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Edwards, California 93523

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Dryden Centerwide Procedure

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Chapter 18
Hearing Conservation

Electronically approved by
Assistant Director for Management Systems

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1.0 PURPOSE OF CHAPTER

This chapter establishes procedures and guidelines, delegates authority, and assigns responsibility for managing the Dryden Flight Research Center Hearing Conservation Program

2.0 PROCEDURE SCOPE & APPLICABILITY

Scope: The DFRC Hearing Conservation Program implements minimum requirements for

- Implementing noise reducing engineering and administrative controls
- Identification of exposed personnel through noise monitoring and assigning them to the medical monitoring program (MMP)
- Use of hearing protection devices
- Audiometric testing
- Training

Applicability: This Hearing Conservation Program is applicable to all personnel on site at Dryden Flight Research Center. Employee participation is required for occupational exposures to noise at or above the action level of an 82 dBA 8-hour time weighted average or the equivalent noise dose of 50 percent.

3.0 PROCEDURE OBJECTIVES, METRICS, & TREND ANALYSIS

Objective: Protect personnel from being exposed to physically damaging noise levels such that there are no permanent threshold shifts in hearing.
Metric: Zero permanent threshold shifts in hearing due to exposures above the criterion sound level at DFRC.

Trend Analysis: Investigate permanent threshold shifts in hearing to determine systemic causes and corrective actions necessary.

4.0 WAIVER AUTHORTY

Waiver to the Dryden Hearing Conservation Program is not allowed.

5.0 RESPONSIBILITIES

An effective hearing conservation program requires a coordinated team effort composed of the following groups.

5.1 Directorates and Single Letter Offices

Directorates and Single Letter Offices are responsible for taking engineering and administrative actions to keep noise levels below the Action Level within their areas of responsibility, where possible.

5.2 Program and Project Managers

Program and Project Managers have the responsibility for ensuring that, where feasible, the design and development, or selection and purchase, of hardware, tools, support equipment, engineering controls, and associated procedures will minimize any noise-exposure hazard to personnel.

5.3 Facility Managers and Design Engineers

A. Select building equipment with low noise emission, where feasible, and provide specifications for equipment that promote the Buy-Quiet and Quiet-by-Design philosophy.

B. Notify the Senior Industrial Hygienist of noisy areas or operations.

C. Design and apply engineering controls that reduce noise to acceptable limits to the maximum extent feasible. For equipment and system designs, noise level criteria should be established to not exceed 85 dBA to the extent feasible.

D. Consider acoustics in design and modification of facilities.

E. Provide engineering drawings and operational plans to the Senior Industrial Hygienist for review and assessment of potential noise hazards.

F. Coordinate engineering noise control measures with the Senior Industrial Hygienist.

5.4 Contracting Officer

Ensure that contract requirements include provisions for written Hearing Conservation Programs in accordance with Part 23 of the NASA FAR Supplement (NFS). When the NFS clause at 1852.223-70, Safety and Health, and the NFS provision at 1852.223-73, Safety and Health Plan, are included in a solicitation or contract, help ensure that the contractor's written Health and Safety Plan addresses how the contractor intends to

comply with Dryden's Hearing Conservation Program as outlined in this document.

For procurement of potentially noise-hazardous machinery or equipment, the purchase requisitioner will coordinate with the contracting officer in the development of specifications, selection criteria, or design targets.

5.5 Chief, Safety, Health, and Environmental Office

The Chief, Safety, Health, and Environmental Office has safety oversight for the DFRC Hearing Conservation Program.

5.6 Industrial Hygienist

The Senior Industrial Hygienist or designated Industrial Hygienist within the Safety, Health, and Environmental Office will

A. Conduct baseline surveys of each new operation, job, or procedure having the potential of being at or above the noise Action Level.

B. Monitor and evaluate noise-hazard areas or operations through noise surveys and personal noise dosimetry. Reevaluate work environments when an employee experiences a Standard Threshold Shift (STS) or repeat STS.

