Preface: Why Such a Large Manual?

Yes, the manual is extensive, and there is a good reason for that. The manual is designed to educate homeowners who might not know much about the critical elements of an AC system and how these elements affect overall performance, especially the drain system. By reading this manual, you will gain a solid understanding of what a proper installation should look like. If you need to call in a professional to correct problems, you will be informed and confident.

After many installations, I noticed that clogged drain lines often resulted from a poor installation of the AC system cabinet, improper drain line construction, and sometimes both. While a typical Zoog Zapper installation takes only about thirty minutes, I usually spend an average of one to two hours on-site. Sometimes, opening an AC cabinet is shocking – coils packed with dirt, the AC cabinet flooded with water (condensate), and bacteria clumping in the drain pan and drain line.

There is a reason for the mess, and I always fixed/improved what I could which most of the time included modifying/rebuilding the drain line. Going the extra mile prevented further system clogs.

AC systems come in many variations, so I have included plenty of examples to help you feel comfortable when you open your AC's front panel. Thoroughly cleaning a system takes time but it is essential to start things off right. Many systems I encounter are old and have years of bacteria buildup. The best way for a homeowner to clear the drain line is by flushing the line with a hose, which is why I developed and provided the "ZoogFlush" kit. Additionally, the "ZoogOut" vacuum adapter allows you to occasionally vacuum out the drain line easily and quickly.

The objective of the Zoog Zapper system is to provide homeowners with all the information and tools necessary to prevent their drain line from ever clogging again, combined with selecting a very formidable, inexpensive, and readily available sanitizer solution. I do not like to be taken advantage of with subscription programs or "proprietary" chemical potions.

Every week, I maintain our pool because neglecting basic maintenance will quickly turn the water green. Maintaining an air conditioner system is much easier than a pool but still requires some level of ongoing care. I have developed and provided the tools to make this maintenance as simple and quick as possible, saving you from expensive service calls and AC shutdowns on holidays….

Although this manual is lengthy, the time you spend reading this manual will be well worth it. The manual will hopefully equip you with enough knowledge to avoid being taken advantage of by vendors and ensure your AC system runs smoothly for years to come!

Rich

Liability Disclaimer

The Zoog Zapper by AC Drain Line Cleaners LLC is designed to help minimize and reduce the occurrence of clogs in air conditioner drain lines. However, AC Drain Line Cleaners LLC makes no guarantees or representations that your air conditioning system will never experience clogging, overflow, or related issues that could lead to water damage.

Water Damage Disclaimer:

AC Drain Line Cleaners LLC shall not be held liable for any water damage, property damage, or losses resulting from clogs, blockages, or overflow of air conditioning drain lines while using our products. Numerous factors that may contribute to potential water damage are outside of our control, including but not limited to:

- Improper or substandard installation of the air conditioning system or components
- Lack of or failure of safety switches and overflow protections
- Age, wear, and deterioration of drain lines and related plumbing
- Environmental factors, debris accumulation, microbial buildup, or other conditions that may block the drain
- Failure to follow our product's recommended installation, usage, and maintenance guidelines

Users assume all responsibility for ensuring the proper installation, maintenance, and monitoring of their air conditioning systems and related components. Regular inspections by a qualified HVAC professional are highly recommended to mitigate risks of water damage and other issues.

By using this product, the user agrees to hold AC Drain Line Cleaners LLC harmless from any claims, damages, or losses arising from system failures, clogs, or water damage that may occur.

Zoog Zapper Installation Manual

Rev 4.6

Table of Contents

Section #1 - What is the Zoog Zapper?

The Zoog Zapper is more than just one product, the Zoog Zapper is a robust "Clog Prevention Program" consisting of three essential components: the "Zoog Zapper Automatic Sanitizer Dispensing System," the "ZoogFlush" drain line flush kit, and the "ZoogOut Universal Vacuum Adapter." Our goal is to equip and enable our customers with everything they need to prevent their AC systems from ever clogging again, and should there be an issue, giving them the tools to remedy the situation quickly and easily themselves. The Zoog Zapper Automatic Sanitizer Dispensing System is innovatively designed to prevent bacterial growth within the entire condensate collection and removal system.

Specifically, the Zoog Zapper targets Zoogloea, a disruptive type of bacteria that can proliferate unchecked and completely obstruct the condensate drainage system, causing operational issues and potentially costly repairs. The Zoog Zapper automatically dispenses a targeted, bacteria-killing sanitizing chemical at regular (and customizable) intervals into the air conditioner's condensate collection and removal drain system, effectively preventing Zoogloea growth.

Complementing the dispensing system is the "ZoogFlush" drain line flush kit, which makes flushing the drain line with water very convenient.

The internal condition of any drain line is the wildcard in the "clogging equation" as we cannot see inside the drain lines. Vacuuming out a drain line only removes what is floating/loose within the drain lines but does not remove what is basically glued to the walls of the piping (think clogged arteries). Flushing the drain line with water at system installation will help greatly to dislodge this stubborn bacteria, followed by an occasional flushing once or twice a year.

The "ZoogOut Universal Vacuum Adapter" is the third piece of the bacteria busting triad which allows for easy occasional vacuuming of any size drain line up to 2.5" in diameter.

The patented cone design allows multiple size wet/dry vacuum hoses to be used to connect to multiple sized drain lines.

An occasional vacuuming of the drain lines which takes just minutes helps to guarantee a clean drain line!

Combined together, these three devices help to ensure that clogged drain lines are a thing of the past!

“Treat the Trough”

What especially distinguishes the Zoog Zapper from any other system on the market is the automatic, consistent, and precise dispensing of a bacteria-targeted sanitizing solution directly into the air conditioner's drain pan.

The fundamental principle behind the Zoog Zapper design is to "Treat the Trough," focusing specifically on sanitizing the complete drain pan by dispensing sanitizer into the individual drain troughs. This targeted design ensures effectiveness and efficiency in combating bacterial growth.

These pictures provide an example of a customer’s fully clogged internal main drain outlet of an attic installed air conditioner. The bacteria (Zoogloea) has proliferated unimpeded inside the air conditioner cabinet and has fully blocked the drain outlet, and the drain line causing water to overflow the drain pan. The safety cutoff switch was also fully clogged and could not operate. The float was mired in bacteria and was stuck!

A critical factor contributing to Zoogloea proliferation is the cost-cutting shift by air conditioner manufacturers from copper to aluminum tubing in evaporator coils. Water flowing over copper tubes generates copper ions, which have antibacterial properties, making older AC units less prone to clogging. In contrast, condensate flowing over the newer aluminum tubes lacks these antibacterial properties, allowing Zoogloea bacteria to thrive unchecked. This transition to aluminum tubing exacerbates Zoogloea proliferation and many homeowners are shocked at how quickly the AC system clogs – and shuts down.

Clogging can also be affected by external factors, for instance homes with pets that shed typically have a higher incidence of clogging.

This is a video of a clogged drain pan in a garage installed air conditioning system showing how the Zoogloea can build up internally in the drain pan and clog the drain outlet:

What the Zoog Zapper is Not

The Zoog Zapper is designed to be a largely "set it and forget it" device, delivering reliable performance with minimal intervention. However, some drain systems may be highly susceptible to clogging due to factors beyond control, which are detailed in this manual. While some of these issues can be corrected, periodic maintenance is still recommended to ensure optimal performance. This includes occasional vacuuming of the drain system and flushing the system with water from a hose approximately every six months. The tools provided make both tasks simple and convenient.

The primary goal of the Zoog Zapper is to dispense sanitizer at regular intervals sufficient to prevent clogs until the next servicing. Maintenance tasks can be easily managed by homeowners using the ZoogOut and ZoogFlush devices. These tools allow for quick and effective cleaning, often taking just a few minutes, and can help avoid the expense of an AC service call.

Skill Level Required

The Zoog Zapper system is specifically designed for homeowners who wish to install the system themselves. The installation process requires minimal technical skill, making it accessible for individuals without technician-level expertise. This manual is written with homeowners in mind and provides a comprehensive overview of proper air conditioner drain line system designs, the diverse types of AC evaporator coil configurations, and detailed step-by-step installation instructions.

To complete the installation, basic tools are required. At a minimum, a 5/16" or 1/4" nut driver is needed to open the AC cabinet for internal access to install the tubing. A pair of diagonal pliers may be required to cut wire ties, and a scissors may be useful for cutting the provided aluminum tape (a one-foot length is included) to seal any openings.

It is crucial to read the entire manual before beginning the installation. This will help you familiarize yourself with the process, understand the components included, and identify potential differences in air conditioner designs. If, after reviewing the manual, the installation feels too complex, consider hiring a handyperson or AC technician to assist.

The first installation typically takes 30 minutes to an hour. However, many installations reveal issues that need to be addressed, such as significant bacterial buildup or problems with the existing AC system design. These challenges, while not always apparent to a homeowner, become more evident after reviewing the manual. By following this guide, homeowners will gain valuable insights into their AC system, enabling them to identify and correct issues effectively.

Opening up an AC cabinet can be shocking:

These three pictures are from the same unit that had been serviced three weeks previously, which at a minimum included a filter change. It is obvious that something is very (very) wrong, and there was. What should have been a quick Zoog Zapper installation became something else altogether…

This manual includes numerous pictures and examples of actual installations, offering a comprehensive overview of the process. For further insights, the website provides case studies showcasing installations across various system types, which can be accessed at AC Drain Line Cleaners Installation Case Studies.

The Installation Process Steps

These are the basic steps installing the Zoog Zapper system. Read this manual in its entirety before attempting the installation. Understanding the process and components will facilitate a simple and quick installation.

