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# HAZARDOUS MATERIALS ON BOARD

Carl Hild



Alaska Sea Grant College Program

Marine Advisory Bulletin No. 43

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## **Poisonings**

### **General Rules for Treatment**

#### **Call Poison Control Number before treatment!**

Don't be a victim yourself! The only thing worse than one hazardous materials victim is two (or more). Call for professional help if there is a possibility you will get contaminated by rescuing someone.

Every person ill from exposure to hazardous materials needs to have their **Airway, Breathing, and Circulation** monitored. If the victim is unconscious, transport on left side.

#### **Poison Control Numbers:**

**Anchorage – (907) 261-3193**  
Poison Control Center (24 hrs)

**Outside Anchorage – (800) 478-3193**  
Call before treatment!

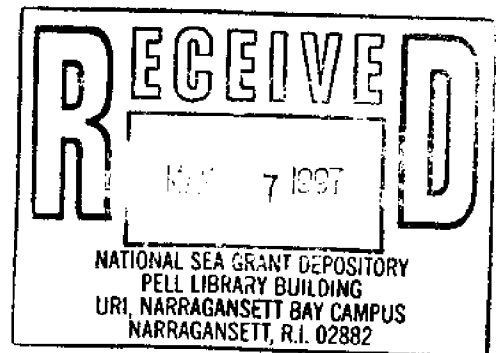
**Seattle – (206) 526-2121**  
Seattle Poison Center, Children's Hospital

Enroll in First Aid courses and stay current in skills!

1. Inhaled poisons (through lungs)
  - A. Get victim out of the exposed environment if it is safe to do so.
  - B. Administer oxygen if available.
  - C. Transport victim as soon as possible.
  
2. Absorbed poisons (through skin)
  - A. Remove all contaminated clothing, including underwear and jewelry (**wear protective gloves, etc., yourself**).
  - B. Wash area with soap and water (**exception: dry lime**).
  - C. Administer oxygen if available.
  - D. Transport.
  
3. Ingested poisons (through swallowing)
  - A. Get history: what was ingested, when, and how much.
  - B. No induced vomiting in victims who:
    - Are unconscious, in a stupor, or having a seizure. Lay person on left side and transport.
    - Have ingested acids, corrosives, or petroleum products. If victim is conscious, give several glasses of water or milk (never give anything by mouth if victim is unconscious).
  - C. If induced vomiting is indicated:
    - Give two glasses of water followed by two teaspoons of syrup of ipecac.
    - If no vomiting after 20 minutes, repeat dosage once only!
    - After vomiting ceases, have victim drink two glasses of water with three tablespoons of activated charcoal in suspension.
  - D. Call **Poison Control Number** or doctor for follow up. Provide the RTECS (Registry of Toxic Effects of Chemical Substances) number if known, as well as the material that was swallowed.

# Hazardous Materials on Board

Carl Hild



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This book was prepared by Carl Hild of the Alaska Health Project under a contract from the Alaska Sea Grant Marine Advisory Program, University of Alaska Fairbanks. It was revised with the assistance of Bob Spencer, Mike Oden, Ron Miller, and Bill Krause of Risk Management, University of Alaska Fairbanks. The information will be helpful to anyone who works around vessels, es-

pecially in Alaska waters. The material contained in this manual is timely as of January 1997. Resources and laws will change in time.

This book is not intended to be the final word on the safety of hazardous materials at sea. The recommendations given here are general and may not hold in every situation due to the unique circumstances surrounding each incident.

Any specific questions or concerns should be referred to one of the contact agencies listed in Chapter 7, References, for a detailed response.

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Throughout this book male pronouns have been used; they are intended to apply to both males and females.

**Good Fishing and Smooth Seas!**

## **THE AUTHOR**

Carl Hild has authored several published articles on working in a cold environment and traditional Inuit survival. Hild is the recipient of the 1990 Alaska Public Health Association Long Term Service Award, and has served as president of the American Society for Circumpolar Health. He was employed by the Alaska Health Project at the time this book was written.



## Recognize the Risk

A ship in the harbor is safe, but ships are not built to stay in the harbor. Hazardous materials that are not used are safe, but the materials are made to be used for specific purposes. They have been chemically developed to remove paint, act like putty and harden like steel while under water,

or do whatever job they have been designed to do. However, the benefit of having these wonderful materials is not without a cost.

All ships require maintenance to get you from one point to another. If you have a vessel, then you need to take care of it. The last ship to make great

claims on its abilities was the *Titanic*. That "unsinkable" ship sank on its maiden voyage. Likewise, all hazardous materials require caution and special handling. If you use hazardous materials, then you need to use them as instructed. Seamen have had a tradition of keeping their

vessels "shipshape." Make sure the condition of your ship lives up to your claims, and that your care in handling hazardous materials is equally conscientious.

Using hazardous materials properly will prolong your life.

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## Causes of Shipboard Hazards

Fishermen encounter problems that result in many shipboard hazards:

- **Spaces are confined.** Severe weather conditions keep crews enclosed and force work to be done in confined spaces with little or no natural ventilation. Improper ventilation can worsen exposures to dangerous fumes and vapors.

- **Professional medical care is not accessible.** Working at sea means that crews do not have quick access to medical attention in emergencies. Health and safety resources are limited

on board, and additional medical care is far away and hard to reach.

- **Engine poses dangers.** Working on vessels means constant exposure to the exhaust, fuel, and noise of a running diesel engine.

- **Toxic gases are always on board.** Working on a fishing vessel means exposure to dead and dying fish, as well as refrigeration systems that contain toxic gases.

- **Movement on a boat is dangerous.** Working on a vessel means working on

a moving surface, using narrow and steep stairways, working close to open holds, and working near multiple open deck levels. All surfaces may be slick from water, ice, petroleum, or fish slime.

- **Fatigue brings on accidents.** Short seasons mean that work is rushed. Fatigue and stress, brought on by long working hours, make workers more susceptible to injury.

- **Predicting crew behavior is difficult.** High turnovers in crews mean are often unfamiliar with the

vessel's resources and other crew members' abilities.

- **Working with unfamiliar materials is dangerous.** Long off-seasons often mean the crew is kept busy repairing the vessel. They may not be well prepared to work with new materials, or trained in proper safety precautions.

## Hazardous Materials

Much of the work done on board vessels today requires the use of hazardous materials. Materials are considered hazardous if they are:

- **Ignitable** (catch fire). Examples are paint wastes, degreasers, and fuels with flash points under 140°F.
- **Corrosive** (burn on contact). Examples are acids or alkalines.
- **Reactive** (explode or release dangerous fumes). Examples are oxidizers and some metal cleaners.
- **Toxic** (poisonous). Examples are cadmium, lead, and pesticides.

When a captain gives permission for hazardous

materials to come on board, he may allow unseen problems to come on board also. Hazardous materials are a bit like fire on board a vessel. Fire is very helpful to cook a meal or to burn off old paint, when it is under control and properly ventilated. Fire out of control is dangerous and deadly.

Hazardous materials are very helpful to clean or repair, when they are under control and properly ventilated. Hazardous materials out of control are dangerous and deadly. Like fire, the key is to keep hazardous materials under control.

Unseen dangers are the ones most likely to catch

you unaware. Gale force winds compel you to take specific actions at sea. But an exhaust manifold leaking carbon monoxide could be more deadly than the gale.

Several fishermen have died when they encountered unseen dangers—they entered “empty” fish holds that were filled with invisible and deadly gases. It is important to be aware of such problems and reduce shipboard hazards, to insure the health and safety of the crew.

Numerous hazardous materials can be found on board vessels and ashore. Examples are cleaning ma-

terials, strippers and paints, welding gases, fuels and exhaust, and gases given off by dead fish. All must be controlled or used properly to avoid harm. Hazardous materials must be kept in line.

Chapter 2, Common Hazardous Materials, is a brief description of the more common hazardous materials found on vessels. They are listed alphabetically for easy reference. Review them, and then refer to the other chapters for additional information on dealing with these hazardous materials on board.

*The captain is the leader of the fishing crew, and he is responsible for the way hazardous materials will be handled*

*on his vessel. He gives the permission to bring them on board, and must give the guidance on how they are used.*

---

### Asbestos

Fibrous, flame resistant material; brown, gray or white; needle-shaped fibers.

**Where Is It Found?** Asbestos was widely used in building materials and shipboard construction, especially prior to the 1970s. It was commonly used in sprayed or trowelled-on fireproofing, lagging around boilers and pipes, fireproof mats and clothing, and insulation. Microscopic fibers can be carried on air currents, especially from damaged, old, dry asbestos material that has been covered, taped, or painted.

**Activities at Risk—**Plumbing, engine room

work, working around asbestos materials.

**Early Signs of Exposure—***There are no immediate nor early signs of exposure to asbestos.* Years after exposure, shortness of breath, dry cough, and upper chest and back pain may be the first signs that an asbestos-related disease has developed.

**Long-Term Health Effects—**Asbestos-related diseases often do not appear for 10 to 40 years after the exposure. Cancers occur in the lung, stomach, and rectum, as well as in the linings of the lung, chest, and stomach. Asbes-

tosis, an irreversible lung disease, is fatal.

**How Do I Protect Myself?** Avoid exposure to asbestos. Asbestos-free materials should be used. If possible, moisten asbestos materials while working with them. If asbestos-containing materials are sanded, cut, drilled, or removed, adequate respirators (especially air-supplied types) should be used (see Chapter 4, Personal Protective Equipment). **Never** dry-sweep asbestos or any material that might contain asbestos.

**Special Precautions—**Never take or wear work clothes home or wash them

at home if they might have asbestos fibers on them. Wives and children of shipyard workers have become sick from asbestos brought home on work clothes. **There is no safe level of exposure to asbestos.** All types of asbestos (white, brown, and blue) can cause cancer and asbestosis. **Smoking greatly increases the risk of lung cancer if you work with asbestos.** Contact a local resource for help if you believe you are working around asbestos (see Chapter 7, References).

---

### Chromates, Chrome, Chromium

**Where Are They Found?** Paints, chrome-plated metals, stainless steel.

**Activities at Risk—**Painting, welding, sheet metal work, any contact with chromates, chrome, or chromium.

**Early Signs of Exposure—**Skin irritation, burning or itching eyes and nose, coughing, headache, fever.

**Long-Term Health Effects—**Skin rashes, skin and nose ulcers; certain

forms of chromates can cause lung cancer.

**How Do I Protect Myself?** Wear protective clothing and correct respirator (see Chapter 4, Personal Protective

Equipment). Paint or weld in well-ventilated areas. Use chromate-free products when possible. Read the hazard descriptions for Paint and Welding in this chapter.

## Cleaners

Chlorinated solvents, phenols, ammonia, base compounds, etc.

**Where Are They Found?** Anywhere on board, especially in the galley, head, engine room, and fish processing areas.

**Activities at Risk—**Cleaning.

**Early Signs of Exposure—**Read the labels of all cleaners to find the directions, precautions, warnings, signs of exposure, and medical treatments in case of misuse. Labels vary from product to product so read each carefully.

**Long-Term Health Effects—**Effects depend on the material and exposure level. Some people become "sensitized" to specific chemicals that are in common cleaners. When the body becomes very reactive to a chemical, it has become sensitized. An individual may develop rashes or illness from the contact. He then can become so sensitive to a chemical that a slight exposure to it again, even much later in life, will make him sick.

**How Do I Protect Myself?** Read the label and follow the instructions. Read the product's Material Safety Data Sheet (MSDS)

(See Chapter 7, References, for information about the MSDS.) Wear the appropriate personal protective equipment.

**Special Precautions—**Be extremely careful with bleach and ammonia! These two are good cleaners alone, but if they are mixed they will form poisonous gas. **Do not mix bleach and ammonia!**

Chlorine solutions must be rinsed thoroughly with water. Bactericides—chlorine bleach with sodium hypochlorite or quaternary ammonium—need special care.

Guidelines are stated in the *List of Chemical Com-*

*pounds Authorized for Use Under USDA Poultry, Meat, Rabbit, and Egg Products Inspection Programs* by the U.S. Department of Agriculture. Also a useful guide, the *List of Proprietary Substances and Nonfood Compounds Authorized for Use under USDA Inspection and Grading Programs* is available for \$25.00 with a one-year subscription from the U.S. Government Printing Office (see Chapter 7, References).

If solutions are chlorinated with chlorine gas from cylinders, appropriate care must be given the high pressure containers. Chlorine gas is extremely poisonous!

---

## Epoxy Resins

**Where Are They found?** Paints, primers, surface coatings, and some glues.

**Activities at Risk—**Electrical work, painting, ship building and repair.

**Early Signs of Exposure—**Skin irritation, itching and redness, eye irritation, coughing.

**Long-Term Health Effects—**Can sensitize the skin and lungs. Once you are sensitized, almost any

exposure can cause a skin rash or make breathing difficult.

**How Do I Protect Myself?** Wear proper protective clothing and gloves, and correct respirator (see Chapter 4, Personal Pro-

TECTIVE Equipment). Work in well-ventilated areas.

**Special Precautions—**Initial exposures must be controlled to prevent sensitization.

---

## Fiberglass, Glass Wool

**Where Are They Found?** Insulation, weatherproofing, and patching materials.

**Activities at Risk—**Plumbing, carpentry, sheet metal work, fiberglass repair. any close contact with fiberglass or glass wool.

