

INDUSTRIAL HYGIENE SPECIAL STUDY
PROJECT NO. 55-92-0400-86
EVALUATION OF POTENTIAL PHYSICAL AND CHEMICAL
CONTAMINANTS IN WORKPLACE AIR,
UNITED STATES ARMY FIELD STATION KUNIA,
WAHIAWA, HAWAII 98786-5000



UNITED STATES ARMY PACIFIC
ENVIRONMENTAL HEALTH ENGINEERING AGENCY

APO SAN FRANCISCO 96343



DEPARTMENT OF THE ARMY CPT Tompkins/cm/228-4834
US ARMY PACIFIC ENVIRONMENTAL HEALTH ENGINEERING AGENCY.
APO SAN FRANCISCO 96343-0079

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C. FILES

REPLY TO
ATTENTION OF:

AJEH-IH

9 May 1986

SUBJECT: Industrial Hygiene Special Study, Project No.
55-92-0400-86, Evaluation of Potential Physical and
Chemical Contaminants in Workplace Air, United States
Army Field Station Kunia, Wahiawa, Hawaii, 96786-5000

Commander
U.S. Army Field Station - Kunia
ATTN: S4 (MAJ Browell)
Wahiawa, HI 96786-5000

Enclosed are four (4) copies of subject report.

FOR THE COMMANDER:

Encls (4 cy)

Ruth Lynn Hooper
RUTH LYNN HOOPER
MAJ, MS
Executive Officer

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Headquarters, Department of the Army (DASG-PSP),
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Commanders:

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U.S. Army Environmental Hygiene Agency, ATTN: HSHB-M,
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U.S. Army Japan/IX Corps, ATTN: AJMD,
APO San Francisco 96343

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DEPARTMENT OF THE ARMY
US ARMY PACIFIC ENVIRONMENTAL HEALTH ENGINEERING AGENCY.
APO SAN FRANCISCO 96343-0079

REPLY TO
ATTENTION OF:

AJEH-IH

9 May 1986

EXECUTIVE SUMMARY
INDUSTRIAL HYGIENE SPECIAL STUDY,
PROJECT NO. 55-92-0400-86,
EVALUATION OF POTENTIAL PHYSICAL AND CHEMICAL
CONTAMINANTS IN WORKPLACE AIR,
U.S. ARMY FIELD STATION - KUNIA, WAHIAWA, HAWAII,
27 OCTOBER - 2 NOVEMBER 1985

1. PURPOSE. This survey was conducted to evaluate workplace air concentrations of potential physical and chemical contaminants within U.S. Army Field Station (USAFS) - Kunia.

2. GENERAL.

a. The survey was prompted by concerns that hazardous levels of carbon monoxide (CO) could be responsible for complaints of respiratory irritation among the workforce.

b. The strategy of the survey was to sample for any potential air contaminants that might enter Kunia in makeup air, or be generated within Kunia.

3. FINDINGS.

a. The power plant was pressurized with fresh makeup air to dilute diesel exhaust gases which leaked from exhaust ductwork. Power plant air was forced into the air conditioning (AC) plant where some was forced out the exhaust tunnel, and some was recirculated into Kunia's air handling system. This recirculation resulted in carbon monoxide concentrations ranging from 0 to 11 parts per million (ppm) within Kunia. All CO levels were below the OSHA Permissible Exposure Limit (PEL) of 50 ppm.

b. Respirable dust concentrations increased from $<0.19 \text{ mg/m}^3$ downstream of the air intake tunnel filter to 69.5 mg/m^3 in Rm N201. This may be another indication of diesel exhaust recirculation.

c. Periodic repair of the asbestos coating on the AC plant boiler had been performed in the past without the use of personal protective equipment, and without measures taken to prevent release of asbestos into the air. A background asbestos concentration determination was performed in Rooms 203 and N213; results were below the lab's limit of detection (<0.04 and <0.02 fibers/cc, respectively).

Industrial Hygiene Executive Summary, Project No. 55-92-400-86

d. Several solvents were used as parts cleaners by AC plant personnel. Sampling for perchloroethylene, stoddard solvent, and fluorotrichloromethane yielded concentrations well below the PEL of each compound. Workers utilizing the parts cleaning area were not protected from potential overexposure by a local exhaust ventilation system. Solvents were flushed directly to the sanitary sewer.

e. Several AC plant personnel were observed utilizing organic vapor respirators. In all cases, the canisters had been stored unprotected prior to use. In one case, the mask facepiece was missing the exhaust valve and both intake valves.

f. Prior to the survey, a list of pesticides applied to the plantation surrounding Kunia's air intake over the past ten years was obtained from the State of Hawaii Agriculture Department. Dust samples were collected from the floor of the intake duct and forwarded to the U.S. Army Environmental Hygiene Agency to be analyzed for the pesticides MIREX, Heptachlor, Velpar and Atrazine. Results are pending.

4. RECOMMENDATIONS.

a. Install helper fans at the surface diesel exhaust exit to eliminate pressurization and subsequent exhaust leakage from the diesel exhaust ducts.

b. Implement an Asbestos Management Plan through consultation with Preventive Medicine, TAMC.

c. Install local exhaust ventilation in the AC parts cleaning area.

d. Investigate state and EPA solvent disposal requirements and implement required changes.

e. Through consultation with Preventive Medicine, TAMC, investigate the requirement for respirator use at Kunia, and if necessary, institute a Respiratory Protection Program.



DEPARTMENT OF THE ARMY
US ARMY PACIFIC ENVIRONMENTAL HEALTH ENGINEERING AGENCY.
APO SAN FRANCISCO 96343-0079

REPLY TO
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INDUSTRIAL HYGIENE SPECIAL STUDY,
PROJECT NO. 55-92-0400-86,
EVALUATION OF POTENTIAL PHYSICAL AND CHEMICAL
CONTAMINANTS IN WORKPLACE AIR,
UNITED STATES ARMY FIELD STATION KUNIA,
WAHIAWA, HAWAII, 27 OCTOBER - 2 NOVEMBER 1985

1. AUTHORITY.

a. Memorandum of Understanding between USARJ and USAHSC, HSCO-RC, 1 August 1984.

b. Preliminary survey 20 and 22 August 1985, and meeting between CPT(P) Drifmeyer, this Agency, and Ms. Kendall, TAMC-PVNTMED, 22 August 1985.

2. REFERENCES. See Appendix A for a listing of references.

3. PURPOSE. The survey was conducted to evaluate workplace air levels of potential physical and chemical contaminants within USAFS - Kunia.

4. GENERAL.

a. The survey was conducted by the following personnel:

(1) David J. Tompkins, CPT, MS, Industrial Hygiene Division, USAPACEHEA, Project Officer.

(2) Joseph R. Copes, Jr., SGT, 91S20, Industrial Hygiene Division, USAPACEHEA.

b. The following personnel were contacted during the survey.

(1) COL Morgan, Chief, Preventive Medicine Service, Tripler Army Medical Center.

(2) MAJ Browell, S4, USAFS - Kunia.

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(3) Ms. Kendall, Chief, Industrial Hygiene Division, Preventive Medicine Service, Tripler Army Medical Center.

(4) Mr. Charles Hickey, MANTECH Corp, c/o S4, USAFS - Kunia.

c. Outbriefings were held with COL Morgan and MAJ Browell.

d. The survey was prompted by concerns that hazardous levels of carbon monoxide could be responsible for complaints of respiratory irritation among the work force. The purpose of this survey was to identify and quantify any potential air contaminants that might enter Kunia in makeup air, or be generated within Kunia.

5. DESCRIPTION OF PHYSICAL PLANT AND GENERAL WORK PRACTICES.

a. Kunia Station is a three-story, 244,000 square foot subsurface structure. The air intake tunnel surfaces in the middle of a pineapple plantation. Site-generated standby electrical power is provided by up to eight large diesel generators in the power plant, which are exhausted through 400 feet of horizontal steel exhaust ductwork before vertically exiting the station. Diesel exhaust is forced through the ductwork by pressure generated by the generators; no helper fans are provided to assist exhaust flow. Because of massive diesel exhaust leakage within the power plant, the air handling equipment has been altered to provide large amounts of fresh air to the power plant, creating a positive pressure dilution effect which forces exhaust fumes up through a ceiling hatch into the air conditioning/recirculation room. Here, some of the power plant air is forced out the exhaust tunnel, and some is recirculated back into the building air supply. Power plant workers stipulated emphatically that they were not able to tolerate the exhaust fumes in the power plant without the positive pressure dilution.

b. Several solvents were used as parts cleaners by air conditioning (AC) plant personnel. There was no provision for local exhaust ventilation at the cleaning stations in the AC plant; waste solvent was captured in a stainless steel sink and drained directly to the sanitary sewer. Because of differing air pressure levels throughout Kunia, some floor drains exhibited a positive flow of air entering the room from the drain.

c. A hydrofluoric acid solution was used to clean the cooling coils in the main air conditioning units.

6. FINDINGS.

a. Prior to the survey, a list of pesticides applied to the pineapple plantation surrounding the air intake duct was obtained from the State of Hawaii Agriculture Department, by Mr. Charles Hickey, Mantech Engineering Corp. c/o S4, Kunia. This information was supplied at the request of the survey project officer. Dust samples were collected from the floor of the intake duct and forwarded to the U.S. Army Environmental Hygiene Agency to be analyzed for the pesticides MIREX, Heptachlor, Velpar, and Atrazine. Dust samples were also collected from the air supply diffuser in Rm N214 and forwarded for the same analyses (Appendix B).

b. Dust samples collected before and after the filter bank indicated a filtration efficiency of >81% for respirable dust (particle size approximately 0.5 microns to 5.0 microns). Respirable dust concentration on the downstream (filtered) side of the filter bank was <0.19 mg/m³ (Appendix B), well below the occupational health standard of 5 mg/m³ (reference 4, Appendix A).

c. Respirable dust samples collected in Rooms N201 and N213 yielded concentrations of 69.5 mg/m³ and 23.9 mg/m³, respectively. A black, sooty deposit was apparent on the supply diffusers in both rooms (Appendix C).

d. At the request of Mantech engineers, dust from an air supply diffuser in Room N214 was analyzed for asbestos fibers, with none found. Air samples for asbestos were collected in Rooms N213 and 203 and yielded results of <0.02 fibers/cc and <0.04 fibers/cc, respectively (Appendix C).

e. Carbon monoxide (CO) levels were checked at several locations on 30 and 31 October while one diesel generator was in operation. CO concentrations ranged from 0 ppm to 7 ppm in office areas. A CO level of 11 ppm was detected in the main vertical air supply duct on the second floor (V227). Air flowing from the power plant generator room into the AC air recirculation room yielded a CO concentration of 1 ppm. Requests from the project officer to have several generators running during the sampling period were unsuccessful. An exhaust leak next to the air conditioning plant steam boiler exhaust duct indicated 94 ppm CO and was probably of some contribution to the general room concentration of 7 ppm CO (Appendix D).

f. Air samples for solvents commonly used in Kunia were collected in Rooms 369, 309A, N201, and N213 to determine if solvent vapors were entering the circulating air directly from

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the AC parts cleaning area or from the sewer system through floor drains. Samples for perchloroethylene, stoddard solvent, and Freon 11 all yielded concentrations of less than 0.2 ppm, with the exception of one Freon 11 sample (5.5 ppm) collected in Rm 369 adjacent to an electrical parts cleaning area (Appendix E).

g. Hydrofluoric acid samples collected to determine if acid mist was present in the air distribution system from the AC coil cleaning process all yielded results below the lab's limit of detection ($<0.008 \text{ mg/m}^3$) (Appendix E).

h. Several AC plant personnel were observed utilizing organic vapor respirators. In all cases, the canisters had been stored unprotected prior to use. In one case, the mask facepiece was missing both intake valves, and the exhaust valve.

