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Testing Acoustic Transducers for the PICASSO32 Dark Matter Experiment

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The PICASSO Collaboration

Project in Canada to Search for Supersymmetric Objects

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Bubble Technology Industries, Canada

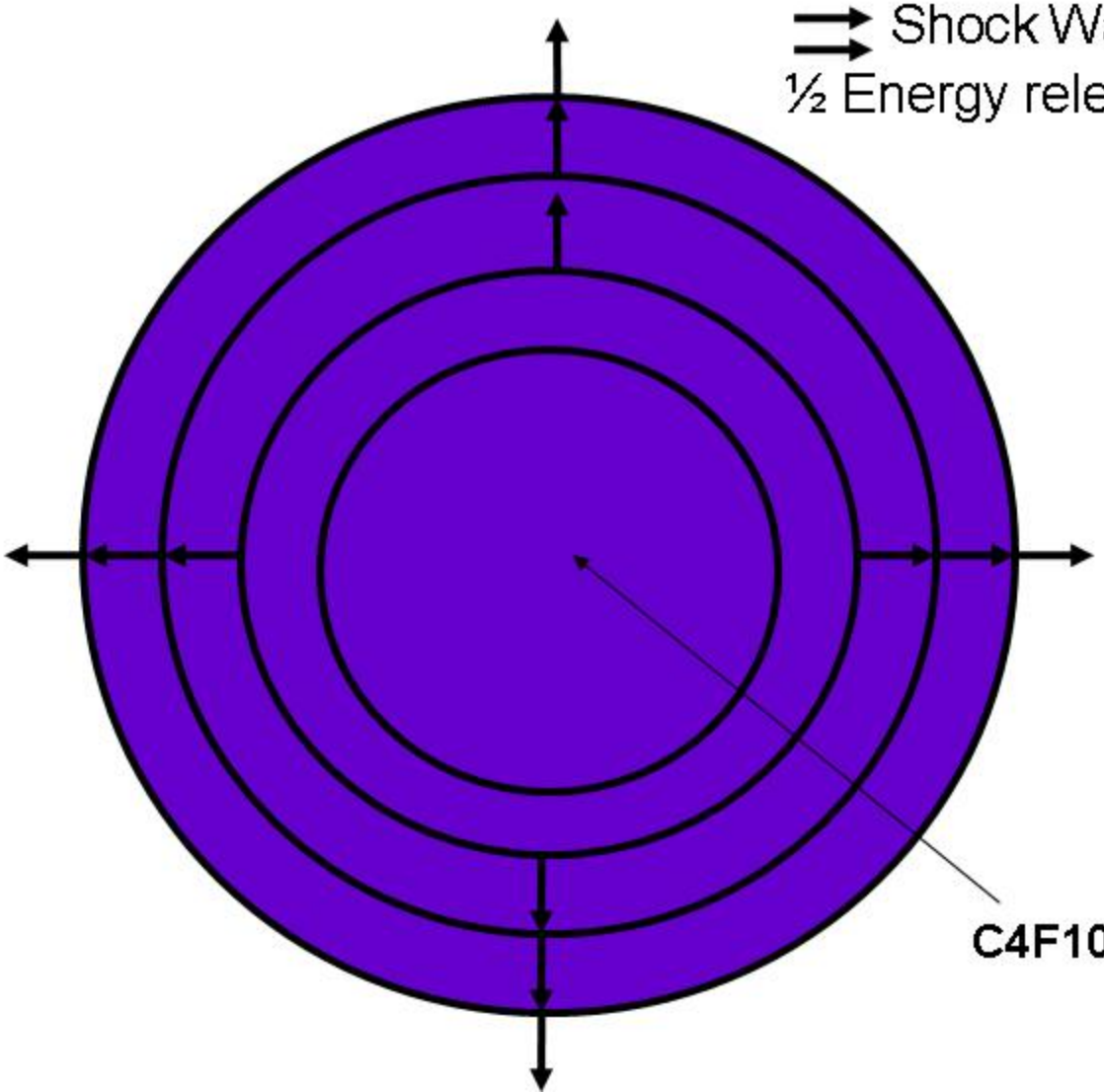
MOU with Universidade de Lisboa, Universite Paris 6&7 (SIMPLE Collaboration)

Phase Transition

- **Bubble Formation!** Liquid Phase → Gas Phase (500x bigger!)

