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HEALTH AND SAFETY PROGRAM

INSTALLATION RESTORATION PROGRAM

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Prepared for

NATIONAL GUARD BUREAU
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and

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1.0 INTRODUCTION

The E.C. Jordan Co. (Jordan) began a formal program of site risk assessment and implementation of mitigative health and safety programs in March 1981. At that time, existing departmental policies/practices were collected and reviewed, additional needs identified and a corporate personnel health and safety plan drafted.

Currently, Jordan's seven-member Personnel Health and Safety Committee (PHSC) regularly reviews health and safety issues, updates practices as new information becomes available, oversees administration of the Health Monitoring Program and provides guidance for personnel training as appropriate. The PHSC is a corporate entity, effectively precluding any departmental and contract pressures on health and safety policy decisions.

Each project site is classified hazardous or non-hazardous by the PHSC after a review of available data. Prior to on-site activities at those sites classified as hazardous, a summary safety plan (Appendix A) must be completed by the project engineer/scientist. This is accomplished by a review of available information on the site to assess the potential risks and provide an initial determination of personal protection requirements. The summary safety plan is subsequently reviewed and must be approved by a member of the PHSC. The designated Site Safety Officer monitors actual site conditions and may alter these requirements as needed. In all cases, personnel safety is the paramount factor in decision-making.

2.0 HEALTH MONITORING AND SAFETY PROGRAM

To protect the health and safety of employees assigned to work at hazardous waste sites, the Jordan has developed and implemented a Health and Safety Program. This program is administered by a committee consisting of representatives of Jordan technical department staffs with support from medical advisors. All personnel on-site must be enrolled in the Health Monitoring Program and must receive training appropriate for their assigned function.

In addition to Jordan employees, subcontractors and consultants working on hazardous waste sites will be enrolled in an equivalent Health Monitoring Program and receive health and safety indoctrination prior to commencing work on the site. Indoctrination, training and periodic followup is conducted as appropriate. Indoctrination and training includes:

- site history;
- inventory of site chemicals known or suspected (will be updated and reviewed at each stage of the field investigation program);
- project organization;
- work plan review;
- project documentation;
- review of site safety plan (site safety plans are updated as new information becomes available)
- review of decontamination procedures;
- proper use and care of personal protective equipment;
- proper calibration and use of monitoring equipment;
- emergency response procedures;
- accident reporting procedures; and
- contingency plans.

The site-specific information required to address the areas noted above is presented in summary safety plans prepared for each site. The plans are intended to provide a framework within which information may be updated and ongoing decisions made regarding actual health and safety concerns at the site. The summary site safety plan format is presented as Appendix A.

3.0 MEDICAL SURVEILLANCE PROCEDURES

3.1 Health Monitoring Program

All on-site Jordan personnel and laboratory staff must be enrolled in the Health Monitoring Program which is implemented through Envirologic Data, Portland, Maine. Envirologic Data consists of a team of physicians and support personnel who specialize in toxicology. This program consists of an initial medical examination to establish the employee's general health profile and provides important baseline laboratory data for later comparative study. The contents of the initial comprehensive physical examination and laboratory testing routine is given in Table 3-1. Follow-up examinations are completed for all personnel enrolled in the health monitoring progam on an annual basis, or more frequently if project assignments warrant testing following specific field activities. Followup examinations are tailored to the exposures recorded by the individual. The level of potential exposure that Jordan personnel are subjected to in carrying out hazardous waste work assignments is recorded by the individual and reviewed by the site supervisor on a daily basis. A copy of the Personal Hazardous Waste Exposure Record is included in Appendix B.

3.2 Review of Exposure Symptoms

Symptoms of exposure to hazardous materials will be reviewed for each site in order to indicate to personnel the recognized signs of possible exposure to those materials. This information will be supplemented with a discussion of the need for objectivity in the personal health assessment to account for normal reaction to stressful situations. The Site Safety Officer will be watchful for outward evidences of changes in worker health. These outward symptons may include skin irritations, skin discoloration, eye irritation, muscular soreness, fatigue, nervousness or irritability, intolerance to heat or cold or loss of appetite. Employees will routinely be asked to assess their general state of health during the project.

Special medical monitoring may be identified for certain sites.

TABLE 3-1

BASELINE HEALTH MONITORING PROGRAM

1. PHYSICAL EXAMINATION

a. Medical history
b. Medical examination
c. Vision:
   - o near/distant
   - o color
d. Audiometry (optional, assignment dependent)
e. Radiology: PA/LAT
f. Spirometry
g. Electrocardiogram (optional, age and history dependent)

2. LABORATORY ANALYSIS

a. Hematology

-- complete blood count
   - red blood cell count
   - hemoglobin
   - platelets
   - sedimentation rate
   - white blood cell count
   - hematocrit
   - indices: MCV, MCH, MCHC

b. Blood Chemistry

-- Multi-22
   - calcium
   - glucose
   - uric acid
   - total protein
   - bilirubin
   - SGPT
   - potassium
   - creatine
   - globulin
   - triglycerides
   - inorganic phosphate
   - blood urea nitrogen
   - cholesterol
   - albumin
   - alkaline phosphatase sodium
   - chloride
   - CO
   - CO/globulin ratio
   - BUN/creating ratio

-- gamma GT
-- serum iron
-- iron binding capacity
-- acetyl cholinesterase
   - plasma
   - red blood cell
   - T3 uptake
   - Total T4
   - Immunoprofile III
-- free erythrocyte porphyrin

c. Urine Analysis

-- Ph, specific gravity, appearance, sugar, etc.

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4.0 PERSONAL PROTECTION LEVEL DETERMINATION

The level of personnel protective equipment required shall be determined by the type and levels of waste or spill material present at the site where project personnel may be exposed. In situations where the types of waste or spill material on-site are unknown, the hazards are not clearly established or the situation changes during on-site activities, the Site Safety Officer must make a reasonable determination of the level of protection that will assure the safety of investigators and response personnel until the potential hazards have been determined through monitoring, sampling, informational assessment, laboratory analyses or other reliable methods. Once the hazards have been determined, protective levels commensurate with the hazards will be used. Protection requirements will be evaluated on a continuous basis to reflect new information as it is acquired.

Preparation of site-specific plans will be based on the site-specific information made available through site files, RAMP and FIT reports, as well as any other sources identified.

The levels of protection utilized by E.C. Jordan Co. are presented below:

Level A. Level A protection must be selected when the Site Safety Officer makes a reasonable determination that the highest available level of respiratory, skin and eye protection is needed. It should be noted that while Level A provides maximum available protection, it does not protect against all possible hazards. Consideration of the heat stress that can arise from wearing Level A protection should also enter into the subtask leaders decision. (Comfort is not a decision factor, but heat stress will influence work rate, scheduling, and other work practices.)

Level B. The Site Safety Officer must select Level B protection when the highest level of respiratory protection is needed, but hazardous material exposure to the few unprotected areas of the body (e.g., the back of the neck) is unlikely.

Level C. The Site Safety Officer may select Level C when the required level of respiratory protection is known, or reasonably assumed to be, not greater than the level of protection afforded by full face air purifying respirators; and hazardous materials exposure to the few unprotected areas of the body (e.g., the back of the neck) is unlikely. Level C requires carrying an emergency escape respirator.

Level D. Level D is the basic work uniform, selected when site hazards are judged to be minimal. Investigators and response personnel, however, must not be permitted to work in civilian clothes. Level D often requires carrying an escape respirator.

Fit testing of safety equipment is an important part of establishing adequate respiratory protection (see also Appendix G). Fit testing is accomplished prior to site explorations and each individual is assigned a fitted respirator for the duration of the project. These are tagged for identification. The equipment used for each level of protection is shown in Table 4.1.

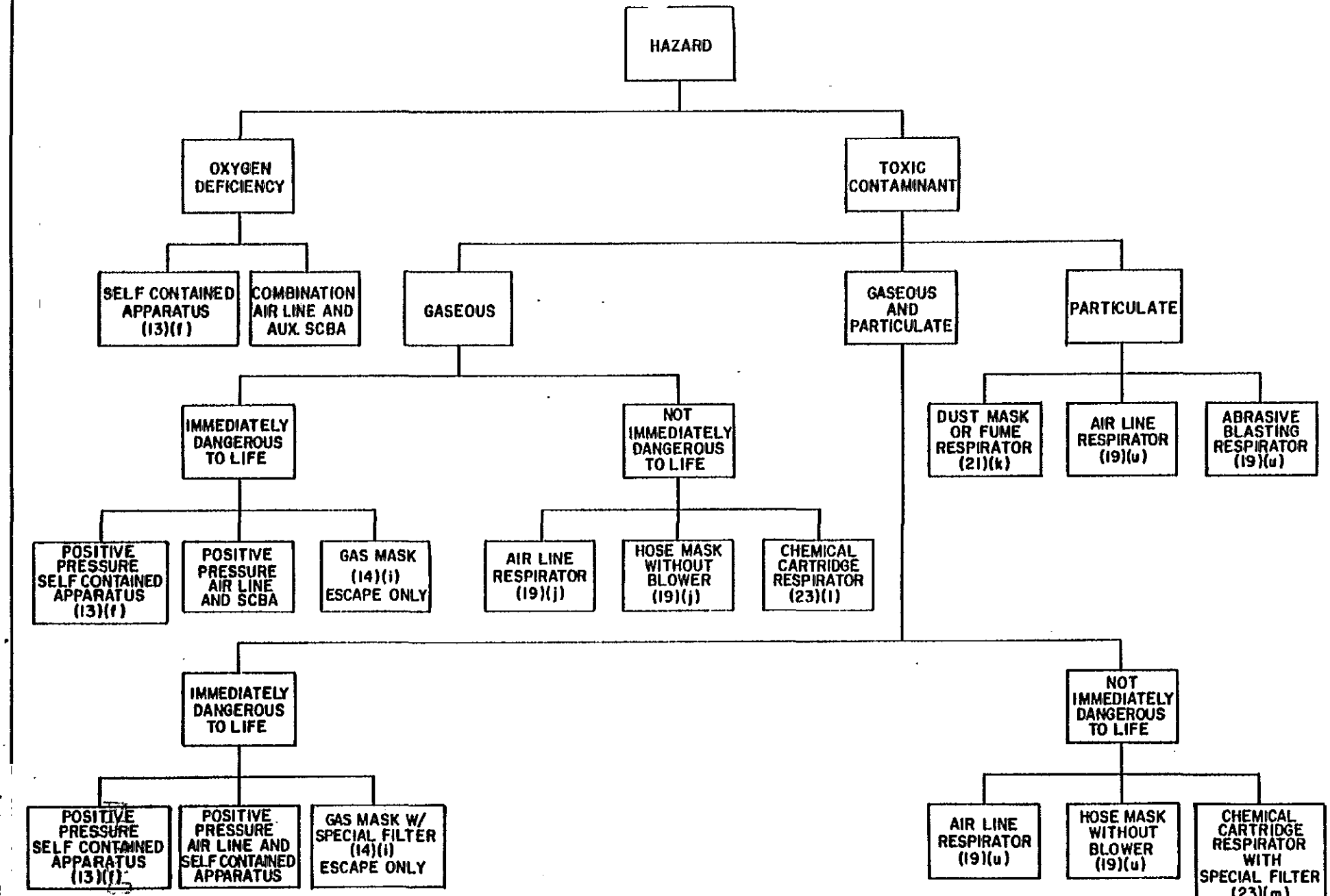
TABLE 4-1
Protective Gear

	Level D	Level C	Level B	Level A
Action Level[1]	0	0 to 5	5-500	500-1000
Respirator Type[2]	Escape	Full Face & Escape	SCBA	SCBA
Clothing				
o Boots	X	X	X	X
o Safety glasses or equivalent	X	X	X	
o Hard hat	X	X	X	
o Gloves, inner and outer	X	X	X	X
o Booties		X	X	X
o Coveralls	X	X	X	
o Chemical protective coveralls		X	X	
o Totally encapsulated suit				X

[1] Action levels are defined as air quality degradation from background levels, in ppm, by volatile contaminants as measured by a photoionization meter calibrated in the clean (support) zone. The action required is review of contaminants and reassessment of appropriate protective gear by the Site Safety Officer.

[2] Use of an air purifying respirator is allowed only where identification of constituents has occurred and appropriate respirator cartridges have been obtained. (Refer to Figure 4-1)

[3] It must be recognized that a photoionzation meter's relative response varies with each compound. Action levels should be reviewed (when constituents are known) to determine appropriate modifications.



BASED ON BUREAU OF MINES INFORMATION CIRCULAR 7792
NUMBERS IN PARENTHESIS REFER TO BUREAU OF MINES SCHEDULES
LETTERS IN PARENTHESIS REFER TO SUBPART OF NIOSH/MESA 30 CFR PART 11

FIGURE 4-1
SELECTION OF RESPIRATORY EQUIPMENT (LUNDIN, A., 1979)

It should be recognized that situations exist where different combinations of respiratory and dermal protective gear are appropriate, e.g., where splash protection is required but no respiratory hazard exists. The Site Safety Officer may elect a modification of the above specified combinations.

4.1 Potential Hazards On-Site

Table 4-2 includes a typical data summary concerning the toxicity of chemicals that may be found in soil and water on-site. A similar table will be included in the summary site safety plan if appropriate.

A review of physical hazards must also be performed.

TABL[illegible] 2
CHEMICAL TO[illegible]Y AND OTHER INFORMATION

Chemical	TLV (ppm)	ACC or STEL (ppm)	Physical State	Skin Penetration	Dermal Toxicity	Potency	LD_{50} (mg/kg) oral(rat)	Remarks
Phenols carbolic acid monohydroxybenzene	5 skin	10	Colorless to brown-black; solid or thick liquid				414 344(mice)	Absorption from spilling phenolic solution on skin may be very rapid. Death has resulted due to absorption of phenol through skin. Symptoms: irritates eyes, nose, throat. May cause anorexia. Contact: Skin burn, tremor, convulsion Target Organ: liver, kidneys, skin, pancreas First Aid. Swallow: water, vomit. Skin: soap wash. Incompatibilities: Strong oxidizers; calcium hypochlorite Toxicity[1]: 3; Persistence[2]: 1
Acetone [CH_2COCH_3] Dimethyl ketone ketone propane	750	1000	liquid; mint-like odor	+++	local	++	9750 1297(mice)	Symptoms: irritates eyes, nose, throat; narcot in high concentrations Target Organ: respiratory system, skin First Aid: Swallow: water, vomit Skin: soap wash Incompatibilities: oxidizing materials, acids. Fire hazard when exposed to heat or flame. Toxicity[1]: 1; Persistence[2]: 0
Chloroform* [$CHCl_3$] trichloromethane	10	50	colorless liquid sweet odor				800 LC_{LO}(mice) = 28 ppm	Causes irritation of the conjunctiva, dilation of the pupils and reduces reaction to light. Prolonged inhalation will bring on paralysis accompanied by cardiac failure. Symptoms: dizziness, mental dullness, nausea, headache, fatigue, eye and skin irritant Target organs: liver, kidneys, heart First Aid: Swallow: Ipecac, vomit Skin: soap wash Incompatibilties: strong caustics; chemically active metals: Al, Mg-powder, Na, K Toxicity[1]: 2, Persistence[2]: 3

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CHEMICAL T[illegible]Y AND OTHER INFORMATION
(continued)

Chemical	TLV (ppm)	ACC or STEL (ppm)	Physical State	Skin Penetration	Dermal Toxicity	Potency	LD_{50} (mg/kg) oral (rat)	Remarks
Benzene* $[C_6H_6]$ benzol	10	25	colorless liquid with aromatic odor	++	local systematic	++ +++		Poisoning occurs most commonly through inhalation; also penetrates through skin. Symptoms: irritates eyes, nose, respiratory system, giddiness, head, nausea, staggered gait; fatigue, depresssion, abdominal pain Target organ: blood, CNS, skin, bone marrow eyes, respiratory system First Aid: Swallow: NO VOMIT Skin: soap wash Incompatibilities: strong oxidizers, chlorine, bromine with iron. Dangerous when exposed to heat or flame. Toxicity[1]: 2; Persistence[2]: 1
Trichloroethylene ethylene trichloride tridene TCE	50	200	colorless liquid, sweet odor				4920 1900(dog)	Symptoms: headache, vertigo, vision distortion, tremors, somnolence, nausea, vomit, irritates eyes, cardiac arrythmias, paresthesias Target organ: respiratory system, heart, liver kidneys, CNS, skin. First Aid: Swallow: Ipecac, vomit Skin: soap wash immediately Incompatibles: strong caustics; chemically active metals: Ba, Li, Na, Mg, liquid O_2, Al, O_2, KNO_3, Ti Persistence[2]: 3

TABLE
CHEMICAL TOXICITY AND OTHER INFORMATION
(continued)

Chemical	TLV (ppm)	ACC or STEL (ppm)	Physical State	Skin Penetration	Dermal Toxicity	Potency	LD_{50} (mg/kg) oral (rat)	Remarks
Toluene [$C_6H_5CH_3$] toluol phenyl methane methyl benzene	100 skin	150	liquid	+	local systematic	+ +	5000 TC_{LO} Human = 200 ppm	Symptoms: fatigue, confusion, euphoria, dizzy, headache, dialated pupils, lack of appetite, nervousness, insomnia Target organ: CNS, liver, kidneys, skin First Aid: Swallow: NO VOMIT Skin: soap wash Incompatibilities: strong oxidizers Toxicity[1]: 2; Persistence[2]: 1
Xylene [$C_6H_4(CH_3)_2$] xylol 1,2-dimethyl benzene	100	150	liquid, colorless; aromatic odors		local systematic		LD_{LO} = 500 mg/kg	Symptoms: dizziness, excitement, drowsiness incoordination, staggering gait, irritates ey nose and throat, corneal vacuolization, nause vomit, abdominal pain Target organ: CNS, eyes, GI tract, blood, liver, kidneys, skin First Aid: Swallow: NO VOMIT Skin: soap wash Incompatibilities: strong oxidizers; dangerous when exposed to heat or open flame. Toxicity[1]: 2; Persistence[2]: 1
1,1,2,2-Tetrachloroethylene ethylene tetrachloride Perchloroethylene [$CCl_2=CCl_2$]	50		colorless liquid; sweet odor				LD_{LO} (dog) = 4000 TC_{LO} Human = 230 ppm	Liquid can cause injuries to eyes, toxic by inhalation. Symptoms: 200 ppm or higher causes irritation of nose, throat, vomiting, nausea, drowsiness. Target organ: liver, kidneys, eyes, upper respiratory system, CNS First Aid: Swallow: Ipecac, vomit Skin: soap wash. Incompatibilities: strong oxidizers; chemicall active metals such as: Ba, Li, Be.