7. DISCUSSION AND RECOMMENDATIONS.

a. Results of pesticide analyses and any supplemental recommendations will be forwarded upon completion of laboratory analysis.

b. The increase in respirable dust concentration from the intake filter bank ($<0.19 \text{ mg/m}^3$) to Rm N201 (69.5 mg/m^3), in combination with CO results (para 6.e and 7.d), indicated possible recirculation of diesel generator exhaust gases into the air supply. Recommendations relative to this finding are addressed in paragraph 7.d.

c. Neither bulk asbestos fibers nor suspended asbestos were detected in the air recirculation system. Several workers did indicate that repair to the asbestos-coated boiler in the AC plant had been conducted without precautions designed to prevent entrainment of asbestos fibers, and without the use of personal protective equipment. After coordination with MAJ Browell (S4), a copy of "Management Procedures for Assessment of Friable Asbestos Insulating Material" was forwarded to Kunia in December 1985 to provide guidance on determining relative asbestos hazard. Professional guidance on developing an Asbestos Management Plan for Kunia, to include requirements for and use of personal protective equipment, and proper work practices designed to minimize the asbestos hazard during asbestos disturbance, should be requested from Ms. Kate Kendall, Chief, Industrial Hygiene Section, Preventive Medicine Service, Tripler Army Medical Center, Hawaii.

d. Carbon monoxide levels detected during the survey were below the Permissible Exposure Limit time weighted average (TWA) of 35 ppm recommended by the National Institute for Occupational

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Safety and Health (NIOSH). The practice of pressurizing the power plant to dilute diesel exhaust leakage, combined with the elevated respirable dust levels in Rooms N201 and N213 and the CO level of 11 ppm detected in the main supply duct, indicate introduction of some of the diesel exhaust into the air recirculation system. While none of the CO levels measured were indicative of a hazard to health, the CO measurements were collected while only one diesel generator was operating and may not indicate the worst case. Priority should be given to redesign of the diesel generator exhaust system. Consideration should be given to installation of helper fans at the surface exhaust exit. The fans should be of sufficient capacity to eliminate pressurization of the horizontal diesel exhaust ducts, thus eliminating leakage of exhaust fumes into the interior of Kunia.

e. Solvent concentrations (<0.2 ppm) were well below the threshold limit values (TLV) for perchloroethylene (50 ppm), stoddard solvent (100 ppm), and Freon 11 (1,000 ppm). However, in keeping with accepted industrial hygiene practice, the solvent parts cleaning section of the AC plant should be supplied with a capture hood and dedicated exhaust to protect the worker and to insure solvent is not introduced into the air recirculation system (Appendix F). Insure that solvent disposal is IAW state and Environmental Protection Agency (EPA) requirements.

f. Hydrofluoric acid concentrations (<0.008 ppm) were well below the TLV of 3.0 ppm.

g. The Preventive Medicine Service, TAMC (see para 7.c) should be consulted as to the requirement for respirator use at Kunia, and if required, proper selection and maintenance of respirators. If determined necessary, a Respiratory Protection Program should be developed for Kunia IAW 29CFR1910.134 and TB MED 502. See Appendices G and H for requirements for a Respiratory Protection Program and for information on uses and limitations of respiratory protective devices. Appendix I provides a listing of respirators available through the Federal Stock System. Note that any use or purchase of respiratory protective devices should be coordinated with Preventive Medicine Service, TAMC.

8. PRIORITIZED SUMMARY OF RECOMMENDATIONS.

a. Repair diesel exhaust system and modify by addition of helper fans (para 7.d).

b. Implement an Asbestos Management Plan (para 7.c).

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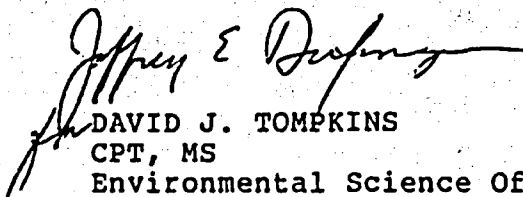
c. Install local exhaust ventilation system in the AC parts cleaning area (para 7.e).

d. Investigate state and EPA solvent disposal requirements and implement required changes (para 7.e).

e. Investigate requirement for respirator use at Kunia, and if necessary, institute a Respiratory Protection Program (para 7.g).

9. CONCLUSION. Kunia was designed and built prior to WWII. The contaminant exhaust controls and breathing air treatment and recirculation systems were not designed to accommodate the personnel increases and mission enhancements currently taking place at Kunia. Consideration should be given to total redesign of the air/environmental control system at Kunia to meet current and expected missions, and to achieve maximum use of current technology and system efficiency.

10. REQUEST FOR FURTHER ASSISTANCE. The primary source of technical advice should be Preventive Medicine Service, Tripler Army Medical Center. Questions concerning this report may be addressed telephonically from USAPACEHEA, Sagami, Japan, AUTOVON 228-4834. Assistance may also be obtained in writing through channels to Commander, U.S. Army Pacific Environmental Health Engineering Agency, Sagami, APO San Francisco 96343-0079, with an information copy of the request provided to Commander, U.S. Army Japan/IX Corps, ATTN: AJMD, APO San Francisco 96343-0076.


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CPT, MS
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APPROVED BY:


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Chief, Industrial Hygiene Division

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APPENDIX A

REFERENCES

1. 29 Code of Federal Regulations, Part 1910, Occupational Safety and Health, General Industry Standards and Interpretations.
2. TB MED 502, Occupational and Environmental Health, Respiratory Protection Program, February 1982.
3. TB MED 503, Occupational and Environmental Health, The Army Industrial Hygiene Program, February 1985.
4. Threshold Limit Values and Biological Exposure Indices for 1985-86, American Conference of Governmental Industrial Hygienists, Cincinnati, OH.
5. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, Centers for Disease Control, U.S. Department of Health and Human Services.
6. Documentation of the Threshold Limit Values, American Conference of Governmental Industrial Hygienists, Inc., Cincinnati, OH.
7. Dangerous Properties of Industrial Materials, 6th Edition, Van Nostrand Reinhold Company, New York, NY, 1984.
8. The Industrial Environment - Its Evaluation and Control, National Institute for Occupational Safety and Health, 1973.
9. Management Procedures for Assessment of Friable Asbestos Insulating Material, USAEHA, February 1981.
10. TG026, Respiratory Protective Devices Approved by the National Institute for Occupational Safety and Health, January 1983.

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APPENDIX B

Results of Analyses of Atmospheric Samples
USAFS - Kunia
28-30 October 1985

Location	Operation	Sampled For	Result	TLV or PEL	Sampling Time	Date Sampled
Floor, main air intake duct, upstream of of filters	supply air filtration bank	MIREX HEPTACHLOR VELPAR ATRAZINE	Samples sent to USAEHA, Aberdeen Proving Ground, MD, 25 Nov 85, results pending	N/A	Bulk Sample	28 Oct 85
Rm N214, Mantech Field Engineering Corp.	diffuser on supply duct	MIREX HEPTACHLOR VELPAR ATRAZINE	Samples sent to USAEHA, Aberdeen Proving Ground, MD, 25 Nov 85, results pending	N/A	Bulk Sample	28 Oct 85
Air Intake Tunnel, upstream of of filters	supply air filtration bank	respirable dust	1.02 mg/m ³	5.0 mg/m ³	200 min	29 Oct 85
Air Intake Tunnel, downstream of filters	supply air filtration bank	respirable dust	<0.19 mg/m ³	5.0 mg/m ³	300 min	29 Oct 85
Air Intake Tunnel, downstream of filters	supply air filtration bank	total dust	<0.20 mg/m ³	10.0 mg/m ³	293 min	29 Oct 85

¹Toxic Limit Value (ACGIH) or Permissible Exposure Limit (NIOSH, OSHA, DA), whichever is most stringent.

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APPENDIX C

Results of Analyses of Atmospheric Samples
USAFS - Kunia
28-30 October 1985

Location	Operation	Sampled For	Result	TLV or PEL	Sampling Time	Date Sampled
Rm N201	Mantech Office	respirable dust	69.5 mg/m ³	5.0 mg/m ³	94 min	30 Oct 85
Rm N213	Operations Management	respirable dust	23.9 mg/m ³	5.0 mg/m ³	295 min	30 Oct 85
Rm N214	Mantech Field Engineering Corp, supply duct diffuser	asbestos	none detected	N/A	bulk sample	29 Oct 85
Rm N213	Operations Management	asbestos	<0.02 fibers/cc	0.5 fibers/cc	117 min	30 Oct 85
Rm 203	Repair and Utilities Facilities	asbestos	<0.04 fibers/cc	0.5 fibers/cc	56 min	31 Oct 85

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APPENDIX D

Results of Analyses of Atmospheric Samples
USAFS - Kunia
28-30 October 1985

Location	Operation	Sampled For	Result	TLV or PEL	Sampling Time	Date Sampled
Air conditioning	Steam boiler	Carbon monoxide	94 ppm	35 ppm	GRAB	29 Oct 85
Air conditioning	General Area	Carbon monoxide	7 ppm	35 ppm	41 min	31 Oct 85
Rm N201	Mantech Office	Carbon monoxide	0 ppm	35 ppm	57 min	31 Oct 85
Rm N201	Mantech Office	Carbon monoxide	2 ppm	35 ppm	GRAB	30 Oct 85
Rm N213	Operations Management	Carbon monoxide	0 ppm	35 ppm	60 min	30 Oct 85
Vehicle Bay	Vehicle movement	Carbon monoxide	0 ppm	35 ppm	174 min	30 Oct 85
Generator Room	Diesel generator	Carbon monoxide	1 ppm	35 ppm	GRAB	31 Oct 85
V227	Main Air Supply	Carbon monoxide	11 ppm	35 ppm	49 min	31 Oct 85
Rm 369	Electrical	Carbon monoxide	7 ppm	35 ppm	53 min	31 Oct 85

