Dialectic
ENGINEERING

Is Sewer Gas Giving Your Customers the Wrong Impression?

Prepared by Dialectic

310 W. 20th St., Ste. 200, Kansas City, MO 64108 816-997-9601 DialecticEng.com

INTRODUCTION

We've all been there. You walk into a public restroom and you immediately wonder if one of the toilets is overflowing. After a quick inspection, you notice that the restroom is clean but there is a foul fog in the air. You're thinking, "This place must not be as clean as it looks!" But is that fair? The restroom in your own establishment may be sparkling clean but it could also be giving your customers an air of uncleanliness about your entire business. And you already know, if you sell food products, that is bad news.

So where is the bad air coming from?

More importantly, how can you keep it smelling like roses?

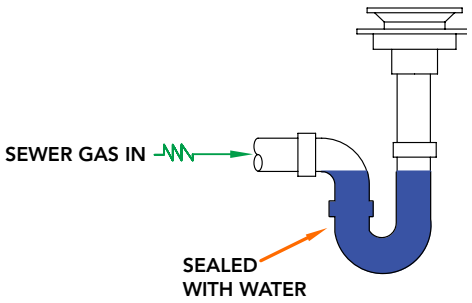
Dialectic ENGINEERING

310 W. 20th St., Ste. 200, Kansas City, MO 64108 816-997-9601 DialecticEng.com

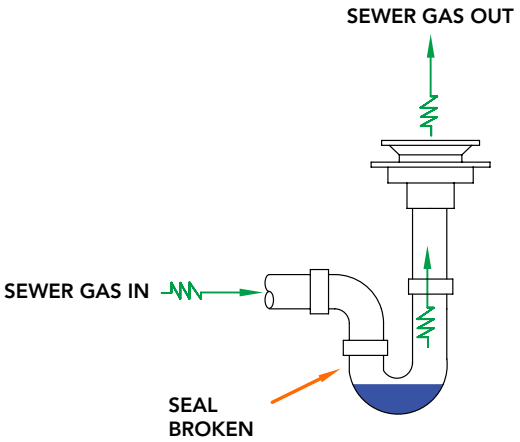
Why are you having this problem?

Certainly cleanliness is a virtue but the bad smell you are experiencing may have nothing to do with it. The smell could be coming from a perfectly clean restroom, kitchen, mechanical room, or water service room. The most common cause of this nuisance is that the water in a nearby floor drain or floor sink trap has evaporated, creating a pathway for sewer gas to escape into the space. This most often happens because floor drains collect little water since their purpose is to drain overflow of a plumbing fixture when necessary, or because today's methods of floor cleaning introduce very little water into the floor drain. Both of these factors contribute to the traps drying out through evaporation. Floor drains, floor sinks, trench drains and sinks have a P-trap (plumbing trap) beneath them that holds (traps) water in it specifically for the purpose of blocking bad-smelling air and/or sewer gas from entering the occupied space. You may have thought this trap was for catching wedding rings and small toys that go down the drain, but it serves a more important purpose.

We all know that the sewer pipes in our homes and businesses carry a mixture of waste and water away to be treated and, hopefully, reused. What you may not know is that to function properly, sewer pipes do not flow full of liquid. The pipes are filled partially with gas and partially with sewage. Given that sewage flows through sewer waste pipes, the gas isn't exactly "fresh." This gas is a mixture of gases, both toxic and nontoxic, that collects in the pipe from the decomposition of the waste. Especially since the advent of low-flow faucets and toilets (plumbing fixtures designed to work with very little water), waste tends to "hang out" and take longer to move through the piping system to the public sewer main waste line due to lower volumes of water being flushed. This allows even more time for the waste products to decompose and for gases to build up. These gases expand, which creates a need for the pressure to be released from the pipe, but hopefully through a dedicated vent pipe outlet and not forced through a P-trap into your shiny clean restroom.



FLOOR DRAIN TRAP SEAL



DRY TRAP

Let's look at why a P-trap, most commonly called a trap, dries out. What must happen to allow that "odiferous bouquet" to enter your space?

Although the purpose of a trap is to hold water that acts as a seal to keep bad-smelling air from escaping, traps do not have to be completely empty for sewer gas to begin seeping past the seal into the room. A trap only needs to lose sufficient water for the trap seal to become shallow enough that sewer gas can pressure its way through. For this reason, a trap that is slowly losing water through evaporation will eventually result in trap failure. Drains that receive little or no water are clearly more prone to dry out than those that are used often. Traps commonly receive water from mopping, spills, trap primer devices and even from purposefully pouring water into them to keep them full. Besides evaporation, there are other ways traps can dry out.

What can cause a trap to dry out?