1) Vacuum the drain line with the ZoogOut vacuum adapter and a wet/dry vacuum.
2) Install the ZoogFlush kit so the drain line remains intact. Modify the drain line if necessary (per the manual).
3) Power off the AC system.
4) Remove the front panel of the system which covers the evaporator coil.
5) *(AC Technicians would also remove the second panel to gain access to the internal wiring, connect the 24VAC converter to the internal transformer power and then replace the panel.)*
6) Clean the drain pan thoroughly of any present visible Zoogloea bacteria.
7) Pour either Vinegar, Bleach, or a drain cleaner like "Drain Solve" into the drain pan front trough so the chemical flows through the trough and into the drain line. (let the chemical sit)
8) Place the Reservoir Holder on the AC cabinet (via magnets) or optional wall mounting.
9) Route the dispense tubing from the pump into the AC cabinet.
10) Route and secure the internal dispense tubing and place the dispense nozzles into position.
11) Connect the power source to the pump.
12) Press the pushbutton two times and when the pump starts running verify no condensate is being drawn into the tubing (this verifies the nozzles are not submerged in condensate). Press the pushbutton one time to stop the pump.
13) If the tubing was extended, calibrate the pump (Command #7).
14) Pour water into the drain pan front trough to flush out any remaining chemical.
15) Flush the drain line with water using the ZoogFlush hose adapter.
16) Vacuum out the drain line to empty the line of standing water.
17) If desired, change the dispense interval (default setting is seven days) (Command #6).
18) Fill the Reservoir with **HOT** water.
19) Add the packet of Steramine tablets.
20) Press the pump pushbutton two times (mixes for seven minutes, then pumps two cups).
21) Observe the pumping operation and verify the Steramine flows properly through the drain pan and out to the drain line.
22) Top off the Reservoir with hot water so the Reservoir is full. (Just pour into the lid opening)
23) Close the cabinet.

Installation Particulars

The installation process allows for flexibility, including the option to extend the dispense tubing to any required length, with detailed instructions provided in the manual. Additionally, the dispensing interval and the amount of sanitizer dispensed can be easily adjusted, and step-by-step guidance for these customizations is fully explained.

As with any task, the first attempt at installation may be the most challenging. Whether you are a homeowner installing the system for the first time or a professional technician, thoroughly reading the manual is essential for successful installation and proper maintenance.

By following the detailed instructions, utilizing the supplied components, and allowing the Zoog Zapper to maintain a consistent dispensing schedule, future drain clogs will be effectively prevented.

Section #2 – The Basics

There are three fundamental concepts which need to be understood and adhered to as much as possible prior to installing the Zoog Zapper system:

1) The air conditioner evaporator cabinet and drain line must be properly installed to ensure optimal performance. Unfortunately, many AC systems and their associated drain lines are marginally or improperly installed, leaving most homeowners unaware of potential issues. Improper installations can negatively impact system operation and significantly increase the risk of drain line clogs.

   Proper drain line construction is particularly critical, as many systems could benefit from physical improvements to promote efficient condensate drainage. The goal of all AC systems is to expel condensate from the internal drain pan and drain line as quickly as possible. Lingering condensate creates a breeding ground for bacteria, increasing the likelihood of clogs. To address these issues, this manual includes a dedicated section that provides educational guidance on system installation, drain line operation, and construction techniques to optimize the drain system if necessary.

   While modifying or improving the drain line may be beyond the capabilities of most homeowners, this information is included to educate and empower. Homeowners who choose to have their drain piping upgraded will be better equipped to understand proper design principles and ensure the modifications enhance the system effectively.

2) The air conditioner's internal drain pan, and entire drain line system should be thoroughly cleaned or cleared during the Zoog Zapper installation. Since the internal condition of the drain piping (such as the percentage of clogging) is typically unknown and cannot be visually inspected, it is advisable to flush the drain line with water. This establishes a clean baseline and helps dislodge as much existing bacteria as possible.

   The included ZoogFlush kit offers a simple and effective solution for flushing the drain line. For detailed instructions, refer to Section #4 of this manual, which is dedicated to thoroughly cleaning the condensate collection and removal system.

3) Dispensing the sanitizer inside the air conditioner cabinet and directly into the drain pan is essential to ensure effective sanitization of the entire condensate collection and removal system. Focusing solely on external drain lines will not prevent internal Zoogloea growth, which can lead to clogs at the drain pan outlet.

   If the drain pan outlet becomes clogged, the consequences depend on the presence of a safety cutoff switch. Systems with a safety switch will shut down to prevent overflow, but those without a switch risk condensate overflowing the drain pan, potentially causing considerable damage to surrounding areas. Proper sanitizer placement is key to maintaining system functionality and avoiding costly damage.

All the necessary components are provided to facilitate the installation of the Zoog Zapper on any AC system and are explained in detail!

Note: The Zoog Zapper can still help prevent clogs even if the conditions in items #1 and #2 are not ideal.

However, if the sanitizer is not dispensed directly into the internal drain pan, there is a significant possibility or probability that the drain pan and drain outlet area may eventually clog.

If, for any reason, the sanitizer is not dispensed inside the cabinet, it is essential to open and clean the air conditioning system cabinet at least every six months to prevent buildup and potential clogging.

Inside the cabinet is where Zoogloea begins to grow…

Section #3 - Proper Drain Plumbing Design

How Did We Get Here?

In 1902, Willis Carrier revolutionized the world by inventing the air conditioning system. He discovered that compressing and then expanding gas inside a metal tube makes the tube cold. Blowing air over these cold tubes creates cool air! The expanded gas is then sent to the outdoor condenser unit, where it is compressed again before returning to the indoor cooling tubes, known as the "Evaporator Coil."

This cooling process also generates "condensate," which forms as warm air passes over the cold tubes. The tubes "sweat" water, which trickles down into a drain pan located beneath the evaporator coil. The drain pan is tilted so the water flows to a drain hole, allowing the condensate to exit through pipes leading to a drain or outside.

While this system is straightforward in concept, issues can arise if the drain system is not properly designed or constructed. Bacteria such as Zoogloea can grow in the drain system, leading to clogs in the drain pan or pipes.

For optimal performance, condensate should exit the drain pan immediately and flow efficiently to the outlet. Poor drainage can cause standing water, which promotes bacterial growth. Each drain system is unique, and some may have physical limitations that increase the risk of clogs. While some drain line issues can be easily resolved, others may require professional assistance due to the location or complexity of the AC cabinet.

This section aims to help homeowners understand how a drain line should be configured and recognize if improvements are needed. A well-designed drain system, paired with regular use of a sanitizing solution, can significantly reduce the risk of clogs.

By learning the basics of good drain line design and addressing potential issues, homeowners can ensure their air conditioning systems run efficiently and remain clog-free.

Why Does the Bacteria Problem Seem to Be Getting Worse?

The issue of bacterial growth in air conditioning systems has been worsening over time. Historically, evaporator coils were constructed using high-quality copper tubing, which is an excellent thermal conductor. An added benefit of copper was its ability to produce anti-bacterial copper ions as condensate flowed over the tubes, helping to naturally suppress bacterial growth.

In recent years, however, AC manufacturers have shifted to using less expensive aluminum tubing for evaporator coils. Unlike copper, aluminum does not generate anti-bacterial ions, leaving nothing to inhibit bacterial growth. As a result, newer AC systems with aluminum coils are far more prone to bacterial buildup and clogs compared to older systems with copper tubing.

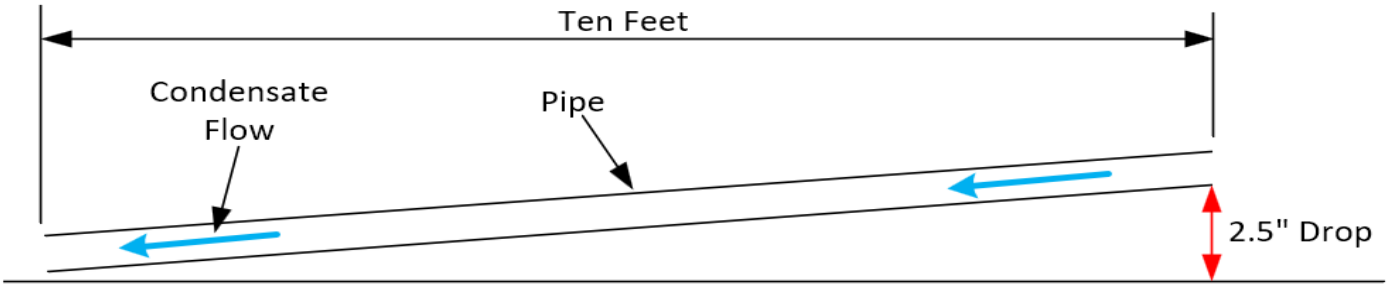
This lack of bacterial suppression is why the Zoog Zapper system was created.

Drain Line Slope

A critical aspect of a well-functioning condensate drain system is the "tilt" or slope of all horizontal piping. Since condensate relies solely on gravity to flow out of the system, the drain line must be angled downward to ensure proper drainage. There is no pressure to force the water through the pipes, so the slope is essential to help the condensate move "downhill" and exit the system effectively.

The drain piping should have a consistent downward angle, referred to as the “slope.” The greater the slope, the easier it is for condensate to flow. Industry standards recommend a minimum slope of **one-quarter inch per foot of pipe**, though increasing the slope whenever possible will further improve drainage and reduce the risk of clogs.

If a length of pipe is ten feet long, the lower end of the pipe should be a <u>minimum</u> of two and one-half inches lower than the higher end.



Systems with proper slope will be the most efficient at expelling the condensate, and in general the less condensate held overall in a system the better. Some drain lines can be modified if the slope is insufficient resulting in an overall improvement.

This example shows an attic-installed system with poor slope and persistent clogging issues. The pipe rises upwards where it rests on piles of insulation (as indicated by the arrow).

While the condensate eventually exits the drain line, the poor slope significantly hinders its flow. This causes the condensate to sit longer in the drain pan, leading to clogs at the drain outlet and filling the drain line with standing water, which will also build up bacteria.

The clogged outlet resulted in condensate overflowing the internal drain pan, dripping onto the AC cabinet floor, and leaking through the cabinet seams into the secondary drain pan below the AC system. When the secondary drain pan filled with condensate, the cutoff switch tripped, shutting down the AC system.

Previously, without having a secondary cutoff switch in the pan, the condensate overflowed the secondary drain pan onto the ceiling and caused the ceiling to collapse! After that incident, a secondary cutoff switch was added. Additionally, after multiple clogs, the drain line plumbing issues were corrected, and the Zoog Zapper was installed.

Here is an attic system that *would* have had sufficient slope if routed properly but the installer used two 90-degree fittings to direct the drain line straight down to the beams which negated any slope. The drain line was always filled with water and clogged regularly.

The drain piping was changed to have the proper slope from the drain pan drain outlet on the left all the way to the 90-degree fitting that exited the attic fifteen feet away.

The condensate now readily flows out of the pipe, guaranteeing that the pipe will not clog.

