



Sewer pipe—inspecting and cleaning

Sewer maintenance and repair operations include many tasks and varied equipment and present a myriad of known, suspected and potential hazards.

1. The operations that involve entering manholes to rod out accumulated concretions and blockages require strict attention to safe practices. This data sheet discusses these practices and what procedures to follow to avoid personal injury.

Contact with sewage

2. Chemical contamination of sewers has been considerably lessened since laws prohibiting unauthorized discharge of chemicals into sewer systems have been enacted in many cities and states. Because of accidents, fires, leakage, bacterial action, oxidation and spills, however, it is possible that oxygen-deficient atmospheres and explosive and toxic gases will be present in manholes and sewers. Therefore, the atmosphere within the confined space must be tested for oxygen deficiency and toxic and combustible gas. Employees exposed to these conditions should wear personal protec-

tive equipment (see paragraphs 33 and 34). Chemicals used for cleaning sewer lines may cause violent reactions. Therefore, employees should be trained in the importance of proper chemical handling and the need for immediate evacuation of manhole or sewer and instant flushing of a line with water. Large quantities of water that are already in a line help reduce this reaction, but the danger from gases and vapors produced still may exist. Therefore, use only National Institute for Occupational Safety and Health-certified respirators suitable for the gas or vapor at the concentrations present. Note: Users must be properly trained in the use of the respirators selected. Air-purifying respirators do not supply oxygen and must not be used if the oxygen concentration is less than 19.5 percent. In such cases, only use positive-pressure, self-contained breathing apparatus or a combination type C-supplied air respirator and SCBA. Employees should wear protective clothing when chemical agents are used for cleaning blocked sewer lines. Gases and vapors from chemicals are dangerous and should not be inhaled. If oxygen concentrations are less than

19.5 percent or toxic atmospheres exceed the permissible exposure limits and entry into the sewer or manhole is necessary, ventilation of the workspace should be instituted, the confined space continuously monitored, and air-line respirator or SCBA should be used.

3. Flooding of manholes has been a frequent cause of injuries. Choked sewer lines are usually cleared from the downstream end; therefore, employees should be trained to detect a sudden release of blockages so they will escape the danger of a sudden flood promptly. Manholes upstream of the one in which the operation is being performed, should be checked before anyone descends to determine the amount of backed-up water and waste. This rule should apply especially where a line extends along steep and lengthy grades, because rapid flooding can be expected from freeing an obstruction. When excessive back-ups are detected, a bulkhead may be constructed in the lines at the upstream manhole, and the sewage removed by pumping.
4. Employees can fall into manholes or fall when they are inside a manhole or sewer. Slippery footing within the sewer, corroded rungs breaking off as an employee climbs into or out of a sewer, and false bottoms due to crustations forming on sewer bottoms are the cause of many injuries. Because head injuries may occur from bumping against objects, such as chemical formations (stalactites) growing on sewer surfaces or other protrusions, it is a good practice to wear approved hardhats.

Hazardous atmospheres

5. The following are hazardous atmospheres encountered in sewers:

a. Flammable - The explosion of a flammable gas or vapors is generally understood; however, it is important to note that a specific gas may be flammable throughout a wide range of mixtures with air. Only testing can determine the existence of such a hazard. If the testing instrument indicates greater than or equal to 20 percent of the lower

flammable limit, also known as the lower explosive limit, do not enter the confined space. Methane, which is used as a fuel at many sewage disposal plants and residences and may be produced by organic decomposition within the sewer lines, is an example of a flammable gas that may be found in a sewer. Other flammable and combustible gases and vapors include:

- Fuel gases, manufactured gas, natural gas and liquefied petroleum gases
- Hydrogen
- Liquid fuel—naphtha, gasoline, kerosene, benzene, etc.
- Solvents—toluene, mineral spirits, alcohols

b. Toxic - Exposure to some gases with no odor, color or taste may be fatal even in very low concentrations. For example, carbon monoxide may be fatal at one-tenth of 1 percent because it accumulates in the body with continued exposure. Certain gases, like hydrogen sulfide H_2S , have paralyzing effects on the sense of smell after the initial exposure. As a result, some people will not be able to detect the smell of H_2S at fatal concentrations. To avoid exposure to hydrogen sulfide, the only safe precaution is use of prescribed testing procedures. The following concentrations of hydrogen sulfide can cause certain symptoms. (see Table 1 on page 3).

