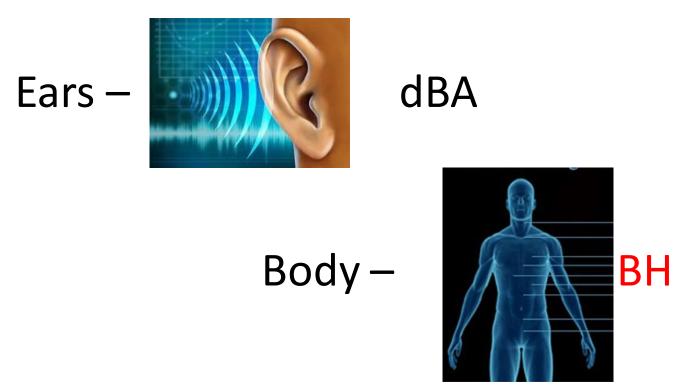
Complementing dBA with dBH

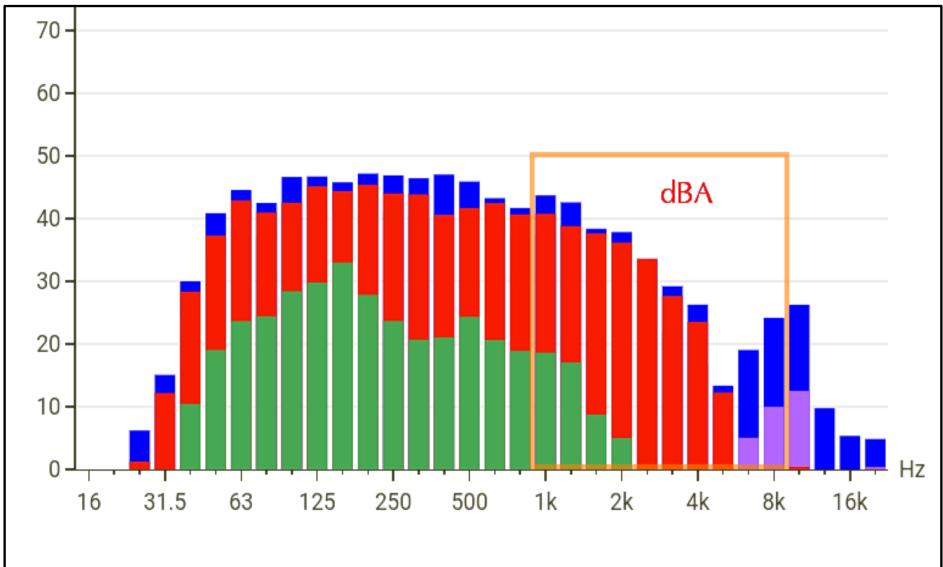


Healthy –

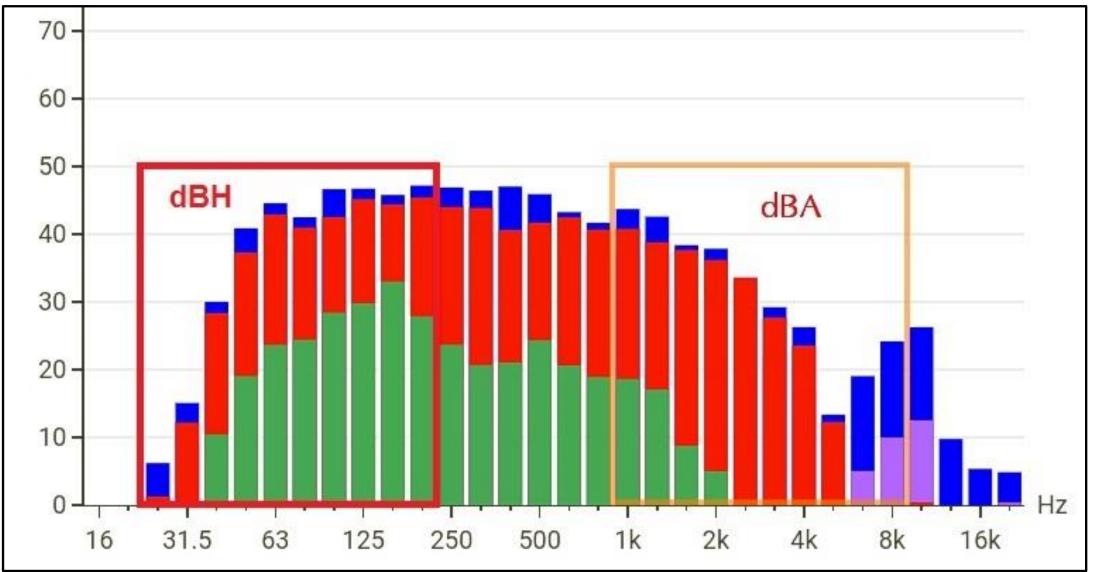


dBA + dBH

The audible aircraft noise annoying you is *not* the low frequency noise harming you.

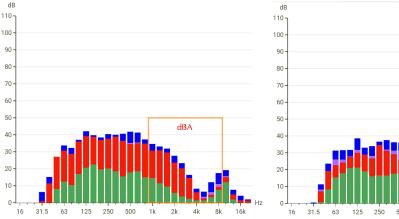


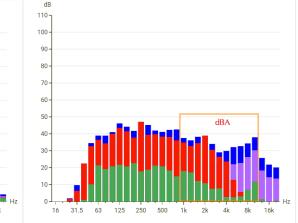
The audible aircraft noise annoying you is *not* the low frequency noise harming you.

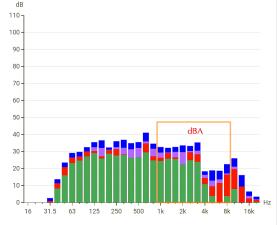


Medium & Heavy Jet Noise Spectra

dB







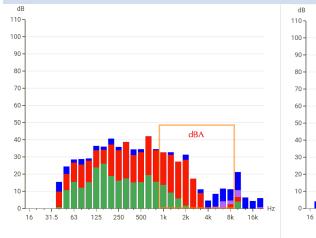
B737

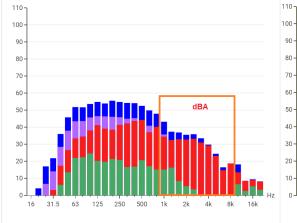
B737 MAX

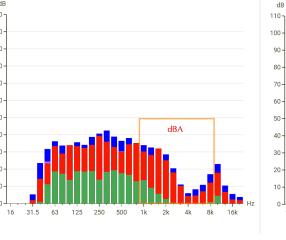
dBA

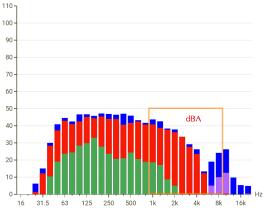












A320

A320 NX

A350



Where the Noise Is and Goes ...

- Majority of the aircraft noise is low frequency <500 Hz
- The most harmful noise is below about 200 Hz
