

CHAPTER 9

HAZARDOUS MATERIALS

I. MATERIALS BROUGHT ON THE JOB

In our work we are required to utilize certain hazardous materials in order to provide the services our customers hire us for. The most common material that we use on our jobs is Radioactive Materials. We have published specific safety manuals on this item. Because of this, we will not attempt here to provide detailed information.

A. Explosives - (If on site with a perforating company).

1. NO SMOKING - Smoking is never allowed in the vicinity of explosives.
2. Electrical, thunderstorms and dust storms - perforating operations must be suspended and loaded guns safely isolated if electrical storms, thunderstorms or dust storms should appear imminent in the area of the job. The exact time to shut down must be agreed upon with the customer, though the storm should not be allowed to get within 5 miles of the operation without stopping work.
3. Mobil transmitters - must not be operated within 200 feet of any perforating operation using electric blasting caps in the process. When the distance is impossible to achieve, as it would in offshore jobs, transmitter switches must be in the "off" position until sufficient preparation has been made to eliminate danger.
4. Primacord, caps and boosters - if primacord is on site, isolate the loading point from other personnel and do not allow spectators to congregate in the loading area.

B. Radioactive Materials

1. No smoking - smoking is never permitted in the area where radioactive materials are being handled. In addition to not smoking, you should never eat or otherwise put anything in your mouth when working with these materials except in designated areas and then only after you have thoroughly washed your hands.
2. Surveys - anytime radioactive materials are to be transported, a survey meter must be on board the transport vehicle. Once at a job site, the work area is to be surveyed for signs of contamination that may be present from past work by another company. At the completion of every job, the site is to be surveyed to ensure we did not contaminate the area. If contamination is found, it must be cleaned up prior to departing the job site. A report (well-head survey) must be completed.
3. TLD badges - film badges (TLD's) must be worn by everyone working in the area around the radioactive materials. The actual work area is to be considered a "restricted area" and no one is to be allowed into the area without a personal monitoring device.

4. Transportation - sealed sources or shields must be transported in their specially designed transport containers (pigs). Tracer material may be transported in the cardboard box it was received in from our supplier. In either case the transport container must be locked to the truck. THERE IS NO EXCUSE FOR LOOSING RADIOACTIVE MATERIALS OFF OF A TRANSPORT VEHICLE.

II. SHOP MATERIALS

The use of hazardous materials around our shops is normally limited to mild acids and cleaning solvents. It is important that every employee at the district know where the Material Safety Data Sheet (MSDS) Book is located. These Data Sheets provide the hazard information on the materials that may be encountered at the shop. Prior to using any hazardous material you must read the data sheet that explains the dangers. Anytime that a new MSDS is issued by our suppliers, a copy is sent to every district that uses that particular material. The new MSDS is to be part of the next Safety Meeting that is held and the data sheet itself is to be filed in the MSDS book. This program is part of the Federal Hazard Communication Standard that is enforced by OSHA. A master copy of all MSDS is kept in the Corporate Home Office.

III. JOB SITE HAZARDOUS MATERIAL

A. Hydrogen Sulfide Gas (H₂S) - Frequently, Cardinal Surveys will be required to work in so called "Sour Gas Wells". These wells are those that produce hydrogen sulfide gas in quantities that might be injurious to the health of personnel or create a serious fire hazard at the well location. Most of the locations where we work are considered the dangerous areas in drilling, testing and completion of wells. Fortunately, most hazardous wells are known in advance so that proper precautions may be taken in advance by the operator, the drilling contractor and the service companies. Due to the potentially extreme hazards involved, the customer should take the lead in advising our personnel on the hazards involved, protective equipment needed, where to locate our equipment and what safety precautions and procedures must be followed. However, do not depend on the customer for your safety. State and federal regulations require that you be trained in the hazards of H₂S gas and the proper use of self contained breathing apparatus (SCBA).

1. Dangers - this gas is often called "Rotten Egg" gas due to its smell. It is lethal in very small quantities, is heavier than air, is soluble in water and hydrocarbons and has a wide explosive range when mixed in air.

