

OSHNC Hazard Advisory #1

Hazard Review Involving Confined Spaces, Trenching, and Related Safety Standards by NCDOL



Clear and Present Dangers

The newspaper headline read, "Two Sewer Workers Killed in Iowa." Unfortunately serious workplace injuries and deaths transcend state lines and other territorial boundaries. Fortunately hazard awareness and workplace safety can, too. Hazards associated with confined spaces and trenching should always be considered and treated as clear and present dangers. To view them otherwise could result in another tragic event.

In recent years, the Division of Occupational Safety and Health in the North Carolina Department of Labor (OSHNC) has issued several advisories pertaining to confined spaces and trench work. Such hazardous conditions may include, but are not limited to, possible cave-ins, failure of protective systems, hazardous atmospheres, water accumulation, access to and egress from confined spaces, and excavation and trench-related work. No state is immune to tragic events involving these activities, as the following details document:

Two construction workers in the process of re-lining city sewer pipes with a plastic resin died in Iowa on July 8, 2002. They were employed on the sewer project by a sub-contractor for the city of Des Moines. Regrettably nine others were also injured as a result of this accident. The Bureau of National Affairs (BNA), recognized news media source for occupational safety and health, received an account of the incident from a Des Moines Fire Department spokesperson. Specifically, the deceased workers collapsed in a 16-foot trench and were recovered from a pool of water at the bottom of the pit. According to Jim Mason, acting assistant chief of operations, the remaining workers were injured when they tried to rescue the first victims. All five remained hospitalized on July 9, one of them in critical condition. Mr. Mason stated that four firefighters were also injured in the rescue. Both the injured workers and firefighters experienced symptoms that were consistent with hydrogen sulfide exposure, including convulsions. The medical examiner concluded that the two workers died from drowning after falling unconscious. They had been working in an area of the sewer line that contained

stagnant water. Disturbing the water resulted in the emission of hydrogen sulfide gas. (Hydrogen sulfide is a natural byproduct produced by the decomposition of organic materials such as sewage.) Since hydrogen sulfide gas is heavier than air, it can displace oxygen in the air, and probably caused these workers to lose consciousness because of a lack of oxygen. It is unlikely that the gas itself incapacitated them. However, in their effort to rescue their two downed co-workers, five additional workers, and subsequently four fire fighters, were affected by the toxic gases.

Hazard awareness and assessment as well as knowledge of safety requirements are paramount for work activities that involve excavation, trenching and confined spaces. Such knowledge is also essential to successful rescue or emergency operations associated with accidents and injuries in these areas. Sharing information is one way to address this tragic event and hopefully prevent others throughout North Carolina and elsewhere.

Relevant OSHA Standards

1910.146 -- Permit Required Confined Spaces

1926.651-- Specific Excavation Requirements

A more complete listing of standards referenced, as well as others, can be viewed at these websites: <http://osha.gov>, see Regulations (Standards - 29 CFR); <http://www.nclabor.com>, Publications, Industry Guide Series (e.g. IG #01 and IG #14)

Definitions:

"Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

"Hazardous atmosphere" is an atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic or otherwise harmful may cause death, illness or injury to persons exposed to it

"Non-permit confined space" means a confined space that does not contain or, with respect to

atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

- (1) Contains or has a potential to contain a hazardous atmosphere;
- (2) Contains a material that has the potential for engulfing an entrant;
- (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- (4) Contains any other recognized serious safety or health hazard.

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

Note: Appendices A through F serve to provide information and non-mandatory guidelines to assist employers and employees in complying with the appropriate requirements of this section:

Appendix B and Appendix E is provided here for review in that it may be helpful to ensure compliance with activity pertaining to sewer system entry.

Appendix B to 1910.146 -- Procedures for Atmospheric Testing

Atmospheric testing is required for two distinct purposes: evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exist.

(1) Evaluation testing. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space. Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

(2) Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using

permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing (i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

- (3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.
- (4) Testing stratified atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.
- (5) Order of testing. A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

Appendix E to 1910.146 -- Sewer System Entry

Sewer entry differs in three vital respects from other permit entries; first, there rarely exists any way to completely isolate the space (a section of a continuous system) to be entered; second, because isolation is not complete, the atmosphere may suddenly and unpredictably become lethally hazardous (toxic, flammable or explosive) from causes beyond the control of the entrant or employer, and third, experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of their frequent entries. Unlike other employments where permit space entry is a rare and exceptional event, sewer workers' usual work environment is a permit space.