- Low frequency, long wave length noise carries furthest
- Low frequency noise & infrasound passes through solid walls
- Low frequency noise causes resonances in human tissue
- Low frequency noise causes harmful changes at cellular level

Health Impacts of Low Frequency & Infraound

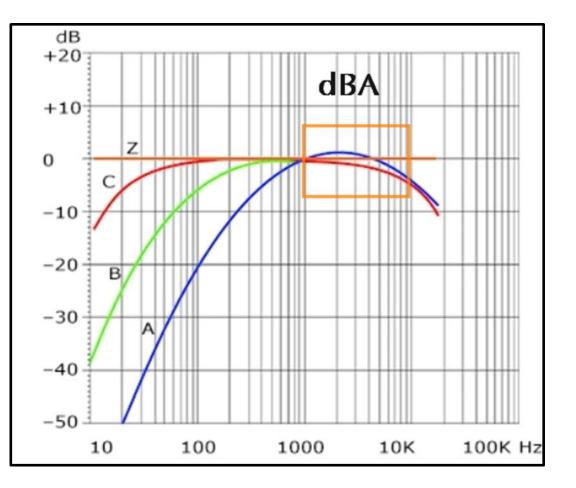
Organ, Process	Effect	Frequency Range	Lur L
Thyroid function	Increased activity	14 Hz	Psychological
Brain function	Response rate	12 & 36 Hz	Pharyn×Lymph nodes
Cognitive learning	Reduced	6-25 Hz, peak 13 Hz	CardiovascularLungs
Balance	Interference	40 Hz	Muscular —Spleen
Blood pressure	Significant increase	Systolic 6 & 16 Hz	Liver — Bone marrow Gallbladder — Otomoch
Blood pressure	Significant increase	Diastolic 12 & 16 Hz	Kidneys
Heart rate	Increase	2.14 Hz	Skeleton Pancreas
EEG rhythms	Variations in morphology	13 Hz	Intestines Urinary blado