⇉ Shock Wave/Sound Wave

½ Energy released acoustically

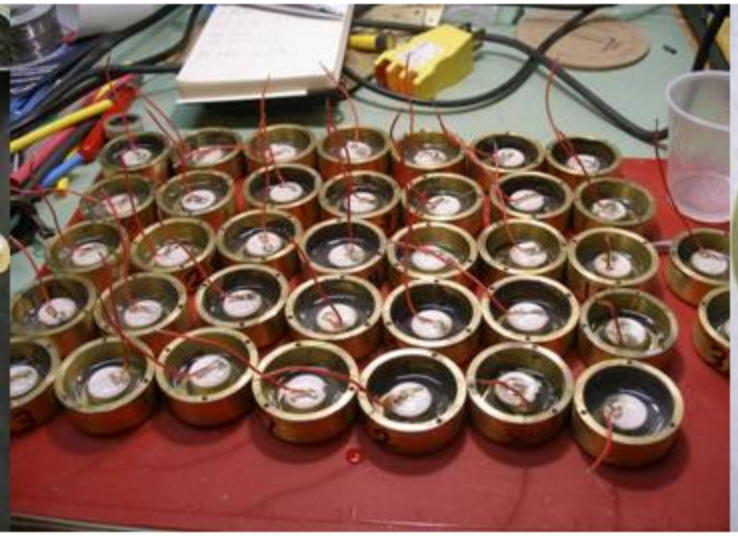


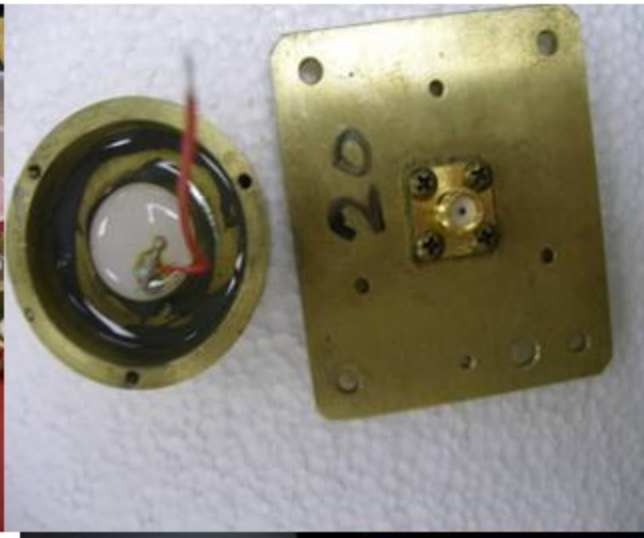
PIEZO SENSOR

Motivation for testing transducers

- Find and eliminate transducers that fail early
- Characterize how the acoustic transducers respond as a function of temperature.
- Find any difference in the response over a large number of temperature cycles.
- To test the transducers, IUSB has built an environment chamber

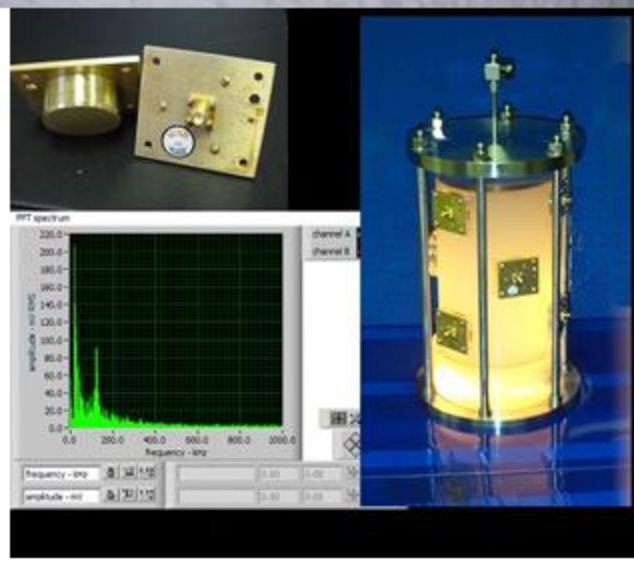
Building the piezo acoustic transducers for the PICASSO32 Detectors