Even The Slope of the Exit Drainpipe Matters!

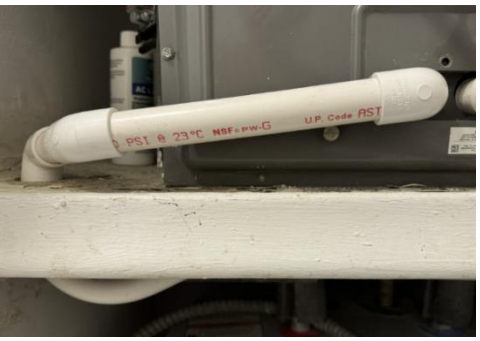
The pipe that is connected to the drain pan outlet must also slope down as much as possible. *This is actually a big deal!*

This picture shows an exit pipe that is practically horizontal. The condensate in the tube did not fully drain out so the tube always held condensate, plus, the drain pan could not drain properly, so the front of the drain pan always held condensate. Not surprisingly, both the drain line and the drain pan would clog often.

This picture shows the bacteria (white) accumulating in the front of the drain pan, and the drain outlet was clogged.

Plus, a trap was NOT installed on the system(to be explained) so that also prevented the condensate from exiting the drain pan expediently.

To remedy the situation, the exit pipe was sloped as much as possible to still allow filter replacement.



This amount of slope was adequate to allow the condensate in the drain pan to flow out quickly which is a huge improvement, combined with the new automatic dispensing of the sanitizer to inhibit bacterial growth.

A trap was also added (to be explained) which is the curved pipe sticking out on the left below the platform.

It cannot be emphasized enough that the pipe coming out of the drain outlet needs to be sloped downwards.

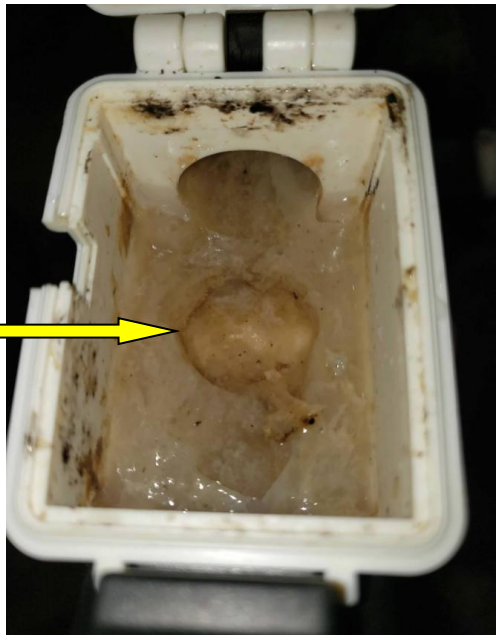
Watch Out for This One

Some drain lines include a backup or secondary in-line cutoff switch. While this seems like a clever idea in general, these switches can be problematic as they are prone to clogging—since all condensate must pass through them.

Float switches, including these types, operate on a simple principle: when condensate rises, the float inside the switch also rises. However, condensate should not rise in the first place. If it does, it indicates the condensate is not exiting the drain pan, which is a significant issue.

When the float rises high enough, a magnet embedded within the float activates the switch, shutting down the air conditioning system. While shutting down the system is a protective measure to prevent further damage, the rising water remains a sign that the drain system needs immediate attention.

If bacteria grows within the switch cavity, the float becomes mired/stuck in Zoog, and now the float can longer float up, rendering the safety switch useless:



This picture shows the round hole where the float was stuck!

The Zoog is ¼" deep!

This system was thoroughly cleaned/cleared and the Zoog Zapper installed.

If your drain system has this in-line switch and the switch cannot be changed, the switch should be opened every three months to double-check. Better safe than sorry…

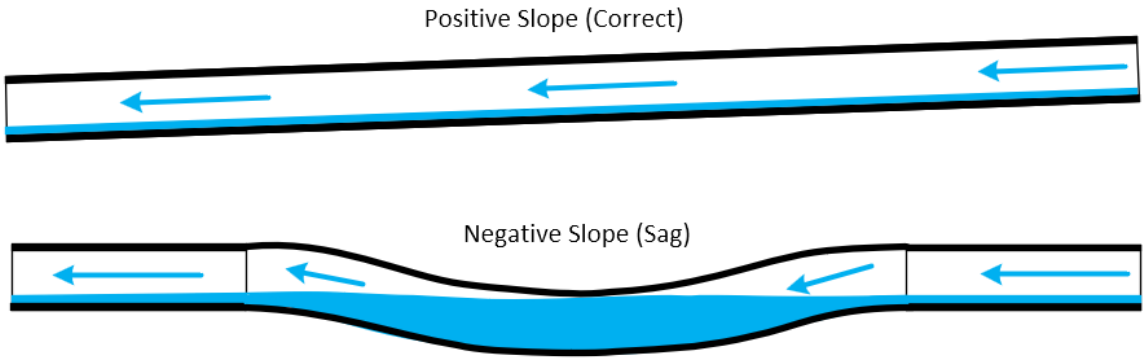
(This system has been Zoog Free with the Zoog Zapper installed since July 2023)

The best location for a cutoff switch is directly off of the drain pan. There are different methods shown online for plumbing the switch but what matters most is there is one switch at least– *that works.*

Drain Line Sags

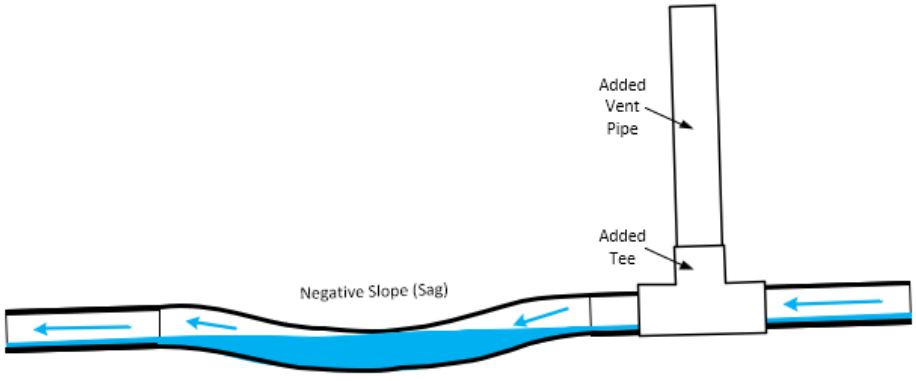
In addition to maintaining adequate slope, it is essential to inspect the drain line for sags or dips in the piping. A sag occurs when the pipe dips downward and then rises again. If the sag is significant, it can create an inline water trap, leading to a condition known as a "Double Trap." This is a problematic scenario that should be avoided.

A proper drain line should only contain one water trap (explained in detail later). However, a sag in the pipe can unintentionally create an additional trap, resulting in a Double Trap. In this condition, condensate becomes trapped between two air pockets and cannot flow freely through the drain line. This blockage will eventually cause the condensate to back up into the drain pan, potentially leading to overflow and other issues.



The most common location for sagging pipes is in attics where elevated temperatures over the summer can cause the piping to bend over time. A sagging line can be raised up and tied off with a strong string or light rope up to the overhead roof beams. (Supports should be no farther than four feet). The slope of a drain line needs to be at the minimum one-quarter inch drop per foot of length.

Some AC installers recommend adding an occasional vent pipe in the drain line if the sagging cannot be easily rectified. The vent pipes allow air into the pipe to prevent a "double trap" scenario. Simply adding a Tee-fitting and a sufficient vertical length of pipe that is higher than the drain pan can ensure a proper flow of condensate out of the compromised drain line:



While not an ideal solution as there will be standing water in the drain line, the flow will be increased. The sanitizing solution will help to prevent bacterial growth within the piping combined with occasionally vacuuming and flushing of the line.

Evaporator Cabinet Slope

Another critical aspect of a proper installation is ensuring the slope of the AC cabinet is correct. In poorly installed systems, the cabinet may be tilted in the wrong direction, causing condensate to flow toward the back of the drain pan instead of the front.

This misalignment can lead to several issues. Water may overflow from the back of the drain pan, accumulating inside the cabinet and leaking out through its seams. Ideally, any overflow would reach a secondary (backup) drain pan. However, if you notice water in the secondary pan, it is a clear indication of a problem with the primary drain system that requires immediate attention.

A telltale sign of a drain system problem is rust in the secondary drain pan, and the accompanying rust inside the cabinet. These pictures are from an attic system that had numerous problems including reverse pitch. The picture on the left is the rust in the secondary drain pan. The black object is the float switch – *which just happens to be missing the float*! The silver arm sticking out of the switch at some point in time had a float. *With no float, the switch will never turn on if water builds up in the secondary drain pan!*

The picture on the right is the inside of the unit and you can see the plethora of rust. The drain pan is full of bacteria which clogged the drain outlet. This system also had an extremely poor drain line configuration.

A level is a straightforward way to check pitch. This is the pitch of the cabinet front to back and the bubble should be towards the right side! The condensate in this system had to go uphill to get out of the drain pan!

This system had turnbuckles in the back of the unit that were adjusted to tilt the cabinet properly, and the drain line was reconstructed. The float switch was changed also, and the drain pan was cleaned/flushed with a hose. To properly fix this system took almost four hours..

This is another attic system that was pitched backwards, and the drain pan was overflowing into the cabinet. There was so much water in the cabinet the blower was sucking up the water and blowing the water out of the vents causing the ceiling paint to peel all around the vents. The AC company that was called because of the excess water at the vents blamed the water on condensation. They did not even look in the attic! The picture on the right is actually

water on the floor of the cabinet and the blower housing is just above the floor. This system was re-positioned to pitch properly.

While attic systems that are hanging can be somewhat adjusted to correct improper pitch, a vertically installed system is usually much more difficult if not impossible to adjust as the ductwork is rigid and does not move easily. Plus, the unit may be anchored to a platform.

On systems that are marginal, the best solution is to make sure the drain line is optimized to move out the condensate as soon as possible. A qualified AC company should correct very problematic systems like the examples shown.

Improper pitch in the drain pan can lead to serious issues for the AC system. When moisture lingers in the drain pan, it creates an ideal environment for bacteria and mold growth, potentially causing damage over time. Unfortunately, poor installations are more common than expected, making proper setup and maintenance critical to avoid these problems.