c. Oxygen deficiency - Oxygen-deficient atmospheres may occur when a sufficient amount of any combination of harmful gases displaces the amount of oxygen necessary to support life. Testing for flammable/combustible or toxic gases may indicate this condition, but oxygen deficiency also can occur when the oxygen is absorbed by earth strata consumed by microorganisms or is depleted by the oxidation of materials. Such oxygen deficiency can be determined only with an oxygen detector. If the oxygen content is less than 19.5 percent, do not enter the confined space, unless equipped with a positive-pressure SCBA or air-line respirator.

Table 1. Symptoms of exposure to hydrogen sulfide

Concentration (ppm)	Symptoms/ Effects
0.00011-0.00033	Typical background concentrations.
0.01-1.5	Odor threshold (when rotten egg smell is first noticeable to some). Odor becomes more offensive at 3-5 ppm. Above 30 ppm, odor described as sweet or sickeningly sweet.
2-5	Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep. Airway problems (bronchial constriction) in some patients.
20	Possible fatigue, loss of appetite, headache, irritability, poor memory, dizziness.
50-100	Slight conjunctivitis ("gas eyes") and respiratory tract irritation after 1 hour. May cause digestive upset and loss of appetite.
100	Coughing, eye irritation, loss of smell after 2-15 minutes (olfactory fatigue). Altered breathing, drowsiness after 15-30 minutes. Throat irritation after 1 hour. Gradual increase in severity of symptoms over several hours. Death may occur after 48 hours.
100-150	Loss of smell (olfactory fatigue or paralysis).
200-300	Marked conjunctivitis and respiratory tract irritation after 1 hour. Pulmonary edema may occur from prolonged exposure.
500-700	Staggering, collapse in 5 minutes. Serious damage to the eyes in 30 minutes. Death after 30-60 minutes.
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death.

Note: limits of exposure for other toxic gases can be found in OSHA regulations 26 CFR, 1910.1000, Tables Z-1, Z-2.

6. Consider the general health of employees. After exposure to sewage or material within the sewer, provide facilities for removal of contaminated clothing and for wash-up as well as clean, dry clothing. Scrupulous personal hygiene, up-to-date inoculations and prompt attention to cuts and abrasions are required.

Supervision and job instruction

7. In addition to the employee in the confined space, at least one trained and experienced employee should be present at all times during sewer cleaning operations. Before starting these operations, a

supervisor should determine the type of industries served by the particular sewer (to help anticipate the hazardous atmospheres that may be encountered). Employees involved should review all possible hazards, the precautions to be taken and the necessary actions in case of an emergency, including rescue procedures, first aid and CPR.

Entering Manholes

8. Sewers are classified as confined Space, thus requirements for OSHA 1910.146 Permit required entry into confined space must be followed. Because of the potential dangers in sewer cleaning operations, at least two employees should work on every sewer maintenance job, one acting as supervisor. When using either portable-powered equipment or truck-mounted powered equipment, properly block or chock the wheels of a unit to prevent movement during cleaning operations. When truckmounted equipment is used, install an audible back-up alarm on the truck to protect employees working behind the unit.
9. Fixed metal-rung ladders are usually found in manholes. Examine them before use, since the rungs may be corroded after exposure to the elements. For this reason, many municipalities use portable ladders to avoid risking falls from broken metal rungs. Also check the condition of sidewalls for danger of collapse. If a well is found to be dangerous, it may be safer to operate from the next manhole.
10. All employees entering sewer manholes must wear a full-body harness with lifelines attached to a winch or tripod device to permit rapid removal in case of collapse. (The atmosphere can change without warning due to chemicals draining into the sewer.)
11. Smoking or open flames must never be permitted in or near a sewer line, sewer manhole or excavations. Provide sparkproof tools for all manual work to be done in underground structures; and when employees are inside the structure, keep a fire extinguisher readily available at all times. If forced

ventilation is used, ensure the ventilation equipment is intrinsically safe.