Siphoning

Sanitary waste piping is designed to flow half full of liquid. The top half can allow air flowing above to displace the water and waste running down the drain, minimizing any potential pressure from forming. This allows for an even flow down the drain. There are locations within a sanitary waste system where this rule of flow naturally does not occur. At the base of stacks where water is traveling vertically and changes direction to horizontal flow, there is a region where turbulence in the water causes this natural flow of air to be disrupted. A slug of water is produced that fills the entire pipe for a short distance. This slug of water can be traveling quickly due to gravity.

When floor drains or traps are connected to this main horizontal line within this region, it is possible for this slug of water to create positive pressure as it arrives and negative pressure as it passes by. Potentially, this can syphon water out of traps as the system is attempting to equalize pressure by pulling air thought the trap. This can also happen near water closets, where similar flow characteristics are possible. For this reason, code requires all horizontal branches to connect to a main sewer line outside of this turbulent area a minimum distance from the stack where flow has been able to achieve equilibrium.

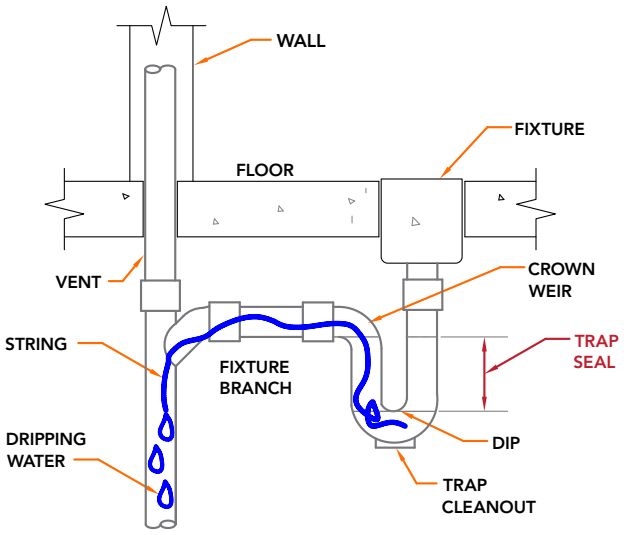
For the International Plumbing Code (IPC) this distance is given as 10 times the diameter of the drain pipe the branch connects to. When waste and vent systems are installed properly in accordance with code the risk of siphoning traps is greatly reduced. For high rise construction additional venting precautions are required to handle these waste slugs in tall vertical waste risers and where there are changes of direction, which is not part of this article.

Evaporation

Standing water in a P-trap, is by its nature, prone to evaporating. The surface water within the trap evaporates slowly into the ambient air in the room, and can continue to do so until the trap seal is broken. The rate in which a trap dries out due to evaporation will vary based on multiple factors such as the ambient air temperature, air flow in the room, humidity, and the surface area of the water exposed to air (a larger trap has more surface area exposed but has a larger trap, so these may offset each other). A trap seal device (when approved by code) can help eliminate the risk of evaporation since it will not allow the water to evaporate into the room.

Capillary action

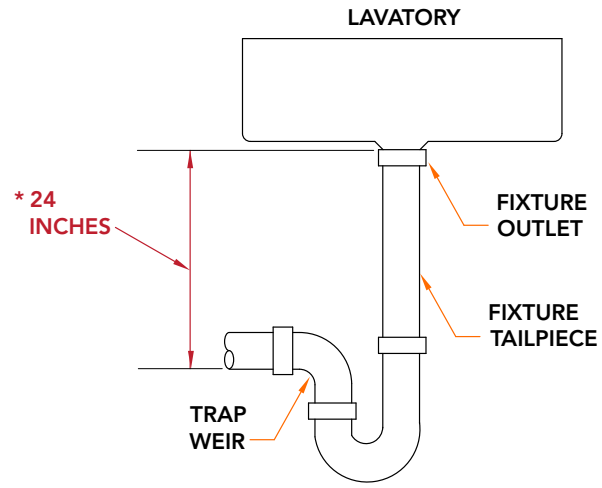
In some cases, traps can slowly have the water pulled out of them by means of capillary action. It is common for items like mop head threads, hair, and other thread-like items that end up in the drainage system. When one end of a thread, string, or similar object is located in the trap, and the other end is on the drain side of the P-trap, capillary action can cause the thread or hair to act as a wick that can slowly pull water out of the trap in a similar way that wax is pulled up through the wick in a candle. This can often be the case where traps are running dry in showers, lavatories, mop sinks and floor drains. Cleaning the trap can help resolve this issue.



