

## **How to make your speaker drivers more resilient to overheating**

**Alice Burghard and Les Bernstein**

- A. Background
- B. Speaker set up Oliver lab Eminence speaker
- C. Instructions for Eminence speaker
- D. Instructions for JBL speaker

## A. Background

Sound exposure is a common procedure to study the injured auditory system. Depending on the research question and animal model used the sound stimulus will vary in duration, intensity and frequency content.

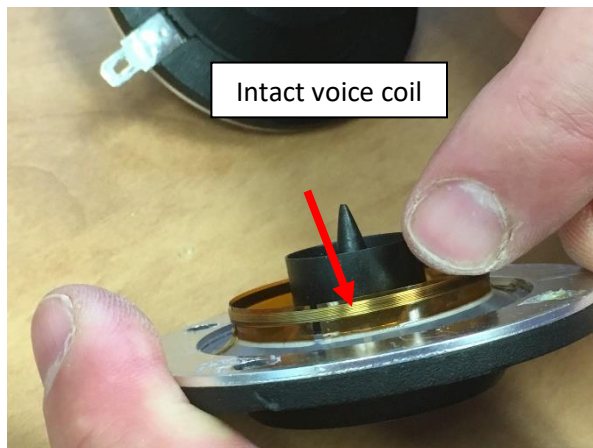
Most common available speakers are designed with the hearing range of humans in mind. If using a rodent as animal model the speaker has to be able to produce reliably high frequency contents at the desired intensity and duration.

Some speakers are able to produce the higher frequencies (e.g.  $\frac{1}{2}$  octave centered at 16 kHz) at the desired stimulus intensity (e.g. 116 dB SPL), but only for a short period of time. The main reason of failure (at least in our lab) is an overheating and resulting damage of the voice coil.

The voice coil is located in the voice coil gap in the magnet part of the driver. This gap can be either air filled or filled with ferrofluid. Air does not conduct heat efficiently so that the heat created during the sound stimulation cannot sufficiently dissipate into the magnet.

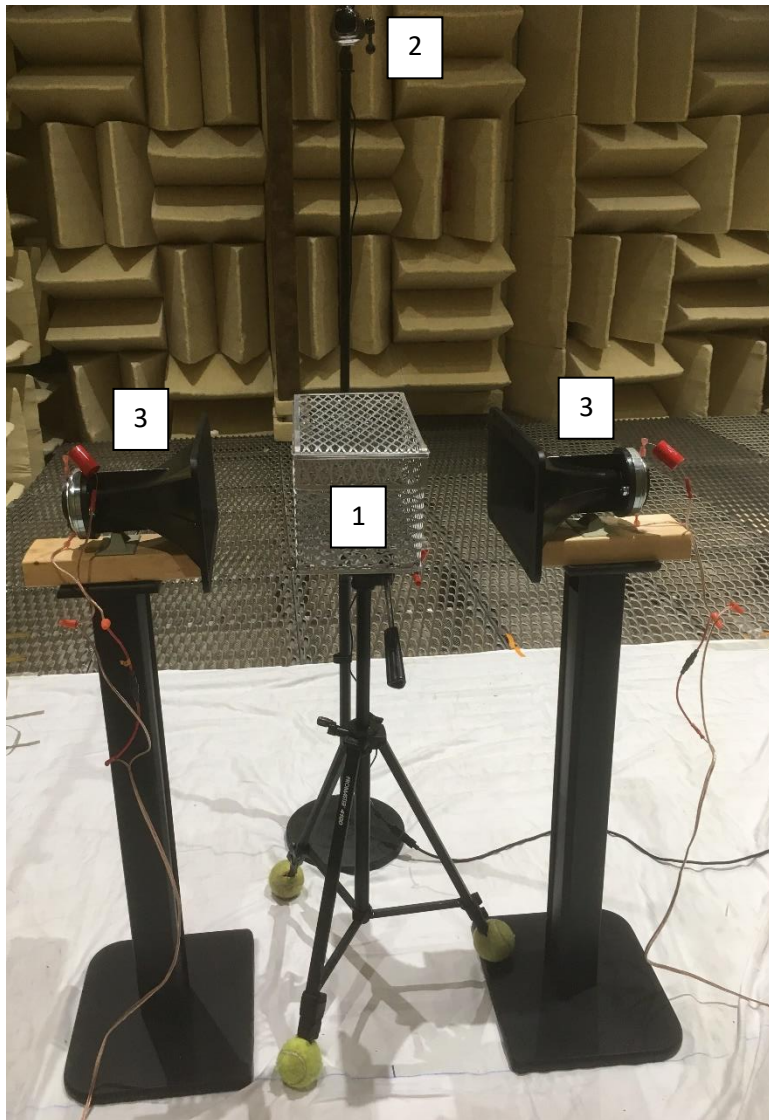
This problem of heat dissipation can be solved by adding ferrofluid into the voice coil gap.