**Early Signs of Exposure—**Itching, skin rashes, coughing, irritated throat.

**Long-Term Health Effects—**Some workers develop allergic skin reactions, especially when working in hot, humid weather. Some cases of

lung damage have occurred after years of exposure.

**How Can I Protect Myself?** Wear gloves and clothing to protect the skin. Use protective creams or powders on hands, neck, or any exposed skin. Tape

gloves to coveralls to create a seal; likewise seal any neck opening or wear a scarf. Use disposable coveralls. Cut or mix fiberglass outside or in a well-ventilated area. Wear an approved dust respirator (see Chapter 4, Personal Protective Equipment).

## Fire Extinguishers

Carbon dioxide, halon, powder.

**Where Are They Found?** All vessels and dock areas are required to have fire extinguishers, and every crew member should know where they are and how to use them.

**Activities at Risk**—Fire fighting, especially in engine rooms with automated extinguishing systems; training; refilling; working below decks when there is a fire above.

**Early Signs of Exposure**—Be careful when extinguishers are in use! Most of the hazardous gases expelled are heavier than air

and will stay on deck and flow down to lower decks. These gases can cause coughing, dizziness, intoxication or a “high” feeling, headache, nausea, rapid heartbeat, and eye and lung irritation, any of which may also be the result of the fire and/or fumes.

**Long-Term Health Effects**—Can be fatal. Breathing halon (a gas used in some extinguishers) in very rare cases can cause people to have strange fits of laughter or frantic behavior, followed by heart attack and death. Lung irritation and respiratory problems have also been reported.

**How Do I Protect Myself?** Know the type of extinguisher you have, and how to use it safely. Keep carbon dioxide jet away from skin as it can cause freezing burns. Do **not** inhale any gas from an extinguisher. Halon types contain bromochlorodifluoromethane (BCF). They produce gases that, under heated conditions, combine with water vapor to form hydrobromic and hydrofluoric acids, which are toxic as well as corrosive.

**Special Precautions**—Because these gases are heavy and flow downward, they will send gases flowing down into the lower parts of

the vessel if they are used on an upper deck. Be aware of this in case of fire on board. Get those crew members out from below decks and away from the fumes that will collect in the hull. Ventilate well before reentering, especially the lower areas of the vessel, even if they were not close to the fire.

Halon-type extinguishers in engine rooms may release acid-forming gases that go throughout the room and engine, and may exit as exhaust. Clean up all dry powder, foam, and liquid immediately, as it will mar surfaces. Use extreme caution with fire and fire extinguishers.

---

## Gas: Carbon Monoxide

Colorless, odorless. In concentrations ranging from 12.5% lower explosive limit (LEL) to 74% upper explosive limit (UEL) carbon monoxide is explosive.

**Where Is It Found?** Carbon monoxide (CO) is a by-product of combustion from smoking, gasoline and diesel engines, gas stoves and heaters, torpedo or salamander heaters and kerosene burners, welding and soldering, and paint removal by burning. CO is most common in confined spaces with poor ventilation.

**Activities at Risk**—Equipment operation, plumbing, cooking, sheet metal work, paint removal, working inside visquene bubbles or plastic tarpaulins, working inside confined spaces with limited ventilation.

**Early Signs of Exposure**—Headache, dizziness, nausea, sleepiness, and cherry red cheeks, lips, and fingernails are signs of severe poisoning.

**Long-Term Health Effects**—Brain damage or death can occur from high concentrations of carbon monoxide because it re-

places oxygen in the blood. The blood's hemoglobin has 250 times the affinity for carbon monoxide as it does for oxygen. Long-term, low exposure may contribute to heart disease.

**How Do I Protect Myself?** Torpedo or salamander heaters should be vented to the outside. Visquene bubbles for work protection should **not** be sealed tightly. Galley areas and engine rooms should be well ventilated. Engines should be kept tuned and exhaust systems tight. Carbon monoxide levels should be tested regularly by using air quality moni-

tors (see Chapter 3, Confined Spaces). See Welding in this chapter for suggestions for welding and soldering.

**Special Precautions**—Workers with chronic heart or lung disease may be more sensitive to the effects of carbon monoxide. Exposure to methylene chloride, a common solvent, can increase the effects because your body converts this solvent to carbon monoxide. Burning off paint may yield noxious or toxic fumes that include lead or other heavy metals, as well as carbon monoxide.

## Gas: Flammable

Fuel vapors, methane, propane, LPG (liquid propane gas), LNG (liquid natural gas).

**Where Are They Found?** Usually near fuel sources, galley, engine room, drums, transfer tanks, or tenders. If its vapor density is greater than air, gas may settle in low places.

**Activities at Risk—**Engine room work, cooking, refueling, fuel transferring, all crew working on board near fuels.

**Early Signs of Exposure—**Smell of gas or fuel, dizziness, light-headedness, nausea, headache, blurred vision, eye and

throat irritation, unconsciousness, central nervous system depression.

**Long-Term Health Effects—**Intoxication, headaches, asphyxiation, death at high concentration. Explosions of these gases will result in burns and a variety of traumatic injuries, and will yield other fumes and noxious gases.

**How Do I Protect Myself?** Report the first smells of fuel immediately. Do not smoke in the area. Ventilate and be prepared for a fire. Do not use electrical switches if you smell gas.

**Explosive Ranges—**Explosive ranges are typically

measured in percent concentration in air (1% equals 10,000 parts per million).

LEL (lower explosive limit) conditions are similar to an engine whose carburetor is set too lean. There is not a high enough concentration of gas present to explode to drive the piston. UEL (upper explosive limit) conditions are similar to an engine that is flooded. There is too much fuel present to explode.

Risk of fire/explosion occurs when the gas is present in concentrations between the lower and upper explosive limits. If gas is present in concentrations greater than the upper explosive limit, great danger exists in bringing conditions back to normal through

ventilation or other means, because the level of concentration will pass through the LEL/UEL explosive ranges as it is diluted.

**Special Precautions—**Ventilate until the flammable gas level is less than or equal to 10% of the lower explosive limit before entering (see Chapter 3, Confined Spaces). **Fuel vapors, methane, and propane gases are explosive—they are bombs waiting for you to make the mistake of setting them off. Use extreme caution!**

---

## Gas: Hydrogen

Colorless, highly flammable, odorless.

**Where Is It Found?** Hydrogen (H<sub>2</sub>) is found wherever lead-acid batteries are charged or hydrogen gas cylinders are used or stored.

**Activities at Risk—**Engine room work.

**Early Signs of Exposure—**Practically none, ex-

cept that it is explosive. Occasionally there will be an acid odor from the bubbles of an overcharged battery.

**Long-Term Health Effects—**Practically none from inhalation; burns and trauma from the explosion.

**How Do I Protect Myself?** Keep all sources of ignition, including electrical sparks, away from recharging lead-acid batteries

or hydrogen cylinders. Catalytic battery caps can be purchased that will combine the oxygen in the air with the hydrogen from the battery to form water.

**Special Precautions—**Hydrogen is lighter than air and will rise to the top of the compartment. Assure adequate ventilation to keep the gas from building up. Keep all electrical switches or equipment that

may spark away from the area. Be extremely careful with metal tools or wires around battery terminals. Make sure gas cylinders are completely off and properly secured.

## Gas: Hydrogen Sulfide, Methane

Hydrogen sulfide is colorless, flammable, with a rotten egg smell that seems to go away in time. Methane is colorless, flammable, odorless.

**Where Are They Found?** Decomposition of fish or any seafood produces hydrogen sulfide ( $H_2S$ ) and methane ( $CH_4$ ). These gases collect in the hold, with the methane rising and the hydrogen sulfide sinking. Hydrogen sulfide is nearly as toxic as the hydrogen cyanide used in gas chambers. Dirty bilges of vessels in long-

term storage can also produce these gases.

**Activities at Risk**—Hold work, vessel salvage.

**Early Signs of Exposure**—Rotten egg odor that will seem to go away in time as it numbs your sense of smell, difficulty breathing, and unconsciousness. This all happens relatively quickly (within a few breaths at high concentrations).

**Long-Term Health Effects**—Continued unconsciousness, respiratory de-

pression, and death within a few minutes at high concentrations after only one or two breaths.

**How Do I Protect Myself?** Prevention is through good housekeeping and sanitation procedures. Test all holds for oxygen, hydrogen sulfide, and combustible gas levels before entering (see Chapter 3, Confined Spaces). The air must contain 19.5% oxygen or more to sustain life; however, this does not mean that the level of hydrogen sulfide is safe. Use a lifeline with a buddy sys-

tem when entering a hold or confined space. Use an outside air source breathing apparatus if the hold air content is unknown and not explosive.

**Special Precautions**—Pre-icing or cooling holds where fish will be held, as well as cleaning holds with a chlorine solution, will help reduce the formation of hydrogen sulfide and methane.

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## Gas: Nitrogen Dioxide, Sulfur Dioxide

Nitrogen dioxide is brown, nonflammable, with a pungent odor. Sulfur dioxide is colorless, nonflammable, with a strong suffocating odor.

**Where Are They Found?** Both nitrogen dioxide ( $NO_2$ ) and sulfur dioxide ( $SO_2$ ) are components of engine exhaust. Sulfur dioxide is also found when too much sodium bisulfite is put on shrimp to prevent blackspot. Use appropriate

amounts and handle this chemical with care.

**Activities at Risk**—Engine room work, working near the exhaust of engines.

**Early Signs of Exposure**—Severe irritation of skin, eyes, and lungs causing coughing, choking, and respiratory arrest.

**Long-Term Health Effects**—With water vapor,

these gases make nitric acid and sulfuric acid that can be inhaled and damage the throat and lungs. Effects include tightness in the chest, pneumonia, lung damage, decreased resistance to infections, and possibly symptoms similar to chronic bronchitis.

**How Do I Protect Myself?** Do not enter infrequently used compartments until the air has been tested or you are wearing an ap-

propriate respirator (see Chapter 4, Personal Protective Equipment). Make sure engine rooms are well ventilated, that the exhaust systems are tight, and an air quality monitor is in place.

**Special Precautions**—Be extremely cautious in all confined spaces (see Chapter 3).

## Glues, Sealants, Pipe Dope

**Where Are They Found?** Roofing and decking systems, ABS and PVC pipe systems.

**Activities at Risk**—Plumbing, shipboard repair.

**Early Signs of Exposure**—Skin, eye, and nose irritation, feeling "high."

Heaters have caused fumes to ignite in poorly ventilated areas, causing burns.

**Long-Term Health Effects**—Effects depend on the product. Many can cause skin rashes and sensitization of skin that will react with future contact.

Some components may cause kidney and liver damage. Many are flammable and can cause burns.

**How Do I Protect Myself?** Use the Alaska Right to Know Law (see Chapter 6, Labels and Laws) to find out what is in

the product. Read the MSDS. Wear protective clothing and gloves, and a respirator if you need one. Use only in well-ventilated areas.

**Special Precautions**—Be extremely cautious in confined spaces (see Chapter 3).

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## Isocyanates

Polyurethane, TDI (2,4, toluene diisocyanate), MDI (methane diphenyl diisocyanate), HDI (hexamethylene diisocyanate).

**Where Are They Found?** Paints, polyurethane foams, roofing and decking systems, glues.

**Activities at Risk**—Electrical work, painting,

plumbing, working with isocyanate-containing materials such as foam insulation systems or paints.

**Early Signs of Exposure**—Skin reddening and rash, eye irritation, coughing.

**Long-Term Health Effects**—May sensitize some workers so that even

very low exposures can cause severe skin rashes or breathing difficulty. The worker will not be able to function at all around the material after becoming sensitized.

**How Do I Protect Myself?** Wear clothing to protect skin. If possible substitute products that do not contain isocyanates.

Wear appropriate, air supplied respirator (see Chapter 4, Personal Protective Equipment).

**Special Precautions**—It is vital to prevent initial exposures to isocyanates to avoid sensitization.

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## Paint Solvents and Pigments, Primer, Coating, Antifouling Paints and Compounds, Urethane

Also see isocyanates.

**Where Are They Found?** When mixing and applying paints, and during cleanup. Highest exposure is often during mixing and cleanup. Improper storage and subsequent damage of containers may occur in

rough seas leading to further exposure.

**Activities at Risk**—Painting, ship building and repair.

**Early Signs of Exposure**—Eye and nose irrita-

tion, feeling "high," dizziness, headache.

**Long-Term Health Effects**—Vary, depending upon the components of the paint. Can include skin rashes, nerve damage, nervous disorders, kidney and

liver damage, and cancer.

**How Do I Protect Myself?** Find out what is in the paint by using the Alaska Right to Know Law (see Chapter 6, Labels and Laws) to obtain and review the MSDS. Work only in



## Paint Solvents, Pigments, etc. (continued)

well-ventilated areas. Be especially careful in confined spaces. Substitute less toxic paints, such as lead-free paints. Use the EPA-approved antifouling additives (see note below on antifouling paint regulations). Use the proper protective equipment (see Chapter 4, Personal Protective Equipment).

**Special Precautions—**Wash up before using the head, eating, drinking, or smoking. Solvents and pigments on your hands can be swallowed when eating,

drinking, or smoking. If you sandblast, see the hazard description for silica. If you burn off old paint, see the hazard description for carbon monoxide.

**NOTE:** Most antifouling paint additives contain mercury, copper, arsenic, or tin compounds even though EPA-approved antifouling additives are available. Antifouling paints must be handled as hazardous materials, and the used equipment and containers must be handled as hazardous wastes.

