FORMALDEHYDE:
Online Training Course

FORMALDEHYDE: Online Training Course

- Welcome to UK's online Formaldehyde Training Course.

- This course is designed to meet the training requirements for the OSHA Formaldehyde Standard (29 CFR 1910.1048), as well as formaldehyde-specific requirements of the OSHA Laboratory Standard (29 CFR 1910.1450) and OSHA Hazard Communication Standard (29 CFR 1910.1200).

- At the conclusion is a short quiz to verify that you have completed the course and understand its contents. You must answer at least 70% of the questions correctly to receive credit for the course.

- If there is a problem with the course or quiz, please call EHS at 257-7600.

CONTENTS

- Properties and Uses of Formaldehyde
- Potential Health Effects
- Review of OSHA Standards and Exposure Limits
- Air Monitoring
- Regulated Areas
- Control Methods
- Protective Equipment and Clothing
- Hygiene Protection
- Housekeeping: Spill Procedures
- Medical Surveillance
- Employee Information and Training
- Reporting Signs and Symptoms of Exposure
- Quiz

Who Needs to Take This Course?

- All employees, including faculty and part-time staff, who work with or may be exposed to formaldehyde.

- The course needs to be successfully completed only once, unless the use(s) of formaldehyde changes.

Properties of Formaldehyde

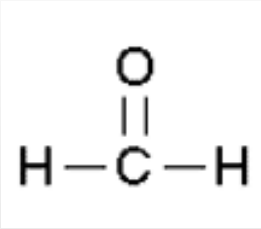
- Formaldehyde can be present in several forms:

- Gas (natural state)

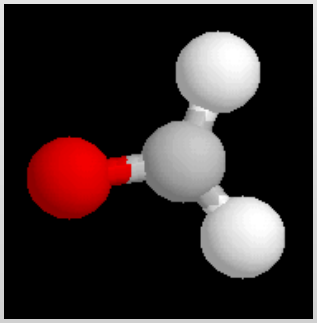
- Solid:
- Paraformaldehyde: waxy solid polymer (HCHO)n

- Aqueous solutions:
- Formalin (formaldehyde in solution with methanol or water)
- Paraformaldehyde solution in water

- Within materials that can release formaldehyde gas:
- Insulation, carpeting, plywood, etc.
- Also as by-product of some combustion processes



Chemical Structure



Properties of Formaldehyde

- If you are unsure whether a process or material is producing formaldehyde gas, consult a Safety Data Sheet (SDS) or contact EHS at 257-7600.

- Synonyms for Formaldehyde:
  - Formalin
  - Formic Aldehyde
  - Paraform
  - Formol
  - Methanal
  - Methyl Aldehyde
  - Methylene Glycol {CH2(OH)2}
    - Dehydrates to generate formaldehyde
    - Formaldehyde and water reversibly bond to generate methylene glycol
    - Both substances frequently present in equilibrium in aqueous solutions

Properties of Formaldehyde

- Formaldehyde is a Volatile Organic Compound (VOC) that can be released as a gas at normal room temperature from aqueous solutions, solids, or materials. For example:
  - Open containers of aqueous solutions or paraformaldehyde solid can release formaldehyde gas.
  - "Off-gassing" can occur in buildings where new carpeting, plywood, or insulation has recently been installed.

Uses of Formaldehyde

- Most common uses in laboratory settings:
  - Tissue fixation and preservation
  - Sterilization or disinfection

- Other uses:
  - Embalming
  - Plywood adhesives
  - Permanent-press textiles
  - Fumigant
  - Component of insulation
  - Many other uses

Formaldehyde Exposure Limits

- Exposure Limits are created and enforced by OSHA (Occupational Safety and Health Administration).

- Exposure Limits state the amount of formaldehyde gas that can be safely inhaled for specific lengths of time.

- Expressed in units of ppm (parts per million by volume):
- Parts of formaldehyde gas per million parts of air

OSHA® Occupational Safety and Health Administration

Formaldehyde Exposure Limits

- Permissible Exposure Limit (PEL):
  - 0.75 ppm as an 8-hour time-weighted average

- Average exposures over an 8-hour period cannot exceed 0.75 ppm.