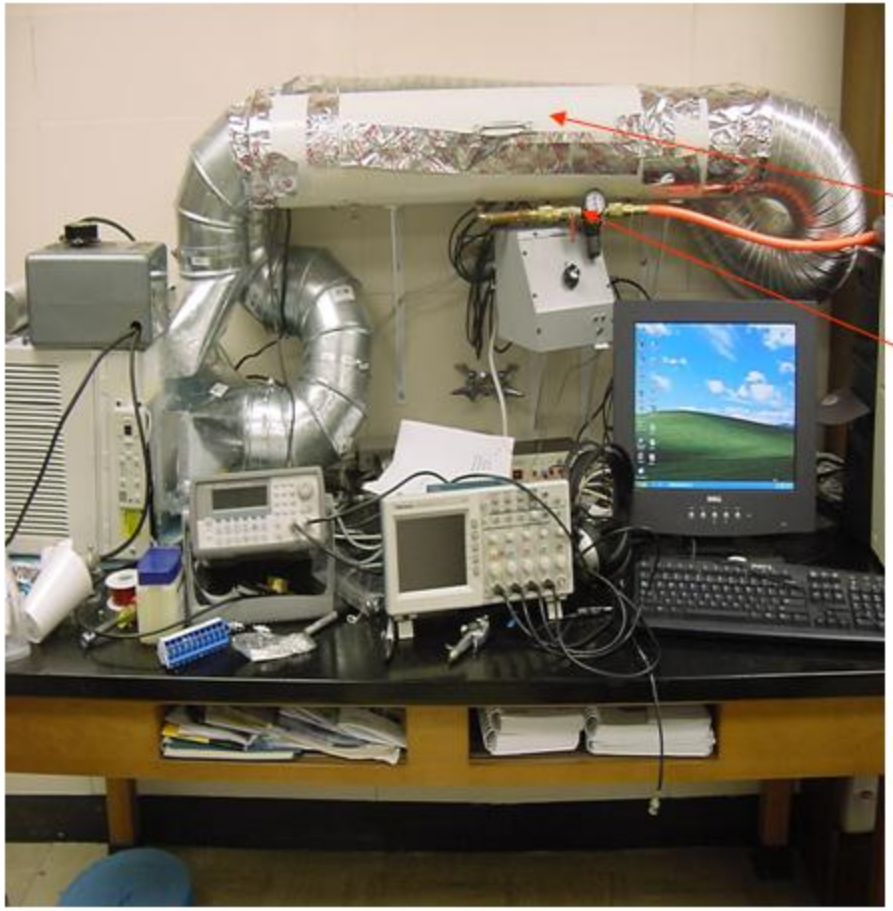


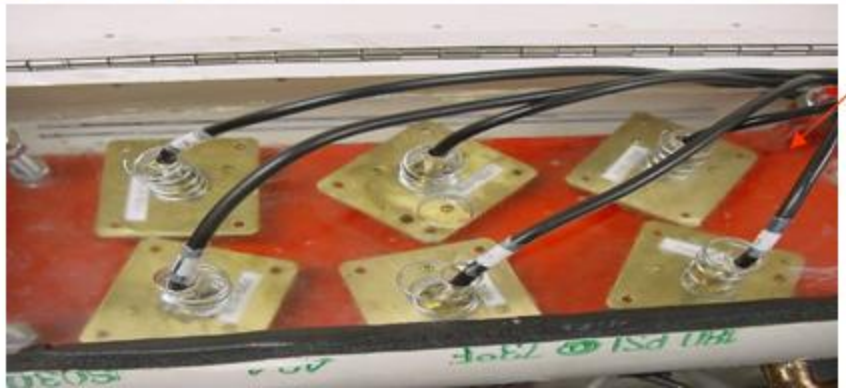
PICASSO32 transducers under construction.