*Alaska Statutes 46.03.020 and 46.03.715 (Senate Bill 131 passed in 1987) state that TBT-(tributyltin) based marine antifouling paints and coatings may not be ordered after June 13, 1987; and may not be sold or used in Alaska waters on vessels, airplane floats, barges, fishing gear, or any submerged item. Any item treated before December 1, 1987 with TBT-based marine antifouling paints or coatings may not be used in Alaska waters after December 1, 1992.*

*Slow leaching, TBT-based, marine antifouling paints may be used on aluminum vessel hulls and lower outboard drive units. Slow leaching is defined as 3 micrograms per square centimeter per day.*

*The above regulations do not apply to government vessels, foreign vessels in state waters less than 90 consecutive days, or vessels greater than 4,000 gross tons. Know the product well before you use it!*

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## PCBs

Polychlorinated biphenyls, chlorinated diphenyls.

**Where Are They Found?** Clear to yellow oily liquid found in older transformers and fluorescent light ballasts. The federal government has banned most uses of PCBs today. If you think you might be working with PCBs, find out for sure. They are highly hazardous materials and must be disposed of properly. Any contaminated

equipment, clothing, or material must be dealt with as a hazardous waste. Avoid contact.

**Activities at Risk—**Electrical work.

**Early Signs of Exposure—**May irritate the skin. There may be no early signs.

**Long-Term Health Effects—**Can cause a serious skin condition known

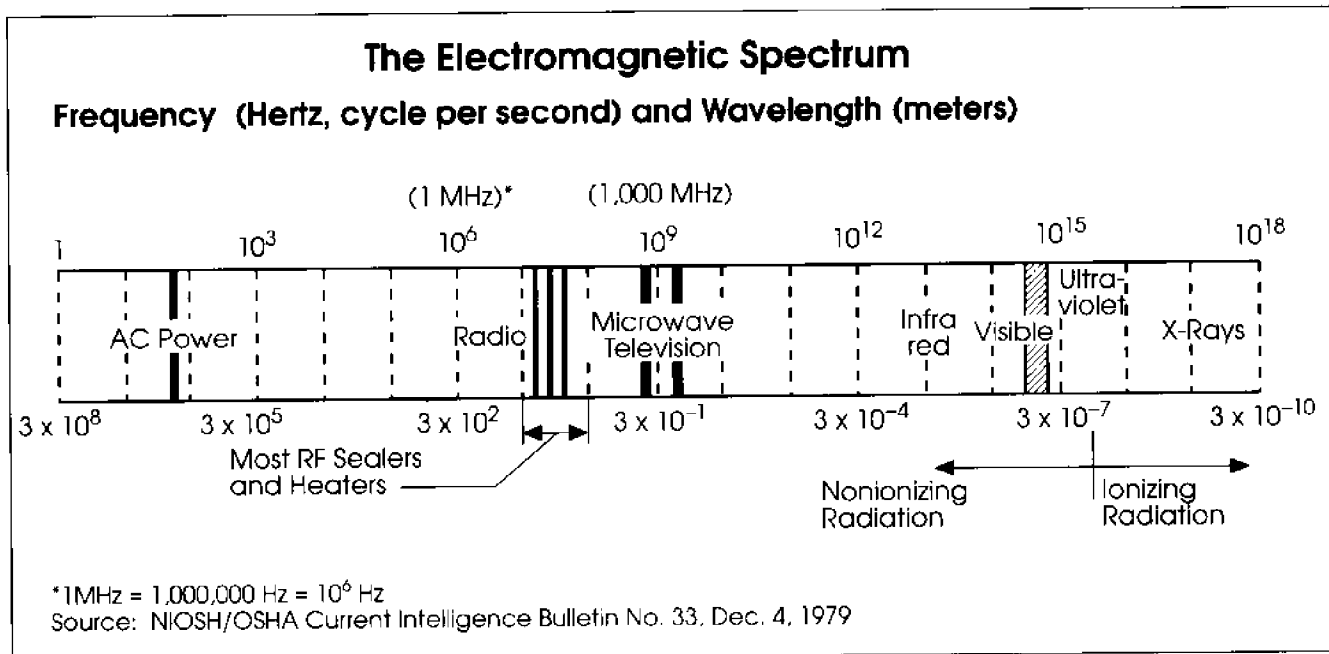
as chloracne. May cause liver damage, birth defects, and cancer.

**How Do I Protect Myself?** Wear proper gloves, clothing, and a face shield or goggles when handling equipment containing PCBs. Dispose of contaminated clothing as hazardous waste: Do **not** wear or wash at home! Wash your hands thoroughly with detergent after working on PCB-containing

equipment, and **before** using the head, eating, drinking, or smoking.

**Special Precautions—**New equipment should have labels marked "no PCBs." If there is no such label, assume that it contains PCBs and take precautions. Contact the Alaska Department of Labor, or Alaska Health Project for more information or assistance (see Chapter 7, References).

## Nonionizing Radiation



Ultraviolet, infrared, laser light, microwave, radar.

**Where Are They Found?** Ultraviolet (UV) and infrared (IR) radiation are emitted during welding, from the sun, from low-pressure mercury lamps, and from "black" lights. Laser light is from lasers that are used mostly for alignment. Microwaves come from cooking units, electronic equipment, and radar. See the diagram on this page showing radiation wavelength and frequency.

**Activities at Risk**—Sheet metal work, welding, cooking, mast work, working around electrical or welding equipment, exposure to the sun for long periods.

**Early Signs of Exposure**—Feels warm or hot,

and looks like sunburn. Burning and irritation of the eyes. Sun or snow blindness, hives, triggers herpes simplex (cold sore), eczema-like skin disorders (dry scaly skin). Radar or microwave ovens that leak may cause nervous and behavioral effects or cause implanted heart pacemakers to malfunction.

**Long-Term Health Effects**—Chronic infrared radiation exposure can cause a cataract-like disorder, or clouding of the eye lens, called pterygium. Ultraviolet radiation can cause a gritty feeling in the eye often called "welder's eye" or "arc flash."

Ultraviolet radiation can also cause skin cancer. Microwaves can cause cancer, birth defects (congenital anomalies), and possibly

cataracts at high dosage. Electromagnetic field effects are still unclear and highly debated; some data indicate that it may promote cancer and birth defects.

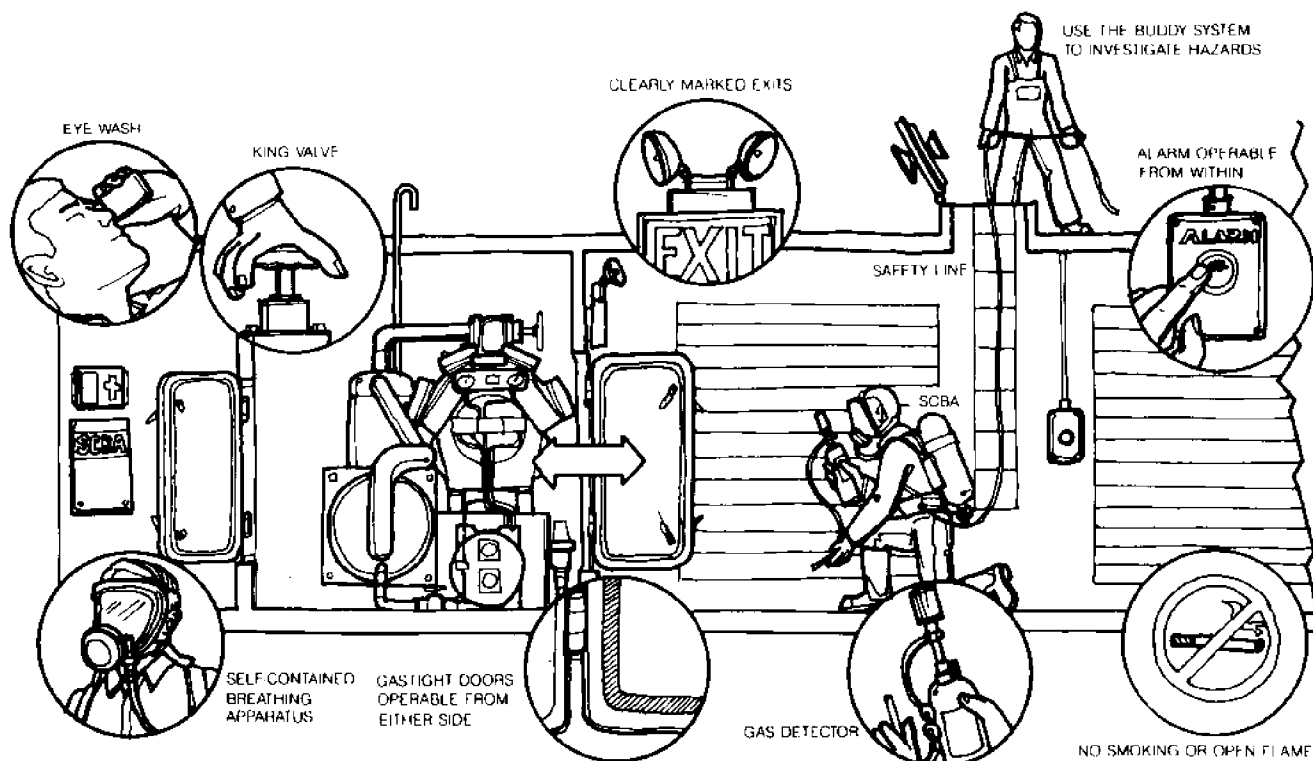
**How Can I Protect Myself?** When working in the sun or while welding wear clothing to cover exposed skin—long-sleeved shirts and pants. Use sun screens or zinc oxide creams to cover frequently exposed and sunburned areas like the nose, lips, ears, and neck.

Wear sunglasses with side shields. Wear tinted goggles or face shields when welding. Avoid working near radar antennas unless you know the system has been turned off. **Never** look directly at welding or laser light without approved eye protection.

**Special Precautions**—Ultraviolet and infrared radiation from welding can affect nearby workers. They should also wear protective clothing and goggles. Portable screens can sometimes be set up around welding operations for additional protection.

Lasers should be avoided unless eye protection is worn. Microwave ovens should be checked with a meter to assure they do not leak. Radar and radio systems should be totally shut down while performing repair or maintenance work on them, their antennas, or in the immediate area of the antennas.

## Refrigerants



Refrigeration safety. The **king valve** shuts down the system and should be clearly marked. SCBAs and medical supplies should be stowed outside the space. A gas detector enables you to pinpoint the source of a leak.

Ammonia; freon such as halon, fluorotrichloromethane, dichlorodifluoromethane; chlorofluorocarbons.

**Where Are They Found?** Refrigerator units, pumps, and lines that circulate throughout the storage holds of the vessel, as well as units on shore.

**Activities at Risk**—Hold work, ship building or repair, working near exposed refrigeration coils.

**Early Signs of Exposure**—Ammonia is quite pungent; however, continued exposure desensitizes the nose so that the gas can no longer be smelled.

Additional exposure may burn the eyes, throat, and lungs, and lead to blindness, vomiting, and breathing difficulty. Ammonia also has a frost injury potential. Freon is odorless or has an ether-like odor. It is irritating and will cause dizziness and unconsciousness.

**Long-Term Health Effects**—Ammonia may cause eye damage, prolonged throat irritation, suffocation, and death. Freon may cause liver damage and skin irritation. Chlorofluorocarbons (CFCs) are linked to the destruction of the ozone in the upper atmosphere, the layer that filters out ultraviolet radiation;

therefore, an extremely long-term effect is damage to the environment.

**How Do I Protect Myself?** Know the type of refrigeration system on your vessel or that you use on shore. Report any strange smells, leaks, or malfunctions immediately. Refrigeration systems are under pressure; therefore, any work done on the system must be done after the system is discharged.

Some refrigerants are flammable and must be protected from ignition. Appropriate breathing apparatus should be worn (Chapter 4, Personal Protective Equipment). Gas detection de-

vices should be used before entering a hold or area where there is a system with a problem (Chapter 3, Confined Spaces).

**Special Precautions**—Refrigeration units can leak chlorofluorocarbons. CFCs will break down in the presence of heat and water vapor to form hydrochloric and hydrofluoric acids and other toxic and corrosive compounds. Only those trained to work on refrigeration units should do so. Be sure that all refrigerator coils, lines, and compressors are protected from accidental damage. CFCs should never be willfully vented into the atmosphere.

## Silica

Sand.

### Where Is It Found?

Sandblasting operations.

**Activities at Risk**—Sandblasting, working near sandblasting.

**Early Signs of Exposure**—May be no early signs.

**Long-Term Health Effects**—Causes a lung disease known as silicosis. Wheezing, coughing, and

difficulty in breathing are symptoms of silicosis.

**How Do I Protect Myself?** Silica should not be used in sandblasting; use steel shot or glass beads. Work in well-venti-

lated areas. Wear an approved respirator (see Chapter 4, Personal Protective Equipment).

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## Solvents, Degreasers, Metal Cleaners

Toluene, xylene, stoddard solvent, turpentine, glycols.

**Where Are They Found?** Paint thinners, cleaners, solvents.

**Activities at Risk**—Cleaning, machine maintenance and repair, painting, ship building and repair.

**Early Signs of Exposure**—Irritation of the skin (especially on hands and

arms), feeling "high," dizziness, nausea, "buzzing" sound in the ears.

