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Instructor's Guide

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13. ABSTRACT *(Maximum 200 words)*

This document is designed for instructors who are presenting a health and safety training course for underground storage tank inspectors. It should be used in conjuction with the Student Guide.

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GENERAL GUIDANCE FOR THE INSTRUCTOR

Course length:

This course is designed to be flexible in length, and may be anywhere from 24-40 hours in length. **Limiting the course to a simple discussion of the material here, will result in a 24 hour course, or perhaps longer, depending on the amount of discussion, review and testing that is incorporated.** Although the written material in the manual is kept to a minimum, it covers a great deal of ground. A slower pace, with lots of discussion is likely to prove more valuable than a "whirlwind" tour of the material.

To increase the length to a 32 hour course, add one day of hands-on training in use of the equipment described in the text: oxygen meter, photoionization detector, flame ionization detector, Drager tubes, combustible gas indicator etc., and conduct a respirator fit test. IF THE COURSE IS BEING GIVEN TO REGULATORS OR OTHER INSPECTORS, IT IS STRONGLY RECOMMENDED THAT THE COURSE INCLUDE THESE THINGS, AS "HEAD KNOWLEDGE" ALONE IS NOT SUFFICIENT. In addition, inspectors and site workers need to meet OSHA training requirements. Twenty four hours of training is required for inspectors and 40 hours for cleanup workers. For those supervising but not actually conducting work on-site, or merely wanting to learn basic safety hazards, 24 hours is probably sufficient.

To increase the course length to 40 hours, add a day of field visits to actual sites to provide additional practice using instruments, and to observe and analyze site conditions. This will provide some very valuable experience and help students to gain confidence in their own abilities. What is accomplished in these days will depend in large measure on your own creativity and the type of sites you select. State field offices of the UST agency may be able to help you select sites at the proper stages of development to make site visits productive or interesting, and indicate sites where a visit would not cause antagonism from the owner or other parties.

Some potential field activities for days 4 and 5 include:

- Visit sites where removals, cleanups and installations are underway; have students observe and analyze the site and workers, identifying safe and unsafe practices/conditions.
- Visit a site and have students develop draft safety plan outlines based on the site conditions and activities they have observed. Follow this up with a group discussion of what they would include.
- Practice using the monitoring instruments and properly recording data in the field setting.

Textbook Format

Split page: This manual is designed with a split page format to provide space for the students to take notes alongside the text, rather than on separate sheets of paper. Encourage them to do this, as it keeps all relevant material together.

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Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
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Boxes: All of the word slides (~160) that accompany the course are reproduced in boxes at the top of the appropriate page of text, so that students do not need to feverishly take notes, and can concentrate on the lecture without missing any material. Point this out at the beginning of the course and encourage them to follow along in the book, where possible.

Lists of objectives: Objectives that a student should be able to accomplish after completing the course are listed at the beginning of each section. These will help to focus students' attention on the most important portions of the chapter. Note that these objectives are worded in such a way that the student should be able to know when he has met an objective. They use words such as "list", "describe", and "define", as opposed to words such as "know", "understand", "believe" that leave the students unsure whether or not they have mastered the material. It is difficult to be sure when material is "known" or "understood", but easy to determine when a list has been learned to compiled.

The objectives can be used as self-quizzes by the student, or can be used as quick understanding-checks or homework by the instructor. In the course introduction, draw students' attention to the objectives, to help them to focus on what they should look for as they go through the chapter, and explain how you will use them.

Accident descriptions: Accidents, by definition, are not planned. But when students are aware of potential accidents, they are more likely to be prevention-oriented. Accident possibilities at sites using a variety of heavy equipment, with a variety of ongoing activities, are almost endless. Where appropriate, a list of relevant real-life accidents has been compiled and placed at the end of each section, to help provide some insight into both the common and the more bizarre things which have occurred on tank sites. Be sure to draw student's attention to these descriptions. Discuss the variety - and similarities - among them, and encourage students to share examples from their own experience as well. Discuss how some of the accidents could have been prevented.

Appendices: The text has been deliberately kept relatively simple. More detailed material on respiratory protection and monitoring equipment is available in the appendices, for those who wish additional information.

Slides: In addition to the word slides, a number of picture slides accompany the course. The instructor notes accompanying each chapter indicate the graphic slides most appropriate for use with that chapter, and provide a small narrative to accompany each slide.