OSHA® Occupational Safety and Health Administration

Formaldehyde Exposure Limits

- Short-Term Exposure Limit (STEL):
  - 2 ppm as a 15-minute time-weighted average

- Average exposures over any 15-minute period cannot exceed 2 ppm

OSHA® Occupational Safety and Health Administration

Formaldehyde Exposure Limits

- Action Level (AL):
  - 0.5 ppm as an 8-hour time-weighted average

- If the AL is exceeded (average exposure >0.5 ppm over 8-hour period), the exposure monitoring and medical surveillance provisions of the Formaldehyde Standard (discussed later) come into effect.

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Formaldehyde Odor Properties

- The odor threshold for formaldehyde is listed at 0.8 ppm*, but persons with sensitive noses can detect it at levels as low as 0.1 ppm.

- Olfactory fatigue causes personnel with exposures to become less sensitive with time, so that levels might be much higher than 0.8 ppm before you can smell it.
  - For this reason, ability to smell should not be used as a method to determine whether you are being exposed.

*Source: U.S. Coast Guard Chemical Hazard Response Information System (CHRIS)

OSHA® Occupational Safety and Health Administration

Potential Health Effects Due to Formaldehyde Exposure

- The next section will describe effects due to exposure through inhalation, skin contact, and eye contact.

- Effects can vary due to either acute or chronic exposure.

- Health complaints should be brought to the attention of your supervisor so that medical attention may be given.

Potential Health Effects Due to Formaldehyde Exposure: Overview

- The following levels of ambient exposure have been associated with the listed symptoms:

- 0.5-2.0 ppm – May cause irritation to eyes, nose, and throat
- 3-5 ppm – Tearing of the eyes; may be intolerable to some personnel
- 5-10 ppm – Cough; tightness of chest; possible ocular damage
- 10-20 ppm – Difficulty in breathing; burning of nose and throat; heavy tearing of eyes
- 25-30 ppm – Severe injury to respiratory tract (pulmonary edema, pneumonitis)
- 100 ppm – Immediately dangerous to life and health

Potential Health Effects Due to Formaldehyde Exposure

- Inhalation – Acute Exposure:
  - Nasal, throat, and pulmonary irritation
  - Inhalation – Repeated or Chronic Exposure:
  - Headaches, rhinitis, nausea, drowsiness, respiratory impairment, kidney injury, pulmonary sensitization, and tissue damage
  - Neuropsychological effects: sleep disorders, irritability, altered sense of balance, memory deficits, loss of concentration, and mood alterations

Potential Health Effects Due to Formaldehyde Exposure

- Inhalation – Carcinogenic Effects:
  - Long-term exposure to formaldehyde is reported to be associated with an increased risk of rare nasopharyngeal and oropharyngeal cancers in humans.
  - Formaldehyde's role in causing lower respiratory tract cancer (e.g. lung cancer) has not been substantiated.

Potential Health Effects Due to Formaldehyde Exposure

- Inhalation – Carcinogenic Effects:

- Formaldehyde has been classified by International Agency for Research on Cancer (IARC) as a Class 1 human carcinogen for nasopharyngeal cancer.

- IARC Class 1 is defined as having sufficient evidence of carcinogenicity in humans, and exposure circumstances entail exposures that are carcinogenic to humans.

Potential Health Effects Due to Formaldehyde Exposure

- Skin Contact – Acute Exposure:

- Vapors, solutions, or resins may cause smarting, white discoloration, roughness, hardness, anesthesia, and first degree burns.

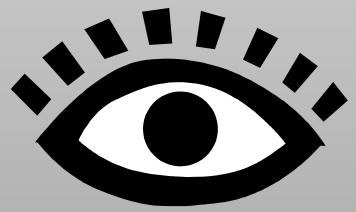
- In previously exposed individuals, subsequent acute exposures may result in sensitization dermatitis characterized by sudden eruption of blisters on the eyelids, neck, face, and arms.

Potential Health Effects Due to Formaldehyde Exposure

- Skin Contact – Repeated or Chronic Exposure:
  - 2nd degree burns
  - Numbness and itching rash
  - Fingernail damage
  - Hardening or tanning of skin
  - Sensitization:
    - As a skin allergen, may cause some people to become highly responsive to low doses, resulting in debilitating dermatitis.
    - Dermatitis may be either a sudden, blistering reaction or may be delayed several years, with eruptions starting on digital areas, wrists, or other body parts.

