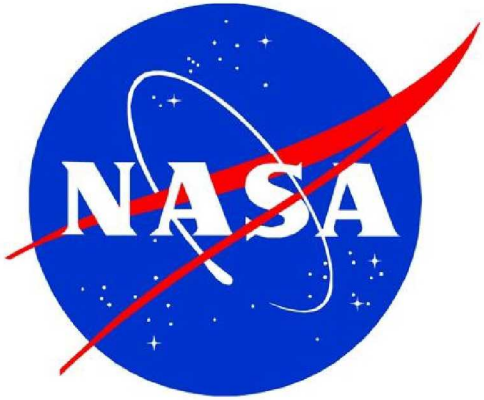
DRIVE RIG MUFFLERS FOR MODEL SCALE ENGINE ACOUSTIC TESTING

Testing of air breathing propulsion systems in the 9x15 foot wind tunnel at NASA Glenn Research Center depends on compressed air turbines for power. The drive rig turbines exhaust directly to the wind tunnel test section, and have been found to produce significant unwanted noise that reduces the quality of the acoustic measurements of the model being tested. In order to mitigate this acoustic contamination, a muffler can be attached downstream of the drive rig turbine. The modern engine designs currently being tested produce much less noise than traditional engines, and consequently a lower noise floor is required of the facility. An acoustic test of a muffler designed to mitigate this extraneous noise is presented, and a noise reduction of 8 dB between 700 Hz and 20 kHz was documented, significantly improving the quality of acoustic measurements in the facility.