How To Get the Condensate Out as Best as Possible

Condensate must be removed from an air handler, which requires an outlet (a hole) in the internal drain pan to allow water to flow out. However, this outlet creates a challenge since it is open to the outside, allowing air to flow in or out of the system.

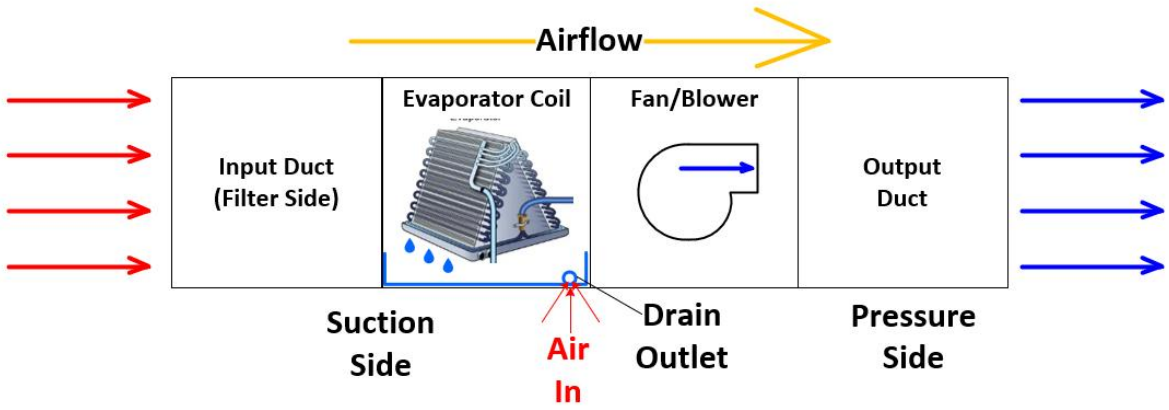
Air handlers fall into two types:

1. **Draw-Through Systems**: These draw air into the cabinet.
2. **Blow-Through Systems**: These blow air out of the cabinet.

Both types face airflow issues that can interfere with proper drainage, but the solution is the same for both: installing a trap in the drain line. This blocks unwanted airflow while allowing condensate to flow freely. A brief understanding of these two system types is helpful for proper installation.

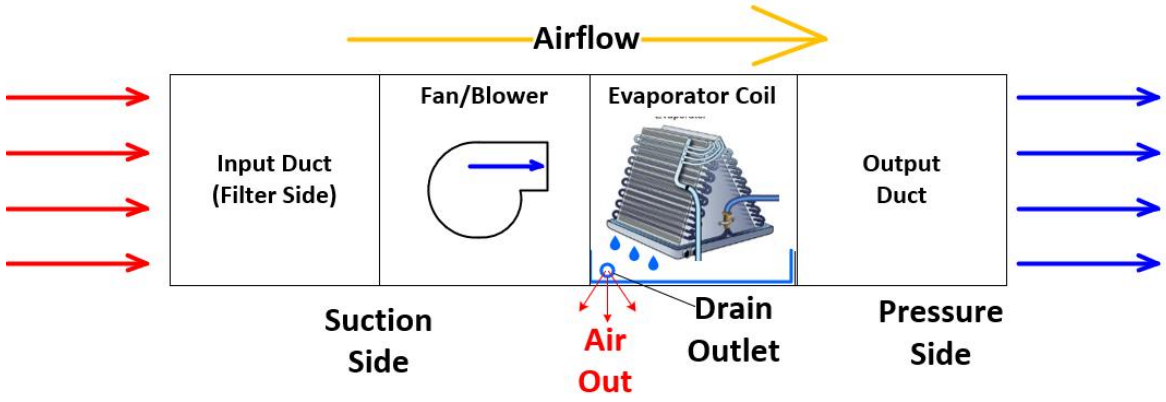
1. **Draw-Through:**

   The blower **pulls** air through the evaporator coil, creating a vacuum effect in the drain pan. This negative pressure prevents condensate from flowing out of the drain pan and will draw outside air into the cabinet (red arrows), reducing efficiency:



2. **Blow-Through**:

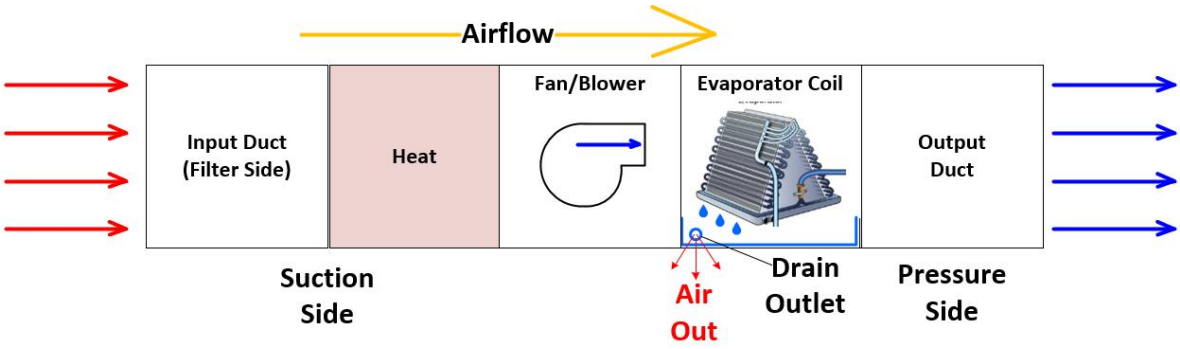
   The blower **pushes** air through the evaporator coil, creating positive pressure in the drain pan. While this helps push condensate out, it also allows conditioned air to escape (red arrows), causing inefficiency:



System Configurations

- **Combination Heat/Cool Systems**:

  In colder climates, systems with gas or oil heat (furnaces) often have the heat section on the input side of the blower and the evaporator coil on the output side, making them Blow-Through systems:



- **AC-Only Systems (No oil or gas heat)**:

  Most AC-Only systems are Draw-Through designs, but exceptions exist, such as certain Trane models configured as Blow-Through systems. AC-Only systems will usually incorporate an electric heating element which will be at the output duct side of the air handler.

The Solution for Both Systems: Add a Trap

The solution to ensure proper condensate drainage for both Draw-Through and Blow-Through systems is the same: add a **trap** to the drain line. A trap blocks unwanted airflow through the drain outlet while allowing condensate to flow freely out of the system.

- **Draw-Through Systems**: A trap is mandatory to counteract the negative pressure created by the blower, which prevents condensate from exiting the drain pan.
- **Blow-Through Systems**: While not required, adding a trap is beneficial as it prevents conditioned air from escaping through the drain outlet, reducing energy waste.

The main downside of using a trap is the potential for clogging. However, with regular use of the Zoog Zapper to dispense sanitizer and occasional vacuuming, clogs are unlikely.

The following discussion on traps focuses on Draw-Through systems, where a trap is essential, but the principles and guidelines also apply to Blow-Through systems for improved performance.

Why a Trap Is Required/Mandatory in a Draw-Through AC System

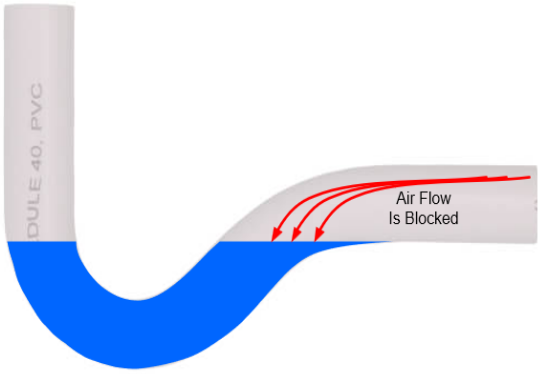
In a Draw-Through AC system, the drain line is essentially an open pipe leading to the exit point. When the AC is running, the internal blower creates strong suction (negative pressure) inside the cabinet. This suction pulls outside air into the cabinet through the open drain line, preventing condensate from flowing out of the drain pan. Essentially, the condensate is "trapped" inside the air handler as opposed to flowing out.

The Consequences of No Trap:

- **Rising Condensate Levels**:
  If condensate cannot exit the drain pan, the water level will rise as long as the system operates.
  - In systems with a cutoff switch, the rising water will eventually trigger the switch, shutting down the AC.
  - Without a cutoff switch, the drain pan can overflow, potentially causing water damage.
  - If the AC cabinet is improperly pitched, condensate may overflow at the back or sides of the pan, bypassing the cutoff switch entirely.
- **Cycling On and Off**:
  When the cutoff switch shuts down the system, the blower stops, and the suction pressure dissipates, allowing condensate to drain. However, as the drain pan empties, the cutoff switch resets, restarting the AC system. This causes a repetitive and inefficient cycle of turning on and off unnecessarily.
- **Increased Humidity and Bacterial Growth**:
  The constant accumulation of condensate in the drain pan allows blower suction to pull moisture back into the air handler, increasing humidity levels. This creates ideal conditions for bacteria to grow on the evaporator coil fins and in the drain pan, further exacerbating issues.
- **Clogged Drain Lines**:
  If the drain line is partially clogged, condensate may accumulate faster than the drain can manage, leading to similar issues.

The Solution

Installing a trap in the drain line solves these problems. The trap prevents outside air from being pulled into the cabinet, allowing condensate to flow freely out of the drain pan. This ensures proper condensate drainage, maintains system efficiency, and prevents unnecessary cycling or water damage.



The overall drain line design objective is to have the condensate exit the drain pan as soon <u>as the condensate is generated</u> – which is why a trap is critical <u>and mandatory</u> for proper system operation.

A trap holds (traps) water in the pipe which blocks the reverse airflow through the drain line. The condensate held in the trap blocks the incoming airflow as shown in the picture. **With the air suction broken the condensate can now freely flow out of the drain pan by gravity into the drain line (it is like magic…)**

On a "Blow-Though" system, the water in the trap will prevent conditioned air from being expelled from the air handler, so a trap is beneficial on both systems.

On a "Draw-Though" system, without a trap located *<u>somewhere</u>* in the drain line (and ideally close to the AC unit) providing the accompanying water block, there is <u>nothing</u> to prevent air from being pulled into the AC cabinet through the drain line from the outside and stopping the flow of condensate out of the drain pan.