C. Recommend appropriate means of controlling hazardous noise exposure.

D. Designate noise hazard areas and notifying managers and supervisors of such areas.

E. Provide noise-monitoring findings to individuals, supervisors, and site managers.

F. Notify supervisors and the Health Unit of employees who should participate in the medical monitoring program. These employees include those who experience:

   1) An Action Level of 80 dB as an 8 hour Time-Weighted-Average (TWA), for 30 or more days per year

   2) An equivalent TWA of 85 dB for 8-hours, for any 1 day of the year

   3) An impact or impulsive noise in excess of limits listed in Table 2.

G. Review facility and operational plans to assess the adequacy of precautions planned or taken to control noise.

H. Maintain noise survey records in accordance with 29 CFR 1910.95 (m) and make these records available to employees.

I. Select hearing-protection devices (in collaboration with the Health Unit physician).

J. Notify supervisors of the need for their employees to wear proper hearing protection equipment.

K. Review the adequacy of the DFRC Hearing Conservation Program every three years or more frequently if program requirements change.

5.7 Health Unit Medical Officer

A. Provide audiometric testing in accordance with applicable requirements of NPR 1800.1B, Chapter 4.

B. Inform employee and employee's supervisor of threshold shifts that require attention or action. Inform the employee of other disorder or disease of the ear. Make a recommendation for further testing or the referral to a hearing specialist when an employee's hearing test indicates the need.

C. Notify both employee, in writing, and the employee's supervisor within 21 days if further testing establishes that a permanent STS has occurred.

D. Notify the Senior Industrial Hygienist when a permanent STS has occurred.

E. Recommend reassignment of employees to work in low noise areas when necessary to prevent further significant hearing loss or the aggravation of other medical conditions that could be worsened in a high noise environment.

F. Provide employees access to their hearing records.

G. Provide annual Hearing Conservation Training in accordance with 29 CFR 1910.95 (k).

H. Ensure that the Occupational Safety and Health Administration reportable hearing loss cases are recorded on C-2 injury log and in Incident Reporting Information System (IRIS). Assist employees in filing Workers' Compensation Claims when significant hearing loss is detected.

5.8 Supervisors

A. Ensure that each worker enrolled in the Hearing Conservation Program follows the requirement of the program, i.e., receives an annual hearing test and uses proper hearing protection equipment when necessary.

B. Report suspected noise hazards in their area of jurisdiction to the Dryden Senior Industrial Hygienist.

C. Provide the Dryden Senior Industrial Hygienist and the Health Unit with the names of persons under their supervision that work in designated

hazardous noise areas and ensure that these persons receive training and hearing protection equipment as required.

D. Refer persons who complain of hearing loss to the Health Unit for evaluation.

E. Enforce the wearing of hearing protection devices and developing administrative controls to limit hazardous noise exposure where possible.

F. Notify the Industrial Hygienist of any changes to the noise levels in his/her area of jurisdiction such as the addition or removal of noise generating equipment.

G. Post hazardous noise signs at appropriate locations and place labels on tools and equipment that require the use of hearing protection when in use.

H. Prior to exposure, see that new employees who work in a noise at or greater than the Action Level receive a baseline physical.

I. Verify that employees who are in the Hearing Conservation Program receive a final audiogram prior to their separation from DFRC.

5.9 Employees

Employees in the Hearing Conservation Program must

A. Use effective noise-exposure control procedures, including the proper use and maintenance of hearing-protective devices.

B. Follow the instructions in this document including wearing and maintaining hearing protection equipment when required.