Chemical	TLV (ppm)	ACC or STEL (ppm)	Physical State	Skin Penetration	Dermal Toxicity	Potency	LD_{50} (mg/kg) oral(rat)	Remarks
,2-Dichloroethane* [$ClCH_2CH_2Cl$] ethylene chloride glycol dichloride ethylene dichloride	10	15	clear liquid with sweet odor	++	local systematic	++ ++	770	High to moderate toxicity via dermal and oral routes. It has specific effects on the cornea. Dermatitis in man has been observed. Symptoms: irritation of eyes, nose and throat, followed by dizziness, nausea, vomitting, increasing stuper, cyanosis, rapid pulse and loss of consciousness. Target organ: respiratory system, liver, kidneys, skin, eyes. First Aid: Swallow: Ipecac, vomit.
hlorobenzene [C_6H_5Cl] monochlorobenzene chlorobenzol	75 (350 mg/m^3)	--	colorless liquid				2910	Symptoms: irritates eyes, nose, causes drowsiness, incoordination, skin irritation, Target organ: respiratory system, eyes, skin, ears, liver First Aid: NO VOMIT Incompatibilities: strong oxidizers, reacts violently with $AgClO_4$ Toxicity[1]: 2; Persistence[2]: 2
thyl benzene [$C_2H_5C_6H_3$] phenyl ethane ethyl benzol	100	125	colorless liquid with aromatic odor	++	local systematic	++ +++	3500 TC_{LO}(Human) = 100 ppm 4 hrs.	Symptoms: irritant to eyes and mucous membrane, headache, narcotic Target organ: eyes, upper respiratory system First Aid: NO VOMIT Incompatibilities: oxiding materials; dangerous when exposed to heat or flame.
,2-dichloroethylene [ClCH=CHCl] acetylene dichloride dioform	200	250	colorless liquid slightly acrid odor				770	Has produced liver and kidney injury in experimental animals. Symptoms: irritable to eyes, respitory system, causes depression. Target organ: respiratory system, eyes, ears

CHEMICAL TOXICIT. , OTHER INFORMATION
(continued)

Chemical	TLV (ppm)	ACC or STEL (ppm)	Physical State	Skin Penetration	Dermal Toxicity	Potency	LD_{50} (mg/kg) oral(rat)	Remarks
								First Aid: Swallow: Ipecac, vomit Incompatibilities: strong oxidizers, dangerous when exposed to heat or flame. Reacts violently with KOH, Na, NaOH.
Methylene chloride [CH_2Cl_2] dichloromethane methylene dichloride	100	500	colorless liquid	++	local systematic	++ +++	2136 TC_{LO}(Human) -500 ppm 8 hrs.	Dangerous to eyes. It induces narcosis; can cause dermatitis with prolonged exposure, highly volatile. It can decompose by contact with hot surfaces and open flame and produce toxic fumes. Symptoms: fatigue, weak, sleepy; limbs numb or tingling Target organ: skin, CVS, eyes, CNS First Aid: Swallow: Ipecac, vomit Incompatibilities: reacts violently with Li, Na, K, terbutoxite; strong oxidizers and caustics
Mesitylene [$(CH_3)_3C_6H_3$] 1,3,5-trimethyl benzene			liquid, peculiar odor				LD_{LO}1500 TC_{LO}(Human) = 10 ppm	Causes CNS disturbances. Incompatibilities: violent with HNO_3
Dioctyl phthalate di-sec-octyl phthalate	5 mg/m³		light, colored liquid				31,000	Toxicity: low to none via oral and dermal routes produce GI symptoms.
1,1,2-Trichloroethane $CHCl_2CH_2Cl$ vinyl trichloride beta trichloroethane	10		colorless liquid, sweet odor					Toxicity: high via subcutaneous and intravenous routes; has narcotic properties; low via inhalation, oral or dermal Symptoms: local irritant to eyes, nose and lungs Target organs: CNS, eyes, nose, liver, kidneys First Aid: Swallow: Ipecac, vomit Skin: soap wash Incompatibilities: strong oxidizers and caustics; active metals: Al, Mg powder, Na, K.

Chemical	TLV mg/m³	ACC or STEL mg/m³	Physical State	Remarks
Cadmium* dust and fumes	.05	0.2	Silver/white/blue tinged metal compounds have different appearances.	Continuous exposure to cadmium may cause irreversible lung injury, abnormal lung function and kidney disease. Increased incidence of prostatic cancer, kidney and and respiratory cancer in cadmium workers has been observed. Dust or powder is flammable, toxic gases may be released in a fire. Symptoms: Inhalation: irritation of nose and throat, 0.5 to 2.5 mg/m^3 exposure can cause non-fatal lung inflamation. 4 to 10 hours exposure - severe chest pain, persistent cough, and difficulty in breathing. Eye: Irritation Ingestion: A dose of 15-30 mg of metal or soluble salt may cause increased salivation, chocking, vomiting, abdominal pain, etc. First Aid: Ingestion: Conscious person - give large amounts of water immediately and seek medical advice. Incompatabilities: Strong oxidizers, elemental sulfur, selenium, zinc, hydrobenzoic acid, ammonium nitrate.
Chromium (II) and (III) Hexavalent (VI)*	0.5 0.05		Steel gray metal or silver metal powder.	The toxicity of chromium varies with different chromium compounds. Chromic acids and chromates appear to be more toxic than chromium metal dust, insoluble chromium salts, and soluble chromic and chromous salts. Exposure to certain hexavalent chromium compounds is associated with an increased lung cancer incidence in humans. Symptoms: Inhalation: Dust may cause irritation of nose, throat, respiratory passages, and lungs. Repeated or prolonged exposure to chromic acid or dust may cause ulceration and perforation of the nasal septum. Skin: Dermatitis, repeated exposure may cause an allergic skin rash. Incompatabilities: Alkalies, dil H_2SO4 & HCl.
Copper Fume Dust & mist as copper	 0.2 1.0		Reddish Lustrous metal	Symptoms: Inhalation: Copper and Copper oxide fumes may cause metal fume fever - chills, fever, aching muscles, dry mouth and throat, headache, nausea, vomiting, diarrhea and stomach pains. Skin: May cause irritation - metal solutions can cause swelling and itching. Ingestion: May cause stomach pain, nausea, vomiting and diarrhea from ingestion of 10 mg of copper by an adult and 8.5 mg by a child. Long Term: No long term effects from inhalation or ingestion reported. Copper fragment in cornea may cause cataracts. First Aid: Ingestion: Seek medical attention. (Pennillamine or triethylenetetramine dihydrochloride may be beneficial in reducing body burden.)

Chemical	TLV mg/m^3	ACC or STEL mg/m^3	Physical State	Remarks
				Incompatabilities: Acetylene gas, magnesium metal, oxidizing agents.
Cyanide Compounds KCN NaCN	5 (Skin)		White solids with faint almond odor	Cyanide compounds of sodium and potassium can affect the body if inhaled or in contact with eyes and skin or ingested. Sufficient cyanide may be absorbed through the skin to cause fatal poisioning. Symptoms: Low level of exposure causes weakness, headache, confusion, may cause nausea and vomiting. Irritation to nose and skin. High exposure causes rapid loss of consciousness, stop breathing and death. First Aid: Obtain medical advice immediately and follow instruction in first aid kit. A first aid kit should contain minimum of 48 ampules each of 0.3 ml amyl nitrate and complete instructions for use. Trained medical personnel should have physician's kit which includes an addition to amyl nitrate, sterile sodium nitrite solution 3% and sterile sodium thiosulfate solution (25%). Incompatibilities: In closed containers it may form toxic concentration of HCN gas. Strong oxidizers such as chlorates, nitrates, acid or acid salts Cyanide salt may react with CO_2 in air to form HCN
Hydrogen Cyanide (gas or liquid)			Colorless or pale blue liquid or gas, bitter almond odor.	Symptoms and First Aid are similar to cyanide. However, liquid or gas is very toxic and additional precautions are required. (HCN odor should be treated as poor warning. Although odor threshold of 0.1 ppm is below the permissible exposure limit the sense of smell is easily fatigued and wide individual variation in the minimum odor threshold is known.) First Aid: Same as cyanide. Incompatibilities: Bases - caustic and ammonia may cause violent polymerization and explosion. Liquid HCN will attack some forms of plastics, rubber and coatings.
Lead Lead Chloride* Lead Nitrate*	0.15	0.45	Bluish white or silvery gray solid.	Lead is a cumulative poison. Increasing amount builds up in the body and eventually a point is reached where symptoms and disability may occur. Lead dust carried home may cause symptoms in other family members. Symptoms: Long term exposure: decreased physical fitness, fatigue, sleep distrubances headache, aching bones, constipation, decreased appetite, and abdominal pain. Inhalation of large amounts of lead may lead to seizures, coma and death.

Chemical	TLV mg/m³	ACC or STEL mg/m³	Physical State	Remarks
				First Aid: Get medical attention. Ingestion: If victim is conscious, give water. Incompatibilities: Reacts violently with potassium.
Nickel and	1		Silvery White workable metal	Nickel is an insoluble metal, but most common salts are soluble.
Soluble Nickel Compounds	0.1	0.3	White or colored crystal or powder	Symptoms: (From nickel dust and salts.) Inhalation: Dust and mists can cause lung irritation, shortness of breath, coughing and wheezing. Skin: Itching, burning and sores referred to as "nickel itch". Eyes: Irritation and damage to cornea. Ingestion: Giddiness and nausea Long term exposure, in addition to symptoms listed above, impairment of sense of smell, chest pain, destruction of nasal tissues and asthmatic lung disease. Dust inhalation has been associated with an increased risk of lung and nasal cancer. First Aid: Ingestion: large amounts of water. Seek medical attention. Incompatibilities: Nickel dust is flammable. Reacts violently with fluorine, strong mineral acids; ammonium nitrate, etc.
Zinc Zinc Chloride*			Blue powder	Zinc is considered an essential trace element, necessary for normal growth and development. Most zinc compounds have a relatively low order of toxicity however, occupational exposure to zinc chloride and zinc oxide has been associated with adverse health effects. Spontaneous combustion may occur if zinc dust is stored in a damp place. Zinc dust forms an explosive mixture with air. Symptoms: Inhalation: Inhalation of mists of fumes may cause respiratory or gastrointestinal irritation, shortness of breath, a feeling of constriction in the chest and coughing with phlegm and bloody sputum. It may also produce a cyanosis, resulting in a blue color of the skin and lip. Exposure to freshly formed zinc oxide fumes can cause a flu-like illness called metal fume fever, with symptoms similar to those encountered with viral influenza. Skin: Skin contact with zinc chloride may produce dermatitis. Ingestion: 12 grams of zinc metal over two days has caused sluggishness, light headedness; a staggering gait and difficulty in writing. Incompatibilities: Acids, strong alkalies, amines, chlorides, chlorates, nitrates, oxides, fluroine, S, CB_2.

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NOTES

TLV - Threshold Limit Value
ACC - Acceptable Ceiling Concentration
STEL - Short Term Exposure Limit

* Suspected carcinogens, teratogens or mutagens.
** First Aid: Unless specified, first aid for all of the listed chemicals are as follows:
Eyes: immediately wash with copious quantity of cold water
Skin: Flush with water promptly
Breath: Artificial respiration
Swallow: Water, vomit
\+ Slight Hazard
++ Moderate Hazard
+++ Extreme Hazard

[1]Toxicity Ratings:

	Toxicity Rating	
No toxicity (none)	0	Material causes no harm in any condition or produces toxic effects on humans in very unusual circumstances or in very large dosage.
Slight toxicity (low)	1	
Moderate toxicity	2	
Severe toxicity	3	

[2]Persistence or each hazardous substance is evaluated on its biodegradability as follows:

	Assigned Value
Easily biodegradable compounds	0
Straight chain hydrocarbons	1
Substituted and other ring compounds	2
M , polycyclic compounds and genated hydrocarbons	3

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5.0 WORKER SAFETY PROCEDURES

Workers will be expected to adhere to the established safety practices for their respective specialties (e.g., drilling, laboratory analysis, construction, etc.). The need to exercise caution in the performance of specific work tasks is made more acute due to weather conditions, restricted mobility and reduced peripheral vision caused by the protective gear itself, the need to maintain the integrity of the protective gear and the increased difficulty in communicating caused by respirators. Work at the site will be conducted according to established protocol and guidelines for the safety and health of all involved. Among the most important of these principles for working at a hazardous waste site are:

1. In any unknown situation, always assume the worst conditions and plan responses accordingly.

2. Employ the buddy system. Establish and maintain communication. In addition to radio communications, it is advisable to develop a set of hand signals as conditions may greatly impair verbal communications.

3. Minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas and procedures to accomplish this. Do not place equipment on drums or on the ground. Do not sit on drums or other materials.

4. Employ disposable items when possible to minimize risks during decontamination and possible cross-contamination during sample-handing. This will require a common sense approach to potential risks and costs.

5. Smoking, eating, or drinking after entering the work zone and before decontamination will not be allowed. Oral ingestion of contaminants is probably the second most likely means of introduction of the toxic substances into the body (inhalation being first).

6. Avoid heat and other work stresses related to wearing the protective gear. Work breaks should be planned to prevent stress related accidents or fatigue. Appendix D provides a summary heat stress casualty prevention plan.

7. Maintain monitoring systems. Conditions can change quickly if subsurface areas of contamination are penetrated.

8. Conflicting situations which may arise concerning safety requirements and working conditions must be addressed and resolved rapidly by the Site Safety Officer to relieve any motivations or pressures to circumvent established safety policy.

9. Unauthorized breaches of specified safety protocol will not be allowed. Personnel unwilling or unable to comply with the established procedures will be replaced. Any changes in established procedure should be documented on the form provided. The change should have a very specific, valid basis and must be approved by the Site Safety Officer.

10. Be observant of not only one's own immediate surroundings but also that of others. Everyone will be working under constraints to awareness and it is a team effort to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment while utilizing personnel protective gear. Vision, hearing and communication are restricted by the protective gear.

11. Use of contact lenses will not be allowed on-site. These prevent proper flushing should corrosive or lachrymous substances enter the eyes.

12. Sites potentially requiring Level C or B protection will require the removal of facial hair (except moustaches) to allow a proper facepiece fit.

13. Rigorous contingency planning, and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.

14. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.

15. Be aware that chemical contaminants may mimick or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol and working with an illness during field investigation assignments.

16. The site leader, the Site Safety Officer and sampling personnel shall maintain records in a bound notebook recording daily activities, meetings, facts, incidents, data, etc., relating to the project. These record books will remain on the site during the full duration of the project so that replacement personnel may add information in the same record book, maintaining continuity. These notebooks and daily records will become part of the permanent project file. Examples of forms, records and logs to be used at each site are given in Appendix B and C.

5.2 Site Entry Procedures

In most cases, Jordan teams are not the first on-site investigators. Considerable knowledge of site history and current status allows the preparation of a site safety plan with reasonable assurance that personnel are adequately protected. In the event that sufficient site information is not available to perform a summary risk assessment and assign the appropriate level of personnel protective equipment, the following procedures should be followed. It must be understood that verification of the level of contamination (even with background information) will always require some of the steps below.

1. Recognize that Jordan's presence on-site implies a perceived contamination potential by the client.

2. Assume that the site is contaminated and conduct a site safety reconnaissance.

- o establish contamination reduction zone (decontamination area);

- o at the highest level of protection practicable, survey site beginning with a perimeter survey and gradually covering all areas of proposed activity with (as appropriate):

  - HNU photoionizer;
  - organic vapor analyzer;
  - radiation survey meter;
  - personal air sampling pumps;
  - chemically reactive indicating tubes
  - oxygen deficiency meter; and
  - explosive mixture meter.

- o establish "hot zone"; and

- o review data, assess risk and select the appropriate level of protection.

3. Prepare summary site safety plan and document all data acquired.

6.0 SITE SAFETY EQUIPMENT

In addition to personnel protective gear designated for the assigned level, various monitoring and safety equipment is maintained on-site. Minimum on-site equipment will generally include:

- Photoionization meter;
- Combustible gas indicator (explosimeter);
- Oxygen meter or oxygen deficiency alarm;
- Chemically reactive indicating tubes (specific to the site hazards);
- Fire extinguishers;
- First aid kits;
- Eye wash station;
- Radiation survey meter or radiation alert; and
- Transportation suitable for emergency response.
- Organic vapor analyzer (optional);

Additional equipment may be specified and obtained as field conditions dictate. An equipment list and field safety gear requirements are specified in the site safety summary (Appendix A).

7.0 EMERGENCY PLANNING

7.1 Emergency Medical Services

Dr. Frank Lawrence, M.D. and Bruce Campbell, R. Ph. of Envirologic Data serve as medical liasons between project staff and hospitals. Prior to site investigation or activity on hazardous sites, nearby health facilities will be evaluated to determine their capabilities in relation to the needs of on-site project staff. Criteria such as emergency department physician coverage, decontamination capabilities and available medical specialists are evaluated.