Right: transducers mounted on a PICASSO32 detector



IUSB's Environment Chamber

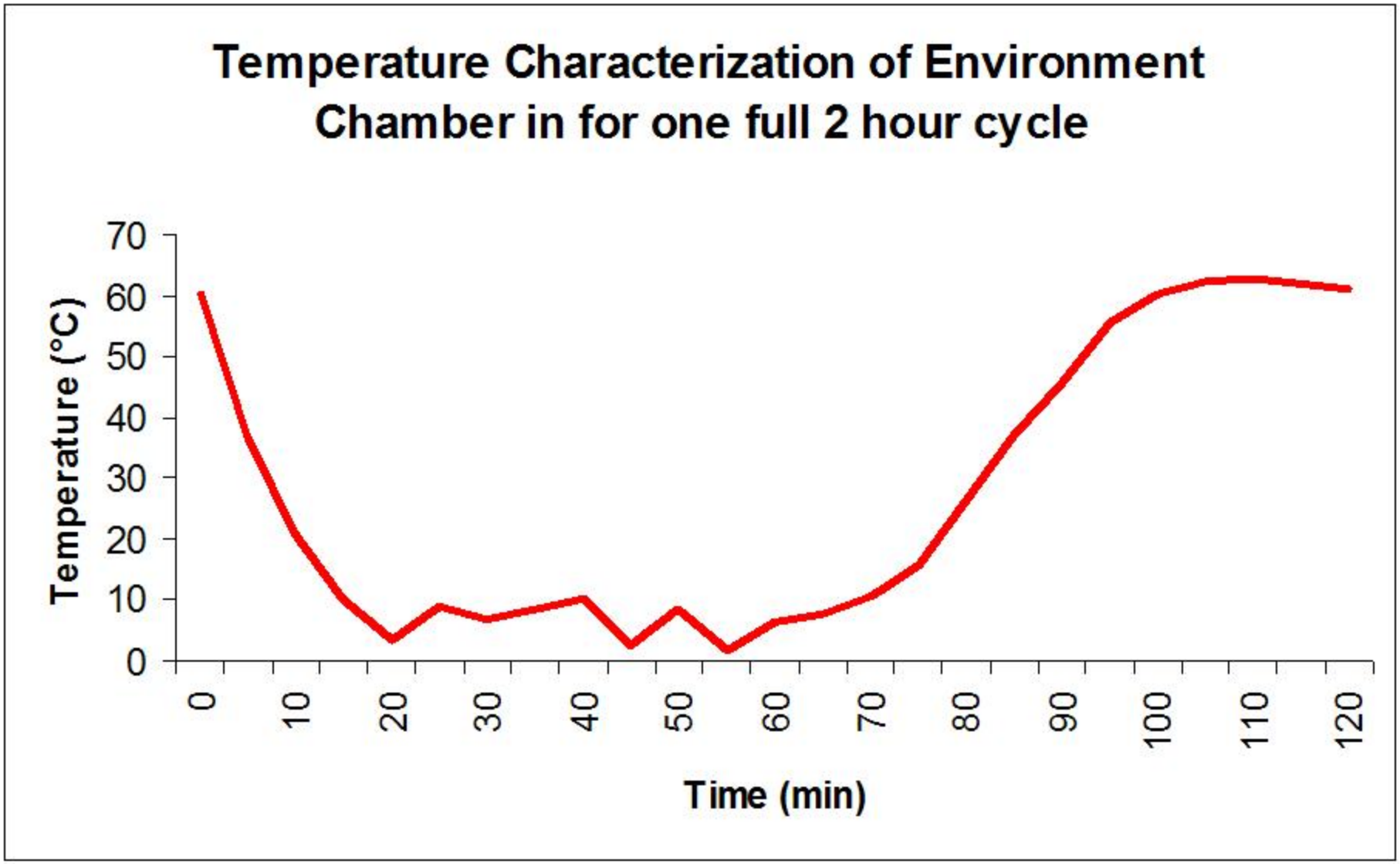




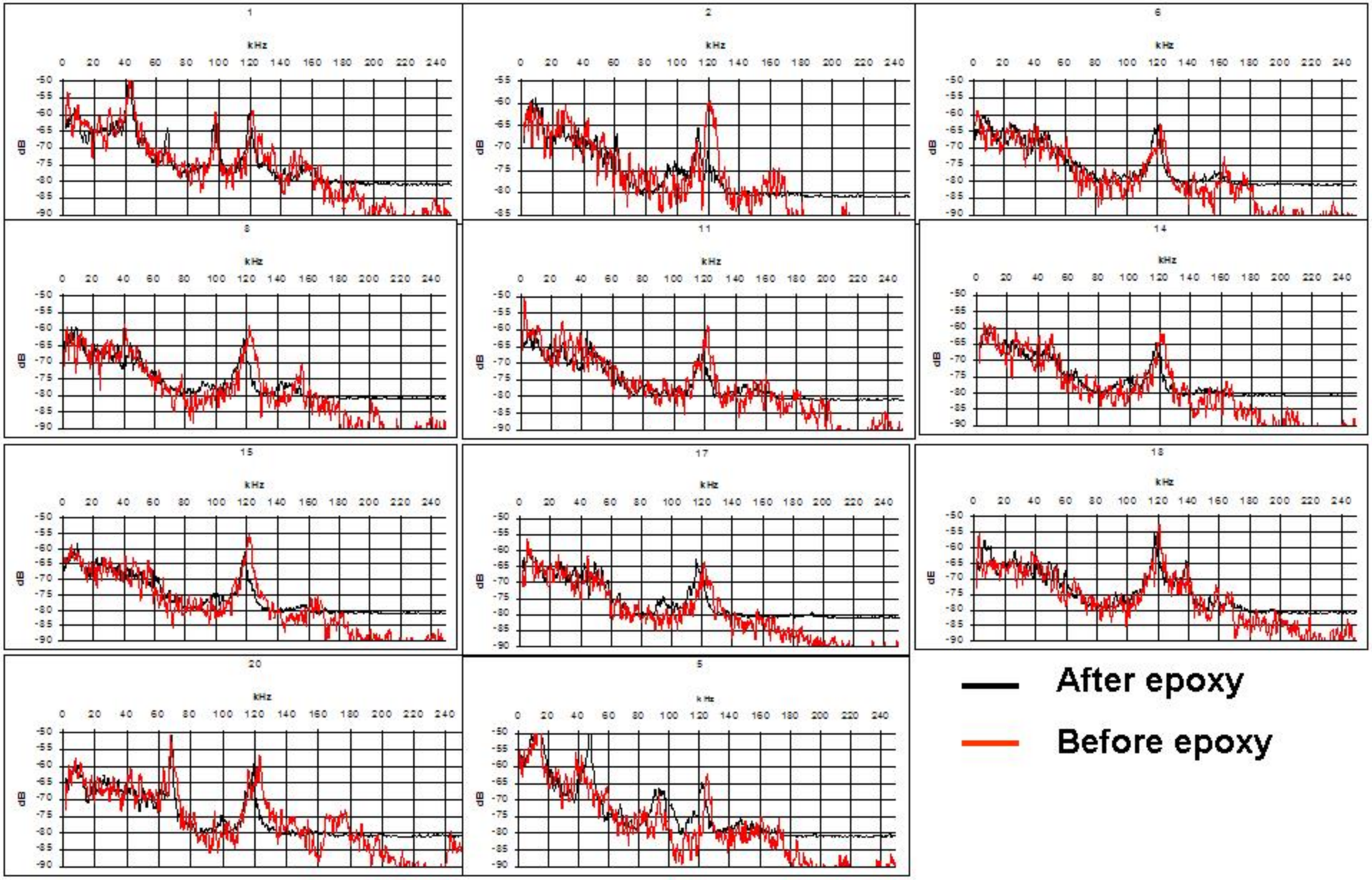
- Tube: Location of Sounding Block
- Switch Box: 12 inputs, 4 outputs, and 3 channel switch designed to minimize electric noise (Faraday Cage)
- Air Blast: used as a white noise source coming out under the sounding block.
- Oscilloscope: Capture FFT and Waveforms
  2014 TDS