Drive Rig Mufflers for Model Scale Engine Acoustic Testing

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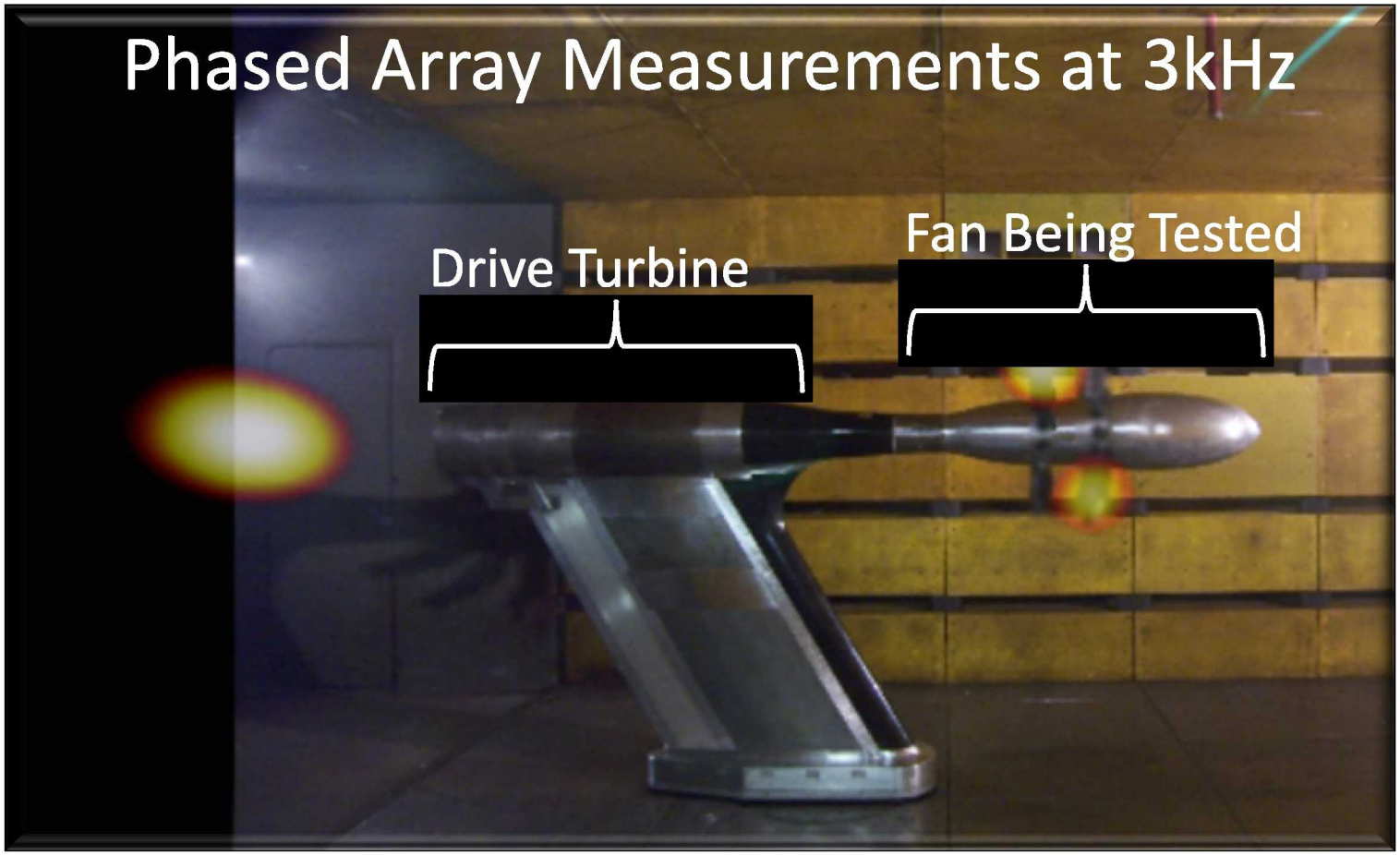
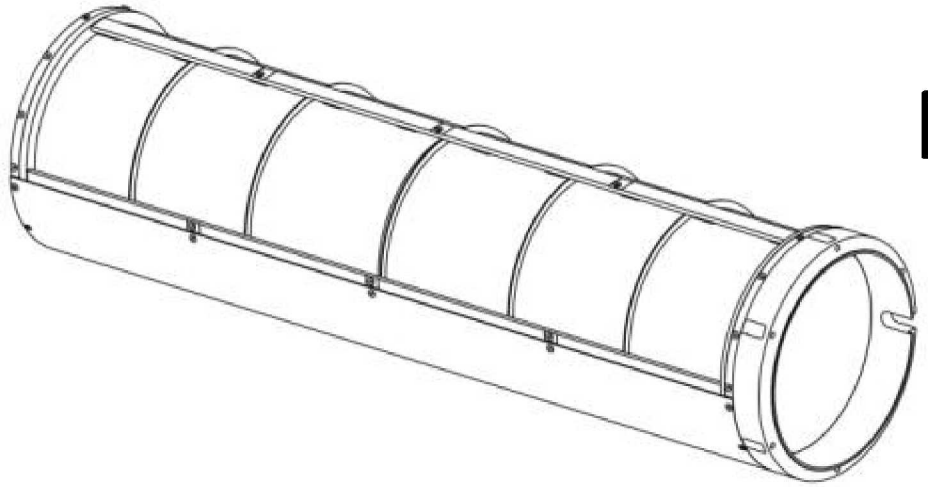
Compressed Air Turbines used for Model Scale Engine Testing

- ORPR: Two, two stage, 400 HP, 8 inch diameter turbines
- Up to 450 PSI air and up to 20 lbm/s





Muffler Specifications

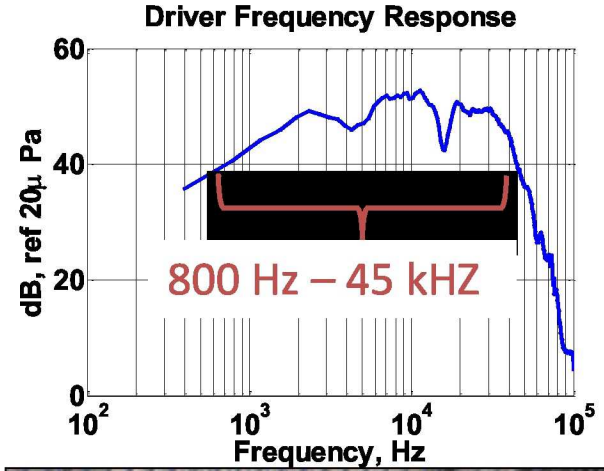
Target Performance:

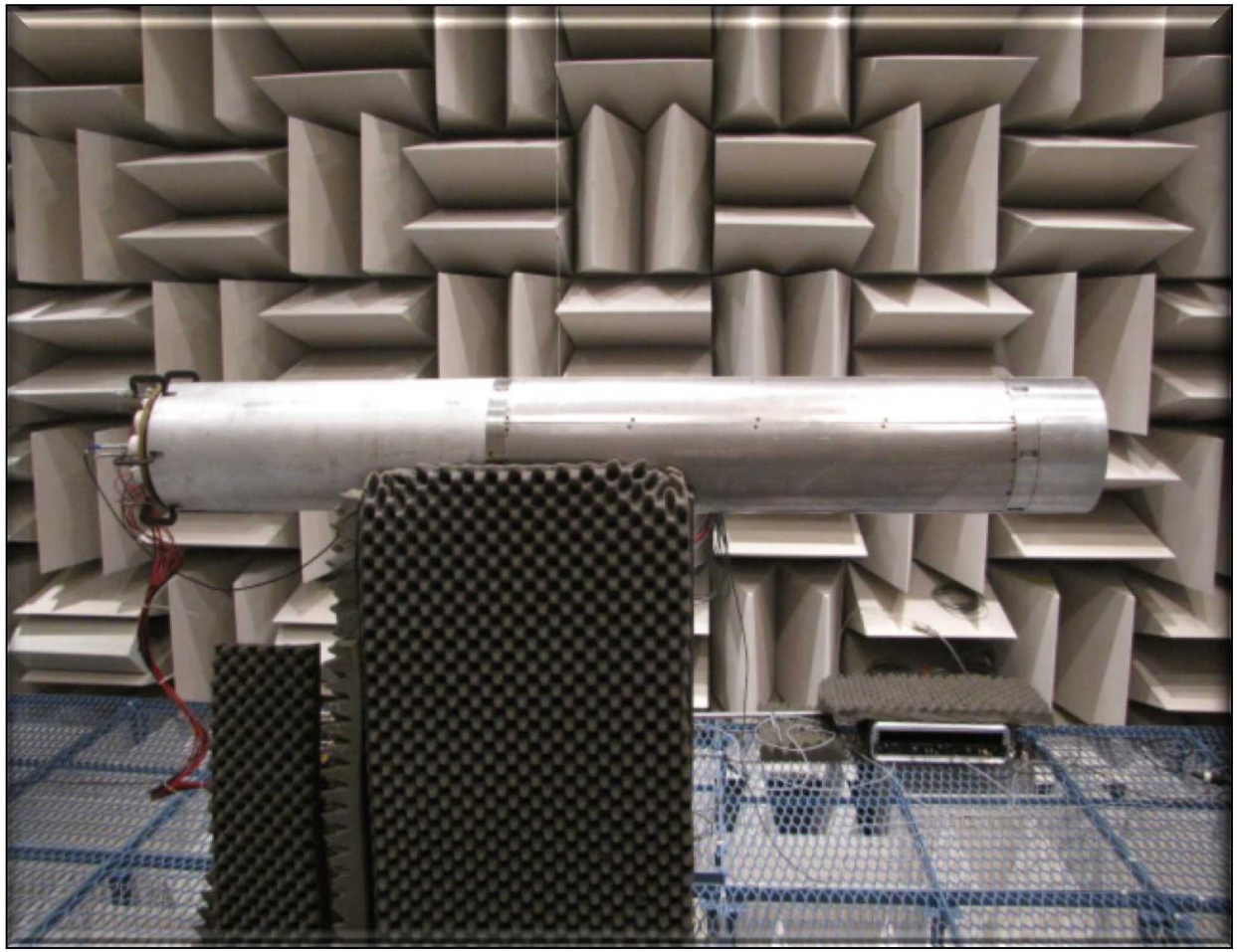
10 dB attenuation 15kHz-25kHz

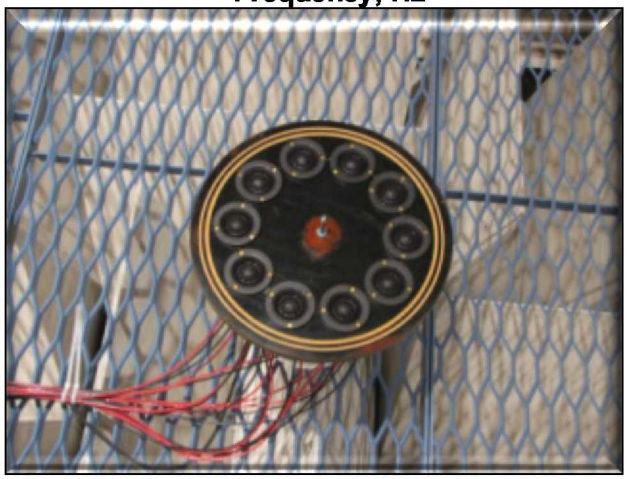
(1/5 scale models)

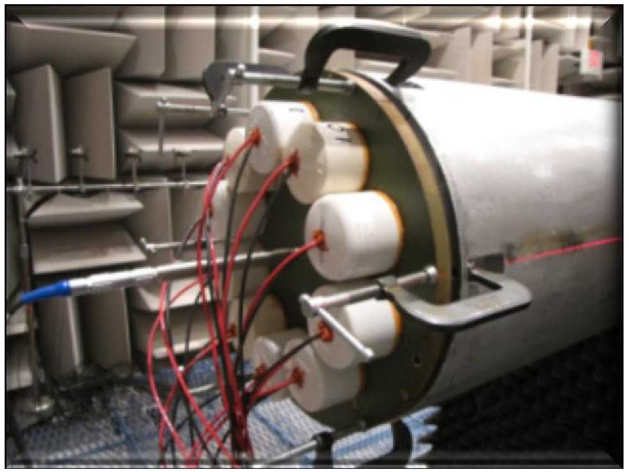
Length	45 in
Inside Diameter	10.5 in
Treated Length	42 in
Acoustic Material	Unwoven Nomex .65" thick 79 oz/sq-yd
Perforate Sheet	300 Series Stainless 0.036” thick 1/16” diameter holes 41% porosity

Acoustic Testing Laboratory (no flow)