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APPENDIX E

Results of Analyses of Atmospheric Samples
USAFS - Kunia
28-30 October 1985

Location	Operation	Sampled For	Result	TLV or PEL	Sampling Time	Date Sampled
Rm 369	Electrical Repair-Office	Perchloroethylene	<0.037 ppm	50 ppm	60 min	29 Oct 85
Rm 309A	Dining Facility	Perchloroethylene	<0.153 ppm	50 ppm	144 min	29 Oct 85
Rm N201	Mantech Office	Perchloroethylene	<0.01 ppm	50 ppm	165 min	30 Oct 85
Rm N213	Operations Management	Perchloroethylene	<0.01 ppm	50 ppm	106 min	30 Oct 85
Rm 369	Electrical Repair-Office	Stoddard Solvent	0.147 ppm	100 ppm	58 min	29 Oct 85
Rm 309A	Dining Facility	Stoddard Solvent	0.03 ppm	100 ppm	144 min	29 Oct 85
Rm N201	Mantech Office	Stoddard Solvent	0.017 ppm	100 ppm	163 min	30 Oct 85
Rm 369	Electrical Repair-Office	Fluorotrichloro methane (Freon 11)	5.5 ppm	1000 ppm	56 min	29 Oct 85
Rm 309A	Dining Facility	Fluorotrichloro methane (Freon 11)	0.074 ppm	1000 ppm	144 min	29 Oct 85

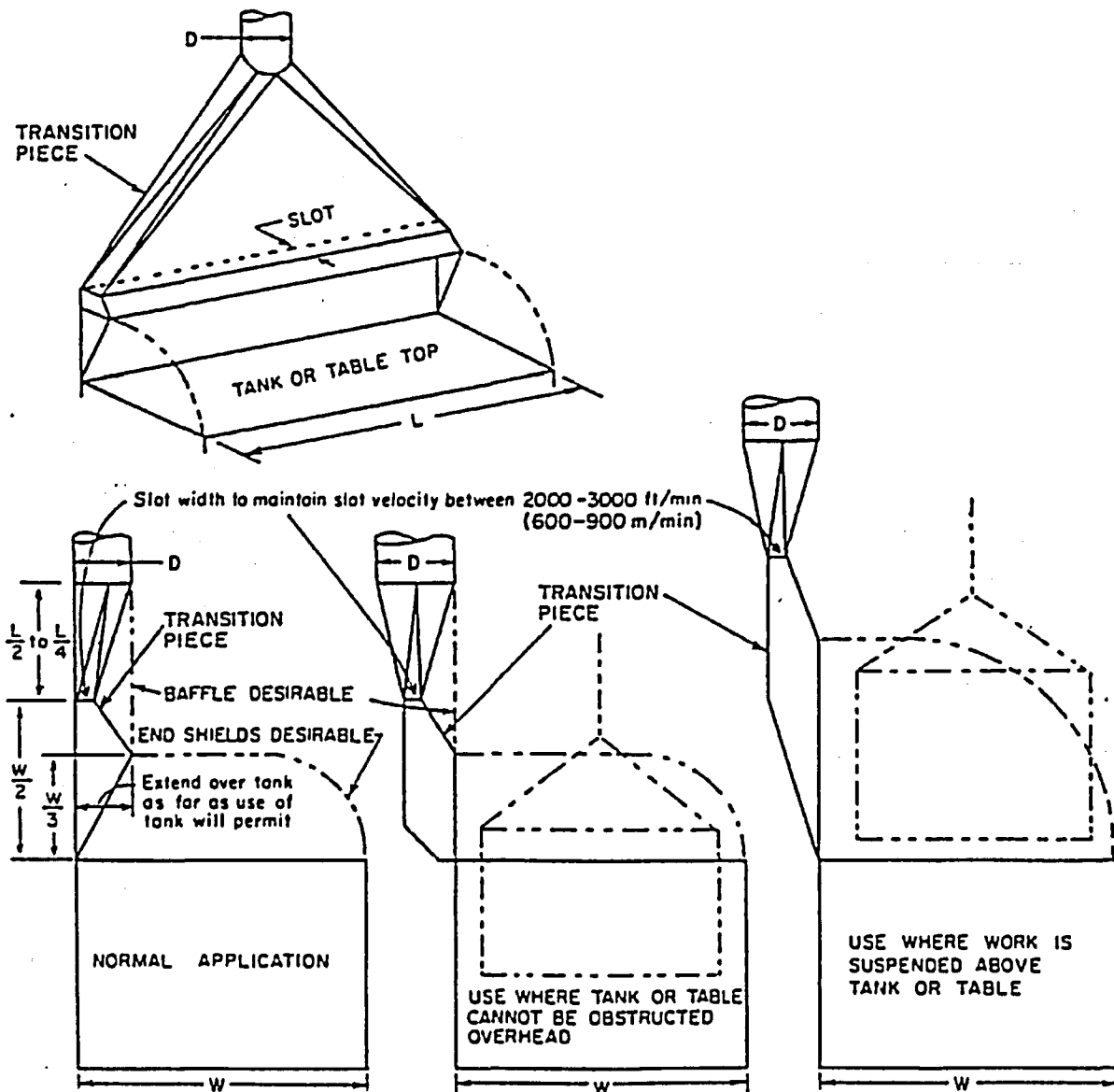
D-1 Industrial Hygiene Special Study, Project No. 55-92-0400-86

APPENDIX E

Results of Analyses of Atmospheric Samples
USAFS - Kunia
28-30 October 1985

Location	Operation	Sampled For	Result	TLV or PEL	Sampling Time	Date Sampled
Rm N201	Mantech Office	Fluorotrichloro methane (Freon 11)	0.037 ppm	1000 ppm	165 min	30 Oct 85
Rm N213	Operations Management	Fluorotrichloro methane (Freon 11)	0.052 ppm	1000 ppm	111 min	30 Oct 85
Rm 369	Electrical	Hydrofluoric acid	<0.008 mg/m ³	3 ppm	58 min	29 Oct 85
Rm 309A	Dining Facility	Hydrofluoric acid	<0.004 mg/m ³	3 ppm	144 min	29 Oct 85
Rm N201	Mantech Office	Hydrofluoric acid	<0.003 mg/m ³	3 ppm	164 min	30 Oct 85
Rm N213	Operations Management	Hydrofluoric acid	<0.005 mg/m ³	3 ppm	60 min	30 Oct 85

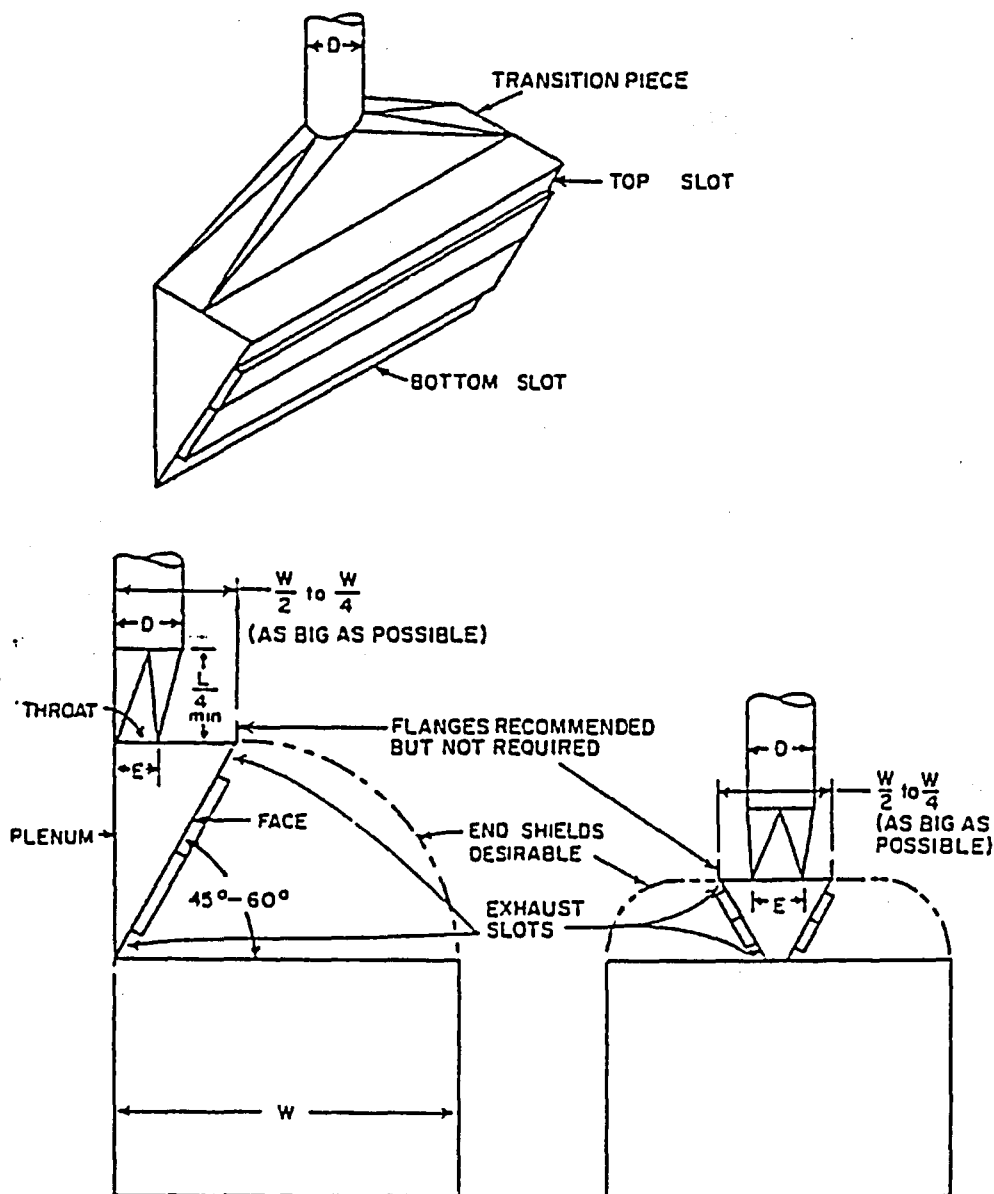
Lateral Exhaust Hoods



NOTES:

- (1) L - tank length; W - tank width; W/L not more than 2 to 1.
- (2) D - duct diameter, usually sized to maintain duct velocity of 1500-3500 ft/min (450-1050 m/min).
- (3) Maximum length of transition piece is 4 ft (1.2 m). Use more than one for longer hoods.
- (4) Hood may be raised 6 inches (15 cm) to allow for pipes over edge of tank; gap should be baffled.

Typical Forms of Lateral Exhaust Hoods



NOTES:

- (1) L - tank length; W - tank width.
- (2) D - duct diameter, usually sized to maintain duct velocity of 1500-3500 ft/min (450-1050 m/min).
- (3) Distribution obtained by either designing throat (E) for a velocity of 2000-3000 ft/min (600-900 m/min) or designing face slots for a velocity of 2000 ft/min (600 m/min). If liquid pickup is expected, air distribution by throat velocity should be used. Liquid level should be kept 6 inches (15 cm) below top edge of tank.
- (4) Transition piece is not required, but desirable, when face slots are used as means of air distribution. More than one is required where plenum throat is used as means of air distribution on tanks over 4 feet (1.2 m) long.