General Comments

Involve your students: Every class is likely to have some experienced people in it. Take advantage of these people and draw them out; get them to share real-world "horror stories" from their own experience, and the course will be more interesting, more lively, and more relevant for everyone.

Bring "real life" into the classroom: Several good videos exist that provide safety information and bring a "field presence" into the classroom. These can be obtained from any Regional EPA office. They include:

- What do We Have Here? An inspector's guide to site assessment at closure (30 minutes). This also includes an additional 14 minute section on field testing instruments and a 7 minute segment on soil and water sampling. (Produced by the New England Interstate Water Pollution Commission).

Doing it Right: proper UST Installation (40 minutes), and

A question of When; An Overview Of Underground Tank Installation For Inspectors (36 minutes). (Produced by the national Fire Protection Association)

For the 32 and 40 hour courses, you will need to have various pieces of monitoring equipment and examples of personal protective equipment available for students to use.

Tailor the subject matter to the class need: This manual is a starting point, but is not intended to be the "perfect course". It provides the basics, but most instructors will want to add their own personal touches. This will also be helpful to the students, if you can slant the class toward your audience. Several different groups of people will be attracted to a health and safety course: workers and inspectors needing to fulfill OSHA safety requirements, managers and supervisors who want a better idea what to expect on a site; contractors who have already had basis training and need CEUs or refresher training for state contractor certification programs. Determine at the beginning who the audience is, what level of detail and hand-on training they need, and what they expect from the class.

Provide proof of course attendance: Many students will need to have proof that they have completed a certain number of hours of training. Consider issuing continuing education units (CEUs) or certificates to those who pass the course.

Testing: Consider including some review and testing, either through mini quizzes or at the end of the course. Given the short length of the course and the volume of material covered, an open-book test may be appropriate. Students tend to take something more seriously if they know they will be tested on it. Always review answers to the quizzes, to reinforce the correct answers.

Guidance for the Instructor: Introductory Section

Suggested Activities:

- Ask students to briefly identify themselves, state their reasons for taking the course, and tell and what they hope/expect to get out of it. This will help you know what to focus more heavily on, so you can best meet their needs.

- Discuss the manual format, and stress that all word slides are reproduced in the text boxes, eliminating the need for extensive note-taking.

- Describe activities the course will and will not accomplish. (Will it include a respirator fit-test? Will students need additional training prior to using respirators or conducting confined-space entries)?

- Pass around a sign-in sheet to insure the names and addresses of all students are correct. Many students will want to obtain CEUs and/or proof they have completed the course. You will want to issue certificates, continuing education credits, or letters to those who complete the course.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable to this chapter:

Slides

-- (Drill rig): Heavy equipment hazards and accidents will be discussed

-- (Various confined spaces): the course will cover confined spaces, but you will need additional training before you are actually qualified to make confined space entries

-- (Large excavation with dragline): excavations have special safety problems

-- (Man smoking during installation): Properties and characteristics of petroleum, particularly flammability of gasoline, and proper activities on UST sites (smoking is not one of them) will be discussed.

-- (Man pouring gasoline from drum to small container): Dos and don'ts of petroleum handling will be discussed

-- (Monitoring equipment): You will learn the types of monitoring equipment used on UST sites, and advantages and disadvantages of each type.

-- (Man sampling): toxicity of petroleum products and exposure potential during various activities such as sampling, will be discussed

-- (Person in protective gear): You will learn the various levels of protection, the proper equipment to use and when to wear it

Other Comments:

OSHA regulations can be obtained from the Government Printing Office (GPO) at a reasonable cost. Contact them for costs and ordering information. You may wish to also pass on this information to the students.

Guidance for the Instructor: Petroleum Types and Characteristics

Additional Suggested Activities:

- Differences in properties of the various petroleum classes will impact their fate and transport, as well as dictating what methods are effective for leak detection, and the degree of exposure workers may expect. Ask students to predict, based on the properties, which classes will be most likely to produce vapors; to migrate most quickly below ground; to have a benzene exposure hazard; to produce explosions; to be best/least likely observed in groundwater wells or vapor monitors, etc.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable to this chapter:

Slides

-- (Oil floating on water in bailer): low specific gravity of petroleum makes it float; this enhances detection and recovery in groundwater monitoring wells.

-- (Excavation): Because of the high vapor density gasoline vapors tend to accumulate in low and enclosed areas, such as excavation tanks, and trenches. Always check these areas for vapors.