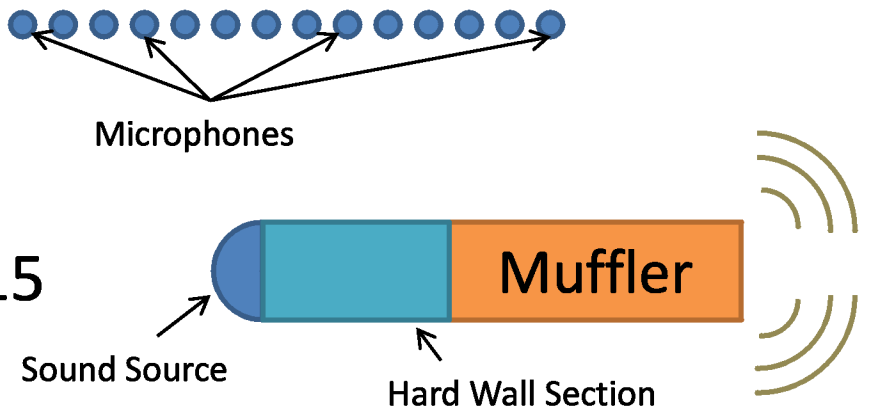




Microphone Configurations

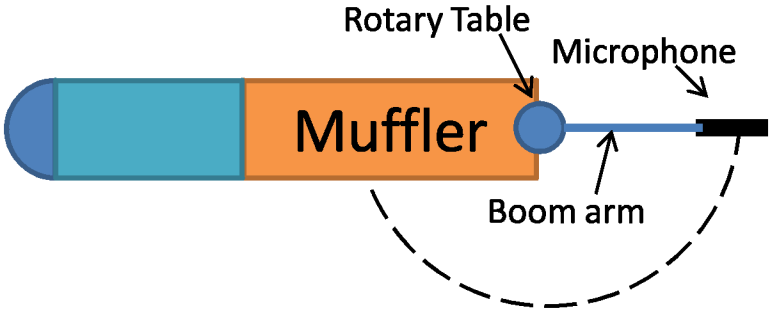
Acoustic Treatment vs Hardwall

- Sideline Test
  - Replicates geometry in 9x15



- Exit Plane Survey
  - Documents insertion loss

- Directivity Survey
  - High spatial resolution

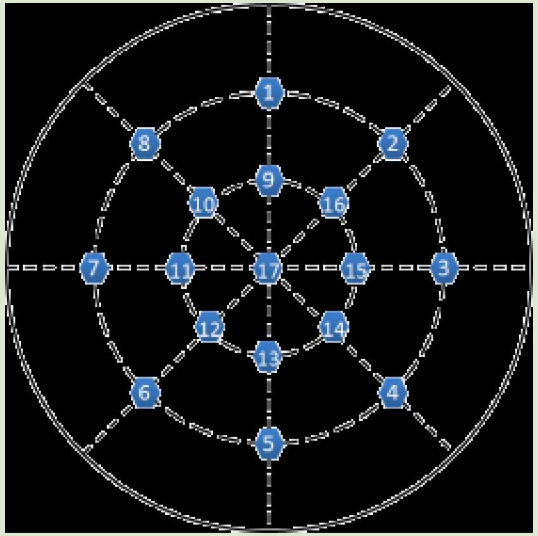


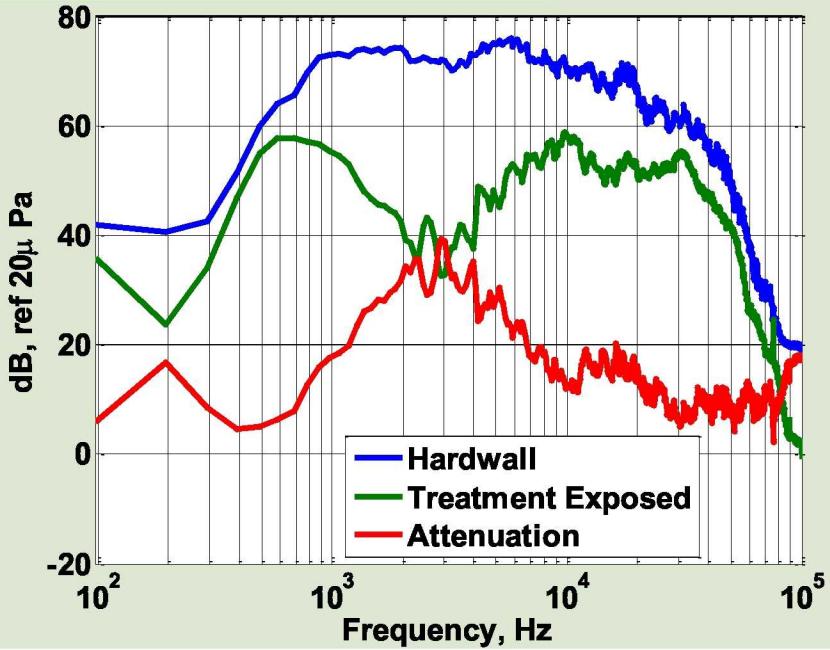
Sideline

Directivity

$$Attenuation\ (dB) = 10 \log_{10} \frac{Hardwall}{Treatment\ Exposed}$$