- Voltage Supply
- Air Conditioner (temperature cycling)
- Heater (temperature cycling)
- Aluminum Bar (sounding block)
  Transducers are coupled to this using disc break grease

- **Temperature cycle from 0°C-60°C in less than an hour**
- **Holds up to 12 acoustic transducers.**
- **12 full cycles per day**

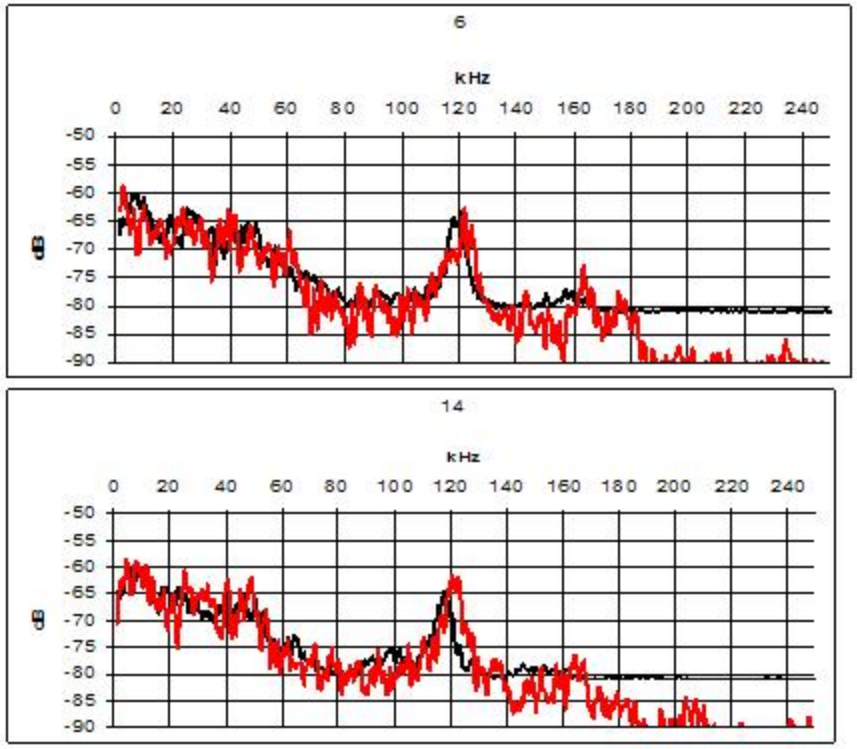

Temperature Characterization of Environment Chamber in for one full 2 hour cycle
Temperature (°C)
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
110
120
Time (min)