The human nose can detect H₂S gas in very small quantities; however, smell cannot be depended upon to protect personnel in high concentrations. High concentrations cause olfactory fatigue and the human nose can no longer smell the gas.

2. Detecting H₂S - since the smell cannot be considered a safe method of detection, detecting devices must be used to determine the presence of this gas and the quantity or concentration in air. Area monitors may be provided by the customer and monitored by one of their safety or operating personnel. Should the customer not provide such a service, Cardinal Surveys will obtain a consultant who has such equipment. Cardinal Surveys provides Personal H₂S monitors that alarm when PEL exceeds 10 PPM.

3. Where is H₂S found? H₂S occurs in a variety of natural and industrial settings. Workers will find hazards associated with H₂S gas as follows:

- a. In energy production from hydrocarbon and geothermal sources.
- b. In production of fibers and sheets from viscose syrup.
- c. In production of Deuterium Oxide (heavy water).
- d. In tanneries.
- e. In sewers, sewage treatment and animal waste disposal.
- f. In work below ground.
- g. On fishing boats.
- h. In chemical operations.
- i. In the oil and gas industry.

In most cases H₂S is a by-product of other operations.

4. Precautions - when a known "Sour Gas Well" is to be worked on, we and the customer must take many precautions to assure the safety of personnel working on the location. Included among these precautions are:

- a. Location of personnel and equipment on the up-wind side of the well.
- b. Location of personnel and equipment on the highest ground available.
- c. Locating protective equipment at easily accessible locations.
- d. Installing a wind sock directional device to warn personnel when the wind direction changes.
- e. Post signs on road to warn personnel entering the area of the potential gas hazard.
- f. Establish remote parking and smoking areas.
- g. Install remote blow out prevention controls in the event the normal controls are not accessible.
- h. Install a warning alarm to warn when gas has reached a hazardous concentration.
- i. Design their mud program to minimize or neutralize possible H₂S contamination of the surrounding area.

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j. Normally, your only concern is following directions, at the time they are given and to be attentive to all training and established procedures.

5. Hazardous properties - H₂S is a highly toxic, colorless gas which is heavier than air. If ignited, it burns with a blue flame and produces sulfur dioxide (SO₂), which is a very irritating gas with a bad odor. H₂S forms explosive mixtures with air, the lower explosive limit being 4.3% hydrogen sulfide and the upper explosive limit being 46%.

DESCRIPTION TABLE

Color	Colorless
Odor (up to 100 ppm)	Very offensive, commonly referred to as rotten egg gas.
Vapor Density	1.189 (air=1.0)
Boiling Point	-76 °F
Explosive Limits	4.3 to 46% by volume in air.
Ignition Temperature	500 °F
Water Soluble	Yes (4 volumes gas in 1 volume water at 32 EF)
Flammabilities	Forms explosive mixtures with air or oxygen.

TOXICITY TABLE

1 ppm = .0001% (1/10,000 of 1%) Can smell.

10 ppm = .001% (1/1,000 of 1%) Maximum 8 hr. exposure per API.

20 ppm = .002% (2/1,000 of 1%) Maximum 4 hr. exposure per OSHA.

Protective equipment required when over the allowable limits.

100 ppm = .01% (1/100 of 1%) Kills smell in 3 to 15 minutes, may burn eyes and throat.

200 ppm = .02% (2/100 of 1%) Kills smell rapidly. Burns eyes and throat.

500 ppm = .05% (5/100 of 1%) Loses sense of reasoning and balance. Respiratory disturbances in 2 to 15 minutes needs prompt artificial resuscitation.

700 ppm = .07% (7/100 of 1%) Will become unconscious quickly. Breathing will stop and death results if not rescued promptly. Immediate artificial resuscitation.

1,000 ppm = .10% (1/10 of 1%) Unconscious at once. Permanent brain damage may result unless rescued promptly.

Susceptibility to H₂S poisoning varies according to the number of exposures by an individual. A second exposure is more dangerous than the first, and so on. Physiological effects of H₂S poisoning are dependant upon the duration of the exposure, the frequency of the exposures, the intensity of the exposure and the individual's susceptibility to the hazardous properties of the gas.