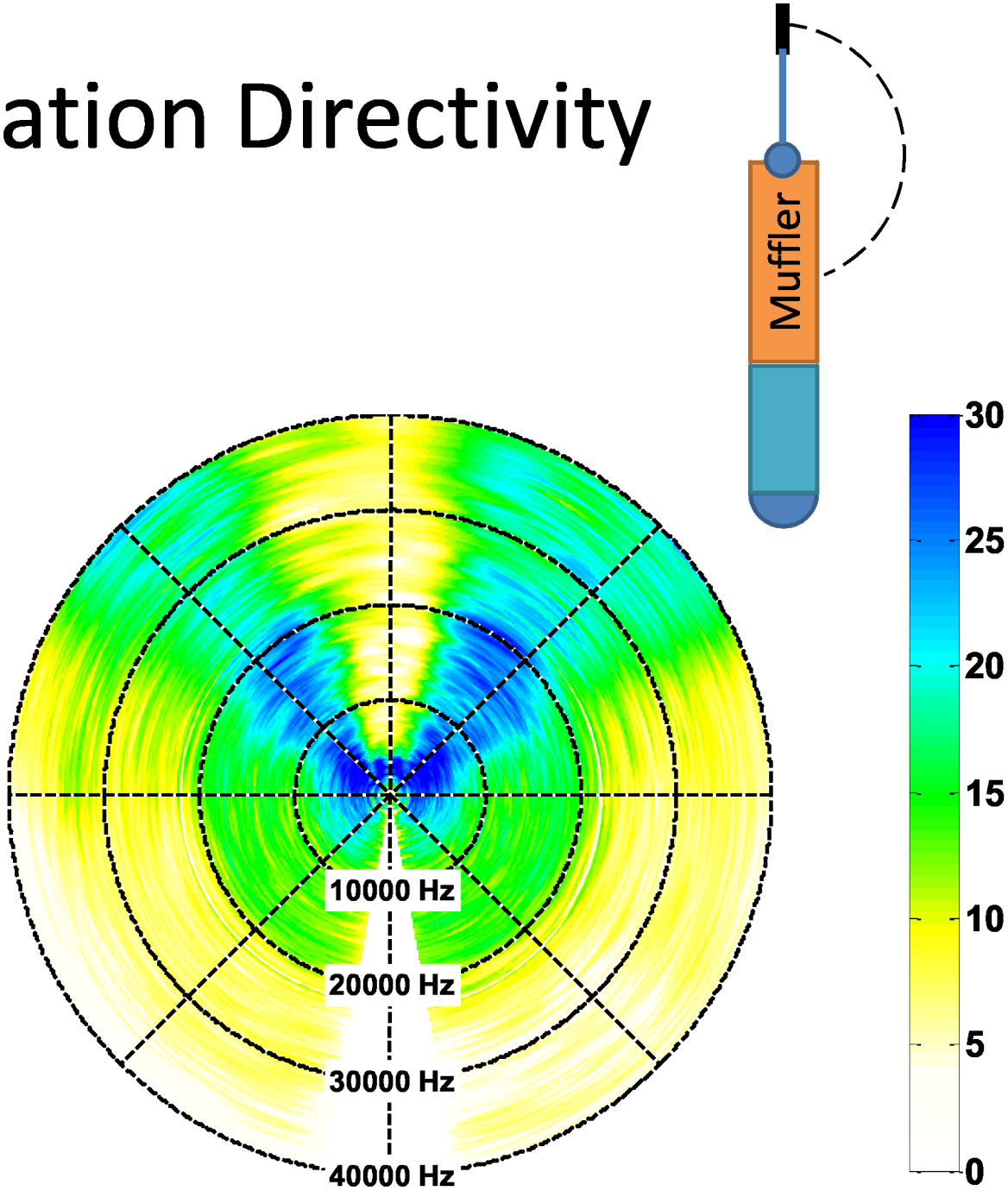
Exit Plane





Attenuation Directivity

- Peak attenuation of 39 dB at +/- 20º and 3.2 kHz
- ~25 dB attenuation at +/- 45º up to 20kHz
- Around 15 dB attenuation at virtually all angles and frequencies below 20kHz



Wind Tunnel Measurements

- Nearly 10 dB improvement measured in tunnel
- Higher background noise level
- Performance objectives essentially met

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