This manual explains this procedures for two speaker types as well as the sound exposure setup for one speaker.



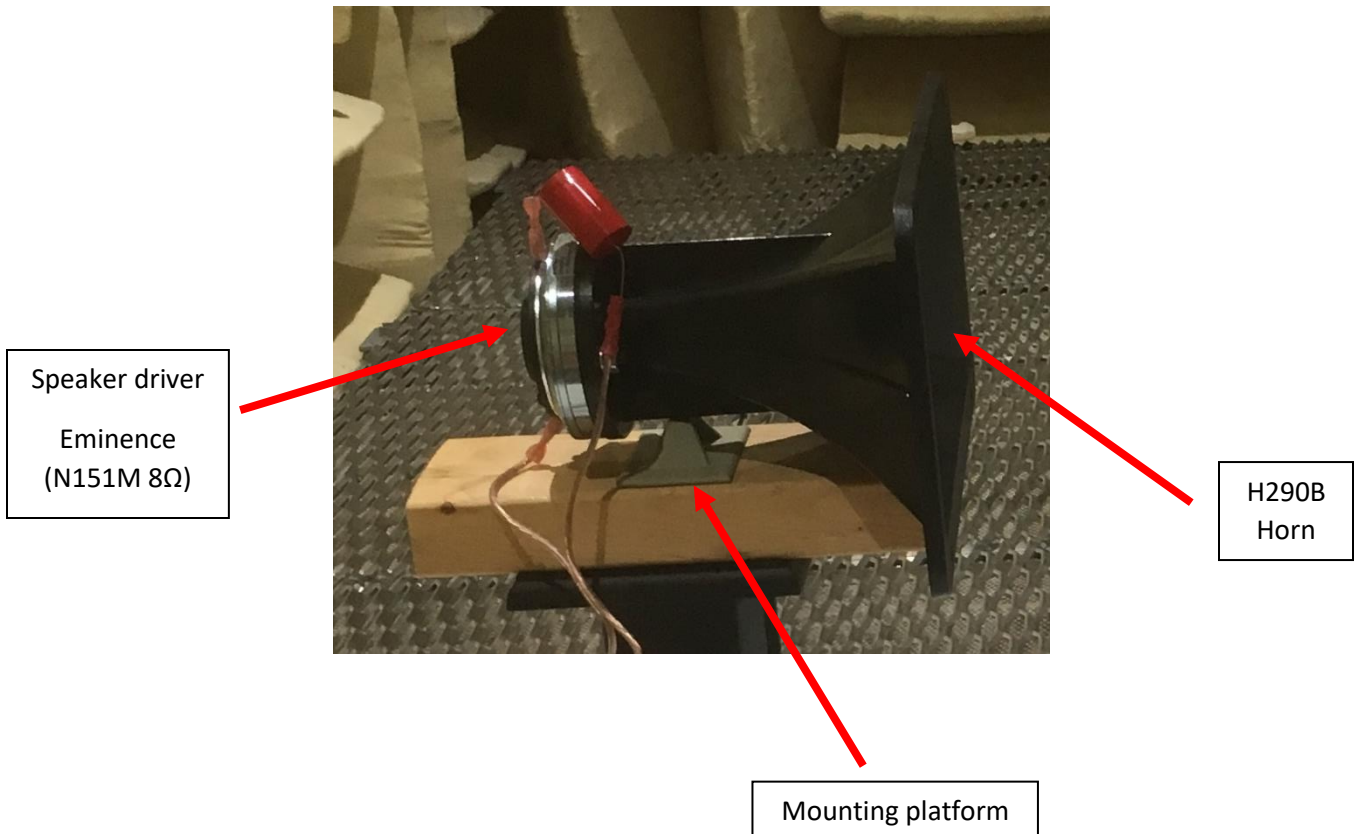
## B. Speaker setup awake sound exposure Eminence speaker - Oliver lab

1. The mouse exposure cage is placed equidistance between two speakers.
2. A video camera is place over the cage to allow live monitoring of the animals during the sound exposure.
3. Both speakers are facing each other (and the cage in the middle).



