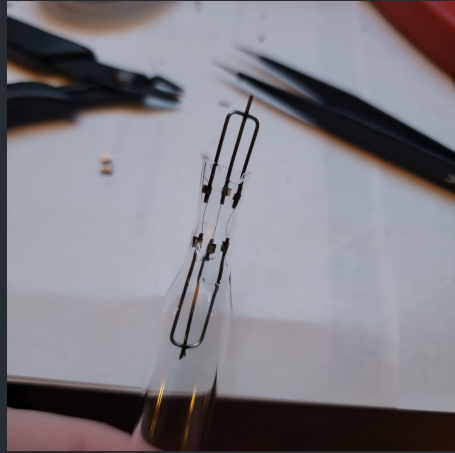
# Stuff You Can Just... Buy

- Induction Heater
  - “Mini Magnetic Induction Heater” on eBay
  - Designed for loosening rusted bolts
  - Use it to outgas metal assemblies under vacuum and fire getters
- Torches, etc.
  - You can get a lot done with a MAPP Gas torch from the hardware store
  - Eventually, you’ll need Oxy-Propane
  - Search terms like “Bench Burner” and “Lampwork”
  - Flashback arrestors!
  - Refurbished medical oxygen concentrators can be used to run a torch
- Glassworking Tools
  - Reamers, mashers, tweezers, etc.
  - Check out suppliers like Mountain Glass and Wale Apparatus



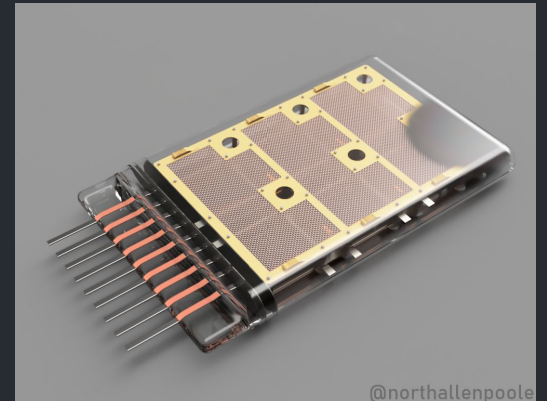
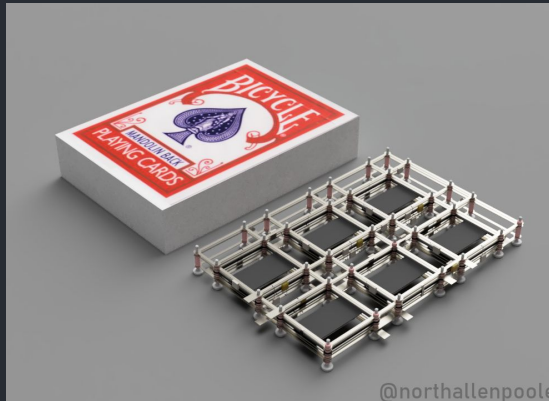
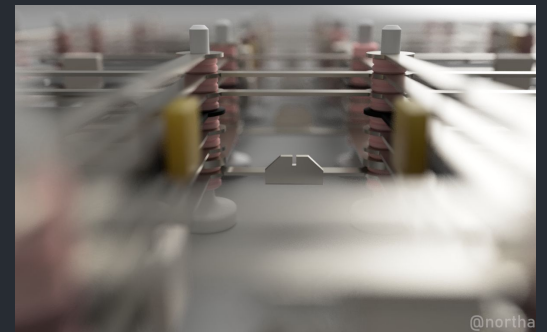
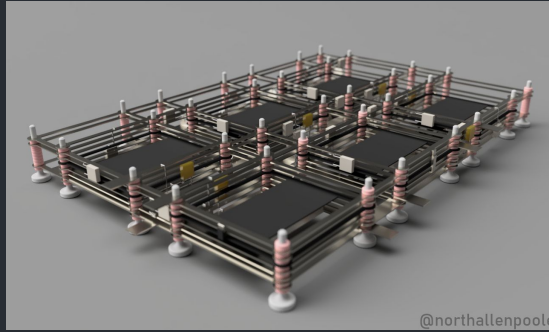
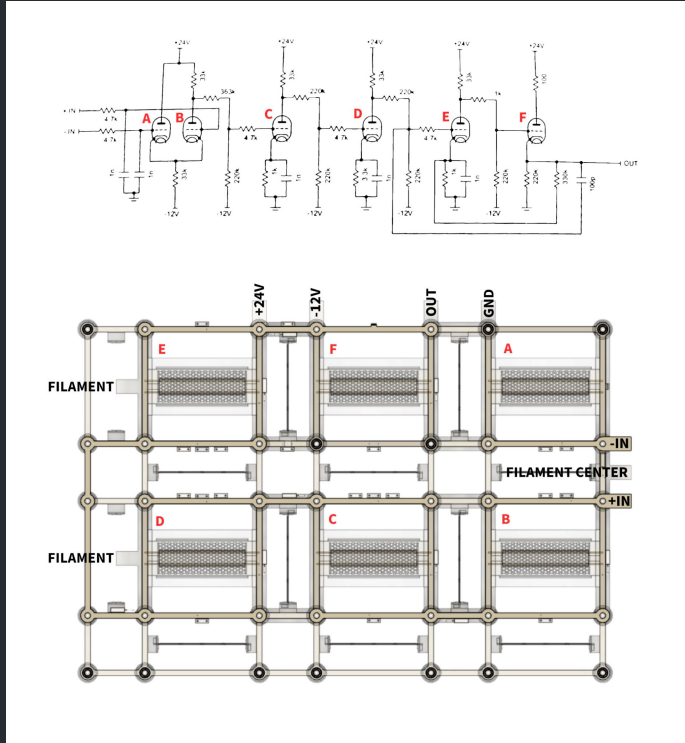
SHOW & TELL

# Quick and Dirty Tube Making



WHERE DOES THIS GO?

# PEMVs “Planar Element Multi-Valve”



# Let's Keep in Touch

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