Hearing Conservation Program

November 3, 2011

Environmental Health & Safety

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1. **Policy Statement:** It is the responsibility of the Georgia Institute of Technology to provide employees with a safe and healthful work environment. This Hearing Conservation Program establishes the procedures that will be used at Georgia Tech to protect Faculty, Staff and Students from noise induced hearing loss.

2. **Scope:** This program covers GA Tech employees (faculty and staff) and students.

3. **Responsibilities:**
   3.1. Environmental Health and Safety:
      3.1.1. Administration of the GT Hearing Conservation Program (see Section 7).
      3.1.2. Anticipating and evaluating workplace hearing hazards.
      3.1.3. Conducting noise monitoring on routine and non-routine tasks to evaluate and quantify the level of hearing hazard.
      3.1.4. Implementing this program for any area/job description where noise exposures exceed an Action Level of 82 dBA (8 hour time weighted average)
      3.1.5. Suggesting appropriate feasible engineering or administrative controls to control/reduce human exposure to hazardous noise whenever possible.
   3.2. Department management:
      3.2.1. Bringing questions about noise and hearing conservation to the attention of EH&S.
      3.2.2. Alerting EH&S about new processes or equipment in the workplace that may produce high levels of noise.
      3.2.3. Informing EH&S about new employees whose jobs require entering noisy areas/working with noisy equipment.
      3.2.4. Ensuring that persons who need to be enrolled in the Hearing Conservation Program have received a baseline audiogram within 6 months of their hire date/2 months of the initial noise hazard evaluation performed by EH&S that identified their jobs as requiring participation in the Hearing Conservation Program .
      3.2.5. Ensuring that only hearing protection devices (HPD) which appear on the United States Air Force (USAF)Approved Hearing Protection Equipment List (available from EH&S) are purchased and issued after May 31, 2004.
      3.2.6. Ensuring that employees use hearing protection correctly and appropriately.
   3.3. Employees:
      3.3.1. Understanding the hazards in their workplace.
      3.3.2. Understanding the limitations of the hearing protection devices which they have been issued.
      3.3.3. Using only hearing protection equipment which has been issued to them at GT.
      3.3.4. Following the procedures described in the training section of this program for inspecting, using, cleaning, and storing their hearing protection equipment.

4. **Reference**
   4.1. Law: None
   4.2. *Legally non-binding regulations*: Code of Federal Regulations 29.1910.95 Occupational Noise Exposure
   4.3. *Consensus Standard*: American Conference of Governmental Industrial Hygienists Threshold Limit Value (ACGIH TLV)
   4.4. Pertinent Guidance*:*
      4.4.1. American Industrial Hygiene Association, Noise and Hearing Conservation, AIHA 1986
      4.4.2. United States Air Force, *USAF Approved Hearing Protection Devises*, April 2001
5. **Risk Assessment**
   5.1. A Hearing Hazard shall be defined as any situation which puts GT personnel at risk for exposure to noise above the action level of 82 decibels, 8 hour time weighted average.
   5.2. Hazard Quantification: Whenever possible, degree of hazard will be quantitatively assessed by noise monitoring and/or personal dosimetry.
   5.3. Calculation of allowable duration of Noise Exposure
      5.3.1. Will be according to the ACGIH guidelines using an 85 dB criterion level (8 hour exposure) and a 3 dB exchange rate as outlined in Appendix A.
   5.4. Exposed population: Faculty, Staff, Students

6. **Objective:** To prevent over exposures to harmful noise levels and to avoid/limit unnecessary exposures whenever possible. (See Program Elements)

7. **Program Elements:**
   7.1. Noise Monitoring**:**
      7.1.1. Shall be accomplished whenever possible to identify and quantify the level of hazard.
      7.1.2. Shall be re-evaluated annually
      7.1.3. Shall be accomplished whenever there is a change in a process that might affect worker exposure/area noise levels
      7.1.4. Any work area (or job description) which results in an 8 hour time weighted average exposure of 82 dBA or any area where noise exposures exceed 115 dBA regularly (such as for particular equipment operation), will be designated as a Hearing Conservation Required Area.
   7.2. The "Hearing Conservation Required" Designation
      7.2.1. Requires baseline, annual and exit audiograms for all affected employees
      7.2.2. Requires initial and annual training in hearing conservation
      7.2.3. Requires use of hearing protection devices in areas where noise exceeds 82 dBA, 8 hour time weighted average
      7.2.4. Requires use of hearing protection devices any time specific tasks or infrequently used equipment has been identified as generating noise levels exceeding 115 dBA.
   7.3. Selection of Hearing Protection Devices:

7.3.1. Only GT EH&S has the expertise to select appropriate hearing protection devices.
7.3.2. Selection of HPDs will be made on the basis of hazard identification/ quantification.
7.3.3. Noise monitoring will be accomplished whenever possible.
7.3.4. All hearing protection devices purchased after May 2004 will be selected from the USAF Approved Hearing Protection Devices list.
7.3.5. Whenever possible, the users will be given several options for hearing protection devices from this list

7.4. Audiometric Testing
7.4.1. All Audiograms will be conducted as described by the Federal Occupational Noise Exposure Standard, 29 CFR 1910.95 (h)
7.4.2. Baseline audiograms will be accomplished within 6 months of an employee being hired into a designated Hearing Conservation Required area or job description
7.4.3. New employees who have not yet had a baseline audiogram will be required to wear hearing protection at all times in noisy areas or while working with noisy equipment, regardless of task duration.
7.4.4. Baseline audiograms will be accomplished for all employees working in an area/job description within 2 months of the area/job description being designated high noise/hearing protection required.
7.4.5. Annual audiograms will be accomplished thereafter
7.4.6. An exit audiogram will be performed when the employee leaves Georgia Tech or when the employee transfers to another job which does not involve exposure to high noise levels.
7.4.7. Audiograms will be re-accomplished whenever an employee demonstrates a Standard Threshold Shift (STS) which is defined as a change in the hearing threshold relative to the baseline audiogram of an average 10 dB or more at 2000, 3000, or 4000 Hz in either ear.

7.5. Training: All persons working in a designated Hearing Conservation Required area or job description will be trained in the following:
7.5.1. The effects of noise on hearing
7.5.2. The purpose of hearing protection devices, the advantages and disadvantages of different types of HPDs, their attenuation levels, and instruction on selection, fitting, use, and care
7.5.3. The purpose of audiometric testing, explanations of test procedures, and the need to ensure that the employee is not exposed to high noise levels within 14 hours prior to an audiogram

7.6. Refresher training: will be given annually to coincide with audiometric retesting

7.7. Re-training shall be accomplished whenever an STS is documented and confirmed by re-testing.

7.8. Documentation
7.8.1. Audiometric Testing Records shall be maintained by the medical testing facility and shall be made available, upon request to the employee.
7.8.2. Notification of a STS shall be made to EH&S

7.8.3. Noise monitoring records shall be maintained by EH&S and kept indefinitely

7.8.4. Training records shall be maintained by EH&S for length of employment + 3 years.

7.8.5. Program Audit Records: Shall be maintained by EH&S for 3 years

7.9. Performance Measure (Program Effectiveness)

7.9.1. Noise monitoring

7.9.1.1. Is it being accomplished when new equipment or processes are introduced?

7.9.1.2. Is it being re-evaluated annually?

7.9.2. Audiograms-

7.9.2.1. Are they being accomplished within 6 months of the hire date and annually thereafter?

7.9.2.2. Are exit audiograms being conducted?

7.9.3. Training- is initial and annual training being accomplished?

7.9.4. Are STSs being reported to EH&S?

8. Non-conformance and corrective action:

8.1. Confirmed STSs are to be investigated by EH&S to determine root cause

8.2. Audit results will be reviewed by the director of EH&S who will make suggestions for improving deficiencies

Appendix A: ACGIH TLVs for Noise[A]

	Duration per Day	Sound Level dBA[B]
Hours	24	80
	16	82
	8	85
	4	88
	2	91
	1	94
Minutes	30	97
	15	100
	7.5[C]	103
	3.75[C]	106
	1.88[C]	109
	.94[C]	112
Seconds	28.12	115

A. No exposure to continuous, intermittent, or impact noise in excess of a peak C-weighted level of 140 dB

B. Sound level in decibels are measured on a sound level meter, conforming as a minimum to the requirements of the American National Standards Institute Specification for Sound Level Meters, S1.4 (1983)[(2)] Type S2A and set to use the A-Weighted network with slow meter response.