- On-site First Aid
  - An industrial first-aid kit will be provided at the work site and contents of the kit will be checked weekly and restocked as necessary. Other equipment may include: oxygen, backboard and straps, splints, and a cervical collar.
  - At least one person qualified to perform first aid will be present on-site at all times during work activity. This person will have earned a certificate in first-aid training from the American Red Cross or will have received equivalent training. Designated first aides will receive regular review training from the American Red Cross or an equivalent session.
  - An emergency shower and eye-wash station will be provided at the work site, as well as flushing water for decontamination of boots, gloves, clothing, tools, etc.
- Transportation to Emergency Treatment:
  - A vehicle will be available at all times for use in transporting personnel to the hospital (in the event an ambulance is unnecessary or unavailable).
  - Personnel stretchers will be located at the work site for use in transporting personnel to the vehicle. Alternate transportation routes to area hospitals will be established prior to on-site activity.

7.2 Contingency Planning

Prior to commencement of on-site activities, field personnel will review safety considerations with the Site Safety Officer (SSO). The Site Safety Officer is responsible for adherence to the designated safety precautions and assumes the role of on-site coordinator in an emergency response situation.

All on-site personnel will be familiarized with both the primary and secondary route to the nearest hospital (which may be shown on a Figure or local map) as well as the location of the nearest working telephone or radio communication device. Each will receive a list of emergency phone numbers as shown in Appendix A.

The local hospital and emergency response team will be advised in advance by the Site Safety Officer of the work to be performed. The hospital will also be briefed on the availability of personnel health data and technical support through Envirologic Data.

Emergency communication will be required to ensure positive pre-planned notification of emergency authorities in the event of episodes requiring initiation of contingency plans.

- The communication will be coordinated with local agencies, fire department, police, ambulance and hospital emergency room.

- Two-way radio communication may need to be established in the field, and a site alarm capable of warning site personnel and summoning assistance will be maintained (air horns).

- Emergency evacuation for residents of nearby homes is an unlikely event, but a person will be designated on-site to be responsible for implementing the contingency plan. The person will be made aware of the total number of households within a radius of 2,000 feet. Appendix A will provide the emergency contacts that will be required and an additional table will provide a list of residences and identifiable operations in the area in the event that evacuation is judged to be a possibility for a particular site.

- Prior to any activity, personnel will investigate possible routes of evacuation.

A copy of an accident report form is provided in Appendix C. It should be filled out by the Site Safety Officer and filed with the individual's supervisor and a copy retained in the project records if an accident occurs.

7.3 Potential Hazards

The most common hazards associated with hazardous waste site investigation include: 1) accidents; 2) contact or ingestion of hazardous materials; 3) explosion; and 4) fire.

7.3.1 Accidents. Accidents must be handled on a case by case basis. Minor cuts, bruises, muscle pulls, etc., will still allow the injured person to undergo reasonably normal decontamination procedures prior to receiving direct first aid. More serious injuries may not permit complete decontamination procedures to be undertaken, particularly if the nature of the injury is such that the victim should not be moved. The nature and degree of surface contamination at a site is generally low enough that emergency vehicles could reach the victim on-site without undue hazard. However, in the event that access on-site is limited, accident victims may be transported to a point accessible by an ambulance by Jordan personnel trained for this response.

7.3.2 Contact and/or Ingestion of Hazardous Materials. Properly prescribed and maintained protective clothing and adherence to established safety

procedures are designed to minimize this hazard. However, it is still a possibility that contact or ingestion of materials may occur. One possibility for exposure is the puncture of a buried drum of liquid during drilling operations which might cause the drum contents to contact personnel. Standard first aid procedures should be followed. The drilling rig will have a tank of water which may be useful in some circumstances, particularly to flush contaminants off any exposed skin areas. Eye wash bottles will also be maintained at the site in case of emergencies. In cases of ingestion or other than minor contact with known substances, the local Poison Control Center and hospital should be contacted and the victim brought there immediately for further treatment and observation.

7.3.3 Explosion. The drilling crew should be keenly aware of combustible gas meter readings and withdraw at any indication of imminently hazardous conditions (greater than 20% LEL). The detection of such conditions shall be reported to local agencies for potential execution of the evacuation plan should the situation be assessed as warranting such response.

7.3.4 Fire. The combustible gas meter also warns of imminent fire hazards at borings. The greatest fire hazard at the site should be recognized as handling the fluids (e.g., methanol, acetone) used for certain decontamination procedures. No smoking or open flames are allowed on site. Carbon dioxide fire extinguishers will be kept at the drilling rig, and the decontamination area/field office. The Fire Department, previously informed of site activities, will be called as needed.

7.4 Evacuation Response Levels

Evacuation responses will occur at three levels: (1) withdraw from immediate work area (100+ feet upwind); (2) site evacuation; and (3) evacuation of surrounding area. Anticipated conditions which might require these responses are described below:

Withdrawal Up-Wind (100 or more feet).

- Sensing ambient air conditions as containing greater contaminant concentrations than guidelines allow for the type of respiratory protection being worn. The work party may return upon donning greater respiratory protection and/or assessing the situation as transient and past.

- Breach in protective clothing or minor accident. The party may return when tear or other malfunction is repaired and first aid or decontamination has been administered.

- Respirator malfunctions and must be replaced.

Site Evacuation.

- Sensing ambient air conditions as containing explosive and persistent levels of combustible gas or excessive levels of toxic gases,

- o Fire or major accident

- o Imminent explosion or explosion

Surrounding Area Evacuation.

- o Persistent, unsuppressable release of toxic or explosive vapors from test pits or borings (possible pressure release from punctured drum). Air quality should be monitored at several distances downwind to assess danger to surrounding area before initiating this response.

7.5 Evacuation Procedures

7.5.1 Withdrawal Upwind. The work party will continually note general wind directions while on-site. (A simple wind sock may be set up near the work site for visual determinations.) Upon noting the conditions warranting movement away from the work site, the crew will move upwind a distance of approximately 100 feet or further as indicated by the site monitoring instruments. Donning SCBA and a safety harness and line, the Site Safety Officer or a member of the crew may return to the work site to determine if the condition noted was transient or persistent. If persistent, then an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don SCBA. An attempt should be made to to decrease emissions only if greater respiratory protection is donned. The Site Safety Officer and client will be notified of conditions. When access to the site is restricted and escape may thus be hindered, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

7.5.2 Site Evacuation. Upon determination of conditions warranting site evacuation, the work party will proceed upwind of the work site and notify the security force, Site Safety Officer and the field office of site conditions. If the decontamination area is upwind and greater than 500 feet from the work site, the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation. There the respirators may be removed (if instrumentation indicates an acceptable condition). As more facts are determined from the field crew, these will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the Site Safety Officer.

7.5.3 Evacuation of Surrounding Area. When the Site Safety Officer determines that conditions warrant evacuation of downwind residences and commercial operations, the local agencies will be notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

7.6 Training

The following matrix (Figure 7-1) will be completed and included with each site safety plan thus indicating the training received by on-site personnel. All personnel must become familiar with the capabilities of each team member as displayed by this matrix to minimize response times in the event emergency action is required.

FIGURE 7-1

ON-SITE PERSONNEL TRAINING

TOPIC	HRS													
INTRODUCTION/REFRESHER	4													
FIRST AID	8													
CPR (OPTIONAL)	8													
NUS COURSE OR EQUIVALENT	30													
OVA	16													
PI METER	2													
SCBA REVIEW	4													
SAMPLING	-													
HEALTH MONITORING	-													

● INDICATES REQUIRED TRAINING COMPLETED

CERTIFIED BY _____

8.0 DECONTAMINATION

8.1 Personnel Decontamination Procedure

Decontamination procedures are carried out by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the site prior to decontamination. A generalized procedure for removal of protective clothing is as follows:

- Drop tools, monitors, samples and trash at designated drop stations. These will be plastic containers or drop sheets.
- Step into designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots. If necessary, wash boots down with clear water in designated wash pit area.
- Remove tape from boots and remove boots. Discard in disposal container.
- Remove outer gloves and place in container.
- Remove hard hat and respirator and place or hang in the designated area.
- Remove outer garment and discard in container.
- Remove inner gloves and discard in container.
- If the site required utilization of a decontamination trailer, all personnel would also shower before leaving the site at the end of the work day.

Note: Disposable items (Tyvek coveralls, inner gloves, and latex overboots) will be changed on a daily basis unless there is reason for changing sooner. Dual respirator canisters will be changed daily unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

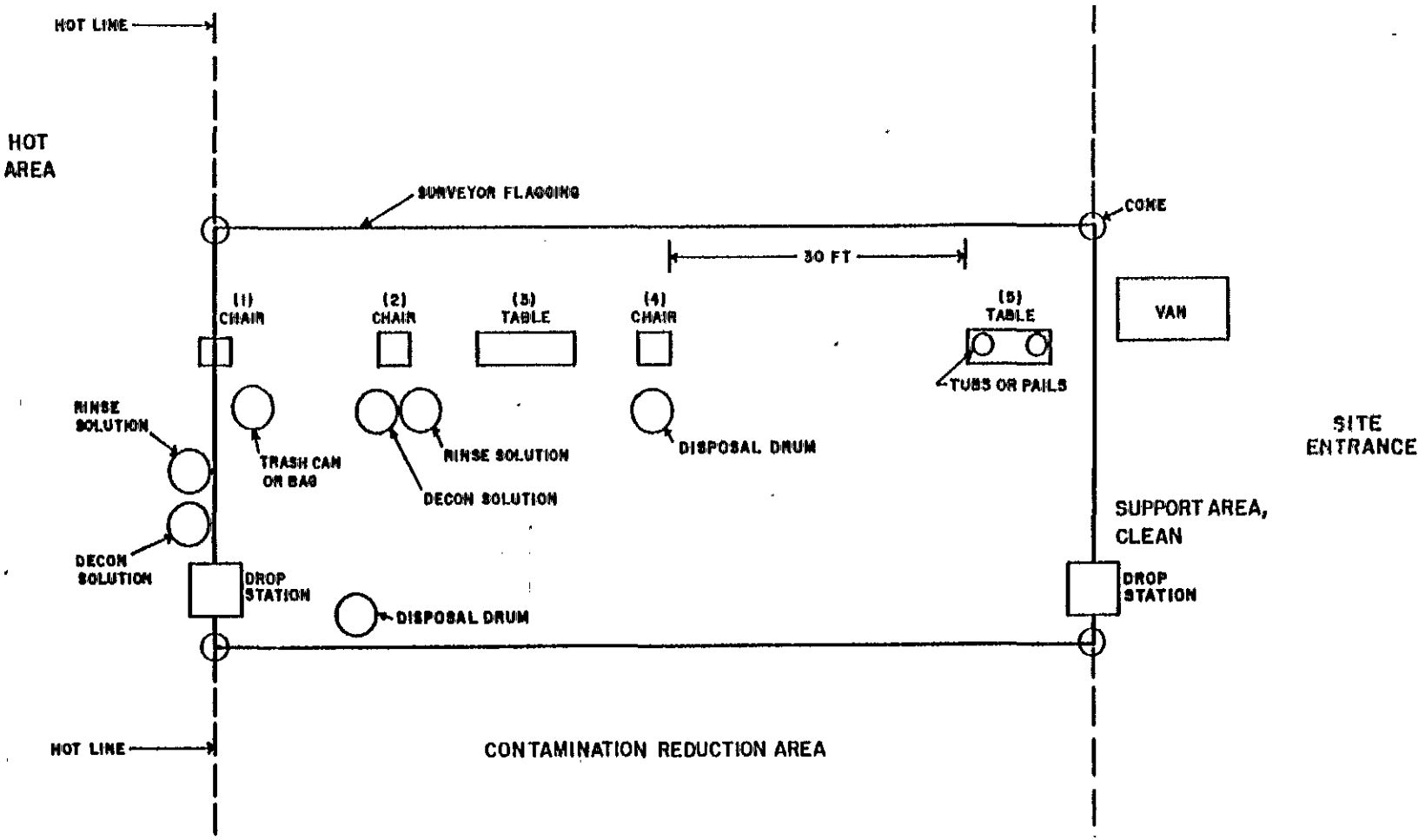
Pressurized sprayers or other designated equipment will be available in the decontamination area for wash down and cleaning of personnel, samples and equipment.

A schematic of a typical decontamination area is shown in Figure 8-1.

8.2 Equipment Decontamination

Equipment to be decontaminated during the project may include: (1) drill rig; (2) tools; (3) monitoring equipment; (4) respirators; (5) sample containers; (6) truck or trailer and (7) laboratory equipment.

All decontamination will be done by personnel in protective gear appropriate for the level of decontamination, determined by the Site Safety Officer. The decontamination work tasks will be split or rotated among support and work crews. Decontamination procedures within the trailer (if used) should take



TASK

(1) Wash boots
(2) Wash gloves—Rinse gloves
(3) SCBA Tank change over table w/spare tanks
(4) Remove boots, gloves
(5) Remove SCBA, wash mask in pails or tubs

NOT TO SCALE

FIGURE 8-1
TYPICAL PERSONNEL DECONTAMINATION STATION

place only after other personnel have cleared the "hot area", moved to the clean area and the door between the two areas closed.

Miscellaneous tools and samplers will be dropped into a plastic pail, tub or other container. They will be brushed off and rinsed (outside, if possible) and transferred into a second pail to be carried to further decontamination stations. They will be washed with a detergent solution, rinsed with methanol or acetone (if required), rinsed with a detergent solution and finally rinsed with clean water.

8.2.1 Drilling Rig and Tools. It is anticipated that the drill rigs will be contaminated during test pit/borehole activities. They will be cleaned with high pressure water or portable high pressure steam followed by soap and water wash and rinse. Loose material will be removed by brush. The person performing this activity will usually be at Level D protection.

8.2.2 Sample Containers. Exterior surfaces of sample bottles will be decontaminated prior to packing for transportation to the analytical laboratory. Sample containers will be wiped clean at the sample site, but it will be difficult to keep the sample containers completely clean. The samples will be taken to the decontamination area. Here they will be further cleaned as necessary and transferred to a clean carrier and the sample identities noted and checked off against the chain-of-custody record. The samples, now in a clean carrier, will be stored in a secure area prior to shipment.

8.2.3 Monitoring Equipment. Monitoring equipment will be protected as much as possible from contamination by draping, masking or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The HNU meter, for example, can be placed in a clear plastic bag which allows reading of the scale and operation of the knobs. The HNU sensor can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes and dried. The units will be checked, standardized and recharged as necessary for the next day's operation. They will then be prepared with new protective coverings.

8.2.4 Respirators. Respirators will be decontaminated daily. Taken from the drop area, the masks will be disassembled, the cartridges set aside and the rest placed in a cleansing solution. (Parts will be precoded, e.g., #1 on all parts of mask #1). After an appropriate time within the solution, the parts will be removed and rinsed off with tap water. The old cartridges will be marked so as to indicate length of usage (if means to evaluate the cartridges' remaining utility are available) or will be discarded into the contaminated trash container for disposal. In the morning the masks will be re-assembled and new cartridges installed if appropriate. Personnel will inspect their own masks to be sure of proper readjustment of straps for proper fit (see also Appendix G).

8.2.5 Decontamination Trailer or Truck and Staging Area. The decontamination trailer or truck, if used, will be cleaned daily. This will include vacuuming with a vacuum having a water filter to capture dust particles. The area will be wet mopped with cleanser and again with clean water. Work bench areas will be wiped down. Wash buckets and the cleaning area will be decontaminated and made ready for the next day's use.

8.2.6 Laboratory Equipment. Sample handling areas and equipment will be cleaned/wiped down daily. Disposable wipes will be used and discarded into a plastic bag. These will subsequently be taken to and placed in the disposal drum for final disposition. For final cleanup, all equipment will be disassembled and decontaminated. Any equipment which cannot be satisfactorily decontaminated will be disposed of (e.g., glassware, covers for surfaces) as previously indicated.

9.0 DOCUMENTATION AND RECORDKEEPING

Samples of field activity documentation forms are attached (see Appendix B). Minimum documentation consists of:

- daily field records kept by the site technical leader or designee;
- site surveillance record kept by the Site Safety Officer;
- sampling - related records kept by sample collection team;
- chain-of-custody records for each sample collected; and
- daily exposure record for each person on-site.

10.0 UPDATING OF HEALTH AND SAFETY PLAN

The Site Safety Officer is responsible for maintaining proper documentation regarding daily safety log sheets. If any deficiency is encountered in the health and safety plan, a report will be prepared and forwarded to the health and safety coordinator at Jordan and copies sent to the project manager and technical director. The Site Safety Officer will immediately initiate necessary changes to improve protection of field staff.

During the remedial investigation process or after initial field investigation, any new chemical hazard encountered will be evaluted and safety plans modified to reflect the effect of that chemical hazard. Similarly, any physical hazards that are discovered will be addressed by the Site Safety Officer and reported.

11.0 REFERENCE GUIDES FOR HAZARDOUS MATERIALS

Reference guides for material classification determinations are:

1) The Merck Index, 9th Edition, Merck, Sharp & Dohme Ltd., 1980.

2) Handbook of Chemistry & Physics, 64th Edition, CRC Press, 1984.

3) Pocket Guide to Chemical Hazards, 1980 Edition, NIOSH/OSHA, DHEW (NIOSH) Publication No. 78-120.

4) Registry of Toxic Effects of Chemical Substances, 8th edition NIOSH, 1978.

5) Dangerous Properties of Industrial Materials, Sax, N.I., Sixth edition, Van Nostrand Reinhold Co., 1984.

6) Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment, 1983-84. Adopted by ACGIH.