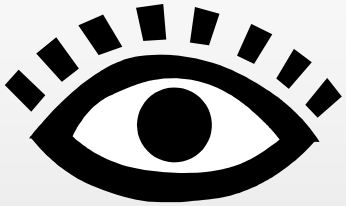
Potential Health Effects Due to Formaldehyde Exposure

- Eye Contact – Acute Exposure:
  - As the airborne concentration increases, the degree of irritation increases. Although uncommon, ocular irritation has been noted at levels as low as 0.05 ppm.
  - Airborne concentrations from 0.05 to 3.0 ppm can cause irritation with redness, itching, pain, blurred vision, and mild tearing.



Potential Health Effects Due to Formaldehyde Exposure

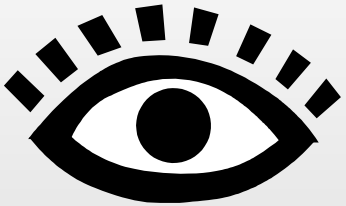
- Eye Contact – Acute Exposure:



  - Concentrations from 4 to 20 ppm can cause profuse tearing and damage to the eye.
  - Solutions with high formaldehyde concentrations may produce severe corneal injury and loss of vision.
  - Solutions containing low formaldehyde concentrations may produce transient discomfort and irritation.

Potential Health Effects Due to Formaldehyde Exposure

- Eye Contact – Chronic Exposure:



  - Unlikely in a University setting.
  - More common in industrial operations such as textile and particle board manufacturing, where a constant ambient level of formaldehyde is present.
  - Effects depend on the concentration and duration of exposure, and individual sensitivity.

The Standards

- OSHA Formaldehyde Standard (29 CFR 1910.1048):
  - Applies to ALL occupational exposures to formaldehyde.
  - Applies to all forms of formaldehyde: gas, aqueous solutions, solids, and materials that can release it.

The Standards

- OSHA Hazard Communication Standard (29 CFR 1910.1200):
  - Applies to all chemicals known to be present in the workplace to which employees may become exposed.
  - This training module is designed to meet Hazard Communication requirements for formaldehyde only, not for other potentially hazardous chemicals that might be in your workplace.

The Standards

- OSHA Laboratory Standard (29 CFR 1910.1450):
  - Supplements (but does not supersede) the Formaldehyde standard in research lab settings;

Air Monitoring

- Air monitoring is performed in the workplace by EHS personnel, to determine the concentration of formaldehyde gas in the air around the employee (known as the employee's breathing zone), and thus determine compliance with exposure limits.

- Passive badges (below, left) or sampling pumps (below, right) can be used for formaldehyde monitoring.

Air Monitoring

- Initial Monitoring:
  - Required for all work operations and/or job classifications where exposure to formaldehyde above the STEL or AL might occur.
  - Reminder: STEL (Short-Term Exposure Limit) = 2 ppm as 15-minute average, and AL (Action Level) = 0.5 ppm as 8-hour average.
  - Contact EHS if you would like to know whether your work operation requires monitoring, or to request monitoring

Air Monitoring

- Periodic Monitoring:
  - Required if initial monitoring shows exposure at or above the AL or STEL;
  - Must be repeated at least every 6 months for employees exposed above the AL;
  - Must be repeated at least annually for employees exposed above the STEL.

Regulated Areas

- Regulated Areas shall be established where airborne formaldehyde levels exceed the PEL or STEL at any time.

- Regulated areas shall be posted and access shall be limited to authorized persons.

- Signs posted at entrances to regulated areas must state the following information:

DANGER

FORMALDEHYDE

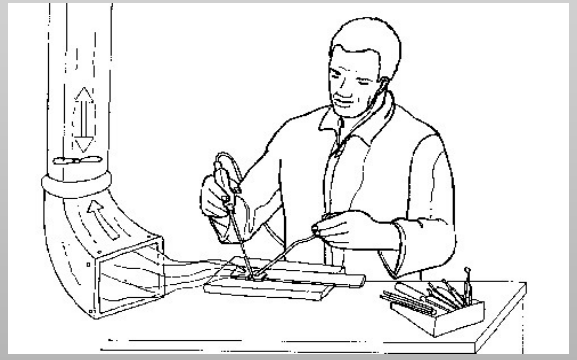
MAY CAUSE CANCER

CAUSES SKIN, EYE, AND RESPIRATORY IRRITATION

AUTHORIZED PERSONNEL ONLY

Control Methods: Engineering Controls

- Engineering Controls:
  - Devices built and installed to maintain exposure to toxic substances below the PEL and STEL.
  - Examples include vented enclosing chemical hoods, local exhaust hoods, and downdraft tables.