Typical Forms of Lateral Exhaust Hoods

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Appendix G

THE RESPIRATORY PROTECTION PROGRAM

2-1. General requirements. *a.* The installation commander shall insure that a respiratory protection program conforming with the requirements of this document is established.

b. Respirators are considered an acceptable method of protecting the health of DA or DLA personnel only under the following circumstances:

(1) When it has been determined to the satisfaction of the installation medical authority that there are no feasible engineering or work practice controls that can be used to adequately control the hazard.

(2) During intermittent, nonroutine operations (i.e., not exceeding 1 hr/day for 1 day/week).

(3) During the interim periods when engineering controls are being designed and/or installed.

(4) During emergencies.

c. The installation medical authority shall evaluate respiratory hazards, identify locations or areas where respiratory protection is required and provide guidance in the conduct of the installation respiratory protection program.

d. Commanders or personnel in charge of operating activities will insure that their personnel are provided with approved respirators (without cost to the worker) after the requirement has been identified by the installation medical authority or personnel under his direction. Respirators (such as rocket propellant gas masks), procured under military or Federal specifications for protection against a contaminant or contaminants for which there is no NIOSH or MSHA schedule, may be used for specific applications involving the specific contaminant or contaminants for which a specification is given with concurrence of the installation medical authority (para 2-2*k*).

e. Individuals provided with respirators shall use them in accordance with instructions and training received (para 2-2*c*).

f. Installation Safety Managers, in coordination with the installation medical authority, shall conduct regular inspections and evaluations to determine the continued effectiveness of the respiratory protection program. The installation medical authority shall reevaluate respiratory hazards, as appropriate, to insure that the respiratory protection provided is adequate.

g. Military protective field masks designed and issued for protection against field concentrations of chemical, biological, and radiological warfare agents shall not be used in industrial applications unless they are also approved respirators.

2-2. Minimum acceptable Respiratory Protection Program. An effective respiratory protection program requires close liaison among workers, supervisors, safety, and medical personnel to safeguard life and health through proper selection and use of respirators. It includes the following elements:

a. Written standard operating procedures governing the selection and use of respirators shall be established (paras 2-3 and 2-6*c*(1)).

b. Respirators shall be selected on the basis of the hazards to which the worker is exposed (para 2-4).

c. The user shall be instructed and trained in the proper use of respirators and their limitations (paras 2-6 and 2-7).

d. Where practicable, the respirators should be assigned to individual workers for their exclusive use (para 2-4*i*).

e. Respirators shall be regularly cleaned and disinfected. Those issued for the exclusive use of one worker should be cleaned after each day's use, or more often if necessary. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use (para 2-8*e*).

f. Respirators shall be stored in a convenient, clean, and sanitary location (para 2-8*g*).

g. Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use, such as self-contained devices, shall be thoroughly inspected at least once a month and after each use (para 2-8).

h. Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained (para 2-10).

i. The continued effectiveness of the program shall be determined by regular inspections and evaluations (para 2-8*d*).

j. Persons shall not be assigned to tasks requiring use of respirators unless it has been determined that

TB MED 502
DLAM 1000.2

they are physically able to perform the work and use the equipment. The local physician shall determine which health and physical conditions are pertinent. The respirator user's medical status shall be reviewed periodically (for instance, annually) (para 2-10).

k. Only approved or accepted respirators shall be used. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities.

2-3. Standing operating procedures. Written standing operating procedures (SOP) shall be prepared including all information and guidance necessary for proper respirator selection, use, care, and maintenance. Possible emergency and routine uses of respirators should be anticipated and planned for. Written procedures shall be prepared covering the safe use of respirators in dangerous atmospheres that might be encountered in normal operations or in emergencies. Personnel shall be familiar with these procedures and the available respirators. Any respiratory SOP should be prepared by supervisory personnel with the assistance and approval of installation safety and medical authorities.

2-4. Selection and use of respiratory protective devices. The correct respirator shall be specified for each job. The installation medical authority or personnel under his guidance or in the case of DLA, the safety and health staff shall, on the basis of environmental evaluations and/or requirements set forth in 29 CFR 1910, Subpart Z, for specific substances, determine the type of respiratory protective device best suited for the task. Also, refer to section III, appendix B, for additional guidance in respirator selection. The individual issuing respirators shall be adequately instructed to insure that the correct respirator is issued. Each respirator permanently assigned to an individual shall be durably marked to indicate to whom it was assigned. This mark shall not affect the respirator performance in any way. The date of issuance shall be recorded. Respirator selection and use shall take into account health and safety factors, such as nature of the hazard, intended uses and limitations of respiratory protective devices, movement and work-rate limitations, emergency escape time and distance requirements, and training requirements. The human factor must also be considered since the effectiveness of the respiratory protection program can largely be determined by the degree of worker

acceptance. Worker acceptance of respirators is influenced by comfort; ability to breathe without objectionable resistance; adequate visibility under all conditions; provisions for wearing prescription lenses, if necessary; ability to communicate; ability to perform all tasks without undue interference; confidence in the facepiece fit; and convincing evidence that a respirator is necessary and that appropriate action is being taken, where possible, to eliminate the need for respiratory protective equipment.

2-5. Classification and description of respirators. Industrial respiratory protective devices have been designed, tested, and approved for protection against specific industrial exposures. These devices are conveniently grouped into two general classifications according to mode of operation. A detailed description is provided in appendix B.

a. Air-purifying respirators.

- (1) Gas masks and chemical cartridge (gases and vapors).
- (2) Particulates (dusts, fog, fume, mist, smoke, and sprays).
- (3) Combination gas, vapor, and particulate.

b. Atmosphere supplying respirators.

- (1) Self-contained.
- (2) Hose-mask.
- (3) Air line.
- (4) Combination self-contained and hose-mask or air line.

2-6. Selection and Limitations of respirators. a. The degree of respiratory hazard, as it refers to the selection and classification of respirators, depends upon the atmospheric oxygen concentration; contaminant's physical state, toxicity, and concentration; the presence of other contaminants or stress factors in the working environment; and worker exposure time and susceptibility. Respiratory hazards may be classified as gas and vapor contaminants (immediately or not immediately dangerous to life or health), particulate contaminants (immediately or not immediately dangerous to life or health), and oxygen deficiencies. Each classification requires a different degree of respiratory protection. Appendix B describes respiratory protective devices and limitations. A guide for the selection of the proper respiratory protective device is provided in table 1, appendix B. Table 2, appendix B, provides a list of tested and approved respiratory protective devices. Table 3, appendix B, lists air purifying respirators and gas masks available in the Federal supply system. An updated list of approved respirators and

information concerning the availability of air-supplied respirators within the Federal supply system will be maintained by the US Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD 21010. A guide to the identification of gas mask canisters is included in appendix C.

b. The importance of proper respirator selection is emphasized by the fact that improperly fitted or improperly selected respiratory protective devices, and devices with deteriorated or depleted canisters or cartridges, may provide reduced respiratory protection. In addition, inadequate protection may be provided against eye hazards such as projectiles; ultraviolet, infrared, or intense visible light; or eye irritants (para 2-4). Precautions must be taken also to insure acceptable air quality (para 2-12c). So that air supplied to hose-mask, air line, or self-contained respirators is not contaminated with carbon monoxide, oil, or other contaminants.

c. Respirator selection and use in atmospheres immediately dangerous to life or health (includes additional personnel requirements).

(1) User activities will prepare a written SOP for safe use of respirators. These procedures will be reviewed and approved by the installation safety and health personnel.

(2) If it is probable that atmospheres immediately dangerous to life or health may occur, then both the normally expected inward leakage and the reliability of the respirator shall be given full consideration. It is essential that in highly toxic atmospheres, inward leakage, if any, be minimal. In oxygen-deficient atmospheres with no toxic materials, inward leakage is normally not a problem unless the leakage exceeds a few percent. The recommended respirator types are listed in table 1, appendix B.

(a) In areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional person shall be present with suitable rescue equipment in the form of self-contained breathing apparatus and protective clothing. Communications (visual, voice, or signal line) shall be maintained between both or all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and have the proper rescue equipment to be able to assist the other(s) in case of emergency.

(b) When self-contained breathing apparatus are used in atmospheres immediately dangerous to life and health, standby personnel shall be present with suitable rescue equipment.

(3) Air line respirators are not approved for use in immediately dangerous atmospheres unless an auxiliary self-contained air supply or an air storage receiver with an alarm is also provided because no respiratory protection is provided if the air supply fails. The alarm for the storage receiver should be an audible or visual alarm, or combination, that is discernible from other alarms. The alarm(s) should be positioned so the respirator wearer and/or the standby personnel can recognize the alarm when activated. The alarm should have a mechanism that is tested prior to work in an immediately hazardous to life and health atmosphere. If conditions preclude use of the recommended types of respirators, air line respirators may be considered for use provided an adequate flow of respirable air is maintained and the conditions listed below are met.

(a) Persons using air line respirators in atmospheres immediately dangerous to life or health shall be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres or other equivalent provisions for the rescue of persons from hazardous atmospheres shall be used.

(b) Standby personnel with suitable self-contained breathing apparatus shall be located at the nearest fresh air base for emergency rescue.

(c) The air supply hose from a compressor or cylinder air supply will be protected from damage, including cutting, kinking, crushing, or burning. In some cases an armored hose will be used. Hose couplings will be protected against disconnection. Trailing air line hose shall be arranged to minimize tripping and to permit ready escape.

(d) The cylinder air supply shall meet the requirements specified in paragraph 2-12c. Oxygen must never be used with air line respirators.

(e) The compressor for supplying air shall conform with the requirements of paragraph 2-12d.

d. If immediately dangerous atmospheres are not present or cannot occur, the consequences of respirator failure are lessened and emphasis can be placed on other factors such as long-term protection, convenience, cost, comfort, and wearer acceptance. These factors should be weighed against one another since they are not always compatible. However, long-term protection should be given priority over all other factors. Long-term protection is determined primarily by the amount of inward leakage of atmospheric contaminants during normal usage of the respirator.

e. Other considerations for respirator selection.

(1) *Exposure time.*

(a) Work time usually determines the length of time for which respiratory protection is needed, including the time necessary to enter and leave a contaminated area. A self-contained breathing apparatus, gas mask, or chemical-cartridge respirator provides respiratory protection for relatively short periods. The hose mask with blower, air line respirator, and other supplied-air respirators provide protection for as long as the facepiece is supplied with adequate respirable air. Particulate-filter respirators can provide protection for long periods, without need for filter replacement, only if the atmospheric particulate loading is low. Therefore, for protracted periods of use, the hose mask with blower and air line respirators offer definite advantages. They also cause less discomfort than air purifying respirators.