Air spray tests done before and after epoxy is poured into transducer

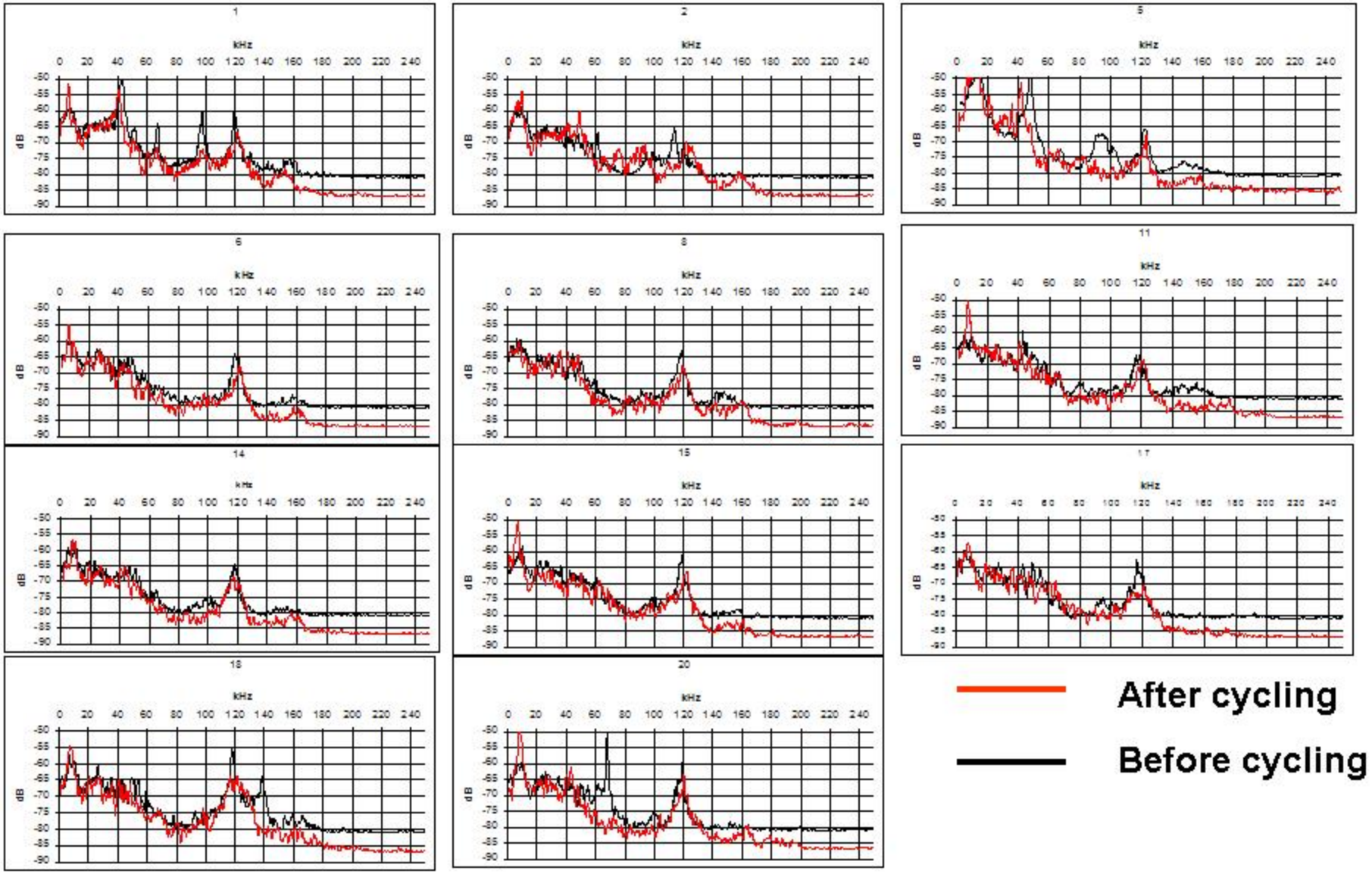


Preliminary investigations of pouring epoxy

- Pouring epoxy seemed to slightly decrease the amplitude of the response at the resonant frequency of 120 kHz
- The resonant frequency has been shifted to slightly smaller frequencies by a small amount

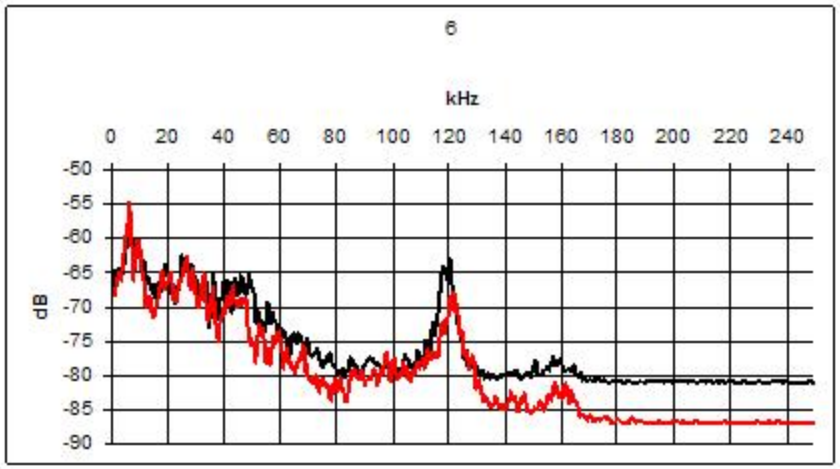


Air spray tests before and after temperature cycling



Preliminary investigations of temperature cycling

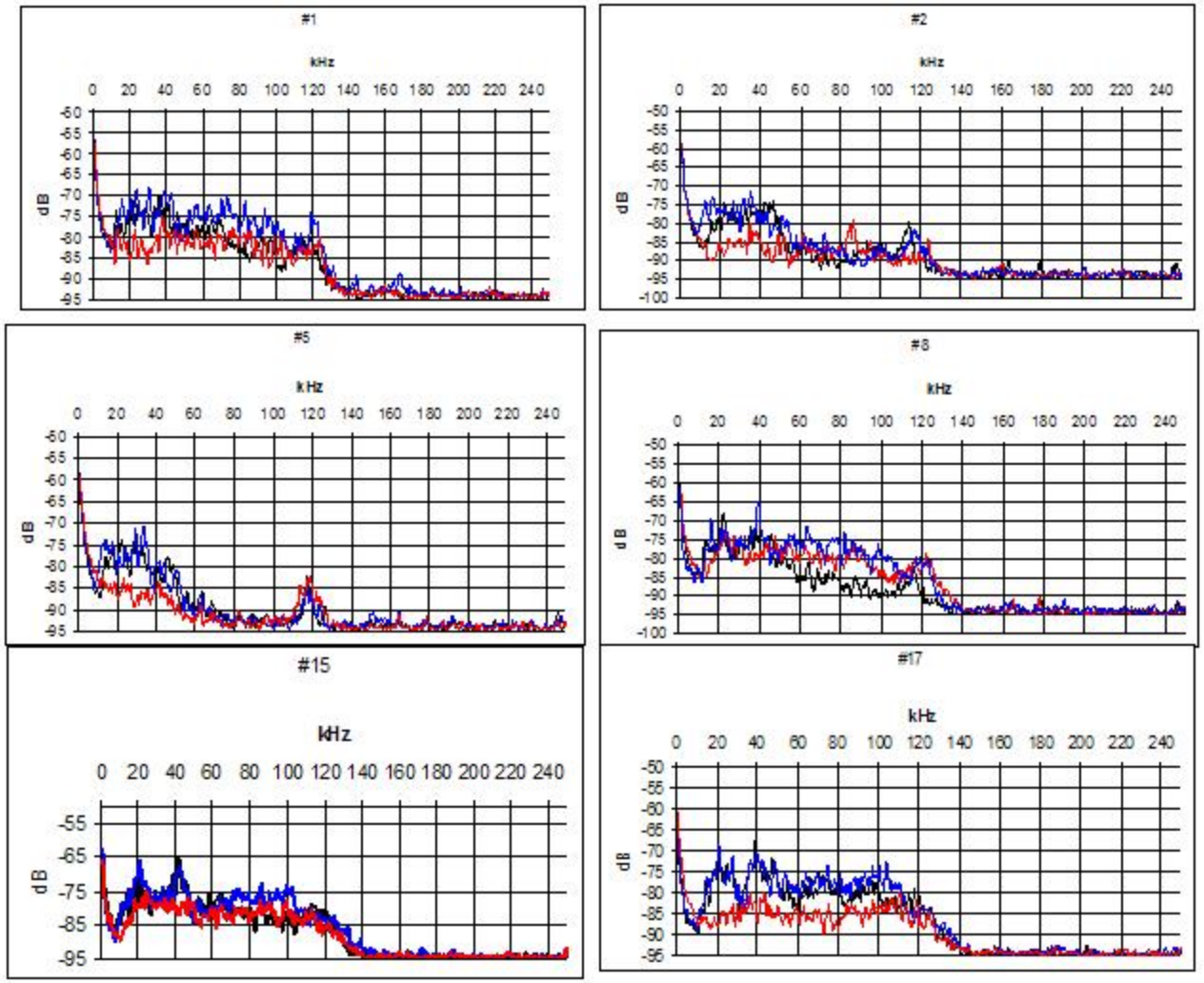
- The acoustic response of the transducer seemed to decrease slightly from temperature cycling
- The shift on the resonant frequency is unclear