C. Limited by the noise source- not by administrative control. It is also recommended that a dosimeter or integrating sound level meter be used for sounds above 120 dB.

Appendix B: USAF APPROVED HEARING PROTECTION DEVICES

August 2000

Air Force Research Laboratory
Human Effectiveness Directorate
Crew System Interface Division

HPD evaluation provided by:
AFRL/HECB (Aural Displays & Bioacoustics), Building 441
2610 Seventh Street, Area B
Wright-Patterson AFB OH 45433-7901

Contents:

I. Attenuation

*(All testing accomplished using **American National Standards Institute (ANSI) S12.6-1984** for devices tested using method A, **ANSI S12.6-1997** for devices tested using method B.)*

(Active Noise Reduction (ANR) Headsets, also known as Electronic Noise Canceling Headsets and Muffs, will be covered in a separate listing since unique tests are required for ANR products.)

ANSI Test Method A: Evaluation of HPDs with trained and experienced test subjects. Fitting the HPD is assisted/facilitated by the experimenter. This is considered best-case data.

***ANSI Test Method B*:** Evaluation of HPDs with naïve test subjects; must obtain their instructions for fitting and use solely from the manufacturer's written instructions accompanying the packaging. No instruction from the experimenter is allowed. This method is proposed to estimate field performance in commercial industry. However, there is debate about how well it suits DoD since service members in a hearing conservation program receive annual training. Devices tested using method B are highlighted and italicized.

C-A Values: Evaluation technique devised by AFRL. See page 7 for values. At this time, current C-A data are still not available for all listed HPDs – updates to come from AFRL/HECB, Wright-Patterson AFB as more testing is accomplished.

Insert Devices	Octave Band Attenuation									NRR
V-51R	125	250	500	*a.*	*b.*	3.1 K	*c.*	6.3 K	*d.*	
Mean Attenuation	24	24	26	33	38	38	33	36	38	**21**
Standard Deviation	4.1	4.3	3.6	5.2	6.0	4.9	4.2	6.5	6.2	
XSM NSN 6515-00-442-4765										
SM NSN 6515-00-467-0085										
MD NSN 6515-00-467-0089										
LG NSN 6515-00-442-4807										
XLG NSN 6515-00-442-4813										
Comfit-Triple Flange										
Mean Attenuation	28	28	30	32	43	45	43	43	45	**20**
Standard Deviation	5.1	5.5	6.3	6.1	7.5	7.8	7.6	5.4	4.9	
SM NSN 6515-00-442-4821										
MD NSN 6515-00-442-4818										
LG NSN 6515-00-467-0092										
3M 1110										
Mean Attenuation	22	25	28	29	34	41	40	40	42	**19**
Standard Deviation	5.1	5.4	5.6	6.1	5.4	4.5	4.2	5.1	4.5	
Bilsom Prop-O-Plast										
Mean Attenuation	19	20	22	30	39	42	40	41	38	**18**
Standard Deviation	5.8	4.5	4.2	4.6	3.7	5.1	4.6	4.2	5.1	
NSN 4240-01-071-2515										
NSN 4240-01-071-2516										
E-A-R Classic										

(Foam Disp.)										
Mean Attenuation	32	35	36	40	43	47	45	45	45	**27**
Standard Deviation	4.8	6.1	6.2	6.1	5.4	5.1	2.8	4.2	4.6	
NSN 6515-00-137-6345										
Flents Quiet! Please										
Mean Attenuation	19	21	23	25	30	37	38	39	40	**11**
Standard Deviation	7.0	8.0	8.0	7.0	4.0	6.0	5.0	6.0	5.0	
Flents Silaflex (silicone)										
Mean Attenuation	21	21	19	28	42	44	41	40	37	**16**
Standard Deviation	4.5	4.1	5.0	5.4	3.3	4.7	4.9	3.1	6.4	
NSN 6515-00-135-2612 24 pairs										
NSN 6515-00-133-5416 100 pairs										
Howard Leight Max 1										
Mean Attenuation	29	30	32	30	36	43	46	47	47	**18**
Standard Deviation	8.0	8.1	7.6	7.2	4.0	4.5	4.9	3.3	3.8	
NSN 6515-01-329-4700										
Moldex Purafit 6800										
Mean Attenuation	24	22	23	25	30	38	38	39	40	**8**
Standard Deviation	8	10	10	9	5	7	7	8	7	