C. Cooperate with supervisors, medical, and safety personnel to prevent hearing loss caused by workplace noise.

D. Notify supervisor of suspected hearing loss.

E. Notify supervisor of equipment or operations that may exceed limits for noise exposure.

6.0 NOISE CONTROLS

The order of precedence for controlling noise hazards is

1) Eliminate the source,

2) Use engineering controls to reduce noise to safe levels,

3) Use administrative controls to minimize exposure to noise, and last when engineering and administrative controls fail to reduce the sound levels to an 85 dBA TWA or below,

4) Use personal hearing protection.

NASA has established the Buy-Quiet and Quiet-by-Design program to emphasize engineering control of noise at procurement for the equipment we buy, and in the design process for the equipment we build.

6.1 Engineering Controls

Where feasible, facilities and equipment will be procured, designed, operated, or modified to prevent employee exposure to noise at or above an 85 dBA TWA. The reduction of noise levels, even if not above 85 dBA, is important. When engineering controls fail to lower the noise level below this level, administrative actions must be taken and/or hearing protection equipment used.

6.2 Administrative Controls

Where engineering control is not sufficient to attenuate noise to less than 85 dBA, the duration of time spent in the noise hazard area will be limited or access restricted so as not to exceed the criterion noise level. Persons working in a hazardous noise area who have hearing loss may be moved to another job or location where there is less noise.

6.3 Personal Hearing Protection

A. To provide adequate personal hearing protection for real work environments, the manufacturer's Noise Reduction Rating (NRR) must be adjusted using the following derating formula prescribed for NASA operations

$$\text{Required NRR} = [(L_A - 85) \times 2] + 7$$

where L_A is the measured ambient sound level to which the employee is exposed.

B. Earmuffs and/or earplugs will be provided to employees assigned to work in areas where they will be exposed to continuous noise in excess of 85 dBA regardless of the duration of exposure. For sanitary purposes, earmuffs and earplugs will not be shared. Disposable foam earplugs should not be reused.

C. Hearing protectors must attenuate noise to an 85 dBA or less for an 8 hour TWA. A combination of earmuffs and earplugs are required where noise levels are 110 dBA or greater. The adequacy of personal hearing protection attenuation will be reevaluated whenever employee noise exposures increase.

D. When reusable preformed earplugs are used, they will be fitted to the individual by a trained medical professional. During fitting, the employee will be instructed in the proper method of insertion, and cleaning of the earplugs. The DFRC Health Unit provides this service.

E. Type II earmuffs will be provided for employees when analysis of noise environments shows that the attenuation provided by earplugs is not sufficient to reduce noise exposure to or below the requirements of Tables 1 and 2. NASA flight line and flight project personnel may obtain earmuffs from the Life Support Section.

F. Sound-suppression and noise cancellation headsets may be used in hazardous noise areas unless they have been damaged, altered, or modified in any way that affects their attenuation characteristics. These headsets are issued by Life Support Section on an as needed basis and are cleaned and sanitized before reissuance.

7.0 NOISE EXPOSURE MONITORING

7.1 Noise Exposure Limits

NASA's allowable noise exposure limit is the equivalent to an 85 dBA, 8-hour TWA exposure using a 3 dB exchange rate. Table 1 contains noise exposure levels and durations that are equivalent to this limit as calculated by the following formula where *L* stands for exposure level and *T* for duration:

$$T\ (\text{min}) = 480/2^{(L-85)/3}$$

Exposures exceeding the equivalent exposures in Table 1 will be controlled, reduced, or eliminated through a hierarchical combination of engineering controls, administrative controls, and hearing protection devices.

TABLE 1
Noise Exposure Limits

Exposure level (dBA)	Hours	Minutes
80	25	24
81	20	10
82	16	0
83	12	42
84	10	5
85	8	0
86	6	21
87	5	2
88	4	0
89	3	10
90	2	31
91	2	0
92	1	35
93	1	16
94	1	0
95	0	47
96	0	37
97	0	30
98	0	23
99	0	18
100	0	15

7.2 Sound Level Measurements

Sound level measurements will be conducted in noisy areas when information, observation, or calculation shows that an employee may be exposed to a hazardous noise level. In determining TWA exposures, all continuous, intermittent, and impulsive noise from 80 to 140 dBA will be integrated into the noise measurements.