This video explains very well the function and the requirement of a trap: **Why a Trap is Needed**

Proper drain line design ***<u>must</u>*** consist -- **at a minimum** -- of one trap installed *<u>somewhere</u>* in the drain line on a "Draw-Through" AC system.

The need for a trap close to the AC cabinet is evident to the extent that there are manufacture's "NOTICE" labels on some air conditioning cabinets explicitly stating:

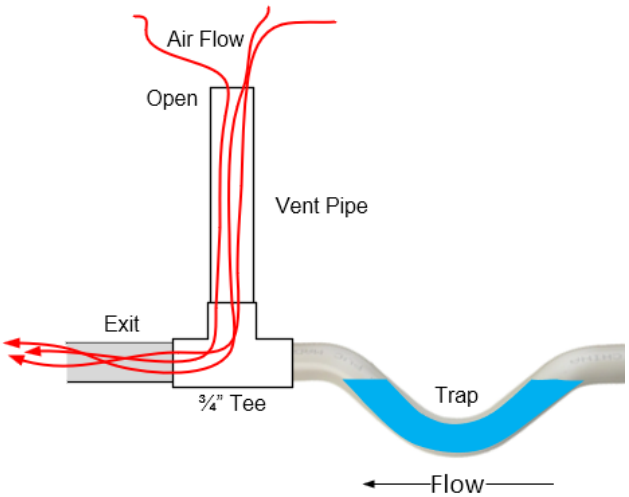
"Do Not Operate Unit Without Condensate Drain Trap"

(*as depicted in the picture the trap is to be installed in **close** proximity to the AC unit*)

Unfortunately, in practice, it is somewhat common for a trap to be omitted near the AC unit *regardless* of the installation instructions...

Newer installations have building codes which specify a trap must be installed in close proximity to the AC drain outlet, but older installations may not have a trap at the unit.

Why is There a Need for a Vent Pipe After a Trap?



A vent pipe installed after a trap allows air to flow into the drain line which helps the condensate flow out freely *and quickly* through the entire drain line, which is a significant factor when it comes to proper drainage.

A vent pipe also prevents having a double trap scenario as previously explained.

A vent pipe can only be installed **after a trap**! If the vent pipe is before the trap, air would flow into the cabinet through the vent pipe due to the blower suction, which is basically an air leak – *and again the condensate cannot exit!*

Adding a vent pipe only requires a "Tee" coupling after the trap with the vent pipe vertical. The vent pipe is always open to let the air flow in. The height of the top of the vent pipe ***must*** be over the height of the drain pan inside the air conditioner so if a backup should occur condensate cannot flow out of the top of the open vent pipe.

Typically, a one-foot length of tubing is more than adequate to be over the internal drain pan height.

Types of Traps – Molded or Constructed

"Constructed Traps" are typically assembled with ¾" PVC fittings and should be avoided as sharp 90-degree turns are locations for bacteria to cling to and then proliferate.

This picture shows an example of "constructed" trap using three 90-degree fittings (yellow circle). This type of trap is prone to clogging (and did).

The sharp 90-degree right angles will tend to allow the bacteria, **being heavier than the water,** to reside in the pipe that connects the two lower 90-degree fittings. Bacteria can also accumulate at the exit of the trap at the third 90-degree fitting. The slow movement of condensate exiting the drain pan will not force the bacteria out of the trap section. The bacteria will grow to the point where the pipe is fully clogged.

On this system, a vent pipe is installed after the trap, which is correct.

In this particular installation, there was also no slope in the piping coming out of the drain pan, (pipe was horizontal and level) so that also will tend to make draining of the drain pan sub-optimal which

has previously been presented. With no slope in the drain pan outlet tube, the drain pan will drain much slower which can allow Zoogloea to build up in the drain pan.

Which is what happened. This system had about 3/8" thick Zoogloea buildup in the front of the drain pan that clogged the drain outlet and the cutoff switch shut the system down. This is a video of vacuuming out the drain pan : **Drain Pan Clogged by Zoogloea Example (youtube.com)**

There was also bacteria building up in the vertical piping ----------

This drain system was almost designed/constructed to clog…!

The entire drain system was replaced using a *molded* trap, vent and the ZoogFlush kit.

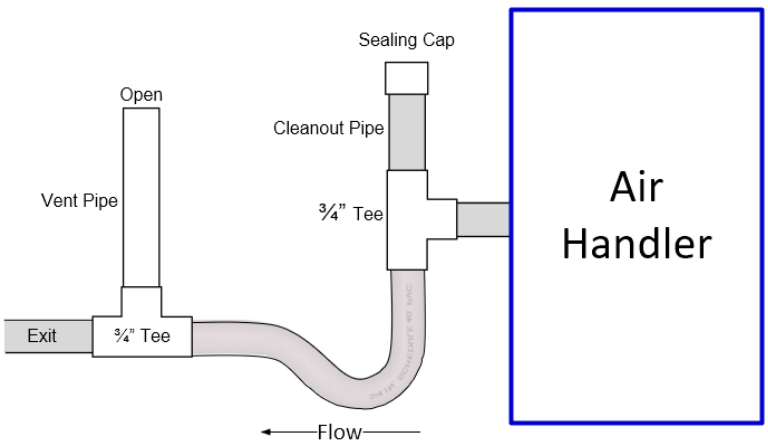
Molded traps are made with smooth curves which do not provide sharp corners/angles where Zoogloea can cling to as easily and grow. There are primarily two preferred molded trap designs. The first design is called a "**P Trap**" as the shape of the trap when viewed from the side is the shape of the letter "P." This "P" trap has an outlet (left side) which is much lower than the input (right side) and is termed a "multi-level" trap as the input and output are not the same levels/height.

The output side is designed to be much lower than the input side so the suction from the AC system blower cannot pull the water vertically out of the trap and back into the drain pan.

If there is physical room and vertical space for this trap, ***the "P" trap should be the default trap to use.***

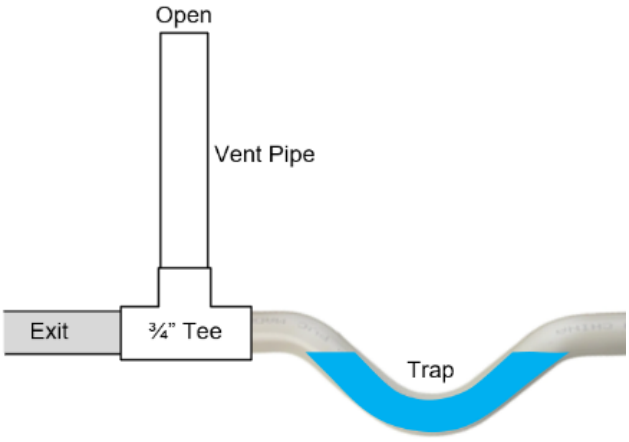
However, using the "P" trap may adversely affect the slope of the drain line. There must always be adequate slope in the drain line, and it may not be possible to install a multilevel trap if the trap outlet height is too low and reduces the overall slope of the drain line to less than the standard one-quarter inch per foot…

This picture shows the proper way to connect a "P" trap along with a Cleanout pipe and a vent:



There is a significant drop in height of the exit pipe compared to the drain outlet height. The exit drain line needs to have adequate slope out. If the slope is not adequate, an alternative trap solution is a second molded trap called a "Running Trap."

This trap has the input and output at the same level and is designed to be inserted directly into the drain line.

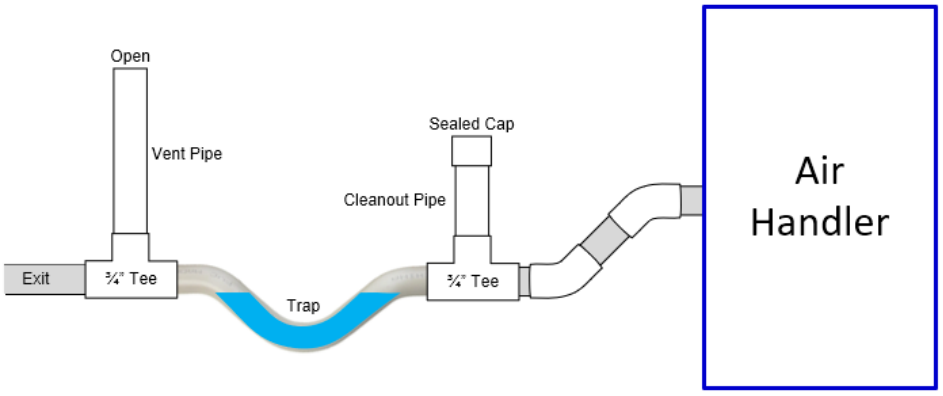


The "dip" in the pipe fills with condensate and breaks the air flow through the pipe. This trap is designed to be inserted into the drain line easily and *should always be followed by a vent pipe.*

However, since the Running Trap does not have the significant height drop of multi-level traps there is less resistance of the water to flow backwards, so *there is a risk if improperly installed that condensate can be drawn back into the air handler by the suction of the internal blower and then with the water out of the trap air will flow into the drain pan and the condensate will not be able to exit. This will result in the drain pan level rising and could cause a system shutdown or a possible drain pan overflow.*

A telltale sign that the condensate has been pulled out of the trap is a "gurgling" sound coming from the vent pipe when the AC system starts operating.

To address this potential problem, positioning the in-line trap somewhat away from the drain pan outlet increases overall resistance so the water in the trap will not be pulled out. Additionally, having the drain line first point downward and then connecting to the trap will effectively provide more height making it more difficult for the condensate to be pulled backwards "uphill" and ideally will still provide adequate slope of the drain line:



Also, having a drop (slope) right at the drain outlet with the 45-deree coupling will improve the condensate flow out of the drain pan. As soon as the condensate is created, the condensate will flow out of the drain pan - which is the goal.

This is an example of a system that had frequent clogging, with a drain line that was about two feet in total length and went into a condensate pump – but the line had **SIX 90-degree fittings** (strike one). Can the drain path be made any more "torturous" for condensate flow? Plus, there is no trap installed which further slows the condensate flow (strike two) and also hardly any overall slope (strike three).

This system was pretty much guaranteed to clog….