After cycling

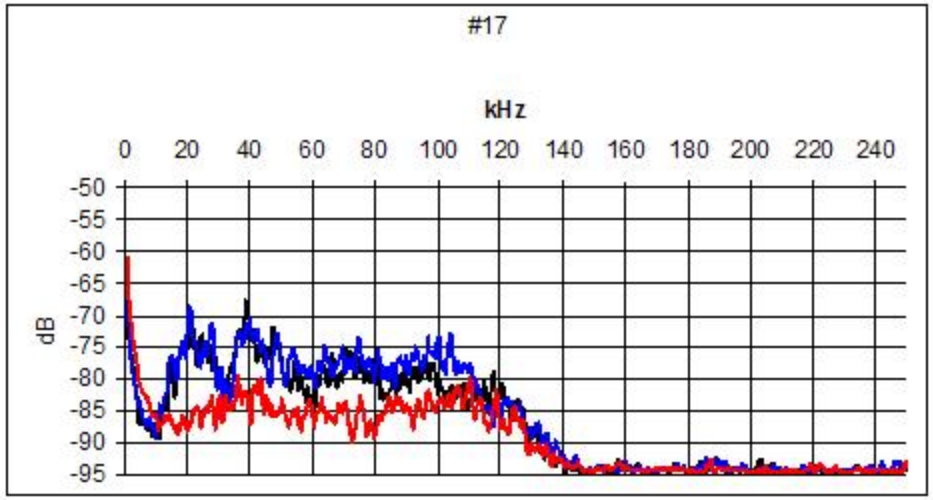
Before cycling

Response of transducers at room, low, and high temperatures before temperature cycling



Response of transducers at room, low, and high temperatures before temperature cycling

- From 0-120 kHz, there are no dead regions where the transducer lost all response at different temperatures
- In some transducers, there is a loss of response at most frequencies at high temperature. This could be due the coupling running off as the temperature is increased.