**Long-Term Health Effects**—There are many different solvents in use, and each can cause different problems. For example, benzene can damage the liver and cause cancer. Some glycols may cause sterility and birth defects. Many solvents can damage the nervous system, kid-

neys, and liver. Read the appropriate MSDS, as labels on containers are usually small and have limited information.

**How Do I Protect Myself?**—Substitute less dangerous solvents, use ethanol rather than benzene or toluene. Wear protective clothing, gloves, and the proper respirator (see Chapter 4, Personal Protective Equipment).

Work in well-ventilated areas.

**Special Precautions**—Be extremely cautious in confined spaces when using solvents (see Chapter 3). **Never** weld near chlorinated solvents like methyl chloroform—ultraviolet radiation can convert solvent vapors to lung-irritating gases. Often the effects of these gases will not appear for several hours.

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## Welding, Soldering, Brazing, Burning, and Cutting Fumes and Materials

**Where Are They Found?** Common welding hazards are ultraviolet and infrared radiation; solvents; carbon monoxide, nitrogen dioxide (see hazard descriptions in this chapter), and ozone gases; fluorides

and acids found in some fluxes; fumes from iron, copper, chromium (see hazard description in this chapter), lead, and zinc (from all galvanized steel materials); and compressed gas cylinders.

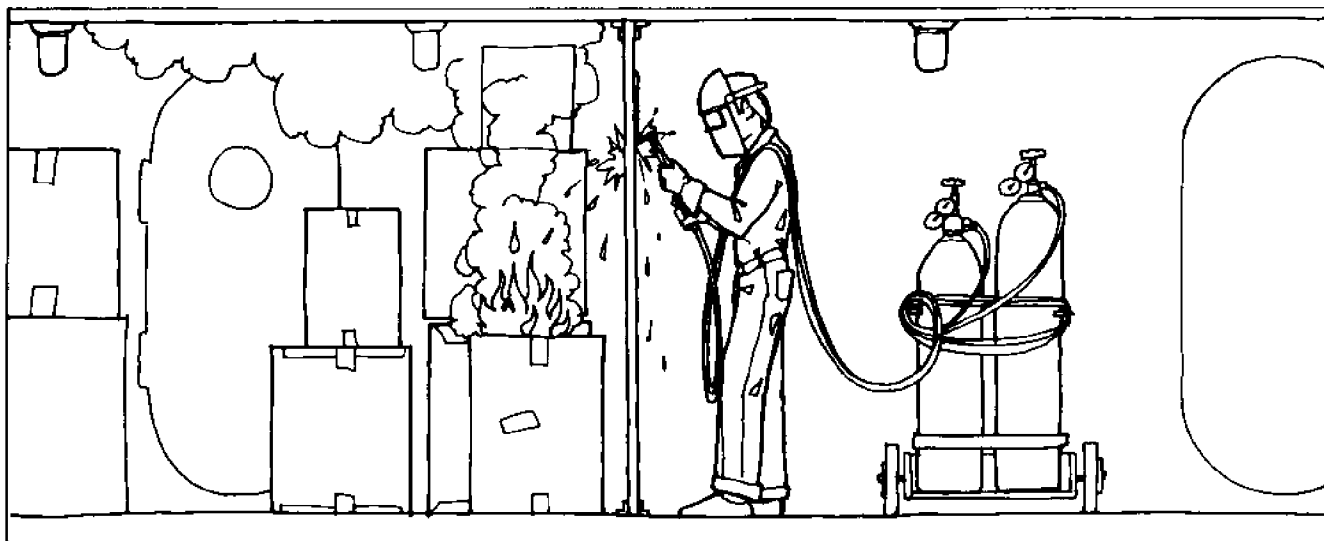
**Activities at Risk**—Sheet metal work, handling gas cylinders, plumbing, electrical work, ship building and repair, gear work.

**Early Signs of Exposure**—Irritation of the eyes,

nose, throat, and lungs. Explosion of damaged or mishandled gas cylinders.

**Long-Term Health Effects**—Metal fume fever is a flu-like illness that lasts a day or two and is caused

## UNSAFE BURNING AND WELDING PRACTICES



### **Welding, Soldering, etc. (continued)**

by exposure to zinc, copper, or iron fumes. Metal poisoning can occur. Health effects vary with materials used and length of exposure. Explosion of cylinders can cause burns and traumatic injuries.

**How Do I Protect Myself?** Read the MSDS for each product to find out what you are working with. Wear protective clothing and use tinted goggles or a welder's face shield. Work in well-ventilated areas.

Mechanical ventilation is required if the work is to be done in a space of less than 10,000 cubic feet per worker, or in an area with an overhead height of 16 feet or less.

Be extremely cautious in confined spaces (see Chapter 3). Position an observer on the far side of the work area (in an adjacent compartment) to assure overall safety and to keep a watch for fire that may start due to heat transferred from the work site. You

may need to wear a respirator; some are designed to fit under a welder's helmet (see Chapter 4, Personal Protective Devices). Cut or weld galvanized steel only in ventilated areas or wear proper respirators.

**Special Precautions—**Double check that the materials to be worked with are safe and create no additional problems from heat transfer or content flammability. Keep gas hoses clear of work area to prevent

their inadvertent cutting and possible fire or explosion. People working near welding and similar operations are also exposed to these hazards. Handle gas cylinders carefully. Keep oxygen away from combustible materials (grease, oil, fuels). Secure cylinders at all times. Keep protection caps on unless cylinder is in use. Consider every gas cylinder as full, a potential bomb that will go off if mishandled.

## Wood Preservatives

Pentachlorophenol or penta, Cuprinol, creosote, inorganic arsenicals, copper-8-quinolinolate.

**Where Are They Found?** Treated lumber, wood preservatives, in some paints and adhesives.

**Activities at Risk**—Carpentry, painting, ship building or repair, using treated wood scrap as a fuel in wood stoves.

**Early Signs of Exposure**—Coughing and sneezing, dizziness, headache, eye and lung irritation.

**Long-Term Health Effects**—Can be fatal. Can cause an acne-like skin condition or liver damage.

**How Do I Protect Myself?** Wear protective gloves, clothing, and the correct respirator when handling (see Chapter 4, Personal Protective Equip-

ment). Work in well-ventilated areas only. Use wood preservatives that are less toxic: copper-8-quinolinolate rather than pentachlorophenol (PCP). Read the MSDS.

**Special Precautions**—These chemicals are absorbed readily through the skin, so wash off immediately. Wash hands thoroughly before using the head, eating, drinking, or smoking. Clean up carefully

and completely. Of the less toxic wood preservatives, the National Marine Fisheries Service supports the use of copper-8-quinolinolate. Avoid using bare wood, especially treated wood, in fish holds. Do not burn any treated wood scrap—the fumes are noxious.

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*Additional information on specific products is available on the MSDS produced by the manufacturer. The supplier of the material must have the MSDS available to provide it to the buyer at the time of purchase. The MSDS is also available through the Alaska Department of Labor, and must be*

*provided to any worker who requests the information under the Employee Right to Know Law in Alaska. The Alaska Health Project will also provide information on specific materials or health concerns.*

In the last few decades several people have died in confined spaces on board vessels. They went into the spaces expecting no problem. They could not see the toxic gases nor the lack of oxygen that caused their deaths.

Countless times, workers in holds or other compartments have not felt well after painting or welding. Cooks complain of getting headaches while preparing the crews' meals. Many of these ailments are related to a lack of good clean air that has enough oxygen. This problem is extremely common in confined spaces.

Vessels have numerous confined spaces such as

holds, tanks, compartments, cofferdams, double bottoms, bilges, galleys, heads, and lazarettes. Equipment sheds and storage bins ashore also are confined spaces. Even the entire vessel on grid, ashore for work and wrapped in plastic sheeting, is a confined space.

Confined spaces have three things in common. First, they are enclosed. It does not matter what the material is, only that it is enclosing. Second, confined spaces have limited entry and exit points. They usually have only one door, hatch, port, or cover. Third, confined spaces have poor natural ventilation. They will hold their own air, even

with open vents, windows, ports, doors, hatches, or covers.

Spaces ventilated only part of the day may become dangerous confined spaces. If a space has been painted and then closed, the air may not have enough oxygen the next day; the curing of the paint may have consumed it. Areas of the vessel with natural ventilation become confined spaces when they remain unused and closed-up.

Holds full of unseen gases seem empty, but are not. Enclosures where work is to be done that may either consume or replace the oxygen (welding, burning, painting, cleaning,

holding decomposing fish) must have their gas monitored before and during the activity. **Assume that unknown confined spaces are dangerous unless proven otherwise.**

Confined spaces have additional problems in cold areas. In order to work with certain products, the area must be warm. A balance must then be met between adequate ventilation and heating. Fans, blowers, or ventilators need to circulate and clean the air while maintaining the temperature.

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### Testing

When you want to go into an unknown confined space, what do you do?

**Assume that it is dangerous,** and then test the air.

Striking a match is a bad idea. It may tell you that there is not enough oxygen in the air when the flame goes out. However, if the gases are explosive, you may not survive the test! There are safer ways to learn the chemical content of the air in which you plan to work.

Numerous gas meters are available, but which one is best? It depends on your needs and what is being tested.

Gases you may want to test for:

- **Oxygen.** If a space has less than 19.5% oxygen, no one should enter. **But enough oxygen does not always mean the atmosphere is safe.**

- **Refrigerants.** If you are going into a refrigeration room, you may want to test for the gas used in the cooling system, usually ammonia or freon.

- **Exhaust gases.** If you are going into a space where there is an engine, exhaust system, or some type of combustion, you may want to test for carbon monoxide, nitrogen dioxide, sulfur dioxide, or combustible gases.

- **Flammable gases.** If you are going into a fuel

tank, you will want to test for flammable gases.

A good general meter is an oxygen meter, but this meter will not test for other gases.

Other gases can be measured with air monitors, available from most marine suppliers and safety equipment stores. Air monitors with hand operated pumps have chemically sensitive disposable tubes that are inexpensive and easy to use. There is one tube for each kind of chemical.

Permanently mounted remote sensors are also available to monitor the local atmosphere for a variety of chemicals and give a digital readout on a central

control panel. The panel has variable settings for automatic audible alarms. Remote sensors are easier to use, but are more expensive.

Depending on your vessel, your need, and your budget, you can select a monitoring system that fits your situation.

Knowing what gases you might find means knowing what the confined space is and its size and shape, what was in it before, what may be in it now, what your job is, and how to do that job safely.

## Ventilating

If testing shows there is not enough oxygen or there is a harmful gas in the space, you must ventilate or get an alternative air supply. Open any ports and hatches, and move the bad air out. If the gases are flammable, do **not** use an electric fan. A spark could cause the gas to explode. A Venturi-type (air pressure) ventilator can be used with flammable gases. Be aware of where the bad air, or exhaust of the ventilation, is going, so as not to

pollute the rest of the vessel or injure the crew.

Once you have ventilated, retest the air. Flammable gases must be lower than 10% of the lower explosive limit before anyone should go in. Acceptable levels for individual gases can be obtained by calling the Alaska Department of Labor or the Alaska Health Project. Oxygen levels must be at least 19.5%. Other tests should show safe air results before anyone enters the space. Once

the space is approved for entry, it must continue to be ventilated to assure enough air circulation for the worker and to remove fumes.

In Alaska ventilation is complicated by the need for heat. Many materials work best when applied at 55-85°F. This means working on one of the few nice days of the year (which are impossible to predict and are always in the middle of the season when you make your living), or by heating an enclosed area. Heaters

produce their own exhaust, they burn up oxygen, and they can break down other volatile chemical fumes to form an atmosphere of some unknown chemical soup. Ventilation-heat is a delicate balance that must be achieved with a thorough understanding of the materials, space, and fumes involved to assure crew safety.

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## Personal Protective Equipment

If any question remains as to the quality of the air, personal protective equipment should be worn. Several methods are available. First, a positive-pressure air supply system with an ap-

propriate compressor and a full face mask can be used. Second, a self-contained breathing apparatus can be worn. Third, depending on the conditions, an appropriate air purifying respirator

can be worn. See the following chapter on protective equipment for details on respirator selection and use.