## Speaker Configuration

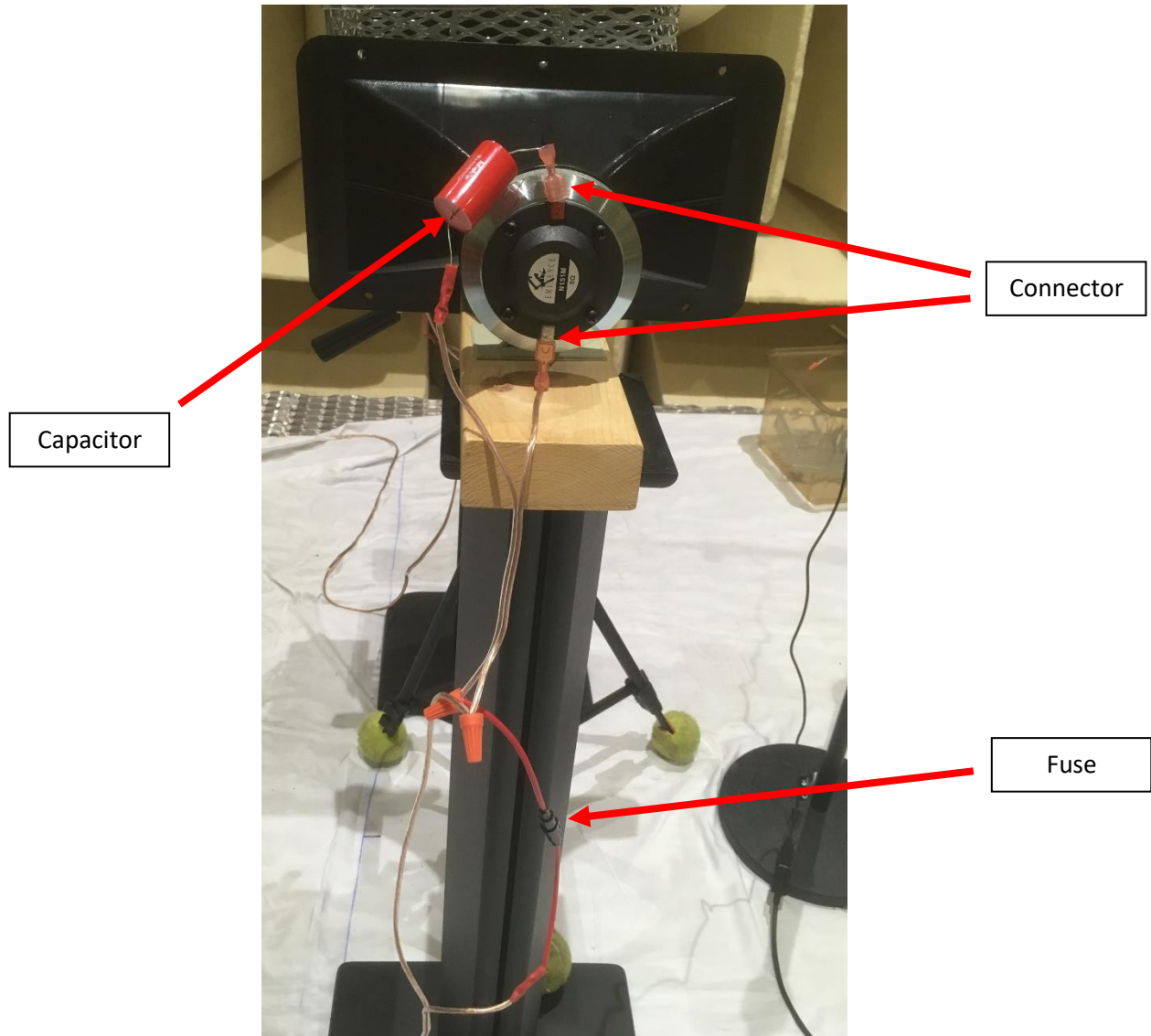
A speaker horn is added in front of the compression driver. This assembly is mounted on a platform to allow a horizontal orientation of the speaker assembly.