Control Methods: Engineering Controls

- Engineering Controls are only effective if they are used!
  - If at all possible, work in a vented chemical hood when preparing, using, or disposing of formaldehyde solutions.
  - Paraformaldehyde solid (powder, granular, prill) should also be weighed and dissolved in a chemical hood.

Control Methods: Work Practices

- Work Practices can reduce airborne formaldehyde gas levels and potential exposures.
  - Keep solution containers of formaldehyde closed when not in use.
  - Perform tasks involving formaldehyde in well-ventilated areas.
  - DO NOT autoclave or microwave formaldehyde solutions.
  - Use formaldehyde preservative substitute whenever possible.

Protective Equipment and Clothing

- Important for employee protection from splash or other sudden contact with formaldehyde.
  - Creates barrier between the user and the potentially harmful agent.

- Minimizes the potential for personnel exposure, but unlike engineering and work practice controls, does not reduce ambient formaldehyde exposure levels.
  - Therefore, protective equipment and clothing is considered a “last line of defense” between user and potentially harmful agent.

Protective Equipment and Clothing: Eyewear

- Indirect vent goggles may be used where a splash hazard is minimized by isolating the formaldehyde.

- For procedures where a splash hazard is probable, such as pouring from one container to another, or when a vessel containing formaldehyde must be manipulated, a faceshield must be worn in addition to the goggles

Protective Equipment and Clothing: Gloves

- In selecting the correct gloves, breakthrough times and permeation data should be used and is available from most manufacturers.
- Materials such as neoprene or nitrile are recommended due to favorable permeation and degradation ratings.
- Latex is not resistant to most chemicals, including formaldehyde, and is not recommended.

Protective Equipment and Clothing: Apparel

- Aprons and sleeves over lab coats may be worn for additional protection.
- As with glove selection, an impermeable material should be chosen.
- Neoprene and nitrile offer excellent resistance to formaldehyde and many other chemicals.
- Full body protection is necessary when airborne concentrations could be >100 ppm.

Protective Equipment and Clothing: Respirators

- Respirators should only be used in limited circumstances:
  - During installation/implementation of feasible engineering and work practice controls;
  - Where engineering and work practice controls are not feasible and/or not sufficient;
  - Emergencies.
  - Employees must receive training, medical evaluation, and fit test before being permitted to wear tight-fitting respirators. Contact EHS at (859) 257-2600 to inquire about respiratory protection needs.




Protective Equipment and Clothing: Respirators

- Air-purifying respirators (those with cartridges or canisters) must be approved by NIOSH for protection against formaldehyde.

- Supplied-air respirators such as airline respirators and self-contained breathing apparatuses (SCBAs) can also be used.

- In areas where exposure limits are exceeded, half-face respirators (example lower left) can only be worn in conjunction with gas-proof goggles.

Protective Equipment and Clothing: Respirators

- Filtering Facepiece Respirators (pictured below) are designed for protection from particulates such as dust, mist, and fumes, and will not protect you from formaldehyde vapors.

Protective Equipment and Clothing: Maintenance

- Protective equipment and clothing that has become contaminated with formaldehyde must be cleaned or laundered before reuse.
- The employer shall repair or replace required protective equipment and clothing for affected employees as necessary to ensure continued effectiveness.
- Make sure that no equipment or clothing that is contaminated with formaldehyde goes home with you.

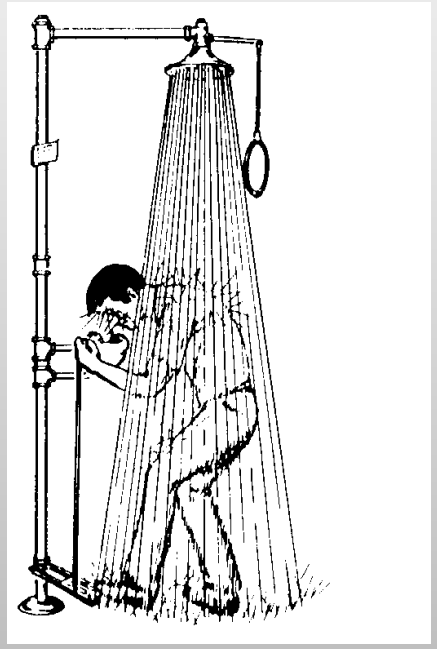
Protective Equipment and Clothing: Summary

- Use nitrile or neoprene gloves.
  - If disposable nitrile gloves are used, change them frequently, especially after they come in contact with formaldehyde solutions.
- Wear a lab coat; aprons are also recommended when decanting or transporting large volumes (>300ml) of solutions.
- Wear goggles at a minimum, and a face shield if there is the probability of a splash hazard.