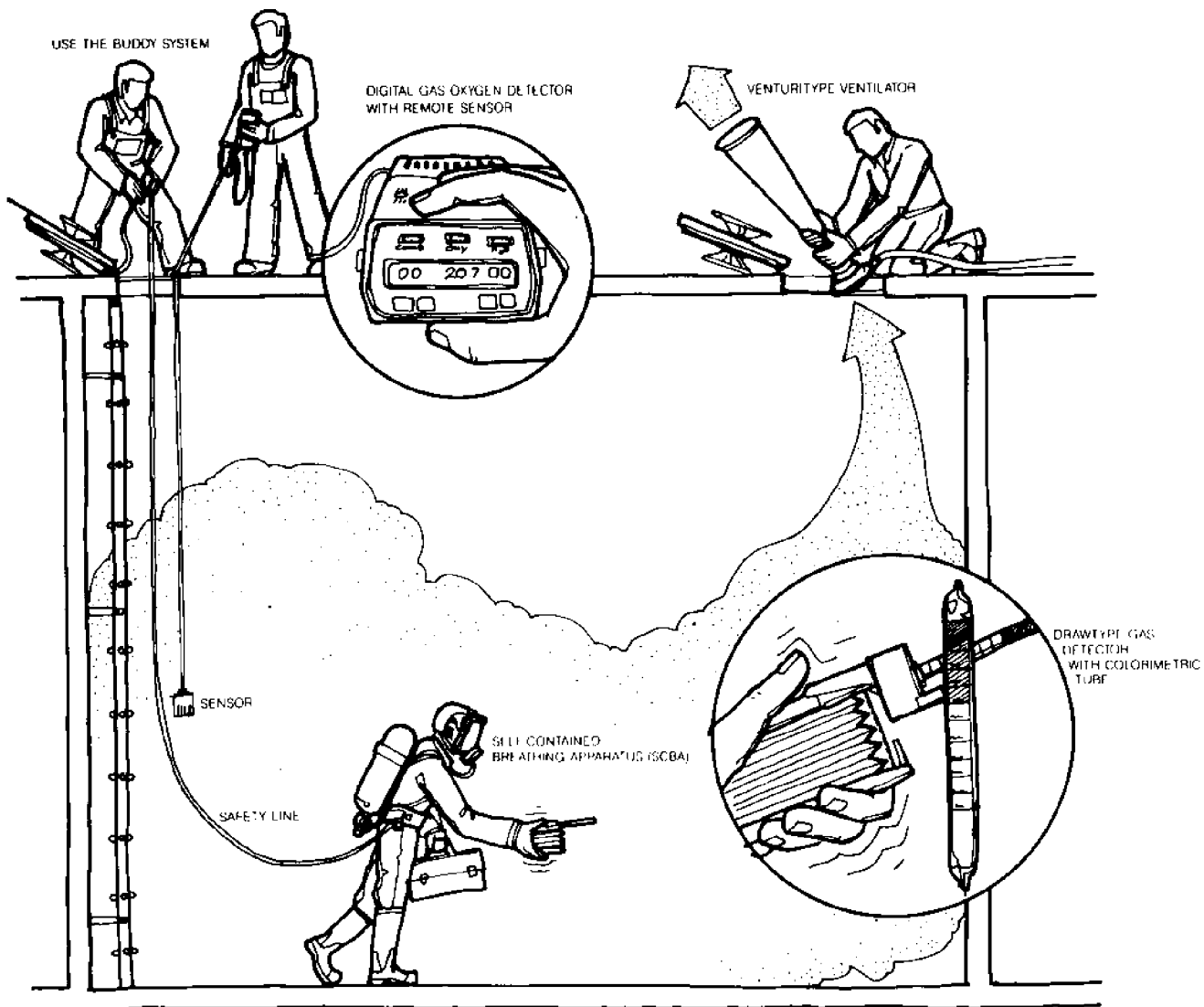
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*Caution: A cartridge or canister type respirator does not provide oxygen and should not be used when oxygen level is a concern.*

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## Have a Plan and a Buddy



*Investigating a confined space hazard. The space must be tested with a remote sensor or by crew equipped with SCBA. Ventilators must be explosion-proof or intrinsically safe. The type pictured above operates by means of compressed air and poses no explosive hazard.*

Before entering any confined space that you suspect may have poor air, have a plan and a buddy. Because the confined space may be filled with deadly gases, always have someone standing by to help. Your buddy could hold your life in his hands, so make

sure you trust each other. Also make sure you both are wearing personal protective equipment. Attach a secure safety line to yourself, then make sure that line is in the hands of your buddy before you enter.

Work out a plan that includes signals (hand signs,

lights, tugs of the rope), time frame, and activities. Once you both know what you are going to do and how you are going to do it, then you can begin.

Do **not** attempt a rescue unless you are prepared. Multiple deaths can occur if the rescuer is not wearing

safety equipment. The illustration on this page shows some precautions to take when investigating a confined space hazard.

## Prepare for your Confined Space Entry

Know what you are getting into. How big is the space, what shape is it, what will you have to get around, what might cause you problems, what work will you have to do, what tools will you need, how much time will it take, can you do it by yourself? Answer these questions first.

Retest the air as you go into the space. There may

be a continuing leak or a new problem. Your activity may create a hazardous environment; for example, paint or welding generate fumes, and sloshing through scum on the bottom of a fish hold may release hydrogen sulfide gas. The air in one part of the space may be very different from where you entered, since some gases are

heavier and sit at the bottom while others are lighter and rise to the top. If there are changes or if you have problems, get out.

Extreme caution should be used in all confined space work. Decreased ventilation, increased concentrations of gases, decreased work space, increased equipment use, decreased numbers of safe

exits, and generally increased risk of complications all make working in confined spaces hazardous.

If you are unclear on the above material, contact one of the resources in Chapter 7, References, to help you set up your confined space entry procedure.

*Proper selection, use, and care of personal protective equipment (PPE) is vital if it is to be effective. Just as using the wrong tool for the job can cause problems, using the*

*wrong protective equipment, or equipment that is in poor condition, can also be a problem.*

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## The Captain Provides the Equipment

When a captain instructs a crew member to perform a task requiring PPE, the captain is responsible to provide the right equipment.

The U.S. Coast Guard requires the captain to provide a personal flotation device for each person on board, and requires owners and operators of vessels to assure the safety of the crew, which includes providing PPE for hazardous jobs. The federal Occupational Safety and Health Administration also requires that PPE be provided to employ-

ees. Alaska state laws require employers to provide their employees with a safe work environment.

The Coast Guard feels that work on board an Alaska licensed vessel falls under the laws of the state. Operation within the national 200 mile limit falls under the federal Occupational Safety and Health Administration guidelines. Work ashore is covered by the Alaska Department of Labor.

If the captain (the employer) requires that a job be done, he must provide

the PPE needed by the crew member (the employee) to perform that job. He can provide "general" equipment for the crew, or he can purchase PPE for each individual.

If the employer purchases PPE for each crew member to be used only by that person, the PPE will fit better and will be better cared for, and will thus be safer. People tend to take better care of their personal tools and equipment than company property.

Purchasing general equipment may be less ex-

pensive, especially for larger, varying crews, but general PPE may be less safe. "One size fits all" equipment rarely does.

The captain must weigh the costs of providing general PPE with the costs of injuries due to improperly fitted equipment. The captain must consider how he can best provide for his crew's safety. It is more difficult to provide well-fitting PPE for large, varying crews than for small, close knit, long-term crews.

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## Respirators

Respirators are widely used in Alaska to protect workers from exposure to airborne hazardous substances. However, the

proper use of respirators requires careful planning by the employer and cautious use by the worker. Unless proper care is taken to se-

lect, fit, and maintain respirators, they will not provide protection from health hazards. The employer is responsible for providing

respirator physicals, including fit-testing, and proper training.

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## LIMITATIONS OF RESPIRATORS

In general, respirators have many drawbacks and limitations, some more than others. You should be aware of the limitations of the kind that you use. Here are some of the general limitations of respirators:

- **Increased Resistance to Breathing.** Some workers will have trouble breathing while wearing a respirator. Workers with chronic

lung disease or heart problems should not wear respirators without a physician's approval.

- **Poor Fit.** Respirators may be uncomfortable. If you have strong bone features or have had a broken nose, cheek, or jaw, the mask may not fit well. Facial hair, as little as two days growth or a full, bushy beard, will prevent the mask

from sealing properly. Large scars on the face may also cause problems. Eyeglasses may break the mask's seal, or the mask may make glasses difficult or impossible to wear. Cold conditions make the mask less flexible and result in a poor fit. Contaminated air may leak into the mask if the seal is inadequate.

- **Irritation.** Sweat

around the face mask can cause a skin rash, or a rash can result from contact with airborne hazards, like acid mist. Additional protective clothing may be needed to cover the skin and eyes.

- **Poor Vision.** Glasses are difficult and sometimes impossible to wear. Special masks or lenses can solve this problem. Full-face masks often fog.

## LIMITATIONS OF RESPIRATORS (continued)

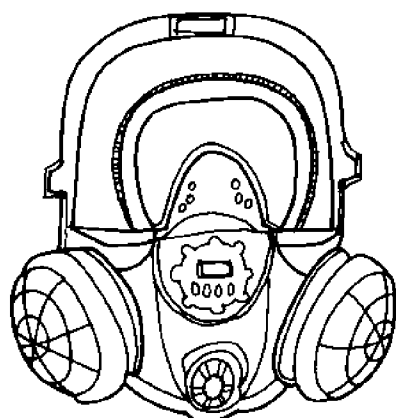
• **Interference with Normal Work.** You may need more time to complete a task while wearing a respirator because of an in-

creased resistance to breathing, the additional weight of the equipment, lack of peripheral vision, and other related factors.

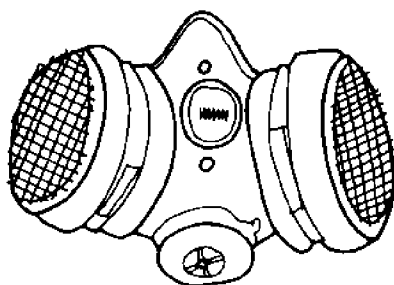
In Alaska, respirator users face additional problems. The cold Alaska winters can cause malfunctions in some respirators. Metal

parts freeze and soft face pieces become rigid or even crack, causing leakage and additional discomfort.

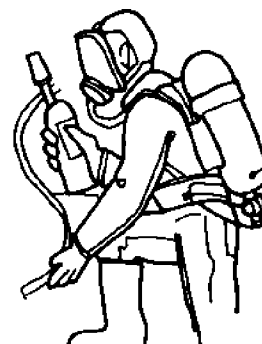
## RESPIRATORS USED IN ALASKA



*Air Purifying Respirator  
Full Face Mask*



*Air Purifying Respirator  
Half Mask*



*Self-Contained  
Breathing Apparatus*

Four major types of respirators are used in Alaska.

1) **Single Use-Throwaway Respirators.** Similar to doctor's masks, these are designed to trap dust and mist before it reaches your mouth and lungs. These can be used only when enough oxygen is present (19.5% or more) and when dust and mist concentrations are low. These masks are good for one use only. Leakage around the mask is usually a problem.

2) **Air Purifying Respirators** (illustrated on this page). Contaminated air is inhaled through a pad, chemical cartridge, or canister which filters out dust, fumes, vapors, or gases.

To select the proper filters for use, several questions must be answered:

A) Is there enough oxygen present for normal breathing? At least 19.5% oxygen must be present in the air. If there is any doubt, such as in a confined space, the oxygen level must be measured (see Chapter 3). Do not use this type of respirator without a safe oxygen level.

B) What hazard is in the air? Is it fiberglass, toluene, or nitrogen dioxide? The proper cartridge type must be selected for the respirator (see table on page 22).

C) How much of the haz-

ard is in the air? At high hazard concentrations, filter cartridges will "wear out" faster than at low concentrations. Some cartridges can be "used up" just by being out of their protective wrapper. Be sure that the cartridges you use are in good condition when you start and are changed when needed.

3) **Air-Supplied Respirators.** Fresh air is pumped into the face mask through a hose from a clean air source. This respirator can be used in areas with low oxygen concentration or when the level of air contaminants is so high that air purifying respirators are not

effective. Make sure that the air source is truly pure. A common mistake is using air that is contaminated with toxic exhaust, which is then pumped into the respirator along with the "fresh" air.

4) **Self-Contained Breathing Apparatus** (illustrated above). Clean air from a portable tank is supplied to the face mask, similar to a scuba system. Because the air supply is limited to the amount of air the tank holds, these units can be used for only short periods before the tank must be replaced and refilled. The units can be used in the same conditions as air-supplied respirators.

## RESPIRATOR PROGRAM REQUIREMENTS

Legal requirements for the use of respirators are in the Alaska Department of Labor regulations. The minimum legal requirements that an employer must follow are in the Alaska General Safety Code, Section 01.0403.

However, **the employer can have a better program than required by law.** The safety code states only the **minimum** required. A concerned employer or captain may want to do far better for his crew; his life may depend on it

just as much as the crew member who is wearing the gear.

The following 11 points from the General Safety Code outline the minimum respiratory protection program. The bracketed [x] text following the exact

wording of the regulations is a helpful explanation. Note that use of the word "shall" means that the employer must follow the regulation. Use of the word "should" means that it is recommended but not required.

- I) Written standard operating procedures governing the selection and use of respirators shall be established. [These should be readable and posted at the job site.]
- II) Respirators shall be selected on the basis of hazards to which the worker is exposed. [Both the type of chemical hazard and concentration must be considered in selecting the right respirator. For example, a dust mask will not protect you from solvent vapors.]
- III) The user shall be instructed and trained in the proper use of respirators and their limitations. [Training should include how to wear the respirator, fit testing, and the limitations of its use. For example, an air purifying dust mask is useless in an oxygen deficient atmosphere.]
- IV) Where practicable, the respirator should be assigned to individual workers for their exclusive use. [Although not required, this should be done to control the spread of dirt and disease, and to insure proper fit.]
- V) Respirators should be cleaned regularly and disinfected. [If used by more than one worker, the respirator should be cleaned and disinfected after each use. If the respirator is assigned to one worker, it should be cleaned once a day when in use.]
- VI) Respirators shall be stored in a convenient, clean, sanitary location. [Respirators can be damaged through improper storage. If the respirator is left unprotected in the area, it can be contaminated by the hazards it is meant to protect against.]
- VII) Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use, such as self-contained devices shall be thoroughly inspected at least once a month and after each use. [For example, filters and cartridges must be replaced periodically and rubber parts should be inspected for pliability and deterioration.]
- VIII) Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained. [The employer must check periodically for the hazards. Monitoring is necessary to determine the level of protection.]
- IX) There shall be regular inspection and evaluation to determine the continued effectiveness of the program. [The employer must review regularly all parts of the respirator program, including air sampling results, training, etc.]
- X) Persons should not be assigned to tasks requiring respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually). [Although not required, this is very important. Because of heart or lung problems, some people may not be capable of using a respirator. Any physician determining that workers can or cannot wear respirators must know about both respirators and the working conditions in question.]
- XI) Approved or accepted respirators shall be used when they are available. [Respirators are designed for particles such as dust or fumes, or for gases and vapors. They must have a "Bureau of Mines" or "NIOSH" approval number (National Institute for Occupational Safety and Health, for example TC-21C-132) and a description of what it protects against stamped on the mask and canisters.]