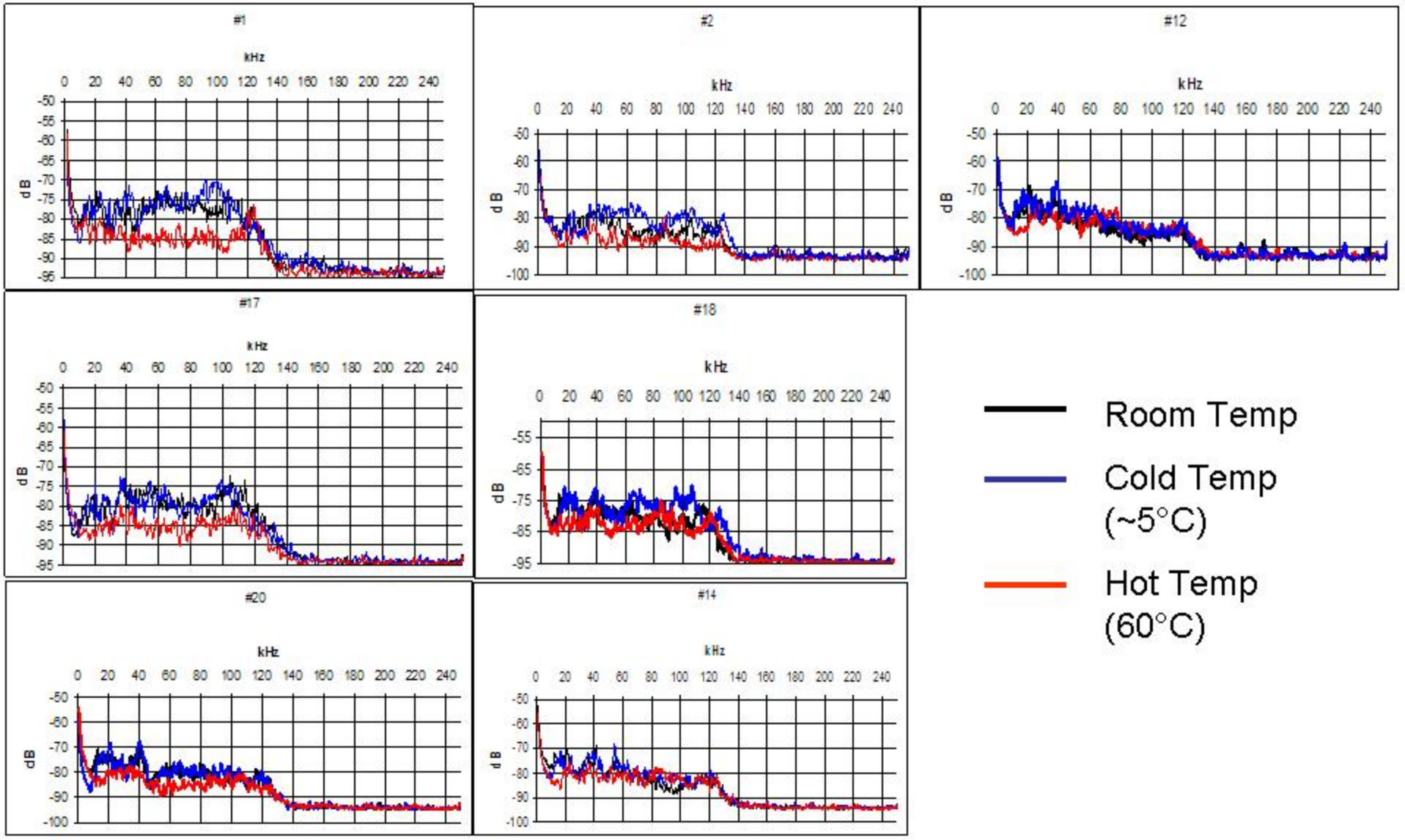


Room Temp

Cold Temp (~5°C)

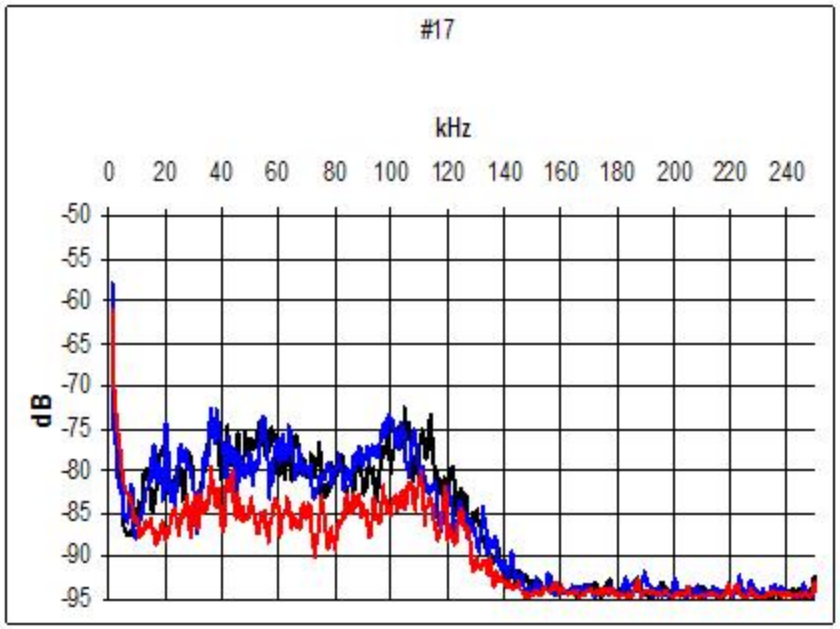
Hot Temp (60°C)

Response of transducers at room, low, and high temperatures after temperature cycling



Response of transducers at room, low, and high temperatures after temperature cycling

- From 0-120 kHz, there are still no dead regions anywhere at all temperatures after temperature cycling
- In some transducers, there is a loss of response at most frequencies at high temperatures. This could be due the coupling running off as the temperature is increased.



Plans for Future

- We plan to continue to test different couplants.
- We will build rings on the sounding board to keep the couplant from running off the transducer.
- We plan to disassemble and reassemble the air blast fixture, and see if this has any effect on the response of the transducers
- We will continue temperature cycling these transducer to find any failures and to investigate any decrease in response from more temperature cycling