Other Comments:

Guidance for the Instructor: Fires and Explosions

Additional Suggested Activities:

- Watch the video "A question of When" (36 minutes, NFPA)

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Flammable ranges): Vapor mixtures too rich or too lean will not burn. The range where combustion can occur is the flammable range, bounded by the LEL (too rich above this) and the LEL (too lean below this).

-- (Fire Triangle): Fuel, ignition source and oxygen are all needed to support combustion. Removing any one of these will prevent it.

-- (Petroleum fire): Occurs when vapors in the flammable range are coupled with oxygen and an ignition source.

-- (Man cutting tank with torch): Vapors, not liquid product, are the most dangerous petroleum state. Never cut into a tank until all vapors are removed; torches are a good ignition source for completing the fire triangle!

-- (Man smoking): another potential ignition source.

-- (Backhoe striking tank): equipment striking the metal tank may produce sparks, causing ignition of vapors.

-- Grounded equipment): grounding equipment will divert static electricity into the earth, eliminating its buildup.

Other Comments:

For additional material, and if students are interested, you may want to expand on the Open Cup and Closed Cup methods for measuring flash point.

Aviation fuels vary widely in fire hazard:

Jet A:	**JP-4**
F.P. = 100-150 degrees F	F.P.= 20 degrees F (variable)
LFL = .7% (significant variability)	LFL = 1.3% (variable)
UFL = 5% (Significant variability)	UFL = 8% (variable)

Accidents involving petroleum transfer are shown in Table 2-1. Stress that petroleum vapor, not the product, is the most dangerous, and that the majority of accident seem to occur during closure.

Guidance for the Instructor: Oxygen Depletion

Additional Suggested Activities:

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Tank): Possible area of oxygen deficiency.

-- (Excavation): Possible area of oxygen deficiency.

-- (Sewer): area for possible accumulation of toxic gasses and/or oxygen deficiency.

-- (Oxygen depletion chart): Normal air is 21% oxygen. Below 19.5%, air supplying respirators must be used.

Other Comments:

Guidance for the Instructor: Confined Spaces

Additional Suggested Activities:

- Discuss the topics a confined space entry plan might be expected to contain and identify other reasons (besides safety) that it would be important to have such a plan.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (photo of various confined spaces): examples of confined space areas

-- (Monitoring tank prior to entry): Be sure you understand conditions of confined spaces on the site. Explosive gasses or oxygen deficiency may be present

-- (Inspecting a large tank prior to entry): Know conditions before entry

-- (Isolation tag and pipes that have been blind-flanged or "blanked"): Isolate confined spaces from other systems prior to entry

-- (Disable and tag-out equipment):

-- (Electrical lockout): Each person has a separate key...

-- (Improper tank entry): In case of emergence here, worker wearing APR cannot be pulled out

-- (Proper tank Entry): Note tripod and harness, SCBA. These assist if worker removal is necessary

-- (Buddy system): using the buddy system is a must when working in confined space conditions.

-- (Tombstone): avoid the ultimate "confined space" by understanding and avoiding confined space hazards

Other Comments:

Guidance for the Instructor: Heavy Equipment

Additional Suggested Activities:

- Show slides with poor safety practices and have students identify what is being done incorrectly or unsafely in each situation. This is a good way to help teach critical evaluation and get class participation. It is also easy to obtain additional slides, because more often than not, everywhere you look, something is being done wrong!

- When showing slides of equipment, have students identify the major hazards associated with each type.

- Review the accidents at the end of the chapter and discuss how they could have been avoided

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Man attaching chain to backhoe bucket): Is he visible to the bucket operator?

-- (Man preparing to attach chain to backhoe bucket):

-- (Man standing close to chain as tank comes out): If the chain should snap, he's standing right in the way

-- (Backhoe): Stand well back to avoid swinging buckets and unstable loads

-- (Backhoe pulling tank): Spark generation and chain snapping are possible hazards here

-- (Dragline sitting on edge of excavation): Heavy equipment too close to the edge of excavations may cause cave-ins. Heavy loads may also pull it into the excavation, injuring the operator and anyone located in the hole

-- (Trackhoe undercutting the ledge it is sitting on): Keep equipment well back from the excavation edge

-- (Drill rig): Avoid rotating parts that may sever limbs. Restrain long hair and avoid loose clothing around all moving equipment

-- (Dragline-type crane): an older type of crane, it is track-mounted and very heavy (and very stable). It can rotate 360 degrees.