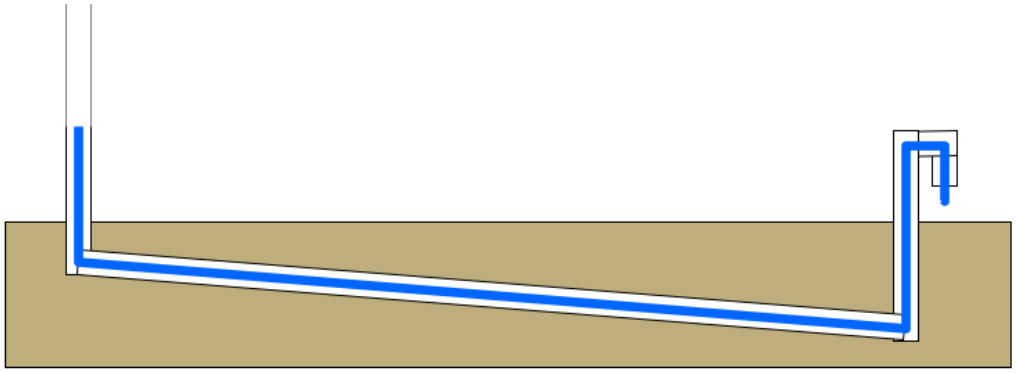
This system was re-plumbed with a cleanout pipe, "P-Trap," vent tube and two 45-degree fittings. A coupling was added where the pipe enters the condensate pump to support the pipe's weight and the tube length from the coupling into the pump is only ½" so the condensate falls freely from the pipe into the pump.

The pump was sitting on a paint can so a plastic bin was added and a second cutoff switch in case the pump should fail.

An "Underground" Trap

On systems which are in confined spaces like closets there may not be enough room for a trap and the "Underground" trap will have to suffice as the system trap.

Underground piping forms a "natural" trap as the piping always holds condensate and breaks the airflow through the pipe. This configuration *functions minimally* and is not optimal as a vent pipe cannot be added.



Many installers consider the "underground trap" as the "required minimum" trap and do **not** install a physical trap near the cabinet. It is better overall for drainage operation if the drain line can be improved by adding a trap and a vent at the air handler cabinet.

This is an example of an AC system that did not have a trap or vent at the unit, but there was adequate room to install them as shown.

The system is located on the second floor of a home and often clogged. The drain line drops down through the floor, across a first-floor ceiling to the side of the home, down through the outside wall to the ground, then underground (creating a trap) for about 20 feet and then back up above ground. Quite a long and tortuous path! The drain line was re-configured and now drains much more freely. The drain line needed to be configured in such a way to allow the air filter (blue) to be removed/replaced (filter cover is off).

A "P" trap was inserted to the drain line dropping down vertically directly from the drain pan. With this configuration the condensate held in the "P" trap cannot be drawn upwards. The "P" trap connects to the ZoogFlush section which is followed by the vent pipe. The vent pipe is run to the left wall and then extends vertically above the height of the drain pan. The line was (of course) flushed out.

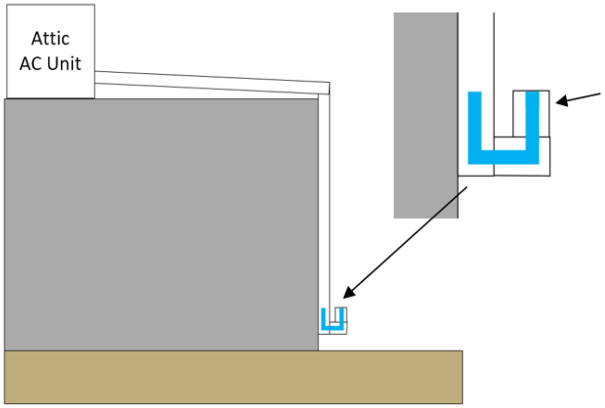
This configuration effectively prevents backward condensate flow while still keeping the trap relatively close to the drain outlet. The vent allows air into the drain line, so the condensate is fully free to flow *all the way* to the exit point unrestricted even with a long journey as in this example.

While there was a trap located *somewhere* in the drainage system which is the *absolute minimum*, the trap location as shown in the above picture being in close proximity to the unit (followed by a vent pipe) is the optimal solution for the most expedient condensate drainage.

The vent pipe prevented a "double trap" scenario with the existing "underground trap" and provides air into the pipe to allow the water to free flow outside. The condensate now flows out of the drain line in a steady stream, verifying the outflow is optimized.

This is a video of this system discharging condensate after the drain line changes:
https://youtube.com/shorts/B1ae9n9qZnU?feature=share

When a Trap *is* Needed/Required at the Exit Point



Every Draw-Through AC system must have at least one trap installed somewhere to break the air flow.

In this example of an attic installation, if a trap is not installed at the AC unit, a trap is required at the exit point and is usually made out of PVC fittings. A "P" trap could (should) also be used which is less prone to clog.

In the picture, a trap is formed by the 90-degree couplings (arrows) pointing upwards as the fittings will fill with condensate and block airflow into the drain line.

In a properly sloped drain line as shown, the only condensate retained in the drain line is at the trap which makes the trap the most susceptible place for bacteria to grow and clog. The bacteria is heavier than the condensate and will coagulate in the 90-degree fittings as the bacteria cannot escape the "trap". So again, if possible, use a "P" trap instead.

On this next actual example system, just one 90-degree coupling outside was used as the "trap", which is not a good design!

Once the piping inside the attic was modified which included a ZoogFlush/trap/vent combo, the outside 90-degree coupling was flipped over so the condensate can readily flow out of the pipe unimpeded. The condensate was now exiting the pipe as a stream.

Therefore, if possible, a trap *should* instead be installed at the AC unit in the attic and the outside trap *should then be removed* as the outside trap is no longer required. Usually there are much less physical restrictions in an attic installation to facilitate adding a trap and vent.

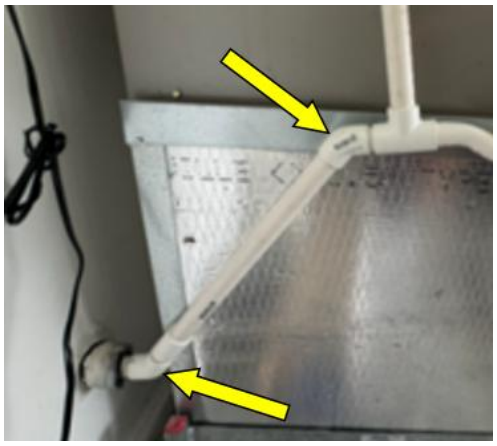
This is another example of an attic system *without* a trap at the AC unit and a trap made from 90-degree fittings at the exit point. This drain line was prone to clogging.

With a trap/vent added at the AC unit, the overall drain system will operate much better and with all the 90-degree fittings removed will be far less susceptible to clogging!

The drain line was also flushed out with the ZoogFlush kit and there was a lot of bacteria growing within the drain line.

There are also additional 90-degree fittings in this drain line path as the drain line turned 90-degrees multiple times as the pipe was routed through the walls from the second floor to the ground, combined with three additional 90-degree fittings at the exit point!

The three outside 90-degree fittings forming a trap were removed as they were no longer needed with the new trap installed at the unit. Only a single 45-degree fitting was used to extend the drain line directly to the ground (away from the wall). The 45-degree fittings eliminate a sharp 90-degree turn.



Any time two 45-degree fittings (yellow arrows) can be used is better for flow than one 90-degree fitting!

Small tweaks like this makes a difference in the overall system performance and decrease the likelihood of clogging.

To verify if a drain line is functioning optimally, observe how efficiently the condensate exits. If the flow is marginal, the condensate will drip slowly rather than flowing out as a rapid drip or a continuous stream.

Before the trap and vent were installed on this drain line, the condensate only dripped out. Now, with these additions, condensate exits in a steady stream (yellow arrow), indicating that the flow has significantly improved. The vent allows the condensate to flow freely throughout the entire drain line, which (again) helps to prevent clogs.

In areas with low humidity, there may not be enough condensate to produce a steady stream, but a fast drip should still be present.

Regularly checking your drain line's outlet is important, as the flow rate can indicate the line's condition.

The Downside of a Trap

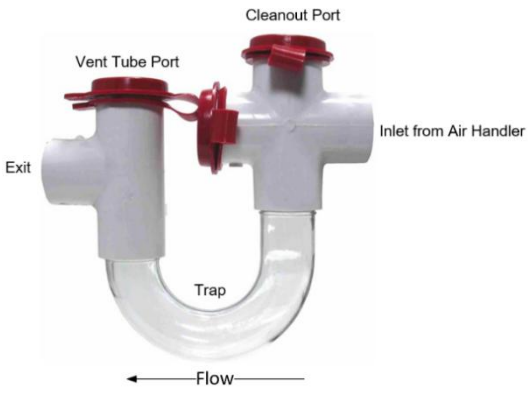
Everything is a compromise... In general, "less is better" when it comes to 90-degree elbows, couplings, and traps in the drain path as these fittings create locations where Zoogloea can "take hold" and grow. However, a trap is required/mandatory – *somewhere in the line*.

Traps hold water and Zoogloea needs water to grow so traps will always be susceptible to clogging, and how prone to clogging is largely based on the trap design.

Because of the uniqueness of each drain line system construction and all the "unknowns" that cannot be seen in a drain system, the drain line should ideally be vacuumed out every month and flushed every six months to remove whatever is surviving and insuring that the line will not clog.

Between the Zoog Zapper dispensing consistently, an occasional clearing of the drain line with a Wet/Dry vacuum and the provided ZoogOut vacuum adapter, followed by a six-month hose flush with the ZoogFlush kit, the odds of a clogged drain system is very minimal to non-existent!

Caution: This trap "system" has a trap section integrated with a cleanout port, a port for a ¾" vent pipe, and a clear tube for viewing. A well-designed device.



However, experience has shown that this trap *for some reason* has a propensity to clog. There may be something in the geometry of the "U" shape combined with 90-degree turns that prevents the bacteria making contact with the sanitizer.

This trap is normally sold with a brush which is used to clean out the trap.

As a precaution, if your system currently has this model trap, the port caps should be opened regularly to see if there is any bacteria growing internally and if so removed. The bacteria can be vacuumed out (best) with the ZoogOut vacuum adapter, brushed out, or both. Refill (prime) the trap after cleaning.

Drain System Summation

To ensure optimal drain line performance, it is recommended to install a trap and vent combination along with the ZoogFlush kit as close to the AC unit as possible. Additionally, the entire drain line should maintain a sufficient slope to facilitate proper condensate flow.