Speaker: <https://www.eminence.com/pdf/F151M-8.pdf>

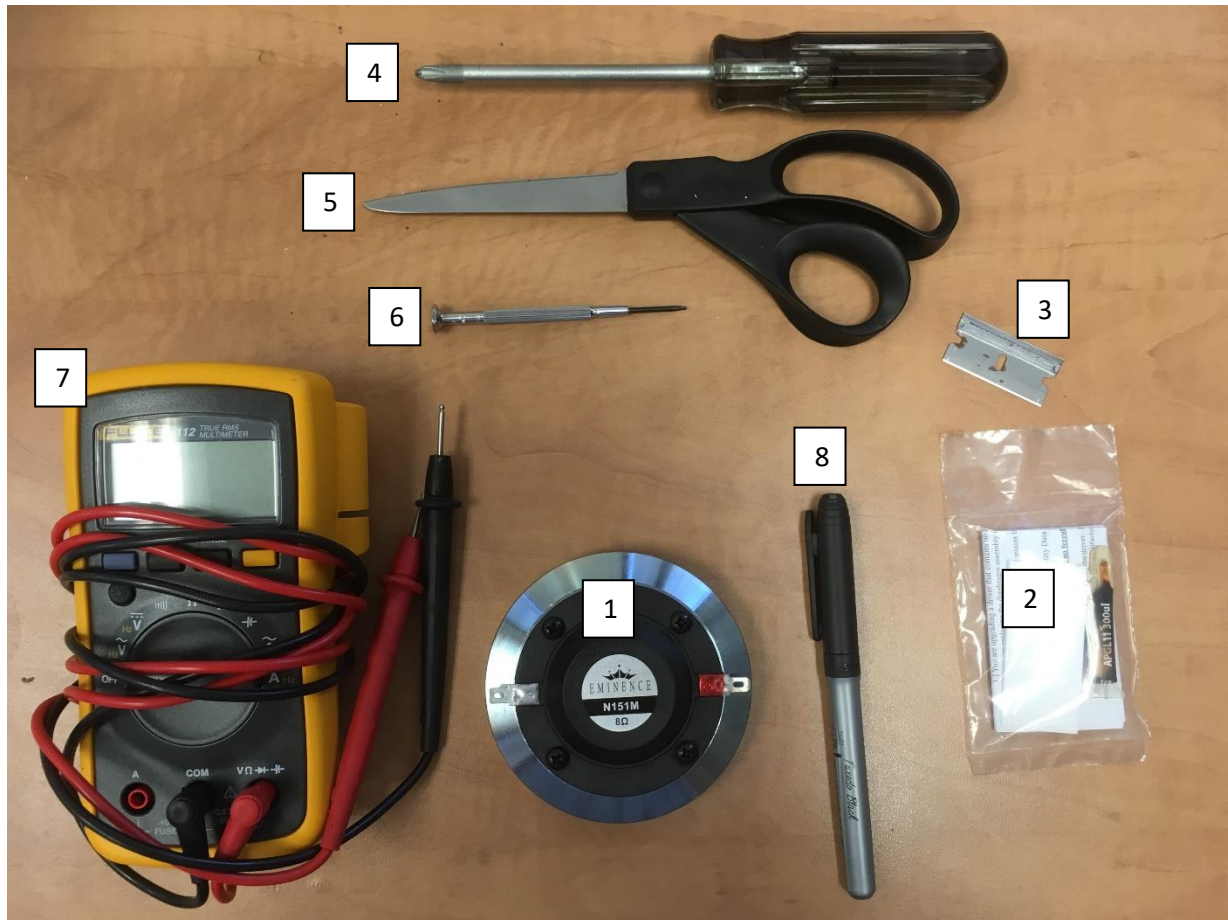
H290B Horn: [https://www.eminence.com/pdf/Eminence\\_HF\\_Components.pdf](https://www.eminence.com/pdf/Eminence_HF_Components.pdf)

To avoid an overload of the speaker circuit a capacitor (Audiophiler, MKP-kondensator, 400VDC  $C \pm 3\%$ , 4.7  $\mu\text{F}$ ) and a fuse (1 A; M5X20MM) have been added into the circuit.



## C. Ferrofluid application Eminence speaker (N151M 8Ω)

What you need:



1) Speaker - Eminence N151M 8Ω

(<https://www.eminence.com/speakers/driver-detail/?model=N151M-8>)

2) Ferrofluid Retrofit Kit – Ferro Tec #020618-L11

([https://www.amazon.com/Ferrofluid-300uL-General-Purpose-Diameter/dp/B00HX0L1E4/ref=sr\\_1\\_15?keywords=ferrofluid+tweeter&qid=1558714951&s=gateway&sr=8-15](https://www.amazon.com/Ferrofluid-300uL-General-Purpose-Diameter/dp/B00HX0L1E4/ref=sr_1_15?keywords=ferrofluid+tweeter&qid=1558714951&s=gateway&sr=8-15))

3) Razor blade

4) Philips screw driver

5) Scissors

6) Mini flat headed screw driver

7) Multimeter

8) Pen

Step 1:

Measure the resistance of the speaker to check everything is working before doing anything else.



Step 2:

Mark the position of one of the connectors.