## CARTRIDGE OR CANISTER CODE FOR AIR PURIFYING RESPIRATORS

Know which canister or cartridge to use for an air purifying respirator. The cartridges are effective only on the hazards for which they are designed. Therefore, the worker is protected from only the substance identified on the cartridge. To assist users with easy identification, a

system of color coding has been developed. This code is used by all manufacturers of respirators in the United States. Some examples of the coding system are in the accompanying table. **NOTE:** *This does not apply to foreign-made filters.*

Hazardous substance to be protected against	Color Code
Acid gases	White
Chlorine gas	White with yellow stripe around the canister near the bottom
Organic vapors	Black
Ammonia gas	Green
Carbon monoxide	Blue
Acid gases and organic vapors	Yellow
All of the above	Red with gray stripe around canister near the top

## INSPECTION CHECKLIST FOR AIR PURIFYING RESPIRATORS

Each time you use an air purifying respirator, even a brand new one, check for the following:

- Are all straps present and in good condition (not

worn or frayed)?

- Are all rubber parts clean and pliable?
- Are inhalation valves in good condition and properly sealed?

- Are exhalation valves in good condition?

- Is exhalation valve cover in place?
- Are the mask and valves clean?

- Are cartridge gaskets present, in good condition, and properly sealed?

- Are parts missing?

## RESPIRATOR FIT TESTING

Fit testing must be done to check the size respirator you need and to test for an adequate seal between you and the face piece. Many factors can affect this seal,

including beards, glasses, scars, and your face size and shape. Respirators will not fit properly over a beard or other facial hair. This is an unpleasant fact for

many seamen; however, those who need to wear a respirator, as anyone on board may, should have a clean chin from ear to ear. The employer should see

that all workers wearing respirators are properly fit tested.

## AIR PURIFYING RESPIRATOR FIELD TEST

You should do your own quick field check **before** wearing your respirator into a hazardous area. Remember: the field check is not a substitute for proper fit testing.

- 1) Put the respirator on and pull all straps snug.
- 2) Cover the air intake openings with your hands

to block the air flow. It sometimes helps to use a plastic bag between your hands and the openings to create a seal.

- 3) Inhale gently. There should now be a vacuum created in the face piece which will make the mask collapse slightly and remain that way until you remove

your hands from the intake openings. Try to detect if any air is leaking between your face and the face piece.

- 4) Now cover the exhalation valve with the palm of your hand.
- 5) Exhale gently. You should not be able to detect air leaking out between

your face and the face piece.

Using a respirator is not as easy as it may first appear. The proper selection, use, and care of respirators is vital. If a good program is not set up and maintained, you may not be getting good protection from your respirator.

## Gloves

Wear protective clothing such as suits or gloves to protect your skin from the damaging or irritating effects of chemicals. This protection can also prevent harmful chemicals from entering your body through your skin. Gloves are the most common kind of protective clothing. Many styles of gloves are avail-

able, made from a variety of materials. Selecting the right glove takes careful consideration. The Glove Selection Chart is a guide to selecting gloves for working with various materials.

No single glove will protect you from all hazards. Leather gloves may work well for protection against

abrasions, splinters, and heat, but they will not protect you from chemicals. Different glove materials provide protection against different chemicals, but even the proper glove only slows down penetration of the chemical.

Gloves should be carefully inspected before each use, and discarded when

they begin to deteriorate. Cracks, discoloration, leakage, and swelling are signs of deterioration. The Glove Selection Chart will help you choose the appropriate gloves for the materials you are working with.

### Glove Selection Chart

	GLOVE MATERIAL							
	Natural Rubber	Neoprene	Buna-N	Butyl	Polyvinyl Chloride	Polyvinyl Alcohol	Polyethylene	Nitrile
<b>Chemical (example)</b>								
Mineral acids (hydrochloric)	G	E	E	G	G	P	G	E
Organic acids (acetic)	E	E	E	E	E	E	G	-
Caustics (sodium hydroxide)	E	E	E	E	G	P	E	G
Alcohols (methanol)	E	E	G	E	E	F	E	E
Aromatics (toluene)	P	F	F	F	P	P	E	E
Petroleum (mineral spirits)	E	E	E	F	P	E	E	E
Ketones (methyl ethyl ketone)	G	G	F	E	NR	F	G	F
Chlorinated hydrocarbons (perchloroethylene)	NR	F	F	NR	NR	E	G	G
Glycol ethers (Cellosolve*)	G	F	-	-	F	E	G	P
<b>Miscellaneous</b>								
Lacquer thinner	F	NR	NR	F	F	E	F	F
Benzene	NR	P	G	NR	F	E	F	G
Formaldehyde	E	E	E	E	E	P	E	F
Ethyl acetate	F	G	F	G	P	F	G	F
Vegetable oil	G	E	E	G	G	E	E	E
Animal fat	P	E	E	G	G	E	E	E
Turpentine	F	G	E	F	F	E	G	E
Phenol	F	E	G	G	G	P	E	NR
<b>Physical performance</b>								
Abrasion resistance	-	F	G	G	G	G	E	E
Cut resistance	-	E	E	G	F	E	F	E
Puncture resistance	E	E	G	G	F	E	E	E
Heat resistance	E	E	F	P	P	F	P	F
Flexibility	F	G	F	G	F	F	G	G
Dry Grip	E	G	G	F	E	E	G	G
Wet Grip	G	F	G	F	E	E	G	F

\*From glove manufacturer data.

Key: E = excellent, G = good, F = fair, P = poor, NR = not recommended

Adapted from Glove Selection Data Sheet, Center for Safety in the Arts, New York, NY.

## Protective Clothing

Clothing protects you from too much sun, heat, cold, dampness, or wind. It also protects you from solvents, sparks, abrasions, and hypothermia.

- Disposable oversuits should be available, used, and appropriately disposed of when working with solvents, paints, resins, and other materials that can be absorbed through the skin.

- Overalls are somewhat protective for dirty jobs, but

they can trap solvents and fumes against the skin where they can be absorbed. If you get penetrating liquids on your overalls or any clothing, remove them quickly to avoid absorbing the hazardous materials through your skin.

- Leather shoes or boots, or rubber boots, offer protection from hazardous materials. Disposable boot covers, made of the same material as disposable

oversuits, may be necessary for prolonged exposure to spilled chemicals. Avoid canvas shoes—they allow materials to reach the skin quickly. Leather materials will absorb hazardous materials and cannot be decontaminated.

- A hat will keep paint, resins, paint dust, and other materials off hard-to-clean areas of the head.

- Long sleeves on a shirt, sweater, or oversuit

will protect forearms from the gloves up.

- Long pants will protect legs from the boots up.

- Fire retardant materials should be worn when welding, cutting, brazing, soldering, burning paint, or performing any heat-producing process.

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## Hearing Protection

Protect your ears while working with loud equipment such as grinders and sanders. Use earplugs and earmuffs to protect from overexposure to noise. Earplugs can be either disposable or nondisposable.

Not all hearing protectors are equally effective. Commercially available protectors are given a noise reduction rating (NRR). This rating estimates how effective the protector is at reducing the noise level.

Look for this rating on the protectors you are using. Ratings usually range from about 10 to 40 dB (decibels—the units in which noise is measured). The higher the rating, the better the noise reduction. Since ratings are calculated from laboratory tests, the actual protection in working conditions will probably be lower; a conservative estimate is about half the reduction. A protector with a NRR of 30 dB can reduce the sound of

your vessel's diesel engine by 15 dB.

Earplugs or earmuffs must be used correctly to be effective. The captain should train the crew in the proper use of hearing protectors. As with respirators, there are factors to consider when using hearing protectors:

- 1) The protectors must fit properly. You may have to try out several types to find the one that fits you best.
- 2) They must be kept

clean. Letting them get dirty and then inserting or wearing them is inviting infection.

- 3) They can be uncomfortable.

- 4) They may cause ear irritation and infection that can be aggravated by using dirty fingers to place and remove the protectors.

- 5) They may interfere with normal and emergency communication with other workers.



## Eye Wear

Safety glasses, goggles, and face shields of clear or dark materials should be used as necessary. During any process that puts particles into the air, eye protection should be worn (paint scraping, grinding, sandblasting, spray or brush painting, fiberglass work). During any process that creates light, tinted eye protection should be worn (welding, cutting, brazing, using lasers). Sunglasses that attach to your glasses, prescription sunglasses, or tinted glasses are needed for long hours in the sun. These should fit under goggles.

As with hearing protection and respirators, eye protection should be fitted before it is needed. The eye gear should fit close to the face to keep flying particles from getting close to the eyes. Tinted eye protectors should block all harmful light.

Find the right protective eye wear for you. If you wear glasses, make sure your eye protection fits over them. Do not rely on your regular glasses to offer protection unless you know for sure they are safety glass. Even then, without side panels they will not offer adequate protection.

If you wear contact lenses, you should remove them before working on or around materials that give off fumes or that will dirty your hands. Contact lenses may trap droplets of hazardous fluid against the eye and away from the tears that would normally wash the eye clean. Soft contact lenses are permeable and some will draw in hazardous vapors and hold them against the eye. Regular cleaning may not restore the contacts to a safe condition. Contact lenses must be removed if the eye becomes irritated. If the hands are dirty or covered with

solvents, there is a delay in removal that may be painful and dangerous.

Cold Alaska environments will cause problems in the use of eye protection. Workers must see what works for them in a variety of conditions. As the temperature drops, condensation builds inside goggles and glasses. Cold glasses fog and ice up when they go from cold dry air outside to warm moist air inside. Cool glasses on a warm, sweating face will fog. In either case the worker is temporarily without sight or protection.

*A crew member comes gasping into the wheelhouse and yells that gas cylinders have come loose of their tie-down. There was a sharp bang and a valve cracked. Chlorine gas is filling the vessel, a man is working in the engine room, and a gale is blowing topside.*

*You are tied up at dockside on a sunny day painting in the lazarette. You are a little cramped but you are painting only fittings and should not be long. You get dizzy and decide to sit down to let it pass: it must be the garlic in the sandwich you had for lunch. When you wake up you are in the hospital.*

---

### Controlling Hazardous Materials

Events like the above can be avoided if hazardous materials are kept in control. When they go out of control they are extremely dangerous, and must be brought under control as soon as possible. A spill is an example of loss

of control, especially with a lack of awareness about how a product affects the local environment.

Just as each vessel should have a plan for fire control, or to rescue a person overboard, each should have a plan for haz-

ardous materials emergencies.

The Material Safety Data Sheet (MSDS) is a document produced by the manufacturer of each hazardous material. It has basic information on handling that material and what to

do in an emergency. The MSDSs for materials on board can be used to make up the outline of the emergency plan for the vessel. Additional help is available from the resources listed in Chapter 7, References.

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### When You Have a Spill

Uncontrolled releases of hazardous materials are considered spills. Spills are not only wet spots on deck or in the engine room, but also fumes and vapors that escape from tanks, cylinders, and holds meant to contain them. Spills may be noticed by any of the senses.

- **Sight.** You may see a liquid drip or spread on the deck from the bottom or side of a container, or see a cloud of gas escaping from a cylinder.

- **Hearing.** You may hear the escaping pressurized gas. You may hear a drip that you cannot see in the dark or a hidden area. You may hear a container fall and sound like it broke when it hit the deck.

- **Smell.** You may smell the vapor of the material itself or the fumes from the reaction that results when it contacts other materials.

- **Touch.** You may feel the heat or chemical burn of a material on your skin, and in your nose, throat, or eyes. You also may feel the coldness of an escaping gas or evaporating liquid.

- **Taste.** You may develop a strange taste in your mouth, or your food or water may not taste right due to some material affecting it.

- **Overall Perception.** You may feel "poorly" or different due to the effects of the fumes from a material. You may also "sense" that something is wrong with your vessel or crew with no

clear explanation.

Once you know something is wrong, act quickly. If you are unsure of the problem, investigate safely. If you think you smell gas in a dark room, do not strike a match and do not turn on the light switch. Get yourself to safety first, then use a protected, anti-spark light source and appropriate safety equipment. If you need more information, be safe and use proper precautions.

As soon as you realize there is a problem you must let others know, both to protect the individuals and to initiate more specific action. As with fire, there should be established procedures on board to deal with spills. When there is a

fire, the established procedure is to continue to yell "FIRE!" as you help others escape the flames and begin to fight the fire.