APPENDIX A

SUMMARY SITE SAFETY PLAN

E.C. JORDAN CO.
SUMMARY SITE SAFETY PLAN

A. GENERAL INFORMATION

SITE: _____

SITE OWNER/CONTACT: _____

LOCATION: _____

PLAN PREPARED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

OBJECTIVE(S): _____

_____

_____

PROPOSED DATE(S) OF INVESTIGATION: _____

BACKGROUND REVIEW: Complete: _____ Preliminary: _____

OVERALL HAZARD: Serious: ____ Moderate: ____ Low: ____ Unknown: ____

_____

_____

B. SITE/WASTE CHARACTERISTICS

SITE DESCRIPTION: _____

_____

_____

_____

_____

_____

_____

_____

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INSERT FIGURE 1

"Site Plan"

WASTE DESCRIPTION:

Waste Types: Liquid ____ Solid ____ Sludge ____ Gas ____

Characteristics: Corrosive ____ Ignitable ____ Radioactive ____

Volatile ____ Toxic ____ Reactive ____ Unknown ____

Principal Disposal Method (type and location): _____

_____

_____

Unusual Features (dike integrity, power lines, terrain, etc.)_____

_____

_____

Status: (active, inactive, unknown) _____

History: (Worker or non-worker injury; complaints from public; previous agency action): _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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C. HAZARD EVALUATION

TABLE 1
CONTAMINANTS OF CONCERN

Chemical	Approximate Odor Threshold (ppm)	TLV (ppm)	Physical Characteristics	Dermal Toxicity	Remarks

D. SITE SAFETY PROCEDURES

Map/Sketch Attached? _____ Site Secured? _____

Perimeter Identified? _____ Zone(s) of Contamination Identified? _____

Perimeter Establishment: _____

_____

_____

MOBILIZATION AND SITE ENTRY: _____

_____

_____

_____

SITE MONITORING INSTRUMENTATION: USE:

_____ _____

_____ _____

_____ _____

_____ _____

TEAM ORGANIZATION:

Team Member	Responsibility	Qualified to Work @ Level
_____	Site Safety Officer	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

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PERSONNEL PROTECTION:

Task	Minimum Level Of Protection

Action Level for Modification: _____

Rationale: _____

DECONTAMINATION PROCEDURES:

Personnel- _____

Equipment- _____

WORK LIMITATIONS (Time of day, etc.): _____

PERSONNEL PROTECTIVE GEAR, DECONTAMINATION FLUID AND OTHER MATERIAL DISPOSAL:

SPECIAL FIRST AID INSTRUCTIONS:

E. EMERGENCY INFORMATION

LOCAL RESOURCES

Ambulance _____

Hospital Emergency Room _____

Poison Control Center _____

Police _____

Fire Department _____

Airport _____

Explosives Unit _____

USEPA Contact _____

SITE RESOURCES

Water Supply Location _____

Telephone Number _____

Radio Frequency _____

Other _____

EMERGENCY CONTACTS

1.	Maine Poison Control Center	(207) 871-2950
2.	E.C. Jordan (Maine)	(207) 775-5401
3.	E.C. Jordan (Florida)	(904) 656-1293
4.	E.C. Jordan (Detroit)	(313) 569-3955
5.	Envirologic Data	(207) 773-3020
6.	USEPA Emergency Response	(800) 424-8802
7.	National Poison Control Center	(800) 492-2414
8.	CMA Chemical Referral Center	(800) 262-8200

F. EMERGENCY ROUTES

(Give road or other directions; attach map)

HOSPITAL: _____

SITE EVACUATION: _____

INSERT FIGURE 2

"Hospital Route"

TABLE 2
PERSONNEL SAFETY EQUIPMENT CHECK LIST

Quantity Required	Protective and Safety Equipment	Model or Material
	.SCBA	MSA 401
	.Spare Cylinders	
	.Escape Mask	ELSA
	.Full Face	
	.Cartridge	
	.Hardhat w/ Face Shield	
	.*Safety Glasses	
	.Ear Protection	
	.*Gloves, inner	surgical
	.*Gloves, outer:	nitrile
	.Chem Resist Coveralls	
	.Disposable Coveralls	Coated Tyvek
	.Splash Aprons	Vinyl
	.*Boots: Safety Boots	
	.Fully Encapsulated Suits	
	.Dosimeters	TLD
	.First Aid Equipment	
	.*Utility first aid kit	
	. Industrial first aid kit	
	.Stretcher	
	.Oxygen	
	.*Eye Wash Station	Portable
	.Emergency Shower	
	.*Fire Extinguisher	CO_2
	.Safety Harness	
	.Emergency Tools	
	.Other	
	. duct tape (rolls)	

* - Mandatory
pp - per person
ppd - per person per day

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TABLE 3

DECONTAMINATION EQUIPMENT/MATERIALS

Quantity	Type	Remarks
	.wash tubs	
	high pressure water sprayer	
	. cold	
	. hot	
	.steam sprayer	
	.scrub brushes	
	containers	
	. contaminated liquids	
	. contaminated disposables	trash bags
	.detergent	
	.methanol/acetone/isopropanol	
	.deionized water	
	.disposable wipes	
	.plastic wrap	
	.Ziploc bags	

G. FIELD TEAM REVIEW

(This sheet must be received by the Site Safety Officer prior to onsite activity)

I, _____, have read the Site Safety Plan for the _____ site. I understand the rationale for the safety procedures specified and for modification of those procedures. I agree to comply with the provisions of this safety plan.

Signature _____

Date _____

INSERT

"Attach MSDS/CHRIS Data Here"

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APPENDIX B

PERSONAL FORMS AND LOGS

PERSONAL HAZARDOUS WASTE EXPOSURE RECORD

NAME: _____

[redacted]E: _____ DATE: _____

NUMBER OF HOURS ON SITE: _____

CONDITION OF SITE: _____

AMBIENT AIR/SOIL/WATER INDICATORS:

LABORATORY: G.C. _____ ON-SITE: G.C. _____

P.I. METER _____ P.I. METER _____

OTHER _____ OTHER _____

TYPE OF EXPOSURE (i.e. inhalation, soil/water contact): _____

_____

OPERATION PERFORMED (i.e. test pit inspection, sampling, drilling): _____

_____

CHEMICALS BURIED OR KNOWN PRESENT: _____

_____

PROTECTIVE EQUIPMENT WORN:

- ☐ SAFETY SHOES (STEEL TOE & SHANK)
- ☐ CHEMICAL RESISTANT BOOTS, TYPE: _____
- ☐ HALF-FACE RESPIRATOR
  - TYPE OF CARTRIDGE: _____
- ☐ FULL-FACE RESPIRATOR
  - TYPE OF CARTRIDGE: _____
- ☐ INNER LAB GLOVES
- ☐ OUTER CHEMICAL RESISTANT GLOVES
  - TYPE: _____
- ☐ COVERALLS
  - TYPE: _____
- ☐ _____

DECONTAMINATION MEASURES TAKEN:

- ☐ CHANGE OF CLOTHES
- ☐ SHOWER
- ☐ CHANGE OF PROTECTIVE EQUIPMENT
- ☐ _____
- ☐ _____
- ☐ _____

PERSONAL PROTECTIVE DECONTAMINATION PROCEDURES: _____

_____

_____

UNUSUAL SITE CONDITIONS/OCCURANCES: _____

_____

OBSERVED HEALTH EFFECTS: _____

_____

[redacted]OTES: _____

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_____

_____

PERSONAL SAFETY LOG

NAME: _____ AFFILIATION: _____

PROJECT: _____ PROJECT #: _____

DATES OF THIS SHEET: _____ PAGE ____ OF _____

	DAY									
	1	2	3	4	5	6	7	8	9	0
WORK AREA										
HOURS ON SITE										
PROTECTIVE GEAR										
COVERALLS										
TYVEK										
GLOVES, IN										
GLOVES, OUT										
BOOTIES										
HARD HAT										
RESP, DUST										
RESP, HALF										
RESP, FULL										
SCBA										
RESP, ESC										
DOSIMETER										
AIR MONITOR										
DECONTAMINATION										
COMPLETE										
INCOMPLETE										
PERSONAL ASSESS.										
OK										
COMPLAINT										

NOTES: _____

_____

BY: _____

DAILY SAFETY LOG

PROJECT NAME:_____ DATE:_____

PROJECT NUMBER:_____ DAY NO:_____

E.C. JORDAN WORK PARTY:_____

SUBCONTRACTOR ( ):_____

VISITORS:_____

WORK SITE LOCATION:_____

SUMMARY OF CONDITIONS ENCOUNTERED:_____

FIRST AID ADMINISTERED?_____

INFRACTIONS OBSERVED:_____

BY:_____

APPENDIX C

MISCELLANEOUS REPORTS

SITE SAFETY FOLLOW-UP REPORT

(To be completed for each field change in plan.)

Was the Safety Plan followed as presented? ___yes ___no

DESCRIBE IN DETAIL ANY CHANGES TO THE SAFETY PLAN:

REASON FOR CHANGES:

APPROVED BY SITE MANAGER: DATE:
SITE SAFETY OFFICER: DATE:

EVALUATION OF SITE SAFETY PLAN

Was the Safety Plan adequate? ___yes ___no

WHAT CHANGES WOULD YOU RECOMMEND?

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ACCIDENT REPORT

Report No.:

SITE:
LOCATION:

PROJECT NO.:

DATE OF REPORT:
NAME AND ADDRESS OF INJURED:

PREPARERS NAME:
SSN:

AGE:
SEX:

YEARS OF SERVICES:
TIME ON PRESENT JOB:
TITLE/CLASSIFICATION:
DIVISION/DEPARTMENT:
DATE OF ACCIDENT:
TIME:

ACCIDENT CATEGORY:
__ Motor Vehicle
__ Property Damage
__ Fire
__ Chemical Exposure
__ Near Miss
__ Other

SEVERITY OF INJURY OR ILLNESS:
__ Non-disabling
__ Disabling
__ Medical Treatment
__ Fatality

AMOUNT OF DAMAGE: $

PROPERTY DAMAGED:

ESTIMATED NUMBER OF DAYS AWAY FROM JOB:
NATURE OF INJURY OR ILLNESS:

CLASSIFICATION OF INJURY

__ Fractures
__ Dislocations
__ Sprains
__ Abrasions
__ Lacerations
__ Punctures
__ Bites
__ Respiratory Allergy
__ Other (explain) _____

__ Heat Burns
__ Chemical Burns
__ Radiation Burns
__ Bruises
__ Blisters
__ Toxic Respiratory Exposure
__ Toxic Ingestion

__ Cold Exposure
__ Frostbite
__ Heat Stroke
__ Heat Exhaustion
__ Concussion
__ Faint/Dizziness
__ Toxic Respiratory
__ Dermal Allergy

PART OF BODY AFFECTED:
DEGREE OF DISABILITY:
DATE MEDICAL CARE WAS RECEIVED:
WHERE MEDICAL CARE WAS RECEIVED:
EMERGENCY SERVICE:
ADDRESS (if off-site):
FOLLOW-UP EXAMINATION REQUIRED:

ACCIDENT LOCATION

Causative agent most directly related to accident (object, substance, material, machinery, equipment, conditions):

WAS WEATHER A FACTOR?

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UNSAFE MECHANICAL/PHYSICAL/ENVIRONMENTAL CONDITION AT TIME OF ACCIDENT (be specific):

UNSAFE ACT BY INJURED AND/OR OTHERS CONTRIBUTING TO THE ACCIDENT (be specific, must be answered):

PERSONAL FACTORS (improper attitude, lack of knowledge or skill, slow reaction, fatigue):

LEVEL OF PERSONAL PROTECTION EQUIPMENT REQUIRED IN SITE SAFETY PLAN:

MODIFICATIONS

WAS INJURED USING REQUIRED EQUIPMENT?

IF NOT, HOW DID ACTUAL EQUIPMENT USE DIFFER FROM PLAN?

WHAT CAN BE DONE TO PREVENT A RECURRENCE OF THIS TYPE OF ACCIDENT (modification of machine; mechanical guards; correct environment; training):

DETAILED NARRATIVE DESCRIPTION (how did accident occur, why; objects, equipment, tools used, circumstance assigned duties. Be specific.):

(Use back of sheet as required)

WITNESSES TO ACCIDENT

Signature of Preparer:
Signature of Site Manager:

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EQUIPMENT CHECK LIST

'ROJECT:_____ PROJECT #_____

DATES THIS SHEET:_____ PAGE_____ OF_____

	DAY									
	1	2	3	4	5	6	7	8	9	0
PHOTOIONIZER										
CLEANED										
CALIBRATED										
RECHARGED										
EXPLOSIMETER										
CLEANED										
CALIBRATED										
RECHARGED										
RADIATION METER										
CLEANED										
CALIBRATED										
FIELD GC, LAB										
CLEANED										
DECONTAMINATION										
TRAILER, CLEANED										

BY:

NOTES:_____

BY:_____

APPENDIX D

HEAT STRESS CASUALTY PREVENTION PLAN

HEAT STRESS CASUALTY PREVENTION PLAN

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there exists an increase in the potential for injury, specifically, heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties.

A. IDENTIFICATION AND TREATMENT

1. Heat Exhaustion

a) Symptoms: Usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, his skin is clammy, and he may perspire profusely. The pulse is weak and fast, breathing is shallow. The victim may faint unless he lies down. This may pass, but sometimes it persists and, while heat exhaustion is generally not considered life threatening, death could occur.

b) First Aid: Immediately remove the victim to the Decomtamination Reduction Zone in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock. (Make the victim lie down, raise feet 6-12 inches, maintain body temperature but loosen all clothing.) If the victim is conscious, it may be helpful to give sips of water. Transport vicitm to a medical facility.

2. Heat Stroke

a) Symptoms: This is the most serious of heat casualties due to the fact that the body excessively overheats. Body temperatures often are between 107°- 110°F. The victim will have a red face and will not be sweating. First there is often pain in the head, dizziness, nausea, oppression, and a dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly. Heat stroke is always serious.

b) First Aid: Immediately evacuate the victim to a cool and shady area in the Decontamination Reduction Zone. Remove all protective outer wear and all personal clothing. Lay the victim on his back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place in a tub of cool water. The main objective is to cool without chilling. Give no stimulants. Transport the victim to a medical facility as soon as possible.

B. PREVENTION OF HEAT STRESS

1) One of the major causes of heat casualties is the depletion of body fluids. Fluids should be maintained in the support zone. Personnel should replace water and salts loss from sweating. Salts can be replaced by either a 0.1% salt solution, more heavily salted foods, or commercial mixes such as Gatorade. The commercial mixes are advised for personnel on low sodium diets.

2) A work schedule will be established during warm weather so that the majority of the work day will be during the morning hours of the day before ambient air temperature levels reach their highs.

3) A work/rest schedule will be implemented for personnel required to wear Level B or C protection (i.e. impervious outer garment). A sufficient period will be allowed for personnel to "cool down". This may require shifts of workers during operations in addition to the breaks provided by required air tank changes (Level B). Maximum time between breaks at Level B or C shall be two hours regardless of temperature. At elevated temperatures, breaks should be scheduled as described below.

Ambient Temperatures	Maximum Time Between Cooldown Breaks
Above 90°F	¼ hr.
85°-90°F	½ hr.
80°-85°F	1 hr
70°-80°F	1½ hr.

4) Periodic breaks for "cooldown" and liquid replenishment should also be scheduled while wearing any chemical resistant outer wear.

C. HEAT STRESS MONITORING

For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism. Monitoring of personnel wearing impervious clothing should commence when the ambient temperature 70°F or above. Frequency of monitoring should increase as the ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 85°F, workers should be monitored for heat stress after every work period. The following are important considerations:

1. Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. If the pulse rate is 100 beats/minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent.

2. Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the OT exceeds 99.7°F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should be measured again at the end of the rest period to make sure that it has dropped below 99°F.

3. Good hygienic standards must be maintained by frequent change of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

APPENDIX E

COLD WEATHER OPERATIONS

COLD WEATHER OPERATIONS

I. INTRODUCTION

Cold weather often causes problems for personnel working outside. There are several types of cold weather injuries which can occur, even at temperatures above freezing. As temperatures drop below freezing, the potential for these injuries increases dramatically, as does the potential for equipment failure. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0° F (-18° C) or if the windchill factor drops below -29° F (-34° C). This level represents a guideline which should be used as an action level unless the Site Safety Officer determines and documents otherwise. Figure 1 shows equivalent temperatures ("wind chill") for a range of ambient conditions.

Snow and ice add additional risks to personnel and operations. Reduced visibility, increased potential for falling injuries, reduced on-site mobility, and the increase in time required to access the site (or off-site support services) are some of the problems posed by snow and ice.

In view of the above, it is critical that the Site Safety Officer establish site specific safety and operating protocols, and that all on-site personnel be made aware of the risks from the recognition of, and the treatment of cold weather injuries.

II. COLD WEATHER INJURIES

There are two basic categories of cold weather injuries; local and systemic.

A. Local Cold Injuries

Local cold injuries are those injuries which affect specific areas of the body (e.g., fingers, ear, toes) and include the more commonly recognized cold weather injuries described below.

1. Chilblains is a condition that can result from prolonged exposure of bare skin to temperatures in the low sixties (°F) or below. This condition generally occurs in the extremities, and is a chronic injury of the skin and peripheral capillary circulation. Covering and protecting the skin from prolonged exposure to the cold is the best method of preventing and treating chilblains.

2. Frostbite is the freezing of some part of the body as a result of exposure to very low temperatures. Frostbite can affect hands, feet, ears, and exposed parts of the face. It occurs when ice crystals form in the fluid in cells of the skin and tissue. As long as blood circulation remains good, frostbite will not occur. Frostbite is a constant hazard in sub-zero weather, especially where there are strong winds.

WIND-CHILL INDEX

Example. What is the equivalent temperature when the actual thermometer reading is 60° F. below zero (−60° F.) and the prevailing wind speed is 15 miles per hour?

Solution. Connect −60° F. on actual thermometer-reading scale with 15 miles per hour on the wind-speed scale, extend to the equivalent temperature scale, and read −110° F. (110 below zero).