Circumaural Muffs	**Octave Band Attenuation**	**NRR**

3M 1435	**125**	**250**	**500**	***e.***	***f.***	**3.1 K**	***g.***	**6.3 K**	***h.***	
Mean Attenuation	10	14	21	28	30	33	35	34	32	**16**
Standard Deviation	3.6	2.5	4.7	4.1	4.1	4.5	3.4	3.5	6.2	
3M 1440										
Mean Attenuation	12	18	25	30	31	34	37	38	37	**18**
Standard Deviation	3.6	3.8	3.6	4.8	3.0	3.6	3.5	2.9	5.1	
Aero Earmuff 1000										
Mean Attenuation	10	13	22	31	29	35	34	35	37	**13**
Standard Deviation	3.6	5.8	3.4	6.0	3.8	3.4	5.5	5.4	5.6	
Bilsom 707 Impact										
Mean Attenuation	11	12	21	25	22	27	31	35	36	**10**
Standard Deviation	4.9	3.9	5.8	5.2	5.2	6.3	5.8	4.7	4.0	
Bilsom 727										
Mean Attenuation	10	18	27	30	33	38	33	33	32	**18**
Standard Deviation	3.0	2.5	2.3	2.5	7.2	3.3	3.0	3.5	4.7	
Bilsom Blue 2308										
Mean Attenuation	7	10	17	28	30	35	36	36	34	**13**
Standard Deviation	3.8	3.5	2.7	3.4	3.1	3.9	4.2	4.9	6.9	
Bilsom Viking 29										
Mean Attenuation	15	21	30	34	32	36	41	41	40	**22**
Standard Deviation	3.1	4.2	3.4	3.7	3.5	2.9	3.5	4.7	5.7	
Blue Point GA 3000										
Mean Attenuation	16	18	28	39	34	33	33	34	32	**19**
Standard Deviation	4.4	4.4	4.1	4.4	3.1	2.5	3.2	4.1	6.2	
Cabot 1720										
Mean Attenuation	7	14	21	30	31	32	34	35	34	**13**
Standard Deviation	5.4	4.5	5.0	5.0	3.5	3.9	3.6	3.7	5.0	
David-Clark 310										
Mean Attenuation	12	18	27	34	30	39	37	37	36	**17**

Standard Deviation	3.9	3.6	5.3	5.9	5.3	4.1	4.1	3.6	3.2	
E-A-R 1000										
Mean Attenuation	8	14	24	28	24	28	26	25	27	**14**
Standard Deviation	3.3	2.9	3.6	4.5	2.5	2.9	4.6	5.3	5.0	
E-A-R 820										
Mean Attenuation	7	9	18	27	27	32	32	32	30	**10**
Standard Deviation	3.9	4.3	4.9	4.4	4.4	3.9	4.5	6.3	7.5	
E-A-R 9000										
Mean Attenuation	9	15	25	25	23	26	25	23	25	**14**
Standard Deviation	3.5	2.5	2.5	5.9	2.9	2.4	2.0	3.1	3.1	
Gentex Wolf Ear	**125**	**250**	**500**	**1K**	**2K**	**3.1 K**	**4K**	**6.3 K**	**8K**	**NRR**
Mean Attenuation	8	14	21	22	20	30	35	35	36	**10**
Standard Deviation	3.4	3.7	5.1	4.0	5.0	6.4	6.7	5.4	5.8	
Howard Leight QM 24										
Mean Attenuation	10	13	18	28	27	29	29	32	33	**10**
Standard Deviation	5.7	6.1	5.0	4.7	3.9	4.2	3.0	5.8	5.9	
Howard Leight Thunder 29										
Mean Attenuation	11	14	19	32	34	38	33	34	32	**13**
Standard Deviation	3.5	3.7	5.4	6.0	6.5	4.7	4.8	4.4	4.4	
NSN 4240-01-357-3998										
MSA Economuff										
Mean Attenuation	9	13	18	24	31	32	32	33	31	**7**
Standard Deviation	7	4	2	10	5	4	3	5	5	
MSA Mark IV										
Mean Attenuation	14	16	22	32	30	40	37	35	34	**15**
Standard Deviation	4.0	5.0	5.6	5.5	4.6	6.2	5.5	5.3	6.7	
MSA SlimPro Plus										
Mean Attenuation	14	17	24	33	32	34	33	32	31	**18**
Standard Deviation	5	4	4	5	3	4	3	5	5	