(b) Some respirators have a means for indicating the remaining service life. Some type of warning is available for all self-contained breathing apparatus and a few gas masks. This may be a pressure gauge, timer, audible or physical alarm, or window indicator in the canister. The user should understand the operation and limitations of each type of warning device. Most other gas masks and chemical-cartridge respirators have no indicator of remaining service life. Canisters and cartridges should be changed according to the manufacturer's directions or on the basis of canister breakthrough data if available.

(2) *Activity of wearer.* The work area to be covered, work rate, and mobility required of the wearer in carrying out his work should be considered in respirator selection.

(a) Air purifying respirators present minimal interference with the wearer's movement. Supplied-air respirators with trailing hoses severely restrict the area the wearer can cover and present a potential hazard where the trailing hose can come in contact with machinery. Self-contained breathing apparatus present a size and weight penalty which may restrict climbing and movement in tight places.

(b) The wearer's work rate determines his respiratory minute volume, maximum inspiratory flow rate, and inhalation and exhalation breathing resistance. The respiratory minute volume is of great significance in self-contained and air line respirators operated from cylinders since it determines their operating life. Useful life under moderate work conditions may be one-third that under rest conditions.

(c) Peak airflow rate is important in the use of constant-flow, air line equipment. The air-supply rate should always be greater than the peak in-

spiratory flow rate to maintain the respiratory enclosure under positive pressure.

(d) High breathing resistance of air purifying respirators under conditions of heavy work can result in distressed breathing.

(3) *Unusual hazards.* Unique factors, which may add additional dimensions to the hazard potential and must be considered when selecting respirators include, for example, skin absorption of the contaminant, skin irritation, eye irritation, and radiation of skin or whole body.

(4) *Vision.* All facepieces will restrict, to some degree, the wearer's vision. This may increase accident potential. Other problems include wearing of prescription glasses and fogging of the respirator lens (para 2-7b(3) and (6)(a) below).

(5) *Communications.* Effective speech communication may be required in jobs for which the respirator is being selected. Conventional respirators distort the human voice. The respirator valve usually provides a pathway for some speech transmission over short distances in relatively quiet areas. However, talking can induce facepiece or component leakage and should be limited while wearing a respirator. Mechanical and/or electrical speech transmission devices which eliminate these problems are available.

(6) *Low temperatures.*

(a) Major problems in the use of full facepieces at low temperatures are poor visibility and freezing of exhalation valves. All full facepieces are designed so that the incoming fresh air sweeps over the inside of the lens to reduce fogging. Otherwise, it would be impossible to wear a full facepiece in ordinary room temperatures without severe fogging. Antifog compounds can be used to coat the inside of the lens to prevent fogging at room temperatures and down to temperatures approaching 0 degrees Fahrenheit. However, below 0 degrees Fahrenheit, antifog compounds will not prevent severe fogging.

(b) Full facepieces are available with nose cups that direct moist exhaled air through the exhalation valve. A properly fitting nose cup should provide satisfactory or adequate visibility at temperatures down to minus 30 degrees Fahrenheit.

(c) At very low temperatures, the exhalation valve may collect moisture and freeze open, allowing the wearer to breath contaminated air, or freeze closed, preventing normal exhalation. The Bureau of Mines has published two pamphlets on this subject: *Performance of Open Circuit Self-Contained Breathing Apparatus at Minus 25° F* and *Low-Temperature Performance of Compressed-Oxygen*

Closed-Circuit Breathing Apparatus. Dry respirable air will be used with self-contained breathing apparatus or air line respirators at low temperatures. The dewpoint of the breathing gas shall be appropriate to the ambient temperature.

(d) High pressure connections on self-contained breathing apparatus may leak because of metal contraction at low temperatures. The connections should not be overtightened since they may break when the temperature returns to normal.

(e) Ideally, air supplied to respirators should be warmed to at least 40° F.

(7) **High temperatures.** A man/woman working in areas of high ambient or radiant temperature is under stress. Any additional stress resulting from use of respirators should, therefore, be minimized. This can be done by selecting and using respirators having minimum weight and breathing resistance. Supplied-air respirators, hoods and suits having an adequate supply of cool breathing air are recommended. Further information on the use of respirators in high temperatures may be found in *A Fire Officer's Guide to Breathing Apparatus for the Fire Service*, published by the National Fire Protection Association (NFPA).

2-7. Training, face-fit, and leak-testing. Commanders shall insure that personnel required to use or to supervise personnel using respiratory protective devices are provided training as outlined in paragraph a below.

a. Training. Unless the reasons for the use of respirator protective devices and instructions on proper selection, use, and maintenance are thoroughly understood, and ongoing training provided, the devices may not be used or may not work properly. Both supervisors and workers shall be instructed by competent persons knowledgeable in the area of respiratory protection. Training shall provide individuals an opportunity to handle the respirator, have it fitted properly, test its facepiece-to-face seal, wear it in normal air for a long familiarity period, and finally to wear it in a test atmosphere. Minimum training shall include:

(1) Instruction in the nature of the hazard, whether acute, chronic, or both, and a frank appraisal of what may happen if the respirator is not used.

(2) Explanation of why more positive engineering or process-oriented controls are not immediately feasible to reduce or eliminate the need for respirators.

(3) A discussion of why this is the proper type of respirator for the particular purpose (app B).

(4) A discussion of the respirator's capabilities and limitations (app B).

(5) Periodic instruction and training in actual use of the respirator (preferably annually for emergency use respirators). Training should also include recognition of the end of the service life of cartridges/canisters or filters (e.g., smelling organic vapors through the cartridge/canister, manufacturer specified termination date, or an increase in breathing resistance).

(6) Classroom and field training to recognize and cope with emergency situations.

(7) Detailed instructions on cleaning and maintenance of the respirator (para 2-8).

(8) Any special training required for unique uses. Training for use of respiratory protective devices for firefighters will continue to be conducted by fire department personnel in close coordination with the medical authority.

b. Face-fit and leak-testing. Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly.

(1) Respirators are generally uncomfortable to wear. If a good facepiece-to-face seal can be obtained only by very tight strap tension, the respirator shall not be worn for prolonged periods and its use shall be avoided. Even though maximum breathing resistant is specified by NIOSH, there are differences among approved respirators and one type may be more acceptable to the worker than another. Facial structure varies considerably from one individual to another, and since a given respirator is usually made only in one size, a successful fit cannot always be achieved for all persons. Different sizes of the same model or different models of approved respirators may have to be obtained to provide employees adequate respiratory protection. Local purchase of respirators is authorized and shall be made when necessary in order to obtain an acceptable face fit.

(2) Before initial use, each respirator shall be properly fitted, leakage tests performed, and the facepiece-to-face seal tested in a realistic test situation. Records of fit tests shall be maintained locally at the installation level. These records shall, as a minimum, contain date of fit test, name of individual tested, make and model of each respirator tested and the results of each test. This test is not required when replacement respirators from the same manufacturer and the same size are obtained ((7) below).

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(3) Proper fitting of respiratory protective devices for individuals wearing corrective spectacles or goggles is a problem. A proper seal cannot be established if the temple bars or straps extend through the sealing edge of the facepiece. As a temporary measure, spectacles with short temple bars or without temple bars may be taped to the wearer's head. Contact lenses shall not be worn in a hazardous environment without appropriate covering safety eyewear. Contact lenses shall not be allowed for use with respirators equipped with full facepiece, helmet, hood, or suit. If a spectacle, goggle, face shield, or welding helmet must be worn with a facepiece, it shall be worn so as not to adversely affect the seal of the facepiece to face. Systems or kits for mounting corrective lenses inside full facepieces can be purchased with the facepiece. When a workman must wear corrective lenses as part of the facepiece, the facepiece and lenses shall be fitted by qualified individuals to provide good vision, comfort, and a gas-tight seal. Corrective lenses may be procured under the provisions of AF 385-32 or chapter 10, DLAM 1000.1.

(4) Each time the wearer puts on the respirator, positive and negative pressure tests shall be conducted to insure a satisfactory face fit. Respirators shall not be worn nor will workers be permitted to perform tasks that require respiratory protection when conditions such as a growth of beard, sideburns, a skull cap that projects under the facepiece, temple pieces on corrective spectacles or goggles, or the absence of one or both dentures prevent a good facepiece-to-face seal. When a specific model or type of respirator is first issued, proper facepiece-to-face seal shall be demonstrated by having the user wear the respirator in a realistic test atmosphere ((5) below).

(a) Positive pressure test. Close the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires the wearer to first remove the exhalant valve cover and then carefully replace it after the test.

(b) Negative pressure test. Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the

tightness of the respirator is considered satisfactory.

(5) The iso-amyl acetate (banana oil; NSN 6810-00-174-6604) vapor test is used principally for testing the facepiece seal of chemical cartridge/canister respirators. The facepiece-to-face seal of particulate-filter respirators may be tested by adapting organic vapor cartridges/canisters to the respirator, or by attaching a bag to the facepiece so as to enclose both inhalant and exhalant valves. An iso-amyl acetate vapor concentration of approximately 100 ppm can be prepared in a vacant room, a special chamber, box, or bag, without damage to its contents or the enclosure by evaporating three drops of iso-amyl acetate from an eyedropper for each 100 cubic feet of space. The face fit is considered satisfactory if the wearer can enter and remain in the test atmosphere for a minute or two without detecting the odor of iso-amyl acetate. If detected, the wearer should retreat to uncontaminated air, check the respirator, and readjust the face fit, then reenter the test atmosphere. Field tests may be conducted by moving a cotton swab containing one or two drops of iso-amyl acetate around the periphery of the facepiece while the wearer breathes normally. If the odor of iso-amyl acetate is detected, the wearer should check the respirator, readjust the face fit, and repeat the test. In either case above, if leakage is still noted, the particular respirator will not adequately protect the wearer.

(6) Quantitative fit testing of respirators is required by OSHA and, therefore, DA and DLA for selected airborne contaminants (refer to 29 CFR 1910). These systems generate atmospheres of some test substance and continuously monitor the internal (inside mask) and external concentrations so that accurate protection factors can be determined. Quantitative fit testing is the preferred method for all negative pressure respirator device fit testing. Installations having large respirator programs should consider procuring systems that quantitate respirator face-fit effectiveness.

Note. Dioctyl phthalate (DOP) as a test substance is not recommended for quantitative face fit testing. This recommendation is based on the current uncertainty of the toxicity of DOP and/or its decomposition products.

(7) Local records of respirator training, face-fit and leak testing shall be kept for at least the duration of employment or as specified by specific contaminant exposure (refer to 29 CFR 1910). These records shall include the following minimal information:

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by rinsing and air drying.

(a) Hypochlorite solution (50 ppm chlorine) for 2 minutes.

(b) Aqueous iodine solution (50 ppm iodine) for 2 minutes.

(3) Hypochlorite and iodine solutions or iodine compounds can damage respirator parts by aging rubber and corroding metal parts if immersion times are extended. Solvents (except as prescribed in (4) below), temperatures above 185 degrees F., and vigorous mechanical agitation should be avoided.