A. A noise survey will be performed to determine representative noise levels, to evaluate employee complaints, or where normal conversation is difficult to hear when the two people are face-to-face three feet apart.

B. When a noise survey shows that an employee, (without hearing protection) may be exposed to noise at or above the Action Level, noise monitoring will be conducted, including area monitoring to characterize general noise conditions and noise dosimetry to

determine the noise dose of the exposed employees. If the noise level is above the Action Level, octave band analysis may be conducted to characterize the noise source in support of a determination of appropriate noise abatement techniques.

C. For exposures above the Action Level, the results of noise dosimetry and monitoring will be made in writing to employees or their representative on request.

D. Noise surveys will be conducted

1) Whenever changes are made to facilities, equipment, work practices, procedures, or noise control measures that alter noise exposure, or

2) To determine changed conditions whenever an employee experiences an STS.

Noise surveys must check for the possible use of chemicals (e.g., certain solvents, heavy metals, carbon monoxide) or physical agents that can affect hearing (e.g., heat and vibration).

E. Design or procurement of machinery or equipment with the potential to exceed a sound level of 85 dBA should be reviewed by the Industrial Hygienist. New equipment or operations that have the potential for creating hazardous noise should be measured before the equipment or operation is put online.

F. The locations of continuous, intermittent, and impulsive sound levels from 80 dBA will be measured and integrated into a noise database by the Safety Office Industrial Hygienist.

G. Employees and/or their representatives will be provided the opportunity to observe noise monitoring activities.

7.3 Medical Monitoring Program (MMP)

A. Exposure to Continuous Noise – When an employee is occupationally exposed to continuous noise at or above the Action Level the employee will be enrolled in the MMP. For the purpose of program enrollment, employee noise exposure will be determined without regard to any sound attenuation provided by the use of hearing protectors.

B. Employees placed in the MMP will receive a physical exam prior to assignments of duties involving exposure to noise levels above the Action Level. The examination will include a baseline audiogram, a medical examination to determine any preexisting disorder or disease of the ear, and a work history to document past noise exposure. The audiogram must be preceded by at least 14 hours, during which the patient is not exposed to known continuous sound levels in excess or 72 dBA or to impact/impulse noise greater than 120 dBA. The

audiogram portion of the exam will be delayed for any person suffering with acute ear, nose, or throat infections until the disease has abated.

C. Employees will not be reassigned a new baseline more than once in their employment at a NASA site. Employees who have been assigned a new baseline will be re-tested within 6 months to determine if further threshold shifts have occurred. Employees who continue to experience threshold shifts will be referred to a hearing specialist or qualified physician.

D. When a physical examination cannot be obtained prior to placement in a job requiring the person to be in the MMP or when persons are already assigned to an area with noise levels at or above the Action Level a physical will be accomplished within 30 days.

E. Persons suffering from acute ear disease should not be assigned to hazardous noise areas until the condition has abated, particularly if the disease precludes the wearing of hearing protection or if additional pathology could occur.

F. Employees enrolled in the MMP will receive an annual audiogram.

G. Employees enrolled in the MMP will receive an audiogram prior to termination or employment, transfer to another installation, or retirement. An audiogram less than 6 months old will meet this requirement.

7.4 Noise Hazard Identification

Entrances to rooms or facilities that contain operations or equipment that generates noise levels of 85 dBA or greater will be posted with caution signs stating that hearing protection is required. Decals or placards with similar information will be affixed to power tools and machines that produce continuous noise at or greater than 85 dBA at the operator's position. Signs and decals will have wording in black letters on yellow or orange background that conform to 29 CFR 1910.145, Specifications for Accident Prevention Signs and Tags Requirements.