Hygiene Protection

- In the event of skin contact:
  - Affected area should immediately be washed with soap and water and contaminated clothing removed.

- In the event of eye contact:
  - Promptly wash for at least 15 minutes, lifting the upper and lower lids, and seek medical attention.
  - If irritation, pain, swelling, lacrimation, or photophobia persist, a physician should be seen.



Hygiene Protection

- Emergency Showers:
  - Must be present in areas where employee's skin could be splashed with solutions containing 10% or greater formaldehyde.

- Emergency Eyewashes:
  - Must be present in areas where employee's eyes could be splashed with solutions containing 0.1% or greater formaldehyde.

- Drench Hoses:
  - Present in many laboratories; can be used as a supplement to eyewashes and showers but NOT as a substitute.

Hygiene Protection

- Safety showers and eyewashes are your immediate first aid treatment for chemical splashes.
- Know the location of your nearest eyewash and safety shower, and how to use it.
- Eyewashes and showers must be periodically checked for proper working order and to purge particulate matter from the water lines.
- Safety showers are checked periodically by Facilities Services, but checking the eyewashes is your responsibility.

Housekeeping: Spill Procedures

- If a spill occurs, the physical and chemical properties determine the hazard potential of the waste generated:
  - Formaldehyde gas is extremely flammable.
  - Formalin solutions in methanol are combustible.
  - Formaldehyde may react violently with strong oxidizing agents, strong alkalis, and inorganic acids:
    - Example: Toxic bis(chloromethyl) ether is formed from the reaction of formaldehyde and hydrochloric acid.

Housekeeping: Spill Procedures

- In areas where spillage might occur, provisions must be made to contain spills, decontaminate the work area, and dispose of the waste.

- Employees repairing equipment leaks and cleaning up spills must be properly trained and wear suitable protective clothing.

Housekeeping: Spill Procedures

- For small spills (less than 300ml aqueous solution):
  - Remove all ignition sources; contain the spill with paper towels and/or absorbent materials while wearing personal protective equipment.
  - If available, use a neutralizing substance such as ALDE-X powder on the spill.
  - Place absorbent materials into a suitable container.
  - Contact Environmental Management (859 323-6280) for guidance on disposal of spill materials, or for assistance if you do not feel comfortable trying to clean up the spill yourself.

Housekeeping: Spill Procedures

- For larger spills (more than 300 ml), or emergencies where the PEL or STEL may be exceeded:
  - Evacuate the area.
  - Contact Environmental Management (859-323-6280) and Campus Police (911 or 859-257-8573) immediately.

Disposal Procedures

- Collect all formaldehyde solutions in a hazardous waste container.

- To request pick-up of formaldehyde waste, submit an online request at https://ehs.uky.edu/env/waste_pick-up.php

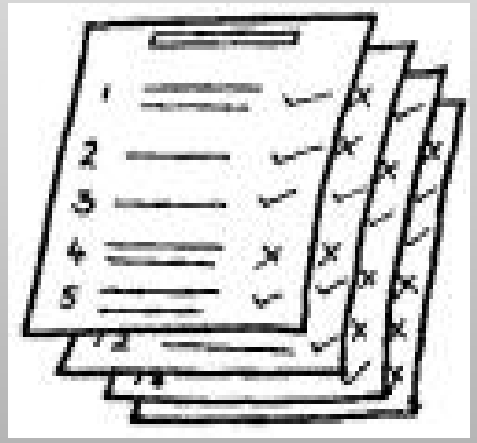
- Do not dispose of formaldehyde waste down the drain;
  - Contact Environmental Management at 859-323-6280 if you are using formaldehyde in such a way that collection in a container is difficult or not possible.

Medical Surveillance

- Medical surveillance must be implemented for all employees exposed to formaldehyde at concentrations that equal or exceed the AL or STEL.
- Occupational medical services shall also be available for employees who develop signs and symptoms of overexposure to formaldehyde, and for employees exposed to formaldehyde in emergencies.

Medical Surveillance

- Medical Disease Questionnaires:
  - Made available when the AL is exceeded and annually thereafter.
  - Also completed for employees having signs or symptoms of overexposure.