Using 45-degree couplings instead of a single 90-degree coupling can further reduce the risk of clogs by promoting smoother water flow. If these features are not currently part of your system, updating the drain line is advisable if feasible.

Maximizing condensate flow is essential to preventing clogs between services when the drain line can be vacuumed or flushed. Regular maintenance, such as spending a few minutes vacuuming the drain line each month, is usually enough to keep the drain line clear. This simple preventative care, combined with the Zoog Zapper's automatic sanitizing of the internal drain pan and drain line, ensures a well-maintained and efficient system.

For additional guidance, many instructional videos on YouTube provide helpful tips on drain line design and installation. If you are uncertain or have concerns, consulting a professional is a smart choice for expert advice.

Section #4 - Cleaning the Condensate Collection and Removal System

The primary aim of the sanitizing solution is to prevent the unchecked growth of Zoogloea within the condensate collection and removal system, serving as a proactive maintenance measure rather than a drain "clearing" product like “Drano.” Hence, before installing the Zoog Zapper system, **it is crucial to inspect and clear the drain pan and drain lines of any existing Zoogloea.**

<u>The current state of the drain line system is a wildcard in the overall clog prevention process.</u>

If the drain lines are already clogged or nearing full clogging as shown in the picture, the volume of bacteria will overwhelm the sanitizer dispensed. The drain system should **always** be cleaned/flushed out with a hose prior to installation of the Zoog Zapper to open the drain piping as much as possible.

Once the drain system is cleared out, the consistent dispensing of Steramine should prevent Zoogloea from growing back, combined with an occasional vacuuming out of the drain lines and a full flush every six months.

Although all air conditioning systems share a common general design, the drain line systems may have design, fabrication, and lack of standardization issues as previously discussed.

Some systems may rarely clog, while others may experience extremely frequent clogging, influenced by external factors such as pet hair, poor-fitting filters, numerous 90-degree turns, poor slope (poor installation), poor AC cabinet installation with improper pitch, not being maintained properly, and high degree of internal bacterial buildup (like the picture), etc.

The key to clog-free operation is to begin with a relatively clean condensate drain system and allow the Zoog Zapper system to maintain this cleanliness and prevent bacterial growth until the next servicing.

During installation, it is also essential to inspect and clean the internal drain pan thoroughly, necessitating removal of the air conditioner cabinet's front panel. The front panel must be removed regardless to install the Zoog Zapper system dispense tubing.

Once inside the cabinet, accessing the drain troughs may be challenging due to interferences, but various tools like brushes, rags, and wet/dry shop vacuums can be used to remove visible bacteria buildup.

What is important to remember about the Zoog Zapper is the parameters can easily be modified to dispense more frequently and a higher amount of Steramine output if a system is truly problematic. The only downside is the reservoir will need to be refilled sooner, but the refilling process is simple - and inexpensive.

Warning: Make sure to turn off the power to the AC system before opening the cabinet. There may also be ultra-violet lights that must be turned off to prevent eye damage!

Using a Hose to Clear the Drain Line

During the installation of the Zoog Zapper, it is important to flush the drain line using a hose. The water pressure from the hose helps break free bacteria that adhere stubbornly to the walls of the piping. While some calcified bacteria may remain after flushing, the process typically creates sufficient pipe openings to allow water to flow freely.

It is reasonable to assume that some bacteria will remain lodged in the drain line system even after using a wet/dry vacuum. Experience shows that flushing with water afterward often dislodges substantial additional amounts of bacteria.

Limitations of Compressed Air or Nitrogen

A common approach to clearing drain lines is using compressed air or nitrogen. While this method can temporarily open a pathway by creating a hole in the blockage, it seldom clears the line entirely. Though quick and easy, it often leads to bacteria regrowing and reclogging the line within weeks. Many users of this method experience recurring clogs shortly after the initial clearing.

Recommended Steps for Clearing and Cleaning a Drain Line

The most effective approach for thoroughly cleaning a drain line involves the following steps:

1. **Vacuum the drain line**
   Use the ZoogOut Vacuum Adapter with a wet vacuum to extract any initial buildup of bacteria. This provides a gauge of the line's condition. *Temporarily cap a vent pipe if there is one. This will pull a suction on the trap then also.*
2. **Apply a chemical solution**
   Dispense a chemical such as vinegar, bleach, or Drain-Solve into the drain line. Let the solution sit and work while continuing with the Zoog Zapper installation.
3. **Complete most of the Zoog Zapper installation**
   Finish the setup but do not add water to the reservoir yet.
4. **Flush the drain line with a hose**
   Use the hose to flush out any loosened debris and bacteria.
5. **Vacuum the drain line again**
   Remove the trapped water and any remaining debris using the vacuum. *Remove the temporary cap on the vent pipe if a cap was used.*
6. **Finalize the Zoog Zapper installation**
   Complete the setup (it is time to pump Steramine).

Initial Steramine Dose

When the Zoog Zapper's pump dispenses the initial two cups of Steramine, the drainpipe will be free of standing water. This allows the Steramine to remain concentrated in areas where water typically accumulates, providing additional time to kill any remaining bacteria and prevent future clogs.

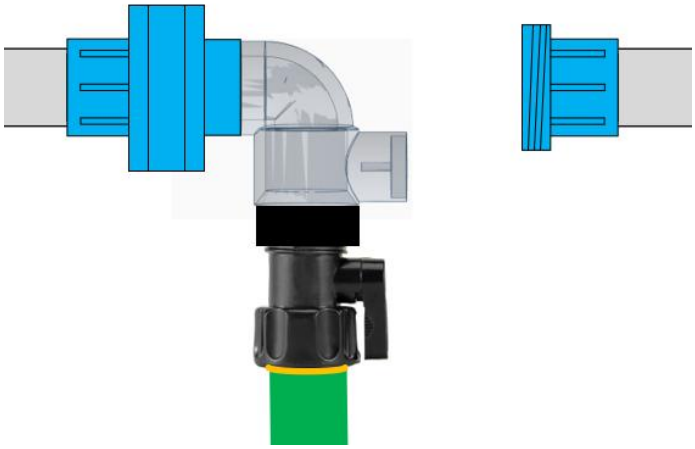
Warning: Using a hose to flush the drain line is highly effective, but you must start with a slow water flow and gradually increase the flow as you confirm water is passing through freely. Starting slowly helps prevent pressure buildup, which could otherwise cause issues.

There is a risk of the drain line cracking, breaking, or the PVC connectors/fittings separating from the pipes if pressure in the line builds up due to a drain line being completely clogged. Any failure of the drain line could potentially cause leaks, including inside walls.

Professionally installed drain lines are typically securely glued, greatly minimizing the chance of separation, but it is important to acknowledge this possibility. (We have never had this happen).

Starting with a low flow rate remains the most critical step as you then will know the drain line is not fully clogged and then the water flow can be increased!

Using the ZoogFlush Kit



The ZoogFlush kit is designed for easy installation and use, allowing you to flush your drain line whenever needed. It features two quick-disconnect union fittings, which make it simple to access the drain line. By utilizing these quick disconnects, you can attach a hose (or transfer pump) to the outgoing drain line and flush the drain line with water. This process helps clear out clogs and creates a larger diameter opening throughout the pipe system.

<u>Even if no other physical changes are made to the drain line, the ZoogFlush assembly should be installed during Zoog Zapper installation and used every 3-6 months to flush the drain line.</u>

Where to Install the ZoogFlush Kit?

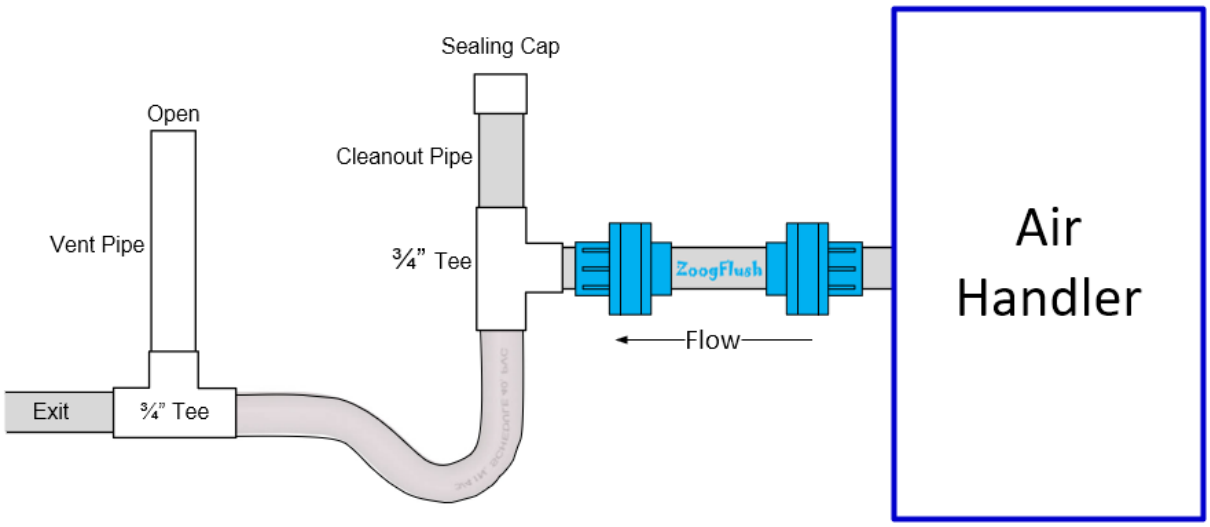
If the drain lines are **not** going to be altered with the addition of a trap/vent combo, the ZoogFlush assembly should be inserted into the drain line as close to the drain pan outlet as possible to flush the maximum amount of drain line. Only **4 1/4"** (108mm) of drain line needs to be removed to insert the ZoogFlush.

If a trap, vent and possibly a "Cleanout" pipe are to be added, then all three should come **AFTER** the ZoogFlush so the trap is flushed.

Cleanout pipes are useful in northern climates if anti-freeze is added at the end of the season and to (fill) prime the trap with water (so the condensate will exit the drain pan immediately). If a trap is dry, air will flow into the AC system and prevent condensate from exiting the drain pan.