North 28-45-00										
Mean Attenuation	4	9	17	25	29	30	22	25	24	**9**
Standard Deviation	3.5	4.3	5.6	3.6	4.8	5.1	3.0	4.6	6.9	
Peltor H10A										
Mean Attenuation	12	18	27	34	35	36	40	37	35	**17**
Standard Deviation	4.9	2.9	5.8	6.7	5.2	5.1	5.4	4.3	8.8	
Peltor H7A					*i.*					
Mean Attenuation	10	19	27	33	33	34	34	30	33	**19**
Standard Deviation	4.5	3.1	2.9	4.2	3.5	3.0	2.2	2.8	2.8	
Safety Direct RBW-71										
Mean Attenuation	7	11	18	33	34	43	30	30	29	**9**
Standard Deviation	4.1	5.5	7.2	6.6	5.5	7.6	7.9	4.1	5.0	
					j.					
Safety Direct USN-86 "Flight Deck"										
Mean Attenuation	17	24	30	39	32	32	32	31	32	**21**
Standard Deviation	4.4	3.5	5.7	4.1	3.5	4.0	4.7	3.6	4.4	
NSN 4240-00-759-3290										
TASCO Golden Eagle 2950					*k.*					
Mean Attenuation	16	21	31	41	37	38	37	34	34	**23**
Standard Deviation	2.9	2.8	3.9	4.8	5.4	6.1	3.7	2.8	5.0	
TASCO Sound Shield 2900	**125**	**250**	**500**	**1K**	**2K**	**3.1 K**	**4K**	**6.3 K**	**8K**	**NRR**
Mean Attenuation	14	20	28	38	35	39	38	36	35	**19**
Standard Deviation	3.0	3.6	6.7	3.9	5.5	5.2	6.1	4.0	3.4	
NSN 4240-01-449-5058										
TASCO/Vallen Pro-Max 1										
Mean Attenuation	15	21	30	35	33	34	35	36	33	**21**
Standard Deviation	3.9	4.4	4.3	3.8	4.0	3.3	2.4	3.9	6.3	
NSN 4240-01-449-										

5058										
Willson 365-Sound Barrier										
Mean Attenuation	13	19	24	38	32	34	36	37	36	**17**
Standard Deviation	3.8	5.3	5.3	6.5	4.6	4.6	6.3	3.5	4.7	
NSN 4240-01-256-3350										
Willson 365A										
Mean Attenuation	15	18	23	33	31	28	34	37	37	**16**
Standard Deviation	5.5	5.9	5.2	4.6	4.1	3.0	3.4	3.4	2.9	
Willson 365GS										
Mean Attenuation	13	19	24	38	32	34	36	37	36	**17**
Standard Deviation	3.8	5.3	5.3	6.5	4.6	4.6	6.3	3.5	4.7	

Communication Headsets	**Octave Band Attenuation**									**NRR**
Astrocom 81349-MIL-H-87819	**125**	**250**	**500**	**1K**	**2K**	**3.1 K**	**4K**	**6.3 K**	**8K**	
Mean Attenuation	16	20	26	41	42	36	33	32	32	**19**
Standard Deviation	4.5	3.7	5.3	7.0	4.8	4.1	5.6	4.2	5.5	
NSN 5965-01-204-8505										
Astrocom H157A										
Mean Attenuation	10	12	16	22	27	35	38	38	38	**11**
Standard Deviation	5.1	2.8	4.6	4.3	4.5	5.2	4.5	5.7	8.5	
NSN 5965-01-128-1410										
David Clark H10-76										
Mean Attenuation	14	20	20	21	33	37	38	34	31	**14**
Standard Deviation	4.0	3.7	3.1	4.9	3.4	4.3	4.6	7.3	7.4	
NSN 5965-01-390-9240										
David Clark H133C										
Mean Attenuation	22	24	31	26	27	29	37	34	34	**17**
Standard Deviation	5.5	5.6	5.3	3.2	5.4	3.9	4.9	2	3.9	
Peltor Lite-Com										
Mean Attenuation	12	19	24	34	30	33	36	35	35	**20**
Standard Deviation	3.1	2.7	2.4	3.4	3.8	2.8	2.7	3.9	3.2	