(1) Adherence to procedure. The employer should designate as entrants only employees who are thoroughly trained in the employer's sewer entry procedures and who demonstrate that they follow these entry procedures exactly as prescribed when performing sewer entries.

(2) Atmospheric monitoring. Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions are

encountered: Oxygen concentration less than 19.5 percent; flammable gas or vapor at 10 percent or more of the lower flammable limit (LFL); or hydrogen sulfide or carbon monoxide at or above 10 ppm or 35 ppm, respectively, measured as an 8-hour time-weighted average. Atmospheric monitoring equipment needs to be calibrated according to the manufacturer's instructions. The oxygen sensor/broad range sensor is best suited for initial use in situations where the actual or potential contaminants have not been identified, because broad range sensors, unlike substance-specific sensors, enable employers to obtain an overall reading of the hydrocarbons (flammables) present in the space. However, such sensors only indicate that a hazardous threshold of a class of chemicals has been exceeded. They do not measure the levels of contamination of specific substances. Therefore, substance-specific devices, which measure the actual levels of specific substances, are best suited for use where actual and potential contaminants have been identified. The measurements obtained with substance-specific devices are of vital importance to the employer when decisions are made concerning the measures necessary to protect entrants (such as ventilation or personal protective equipment) and the setting and attainment of appropriate entry conditions. However, the sewer environment may suddenly and unpredictably change, and the substance-specific devices may not detect the potentially lethal atmospheric hazards which may enter the sewer environment.

Although OSHA considers the information and guidance provided above to be appropriate and useful in most sewer entry situations, the Agency emphasizes that each employer must consider the unique circumstances, including the predictability of

the atmosphere, of the sewer permit spaces in the employer's workplace in preparing for entry. Only the employer can decide, based upon his or her knowledge of, and experience with permit spaces in sewer systems, what the best type of testing instrument may be for any specific entry operation. The selected testing instrument should be carried and used by the entrant in sewer line work to monitor the atmosphere in the entrant's environment, and in advance of the entrant's direction of movement, to warn the entrant of any deterioration in atmospheric conditions. Where several entrants are working together in the same immediate location, one instrument, used by the lead entrant, is acceptable.

(3) Surge flow and flooding. Sewer crews should develop and maintain liaison, to the extent possible, with the local weather bureau and fire and emergency services in their area so that sewer work may be delayed or interrupted and entrants withdrawn whenever sewer lines might be suddenly flooded by rain or fire suppression activities, or whenever flammable or other hazardous materials are released into sewers during emergencies by industrial or transportation accidents.

(4) Special Equipment. Entry into large bore sewers may require the use of special equipment. Such equipment might include such items as atmosphere monitoring devices with automatic audible alarms, escape self-contained breathing apparatus (ESCBA) with at least 10 minute air supply (or other NIOSH approved self-rescuer), and waterproof flashlights, and may also include boats and rafts, radios and rope stand-offs for pulling around bends and corners as needed.

Trenching and excavations have general and specific requirements; some specific requirements are listed below for review that may also be helpful to ensure compliance with activity pertaining to sewer system entry.

1926.651(g) Hazardous atmospheres –

1926.651(g)(1) Testing and controls. In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50 - 1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

1926.651(g)(1)(i) Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

1926.651(g)(1)(ii) Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

1926.651(g)(1)(iii) Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

1926.651(g)(1)(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

1926.651(g)(2) Emergency rescue equipment.

1926.651(g)(2)(i) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

1926.651(g)(2)(ii) Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

1926.651(h) Protection from hazards associated with water accumulation.

1926.651(h)(1) Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

1926.651(h)(2) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be

monitored by a competent person to ensure proper operation.

1926.651(h)(3) If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

1926.651(k) Inspections.

1926.651(k)(1) Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

1926.651(k)(2) Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

This advisory serves to inform employers and workers throughout North Carolina of the hazards identified and standards associated with confined spaces and trenching. At the time of this publication, findings and results of Iowa's safety department (IOSHA) accident investigation had not been completed. This advisory also provides information on how to obtain current copies of safety and health standards. Safety and Health Standards for 29 CFR 1910 (General Industry) and 29 CFR 1926 (Construction) are available at NCDOL/ETTA. Orders are taken and material provided upon request; publications can also be ordered online. Other North Carolina Occupational Safety and Health publications include books, brochures, "Notice to Employees" poster, forms, industry guides, and a publications list. For further information or technical assistance, please feel free to contact:

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Bureau of Education, Training, and Technical Assistance
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North Carolina Department of Labor Web Site
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