6. Training - any training that is conducted by the company or by customer personnel must be eagerly accepted and directions followed strictly. Failure to do so could not only endanger your life but the lives of others. Training is provided at no cost to the employee.

7. Protective equipment - a complete self-contained breathing apparatus (SCBA) equipped with air tight fittings covering the eyes, nose and mouth must be used. Such protection as a handkerchief over the mouth or even a filter type canister mask is useless. Filter type canisters are dangerous for several reasons:

- they give you a false sense of security and do not protect.
- the neutralizing medium is effective only for very low concentrations of this gas.
- the canister has only a very short time period, even in low concentrations, during which it is effective. This makes it suitable for use only as an escape device, although not recommended even for this purpose.

The only proper protective equipment suitable for use is a self-contained breathing apparatus. There are two types of equipment that you may be required to use in a gaseous area.

a. Back pack / bottled air - this type is similar to that which a SCUBA diver might wear and is the most commonly used type. It is the only type that can be used in areas of extremely high concentrations of H₂S gas.

b. Oxygen generation and filtering canister - is self-contained because it filters and purifies the individuals breath and generates replacement oxygen.

c. When respiratory equipment is not provided by the customer, Cardinal Surveys will provide respiratory equipment for the employees use against harmful vapors and oxygen deficient atmospheres, at no cost to the employee. It is very important for every employee who may be exposed to H₂S, to know how to use the protective breathing equipment as well as any other safety equipment.

8. Protective Procedures - To protect against the hazards associated with H₂S, careful planning is a must. In most cases the customer will have provided various means of protection for our personnel, however, Cardinal Surveys employees are cautioned that they are always responsible for their own safety on the job.

a. Upon arrival on location ensure a safety plan has been developed and all personnel are aware of it. This plan must include a layout of the worksite, safety equipment, work practices, effective supervision and emergency plans.

b. When approaching the well location make note of the wind direction, movement of personnel and the location of "condition" signs and alarms.

c. Note escape routes (there should be at least two).

- d. Eliminate all ignition sources. "No Smoking" rules must be strictly enforced.
- e. Avoid low lying areas as H₂S is heavier than air and will accumulate in these areas.
- f. Use the "Buddy" system for mutual protection.
- g. Every person must know his or her responsibilities in the event of an H₂S emergency.
- h. When performing work where protective breathing apparatus is required, a standby man shall be used.
- i. When performing work in a confined space and a protective breathing apparatus is required, a standby man and safety harness with line must be used.

9. Rescue Procedures - If an individual working in an H₂S environment is overcome, immediate rescue of the person is mandatory. **DO NOT PANIC! REMAIN CALM - THINK. DO NOT ATTEMPT RESCUE WITHOUT PROPER SCBA EQUIPMENT!**

- a. Put on breathing apparatus. Test before proceeding.
- b. Remove victim(s) to fresh air as quickly as possible. Go upwind from the source or at right angles to the side - NOT DOWN WIND.
- c. Maintain the victim at rest until the individual's condition can be ascertained.
- d. Begin artificial resuscitation as required.

10. Symptoms of H₂S poisoning - In low concentrations, the gas is irritating to the eyes. In moderate concentrations, there will be irritation to the upper respiratory tract. High concentrations will cause headaches, dizziness, excitement, a staggering gait and diarrhea. Other respiratory symptoms may also be present.

Massive doses can cause instant death due to the paralysis of the central nervous system causing the cessation of breathing.

- a. Acute exposure results in almost instantaneous asphyxia with seeming respiratory paralysis. Acute poisoning, or strangulation, may occur after even a few seconds inhalation of a high concentration causing panting, pallor, cramps, paralysis and almost immediate loss of consciousness. Death may follow with extreme rapidity from respiratory and cardiac paralysis.
- b. Sub-acute exposure results in irritation, principally smarting of the eyes, persistent cough, tightening or burning of the chest and skin irritation. A concentration of a few hundredths of one percent higher than that causing irritation can cause asphyxia and death; there is a very narrow margin between consciousness and unconsciousness and death.

c. Other effects of H₂S are unpredictable. Hysteria is not uncommon. Violent convulsions may result with the victim becoming very rigid before falling.