Medical Surveillance

- Medical Examinations:
  - Might be recommended by health care provider based on information provided in the medical questionnaire;
  - Required for personnel who need to wear respirators to reduce exposures to formaldehyde.

- Medical Removal:
  - Can be granted due to significant irritation of the eye and/or upper airways, respiratory sensitization, or dermal sensitization/irritation;
  - Maintenance of earnings, benefits, and seniority while on reassignment due to medical removal.

Employee Information and Training

- All employees assigned to workplaces where there is an actual or potential health hazard from formaldehyde shall participate in a training program.

- All UK employees who are using formaldehyde are required to successfully complete this training class

Employee Information and Training

- Training shall be completed at the time of initial assignment.

- Retraining shall occur in the following circumstances:
  - When a new formaldehyde hazard is introduced into the work area;
  - When the scope or type of formaldehyde use is changed;
  - When monitoring results show that airborne levels of formaldehyde are above 0.1 ppm, annual training is required.

Employee Information and Training: Hazard Communication

- Hazard Communication provisions apply to:
  - Formaldehyde gas;
  - All mixtures or solutions composed of greater than 0.1% formaldehyde;
  - Materials capable of releasing formaldehyde into the air under reasonably foreseeable conditions of use at concentrations reaching or exceeding 0.1 ppm.

Employee Information and Training: Hazard Communication

- Labels on original containers must not be defaced.
- All containers holding formaldehyde gas, solutions, or solid must be labeled to meet the requirements of Global Harmonized System
  - Suggested label is shown. Labels can be computer generated or purchased from vendors.

GHS-US labelling

Hazard pictograms (GHS-US)	:	 GHS02 GHS05 GHS06 GHS08
Signal word (GHS-US)	:	Danger
Hazard statements (GHS-US)	:	H226 - Flammable liquid and vapour H302 - Harmful if swallowed H314 - Causes severe skin burns and eye damage H317 - May cause an allergic skin reaction H318 - Causes serious eye damage H331 - Toxic if inhaled H350 - May cause cancer (Inhalation) H401 - Toxic to aquatic life
Precautionary statements (GHS-US)	:	P201 - Obtain special instructions before use P202 - Do not handle until all safety precautions have been read and understood P210 - Keep away from heat, sparks, open flames, hot surfaces. - No smoking

Employee Information and Training: Hazard Communication

- If formaldehyde is transferred into non-original containers, the chemical name and hazard warning information must be included on the non-original containers.
  - The only exception is when the substance is transferred into another container that is intended only for the immediate (short-term) use of the employee who performed the transfer.
  - Example: Freshly-made 4% paraformaldehyde solution must be labeled if it will be stored for several hours or overnight, but does not need a label if it is used by the preparer immediately after being made

Employee Information and Training: Hazard Communication

- Safety Data Sheets (SDSs):
  - Must be maintained in workplace;
  - Must be accessible to affected employees;
  - May be maintained electronically, so long as no barriers to immediate employee access in the workplace are created by electronic maintenance.

Shipping and Receiving Requirements

- Formaldehyde in all forms is classified by the Department of Transportation as a Hazardous Material, and by IATA as a Dangerous Good, due to its corrosivity and toxicity.

- Therefore, there are special requirements for packaging and documentation prior to shipment of specimens or other items containing formaldehyde.

- If you are responsible for shipping items containing formaldehyde, you must complete the IATA-DOT shipping training module, located at https://ehs.uky.edu/env/shipping.php.
- Call EHS if you have any questions about shipping and receiving.

Reporting Signs or Symptoms of Exposure

- If you develop signs or symptoms that you suspect are due to formaldehyde exposure, notify your supervisor immediately.

- Injuries must be reported to your supervisor or designee as soon as practicable. Your supervisor must ensure that paperwork required for reporting work-related injuries or illnesses gets filled out and submitted to EHS

Reporting Signs or Symptoms of Exposure

- Make an appointment with University Health Services (859-323-2778), located in the UHS Building at 830 S. Limestone, Lexington, KY 40536; UHS is open 7:30am-5:00pm M-F.

- Report to UK Hospitals ER in the event of an emergency or after-hours exposure.

- Medical personnel at the UK Hospitals ER will notify affected employees whether any follow-up visits or procedures are required.

Conclusion

- For more information or assistance in working safely with formaldehyde, please contact the Department of Environment, Health & Safety at 257-7600.

- In order to receive credit for this training, you must pass the Formaldehyde Review Quiz.