- 12.** Before entering a sewer manhole located in an industrial area where there is even a slight possibility of a manufacturing chemical draining into the sewer and creating a hazardous vapor or gas, place an air monitoring device in the manhole in which work is being performed. Continuously monitor the manhole or sewer atmosphere while workers are inside.
 - 13.** Pre-entry precautions against hazardous atmosphere include sampling and testing at all levels within the confined space to detect and monitor the presence of poisonous/toxic or flammable gases or vapors, or an insufficient oxygen supply. If any one of these conditions is detected, thoroughly ventilate the manhole with a forced-air blower to dilute the atmosphere below the PEL and 10 percent of the LEL, whichever is lower. Then retest the atmospheric condition before entry to determine if it is safe. (Forced draft is superior to suction draft; however, enter manholes and sewers with caution, as dangerous pockets of toxic or flammable gases may still be present.)
 - 14.** Locate gasoline- or diesel-powered blowers downwind from manholes to prevent accumulation or introduction of carbon monoxide in the sewer or manhole. Blower intakes should be located where they pick up only fresh air and no engine exhaust vapors.
 - 15.** Explosive/combustible gases can accumulate in sewers with traps, in regulators, and in combination storm and sanitary lines.
 - 16.** Effects of toxic gas may include dizziness or drowsiness. If either of these symptoms is noted, immediately order the employees out of a manhole or sewer.
 - 17.** The symptoms of oxygen deficiency may include difficulty in breathing. If these are noted, immediately order employees out of a manhole or sewer.
 - 18.** If there is an indication of oxygen deficiency or toxic gas greater than the PEL and ventilation will not make the manhole safe, employees should wear suitable NIOSH-certified respiratory protection to enter. This may include positive-pressure SCBA or an air-line respirator with escape cylinder. When any employees are in a manhole under such conditions, a standby employee with a SCBA available, who has been trained in emergency rescue procedures, should remain outside the manhole prepared to assist persons in the manhole, if the need arises.
 - 19.** Investigate the cause of contamination in sewers or manholes that cannot be cleared by ventilation.
 - 20.** Provide sufficient lighting when working in deep manholes or sewers during either day- or night-time operations. Use only approved explosion-proof lights.
- ## Equipment handling
- 21.** Careless handling of equipment can cause injuries, either when materials are passed down to or up from an employee working in a manhole, or while they are being used in a manhole. The use of a tool pouch attached to a rope line is recommended for lowering materials to employees in the manhole.
 - 22.** For shallow manholes (not exceeding six feet deep), where manual rods are used, assemble cutters and rods at ground level. Then lower to employees in the manhole and feed into the sewer. Employees in a manhole should be wearing a safety hat, safety glasses and safety shoes while a rod is being passed down into the sewer. An employee at ground level twists the rod, while the employee in the manhole feeds the rod into the sewer. Extension rods are attached by an employee on ground level.
 - 23.** For manholes deeper than six feet, or when powered equipment, such as water jets or powered rodders, are being used, use a guide pipe or "boot." Thread the manual rod or flexible rope of the powered equipment through the boot, and attach a cutter at ground level. Fit the curved section of the boot into a sewer line, and securely anchor the upper section

with a specially constructed clamp. The top of the device will not extend more than one foot above the top of the manhole. The boot keeps the manual rod or flexible wire in position and eliminates the need for having an employee in the manhole to feed the rod or rope into the sewer. This procedure reduces the dangers of injury to employees in a manhole.