Roanwell 81349-MIL-H-87819										
Mean Attenuation	18	18	26	35	31	34	35	35	34	**14**
Standard Deviation	5.3	6.7	5.2	8.7	6.4	8.2	7.4	7.2	6.5	
NSN 5965-01-204-8505										
Roanwell 495-622-001-604	**125**	**250**	**500**	**1K**	**2K**	**3.1 K**	**4K**	**6.3 K**	**8K**	**NRR**
Mean Attenuation	12	18	23	*l.*	*m*	29	*n.*	32	*o.*	**13**
Standard Deviation	6.9	5.2	5.2	*p.*	*q.*	3.3	*r.*	5.9	*s.*	
				t.	***u.***		***v.***		***w***	
Wire-Com De-Icing				***x.***	***y.***		***z.***		***a***	
Mean Attenuation	13	15	26	32	30	34	38	40	38	**20**
Standard Deviation	3.8	1.7	3.5	3.6	3.6	2.5	2.8	4.0	4.0	

Helmet	**Octave Band Attenuation**									**NRR**
HGU-26/P **With MX 8376/AR ear cups**	**125**	**250**	**500**	***b***	***c***	**3.1 K**	***d***	**6.3 K**	***e***	

Mean Attenuation	7	6	14	22	33	43	44	40	37	**6**
Standard Deviation	5.1	5.6	5.0	4.4	6.5	5.7	5.7	11.0	10.7	
HGU-26/P With Pillow Block Ear pad										
Mean Attenuation	2	6	10	13	20	28	30	37	35	**2**
Standard Deviation	5.8	5.4	5.2	5.1	7.2	7.8	9.5	7.4	5.5	
HGU-53/P, Gentex										
Mean Attenuation	15	8	19	26	39	46	50	54	53	**10**
Standard Deviation	4.4	2.4	6.9	7.8	5.7	4.9	4.2	5.3	6.3	
HGU-55/P, Gentex										
Mean Attenuation	10	5	19	31	44	46	49	50	50	**12**
Standard Deviation	4.1	2.8	3.1	5.1	3.4	5.0	7.3	6.4	6.8	
SPH-4B, Gentex										
Mean Attenuation	14	13	24	37	38	40	40	45	43	**20**
Standard Deviation	2.8	2.2	2.2	5.4	2.6	4.0	4.3	5.0	4.8	

Plug and Muff	Octave Band Attenuation									NRR
E-A-R Plugs/Blue Point GA-3000	**125**	**250**	**500**	*ff*	*gg*	**3.1 K**	*hh*	**6.3 K**	*ii*	

Mean Attenuation	31	30	37	*jj*	*kk*	44	*ll*	46	*mm*	**20**
Standard Deviation	8.4	8.2	8.4	*nn*	*oo*	6.4	*pp*	6.4	*qq*	
				rr	***ss***		***tt***		***uu***	
				vv	***ww***		***xx***		***yy***	
E-A-R Plugs/Howard Leight Thunder 29				***zz***	***aa***		***bb***		***cc***	
Mean Attenuation	33	38	47	44	36	47	50	46	45	**27**
Standard Deviation	5.6	9.0	8.6	5.8	5.2	6.2	6.0	5.2	4.2	
E-A-R Plugs/Peltor Twin Cup Muffs										
Mean Attenuation	31	32	43	42	38	50	50	50	48	**26**
Standard Deviation	6.7	7.6	8.2	6.3	5.2	6.3	5.8	3.4	3.3	
E-A-R Plugs/Safety Direct				***dd***	***ee***		***ff***		***gg***	

RBW-71										
Mean Attenuation	31	37	44	41	38	48	49	48	46	**28**
Standard Deviation	6.5	6.3	8.2	5.3	5.4	6.0	4.1	3.2	4.4	

Plug and Communication Headset	**Octave Band Attenuation**									**NRR**
E-A-R Plugs / Astrocom H-157-A	**125**	**250**	**500**	***h***	***ii***	**3.1 K**	***jj***	**6.3 K**	***k***	
Mean Attenuation	29	38	47	49	47	52	52	51	49	**32**
Standard Deviation	5.0	5.0	6.5	4.1	8.1	6.3	4.2	4.2	4.0	
V51R / Astrocom H-157-A										
Mean Attenuation	25	25	30	38	47	49	49	46	45	**21**
Standard Deviation	8.3	7.2	5.3	4.4	6.0	7.5	5.9	4.3	5.6	
E-A-R Plugs / Roanwell										
Mean Attenuation	32	34	35	37	34	46	48	48	45	**20**
Standard Deviation	5.6	7.6	8.4	8.0	6.3	7.2	7.1	7.2	5.6	