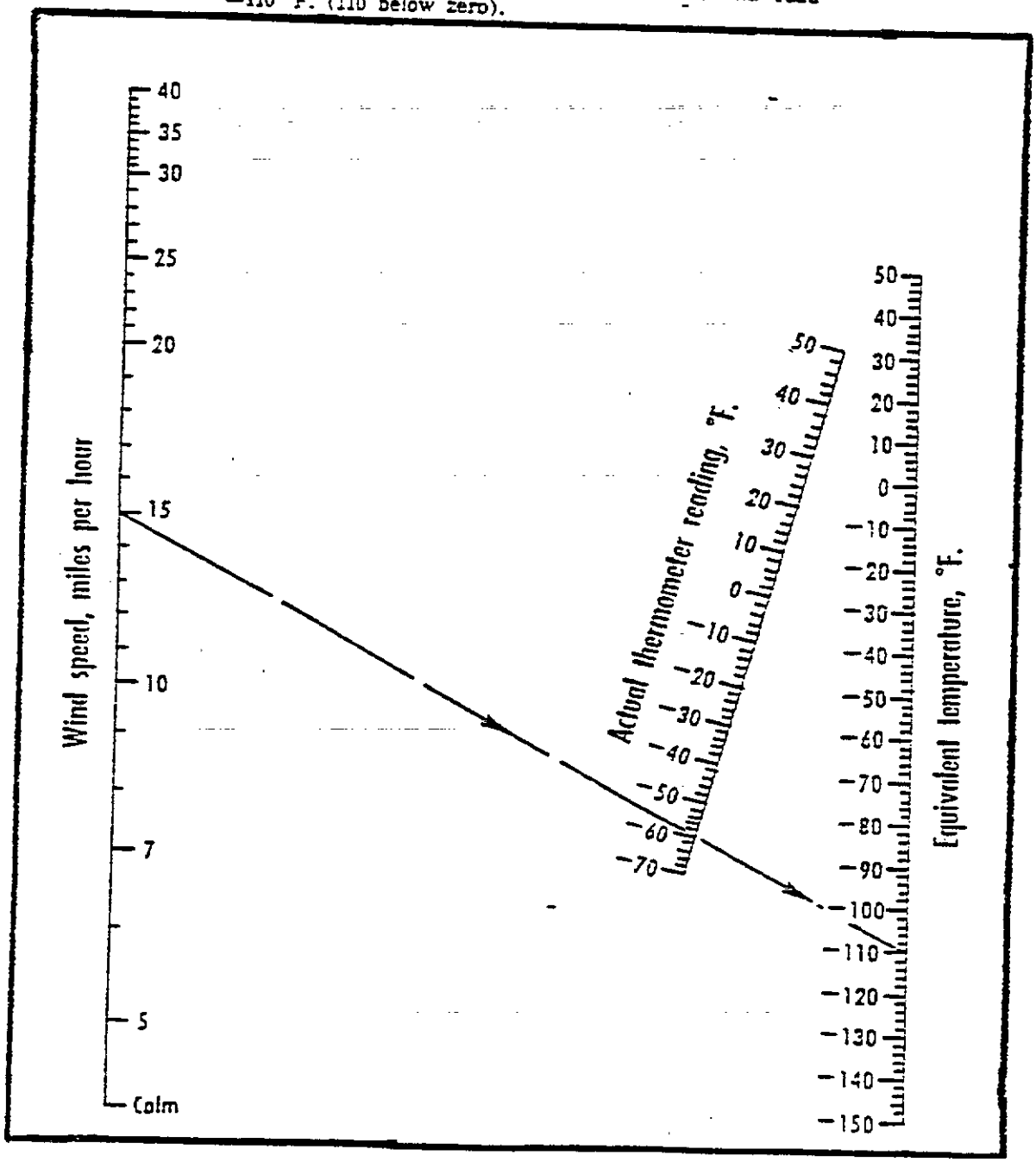

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FIGURE 1

There are three stages of frostbite. Classification depends upon the amount of tissue damage. Severity can range from incipient frostbite (frostnip), which affects the skin, to superficial frostbite, which involves the skin and the tissues immediately beneath it, to deep frostbite, a much more serious injury with damage that may affect deeper tissue and even bone.

a. Symptoms

Symptoms for each of the three stages of frostbite include:

Frostnip
Skin first turns red, later becomes pale or waxy white.
May be tingling, stinging, or aching or uncomfortable sensation of coldness, followed by numbness, or it may be unnoticed by person.

Superficial Frostbite
Skin is white or gray-white and waxy in appearance.
Skin is firm to touch, does not move easily.
Tissue beneath the skin is soft and resilient.
Lack of sensation in the area.

Deep Frostbite
Tissues are pale, cold, solid.
Usually affects hands and feet.
Blisters and swelling may occur.

b. Emergency Treatment of Frostbite

Frostnip is easily reversed in the field by the application of body heat. Apply body heat before the affected area becomes numb. Thaw frozen spots immediately. Do not rub affected areas.

If frostnip affects your fingers and hands, place them against the skin of your chest or in your armpits. To warm your face, hold a mitten or scarf over the lower part of your face and breathe into it.

Superficial Frostbite usually responds to the application of body heat. If it does not or if it resembles the early stages of deep frostbite, treat the condition as though it were.

Deep Frostbite
If possible remove person to a heated shelter to avoid further frostbite.

Remove all constricting items (boots, gloves, socks) from area of injury if it can be done without danger of further frostbite.

RAPID REWARMING WILL MINIMIZE TISSUE LOSS.

Warm extremities in a carefully-controlled warm water bath (104°F to 106°F) until tips of the fingers or toes turn pink and feeling is restored.

If a water bath is not available, use ALTERNATE METHODS;

Apply wet packs (100°F to 112°F) to the person's body.

Gently wrap frostbitten area in blankets or other warm material.

DO NOT attempt to thaw by exercising the affected parts or heating them in front of an open fire, heat lamps, radiator or a stove. The person may have lost sensation in the parts and may receive a heat injury as a result.

DO NOT use snow to thaw frostbite.

DO NOT rub, massage or use pressure on the affected areas.

Watch to see if CPR is necessary.

Continue Care:

Keep frostbitten parts elevated if possible.

Give victim warm drinks such as tea, coffee, or soup.

DO NOT GIVE ALCOHOLIC BEVERAGES.

Have victim exercise fingers or toes as soon as they are warmed.

Do NOT allow a person with frostbitten feet to walk. It may cause additional damage.

c. Medical Treatment of Frostbite

Frostnip usually does not require medical care.

Superficial Frostbite. Blisters may require medical care.

Deep Frostbite. EARLY MEDICAL TREATMENT IS URGENT! Get the victim to medical care at once.

d. Prevention of Frostbite

It is far easier to prevent or to stop frostbite in earlier stages than to thaw and take care of badly frozen flesh:

Wear enough clothing to protect yourself against cold and wind.

Wear warm gloves and boots.

Pull a scarf or jacket flap over the lower part of your face or a hood tightly around your face.

Exercise face, fingers and toes from time to time to keep them warm and to detect any areas that may have become numb.

Crew members should watch each other closely for signs of frostbite, especially on the face.

3. Immersion foot (formerly called trench foot) is a cold injury resulting from prolonged exposure to temperatures near freezing, especially when standing or walking in wet or swampy ground.

a. Symptoms

In the early stages the feet and toes are pale, feet are cold, numb, stiff. Walking is difficult. If preventive action is not taken, feet will swell and ache. In extreme cases, irreversible damage to the tissues of the foot or leg may result.

b. Emergency Treatment of Immersion Foot

Feet should be handled very gently. Do not rub or massage.

If necessary, clean feet carefully with soap and water, then dry and elevate them and expose them to warm but not hot air.

c. Prevention of Immersion Foot

Because early stages of immersion foot are not painful, you must be constantly alert to prevent this condition.

Check feet often when working in wet cold.

Keep your feet dry by wearing waterproof foot gear and by avoiding standing in wet areas.

Since perspiration trapped inside waterproof boots or heavy footgear can contribute to immersion foot symptoms, change your socks frequently.

Dry your feet as soon as possible if they get wet. Warm them with your hands. Use foot powder and put on dry socks.

If you cannot change wet boots and socks, exercise your feet frequently by wriggling your toes and moving your ankles. Never wear tight boots.

B. Systemic Cold Injuries

Systemic injuries are those that affect the entire body system. Severe general body cooling is known as systemic hypothermia, and can occur at temperatures well above freezing. Hypothermia is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse. Subnormal temperature within the central body can be fatal. A large percentage of wilderness deaths are the result of hypothermia.

Hypothermia is caused by exposure to cold and it is aggravated by moisture, cold winds, fatigue, hunger, and inadequate clothing or shelter. Excessive perspiration from strenuous exercise followed by too rapid cooling can lead to hypothermia.

Hypothermia usually occurs between the temperatures of 30-50°F, temperatures which most people believe are not dangerous. Crew members should be alert for symptoms of hypothermia, especially when temperatures are dropping rapidly or when they must work in rain, snow or ice.

Hypothermia may occur on land or following submersion in even moderately cold water, 65°F or below. Death in cold water may seem to be from drowning but it is usually the result of hypothermia.

On land, hypothermia may take up to a full day or more of exposure to develop. If the cold conditions are extremely severe, however, death may occur within a few hours of the first symptoms.

In water, skin and nearby tissues chill very fast. Within even 10 to 15 minutes, the temperature of the heart and brain may drop. When core (internal body) temperature reaches 90°F, unconsciousness may occur. In water, when the body temperature drops to 80°F, heart failure is the usual cause of death. A person may drown as a result of losing the use of arms and legs or by becoming unconscious.

a. Symptoms

In the early stages of hypothermia, the body begins to lose heat faster than it can produce it and makes efforts to stay warm by shivering. When the body can no longer generate heat fast enough to overcome heat loss and the energy reserves of the body are becoming exhausted, a second stage begins; the body temperature begins to drop. This affects the ability of the brain to make judgments and also results in loss of muscular control.

As the body temperature drops, hypothermia symptoms become increasingly severe:

SYMPTOMS OF HYPOTHERMIA	APPROX. CORE TEMPS.
Person is conscious, alert. May have shivering that becomes uncontrollable as core temperature nears 95°F. Respirations increase at first.	Above 95°F

Person is conscious but disoriented, apathetic. Shivering present but diminishes as temperature drops. Below 92°F respiratory rate gradually diminishes, pupils begin to dilate.	95-90°F
Person is semi-conscious. Shivering replaced by muscular rigidity. Pupils fully dilated at about 86°F.	90-86°F
Unconscious, diminished respirations.	Below 86°F
Barely detectable or nondetectable respirations.	Below 80°F

b. Emergency Treatment of Hypothermia

In very mild cases of hypothermia, dry clothing and shelter may be all that is needed.

Move victim to shelter and warmth as rapidly as possible.

Gently remove all wet clothing (so victim does not expend energy warming and drying wet clothing) and replace it with dry.

Give the person something warm to drink. Do not give alcoholic beverages.

ALL OTHER CASES SHOULD BE CONSIDERED MEDICAL EMERGENCIES.

PROVIDE EXTERNAL HEAT ANY WAY POSSIBLE!

A WARM BATH with the water kept between 105°F and 110°F is the most effective way of warming a victim of hypothermia. (NEVER put an UNCONSCIOUS VICTIM in a bathtub.)

If it is not possible to give the person a warm bath, use an ALTERNATIVE METHOD:

Wrap warm moist towels (or other fabric) around the victim's head, neck, sides, groin. As the packs cool, rewarm them by adding warm water (about 105°F). (Check the temperature of the water with your elbow or the inside of your arm. Water should be warm but not hot).

Or, if you are at an remote outdoor location and cannot use any of the other methods:

Make a "human sandwich" by placing the unclothed victim in a sleeping bag (or between blankets) with two other undressed persons to provide body-to-body heat transfer. THIS WILL SAVE LIVES. Additional sleeping bags or blankets can be placed over and under the sleeping bag.

Do NOT wrap a hypothermia victim in a blanket without an auxillary source of heat unless it is to protect against any further heat loss before treatment can begin.

Do NOT leave the person in a sleeping bag without extra heat in order to go for help unless there is no other alternative.

Continue treatment:

Give warm liquids and nourishing food if the person is conscious.

Check the person for symptoms of frostbite and if necessary, give treatment for frostbite.

Handle the patient gently and do not allow him to walk. Exertion can circulate cold stagnant blood from extremities to the central body and cause "after-drop", in which the patient's core temperature may drop below the level which will sustain life. (Alcohol also contributes to after-drop.)

c. Medical Care for Hypothermia

HYPOTHERMIA IS A SEVERE EMERGENCY. GET MEDICAL TREATMENT AS SOON AS POSSIBLE. Even persons with mild hypothermia should see a doctor.

d. Prevention of Hypothermia

Never go into the field in cold weather without wearing adequate clothing and taking a complete change of warm clothes and one or two pairs of extra socks (in plastic bags).

Wear or carry a windproof, water-resistant outer jacket. In rain or snow, wear adequate rain gear.

Stay dry. If your clothing becomes wet from perspiration, rain, snow or immersion in water, change it as soon as possible.

If you start to shiver in a prolonged or violent way, seek shelter at once. Shivering produces heat but uses up energy. Shivering violently may be an early sign of hypothermia.

Avoid accidental immersion in water. Practice boat safety and learn cold water survival techniques if your field work involves activities where you could fall into the water.

If you do fall into water (and are not very close to shore), remain quiet with your head out of water or climb onto the boat or any other object that will support you and keep you up out of the water.

C. Safety/First Aid Equipment

In view of the causes, results, and appropriate treatment of cold weather injuries discussed above, the following items should be included as safety equipment during cold weather operations.

Extra clothing for all personnel
Blankets/sleeping bag
High energy food, and drinking water supply
Toboggan
Tow ropes

In extreme cold conditions, the following safety items should also be included:

Electric blanket
Portable emergency generator (with fuel, oil, and cords)
Space heater and fuel

III. GENERAL WINTER OPERATIONS

Cold weather conditions can severely affect winter operations. The Site Manager and Site Safety Officer must plan work schedules and project tasks accordingly.

A. Preliminary Assessment

If you will be working outdoors in cold weather, assess the local weather conditions through the news media (radio, television, newspapers) in order to know the amount of preparation you will need to make. Carefully consider such questions as:

What are the typical wind and weather conditions for the period in which you will be sampling?

Are the areas in which you will work sheltered or open to the wind?

Is there a place nearby for periodic warming breaks? Can you obtain or heat warm food and beverages there? Is there a source of drinking water?

Are there ways to minimize the length of time that crew members will have to work outdoors in the cold?

If you use a vehicle for a warming area or will use a heater in a closed room, how can you insure there is adequate ventilation to prevent carbon monoxide poisoning?

B. Scheduling

Try to schedule work in the least severe weather.

Plan to rotate crew members to keep cold exposures short.

Allow sufficient time for frequent warming breaks.

Remember that workers in heavy clothing may need more time to complete tasks and may become fatigued more easily.

Be aware that you may have to discontinue operations if winds increase or the temperature drops.

Remember that winter days are short. Scheduling should allow time for taking care of equipment and supplies before nightfall when it is more difficult to gauge terrain and when temperatures are likely to drop.

C. Site Access

Snow and ice could make travel on site access roads impossible, or treacherous at best. Personnel should not be allowed to work on-site if conditions severely hamper the arrival or departure of emergency vehicles. An otherwise minor injury could result in a major medical emergency if the route to off-site medical facilities is blocked by snow, ice, etc.

If conditions warrant, the following provisions should be made:

1. Snow removal/plowing services for site access roads should be secured.

2. A dependable four wheel drive vehicle should be immediately available on-site to transport injured to off-site medical facilities.

3. Sleeping bags, blankets, food supply, and water should be kept on-site in the event a sudden storm requires personnel to remain on-site overnight.

The Site Safety Officer must decide when weather conditions make site access unsafe, and must stop work until conditions improve.

D. Equipment and Supplies

You should obtain equipment and supplies that will help prevent cold stress and that will help in the treatment of cold stress disorders.

Take a reliable ambient temperature thermometer, a wind gauge and a wind chill chart.

If the site is very windy, try to provide means of shielding workers from the wind.

If you are working at a distance from stores, carry extra food and water since hunger and dehydration contribute to cold stress. Try to take a means of providing hot food and beverages if one is not available nearby.

Provide emergency communication equipment for use between ground crews and those working in the cold, at heights, or in remote locations.

Very close attention must be paid to the effects of cold weather on field equipment. Many types of batteries can be severely affected by cold resulting in disabled radios, air monitoring equipment, sampling pumps, and vehicles. A supply of fresh batteries, sufficient number of charging units, and a set of automotive jumper cables should be maintained on-site.

The electronics in many field instruments such as PI meters, LEL meters and oxygen meters can also be adversely affected by the cold. Manufacturers literature must be consulted for operating ranges.

If at all possible, monitoring well sampling tasks should not be scheduled during cold weather. These tasks generally require the use of (relatively delicate) pumps; long, uninsulated stretches of tubing; and significant quantities of decontamination solutions. Unless considerable effort is expended to prevent pumps, hoses, decontamination solutions, and sample containers from freezing, attempting to sample monitoring wells in cold weather may be counter-productive. Portable shelters should be considered if cold weather sampling is necessary.

IV. CONCLUSIONS

Safe cold weather operations require considerable planning on the part of the Site Manager and Site Safety Officer.

Weather conditions and forecasts must be watched closely, and on-site activities and procedures modified accordingly.

On-site personnel must be made aware of the hazards of cold weather, and the symptoms and treatment of cold weather injuries.

A sufficient number of warm-up breaks must be provided to on-site personnel.

Enclosed, heated decontamination facilities may be required.

Additional time must be allotted in the morning to check out and warm-up field equipment. Additional time must also be allotted for the end of the day to drain hoses and pumps, pack and secure equipment, and plan the next day's activities based upon up-to-date weather forecasts.

APPENDIX F

LEVEL B OPERATIONS

I. Introduction

Level B protection is selected when respiratory and dermal hazards are severe, but total encapsulation is not indicated. Level B protection includes a self-contained breathing apparatus (SCBA), a hard hat, steel-toed chemical resistant boots, two pair of chemical resistant gloves and chemical resistant coveralls. A rubber apron to protect the SCBA harness assembly and regulator from contamination may be needed at sites where high chemical concentrations and splash potential are anticipated. Decontamination workers should utilize Level C protection whenever site workers have selected Level B as they may also be exposed to highly volatile liquids, highly toxic materials, or other hazardous substances in the decontamination area.