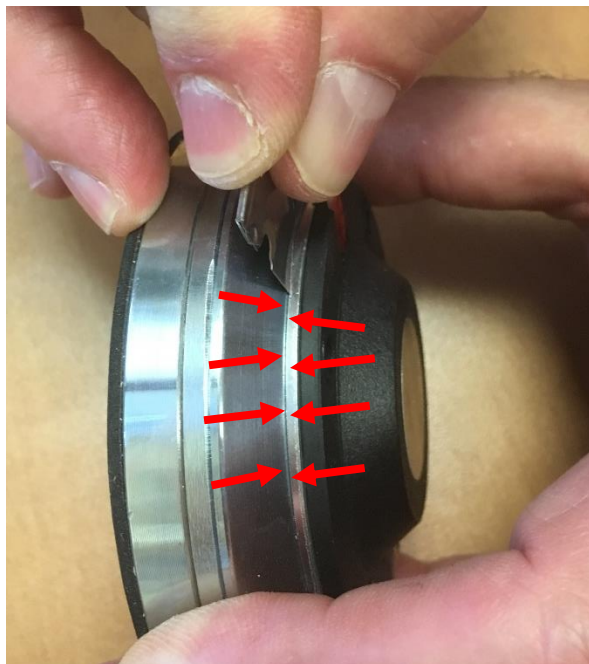
Step 3:

Remove the four screws. Place them far away from the driver (very strong magnet!)



Step 4:

Use the razor blade to cut between the metal ring and the magnet.



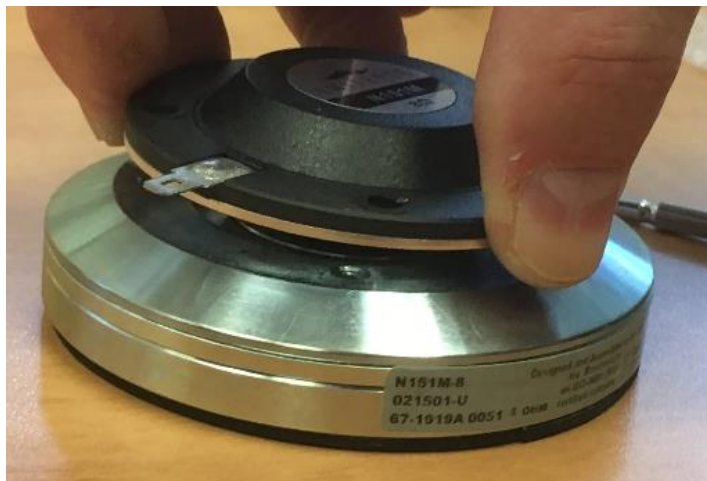


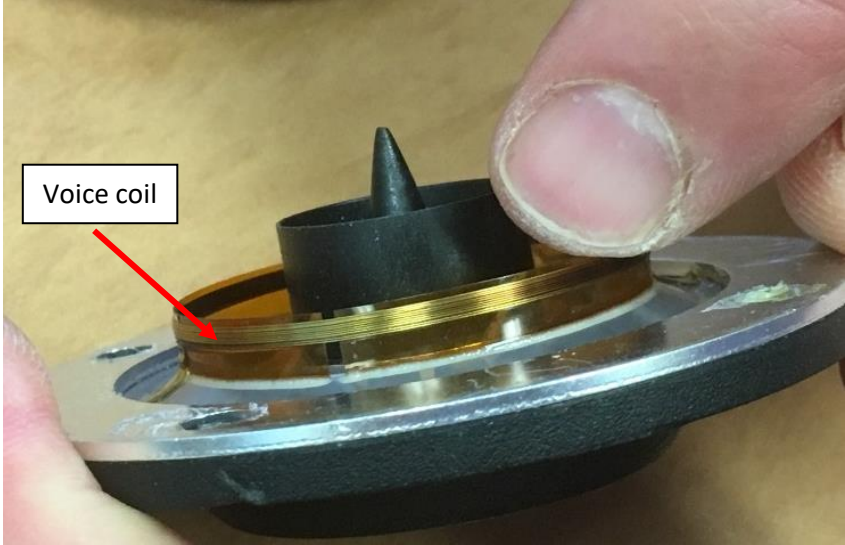
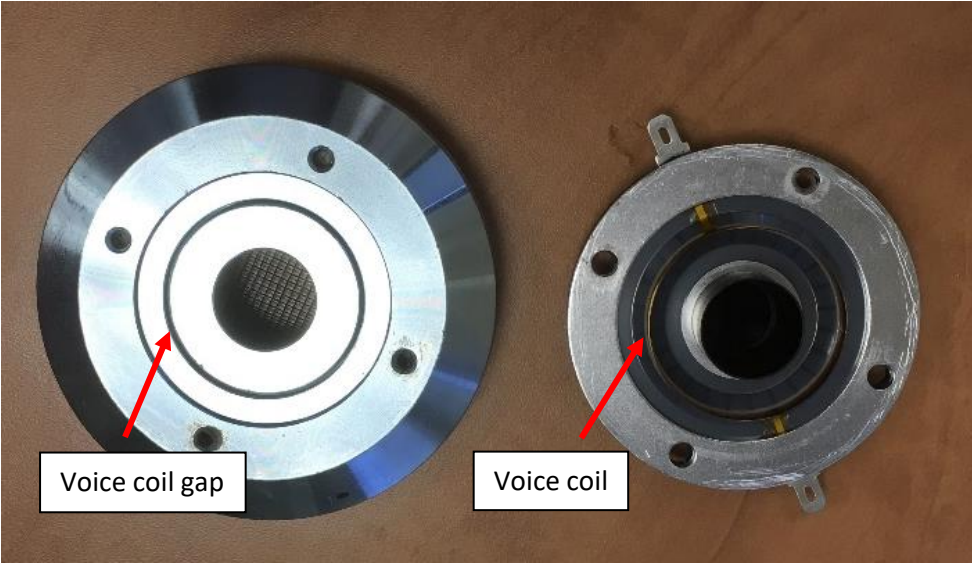
Use the mini screw driver to widen the gap between the two metal parts.