NSN 5965-01-121-2319										

Plug and Helmet	Octave Band Attenuation									NRR
E-A-R Plugs / Gentex 53P	125	250	500	ll	m	3.1 K	n	6.3 K	o	
Mean Attenuation	31	30	41	41	45	51	54	55	53	**29**
Standard Deviation	5.6	5.5	6.0	4.7	4.3	5.7	4.9	5.9	5.8	
E-A-R Plugs / Gentex 55P										
Mean Attenuation	26	27	41	44	46	55	55	56	58	**28**
Standard Deviation	4.7	5.0	5.8	5.1	5.3	5.0	4.9	6.7	7.0	
V51R Plugs / Gentex 53P										
Mean Attenuation	22	23	34	36	46	54	56	57	56	**24**
Standard Deviation	4.4	4.8	5.4	3.5	5.4	5.6	4.6	5.4	5.5	

C-A Values

ppp. Device	**-2 thru 0**	**1 thru 3**	**4 thru 7**	**8 thru 10**	**11 and up**
E-A-R Classic (Foam Disp. earplug)	26	23	20	20	19
Howard Leight Max earplug	26	22	20	19	19
E-A-R 9000 earmuff	24	23	19	16	13
Willson 365A earmuff	30	26	23	20	18
Tasco 2900 earmuff	33	30	26	22	19
Howard Leight QM 24 earmuff	26	22	18	15	13
Bilsom Viking 29 earmuff	34	30	26	22	19
Bilsom 707 impact earmuff	25	21	18	15	13
Safety Direct RBW 71 earmuff (blue)	27	22	17	14	11
Peltor H7A earmuff	31	27	22	18	15
Tasco Golden Eagle #2950 earmuff	32	30	27	23	21
Cabot 1720 earmuff	28	23	18	14	11
E-A-R 1000 earmuff	25	22	18	15	12
Gentex Wolf Ear earmuff	24	21	18	15	12
Aearo 1000 earmuff	29	23	18	15	12
Blue Point GA 3000 earmuff	32	29	24	21	12
Bilsom 727 earmuff	31	27	22	18	14
North Earmuff 28-45-00	23	19	14	11	8
Wilson 365 Sound Barrier earmuff	31	27	23	20	17
E-A-R 820 earmuff	26	20	15	12	10
3M 1435 earmuff	29	24	19	16	13
3M 1440 earmuff	31	27	22	19	16
Peltor H10A earmuff	33	31	26	23	19
Tasco Sound Shield earmuff	34	31	27	23	21
MSA Mark IV earmuff	30	25	21	18	15
Howard Leight Thunder 29 earmuff	29	25	21	18	15
David Clark 310 earmuff	32	28	24	20	16
Bilsom Blue 2308 earmuff	26	20	15	12	10
Vallen Pro-Max I	33	30	26	22	19
David Clark H-133 headset	30	28	27	26	24
Peltor Lightcom headset	31	26	22	19	16
Roanwell Headset 495-622-001-604	25	23	21	18	16

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II. Explanation of NRR

The Noise Reduction Rating (NRR) is an attempt to describe hearing protection via a single number description. This was proposed to simplify complex attenuation data for the general public and was made a legal requirement by the Environmental Protection Agency (EPA) for manufacturers of hearing protection. The NRR has been widely criticized by the scientific community as being an oversimplification and a compromise. Applying complete octave band data provides far more accuracy. Furthermore, the NRR was intended to be subtracted from C-weighted noise data. However, OSHA inspection teams found the NRR was often being used in conjunction with A-weighted noise data in private industry. OSHA mandated a seven (7) dB correction factor to account for the difference in low-frequency weighting between A and C filters on sound measurement equipment when the NRR is subtracted from A-levels. *Bottom line: You do **not** need to subtract an additional 7 dB from the NRR if your sound levels are obtained in **C-weighted** sound pressure levels.*