In case you have a spill, the crew must know where the vessel's safety equipment is and how to use it. They must also know what they are fighting. Just as the crew knows they should not put water on an oil fire, they need to know they shouldn't put bleach on an ammonia spill. Once again, the captain must know what is on his vessel, and inform his crew so anyone on board can deal with it when it is out of control.

## Effects on the Local Environment

Not only does the captain need to know how to control hazardous materials, he needs to know what effects they will have on the local environment. "Local environment" does not just mean the state, bay, municipality, or even dock area. Local environment is the closest environment to the individual, the vessel, or area of the vessel. The captain must know how each hazardous material used or carried on his vessel will affect each crew

member and the vessel as a whole.

When a hazardous material goes out of control the captain must protect his crew. He needs to know how each job can be done and what materials are necessary. If a hazardous material is needed and there is no alternative, then the captain must take all the precautions to assure that the crew has all the materials and information to do the job safely and completely. When a job is to be

done, the effects on the local environment must be considered.

The captain must answer many questions before work starts: What will the workers need for preparation of the area, for doing the actual work, for cleaning up after the work is done? Do the workers have sufficient training? Are there ways to reduce the number or amounts of hazardous materials used? What will the workers need for their own personal pro-

tection? Does the product have to be used at a specific temperature? If so, how will the area be heated? Does the area have to be ventilated? Can it be kept warm and ventilated? Where is the bad air, or exhaust from the ventilation going? What will be the effects on other crew members in the nearby area? What will be the effects on the vessel? What will be the effects on the crew and vessel if there is a problem?

---

## Captain and Crew as a Team

The above list of questions is long, but the captain must have answers to be truly responsible for his crew and vessel. Hazardous materials must be kept under control. The keys are to:

- Prevent them from getting out of control and creating problems.
- Be prepared to handle

the materials used.

- Understand their effects and side effects.
- Have a plan in case of emergency or accident.

At the same time, a crew member is not worth his salt unless he follows orders and instructions, and does his best for the rest of the crew and vessel. This means that every crew

member needs to know what to do in an emergency. He also needs to know how each product used on board should be handled to protect himself and others. He needs to know how the material will affect the local environment and himself.

The crew is the first bulkhead in controlling hazard-

ous materials on board. As with all activities on board, it is a team effort, with the captain at the helm. Everyone is responsible for his part of the total job, for the health and safety of everyone on board, and for the control of hazardous materials on board.

Hazardous materials on board your vessel must be handled with care. Accurate and clear information is your best tool in dealing with these materials. Clear procedures for a vessel need to be outlined by the captain. Crew members must learn and abide by these procedures.

Information on all hazardous products must be made available when it is requested. As an employer the captain must provide Material Safety Data Sheets (MSDS) (see Chapter 7 for detailed explanation) to any employee who requests information or training on a material that he must work with or around. This is spelled out in the Alaska Em-

ployee Right to Know Law. Copies of this law are available through the Alaska Department of Labor or the Alaska Health Project.

Captains, or the person who purchases the hazardous materials to be used on board, should request the MSDS from the supplier. A copy of the MSDS for each hazardous material should be available on board in case of emergency. These could be included in a binder or put in the North Pacific Fishing Vessel Owner's Association Vessel Safety Manual (see Chapter 7, References).

## Labels

Read product labels and look for a box with the word **CAUTION**, **WARNING**, or **DANGER** in capitals and often in red ink, plus some advice in very small print (see illustration of label example on this page). It may state "contains dichlorodifluoromethane" or some other chemical name. If you do not understand the label, ask for more information and clarification.

Many labels are hard to read: The print is small, the words are not common, and often legal language is included at the bottom. However, this information is there to help you. The words carry specific, agreed upon meanings as in the following examples:

**Caution:** One tablespoon to one pint will be toxic.  
**Warning:** One teaspoon to one tablespoon will be toxic.  
**Danger:** Breathing the fumes or one teaspoon will be toxic.

The label may also contain first aid information, which will be helpful if you get hurt. But before administering first aid, if at all possible contact a poison control center or CHEMTREC in Colorado (see Chapter 7, Refer-

ences, and inside back cover for phone numbers). You should not rely solely on the antidote information on the label. Some companies hide the exact "formula" of a product by giving simplified and generalized antidote information.

If you are not sure what a label means ask someone (see Chapter 7, References). Before buying or using any materials, even putty or paint, **read the label**.

Because people have been hurt when they misused hazardous materials,

many labels now include two legal statements. For federal Environmental Protection Agency registered pesticides and many anti-fouling paints, the statement reads, "It is a violation of federal law to use this product in a manner inconsistent with this labeling." In other words if you do not follow the directions on the can, you are breaking a federal law. Another one states, "The manufacturer and vendor assume no responsibility due to the misuse of the product." In other words if you do not follow

the instructions on the label and then get hurt while using this product, do not go crying to them (they told you it was nasty stuff). **Follow all instructions on the label.**

Another portion of the label tells how to clean up and dispose of waste. Often the recommended cleanup product is also a hazardous material: paint thinner is flammable, as are paint and turpentine. Some rags used with wood oil are to be burned after use.

Some bottom paints are pesticides and must be



## Labels (continued)

"triple rinsed, and disposed of in accordance with state and local procedures." In other words what is left in the can must be rinsed out into a holding container three times.

The liquid that is not used and the cleanup liquid are hazardous wastes. These wastes, plus the

empty container, plus any dirty rags, clothes, and brushes must be taken to an approved hazardous waste site. Because there is no hazardous waste disposal site in Alaska, you may have to ship hazardous waste to another state. If you paint the bottom of your boat with antifouling

paint, you may have to ship a barrel of hazardous waste to another state for disposal, or you will be breaking federal and state laws. You need to know the law and avoid breaking it. It protects you and your environment.

It pays to read the label and follow instructions. It

pays to look for ways to reduce the amount of hazardous material you use, and to reduce the amount of hazardous waste you create.

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## Crew Rights and Responsibilities

Crew members, as employees, are protected by law from having to work with or around hazardous materials without information, training, and proper personal protective equipment to deal with the dangers. The Employee Right to Know Law in Alaska provides this protection. If a crew member is asked to work with any product, he may legally request to see the MSDS for that product.

Once the crew member begins to work with a product, he is responsible for doing the best job he knows how. This means that the worker should do everything within his ability to assure that the product is used as directed. By following the directions on the label and the standard operating procedures of the vessel, he should be able to use the material safely.

The crew member must

know what to do and whom to contact if there are any problems using a hazardous material. You must act quickly. Follow the standard requirements for reporting marine accidents. If you are at sea you may have to contact the Coast Guard. If you are in port you may have to contact a different group of people. If a person is injured, medical help must be called: health aid, EMT, nurse, clinic, or hos-

pital. If there is a fire or gas leak, then public safety officers, troopers, firemen, or emergency response teams must be contacted. If the problem is on your vessel in the water, the Coast Guard may still need to be contacted. On the inside back cover is a list of emergency numbers to call and a place for you to write in your own local numbers. Do that right now.

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## Captain's Rights and Responsibilities

It really is up to you. Captains make the rules and give the orders on board their vessels. If they are successful, the captain is given the credit. If they are unsuccessful, the captain is at fault. How well a crew fares is reflective of the

success of the captain. It is very important that the captain be aware of the crew's well-being and insure their health.

The captain gives the final okay on which materials are brought on board or used on his vessel. The

captain tells the crew how to do the work and how he likes to keep his ship. His direction will mold their habits. If the captain knows and uses hazardous materials in a safe and positive manner, then his crew will follow his lead.

Captains spend years learning about the sea and running vessels, including repair and maintenance. This experience will be passed on to the captains of tomorrow. They will follow the lead of today's captains.

### Material Safety Data Sheet

An MSDS is an information sheet prepared by the manufacturer containing basic health and safety information for the product. An MSDS should be the **starting point** to understanding the health problems associated with a hazardous material. It should lead you to other sources of information and to other chapters of this guide.

Because the MSDS is filled out by the manufacturer of the product in question, the quality of the MSDS varies widely. Spot checks for accuracy are done by the federal Occupational Safety and Health Administration (OSHA). If you feel that an MSDS is not accurate, the Alaska Department of Labor will look into your complaint.

Not all MSDSs follow the same format. The following text helps interpret the sample MSDS shown.

#### Section I. Product Identification

**Section II. Ingredients—**This section lists the ingredients by their formal chemical name or generic name, and may include the percent by weight or volume and the threshold limit value (TLV) recommended by the American Conference of Governmental Industrial Hygienists, as well as the permissible exposure limit (PEL) that is legally enforceable. The TLV and PEL are the average amount of exposure to a specific chemical that is believed to be harmless to most workers. Air sampling must be done to measure these exposures. Not all chemicals have been given TLVs or PELs. TLVs are recommended levels, while PELs are legal limits.

**Section III. Physical Data—**The selected chemical data listed can be useful in deciding how dangerous a product is. For example, if the vapor density is much more than air (air = 1), the substance may collect in

low places and be a hazard to workers in low-lying confined spaces.

**Section IV. Fire, Explosion Hazard and Reactivity Data—**A material with a flash point of less than 140°F is a hazardous material because of its ignitability. A flash point near or below 100°F indicates a substance so unstable that it might catch fire or explode as the result of static electricity or a cigarette. The flammable limits refer to the range of vapor concentrations in the air that will enable explosion in the presence of heat. If a lower explosive limit (LEL) is a low number, that means an explosion can occur with a small amount of the vapor of that substance in the air, i.e., it is more dangerous.

Reactivity information explains conditions that could cause the product to react dangerously or to decompose and release dangerous materials.

**Section V. Health Hazard Data—**This very important section is sometimes incomplete. Long-term or suspected hazards, such as cancer or reproductive problems, may be left out. If you want to know more about the health hazards than is listed on the MSDS, use the resources in this chapter.

**Section VI. Precautionary Measures—**Minimal information is provided on the personal protective equipment and ventilation to be used with the product.

#### Section VII. First Aid

#### Section VIII. Spill and Disposal Procedures

#### Section IX. Transportation Data

#### Section X. References

CAT. NO. 14393

# MATERIAL SAFETY DATA SHEET

PO# FS113889  
HACH ORDER#: 520197

MSDS DATE: 1/13/93  
CHANGE NO.: 8745

For Assistance, Contact:  
Regulatory Affairs Dept.  
PO Box 907 Ames, IA 50010  
(800) 227-4224

HACH COMPANY  
PO BOX 907  
AMES, IA 50010

Emergency Telephone #  
Rocky Mountain Poison Ctr.  
(303) 623-5716

## I. PRODUCT IDENTIFICATION

PRODUCT NAME: Mercuric Nitrate 0.2256 ± 0.0010 N  
CAS NO.: NA CHEMICAL NAME: Not applicable  
FORMULA: Not applicable CHEMICAL FAMILY: Not applicable

## II. INGREDIENTS

Mercuric Nitrate  
PCT: < 10 CAS NO.: 7785-34-8 SARA: LISTED  
TLV: 0.1 mg/M3 as Hg PEL: C: 1 mg/M3 as Hg  
HAZARD: Extremely toxic; corrosive

Nitric Acid ACS Grade  
PCT: < 5 CAS NO.: 7697-37-2 SARA: LISTED  
TLV: 2 ppm PEL: 2 ppm  
HAZARD: Causes severe burns; powerful oxidizer

Deminerlized Water  
PCT: to 100 CAS NO.: 7732-18-5 SARA: NOT LISTED  
TLV: Not applicable PEL: Not applicable  
HAZARD: None

## III. PHYSICAL DATA

STATE: liquid APPEARANCE: Clear and colorless ODOR: Not determined  
SOLUBILITY IN: WATER: Soluble ACID: Soluble in HNO3  
OTHER: Not determined BOILING POINT: ND MELTING PT.: NA  
SPEC GRAVITY: 1.026 pH: 0.8 VAPOR PRESSURE: Not determined  
VAPOR DENSITY (air=1): ND EVAPORATION RATE: 0.55  
METAL CORROSIVITY - ALUMINUM: ND STEEL: ND  
STABILITY: See Conditions to Avoid  
STORAGE PRECAUTIONS: Store tightly closed.

## IV. FIRE, EXPLOSION HAZARD AND REACTIVITY DATA

FLASH PT.: Not applicable METHOD: NA  
FLAMMABILITY LIMITS - LOWER: NA UPPER: NA  
SUSCEPTIBILITY TO SPONTANEOUS HEATING: None  
SHOCK SENSITIVITY: None AUTOIGNITION PT.: ND  
EXTINGUISHING MEDIA: water, carbon dioxide, or dry chemical  
FIRE/EXPLOSION HAZARDS: May emit toxic fumes in fire  
HAZARDOUS DECOMP. PRODUCTS: May emit toxic fumes of mercury and nitrogen oxides in fire  
OXIDIZER: No NFPA Codes: Health: 2 Flammability: 0 Reactivity: 0  
CONDITIONS TO AVOID: Heat, evaporation; contact with oxidizers, reducers, alcohols, sulfur, phosphine, hypophosphoric acid

## V. HEALTH HAZARD DATA

THIS PRODUCT MAY BE: corrosive to eyes and skin  
ACUTE TOXICITY: Toxic  
ROUTES OF EXPOSURE: Ingestion  
TARGET ORGANS: kidneys  
CHRONIC TOXICITY: Danger of cumulative effects  
ROUTES OF EXPOSURE: Ingestion, skin absorption  
TARGET ORGANS: central nervous system, kidneys  
CANCER INFORMATION: Not determined  
ROUTES OF EXPOSURE: Not determined  
TARGET ORGANS: Not determined  
OVEREXPOSURE: Causes burns. May cause ulcerations in the digestive tract if ingested. Mercury is a general protoplasmic poison; it circulates in the blood and is stored in the liver, kidneys, spleen and bones. May cause kidney damage.  
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Nervous disorders, impaired kidney or respiratory function, allergies or sensitivity to mercury may increase susceptibility to the effects of the substance.