8.0 TRAINING

Employees who are enrolled in the Hearing Conservation Program and their supervisors will receive annual training provided by the Health Unit on the hazards of noise exposure. The training will include, as a minimum

A. An overview of the hearing conservation and medical monitoring programs

B. A review of the effects of noise on hearing

C. The purpose of hearing protection

D. The advantages, disadvantages, and attenuation characteristics of various types of protectors

E. An explanation of audiometer procedures and their purpose

F. Encouragement to use hearing protectors whenever they are exposed to noise during off-duty activities.

9.0 ACCESS TO HEARING CONSERVATION RECORDS

Copies of the DFRC Hearing Conservation Program and any appropriate records required by this document or 29 CFR 1910.95 will be provided, on request, to employees, former employees or their representatives, government agencies, and individuals authorized to receive such documents.

10.0 MANAGEMENT RECORDS & RECORDS RETENTION

Records are preserved, maintained, and disposed of in accordance with NPR 1441.1, NASA Records Retention Schedules, and DCP-F-603, Records Management.

10.1 Medical Records

Audiograms, pathological findings, and noise exposure measurement records of persons in the MMP will be maintained as a permanent part of the individual's medical records. If the exposure measurements were made of an area and are representative of more than one employee, a record of the measurements will be placed in each individual's medical record. These records will be maintained for the duration of employment plus 30 years. See 29 CFR 1910.1020.

10.2 Audiometric Test Rooms

Records of the measurement of the background sound pressure levels of audiometric test room will be maintained by the Health Unit in accordance with 29 CFR 1910.95 (m), Record Keeping and NPD 1440.6, NASA Records Management.

Accurate records of noise surveys/monitoring, results of special noise studies, and records of special action or engineering controls installed to control noise exposures will be maintained by the DFRC Senior Industrial Hygienist for the period of employment of the affected employees plus 30 years. See CFR 29 1910.95 (m) and 29 CFR 1910.1020

10.3 Other records

Records not containing medical, surveys and noise monitoring information, as noted above, will be maintained in accordance with NPD 1440.6, NASA Records Management, and NPD 1441.1D, Record Retention Schedules.

11.0 RELEVANT DOCUMENTS

11.1 Authority Documents

FAR Supplement	Part 23
NPD 8700.1	NASA Policy for Safety and Mission Success
NPD 1800.2	NASA Occupational Health Program
NPR 1820.1	NASA Hearing Conservation
29 CFR 1910.95	Occupational Noise Exposure: This OSHA document sets the minimum requirements for a Hearing Conservation Program.
29 CFR 1910.1029	Access to Exposure and Medical Records
29 CFR 1904.10	Occupational Injury and Illness Recordkeeping and Reporting Requirements
NPD 8710.2C	NASA Safety and Health Program Policy

11.2 Reference Documents

NPR 1800.1B	NASA Occupational Health Program Procedures
NPR 8715.3	NASA Safety Manual w/Changes through Change 1, 6/19/02.
NPR 8715.1	NASA Safety and Health Handbook Occupational Safety Health Programs
NPR 1441.1	NASA Records Retention Schedules
NPD 1440.6	NASA Records Management
ANSI S1.4	Specifications for Sound Level Meters
ANSI S1.25	Specification for Personal Noise Dosimeters
ANSI S3.6	Specifications for Audiometers

12.0 ABBREVIATIONS, ACRONYMS, & DEFINITIONS

12.1 Abbreviations & Acronyms

dB	Decibel
dBA	Decibels-A-Weighted
Hz	Hertz
IRIS	Incident Reporting Information System
OSHA	Occupational Safety and Health Administration
MMP	Medical Monitoring Program
PTS	Permanent Threshold Shift
STS	Standard Threshold Shift
TTS	Temporary Threshold Shift
TWA	Time-Weighted-Average