II. Team Size

Team size and organization will depend upon the degree of difficulty of tasks and the site-specific requirements of the individual investigation. An important consideration during Level B operations is that each team member receive sufficient training to readily complete an emergency response task that may occur on the site. This means that every person on the site who is part of the operating team must be able to respond to an emergency by using all available safety equipment and, if necessary, entering the contaminated zone.

A minimum of three people are required, but four are recommended, for any Level B operation. There should always be at least one person outside the contaminated zone dressed at the same level of protection as the downrange people, filling the functions of emergency response person and site safety officer.

Site Safety Officer

The site safety officer usually remains at the decontamination area in order to monitor all downrange operations. Downrange personnel are either in the safety officer's line of sight or other individuals are located between the safety officer and downrange personnel in order to maintain an unbroken person to person line of sight. In some operations constant radio contact between the site safety officer and downrange personnel may be sufficient. The specific responsibility of the site safety officer during a Level B operation is to: 1) monitor "on-air" work time and physical conditions of all personnel (especially heat stress & fatigue); 2) to make all decisions concerning protective equipment; and 3) monitor all activities to remove personnel from any developing unsafe work conditions or unsafe work activities.

Decontamination Person

This individual is responsible for organizing decontamination stations, assisting/supervising all decontamination operations, changing air tanks, disassembling the decontamination stations, and disposing of all contaminated fluids.

Emergency Response Person

This person is outfitted in Level B protection but normally is not utilizing his containerized air supply. The rescue person remains at the decontamination station and goes downrange only to assist with emergency evacuations. On small teams, the rescue and decontamination task can be handled by a single individual.

Sample/Field Personnel

These are individuals who complete all downrange operations. On large teams, the field personnel who are not currently downrange can assist with decontamination or command post operations.

Other Personnel

In some operations it is considerably more efficient to dedicate a person to record notes transmitted by radio from downrange personnel, to fill out sample claim-of-custody and other paperwork or to monitor and refill tanks for the longer operations. Other personnel must be planned on a task specific basis.

III. Record Keeping

In addition to the basic records kept during any field activity, a record containing the chronology of operations must be completed. This record includes all personnel and the times they were utilizing a self-contained breathing apparatus.

APPENDIX G

RESPIRATORY PROTECTION PROGRAM

E.C. JORDAN CO.
RESPIRATORY PROTECTION PROGRAM

I. INTRODUCTION

This program has been developed to govern the selection and use of respiratory protective devices by E.C. Jordan Co. (Jordan) personnel. The program is intended to comply with Occupational Safety and Health Administration (OSHA) requirements as set forth in 29 CFR 1910.134(b). The scope of this program is limited to activities related to field investigations of potentially hazardous waste disposal sites.

II. PERSONNEL REQUIREMENTS

All personnel assigned to field activities at hazardous or potentially hazardous locations are currently required by Jordan's Health and Safety policies to be enrolled in the corporate Health Monitoring Program. A portion of this program involves spirometry, a measure of the respiratory system status. No personnel may be assigned to the use of, or withdraw from stock, any respiratory protective device without physician certification that use of such a device will not be injurious to health. Psychological limitations, e.g. claustrophobia, are also considered in personnel assignments. Training in the use of the selected device and fit testing, as described herein, are also required.

No personnel will be assigned duties which require a respirator when facial hair, skullcaps or eye glasses will interfere with a proper fit. No contact lenses may be worn with any respiratory protective device. Eyeglass frames which fit inside the respirator facepiece are provided as necessary.

III. APPLICABLE EQUIPMENT

Jordan maintains the following respiratory protective equipment:

- full-face chemical/mechanical air purifying respirators
- self-contained breathing apparatus
- full-face air line-supplied breathing apparatus
- 5-minute escape air supply

This equipment is intended for use on an as needed basis, to be determined by an evaluation of on-site conditions. Respiratory protective equipment should not be used arbitrarily by any Jordan personnel.

Selection criteria are presented separately; training is required in the use of each type of equipment prior to drawing from stock.

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IV. PERSONNEL TRAINING

Training of personnel in the proper use and care of respiratory protective equipment is considered essential to the success of the program. Training encompasses:

- o respiratory protection principles
- o selection of appropriate equipment
- o use of equipment
- o maintenance of equipment
- o fit testing

Information regarding each topic is presented as standard respiratory protection procedures.

V. STANDARD RESPIRATORY PROTECTION PROCEDURES

The following information has been organized and presented by topic as Standard Respiratory Protection Procedures, to be used both in training and as reference material for field operations.

Standard Respiratory Protection Procedure No.	Topic
1	Respiratory Protection Principles
2	Selection of Respirators
3	Fit Testing
4	Inspection/Maintenance/Storage

These procedures are attached.

VI. PROGRAM ADMINISTRATION AND DOCUMENTATION

The administration of Jordan's Respiratory Protection Program is the responsibility of the Personnel Health and Safety Committee (PHSC). Administration includes:

- o respirator selection
- o personnel training
- o fit testing

- respirator maintenance
- documentation
- program evaluation and improvements
- personnel pulmonary testing and certification

Written health and safety plans for each site, and site hazard assessments result in respirator selection in accordance with the decision logic set forth in Standard Respiratory Protection Procedure No. 2.

Fit testing and respirator maintenance is performed by the equipment manager of Jordan's Sample Control and Staging Center under the administration of PHSC. Major maintenance is performed by manufacturer certified technicians only. Personnel training in respiratory protection is one aspect of PHSC's ongoing personnel training programs.

Program evaluation is a dynamic process, occurring each time a Project Health and Safety Plan is prepared.

Medical supervision of personnel occurs as part of Jordan's Health Monitoring Program, also administered by PHSC. Medical surveillance is required for all personnel assigned to hazardous or potentially hazardous site activities.

Documentation of the various elements of Jordan's Respiratory Protection Program is achieved through several media:

- Documentation of respirator selection is included in the hazard assessment of each site's Health and Safety Plan.

- Documentation of personnel training is maintained in both hard-copy and computerized files.

- Documentation of medical surveillance is achieved indirectly by maintaining a list of enrolled employees in the Health Monitoring Program and directly through physician certification of personnel allowed to be assigned respiratory protective devices.

- Documentation of fit-testing is maintained on file with the equipment manager of the Sample Control and Staging Center, utilizing the appropriate form. (Exhibit 1)

- Documentation of site surveillance is required both by this program and by the Health and Safety Plan for each site. Records of site surveillance are created by the Site Safety Officer and maintained in project files.

- Respirator inspection and maintenance records are created and maintained for each respirator, SCBA, and escape respirator by the equipment manager. (Exhibit 2)

  Inspection and documentation occurs before each unit is removed from stock and when it is returned, or monthly.

Exhibit 1

Respirator Fit Test Worksheet

RESPIRATOR FIT TEST WORKSHEET

Applicant Name _____

Organization _____

Date of Test _____

Employee Number _____

Equipment Type _____

Manufacturer _____

Model/Size _____

Test Conducted by _____

TEST RESULTS

(1) Negative Pressure Test — Pass ( ) Fail ( ) _____

(2) Positive Pressure Test — Pass ( ) Fail ( ) _____

(3) Isoamyl Acetate Vapor Test
Initial Odor Recognition — Yes ( ) No ( ) _____
Odor Detected w/ Respirator On — Yes ( ) No ( ) _____

(4) Irritant Smoke Test
Irritant Detected — Yes ( ) No ( ) _____

Employee briefed on fundamental principals of respiratory protection, use, inspection, cleaning, maintenance and storage of equipment
Yes ( ) No ( )

ADDITIONAL INFORMATION

Last Employee Physical Exam Conducted on _____
Stress Test Included Yes ( ) No ( )

At Medical Facility _____

Corrective Lenses Required for Normal Work Tasks Yes ( ) No ( )

Facial Characteristics: Clean Shaven ( ) Beard ( ) Other ( ) _____
Specify

Follow-up Physical Due _____

I hereby certify the subject employee has been fit tested according to procedures specified in RESPIRATORY PROTECTION PROCEDURE NO. 3.

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_____ Tester Name

_____ Date

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Exhibit 2

Respirator Use & Maintenance Record

RESPIRATOR USE AND MAINTENANCE RECORD

Respirator

ID Number

Respirator Type

Manufacturer

Model Number Date Place In Service

Date	Assigned to Whom or Location of Storage	Inspection/Maintenance and Charging (SCBAs) Information	Serviced By

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STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 1
RESPIRATORY PROTECTION PRINCIPLES

1.1 INTRODUCTION

Since the lungs are not completely effective in protecting the body against respirable chemical hazards, they must be artificially protected from toxic gases, vapors, and particulates. In addition, the body must be supplied with enough oxygen to maintain a normal capacity to perform tasks.

1.2 ROUTES OF EXPOSURE

The volume of air inhaled during "normal" activities is approximately 6 ℓ/min. The volume of air inhaled during brisk activity or during periods of stress can go up to 75 ℓ/min (a 12-fold increase).

Air is inhaled through the nose and mouth and travels an extremely turbulent path to the lungs. This turbulency results in the air impinging on many sites, thus allowing the insoluble particulates to become impacted and soluble particulates, vapors, and gases to become absorbed.

The inhaled air passes through the pharynx, the common passageway for both food and air, and enters the trachea at the larynx. The trachea (or windpipe) divides into two bronchi, which lead to the two lungs. All of these organs are collectively called the conducting tubes, since they lead the air to the alveoli, the site of gaseous exchange with the pulmonary capillaries (i.e., the blood).

Toxic substances may be absorbed at any point in the respiratory tract. The conducting tubes are lined with mucus and cilia. Insoluble contaminants caught in the mucus are swept up to the esophagus by the cilia and swallowed, thus causing an ingestion problem.

1.3 OXYGEN DEFICIENCY

1.3.1 Oxygen and the Respiratory Process

The chemical composition of normal air is presented below as Table 1.

Table 1. Atmospheric Composition

Gas	Volume (%)	Partial Pressure (mm Hg at sea level)
Nitrogen	78.9	594
Oxygen	20.95	159
Argon	0.93	7
Carbon dioxide	0.04	0.3

It is not the percentage of O_2 in the air, but rather its partial pressure (pO_2), that is important in respiration. As one increases in altitude, the percentage of O_2 stays constant, but pO_2 drops. Additionally, as the percentage of O_2 in the air drops, so does its partial pressure.

The "anatomic dead space volume" of the respiratory tract is about 150 ml. The average breath draws in about 500 ml of air; this air is mixed with the air remaining in the dead space from the previous exhalation, which has been depleted in oxygen due to the normal respiratory process. The overall effect is a lower pO_2 in the respiratory tract as compared with the ambient air. The average respirator adds about 100 ml of dead space to the respiratory system, which further lowers the pO_2 in the respiratory system, causing a slight oxygen deficiency.

1.3.2 Oxygen Levels/Physiological Effect

The currently accepted National Institute for Occupational Safety and Health (NIOSH) standards specify that if an atmosphere contains less than 19.5 percent by volume O_2 at sea level, then an atmosphere-supplying device must be used.

Note that as altitude increases, the percentage of O_2 stays constant, but the pO_2 drops. There is currently no standard that accounts for the drop in pO_2 with altitude; the problem is currently under study by NIOSH.

The physiological effects of oxygen deficiency are indicated in Table 2.

1.4 PARTICULATE CONTAMINANTS - AEROSOLS

Aerosol is a term used to describe particulates in air without regard to their origin. Particulates are collected on the walls of the respiratory tract depending upon their size as follows:

1. Pharynx - 10-30 µm
2. Trachea - 10 µm
3. Bronchus - 5-10 µm
4. Alveoli - 0.1-1 µm

Particulates less than 0.5 µm may never be deposited in the respiratory tract and may simply be exhaled.

Particulates affect the human body as follows:

1. Nuisances - inert substances that cause no lung damage but inhibit proper functioning of the lungs.

2. Inert pulmonary reaction causing substances - substances that produce nonspecific pulmonary effects.

Table 2. Physiological Effects of Oxygen Deficiency

O_2 Volume Percentage at Sea Level	Physiological Effect
16-12	Increased breathing volume. Accelerated heartbeat. Impaired attention and thinking. Impaired coordination.
14-10	Very faulty judgment. Very poor muscular coordination. Muscular exertion causes rapid fatigue that may cause permanent heart damage. Intermittent respiration.
10-6	Nausea. Vomiting. Inability to perform vigorous movement, or loss of all movement. Unconsciousness, followed by death.
Less than 6	Spasmatic breathing. Convulsive movements. Death in minutes.

3. Pulmonary fibrosis causing substances - substances that produce effects ranging from nodule production to serious diseases such as asbestosis.

4. Irritants - substances that irritate, inflame, or ulcerate lung tissues.

5. Systemic poisons - substances that cause injury to specific organs and body systems.

6. Allergens - substances that produce hypersensitivity.

1.5 GASEOUS CONTAMINANTS

Gaseous contaminants are "filtered" to a small degree by the respiratory tract before they reach the alveolar spaces. However, if the contaminants are soluble, they can be directly absorbed through the walls of the respiratory tract.

Gaseous contaminants affect the human body as follows:

1. Irritants - corrosive compounds that injure and inflame tissue.

2. Asphyxiants - substances that displace oxygen or prevent the use of oxygen by the body.

3. Anesthetics - substances that depress the central nervous system and cause intoxication or loss of sensation.

4. Systemic poisons - substances that cause diseases.

1.6 EXPRESSING AIR CONTAINMENT CONCENTRATIONS

Any substances that are not normal components of breathing air (oxygen, nitrogen, etc.) are considered to be contaminants. The respiratory threat posed by contaminants is a function of the actual contaminant and its concentration in the air. The concentration is expressed in a variety of ways, as listed below.

1. Particulates

    a. mppcf - millions of particulates per cubic foot.
    b. ppcc - particles per cubic centimeter.
    c. mg/m^3 - milligrams per cubic meter.

2. Gases and Vapors

    a. ppm - volumes per million volumes of air (parts per million).

    b. ppb - volumes per billion volumes of air (parts per billion).

    c. mg/m^3 - milligrams of gas per cubic meter.

d. Conversion of units. The following equation converts mg/m^3 to ppm, at 24°C and 760 mm Hg.

$$ppm = \frac{24.45}{\text{molecular weight}} \; mg/m^3,$$

This equation is extremely useful for determining respiratory protection requirements.

1.7 MEASURES OF RESPIRATORY HAZARDS

Every contaminant contained in breathing air has a limit, above which it becomes a threat to human health. These limits are determined either from animal studies or from epidemiological data. Unfortunately, animal studies can only approximate human response and may vary widely for individual chemicals. Epidemiological studies, although capable of providing a more precise forecast of human response, are limited by a lack of accurate records and a lack of controlled studies. Therefore, the "safe" limits of various chemicals must be viewed only as guidelines. Furthermore, these guidelines are primarily designed for the industrial situation where an individual is being exposed to one or two well-defined substances. These guidelines do not address the problems of synergism, potentiation, or allergic response.

The guidelines used in measuring respiratory hazards are listed below.

1. Threshold Limit Value. The threshold limit value (TLV) is recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) and is derived from consensus review. It is a time-weighted average concentration set for a particular substance that represents a level that almost all workers can be exposed to for an 8-hr day (40-hr week) without suffering adverse health effects. It is assumed that following each 8-hr. exposure there will be a 16-hr. recovery period and that after 5 days there will be a 48-hr. recovery period. The TLV lists are revised on a yearly basis.

2. Permissible Exposure Limits. The permissible exposure limits (PELs) are set forth in the Occupational Safety and Health Administration (OSHA) Standards 29 CFR 1910.1000, Tables Z_1, Z_2, and Z_3. These levels were promulgated initially from the ACGIH TLV lists (1968). As part of the law, they represent the legal maximum concentrations for personnel exposure. They are not updated on a yearly basis, as is the TLV list. Therefore, the most current ACGIH TLV is used in determining respiratory protection, rather than the PEL listing.

3. Immediately Dangerous to Life and Health. 30 CFR 11.3 defines conditions that are immediately dangerous to life and health (IDLH) as "conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants such as radioactive materials, which are likely to have an adverse cumulative or delayed effect on health".

OSHA adds these criteria:

a. The worker must be able to escape without losing his life or suffering permanent health damage within 30 minutes.

b. The worker must be able to escape without severe eye or respiratory irritation or other reactions.

4. Lower Flammable Limit. The lower flammable limit (LFL) is the lowest concentration by volume of a gas or vapor in air that will explode when there is an ignition source.

1.8 RESPIRATORY PROTECTION

When it has been determined that the ambient atmosphere is hazardous, it becomes necessary to protect the individual by:

1. avoiding and/or minimizing exposure;
2. applying engineering controls such as ventilation; and
3. using a respirator to either filter the air or supply air.

The legal requirements for respiratory protection are summarized below.

1. Williams and Steiger Occupational Safety and Health Act of 1970 established standards that state that "approved or accepted respirators shall be used when they are available".

2. 29 CFR 1910.134 gives legal requirements for the selection and use of respiratory equipment as promulgated by OSHA and based on American National Standards Institute (ANSI) Standard Z88.2, "American National Standards Practices for Respiratory Protection". Standard Z88.2 was originally a consensus standard, but now has been cited as a Federal regulation.

3. 30 CFR Part 11 describes tests for permissibility of respiratory protective apparatus and updates or deletes approvals. 30 CFR Part 11 also cites ANSI Z88.2 as the basis for respiratory protection.

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 2
SELECTION OF RESPIRATORS

2.1 INTRODUCTION

This text is based on "Joint NIOSH/OSHA Standards Completion Program - Respirator Decision Logic". The text is excerpted for the purpose of covering the major points of the respirator decision logic. For the complete text, see John S. Pritchard's, "A Guide to Industrial Respiratory Protection" (U.S. Department of Health, Education, and Welfare, U.S. Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, Ohio, June 1976). It is not intended to be all-inclusive in content.

The purpose of the respirator decision logic is to provide technical accuracy and uniformity in the selection of respirators and to provide necessary criteria to support this selection. The decision logic is a step-by-step elimination of inappropriate respirators until only those that are acceptable remain. Judgment by persons knowledgeable of inhalation hazards and respiratory protection equipment is essential to ensure appropriate selection of respirators.