SAMPLE NRR: Source--NIOSH Hearing Protector Compendium

Octave band center frequency, Hz	**125**	**250**	**500**	**1000**	**2000**	**3000**	**4000**	**6000**	**8000**	**Log Sum**
1. Assumed pink noise (dB)—"flat "	100	100	100	100	100		100		100	
2. C-weighting corrections (dB)	-0.2	0	0	0	-0.2		-0.8		-3	
3. Unprotected ear C-weighted level	99.8	100	100	100	99.8		99.2		97	**107.9**
4. A-weighting corrections (dB)	-16.1	-8.6	-3.2	0	1.2		1.0		-1.1	
5. Unprotected ear A-weighted level	83.9	91.4	96.8	100	101.2		101		98.9	
6. Average attenuation at each frequency (example)	21	22	23	29	41	43	47	41	36	
	21	22	23	29	41		45*		38.5*	
7. Std. deviation in dB at each frequency (example)	3.7	3.3	3.8	4.7	3.3	3.3	3.4	6.1	6.5	
(Std. deviation x 2)	x2	x2	x2	x2	x2					
	7.4	6.6	7.6	9.4	6.6		6.7**		12.6**	
8. Attenuation less SD in dB at each frequency (line 6 - line 8)	13.6	15.4	15.4	19.6	34.4		38.3		25.9	
9. Protected ear A-weighted level (average attenuation minus two std. deviations develops the A-weighted levels (line 5 - line 8))	70.3	76.0	81.4	80.4	66.8		62.7		73.0	**85.1**
10. **NRR** is unprotected ear "C" level (line 3) minus protected ear "A" level (line 9) minus 3 dB										**19.8 NRR=20**

*** Average attenuation at 3000 and 4000 Hz and at 6000 and 8000 Hz.**

**** Summed standard deviation for 3000 and 4000 Hz and 6000 and 8000 Hz.**

SAMPLE NRR: Source--NIOSH Hearing Protector Compendium

NOTE:

When C-weighted sound level measurement is available, the following formula should be used:

Noise Level in dB(C) - Protector NRR = presumed at-the-ear exposure

When A-weighted sound level measurement is available, the following formula should be used:

Noise Level in dB(A) - (Protector NRR - 7 dB) = presumed at-the-ear exposure

III. Explanation of Method A vs. Method B

ANSI Test Method A: American National Standards Institute (ANSI) S12.6-1984 for devices tested using method A. Evaluation of HPDs with trained and experienced test subjects. Fitting the HPD is assisted/facilitated by the experimenter. This is considered best-case data.

***ANSI Test Method B*:** ANSI S12.6-1997 for devices tested using method B. Evaluation of HPDs with naïve test subjects; must obtain their instructions for fitting and use solely from the manufacturer's written instructions accompanying the packaging. No instruction from the experimenter is allowed. This method was proposed to estimate field performance in commercial industry. However, there is debate about how well it suits DoD service members in a hearing conservation program receiving annual training (which is why the May 1999 List of Approved HPDs was rescinded). Devices tested using method B in this report are highlighted and italicized. These method B values are often significantly less than method A values for insert and plug types of HPDs. You will simply be conservative using them. There appears to be relatively little difference between methods A and B for muffs and headsets.

The DoD Tri-Service Hearing Conservation Working Group is the organization determining how attenuation testing is to be conducted for DoD (which standard and which method, etc.). The manufacturers of hearing protection use older versions of the ANSI S.12 standard as bound by the Environmental Protection Agency (EPA). The EPA doesn't require the updated versions because that office within the EPA was zero funded.

IV. Explanation of C – A

The C – A method was devised by USAF researchers. It is a statistical model based on linear regressions involving 50 representative USAF noises encompassing all the acoustical spectra to which USAF personnel are exposed. Please see AFOSH 48-20 for instruction on application of C - A data. The list will be expanded to include all HPDs in the near future (project awaits funding).

V. Order of Preference for calculating HDP noise attenuation

Octave band is the preferred method to calculate HPD noise attenuation (see instructions in AFOSH STD 48-19) , where octave band measurements have not been collected, noise attenuation may be estimated from A-weighted and C-weighted sound pressure levels of the noise source. NRR is the *LEAST* preferred method of estimating HPD noise attenuation.

VI. Points of Contact

For further information please contact the Aural Displays & Bioacoustics Branch of the Human Effectiveness Directorate at the Air Force Research Laboratory, Wright-Patterson AFB.

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