(4) Respirators contaminated with organic phosphate pesticides should be decontaminated by an alkaline soap wash and 50 percent isopropyl or ethyl alcohol rinse followed by the normal cleaning procedure.

f. Replacement or repair shall be done only by experienced persons using parts designed for the respirators. No attempt shall be made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations. Reduction or admission valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair.

g. Respirator storage shall be as follows:

(1) After inspection, cleaning, and necessary repair, respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals and other contaminants. Respirators placed at stations and work areas for emergency use should be stored in compartments built for that purpose, clearly marked to indicate the content, and must be quickly accessible at all times. Routinely used respirators, such as dust respirators, may be placed in plastic bags. Respirators should not be stored in such places as lockers or tool boxes unless they are in containers or cartons.

(2) Respirators shall be packed or stored so the facepiece and exhalation valve will not be damaged by being subjected to crushing or cramming.

(3) Instructions for proper storage of emergency respirators, such as gas masks and self-contained breathing apparatus, are found in "use and care" instructions usually mounted inside the carrying case lid.

2-9. Routine inspections. a. Respiratory protection is no better than the respirator in use, even though it is worn conscientiously. Frequent random inspections shall be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained.

b. Respirators used routinely will be inspected

during cleaning. Experienced personnel shall replace worn or deteriorated parts with parts designed for the respirator. No attempt shall be made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations. Reducing admission valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair. Respirators for emergency use, such as self-contained devices, shall be thoroughly inspected at least once a month and after each use, and a written record kept of inspection dates and findings.

2-10. Medical evaluation of worker. Workers shall not be assigned to tasks requiring the use of respirators unless it has been determined by medical evaluation that they are physically and physiologically able to perform their work while wearing the prescribed respiratory protection. This medical evaluation should consist of pulmonary function screening, including as a minimum the determination of the forced expiratory volume in 1 second (FEV₁) and the forced vital capacity (FVC). It may also include other procedures, such as tests of the cardiovascular and respiratory systems, which the medical examiner considers useful in evaluating the ability to use respirators. It should be noted that pulmonary function tests (PFT) are useful in this evaluation only as a screening tool. Abnormal PFT in and by themselves are not grounds for disqualification. In the event abnormal PFT are noted, the worker's medical history, the worker's age, the nature of the work to be performed while wearing a respirator, the type of respirator to be employed, the results of other tests of cardiovascular and respiratory status, and a "use" test should be considered before disqualifying the worker for respirator use. The medical status of the respirator user should be reviewed periodically.

2-11. Bioassay. When respiratory protection is used to control individual exposure to radioactive materials, all provisions of 10 CFR 20 shall be followed by the Nuclear Regulatory Commission (NRC) licensee to include verification of the effectiveness of the program by a routine bioassay program performed by an accredited laboratory. Bioassay services are available from the US Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD 21010. Except as authorized by the NRC, no allowances may be made for radioactive particle size or for the protective clothing or equipment in determining whether an individual was exposed to excessive concentrations (AR 40-14/DLAR 4145.24). (See NRC Regulatory Guide

(a) Name, social security number (or other identifying worker number).

(b) Job title.

(c) Office symbol, work location, supervisor's name.

(d) Date of training or testing.

(e) Date of medical evaluation.

(f) Type of respirator tested.

(g) Results of respirator fitting tests.

(h) Success or failure of person to obtain a satisfactory fit if a qualitative fitting test was performed.

(i) Respirator protection factor based upon test results if a quantitative respirator fitting test was performed.

(j) Name of person performing the training or testing.

(k) The presence of facial hair, long hair or side burns, etc.

(l) Wear's need for glasses or other eye protection.

(m) Other pertinent information.

Records should be identified to allow for cross-referencing with worker contaminant exposure data (sampling data).

(8) Locally designed respirator user cards should be issued to individuals who have been trained, fitted, and medically evaluated to use respirators. A respirator user card should indicate:

(a) Name or other worker identifying number.

(b) A statement that "_____ has been trained, fitted, and medically evaluated to use the respirator(s) indicated."

(c) The respirator(s) for which the cardholder may be issued.

(d) The expiration date.

2-8. Maintenance and care of respirators. When respirators are issued to individuals, the individual is responsible for primary maintenance and care of his/her respirator. Where respirators are used collectively or kept ready for emergencies by a shop or operating activity, the commander or supervisor of the activity is responsible for establishing a respirator maintenance and cleaning program. This program shall be adjusted for the number of types of respirators in use, working conditions and hazards involved, and shall include the basic services: inspection for defects (including a leak check), cleaning and disinfecting, repair, and storage. Equipment shall be properly maintained to retain its original effectiveness.

a. All respirators shall be inspected routinely before and after each use. A respirator that is not

routinely used but kept ready for emergency use shall be inspected after each use and at least monthly to assure that it is in satisfactory working condition.

b. Self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be fully charged according to the manufacturers' instructions. It shall be determined that the regular and warning devices function properly.

c. Respirator inspection shall include a check of the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters. Rubber or elastomer parts shall be inspected for pliability and signs of deterioration. Stretching and manipulating rubber or elastomer parts with a massaging action will keep them pliable and flexible, and prevent them from hardening or stiffening during storage.

d. The user activity shall keep a record of inspection dates, findings, and corrective actions for respirators maintained for emergency use.

e. Respirators issued to specific individuals shall be collected, cleaned, and disinfected as frequently as necessary to insure that skin penetrating and dermatitis-causing contaminants are removed from respirator surfaces. Respirators maintained for emergency use or used by more than one person shall be cleaned and disinfected after each use.

(1) The following procedure is recommended for cleaning and disinfecting respirators:

(a) Remove any filters, cartridges, or canisters.

(b) Wash facepiece and breathing tube in a cleaner-disinfectant solution. A brush may be used to facilitate dirt removal.

(c) Rinse completely in clean, warm water.

(d) Air dry in a clean area.

(e) Clean other respirator parts as recommended by the manufacturer.

(f) Inspect valves, headstraps, and other parts; replace defective parts with new ones.

(g) Insert new filters, cartridges, or canisters periodically as specified by the manufacturer; make sure seal is tight.

(h) Place in plastic bag or other closed container for storage.

(2) Cleaner-disinfectant solutions may be commercially prepared solutions, which are followed by a clean, warm-water rinse and air dried; or respirators may be washed in a liquid detergent solution. After washing, additional disinfection may, if desired, be provided by dipping the mask in one of the following disinfectant solutions, followed

8.15. Acceptable Program for Respiratory Protection.)

2-12. Air quality. Compressed air, compressed oxygen, liquid air and liquid oxygen used for respiration shall be of high purity.

a. Cylinders shall be tested and maintained as prescribed in the Shipping Container Specifications of the Department of Transportation (49 CFR 178).

b. Oxygen shall meet the requirements of the United States Pharmacopeia for medical or breathing oxygen: Oxygen at least 99 percent, carbon dioxide less than 300 ppm, carbon monoxide less than 10 ppm, and nitric oxide and nitrogen dioxide less than 5 ppm. Compressed oxygen shall not be used in supplied air respirators or in open circuit self-contained breathing apparatuses that have previously used compressed air. Oxygen must never be used with air line respirators.

c. Breathing air for respirators may be supplied from cylinders or air compressors. It shall meet at least the requirements of the specification for Grade D breathing air as defined in American National Standards Institute (ANSI) Standard Z86.1/ Compressed Gas Association (CGA) Specification G-7.1, viz.: oxygen 19.5-23.5 percent, hydrocarbons (condensed) less than 5 mg/m³, carbon monoxide less than 20 ppm, and carbon dioxide less than 1000 ppm.

d. The compressor for supplying breathing air shall be equipped with necessary safety and standby devices as stated below. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system. Suitable in-line air purifying sorbent beds and filters shall be installed and maintained to further assure breathing air quality. An air storage receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in event of a compressor failure, and alarms to indicated com-

pressor failure and/or overheating shall be installed in the system. When feasible, oil-free compressors should be procured when obtaining additional or replacing existing compressors used for supplying breathing air. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor should be tested for carbon monoxide at least monthly, or more frequently as indicated, to insure that it meets air quality specifications. Accurate records of these test results should be maintained by the appropriate user surveillance organization. For activities having difficulty in acquiring breathing air alarm systems, breathing air will be sampled prior to use and every 4 hours during use with NIOSH approved direct reading carbon monoxide indicator tubes or commercially available direct reading instruments. If carbon monoxide levels exceed 10 ppm, operations will be stopped until corrective action is taken. Accurate records of these sampling results will be maintained.

e. Air line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air line respirators with nonrespirable gases or oxygen. Installation areas having heavy piping or outlet areas with more than one type of gas system should be properly marked with labels, signs, and/or color code connectors to further prevent attempts to connect to nonrespirable air supplies.

f. Breathing gas containers shall be marked in accordance with American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained, Z48.1-1954; Federal Specification BB-A-1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG-B-00675b, April 27, 1965, Breathing Apparatus, Self Contained.

REFERENCES

- AR 40-5, Health and Environment.
AR 40-14/DLAR 4145.24, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation.
AR 310-25, Dictionary of United States Army Terms.
AR 385-32, Protective Clothing and Equipment.
Defense Logistics Agency (DLA) Manual 1000.1, DLA Safety and Health Manual.
Federal Specification BB-A-1034a, Compressed Air for Breathing Purposes, 21 June 1968.
Interim Federal Specification GG-B-00675b, Self-Contained Breathing Apparatus, 27 April 1965.
Title 10, Nuclear Regulatory Commission, Code of Federal Regulations (CFR), Part 20, Standards for Protection Against Radiation.
Title 29, Department of Labor (DOL), CFR, Part 1910, Occupational Safety and Health Standards.
Title 30, DOL, CFR, Part I, Mine Safety and Health Administration, Establishment and Use of Official Emblem.
Title 30, DOL, CFR, Part II, Respiratory Protection Devices; Test for Permissibility; Fees.
Title 49, Department of Transportation, CFR, Part 178, Shipping Container Specifications.
American National Standards Institute (ANSI) Standard Z48.1/Compressed Gas Association (CGA) C-4-1954, Method of Marking Portable Compressed Gas Contained to Identify the Material Contained.
ANSI Standard Z86.1-1973/CGA Specification G-7.1, Commodity Specification for Air.
ANSI Standard Z88.1-1969, Safety Guide for Respiratory Protection Against Radon Daughters.
ANSI Standard Z88.2-1980, Practices for Respiratory Protection.
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Appendix H

DESCRIPTION AND LIMITATIONS OF RESPIRATORY PROTECTIVE DEVICES

Section I. AIR PURIFYING RESPIRATORS

B-1. General description. Half-mask facepiece, full facepiece, or mouthpiece respirators equipped with air purifying units to remove gases, vapors and particulate matter from the ambient air prior to its inhalation. Some air purifying respirators are blower-operated and provide respirable air to the facepiece (or hood) under a slight positive pressure.