11. First aid - immediate removal from the exposure, giving artificial respiration if necessary, treatment for shock and the immediate transportation to medical facilities is the treatment for high exposures. For minor exposures simply remove the victim from the area and proceed as follows:

a. If victim is not breathing, begin artificial respiration immediately. Mouth to mouth resuscitation is acceptable.

b. Keep victim warm.

c. If eyes are affected, wash them thoroughly with clear water (for slight eye irritation); cold compresses will help.

d. Provide prompt transportation to a hospital, continuing artificial respiration if needed. Hospital, or other medical facility, must be notified in advance of the possibility of H₂S poisoning.

B. Benzene - Benzene is an aromatic compound which may be present in produced hydrocarbons and as a component of some chemicals. Warning signs must be posted at entrance to areas where exposure to benzene might reasonably be expected to exceed the permissible exposure level (1 ppm averaged over an 8-hour workday). Petroleum refining sites, tank gauging (tanks at producing, pipeline & refining operations and field maintenance are several potential locations where exposure to Benzene could occur

1. Benzene is harmful if it inhaled, absorbed through the skin or swallowed.

a. Short-term exposure to benzene, well above the levels where it can be smelled can cause breathless, irritable, euphoric, or giddy feelings. Throat, eyes and nose may become irritated.

b. Symptoms include feeling dizzy, nauseated, intoxicated, or a headache

c. Severe exposure can cause unconsciousness or convulsions.

2. Protective Clothing and Equipment - Respirators are required where laboratory fume hoods or other local exhaust systems cannot be used. Respirators must be approved for use with Benzene and properly fitted and cartridges must be replaced before their service life ends. Wearers must be trained in use and understand limitations before using any respirator.

a. Never enter an area without proper safety equipment if the area may have benzene concentrations that are too high

b. Protective clothing should be worn to prevent skin contact if working with benzene. Use boots, gloves, sleeves, aprons, etc. over any part of the body that may come in contact with liquid benzene.

c. Eye and face protection should be worn to prevent benzene from being splashed into eyes. Personal Protective Equipment includes safety glasses, splash-proof safety goggles, or a face shield.

3. Benzene is highly flammable.

a. Fire extinguishers must be readily available.

b. Smoking is prohibited in areas where benzene is used or stored.

4. Emergency and First Aid.

a. If Benzene is splashed in the eyes, wash out immediately with large amounts of water. If irritation persists or vision seems impaired, seek immediate medical attention.

b. If Benzene is spilled on skin or clothing, remove clothing and immediately wash the exposed skin with large amounts of soap and water. Wash contaminated clothing before wearing again.

c. If large amounts of Benzene are breathed in, get the exposed person to fresh air immediately. If breathing has stopped, apply artificial respiration and call for medical assistance.

d. If Benzene has been swallowed and the person is conscious, do not induce vomiting. Call for medical assistance immediately.

C. Other hazardous materials - Oil well fluids (oil, produced and injection water, etc.) are classified as hazardous materials. Other contractors may bring additional hazardous materials (acids, treating fluids, corrosion inhibitors, drilling fluids and muds, etc.), on location. You have the right to request MSDS data before you can be required to work around or with these materials. Do not assume that just because other workers are using these materials that there is no hazard. Pay particular attention to warning labels and placards. Wear appropriate clothing and safety equipment. Avoid breathing vapors and skin contact.

D. Most of the locations where we work are considered the dangerous areas in drilling, testing and completion of wells. Fortunately, most hazardous wells are known in advance so that proper precautions may be taken in advance by the operator, the drilling contractor and the service companies. Due to the potentially extreme hazards involved, the customer should take the lead in advising our personnel on the hazards involved, protective equipment needed, where to locate our equipment and what safety precautions and procedures must be followed.