-- (Tank being lowered by boom on cherry picker): newer type cranes, these are often found at UST sites because they are truck-mounted and very mobile. They are equipped with outriggers that must be set before the lifting arm is used, and must remain in place until the lift arm is retracted. The further extended the arm, the less weight the crane can lift.

-- (Frayed cable): Minor fraying may not significantly affect performance, but more severe fraying is dangerous; load limits of frayed cable are not known, and cable may snap. Frayed cable may also hang and snarl.

-- (Workers standing under suspended tanks): Workers should use cables or rods to position suspended tanks. They should not stand under tanks and use their bodies or hands to adjust tank position.

-- (Overhead electrical line): A major hazard to cranes; it can be easily snagged, causing electrocution hazards

-- (Trackhoe operating near overhead line): If contact with a live overhead line occurs, equipment operators should remain in the cab of the equipment, sit still, and avoid touching the cab controls and all metal surfaces.

Other Comments:

Guidance for the Instructor: Excavations

Additional Suggested Activities:

- Review the accidents listed at the end of the chapter, and discuss how they could have been avoided.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Trench shield or trench box):

-- (Trench supports or shoring):

-- (Sloping):

-- (Dangerous excavation): shows poor shoring, spoil too close to edge, and heavy equipment straddling the trench

-- (Spoil piled too close to excavation):

-- (Water accumulating in excavation):

-- (Ribbon barricades): placing barricades around the work area will prevent people and equipment from getting too close to the excavation edge.

-- (Sawhorse barricade with light): lighted barricades reduce nighttime hazards by alerting pedestrians

-- (Car in excavation): Roping off or barricading the excavation might have prevented this.

Other Comments:

Guidance for the Instructor: Toxicity

Additional Suggested Activities:

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Exposure routes): The four main exposure routes are the eyes, skin, respiratory tract and digestive system

-- (Skin and lungs): The most likely routes of entry for petroleum are absorption through the skin and by inhalation

Other Comments:

This topic is very complicated, and the student may get "buried". Exposure routes and types, and main symptoms of exposure are important. However, it probably is not necessary for students to know all of the differences in toxic effects between the various petroleum types. You may wish to skip some of the detail in this chapter, using Table 2-3, as a convenient summary.

Gasoline is so commonly used and is so familiar to most people that many do not take exposure seriously. They have cleaned paint brushes, killed weeds, de-greased car parts, and filled their lawn mowers. Stress that they need to be aware that this familiarity can lead to overexposure if care is not taken; the skin is the main exposure route.

Guidance for the Instructor: Sampling

Additional Suggested Activities:

- During the field portion of the course, practicing correct methods for taking samples from monitoring wells and areas of contaminated soil.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Soil sampling from drill): take samples from core or backhoe bucket; avoid entry into the excavation.

-- (Man mouth-piping sample from drum to jar): A good way to ingest petroleum

-- (Bailer): Obtain samples indirectly from bailers or through other means. Avoid direct contact with contaminated soil and water as much as possible.

Other Comments:

Guidance for the Instructor: Site Safety Plans

Additional Suggested Activities:

- Describe (or actually visit) a site, and have students outline a draft safety plan or discuss as a group, what elements would be needed. Discuss the merits of generic and site-specific safety plans.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides -----

Other Comments:

Guidance for the Instructor: Personal Protective Equipment

Additional Suggested Activities:

- Obtain samples of the various materials (tyvek, viton, etc.) and allow students to examine them to get a better feel for their differences. Point out positive and negative factors associated with the different materials.

- Obtain several different styles of goggles and point out the good and poor features of each.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Various goggle types): Cushion-filled goggles and face shields are recommended for inspectors.

-- (Various boot types): Class 75 steel toe/shank safety shoes are recommended for inspectors

-- (Various glove types): When choosing gloves, strength and permeability are factors to consider. Neoprene, nitrile and viton are all good protection against petroleum

-- (Level D protection): Used only when no respiratory or skin protection is required

-- (Level C protection): Adds an air purifying respirator to level D

-- (Level B protection): Adds an air supplying respirator; wear when the highest level of respiratory protection is needed

-- (Level A protection): Provides the highest level of both skin and respiratory protection

-- (Spider): Be alert for unexpected biological hazards

-- (Rattlesnake): Biological hazard

-- (Man with bee stings): swarming insects may pose a hazard

-- (Man with shotgun): If you encounter this type of hazard, don't argue: leave and return with the U.S. Marshal