Step 6:

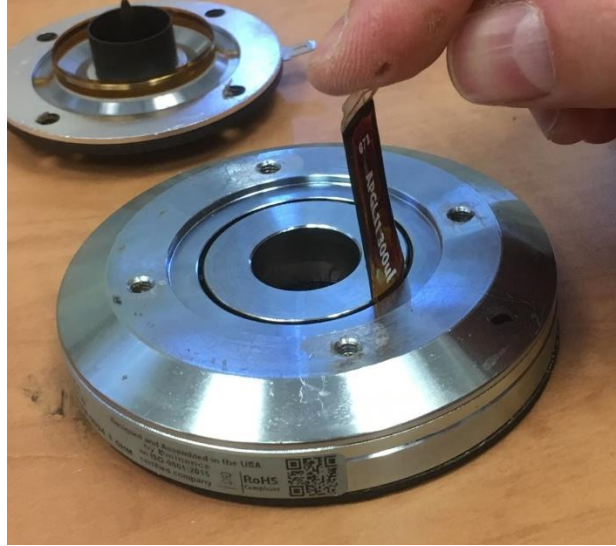
If the gap is wide enough, carefully lift the voice coil out of the gap.



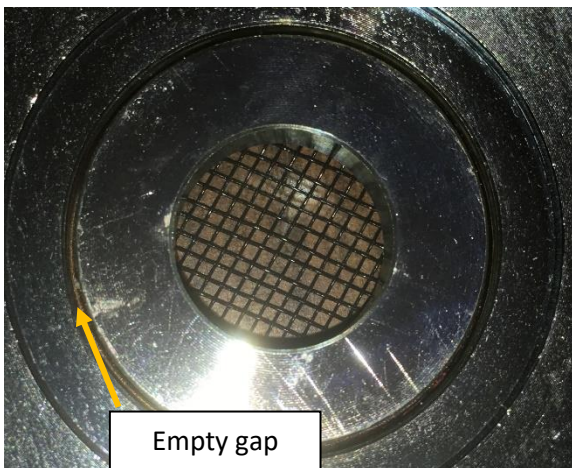


Step 7:

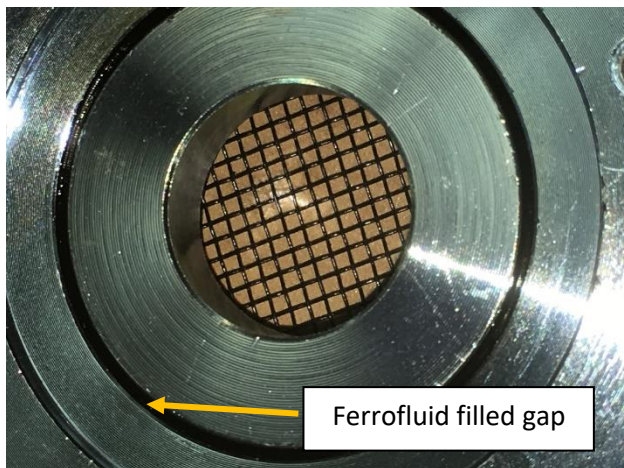
Apply the ferrofluid: Use the notch in the bag as a guide to snip of the top with the scissors. Place the opening into the voice coil gap and squeeze the bag. There is no need to rotate the magnet while doing so. The ferrofluid distributes itself in the gap. The amount in the bag is more than what is needed to fill the air gap. There is no need to squeeze out the last drops.