The primary technical criteria for what constitutes a permissible respirator are based on the technical requirements of 30 CFR 11. The health standards will allow only respirators approved under 30 CFR 11. Classes of respirators are only included when at least one device has been approved.

Protection factors are criteria used in determining what limiting concentrations are to be permitted for each respirator type that will afford adequate protection to the wearer. The referenced Subparts of 30 CFR 11 give technical descriptions concerning each type or class of respirators referenced in the decision logic; 30 CFR 11 should be used with the decision logic in order to properly understand the criteria for the specification of allowable respirators.

Throughout this text, reference is made to PELs. Prudent, accepted practice dictates the use of current ACGIH TLVs, which are updated each year, in the place of the PEL, which is only periodically updated.

2.2 GENERAL DECISION LOGIC FLOWCHART

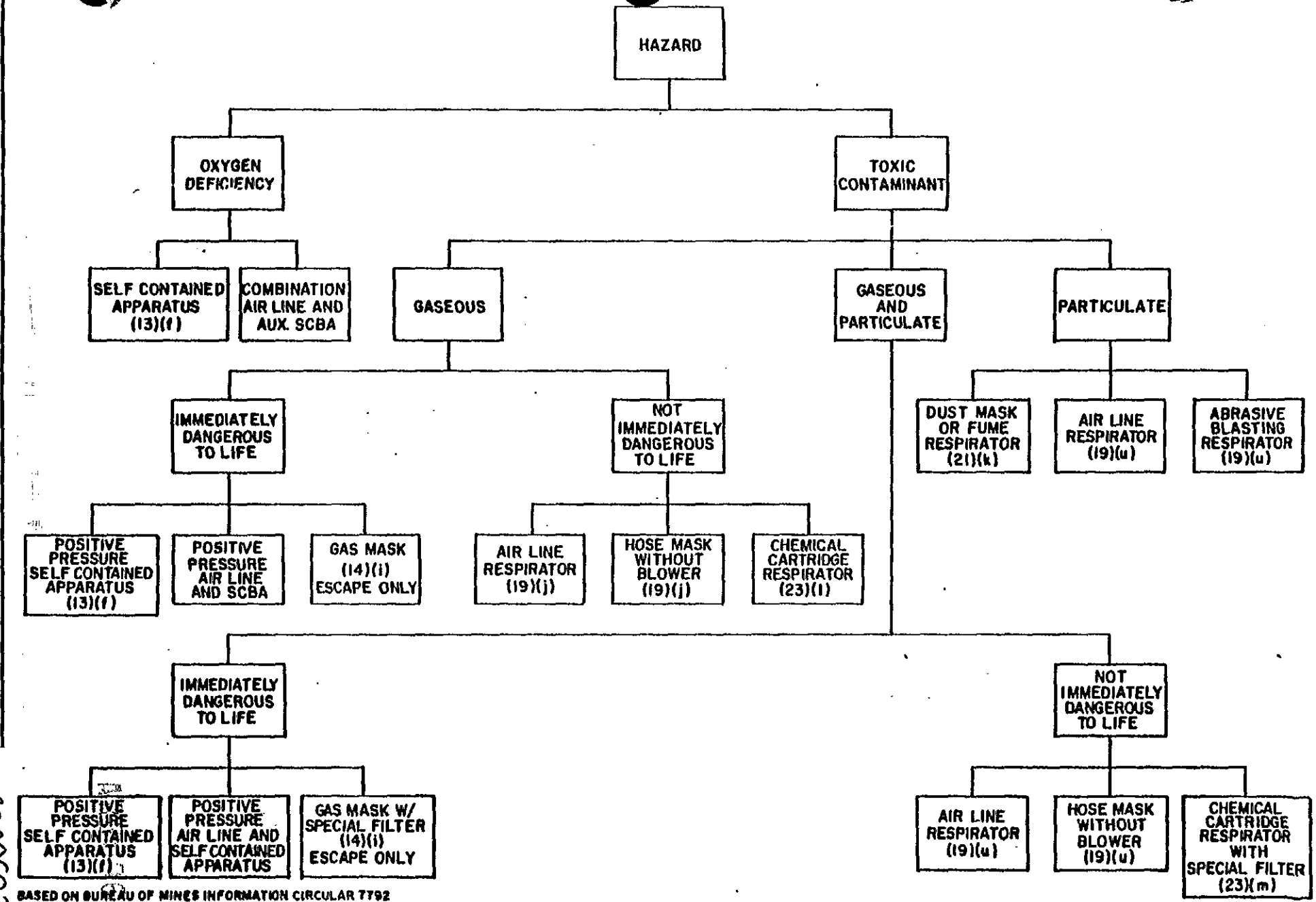
The following material used in concert with the decision logic chart (Figure 1) provides a formalized selection guide for respiratory protection.

1. Step 1 - Assemble Information on Substance. Assemble necessary toxicological, safety, and research information for the particular contaminant. The following are required:

   a. Permissible exposure limits specified in 29 CFR 1910.1000 (Tables Z-1, Z-2, and Z-3).

   b. Warning properties if the substance is a gas or a vapor.

   c. Eye irritation potential of the substance.



BASED ON BUREAU OF MINES INFORMATION CIRCULAR 7792
NUMBERS IN PARENTHESIS REFER TO BUREAU OF MINES SCHEDULES
LETTERS IN PARENTHESIS REFER TO SUBPART OF NIOSH/MESA 30 CFR PART 11

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FIGURE 1.

SELECTION OF RESPIRATORY EQUIPMENT (LUNDIN, A., 1979)

E.C. JORDAN CO.

d. LFL for the substance.

e. IDLH concentration for the substance.

f. Any possibility of poor sorbent efficiency at IDLH concentration and below.

g. Any possibility of systemic injury of death resulting from absorbance of the substance (as a gas or vapor) through the skin.

h. Any possibility of severe skin irritation resulting from contact of the skin with corrosive gases, vapors, or particulates.

i. The vapor pressure of the substance (and equivalent ppm).

j. Any possibility of high heat of reaction with sorbent material in cartridge or canister.

2. Step 2 - Determine Physical State of Substance. Determine the physical state(s) of the substance as it is likely to be encountered in the occupational environment. It will be either (1) gas or vapor; (2) particulate (dust, fume or mist); or (3) combination of (1) and (2).

3. Step 3 - Assemble a Table of Permissible Respiratory Protection for Substance. This is done using the material from Step 1 and the appropriate specific decision logic chart from Section 2.3 below and respirator protection factors. Classes of respirators are only included where at least one device has been approved.

4. IF STEPS 1 THROUGH 3 CANNOT BE COMPLETED, THE ATMOSPHERE IS UNKNOWN AND MUST BE CLASSIFIED IDLH. ONLY POSITIVE PRESSURE SCBA MAY BE SELECTED.

2.3 SPECIFIC DECISION LOGIC CHARTS

A decision logic chart for respiratory protection against gases or vapors and against particulates is shown as Figure 1.

2.4 DECISION LOGIC CRITERIA

2.4.1 Skin Absorption and Irritation

Respirator selection criteria are based primarily on the inhalation hazard of the substance. A supplied-air suit may protect the skin from extremely toxic substances that may be absorbed through the skin or from substances which may cause severe skin irritation or injury.

Supplied-air suits are not covered in 30 CFR 11. Data are not available upon which to make recommendations for supplied-air suits for all types of exposures.

Where information is available indicating systemic injury or death resulting from absorbance of gas or vapor through the skin or where severe skin irritation or injury may occur from exposure to a gas, corrosive vapor, or particulate, the following statement is included as a footnote to the respirator tables, and both the employee and employer are cautioned in the appendices concerning their use:

> Use of supplied-air suit may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of (specific substance). Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits. Where supplied-air suits are used above a concentration which may be IDLH (concentration), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

As a guideline for inclusion of the supplied air-suit statement for substances that are sorbed through the skin, a single skin penetration LD_{50} of 2 g/kg for any species is used.

2.4.2 Poor Warning Properties (Refer to Table 1)

It is important to realize that 30 CFR 11 approvals for air-purifying (organic vapor) devices prohibit use against organic vapors with poor warning properties.

Warning properties include odor, eye irritation, and respiratory irritation. Warning properties relying upon human senses are not foolproof. However, they provide some indication to the wearer of possible sorbent exhaustion or of poor facepiece fit or other respirator malfunction.

Adequate warning properties can be assumed when the substance odor, taste, or irritation effects are detectable and persistent at concentrations at or below the permissible exposure limit.

If the odor or irritation threshold of a substance is more than three times greater than the permissible exposure limit, this substance should be considered to have poor warning properties. If the substance odor or irritation threshold is somewhat above the permissible exposure limit (not in excess of three times the limit) and there is no ceiling limit, consideration is given to whether undetected exposure in this concentration range could cause serious or irreversible health effects. If not, the substance is considered to have adequate warning properties. Some substances have extremely low thresholds of odor and irritation in relation to the permissible exposure limit. Because of this, these substances can be detected by a worker within the facepiece of the respirator even when the respirator is functioning properly. These substances are, therefore, considered to have poor warning properties.

Though 30 CFR 11 does not specifically eliminate air-purifying respirators for pesticides with poor warning properties, prudent practice dictates that a respirator should not be used to protect against any substance with poor warning properties.

TABLE 1. COMPARISON OF ODOR THRESHOLDS AND TLVs
FOR SELECTED CHEMICAL COMPOUNDS

Compounds	Odor Threshold (ppm)	TLV (ppm)
Group 1 - Odor Threshold and TLV Approximately the Same		
Acrylonitrile	21	20
Arsine	0.21	0.05
Cyclohexane	300	300
Cyclohexanol	100	50
Epichlorhydrin	10	5
Ethyl benzene	200	100
Ethylene diamine	11	10
Hydrogen chloride	10	5
Methyl acetate	200	200
Methylamine	10	10
Methyl chloroform	500	350
Nitrogen dioxide	5	5
Propyl alcohol	200	200
Styrene monomer	200	100
Turpentine	200	100
Group 2 - Odor Threshold from 2 to 10 Times the TLV		
Acrolein	0.2	0.1
Allyl alcohol	7	2
Carbon tetrachloride	75	10
Chloroform	200	25
1,2 Dichloroethylene	500	200
Dichloroethyl ether	35	5
Dimethyl acetamide	46	10
Hydrogen selenide	0.3	0.05
Isopropyl glycidyl ether (IGE)	300	50
Group 3 - Odor Threshold Equal to or Greater Than 10 Times TLV		
Bromoform	530	0.5
Camphor (synthetic)	1.6-200	2
Carbon disulfide	(a)	20
Chloroacetophenone	1	0.05
Chloropicrin	1	0.1
Crotonaldehyde	7	0.1
Diglycidyl ether (DGE)	5	0.5
Dimethyl formamide	100	0
Ethylene oxide	500	50
Mercury vapor	(a)	0.5
Methyl bromide	(a)	15
Methyl chloride	(a)	100

TABLE 1. COMPARISON OF ODOR THRESHOLDS AND TLVs
FOR SELECTED CHEMICAL COMPOUNDS (cont.)

Compounds	Odor Threshold (ppm)	TLV (ppm)
Group 3 - Odor Threshold Equal to or Greater Than 10 Times TLV (cont.)		
Methyl formate	2000	100
Methanol	2000	200
Methyl cyclohexanol	500	50
Phosgene	1.0	0.1
Phosphine	(a)	0.3
Radioactive gases and vapors	(a)	
Toluene 2,4 diisocyanate (TDI)	2	0.2

(a) Information not available

2.4.3 Sorbents

There are certain limitations involved with the use of sorbents in cartridge/canister sorbents. When the following conditions occur, a sorbent cartridge is not recommended:

1. Where supporting evidence exists of immediate (less than 3 min.) breakthrough time at the IDLH concentration and below for a cartridge or canister sorbent, air-purifying devices shall not be allowed for any use, escape or otherwise. See Table 2.

2. Where there is reason to suspect that commonly used sorbents (e.g., activated charcoal) do not provide adequate sorption efficiency against a specific contaminant, use of such sorbents shall not be allowed. However, where another sorbent material has been demonstrated to be effective against a specific contaminant, approved respirators using the effective sorbent material shall be allowed.

3. Where there is reason to suspect that a sorbent has a high heat of reaction with a substance, use of that sorbent is not allowed.

4. Where there is reason to suspect that a substance sorbed on a sorbent of a cartridge or canister is shock sensitive, use of air-purifying respirators is disallowed.

2.4.4 Eye Irritation

In addition to respiratory protection, it is important to consider a chemical's potential for producing eye irritation or damage. The following guidelines deal with eye protection:

1. For routine work operations, any perceptible eye irritation is considered unacceptable. Therefore, only full facepiece respirators are permissible in contaminant concentrations that produce eye irritation. Protection may be required in certain concentrations of gases and vapors. For escape, some eye irritation is permissible if it is determined that such irritation would not inhibit escape and such irritation is reversible.

2. Where quantitative eye irritation data cannot be found in literature references, and theoretical considerations indicate that substance should not be an eye irritant, half-facepiece respirators are allowed.

3. Where a review of the literature indicates a substance causes eye irritation but no eye irritation threshold is specified, the data will be evaluated to determine whether quarter- or half-facepiece respirators can be used.

2.4.5 IDLH

The definition of IDLH provided in 30 CFR 11.3(t) is as follows:

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a]

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Aromatics	
Benzene	73
Toluene	94
Ethyl benzene	84
m-Xylene	99
Cumene	81
Mesitylene	86
Alcohols	
Methanol	0.2
Ethanol	28
Isopropanol	54
Allyl alcohol	66
n-Propanol	70
Sec-Butanol	96
Butanol	115
2-Methoxyethanol	116
Isoamyl alcohol	97
4-Methyl-2-pentanol	75
2-Ethoxyethanol	77
Amyl alcohol	102
2-Ethyl-1-butanol	76.5
Monochlorides	
Methyl chloride	0.05
Vinyl chloride	3.8
Ethyl chloride	5.6
Allyl chloride	31
1-Chloropropane	25
1-Chlorobutane	72
Chlorocyclopentane	78
Chlorobenzene	107
1-Chlorohexane	77
o-Chlorotoluene	102
1-Chloroheptane	82
3-Chloromethyl heptane	63

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a] (cont.)

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Dichlorides	
Dichloromethane	10
Trans-1,2-dichloroethylene	33
1,1-Dichloroethane	23
cis-1,2-Dichloroethylene	30
1,2-Dichloroethane	54
1,2-Dichloropropane	65
1,4-Dichlorobutane	108
o-Dichlorobenzene	109
Trichlorides	
Chloroform	33
Methyl chloroform	40
Trichloroethylene	55
1,1,2-Trichloroethane	72
1,2,3-Trichloropropane	111
Tetra- and Pentachlorides	
Carbon tetrachloride	77
Perchloroethylene	107
1,1,2,2-Tetrachloroethane	104
Pentachloroethane	93
Acetates	
Methyl acetate	33
Vinyl acetate	55
Ethyl acetate	67
Isopropyl acetate	65
Isopropenyl acetate	83
Propyl acetate	79
Allyl acetate	76
sec-Butyl acetate	83
Butyl acetate	77
Isopentyl acetate	71
2-Methoxyethyl acetate	93
1,3-Dimethylbutyl acetate	61
Amyl acetate	73
2-Ethoxylethyl acetate	80
Hexyl acetate	67

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a] (cont.)

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Ketones	
Acetone	37
2-Butanone	82
2-Pentanone	104
3-Pentanone	94
4-Methyl-2-pentanone	96
Mesityl oxide	122
Cyclopentanone	141
3-Heptanone	91
2-Heptanone	101
Cyclohexanone	126
5-Methyl-3-heptanone	86
3-Methylcyclohexanone	101
Diisobutyl ketone	71
4-Methylcyclohexanone	111
Alkanes	
Pentane	61
Hexane	52
Methylcyclopentane	62
Cyclohexane	69
Cyclohexene	86
2,2,4-Trimethylpentane	68
Heptane	78
Methycyclohexane	69
5-Ethylidene-2-norbornene	87
Nonane	76
Decane	71
Amines	
Methyl amine	12
Ethyl amine	40
Isopropyl amine	66
Propyl amine	90
Diethyl amine	88
Butyl amine	110
Triethyl amine	81
Dipropyl amine	93
Diisopropyl amine	77
Cyclohexyl amine	112
Dibutyl amine	76

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a] (cont.)

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Miscellaneous Materials	
Acrylonitrile	49
Pyridine	119
1-Nitropropane	143
Methyl iodide	12
Dibromomethane	82
1,2-Dibromoethane	141
Acetic anhydride	124
Bromobenzene	142

[a] The above cartridge pairs were tested at 1000 ppm, 50 percent relative humidity, 22°C, and 53.3 1/min. (equivalent to a moderately heavy work rate). The time to achieve a 1 percent breakthrough is noted for each cartridge pair. Cartridges were preconditioned at room temperature and 50 percent relative humidity for at least 24 hours prior to testing.

"Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health.

The purpose of establishing an IDLH exposure concentration is to ensure that the worker can escape without injury or irreversible health effects from an IDLH concentration in the event of failure of the respiratory protective equipment. The IDLH is considered a maximum concentration above which only highly reliable breathing apparatus providing maximum worker protection is permitted. Since IDLH values are conservatively set, any approved respirator may be used up to its maximum use concentration below the IDLH.

In establishing the IDLH concentration the following factors are considered:

1. Escape without loss of life or irreversible health effects. Thirty minutes is considered the maximum permissible exposure time for escape.

2. Severe eye or respiratory irritation or other reactions that would prevent escape without injury.

IDLH should be determined from the following sources:

1. Specific IDLH provided in the literature, such as the AIHA Hygienic Guides.

2. Human exposure data.

3. Acute animal exposure data.

Where such data are lacking, acute toxicological data from analogous substances may be considered.

The following guidelines should be used to interpret toxicological data reported in the literature for animal species:

1. Where acute animal exposure data are available (30 min. to 4-hr. exposures), the lowest exposure concentration causing death or irreversible health effects in any species is determined to be the IDLH concentration.