Other Comments:

Guidance for the Instructor: Respiratory Protection

Additional Suggested Activities:

- It is strongly suggested that the course include a respirator fit test. UST inspectors should have respiratory training, and will need to get it elsewhere, if it is not offered here. In addition, the additional day will help them to meet OSHA requirements.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Scott half-face respirator):

-- (MSA full-face respirator):

-- (Assorted MSA gas masks and a full face respirator):

-- (Scott full-face respirator):

-- (Air purifying respirator): These remove contaminants but do not add oxygen. Change the cartridges frequently. They should not be used if oxygen levels fall below 19.5%

-- (Air supplying respirator): These supply clean contained air.

-- (Inspecting face-piece for defects):

-- (Checking for proper fit): Respirator should fit tightly with a seal. Beards impede the seal's effectiveness

-- (Fit test agents: banana oil, saccharine, and stannic chloride): These agents are harmless but easily smelled or noticed if the respirator does not fit properly.

-- (Banana oil fit test): If the respirator fits correctly, the wearer will not be able to smell the oil.

-- (Stannic chloride smoke tube): Used for fit-testing, this produces an irritating smoke

-- (Stannic chloride fit test): If the fit is good, the wearer should not be able to detect the smoke.

Other Comments:

OSHA regulations require all respirator wearers be fit-tested and have adequate respirator training before using respirators. It is highly recommended that this course include a fit test for students. If it does not, be sure that students are aware they must undergo such a test before using respirators.

Guidance for the Instructor: Monitoring Instrumentation

Additional Suggested Activities:

- Hands-on work with equipment is invaluable. Obtain an OVA, oxygen meter, HNu, CGI and other pieces of equipment, divide students into teams, and allow them to practice using equipment on some spiked samples of air and soil. You will probably want to allow one half day for this.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (Oxygen meter): Used to measure oxygen levels. Readings are most useful when paired with CGI readings

-- (Hydrogen sulfide meter): Detects hydrogen sulfide, a concern mainly in sewers

-- (Combustible gas indicator): Used to determine the concentration of flammable gasses

-- (MSA explosimeter and explosimeter/oxygen meter combination): a combination of two functions sometimes makes transport easier.

-- (Industrial Safety Explosion/Oxygen meter):

-- (AIM 3000 Explosion/oxygen/Organic Vapor/Carbon monoxide detector): Having a number of functions in one piece of equipment minimizes the number of things to carry around.

-- (Man checking tank with CGI):

-- (Drager pump and tube): Can be used as a screening method, but it is not very accurate

-- (Pumping): a hand held pump draws air through the tube

-- (Drager tube):

-- (Colorimetric tube):

-- (Foxboro OVA): Detects concentration of volatile organics

-- (Schematic of OVA):

-- (Strip chart recorder for OVA):Used to provide a permanent record of concentrations, for the file

-- (Probe extension for OVA):

-- (HNu photoionization detector): Detects organic compounds

-- (Schematic of HNu):

-- (Instrument plate): a permanent plate affixed to the monitoring instrument indicates the instrument has an approved rating for use

Other Comments:

Inspectors should be thoroughly trained in and familiar with use and interpretation of all the direct reading instruments

A summary of costs for various equipment types may be of interest to certain audiences.

Guidance for the Instructor: Permissible Exposure Levels

Additional Suggested Activities:

Pass out copies (or photocopies) of the various exposure guides, such as the NIOSH Pocket Guide To Chemical Hazards, and practice interpreting some of the data within them. Give some concentration and/or exposure levels, and have students determine if the levels are safe.

Visuals:

In addition to the word slides shown in this chapter, the following graphic slides are applicable:

Slides

-- (DOT flammable liquid placard): The DOT labelling system is required by law. (NFPA and UN systems are voluntary).

-- (Explanatory graphic for DOT labels): The system provides a graphic and written hazard description plus a four digit identification number

-- (DOT labels): Examples

-- (Full color NFPA label): Provides information on relative hazard levels for flammability, health and reactivity

-- (Health diamond): Rankings range from 0 (lowest hazard) to 4 (highest hazard)

-- (Flammability diamond): Rankings range from 0 (lowest hazard) to 4 (highest hazard)

-- (Reactivity diamond): Rankings range from 0 (lowest hazard) to 4 (highest hazard)

-- (Other info diamond)

Other Comments:

You may want to discuss the 0-4 ranking criteria in greater detail if need/interest exists.