- 24.** When bucket scooping is done, extra care must be taken to ensure employees in a manhole are alert. Use rope lines in good condition. No one should be in the manhole when powered equipment is used. If the controls for powered equipment are located above ground, anyone in a manhole cannot control the hazards to which he is exposed.
- 25.** Good housekeeping around a manhole reduces the overhead hazard to employees below the surface, and helps prevent trips and falls. Keep materials in an orderly fashion and as far away as practical from the edge of an opening. Also, do not allow debris to lie where it can be accidentally kicked or knocked into a manhole.
- 26.** Place manhole covers well away from the work area and away from traffic. Serious injuries have occurred when vehicles strike manhole covers and throw them into nearby employees.
- 27.** The metal rod and cutter used in mechanical rodding can cause serious injuries. Gloves should be worn and extra precautions taken when applying cutting accessories to a rod. Note: Never use cloth gloves in handling sewer rods. Use only rubber or rubber-covered gloves.
- 28.** Cautiously remove manually operated rods. If a rod suddenly springs free from a distorted position and strikes an employee or throws the employee against the wall; arms, hands or other parts may be injured. To minimize this hazard, hold a rod firmly.
- 29.** Rods that are burred or partly fractured can cause injury to an employee, possibly resulting in lost time: Therefore, inspect them after each use.

30. Injuries due to overexertion are common in this type of operation. Workers should stand to the side when pulling rods. When extra exertion becomes necessary, obtain additional manpower or remove the rod mechanically. Pushing rods with jointed sections or exerting pressure against an obstruction is hazardous because of the danger of a sudden collapse of the obstruction or the rod.

- 31.** Turning rods with ratchets is also dangerous and should not be done. Manual push-rodding is considered safer, using a hand crank to turn the rod in or out.
- 32.** Closed-circuit television used for inspection of sewer lines not only saves time, but assists personnel in conducting safer inspection and cleaning operations.

Personal protective equipment

- 33.** Protective clothing required for employees in sewer line cleaning includes rubber gloves, safety hats, safety-toed rubber boots, goggles and raincoats. Respiratory equipment (NIOSH-certified) also should be immediately available for use.
- 34.** After each operation, clean and inspect protective clothing, equipment (such as boots, hats and gloves), and other equipment used in sewer pipe cleaning operations for failures and defects. The clothing and accessories should fit well. During continuous operations, provide clean clothing at the beginning of each shift or workday. Loose or torn clothing is a real hazard when working in the tight confines of a manhole.
- 35.** Publish and follow the rules and procedures determined by job safety analyses or risk assessments. These should include the following procedures: Reporting accidents, emergency calls, use of respiratory protection and safe work practices.
- 36.** All sewer cleaning and maintenance operations, manual or mechanical, can and should be expected to have hazards associated with them. Conscien-

tiously prepared risk assessment and applied JSAs can pinpoint these hazards, show when protective equipment is necessary and provide a training program good for both operating procedures and safety. Well-trained employees, good operating procedures and planned preventive maintenance produce a safe, productive sewer maintenance force.

- 37.** Remember, surveillance and enforcement of safe practices should be paramount in the duties of supervisors and employees at all levels.

Traffic control

- 38.** Traffic and pedestrian barricades are required at all times, even if a job is small and time is short. Sewer employees must realize this protection is important. A flagman should be stationed at least 50 feet ahead of a site, and should be visible to oncoming traffic for at least 500 feet. The actual distance depends on location, speed zone and traffic conditions.
- 39.** On all jobs, sufficient barricades, signs, flashers, high-level warning devices, cones and lanterns should be available in sufficient quantity. (Do not use open-flame warning devices.) Rubber cones may be used for channeling traffic around a site. Arrange advanced warning devices to warn motorists and pedestrians of a hazard and to guide them around the hazard.
- 40.** Protect pedestrians completely. Barricades should have railings extending at least eight inches beyond the edge of an opening. Place battery-operated lanterns or flashers at strategic points around and on barricades. Note: Use only grade D breathing air in airline respirators. Oil-lubricated air compressors may generate harmful carbon monoxide and other gases. If air compressors are used to supply breathing air, they must be equipped with temperature alarms or carbon monoxide alarms as well as air filters.

Source of information

National Safety Council. 1121 Spring Lake Drive, Itasca, IL 60143.

OSHA 1910.146 Permit-required Confined Spaces

National Institute for Occupational Safety and Health, 1600 Clifton Road, Atlanta, GA 30333. Criteria for a Recommended Standard: Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30329-4027 USA Working Safely In Confined Space

Accident Prevention Manual for Industrial Operations, Administration and Programs volume, 14 ed. Job Safety Analysis. Chicago. National Safety Council, 2015