2. Chronic exposure data may have no relevance to the acute effects and should be used in determining the IDLH concentration only upon competent toxicologic judgment.

3. Where there is no toxicologic evidence of an IDLH concentration, 500 times the permissible exposure limit shall determine the upper limit above which only highly reliable breathing apparatus providing maximum worker protection is used.

2.4.6 Lower Flammable Limit

In addition to toxic chemicals and irritants, it is necessary to consider flammable substances. In any atmosphere where there is a likelihood of a chemical fire, there is the risk of creating toxic vapors in the fire or of

asphyxiation cause by reduction of the oxygen content by the products of combustion.

Contaminant concentrations in excess of the LFL are considered to be IDLH. At or above the LFL, the use of respirators is limited to those devices that provide the maximum protection (i.e., positive pressure self-contained breathing apparatus (SCBA) and the combination positive pressure supplied-air respirators with auxiliary positive pressure SCBA).

2.4.7 Protection Factors

The protection factors of respiratory protection devices are a useful numerical tool to assist in the choice of a protective system. Protection factors are a measure of the overall effectiveness of a respirator. Filtering efficiency is a part of the protection factor and becomes a significant consideration for less efficient air-purifying respirators.

The protection factor of a given respirator for a specific user times the PEL (or TLV) for a given substance is the maximum allowable concentration for that substance for which the respirator may be used. For example, say the protection factor for a full-face mask respirator will provide protection up to 1000 ppm. Note that there is a difference between "quantitative" protection factors and "qualitative" protection factors. The correct protection factor must be used in determining the maximum allowable concentration.

2.4.8 Escape

Jordan provides and requires employees to carry an escape respirator where exposure may occur to extremely toxic substances. This escape respirator provides a 5-minute self-contained air supply. (An extremely toxic substance is defined as a gas or vapor having an LC_{50} of less than 10 ppm.)

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 3
RESPIRATOR FIT TESTING - QUALITATIVE

3.1 RESPIRATOR QUALITATIVE FITTING METHODS

Despite the care that goes into respirator design and manufacture to give maximum protection, efficiency will be lost if there is an improper match between the facepiece and the user, or other improper wearing practices. The problem is twofold. Since more than one brand of particular type of facepiece is available, the first problem is to determine which fits best. The second problem is whether the user knows when the respirator fits properly. Both problems can be solved by the use of a fitting test, which is in fact an OSHA requirement. A number of tests and fitting procedures can be performed easily, as outlined below.

Note: During any fitting test, the respirator head straps must be as comfortable as possible. Tightening the straps will sometimes reduce the facepiece leakage, but the user may be unable to tolerate the respirator for any length of time.

3.1.1 Test 1 - Negative Pressure Test

The user will perform this test alone in the field. It consists of merely closing off the inlets of the canister, cartridge(s), or filter(s) by covering with the palm(s) or replacing the seals over the canister or cartridge inlets, or by squeezing breathing tubes so that air cannot pass; inhaling gently so the facepiece collapses slightly; and holding the breath for ten seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator is probably tight enough.

Although this test is simple, it has several major drawbacks, primarily that the user must handle the respirator after it has supposedly been positioned on the face. Handling can modify the facepiece-to-face seal. When the respirator is to be used in a relatively toxic atmosphere, this test should be used only as a very gross determination of fit. The user will perform this test just before entering any toxic atmosphere.

3.1.2 Test 2 - Positive Pressure Test

This test is very much like the negative pressure test; it has the same advantages and limitations. It is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can be built up inside the facepiece without any evidence of outward leakage. For some respirators, this method requires the user to remove the exhalation valve cover and then carefully replace it after the test, often a most difficult task which can disturb the respirator fit even more than does the negative pressure test. If removing and replacing the valve cover is required, this test should be used sparingly. For respirators whose valve covers have a single small port that can be covered by the palm or finger, this test is easy. Where applicable, this test will be performed just before entering any hazardous atmosphere.

3.1.3 Test 3 - Isoamyl Acetate Vapor (Banana Oil) Test

The chemical isoamyl acetate has a pleasant, easily detectable odor, so it is used widely in checking respirator fit.

The test gives the user the required opportunity to wear the respirator in a test atmosphere. Generally, it consists of creating an atmosphere containing banana oil around the user of an atmosphere-supplying or air-purifying respirator with an organic vapor removing cartridge(s) or canister. If the hazard is particulate matter or a non-organic vapor or gas, the organic vapor cartridge(s) or canister must be replaced with a particulate filter(s) or proper cartridge(s) or canister after this test. Thus, this test can be used for any facepiece that has the capability of accepting chemical cartridges and particulate filters. It must be emphasized, however, that the correct cartridge, canister or filter must be replaced on the facepiece before the user enters the specific exposure area.

The isoamyl acetate test is performed with single use capsules, or may be performed by saturating a piece of cotton or cloth with the liquid and passing it close to the respirator near the sealing surface, taking care to avoid skin contact.

In general, the isoamyl acetate fitting test will be performed as follows:

1. The user puts on the respirator in a normal manner in an area where he/she cannot smell banana oil and thus not be influenced by the odor while performing the fitting test. If it is an air-purifying device, it must be equipped with a cartridge(s) or canister specifically designed for protection against organic vapors.

2. The capsule or saturated cloth is passed close to the respirator sealing surfaces.

3. If the user smells banana oil, he readjusts the facepiece and/or adjusts the head straps without unduly tightening them.

4. The user repeats step 2. If banana oil is not smelled, there is assumed to be a satisfactory seal. If the wearer smells the vapor, an attempt should be made to find the leakage point. If the leak cannot be located, another respirator of the same type and brand should be tried. If this leaks, another brand of respirator with a facepiece of the same type but slightly different shape or size should be tried.

5. After a fit is obtained, if the respirator is an air-purifying device, it must be equipped with the correct filter(s), cartridge(s) or canister for the anticipated hazard.

During the test, the subject must make movements that approximate a normal workng situation. These will include, but not necessarily be limited to, the following:

1. Normal breathing.

2. Deep breathing like during a heavy exertion period: this should not be done long enough to cause hyper ventilation.

3. Slowly performing side-to-side and up-and-down head movements: these movements should be exaggerated, but should approximate those that take place on the job.

4. Talking: this is most easily accomplished by reading prepared text loudly enough to be understood by someone standing nearby.

5. Other exercises may be added depending upon the situation: for example, if users are going to spend a significant part of their time bent over at some task, it will include an exercise approximating this bending.

When the test is used in training workers and selecting the respirators that fit best, they will perform the complete set of exercises. However, the number of exercises may be reduced when the test is used as a quick field check before routine entry into a contaminated atmosphere.

3.1.4 Test 4 - Irritant Smoke Test

This test is similar to the isoamyl acetate test in concept. It involves exposing the respirator wearer to an irritating aerosol produced by stannic chloride or titanium tetrachloride smoke tubes normally used to check the quality of ventilation systems. (Note: Other types of smoke tubes such as acetic acid are available, but should not be used for respirator fitting.) When the tube ends are broken and air is passed through it, the material inside reacts with the moisture in the air to produce a dense, highly irritating smoke, consisting of hydrochloric acid absorbed in small solid particles. As a qualitative means of determining respirator fit, this test has a distinct advantage in that the user usually reacts involuntarily to leakage by coughing or sneezing. The likelihood of this giving a false indication of proper fit is reduced. On the other hand, the aerosol is very irritating and must be used carefully to avoid injury.

This test can be used for both air-purifying and atmosphere-supplying respirators, but air-purifying respirators must have a high-efficiency filter(s). After the test, it may be necessary to replace the high-efficiency filter(s) on the air-purifying respirator with another type of air-purifying element(s) depending upon the hazard to which the respirator user is to be exposed. This test can be used for worker training or respirator selection.

The irritant smoke test must be performed with proper safeguards because the aerosol is highly irritating. The procedure is as follows:

1. The user puts on the respirator normally, taking care not to tighten the headstrap uncomfortably and stands with his/her back to a source of exhaust ventilation.

2. The tester tells the user to close his/her eyes, even if wearing a full facepiece respirator, and to keep them closed until told to open them.

3. The tester lightly puffs smoke over the respirator, holding the smoke tube at least two feet from it. At this time, the test should keep the amount of smoke minimal and pause between puffs to note the user's reaction.

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4. If the user detects no leakage, the tester will increase the smoke density and move the smoke tube progressively closer to the subject, still remaining alert to any reactions.

5. When the smoke tube has been brought to within about 6 inches of the respirator with no leakage detected, the tester will start to direct smoke specifically at potential sources of leakage, around the sealing surfaces and exhalation valve, while the subject's head is still.

6. At this point, if no leakage has been detected, the user may cautiously begin the head movements described in the isoamyl acetate test. The tester should remain especially alert and be prepared to stop producing smoke immediately.

7. If leakage is detected at any time, the tester should stop the smoke and let the user readjust the facepiece or head strap tension. The tester should then start the test at step 2.

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 4
INSPECTION/MAINTENANCE/STORAGE

4.1 INTRODUCTION

Respirator maintenance is an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all. Personnel wearing defective devices think they are protected when, in reality, they are not. Emergency escape and rescue devices are particularly vulnerable to poor maintenance as they generally are used infrequently, and then in the most hazardous and demanding circumstances. Serious injury or death can result from wearing a defective device during emergency escape or rescue.

This program includes:

1. Inspection for defects (including a leak check).
2. Cleaning and disinfecting.
3. Repair as required.
4. Proper and sanitary storage of equipment.

4.2 INSPECTION FOR DEFECTS

The most important part of a respirator maintenance program is continual inspection of the devices. If properly performed, inspections will identify damaged or malfunctioning respirators before they can be used. Two types of inspections will be performed.

1. While the respirator is in use.
2. While it is being cleaned.

Since the use and cleaning will, to a large extent, be performed by the same personnel, these inspections may become concurrent.

4.3 FREQUENCY OF INSPECTION

OSHA requires that "All respirators be inspected before and after each use" and that those not used routinely, i.e., emergency escape and rescue devices, "shall be inspected after each use and at least montly..." Obviously, emergency escape and rescue devices do not require inspection before each use. Records of inspections are kept on forms presented in Section VI-Program Administration and Documentation.

4.4 INSPECTION PROCEDURES

Respirator inspection shall include checking of:

1. Tightness of the connections.
2. Facepiece.
3. Valves.

4. Connecting tubes.
5. Canisters, filters, or cartridges.

In addition, the regulator and warning devices on a SCBA shall be checked for proper functions.

4.5 FIELD INSPECTION OF AIR-PURIFYING RESPIRATORS

Routinely used air-purifying respirators will be checked as follows before and after each use:

1. Examine the facepiece for:

   a. Excessive dirt.

   b. Cracks, tears, holes or physical distortion of shape from improper storage.

   c. Inflexibility of rubber facepiece (stretch and knead to restore flexibility).

   d. Cracked or badly scratched lenses in full facepieces.

   e. Incorrectly mounted full facepiece lenses, or broken or missing mounting clips.

   f. Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s).

2. Examine the head straps or head harness for:

   a. Breaks.
   b. Loss of elasticity.
   c. Broken or malfunctioning buckles and attachments.
   d. Excessively worn serrations on head harness, which might permit slippage (full facepieces only).

3. Examine the exhalation valve for the following after removing its cover:

   a. Foreign material, such as detergent residue, dust particles or human hair under valve seat.

   b. Cracks, tears or distortion in the valve material.

   c. Improper insertion of the valve body in the facepiece.

   d. Cracks, breaks or chips in the valve body, particularly the sealing surface.

   e. Missing or defective valve cover.

   f. Improper installation of the valve in the valve body.

4. Examine the air-purifying element(s) for:

a. Incorrect cartridge, canister or filter for the hazard.

b. Incorrect installation, loose connections, missing or worn gasket or cross threading in the holder.

c. Expired shelf-life date on the cartridge or canister.

d. Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc. over the inlet.

e. Identical cartridges if more than one are used.

4.6 CARE AND CLEANING OF SELF-CONTAINED BREATHING APPARATUS (SCBA)

The proper care of SCBAs involves:

1. Inspection for defects.
2. Cleaning and disinfecting.
3. Repair.
4. Storage.

The following checklist is to be used by personnel whenever they have to check out an SCBA. (Note: Any discrepancy found should be cause to set the unit aside until it can be repaired by a certified repair-person.)

1. Preliminary inspection. Check to ensure that:

   a. High-pressure hose connector is tight on cylinder fitting.
   b. Bypass valve is closed.
   c. Mainline valve is closed.
   d. There is no cover or obstruction on regulator outlet.
   e. Pressure in the tank is at least 1800 psi.

2. Backpack and harness assembly.

   a. Straps

      1. Visually inspect for complete set.
      2. Visually inspect for frayed or damaged straps that may break during use.

   b. Buckles

      1. Visually inspect for mating ends.
      2. Check locking function.

   c. Backplate and cylinder lock

      1. Visually inspect backplate for cracks and for missing rivets or screws.
      2. Visually inspect cylinder hold-down strap and physically check strap tightener and lock to ensure that it is fully engaged.

3. Cylinder and cylinder valve assembly

   a. Cylinder

      1. Physically check cylinder to ensure that it is tightly fastened to backplate.

      2. Check hydrostatic test date to ensure that it is current.[1]

      3. Visually inspect cylinder for large dents or gouges in metal.

   b. Head and valve assembly

      1. Visually inspect cylinder valve lock for presence.

      2. Visually inspect cylinder gauge for condition of face, needle, and lens.

      3. Open cylinder valve and listen or feel for leakage around packing. (If leakage is noted, do not use until repaired.). Note function of valve lock.

4. Regulator and high-pressure hose

   a. High-pressure hose and connector

      Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily mean a faulty hose.)

   b. Regulator and low-pressure alarm

      1. Cover outlet of regulator with palm of hand. Open mainline valve and read regulator gauge (must read at least 1800 psi and not more than rated cylinder pressure).

      2. Close cylinder valve and slowly move hand from regulator outlet to allow slow flow of air. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 630 and 550 psi. Remove hand completely from outlet and close mainline valve.

      3. Place mouth onto or over regulator outlet and blow. A positive pressure should be created and maintained for 5 to 10 seconds without any loss of air. Next, establsih a slight negative pressure in regulator and hold for 5 to 10 sec. Vacuum should remain constant. This tests the integrity of the diaphragm. Any loss of pressure or vacuum during this test indicates a leak in the apparatus.

[1]Monthly inspection only.

4. Open cylinder valve.

5. Place hand over regulator outlet and open mainline valve. Remove hand from outlet and replace in rapid movement. Repeat twice. Air should escape when hand is removed each time, indicating a positive pressure in chamber. Close mainline valve and remove hand from outlet.

6. Ascertain that no obstruction is in or over the regulator outlet. Open and close the bypass valve momentarily to ensure flow of air through bypass system.

5. Facepiece and corrugated breathing tube.

a. Facepiece

1. Visually inspect head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.

2. Visually inspect lens for proper seal in rubber facepiece, retaining clamp properly in place, and cracks or large scratches.

3. Visually inspect exhalation valve for visible deterioration or foreign materials buildup.

b. Breathing tube and connector

1. Stretch breathing tube and visually inspect for deterioration and holes.

(2) Visually inspect connector to ensure good condition of threads and for presence and proper condition of "O" ring or rubber gasket seal.

(3) Negative pressure test on facepiece.[2]

(a) Don backpack and facepiece.

(b) With facepiece held tightly to face or facepiece properly donned, stretch breathing tube to open corrugations and place thumb or hand over end of connector.

(c) Inhale. Negative pressure should be created inside mask, causing it to pull tightly to face. This negative pressure should be maintained for 5 to 10 sec. If negative pressure leaks down, the facepiece assembly is not adequate and should not be worn.

[2]For regular monthly inspection, only steps (b) and (c) of procedure are necessary.

6. Storage of units. Check that:

   a. Cylinder is refilled as necessary and unit is cleaned and inspected.

   b. Cylinder valve is closed.

   c. High-pressure hose connector is tight on cylinder.

   d. Pressure is bled off high-pressure hose and regulator.

   e. Bypass valve is closed.

   f. Mainline valve is closed.

   g. All straps are completely loosened and laid straight.

   h. Facepiece is properly stored to protect against dust, sunlight, heat, extreme cold, excess moisture, and damaging chemicals.

4.7 CLEANING AND SANITIZING

Any good detergent may be used followed by a disinfecting rinse or a combination disinfectant-detergent for a one step operation. Reliable, effective disinfectants may be made from readily available household solutions, including:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately two milliliters of bleach (such as Clorox) to one liter of water, or two tablespoons of bleach per gallon of water. A two-minute immersion disinfects the respirators.

2. Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or one teaspoon of tincture of iodine per gallon of water. Again, a two-minute immersion is sufficient.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140°F, but it should not be less than 120°F to ensure adequate cleaning.

4.8 RINSING

The cleaned and disinfected respirators should be rinsed thoroughly in water (140°F maximum) to remove all traces of detergent and disinfectant. This is very important for preventing dermatitis.

4.9 DRYING

The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes, but care must be taken not to damage or distort the facepieces.

4.10 REASSEMBLY AND INSPECTION

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks.

For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

4.11 MAINTENANCE AND REPAIR

Replacement or repair shall be done only by trained, experienced persons with parts designed for the respirator. Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval of the device.

This restriction applies particularly to maintenance of the more complicated devices, especially SCBA, and more specifically, regulator valves and low pressure warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair.

No problems are anticipated in repairing and maintaining most simple respirators, particularly the commonly used air-purifying type.

4.12 RESPIRATOR STORAGE

Respirators must be stored to protect against:

1. Dust.
2. Sunlight.
3. Heat.
4. Extreme cold.
5. Excessive moisture.
6. Damaging chemicals.
7. Mechanical damage.

Damage and contamination of respirators may take place if they are stored on a workbench, or in a tool cabinet or toolbox, among heavy tools, greases and dirt or in a vehicle.

Freshly cleaned respirators should be placed in reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set".