B-2. General limitations. *a.* Air purifying respirators do not protect against oxygen-deficient atmospheres nor against skin irritation by or absorption through the skin of airborne contaminants.

b. The maximum contaminant concentration against which an air purifying respirator will protect is determined by the designed efficiency and capacity of the cartridge, canister or filter for the contaminant. The maximum concentration for which the air purifying unit is effective is specified below or by applicable Federal occupational health standards. *Respirators do not provide the maximum design protection specified unless the facepiece is carefully fitted to the wearer's face to prevent inward leakage.* The time period over which protection is provided is dependent on canister, cartridge or filter type; concentration of contaminant; and the wearer's respiratory rate. The proper type of canister, cartridge or filter must be selected for the particular atmosphere and conditions. Air purifying respirators may cause discomfort and objectionable resistance to breathing. Respirator facepieces present special problems to individuals required to wear prescription lenses.

B-3. Gas and vapor-removing respirators. *a. General description.* Packed sorbent beds (cartridge or canister) remove single gases or vapors (for example, chlorine gas); a single class of gases or vapors (for example, organic vapors); or a combination of two or more classes of gases and vapors (for example, acid gases, organic vapors, ammonia, and carbon monoxide) by adsorption, chemical reaction or catalysis, or a combination of these methods.

b. General limitations. No protection is provided against particulate contaminants, unless specified on canister or cartridge label. A rise in canister or cartridge temperature indicates that a gas or vapor is being removed from the inspired air. This is not a reliable indicator of canister performance. An uncomfortably high temperature indicates a high concentration of gas or vapor, and requires an immediate return to fresh air.

c. Gas masks.

(1) Description. Includes all completely assembled air purifying masks which are designed for use as respiratory protection during entry into atmospheres not immediately dangerous to life or health, or escape only from hazardous atmospheres containing adequate oxygen to support life. They are further described according to the types of gases or vapors they are designed to protect against.

(a) Front-mounted and back-mounted. A gas mask which consists of a full facepiece, breathing tube, canister at the front or back, canister harness, and associated connections.

(b) Chin-style gas mask. A gas mask which consists of a full facepiece, canister which is usually attached to the facepiece and associated connections.

(c) Escape gas mask. A gas mask designed for use during escape only from hazardous atmospheres which consists of a mouthpiece, canister and associated connections.

(2) Limitations.

(a) Gas masks shall be used only for escape from (not entry into) atmospheres immediately dangerous to life or health, and shall not be used against gases or vapors with poor warning properties or which generate high heats of reaction with sorbent materials in the canister.

(b) In general gas masks have only been tested and approved against the following contaminants or class of contaminants as follows:

Contaminant	Mask type					
	Front or back mounted		Chin style		Escape only	
	Max. conc. (ppm)	Time (min)	Max. conc. (ppm)	Time (min)	Max. conc. (ppm)	Time (min)
Acid gas	20,000	12	5,000	12	5,000	12
Ammonia	30,000	12	5,000	12	5,000	12
Organic vapor	20,000	12	5,000	12	5,000	12
Carbon monoxide	20,000	60	none	—	10,000	60
Combination of all above	Same as above except time for acid gas, organic vapor and ammonia is 6 minutes.					

(c) Eye protection may be required when escape type gas masks are used.

d. Chemical cartridge respirators.

(1) *Description.* Includes all completely assembled respirators which are designed for use as respiratory protection during entry into or escape from atmospheres not immediately dangerous to life and health, and are described according to the specific gases or vapors against which they are designed to provide respiratory protection. Each device may contain the following component parts,

as appropriate: Facepiece (half-mask or full), mouthpiece, hood, or helmet; cartridge; cartridge with filter; harness; breathing tube; attached blower.

(2) Limitations.

(a) *Chemical cartridge respirators shall not be used in atmospheres immediately dangerous to life or health, and will be limited to the maximum concentration of gases and vapors specified below or as specified on the cartridge (also see specific standard for control of exposure to chemical(s) in question):*

Type of chemical cartridge respirator

	Maximum use concentration (ppm)
Ammonia.....	300
Chlorine.....	10
Hydrogen chloride.....	50
Methyl amine.....	100
Organic vapor*.....	1,000
Sulfur dioxide.....	50
Vinyl chloride.....	10

*Not for use against organic vapors with poor warning properties or those which generate high heats of reaction with sorbent material in the cartridge. Maximum use concentrations are lower for organic vapors which produce atmospheres immediately dangerous to life or health at concentrations equal to or lower than this concentration.

(b) *Half-Mask facepiece.* No protection is provided for the eyes. Fabric coverings of the facepiece shall not be used since they will permit gases and vapors to leak into the mask.

(c) *Mouthpiece respirator.* Mouth breathing prevents detection of contaminants by odor. The nose clip shall be securely in place to prevent nasal breathing. No protection is provided to the eyes.

B-4. Dust, fume, and mist respirators. a. Description. Includes all completely assembled respirators designed for use as respiratory protection during entry into and escape from hazardous particulate atmospheres which contain adequate oxygen to support life. Devices may be attached to a powered blower. Each device may contain the following component parts as required: Facepiece (half-mask or full), mouthpiece with nose clip, hood or helmet; filter unit; harness; attached blower; and breathing tube. These devices are further described as follows:

(1) Respirators, either with replaceable or reusable filters, designed as respiratory protection against dusts, fumes, and mists having maximum acceptable exposure limits not less than 0.05 milligram per cubic meter (mg/m³) of air.

(2) Respirators, with replaceable filters, designed as respiratory protection against dust, fumes, and mists having maximum acceptable exposure limits less than 0.05 mg/m³ (high efficiency filter).

(3) Respirators, with replaceable filters, designed as respiratory protection against radon daughters, and radon daughters attached to dusts, fumes and mists (high efficiency filter).

(4) Respirators, with replaceable filters, designed as respiratory protection against asbestos containing dusts and mists.

(5) Single-use dust respirators designed as respiratory protection against pneumoconiosis and

(a) *Demand type apparatus.* An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during exhalation and negative during inhalation.

(b) *Pressure-demand type apparatus.* An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during both inhalation and exhalation.

b. Limitations.

(1) *General.* Use is permissible in atmospheres immediately dangerous to life or health. The period over which the device will provide protection is limited by the amount of air oxygen in the apparatus, the ambient atmospheric pressure (service life is cut in half by a doubling of the atmospheric pressure), and workload. A warning device shall be provided to indicate to the wearer when the service life has been reduced to a low level. Some SCBA devices have a short service life (few minutes) and are suitable only for escape (self-rescue) from an irrespirable atmosphere. Chief limitations of SCBA devices are their weight or bulk or both, limited service life, and the training required for their maintenance and safe use.

(2) *Closed-circuit apparatus.* The closed-circuit operation conserves oxygen and permits longer service life.

(3) *Open-circuit demand and pressure demand.* The demand type produces a negative pressure in the facepiece on inhalation whereas the pressure-demand type maintains a positive pressure in the facepiece and is less apt to permit inward leakage of contaminants.

B-10. Supplied-air respirators. a. Description. Includes all completely assembled respirators designed for use during entry into or escape from hazardous atmospheres. The respirable air supply is not limited to the quantity an individual can carry, thus the devices are lightweight and relatively simple.

(1) *Type "A" supplied air respirator.* A hose mask respirator for entry into and escape from atmospheres not immediately dangerous to life or health. It consists of a motor-driven or hand-operated blower that permits the free entrance of air when the blower is not operating, a strong large-diameter hose having a low resistance to airflow, a harness to which the hose and the lifeline are attached, and a tight fitting facepiece. (This respirator shall not be used in oxygen deficient atmospheres.)

(2) *Type "B" supplied-air respirator.* A hose mask respirator for entry into and escape from atmospheres not immediately dangerous to life or

health. It consists of a strong, large-diameter hose with low resistance to airflow through which the user draws inspired air by means of his lungs alone, a harness to which the hose is attached, and a tight fitting facepiece.

(3) *Type "C" supplied-air respirator.* An air line respirator for entry into and escape from atmospheres not immediately dangerous to life or health. It consists of a source of respirable breathing air; a hose; a detachable coupling; a control valve; orifice; demand valve or pressure-demand valve; an arrangement for attaching the hose to the wearer; and a facepiece, hood or helmet.

(4) *Types "AE," "BE," and "CE" supplied-air respirators.* Types "A," "B," or "C" supplied air respirator equipped with additional devices designed to protect the wearer's head and neck against impact and abrasion; and with shielding material to protect the window(s) of facepieces, hoods, and helmets that do not unduly interfere with the wearer's vision and permit easy access to the external surface of such window(s) for cleaning.

b. Limitations.

(1) *General.* The wearer is restricted in movement by the hose or air line, and must return to a respirable atmosphere by retracing his route of entry. The hose or air line is subject to being severed or pinched-off.

(2) *Type "A" hose mask respirator with blower.* If the blower fails, the unit still provides an air supply and sufficient protection to permit the wearer to escape although a negative pressure exists in the facepiece during inhalation. Use is not permissible in atmospheres immediately dangerous to life or health including oxygen deficient atmospheres.

(3) *Type "B" hose mask without blower.* If the air supply fails, no protection is provided the wearer. Limited to use in atmospheres not immediately dangerous to life or health and from which the wearer can escape unharmed without aid of the respirator.

(4) *Type "C" air line respirators* (continuous flow, demand and pressure-demand types). The demand type produces a negative pressure in the facepiece on inhalation, whereas continuous flow and pressure-demand types maintain a positive pressure in the facepiece at all times and are less apt to permit inward leakage of contaminants. Demand flow and pressure-demand air line respirators may be used in atmospheres immediately dangerous to life or health provided an auxiliary self-contained air supply is worn to permit escape if the air supply fails.

fibrous producing dusts, or dusts and mists, including asbestos.

b. Limitations.

(1) *General.* Protect against nonvolatile particles only. No protection against gases and vapors. The filter shall be replaced or cleaned when breathing becomes difficult due to plugging by retained particles. These respirators shall not be used during shot and sand blasting operations.

(2) *Half-Mask facepieces.* Fabric coverings are only permissible in atmospheres of coarse dusts and mists of low toxicity. No protection is provided to the eyes.

(3) *Mouthpiece respirator.* Nose clip shall be firmly in place to prevent nasal breathing. Mouth breathing prevents the detection of any incidental vapor contaminants by odor. No protection is provided to the eyes.

B-5. Combination gas, vapor, and particulate removing respirators.

a. Description. Includes all the devices discussed having either canisters or cartridges with filters for protection against dusts, mists, fumes, gases and vapors. These include respirators which have been tested against lacquer and enamel mists (paint spray respirators).

b. Limitations. With the exception that these devices protect against both gases and vapors and particulates, the limitations of the other devices would also apply to the combination device.