## VI. PRECAUTIONARY MEASURES

Avoid contact with eyes, skin and clothing  
Wash thoroughly after handling.  
PROTECTIVE EQUIPMENT: adequate ventilation, lab grade goggles, neoprene gloves, lab coat

## VII. FIRST AID

EYE AND SKIN CONTACT: Immediately flush eyes and skin with water for 15 minutes. Remove contaminated clothing. Call physician.  
INGESTION: Give egg whites, milk or activated charcoal. Induce vomiting by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician.  
INHALATION: Remove to fresh air.

## VIII. SPILL AND DISPOSAL PROCEDURES

IN CASE OF SPILL OR RELEASE: The toxicity of mercury is such that the element and its compounds should not be allowed to contaminate air or water. Soak up solution with inert material. Do not breathe fumes. Decontaminate the area with mercury absorbing compounds available commercially. Dispose of all mercury contaminated material in an EPA approved hazardous waste facility.  
DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE, AND LOCAL REGULATIONS.

## IX. TRANSPORTATION DATA

D.O.T. PROPER SHIPPING NAME: Corrosive liquid, N.O.S.  
(Nitric Acid/Mercuric Nitrate)  
HAZARD CLASS: Corrosive Material ID: UN1760

I.C.A.O. PROPER SHIPPING NAME: Corrosive liquid, N.O.S.  
(Nitric Acid/Mercuric Nitrate)  
HAZARD CLASS: 8 ID: UN1760 GROUP: II

I.M.O. PROPER SHIPPING NAME: Corrosive liquid, N.O.S.  
(Nitric Acid/Mercuric Nitrate)  
HAZARD CLASS: 8 ID: UN1760 GROUP: II

## X. REFERENCES

- 1) TLV's Threshold Limit Values and Biological Exposure Indices for 1988-1989. American Conference of Governmental Industrial Hygienists, 1988.
  - 2) Air Contaminants, Federal Register, Vol. 54, No. 12, Thursday, January 19, 1989. pp. 2332-2983.
  - 3) In-house information
  - 4) Technical judgment
  - 5) NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. Cincinnati: Department of Health and Human Services, 1981.
- SARA: This product contains a chemical or chemicals subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

## Further Reading

These books on chemical hazards can be found at the Alaska Health Project, public or University of Alaska libraries, one of the agencies listed in this chapter, or local unions. The books also can be ordered from most book stores. Do not hesitate to ask for help while learning to use these reference books. Researching the health effects you may face is easy once you get over the intimidation of the unfamiliar chemical names. The first three books are written for workers and are interesting and easy reading. They are a good way for you to find out more.

**Work Is Dangerous to Your Health.** Stellman, J.M. and Daum, S.M. 1973. New York: Pantheon

**Books.** An inexpensive paperback, this is the classic book on occupational health written for workers. It provides an excellent overview of occupational health and work-related diseases and contains much information on common work place chemicals and their possible health effects. Although it is somewhat out of date, it is still useful. Available through the Alaska Health Project, price \$8.00

**NIOSH Pocket Guide to Chemical Hazards.** 1994. NIOSH Publications, Mailstop C-13, 4676 Columbia Parkway, Cincinnati, OH 45226-1998, (800) 356-4674. This is a handy quick source of information on working with 677 chemicals. This is an excellent re-

source for all vessels. Single copies are provided at no charge; multiple copies available. Electronic versions on CD-ROM or cassette are available from commercial vendors, and have enhancements not included in the printed version.

**1996 Emergency Response Guidebook.** Publication No. P 5800.5. U.S. Department of Transportation, Research and Special Programs Administration, Office of Hazardous Materials Transportation (DHM-51), Washington, D.C. 20590-0001. Available through American Labelmaster Company, 5724 N. Pulaski Road, Chicago, IL 60646-6797, order Style No. ERG-90PB, phone (800) 621-5808.

This is a handy, quick source of information on how to transport and deal with spills of over 500 common chemicals. It is an excellent resource for all vessels.

**List of Proprietary Substances and Nonfood Compounds Authorized for Use Under USDA Inspection and Grading Programs.** This manual and one-year subscription includes guidelines on using cleaning compounds and can be purchased for \$25.00 from the U.S. Government Printing Office, Superintendent of Documents, 710 North Capitol St. NW, Washington, D.C. 20402-9371. Order line (202) 512-1800 8 a.m.-4 p.m. EST, MasterCard/Visa.



## Call for More Information

Alaska Department of Environmental Conservation  
410 Willoughby Ave., #105  
Juneau, AK 99801-1795  
(907) 465-5010  
[www.state.ak.us/local/akpages/ENV.CONSERV/home.htm](http://www.state.ak.us/local/akpages/ENV.CONSERV/home.htm)

Alaska Department of Environmental Conservation  
Northern Region  
610 University Ave.  
Fairbanks, AK 99709  
(907) 451-2360

Alaska Department of Environmental Conservation  
Southcentral Region  
555 Cordova St.  
Anchorage, AK 99501  
(907) 269-7500

The Alaska Department of Environmental Conservation can provide information to employees and employers on hazardous materials transportation and handling and hazardous waste disposal. They also can find articles on specific topics of concern.

Oil and hazardous substance spills:

Anchorage (907) 269-7500  
Fairbanks (907) 451-2360  
Juneau (907) 465-5340

After hours: Environmental health spill reporting

(800) 478-9300

Alaska Department of Labor  
Labor Standards and Safety  
Occupational Safety and Health (OSH)  
P.O. Box 107022  
Anchorage, AK 99510-7022  
(907) 269-4942

Alaska Department of Labor OSH  
Box 21149  
Juneau, AK 99802-1149  
(907) 465-4855  
[www.state.ak.us/local/akpages/LABOR/home.htm](http://www.state.ak.us/local/akpages/LABOR/home.htm)

Alaska Department of Labor OSH  
675 Seventh Ave.,  
Station J  
Fairbanks, AK 99701-4596  
(907) 451-2888

Alaska Department of Labor OSH  
120 Trading Bay Rd., #290  
Kenai, AK 99611  
(907) 283-7206

Alaska Department of Labor OSH  
2030 Sea Level Dr., #220  
Ketchikan, AK 99901  
(907) 225-4518

OSH is the enforcement agency for the state of Alaska. It is responsible for most private and public work places except federal employees, and dock or harbor workers. They are available to answer questions, do training, and respond to workers' re-

quests for inspections. These services are provided at no charge.

Alaska Health Project  
218 E. 4th Ave.  
Anchorage, AK 99501  
(907) 276-2864  
In Alaska (800) 478-2864

The Alaska Health Project, a nonprofit service organization, provides job safety and health information and services to workers, labor unions, businesses, health professionals, and other organizations. They maintain the Occupational and Environmental Health Library that is open to the public. Professional staff provide telephone support during regular business hours and there is a 24-hour answering machine. Many services are provided at no charge.

Alaska Health Sciences Library  
3211 Providence Drive  
Anchorage, AK 99508-8176  
(907) 786-1870

The health sciences library has a number of journals and magazines in the area of job safety and health. They are often interesting to look at and may provide answers to questions. Ask the librarian for help. There is no charge to use the library; however, there is a charge for librarian services.

Alaska Sea Grant Marine Advisory Program  
University of Alaska Fairbanks  
2221 E. Northern Lights Blvd., #110  
Anchorage, AK  
99508-4140  
(907) 274-9691

The Alaska Sea Grant Marine Advisory Program provides information and assistance on a variety of marine subjects. Several communities have marine advisory agents.

Bethel (907) 543-4515  
Cordova (907) 424-3446  
Dillingham (907) 842-1265  
Homer (907) 235-5643  
Kodiak (907) 486-1500  
Petersburg (907) 772-3381  
Seward (907) 224-5261  
Sitka (907) 747-3988

Alaska Marine Safety Education Association (AMSEA)  
Box 2592  
Sitka, AK 99832  
(907) 747-3287

AMSEA is a nonprofit corporation that conducts marine safety and survival classes for fishermen, and develops marine safety education materials (brochures, videos, etc.). AMSEA publishes a quarterly newsletter on marine safety topics and maintains a marine safety video and book lending library for the public. AMSEA instructors conduct first aid courses for fishermen.

**CHEMTREC**  
Chemical Manufacturers  
Association

(800) 424-9300

This is the 24-hour emergency number to call to find out how to control a hazardous materials spill, fire, leak, exposure, or accident.

(800) 262-8200

The Information Services Hotline is a non-emergency CHEMTREC number you can call for information on hazardous materials, health, and safety. Call between 9 a.m. and 6 p.m. EST Monday through Friday.

National Institute for Occupational Safety and Health (NIOSH)  
4676 Columbia Parkway  
Cincinnati, OH 45226-1998  
(513) 841-4428  
(800) 35-*NIOSH* (356-4674)  
Automated voice fax system and direct contact with NIOSH technical information staff.  
[www.cdc.gov/niosh/homepage.html](http://www.cdc.gov/niosh/homepage.html)

NIOSH  
Alaska Field Station  
Grace Hall, #310  
4230 University Dr.  
Anchorage, AK 99508  
(907) 271-2382

NIOSH does research in all areas of job safety and health, and provides technical information, assistance, and publications. For general information, technical information or to request a hazard evaluation of your work place, contact the office in Cincinnati. These services are provided at no charge.

U.S. Environmental Protection Agency  
Region 10 Office  
1200 6th Ave.  
Seattle, WA 98101  
(206) 553-1200 or (800) 424-4372, M-F 8:30-4 PST  
24-hour emergency response: (206) 553-1263  
[www.epa.gov/r10earth/](http://www.epa.gov/r10earth/)

Hazardous materials, waste management, Resource Conservation Recovery Act (RCRA) permitting.

North Pacific Fishing Vessel Owners' Association, Vessel Safety Program  
1900 W. Emerson, #101  
Fishermen's Terminal  
Seattle, WA 98119  
(206) 285-3383

NPFVOA is a voluntary, industry-sponsored effort to save lives and property. They have a vessel safety program, which includes crew training courses and

production of safety videos and books. Their *Vessel Safety Manual* is available for \$65 plus \$5 postage.

Occupational Safety and Health Administration (OSHA)  
U.S. Department of Labor  
OSHA  
301 W. Northern Lights Blvd., #407  
Anchorage, AK 99503  
(907) 271-5152  
[www.osha.gov/](http://www.osha.gov/)

OSHA is the federal enforcement agency. They are responsible for overseeing the Alaska state program (OSH) and for enforcement among federal government workers, and longshoremen and harbor workers. They are available to answer questions, do training, inspect work places (as requested by workers), and respond to complaints about OSH. These services are provided at no charge.

The U.S. Coast Guard performs rescues, provides information and assistance, does inspections, and enforces federal regulations.

If someone is injured and needs to be transported by Coast Guard helicopter or boat, call the Rescue Coordination Centers:

From anywhere in Alaska except Juneau, Douglas, and Kodiak  
(800) 478-5555  
In Juneau and Douglas  
463-2000  
In Kodiak 487-5888

For vessel inspection, information on transporting hazardous materials, and to report that a hazardous material has been spilled into the water call the U.S. Coast Guard Marine Safety Offices:

Valdez (907) 835-7200  
Juneau (907) 463-2450  
Anchorage (907) 271-6700

To report spills of hazardous materials you can also call the National Response Center. They are staffed by U.S. Coast Guard personnel, and will notify either the Coast Guard or the Environmental Protection Agency, depending on who has jurisdiction.

(800) 424-8802

## Emergency Phone Numbers

**911** This 24-hour, three digit phone number will quickly connect you with emergency assistance. It should be posted at the work place for life threatening emergencies. Check to see if this number will work in your community, as some areas of Alaska do not yet have this system in place. If it does not work in your area, write in your emergency telephone numbers here:

Health/Ambulance .....

Police/Public Safety .....

Fire .....

Harbormaster .....

### CHEMTREC

Chemical Manufacturers Association ..... (800) 424-9300

This is the 24-hour emergency number to call for information about a **hazardous materials spill, fire, leak, exposure, or accident.**

### POISON CONTROL

Poison Control Center, Providence Hospital, Anchorage, AK 99518

In Anchorage ..... 261-3193

Outside Anchorage ..... (800) 478-3193

Seattle Poison Center, Children's Hospital ..... (206) 526-2121

The Poison Control Center can provide information on **emergency care when chemicals are accidentally inhaled, sprayed in the eyes, spilled on the skin**, or otherwise encountered. They maintain a 24-hour hotline.

### U.S. COAST GUARD

From anywhere in Alaska except Juneau, Douglas, and Kodiak ..... (800) 478-5555

In Juneau and Douglas ..... 463-2000

In Kodiak ..... 487-5888

The U.S. Coast Guard **performs rescues**. If someone is injured and needs to be transported by Coast Guard ..... enters at the numbers above.

**National Sea Grant Depository**

Pell Library Building - GSO

University of Rhode Island

Narragansett, RI 02882-1197USA