CAPILLARY ACTION

Velocity

Similar to the conditions in stacks that can cause a siphon at a branch connection, it is also possible for water to move quickly through a trap and create a siphon within the trap itself, pulling water out of the trap and down the drain. When a tailpiece or inlet pipe serving a P-trap is too long it allows the water traveling down the drain to pick up speed due to gravity. Once this water hits the bottom of the trap it fills the pipe, and as it exits the trap, it creates a negative pressure that can pull water from the trap. Please keep in mind that a trap does not need to be completely emptied of water to fail. It only needs to lose enough water to allow pressure to break through the trap seal.



*MAXIMUM DISTANCE FROM FIXTURE OUTLET TO TRAP WEIR

VERTICAL DISTANCE OF TAILPIECE DROP

What can you do to help prevent a sewer gas problem?

So now you know why you could be having a sewer gas problem. What can you do about it? There are various ways you can prevent sewer gas from leaking into your space from traps. The solution you choose will be dependent on your situation and local code requirements. Luckily you have a variety of options. We'll explore what the plumbing codes have to say about the subject a little further on. For now, let's examine some common devices used to solve and prevent the problem.

Trap seal types

Automatic (electronic) trap seal primers

Pros

- Electronic solenoid operated valves sometimes known as automatic trap primers
- Solenoid valve and a timer to allow water to enter trap

Cons

- Costly compared to other types of devices
- Requires electricity

Automatic trap seal primer

Continuous flow trap seal

Pros

- Original style of trap seal primer
- Cast brass or bronze with a neoprene float inside the device that rises when water flows through it
- Amount of water directly related to the amount of flow through device

Cons

- Prone to clogging, no means of screening out line debris
- Requires maintenance
- Correct placement needed – drain may not receive water if the seal is not placed before the fixture

Flush valve trap seal primers

Device installed below flush valve to direct water to floor drain every time flush valve is used.

Flush valve trap seal primer

Photo Credit: Dialectic

Pressure-drop-activated trap seal primers

Pros

- Valve actuated by pressure differential
- Device seals the water line when line pressure is static
- When line pressure drops, as little as 3 psi, a metered amount of water flows into trap
- Must be installed on a water line with recurrent pressure drops, such as a water closet or sink

Cons

- Needs occasional maintenance
- Correct placement needed – drain may not receive water if seal is not placed before fixture

Pressure activated trap seal primer

Photo Credit: Dialectic

Waterless trap seal protection device

Pros

- Barrier-type device installed in the drain line at the floor drain or sink.
- Cheaper alternative
- Maintenance free

Cons

- May not be approved in all jurisdictions

Trap seal protection device

P-trap tailpiece primer

Pros

- Gravity feeds floor-drain trap primer connection
- No mechanical parts
- No access doors
- Uses the "head" of waste water in a P-trap during usage – diverts a small amount of the waste water into the line connected to the trap to "prime" the floor drain
- Considered a "green" trap priming alternative, uses the water that would have gone through the toilet anyway

Cons

- Could become clogged and require maintenance
- Location is dictated by fixture location which could place them too far from the floor drain

P-trap tailpiece primer

Deep seal P-traps

Pros

- Trap seal depth of 4" or more
- Greater capacity of liquid in trap seal – less likely to lose its seal

Cons

- Deeper larger trap is tougher to fit into tight spaces
- May not meet code required of "trap seal protection"

What does the plumbing code recommend?

The plumbing codes have a lot to say about trap protection.

2018 Uniform Plumbing Code (UPC)*

1005.0 Trap Seals.

1005.1 General. Each fixture trap shall have a liquid seal of not less than 2 inches and not more than 4 inches, except where a deeper seal is found necessary by the Authority Having Jurisdiction. Trap shall be set true with respect to their liquid seals and, where necessary, they shall be protected from freezing.

1007.0 Trap Seal Protection.

1007.1 General. Floor drain or similar traps directly connected to the drainage system and subject to infrequent use shall be protected with a trap seal primer, except where not deemed necessary for safety or sanitation by the Authority Having Jurisdiction. Trap seal primers shall be accessible for maintenance.

1007.2 Trap Seal Primers. Potable water supply trap seal primer valves shall comply with ASSE 1018. Drainage and electronic design type trap seal primer devices shall comply with ASSE 1044.

The UPC doesn't allow deep seal traps unless approved on a case-by-case bases.

2018 IPC*

1002.4 Trap Seals. Each fixture trap shall have a liquid seal of not less than 2 inches and not more than 4 inches, or deeper for special designs relating to accessible fixtures.

1002.4.1 Trap Seal Protection. Trap seals of emergency floor drain traps and trap seals subject to evaporation shall be protected by one of the methods in Sections 1002.4.1.1 through 1002.4.1.4.

1002.4.1.1 Potable water-supplied trap seal primer valve. A potable water-supplied trap seal primer valves shall conform to ASSE 1018. The discharge pipe from the trap primer valve shall connect to the trap above the trap seal on the inlet side of the trap.