B-6. Pesticide respirators. *a. Description.* Completely assembled respirators designed for use as

respiratory protection during entry into and escape from atmospheres containing hazardous levels of pesticides. These include the following types:

- (1) Front- or back-mounted gas masks.
- (2) Chin style gas masks.
- (3) Chemical cartridge respirator.
- (4) Air purifying respirator with attached blower.
- (5) Combination devices.

b. Limitations. Limitations previously discussed for each type of device will also apply, in general, to pesticide respirators.

c. Fumigation. Fumigant use in enclosed areas, indoor areas, or where poor ventilation is present should be closely controlled. Only gas masks,* air line or self-contained breathing apparatus (SCBA) should be used. Only canisters specifically designed for the particular fumigant exposure should be used. Canisters should be used only once because of the poor warning properties of many fumigants.

<i>Fumigant</i>	<i>Suggested respiratory protection</i>
Aluminum phosphide ...	Canister specifically for phosphine; SCBA; air line
Hydrocyanic acid (hydrogen cyanide)....	Canister specifically for hydrogen cyanide; SCBA; air line
Methyl bromide.....	Canister specifically for methyl bromide; SCBA; air line
Methylene chloride	SCBA or air line only

* Gas masks are designed solely to remove specific contaminants from the air. It is essential that their use be restricted to atmospheres which contain sufficient oxygen to support life (at least 19.5 percent by volume) and which contain generally no more than 2 percent concentrations of toxic gases and vapors by volume. If the specific exposure concentrations are suspected of exceeding the specific limitations, only a self-contained breathing apparatus or air line respirator should be used.

Section II. ATMOSPHERE SUPPLYING RESPIRATORS

B-7. General description. A respirable atmosphere is supplies independent of the ambient air surrounding the wearer. These devices provide protection against oxygen deficiency and most toxic atmospheres.

B-8. General limitations. Except for the supplied-air suit, no protection is provided against skin irritation by materials such as ammonia and hydrochloric acid (HCl), or against absorption of materials such as hydrocyanic acid (HCN), tritium, or organic phosphate pesticides through the skin. Facepieces present special problems to individuals required to wear prescription lenses.

B-9. Self-contained breathing apparatus. *a. Description.* Includes all completely assembled, portable, self-contained devices designed for use as respiratory protection during entry into and escape from, or escape only from, hazardous atmospheres.

(1) *Closed-circuit apparatus.* An apparatus of the type in which the exhaled air is rebreathed by the wearer after the carbon dioxide has been effectively removed and a suitable oxygen concentration restored from sources composed of compressed, chemical, or liquid oxygen.

(2) *Open-circuit apparatus.* An apparatus of the following types from which exhaled air is vented to the atmosphere and not rebreathed:

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Appendix I

Section III. TABLES FOR GENERAL INFORMATION

Table 1. Guide for Selection of Respirators
*Respirator**

<i>Hazard</i>	
Oxygen deficiency.	Self-contained breathing apparatus. Combination air-line (Type C) with auxiliary self-contained air supply or an air-storage receiver with alarm.
Gas and vapor contaminants immediately dangerous to life or health.	Self-contained breathing apparatus. Air-purifying, full facepiece respirator with chemical canister (gas mask for escape only).** Self-rescue mouthpiece respirator (for escape only).** Combination air-line respirator (Type C) with auxiliary self-contained air supply or an air-storage receiver with alarm.
Not immediately dangerous to life or health.	Air-line respirator (Type C). Hose mask with blower (Type A). Hose mask without blower (Type B). Air-purifying, gas-mask or chemical cartridge respirator with appropriate canister or cartridge.**
Particulate contaminants immediately dangerous to life or health.	Self-contained breathing apparatus. Air-purifying, full facepiece respirator (gas mask) with appropriate filter (for escape only).** Self-rescue mouthpiece respirator (for escape only).** Combination air line respirator (Type C) with auxiliary self-contained air supply or air-storage receiver with alarm.
Not immediately dangerous to life or health.	Air purifying, half-mask or mouthpiece respirator with filter pad or cartridge. Air line respirator (Type C). Air line abrasive-blasting respirator (Type CE). Hose mask with blower (Type A). Hose mask without blower (Type B or BE).
Combination gas, vapor and particulate contaminants immediately dangerous to life or health.	Self-contained breathing apparatus. Air purifying, full facepiece respirator with chemical canister and appropriate filter (gas mask with filter).** Self-rescue mouthpiece respirator (for escape only). Combination air line respirator (Type C or CE) with auxiliary self-contained air supply or an air-storage receiver with alarm.
Not immediately dangerous to life or health.	Air line respirator. Hose mask with blower (Type A). Hose mask without blower (Type B or BE). Air purifying, gas mask or chemical cartridge respirator with appropriate filter.**

* Refer to section I, appendix B, for a more complete description of respirator.

** Not for use against gases or vapors with poor warning properties or which generate high heats of reaction with sorbent materials in canister or cartridge.

Table 1. Air Purifying Respirators and Gas Masks Available in the Federal Supply System

NSN†	Respirator
4240-00-022-2524*	Respirator, air filtering; cartridge filter and filter pad filter; half facepiece mask; designed for paint mist filter protection; cartridge for organic vapors. Accessory single cartridge type furnished with 25 cartridges and 50 filter; dual cartridge type furnished with 50 cartridges and 100 filters.
4240-00-069-2684*	INACTIVE - DELETED replaced by 4240-01-015-5194
4240-00-084-9394*	Respirator, air filtering; filter pad filter; half facepiece mask; designed for nuisance, pneumococcosis and toxic dust filter protection including asbestos. Accessory 50 filter elements furnished with each type I respirator having single attachment and 100 filter elements with each type I respirator having 2 attachment provisions. (Protection included for asbestos.)
4240-00-099-6939*	Respirator, air filtering; filter pad filter; half facepiece mask; designed for metal fumes filter protection. Accessory single filter receptacle type furnished with 50 filters, dual filter receptacle type furnished with 100 filters.
4240-00-276-8935* (when exhausted, use 4240-00-022-2524)	Respirator, air filtering; half facepiece mask; cartridge for organic vapor protection.
4240-00-368-6149	Respirator; air filtering; half facepiece mask; designed for nuisance dust filter protection.
4240-00-817-9233* (To be discontinued; use until depleted)	Respirator, air filtering; cartridge filter and filter pad filter; half facepiece mask; designed for paint mist filter protection.

See footnotes on page A-2.

NSN†	Respirator
4240-01-015-5194*	Respirator, air filtering; half facepiece mask; cartridge for organic vapor protection. Accessory 50 cartridges shall be furnished with each single receptacle mask and 100 cartridges with each dual receptacle mask.
4240-01-035-9250*	Respirator, air filtering; half facepiece mask; designed for toxic pesticides in dust, mists, sprays, and vapors filter protection. Accessory 25 cartridges and 50 filters shall be furnished with each single acceptable mask and 50 cartridges and 100 filters with each dual receptacle mask. Note: Requisitions for 4240-01-035-9250 to the Defense Logistics Agency Supply System must be made "off line" until such time as this National Stock Number is published in the Army Master Data File.
4240-00-268-9735	Mask, Gas, Acid and Organic Vapors, M10
4240-00-540-2404	Mask, Gas, All Purpose, M11A1
4240-00-268-9736	Mask, Gas, Ammonia, M12
4240-00-723-5472	Mask, Gas, Rocket Propellant, Small ABC-M21
4240-00-723-5471	Mask, Gas, Rocket Propellant, Medium
4240-00-725-7490	Mask, Gas, Rocket Propellant, Large

* Respirators procured under Mil Spec GGG-M-125 requiring National Institute for Occupational Safety and Health (NIOSH) testing and certification.

† Different manufacturer's products may be received under the same National Stock Number as a result of General Services Administration procurement procedures.

NSN	Breathing apparatus	Use
4240-00-880-1728	Breathing apparatus, self-contained demand type, M-23 facepiece and breathing tube assembly, body harness and air or oxygen containers, demand valve, pressure reducing valve.	Used in atmospheres that are immediately dangerous to life due to oxygen deficiency or high concentration of contaminants.

NOTICE

PLEASE READ CAREFULLY BEFORE USING TABLE 3

Table 3 was updated using the DHEW (NIOSH) Publication No. 82-106. Appendix E contains specific guidance on high efficiency filter use. The philosophy in Appendix E was not consistently reflected in the NIOSH publication. Therefore the information in Appendix E should be taken into consideration before making a decision concerning respirators for asbestos, paint spray containing chromium or lead, and pesticides.

Call Mr. Stephan Graham, AUTOVON 584-2559/2439, if you see something in error or if you have a question.

TABLE 2. Air-supplied and Self-Contained Breathing Apparatus Available in the Federal Supply System

NSN	Breathing apparatus	Use
4240-00-049-5435	Breathing apparatus, self-contained, M-15, facepiece, hose, regulator, and back-pack and harness. <u>Note:</u> The M-15 breathing apparatus <u>cannot</u> be certified under provisions of 30 CFR 11 due to design deficiencies.	To supply respirable air to handlers of liquid guided missile fuels and oxidizers. Also can be used in any area where there is a deficiency of oxygen. It is <u>not</u> certified for use to provide protection in atmospheres containing high levels of toxic chemical agents.
4240-00-678-5263	Breathing apparatus, oxygen-generating, M-20, facepiece, breathing-bag assembly and cannister. <u>Note:</u> The M20 apparatus is <u>not</u> intended for use in place of a field protective mask for CBR protection. The apparatus supplies breathable oxygen to the user for only 1 hour when breathing rate is comparable to doing moderately heavy work. <u>Limitation:</u> The basic design is adapted from commercial sources but modified to back-pack configuration to meet military requirements. This modification nullified previous Bureau of Mines approval. The apparatus <u>cannot</u> be certified due to design deficiencies.	Use where there is a deficiency of oxygen in the atmosphere or a high concentration of toxic vapor, gas, dust, or smoke that precludes the use of an air-purifying canister-type mask.

APPENDIX E

HIGH EFFICIENCY FILTER USE

E-1. There have been numerous inquiries concerning the use of various approved respirators on certain applications that are not specified in 30 CFR 11 or 29 CFR 1910. The use of the NIOSH/MSHA approved respirators are acceptable for the following applications provided the maximum use concentration permitted in each class of respirator is not exceeded.

- a. Asbestos. High efficiency particulate filter cartridges.
- b. Paint spray containing chromium or lead. Combination high-efficiency particulate filter and organic vapor cartridges or canisters.
- c. Pesticides. Combination high-efficiency particulate filter and organic vapor cartridges or canisters.

E-2. The Type H high efficiency filter is approved for dusts, fumes, and mists having a Permissible Exposure Level (measured as an 8 hour time weighted average) less than 0.05 milligram per cubic meter. These filters must be at least 99.97 percent efficient against a 0.3 μ m particulate to be approved.

E-3. NIOSH regards all approved Type H respirators as satisfactory protection against asbestos. In fact, because of their higher efficiency the Type H may offer more protection than the approved "asbestos containing dust and mist filter."

E-4. However, Type H filters generally have poorer loading characteristics than the filter designed for protection against less toxic dusts. This means that the breathing resistance increases faster. Thus, the filters may have to be changed more often.