12.2 Definitions

Action Level	An 8-hour time-weighted average of 82 decibels measured on the A-scale, slow response, or equivalently, a dose of 50 percent. TWA noise measurements integrate all continuous, intermittent, and impulsive sound levels, from 80 dBA to 140 dBA. Employee exposure at or above the action level triggers enrollment into a hearing conservation program.
Administrative Controls	Any procedure that limits noise exposure by restricting access to noise areas or by control of exposure times, distance, and/or work practices.
Audiogram	A graph showing an individual's hearing threshold levels as a function of frequency.
Audiologist	A trained and certified person who performs audiometric testing.
Audiometer	The instrument used to measure a persons hearing response.
Baseline Audiogram	The earliest audiogram that is used to compare subsequent audiograms for changes.
Buy-Quiet and Quiet-by-Design	A program that promotes engineered control of noise by procuring and designing equipment and machines that

	have safe noise levels or the lowest noise levels practicable.
Continuous Noise	Noise sources cycles at greater than one cycle per second or 60 cycles per minute.
Criterion Sound Level	A sound level of 85 dBA TWA, which is NASA's maximum permissible occupational exposure level.
Deafness	Where pure tones of 500, 1000, 2000, and 3000 Hz must be at least 93 dB for the individual to hear. See ANSI S3.6-1996.
Decibel (dB)	A unit of energy used to measure noise or sound.
Decibels-A-weighted (dBA)	A unit of energy used to measure noise or sound by an A-weighted scale at slow response programmed into a sound level meter.
De-rating	The process of revising the manufacturers' NRR values for hearing protectors to more realistic, real-world performance values.
Engineering Controls	Any mechanical device, physical barrier, enclosure, feature, or other design that reduces the sound level at the source of noise generation or along the path of the noise to the individual.
Hazardous Noise	A noise with intensity and duration enough to cause permanent loss of hearing.
Hertz (Hz)	Measurement of frequency in cycles per second.
Impact or impulse Noise	Noise peaks with intervals of greater than one second. If noise peaks are less than one second, the noise is considered continuous.
Noise	Any unwanted sound.
Noise Dose	Cumulative noise measured by intensity (dBA) and time.
Noise Dosimeter	An instrument that measures cumulative noise over time to produce a noise dose.
Noise Hazard Area	Any area at DFRC that produces continuous noise of 85 dBA or greater. Noise hazard areas must be posted with

warning signs.

Noise Reduction Rating (NRR)	A noise reduction value, in decibels, averaged across the frequencies from 125 Hz to 8 kHz, computed from laboratory tests of the attenuation of hearing protectors measured under ideal conditions. The NRR, per a 1979-EPA regulation, is required to appear on all devices worn on the head or ear that are sold for purposes of personal noise reduction. See "Derating."
Otolaryngologist	A physician specializing in ear, nose, and throat disorders.
Permanent Threshold Shift (PTS)	A change in hearing that lasts after a normal period of recovery, (72 hours).
Revised Baseline	The most recent audiogram that has established a threshold shift. The revised baseline will be used to evaluate future audiograms.
Standard Threshold Shift (STS)	A change in the hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2,000, 3,000, and 4,000 Hz in either ear.
Temporary Threshold Shift (TTS)	A change in hearing that returns to baseline in 14 to 72 hours.
Time Weighted Average (TWA)	The time-weighted average noise exposure for a conventional 8-hour workday and a 40-hour workweek.

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This page is for informational purposes and does not have to be retained with the document.

Status Change	Document Revision	Effective Date	Page	Description of Change
Baseline		07-09-04		Replaces DCP-S-037
Admin. Change	Baseline-1	05-12-05	All	• Separates each chapter of the document into individual files • Minor formatting corrections
Revision	A	11-20-08	All	• Updated format to current template • Incorporated changes to conform to Hearing Conservation requirements of NPR 1800.1B, NASA Occupational Health Program Procedures, including responsibilities for buy quiet, quiet by design and a 3 dB exchange rate.