1002.4.1.2 Reclaimed or gray water-supplied trap seal primer valve. A reclaimed or gray water-supplied trap seal primer valve shall conform to ASSE 1018. The quality of reclaimed or gray water supplied to trap seal primer valves shall be in accordance with the requirements of the manufacturer of the trap seal primer valve. The discharge pipe from the trap seal primer valve shall connect to the trap above the trap seal, on the inlet side of the trap.

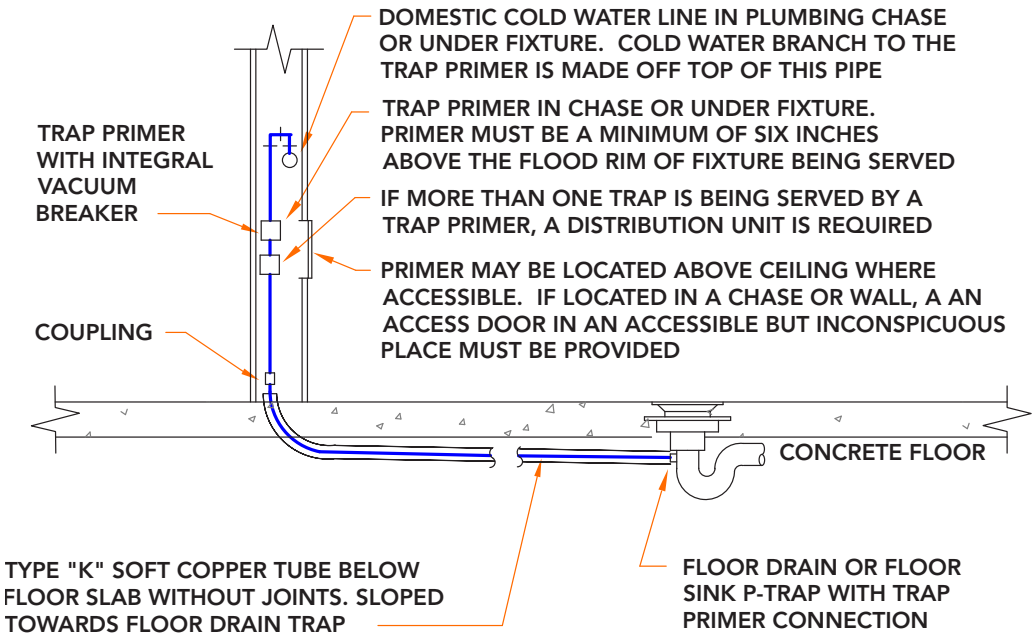
1002.4.1.3 Waste water supplied trap primer device. A waste water-supplied trap primer device shall supply water to the trap. Waste water-supplied trap primer devices shall conform to ASSE 1044. The discharge pipe from the trap seal primer device shall connect to the trap above the trap seal on the inlet side of the trap.

1002.4.1.4 Barrier-type trap seal protection device. A barrier-type trap seal protection device shall protect the floor drain trap seal from evaporation. Barrier-type floor drain trap seal protection devices shall conform to ASSE 1072. The devices shall be installed in accordance with the manufacturer's instructions.

Note, the IPC also doesn't allow deep-seal traps on standard installations, only special designs due to accessibility. It does, however, allow a variety of solutions to infrequently used floor drains.

*Information also relevant to older versions of this code.

Design and installation considerations



TRAP PRIMER

- All connections between the sewer system and potable water requires protection from contamination. All primers are manufactured or fitted with a device that prevents cross- contamination. Many jurisdictions require an air-gap fitting.
- Water type and pressure-differential-actuated valves should be installed at least six (6) inches above the floor drain.
- Supply connection line to be installed with a vertically raised elbow, so debris can't enter the primer and cause it to malfunction.
- Trap primers with moving parts will eventually need to be replaced, repaired, or cleaned, requiring an adequately sized access door.
- A shut-off valve should be installed before the primer for ease of repair and maintenance.
- The primer line should be thoroughly flushed prior to installation. These lines are small and prone to clogging and if the line is not clean when installed there is no hope the floor drain will see any water.

CONCLUSION

There is a lot to consider when choosing the appropriate form of trap protection and it merits careful consideration. In the world of first impressions, the last thing you want to do is leave your customers with the impression that your business "stinks."

99¢ air fresheners are not the solution.

At Dialectic, our experienced plumbing engineers will help you make an informed decision on what is the best practice for trap protection for your project or business.

REFERENCES

2018 International Plumbing Code (IPC). International Code Council, Inc.

2018 Uniform Plumbing Code (UPC). International Association of Plumbing and Mechanical Officials.