

UTILITY MANAGEMENT

Smoking Out Sewer Leaks: An Overview of Smoke Checks

Smoke testing can be performed to determine the sources of excess inflow

Paul Tashian

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Although video inspection and other techniques certainly are important components of an I&I survey, research has shown that approximately 65% of all extraneous [stormwater](#) inflow enters the system from somewhere other than the main line. [Smoke testing](#) is a method of inspecting both the main lines and laterals. Smoke travels throughout the system, identifying problems in all connected lines. Even sections of line that were not known to exist or thought to be independent or unconnected.

How Sewer Smoke Testing Works

Used extensively for more than 40 years, smoke testing has proven to be a vital

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deteriorating collection systems. In addition, programs such as the U.S. Environmental Protection Agency's (U.S. EPA) new Capacity, Management, Operations and Maintenance (CMOM) program emphasize a focus on proactive, preventive maintenance practices. [Smoke testing](#) can aid in documenting sources of inflow and should be part of any CMOM program.

Just as a doctor would require the aid of several instruments to evaluate the status of a person's health, various test methods should be used in performing a complete sanitary sewer evaluation survey (SSES). In addition to smoke testing, these could include dyed water testing, manhole inspection, TV inspection and [flow monitoring](#). Specializing in [sanitary sewer](#) evaluation surveys, Wade & Associates of Lawrence Kansas reports a reduction of 30 to 50% in [peak flows](#) can be expected as a result of implementing these types of programs.

How do you Smoke a Sewer Line for Testing?

Smoke testing is a relatively simple process that consists of blowing smoke mixed with large volumes of air into the sanitary [sewer line](#) usually induced through the manhole. The smoke travels the path of least resistance and quickly shows up at sites that allow [surface water inflow](#). Smoke will identify broken manholes, illegal connections including roof drains, [sump pumps](#) and yard drains, uncapped lines and even will show cracked mains and laterals, providing there is a passageway for the smoke to travel to the surface.

Although video inspection and other techniques certainly are important components of an I&I survey, research has shown that approximately 65% of all extraneous stormwater inflow enters the system from somewhere other than the main line (see private sector diagram). Smoke testing is a method of inspecting both the main lines and laterals. Smoke travels throughout the system, identifying problems in all connected lines—even sections of line that were not known to exist or thought to be independent or unconnected. Best results are obtained during dry weather, which allows smoke better opportunity to travel to the surface.

Necessary Equipment for Sewer Smoke Testing Blowers

Most [engineering](#) specifications for smoke testing identify the use of a [blower](#), which is able to provide 1,750 cu ft of air per minute (cfm) However, in today's world it seems to be the mindset that bigger is better. New [smoke blowers](#) on the market can deliver more than 3,000 cfm. The question is: Is this really needed? Once the manhole area is filled, the smoke only needs to travel sections of 8- or 10-inch [pipe](#). Moving the air very quickly is useless if the blower does not have the static pressure to push that air/smoke through the lines. If you have used high cfm blowers and found that smoke frequently backs up to the surface, this may be the problem.

There are two types of blowers available for smoke testing sewers: squirrel cage and direct drive propeller. In general, squirrel cage blowers usually are larger in size but can provide more static pressure in relation to cfm. The output of the squirrel cage type usually is adjustable by alternating pulleys and belts to meet the demands of the job. Propeller-style blowers usually are more compact and generally offer

smoke blower, you should ask the manufacturer if the cfm and static pressure output it is quoting is the specification of the propeller itself (uninstalled/free air) or if it is the actual performance when installed in the blower assembly. These two numbers can vary significantly.

Smoke Types

There are two types of smoke currently offered for smoke testing sewers: classic smoke candles and smoke fluids.

Smoke candles first were used for [testing sewers](#) when the process began its popularity in 1961, and continue to be the most widely used. They are used by simply placing a smoke candle on the fresh air intake side of the blower. Once ignited, the exiting smoke is drawn in with the fresh air and blown down into the manhole and throughout the system. Smoke candles are available in various sizes that can be used singularly or in combination to meet any need. This type of smoke is formed by a chemical reaction, creating a smoke that contains a high content of atmospheric moisture. It is very visible even at low concentrations and extremely effective at finding [leaks](#).

Another available source of smoke is a [smoke fluid system](#). Although they just recently have been more aggressively marketed, smoke fluids became available for [sewer testing](#) shortly after smoke candles, some 30 years ago. They certainly can be used effectively, but it is important to understand how they work. This system involves injecting a smoke fluid—usually a petroleum-based product—into the hot exhaust stream of the engine where it is heated within the muffler (or heating chamber) and exhausted into the air intake side of the blower. One gal of smoke fluid generally is less expensive than 12 smoke candles. However, smoke fluids do not consistently provide the same quality of smoke. When using smoke fluid, it is important to understand that as fluid is injected into the heating chamber (or muffler) it immediately begins to cool the unit. The [heating chamber](#) eventually will reach a point where it is not hot enough to completely convert all the fluid to smoke, thus creating thin/wet smoke. This actually can happen quickly depending on the rate of [fluid flow](#). If the smoke has become thin, it can be especially difficult to see at greater distances. Blocking off sections of line usually is a good idea with any type of smoke but becomes almost a necessity when using smoke fluid. Some manufacturers have taken steps to address this issue and now offer better flow control, fluid distribution and, most importantly, insulated heating chambers to help maintain necessary temperatures.

Safety

Maybe one of the more talked about, yet least understood aspects of smoke testing is the use and safety of these products. As manufacturers have become more competitive, some marketing programs and advertisements have implied danger in the use of competing types of smoke products. Laboratory reports, scientific studies and even Material Safety Data Sheets can be quite confusing to most people who are not trained nor qualified to make scientific judgements on this data. Having this information delivered to the public in the form of advertising can be dangerous, as

Although the author quotes no scientific literature to support this statement, competitive propaganda has made such implications. It is interesting to note that the same exact statement could be made for smoke fluids. Smoke from fluid is created in the exhaust system of the engine, which contains carbon monoxide.

Other statements that have been made include warnings to wear a respirator while smoke testing. While certain manufacturers have issued this warning about competitive products, they do not qualify the statement, nor do they mention the fact that the same thing could be said of similar products. The fact is that a respirator should be worn whenever a person would be exposed to any substance in quantities that exceed OSHA limits. Would smoke-testing personnel be exposed to enough smoke to exceed these limits? Not very likely. The bottom line on safety is that it is important to use common sense. All smokes, candles and fluids can be used safely and effectively when used as directed.

When planning to smoke test, it is important to develop a proactive public notice program. Ads in local papers, door hangers, mailers and door-to-door inquiries are recommended. It is helpful to educate the public as to why the test is being performed and the positive benefits to the community. In addition, it should instruct residents on what to do and who to call if smoke should enter their homes. It also is important to notify local police and fire departments daily as to where and when smoke testing will be taking place.

Reducing [stormwater inflow](#) into [collection systems](#) means reduced chances of [overflows](#), less emergency maintenance and less money spent on treatment.

This article was originally published on Nov. 13, 2002. It has been revised for clarity.

About the Author

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