Before:



After:



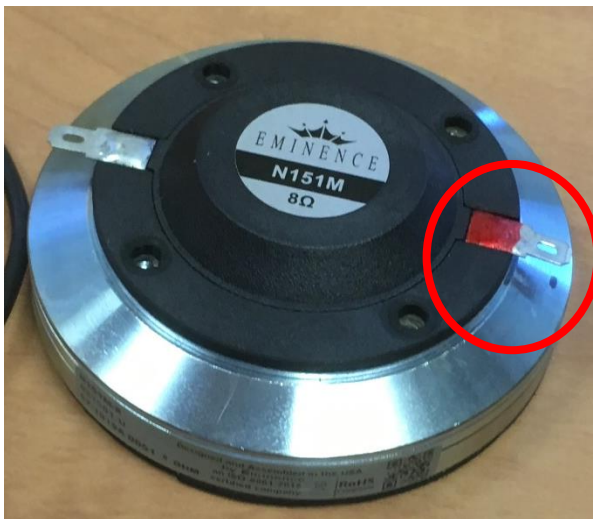
Step 8:

Reassemble the speaker. Align the red connector with the black mark on the magnet and lower the voice coil back into the voice coil gap.



Step 9:

Check the position of the connector on the magnet and put the screws back.



Step 10:

Mark the speaker as being treated with ferrofluid and check its resistance.

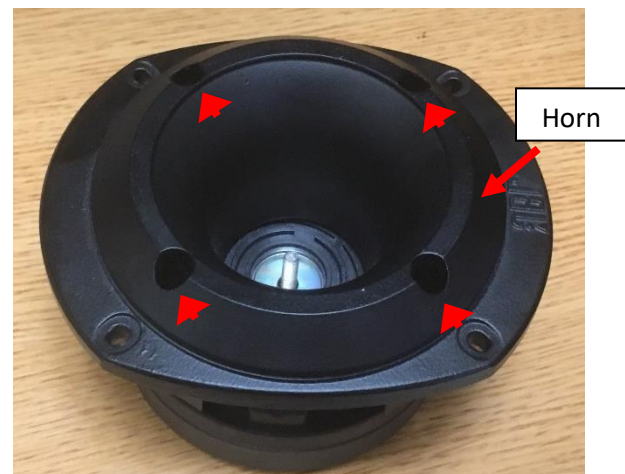
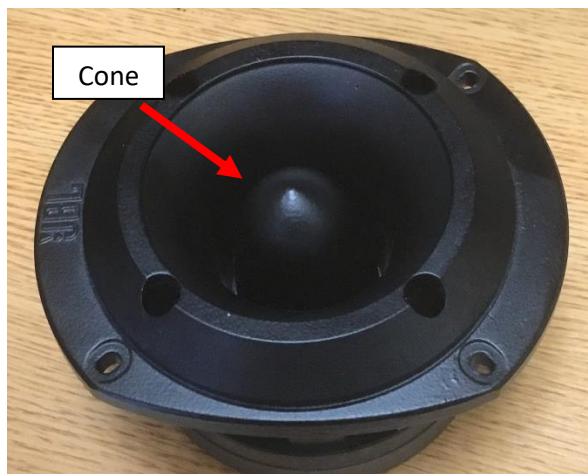


## D. How to disassemble the JBL speaker – Super Tweeter ST400 BLK

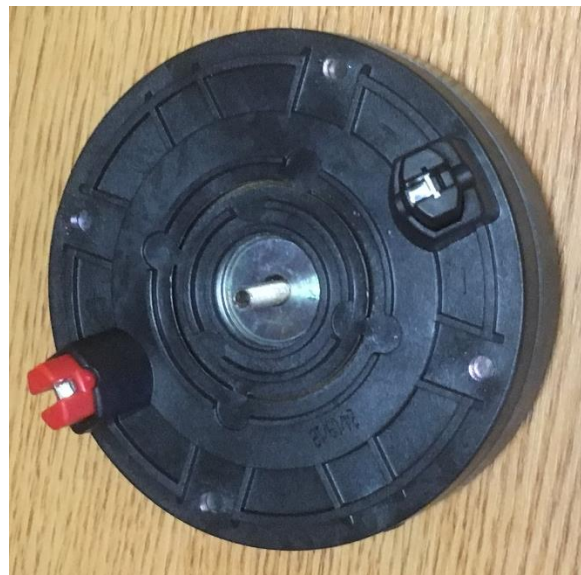
### 1. What you need:

- JBL Super Tweeter ST400 BLK ([https://www.amazon.com/Selenium-ST400-Super-Tweeter-Black/dp/B0049U4EBS/ref=sr\\_1\\_fkmr0\\_1?keywords=jbl+super+tweeter+st400+bulk&qid=1562970556&s=gateway&sr=8-1-fkmr0](https://www.amazon.com/Selenium-ST400-Super-Tweeter-Black/dp/B0049U4EBS/ref=sr_1_fkmr0_1?keywords=jbl+super+tweeter+st400+bulk&qid=1562970556&s=gateway&sr=8-1-fkmr0))
- Philips screw driver
- Ferrofluid (> 300 $\mu$ L)

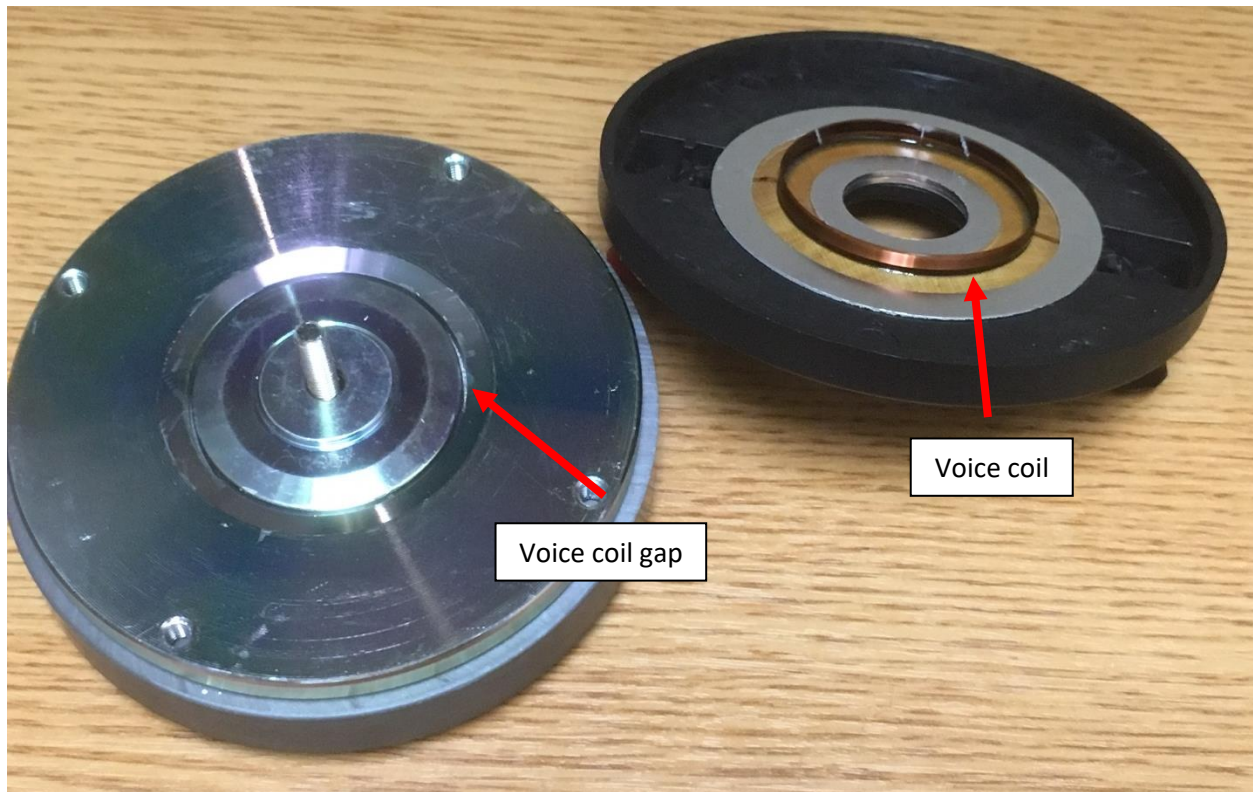
### 2. First remove the cone (screw is in the back of the speaker assembly).



### 3. Remove the horn. The screws are accessed from the front (see arrowheads).



4. Lift the voice coil out of the voice coil gap



5. Apply the ferrofluid into the voice coil gap. As the diameter of the voice coil gap is 1.7", there is no ready to use retrofit kit available (only for 1.5" or 2").