Aircraft Noise & Cardiovascular Disease

A	A Decibel scale [dBA] B Adverse health effects of noise exposure							C 2018 WHO Environmental noise guidelines		
:-!	120 aircraft on take off	Adverse health effects	Noise source	Association			Participants (n)	Events (n)	Quality level of evidence	Chronic noise exposure
	110 rock band 100 jackhammer	Stroke	Road	Incidence– Mortality –	, .	•	51,485 581,517	1,881 2,634	+++ +++	L _{den} >45 dB(A) for aircraft noise
T	90 truck 80 telephone ringing		Aircraft	Incidence – Mortality –		-1	>9 million >4 million	97,949 25,231	+ +++	L _{den} >54 dB(A) for road and
10 10 11 11		Coronary artery disease	Road	Incidence – Mortality –			67,224 532,268	7,033 6,884	++++ +++	railway noise
er)	40 quiet living room		Aircraft	Incidence – Mortality –	-•		>9 million >4 million	158,977 15,532	+ ++	
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	 30 whisper 20 ticking of a watch 	Depression	Road	Incidence-			>1.2 million	-	+++	
N	10 rustling leaves	Anxiety	Road	Incidence-	⊢ ⊢ ↓	•	372,079	-	+++	
1	o threshold of hearing	Sleep disturba	nce							L _{night} >40-42 dB(A)
	0.8 1.0 1.2 1.4 Estimated RR per 10 dB(A) (95% CI)									

Numbers & Graphs – A, C and Z Filters

Centre Frequency (Hz)	Wave Length (m)	Effective Band (Hz)	A Weighting (dBA)	C Weighting (dBC)
31.5	11	22.1 - 44.2	-39.4	-3
63	5.4	44.2 - 88.4	-26.2	-0.8
125	2.7	88.4 - 177	-16.1	-0.2
250	1.4	177 - 354	-8.6	0
500	0.69	354 - 707	-3.2	0
1000	0.34	707 - 1,414	0	0
2000	0.17	1,414 - 2,828	1.2	-0.2
4000	0.09	2,828 - 5,657	1	-0.8
8000	0.04	5,657 - 11,314	-1.1	-3



Pros and Cons of the A-Filter (dBA)

Pros

- Good for measuring 'annoying' noise a 'subjective' metric
- Only measures a small portion of the aircraft noise spectrum
- Useful for monitoring socio-psychological impacts of aircraft noise
 Cons
- Excludes almost all low frequency noise and all infrasound
- Excludes frequencies known to cause clinical harm
- Not useful for mitigating or managing harmful noise frequencies

Summary Recommendations

- Consider making mandatory using the Full Spectrum Metric (FSM) 0 Hz -20 kHz - for aircraft noise monitoring and reporting.
- Revise research protocols to ensure low frequency and infrasound frequencies (FSM) are monitored to ensure effects are documented.
- Regulatory and commercial organisations notified to ensure low frequency and infrasound aircraft noise is monitored and controlled.
- Manufacturers notified and requested to make necessary equipment modifications.
- Having adopted FSM as a national standard urge governments to advocate its adoption, beginning with the EU and UN ICAO.
- Propose the name *dBH* for revised policy, protocols and practice for the low frequency (20-200 Hz) and infrasound (0-20 Hz) metric.