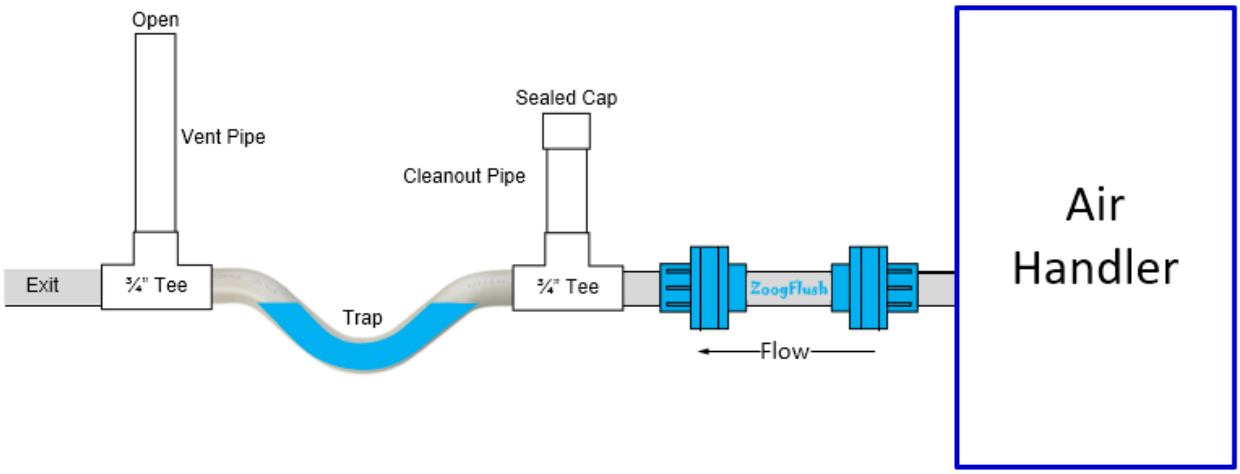
It is best to pour water into the cleanout pipe to fill (prime) the trap upon installation and in the spring in northern climates as the condensate will evaporate over the winter.

This picture shows the suggested configuration of the various components using a "P-Trap" if there is physical room. The ZoogFlush should be inserted as close to the AC unit as possible to flush as much of the drain line as possible:



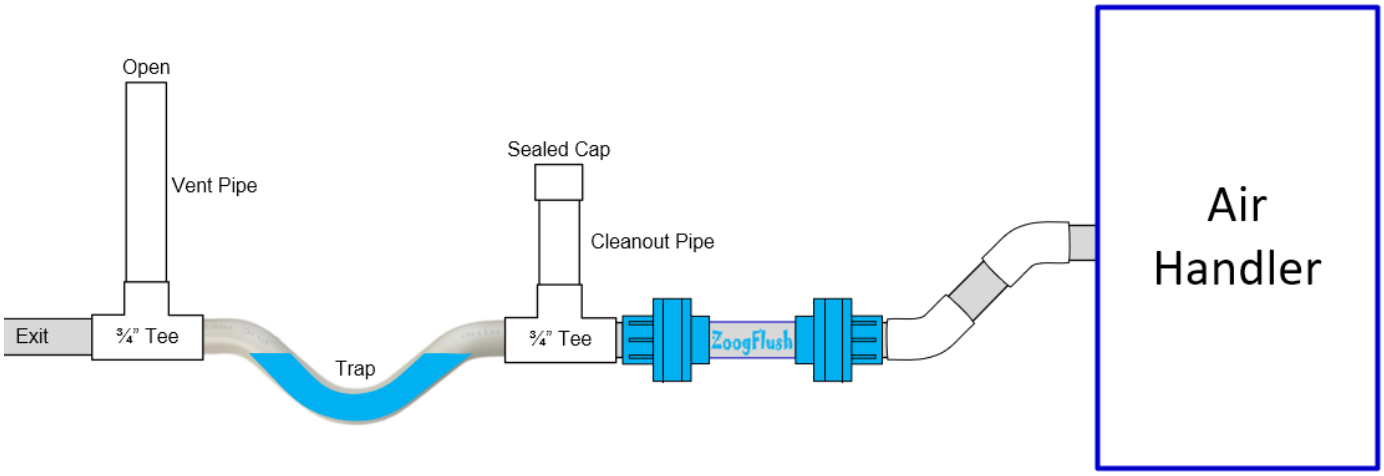
The above configuration is an ideal overall drain line solution which provides all of the features that should be incorporated into all drain lines *if possible.* Again emphasizing, the drain line must be slightly sloped down in actual usage, so the condensate exits the drain line quickly!

This is the suggested configuration of the various components using a Running Trap if there is not enough physical room and slope to use a "P" trap:



Since the Running Trap inlet and outlet are at the same height, there is much less resistance to overcome and the condensate in the trap could be pulled out backwards by the suction of the blower. Installing the Running trap a longer distance (three to four feet) from the AC cabinet may be needed.

If there is adequate slope for the exit drain line, using two 45-degree couplings will provide more height difference (drop) and make it more difficult to pull the condensate out of the trap:



If there is even more drain line length available, the ZoogFlush and the Cleanout pipe should be installed as close to the drain outlet as possible, and the trap and vent pipe can be placed even further away.

Due to the "trickiness" of installing a Running trap, installing the P-Trap should be prioritized. Whichever trap is used, the system should be observed running long enough to verify that condensate is exiting the drain pan properly and flows out to the exit point. With PVC piping it is quite easy to change the configuration if there are any issues.

Installing the ZoogFlush Kit

Items needed:

Hacksaw or PVC cutter	Tape Measure
PVC Cement (must be purchased)	Sharpie/Pencil/Pen
Sandpaper or Metal File	Rag/Paper Towels

The ZoogFlush Installation Process:

Installing the ZoogFlush kit is a relatively straightforward process but using PVC cement is required. A 4 1/4" (108mm) section of the ¾" drain line is removed and two quick-disconnect union fittings are cemented onto the drain line. **A total length of 6" is required for the device to fit with the fittings!**

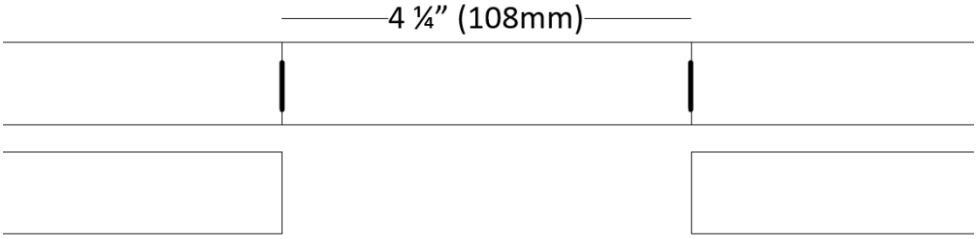
If you do not have any experience using PVC cement, there are many on-line instructional videos available. Using a primer is not necessary as the drain line is not subjected to high pressures, so just using PVC glue will suffice. Using PVC cement also lubricates the fittings allowing the fittings to easily slide fully onto the drainpipe.

The ZoogFlush Installations Steps:

1) Turn off the air conditioner to stop the flow of condensate.

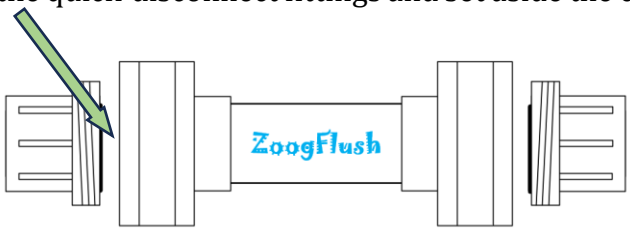
2) Once a location is determined, a 4 1/4" (108mm) section of the drain line is to be removed (again, a 6" total clear length of pipe is required). A hacksaw or PVC cutter can be used. (Sometimes the pipe used on the drain line is a thinner gauge and can be cracked by a PVC cutter, so a hacksaw is best if you do not know the pipe gauge.)

3) Mark two cutlines **4 1/4"** inches (**108mm**) from each other and cut the pipe.

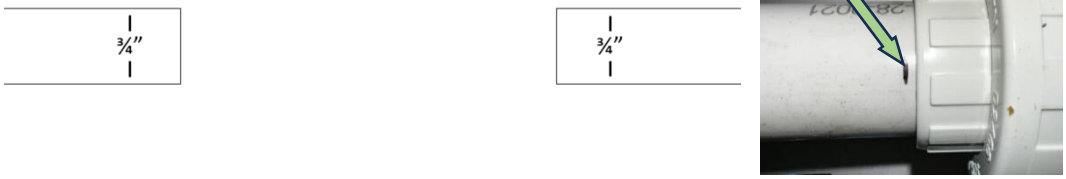


4) Sand or file both ends of the cut drain line to remove any burs. Using a PVC cutter can deform the ends of the pipe slightly so "cleaning up" the pipe edges will be helpful when sliding on the two union fittings.

5) Unscrew the collars on the quick-disconnect fittings and set aside the center section with the pipe.



6) As a suggestion, mark both pipes at ¾" so you will know when the two fittings are inserted all the way onto the pipes. It is important that both end fittings are fully slid onto the pipe, which is ¾." When the fittings are slid fully on, the ¾" mark should be visible but not by much:



7) Cement both fittings onto the drain line:

8) Wait a few minutes for the PVC cement to set fully.

The ZoogFlush installation is complete, and the drain line can now be flushed.

Flushing the Drain Line

Flushing the drain line consists of connecting the supplied ZoogFlush Hose Adapter to a hose, connecting the ZoogFlush Hose Adapter to the output-side union fitting and then flushing out the drainpipe with water.

(FYI – shipped with the Hose Adapter is the mating union fitting which is not attached to the Hose Adapter. The complete union is shipped providing a backup O-ring and fitting in case there is a problem encountered gluing on the fitting to the drainpipe.)

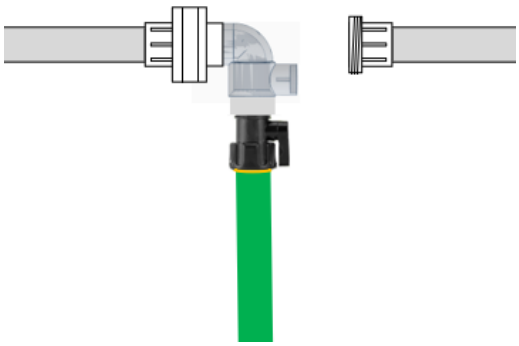
CAUTION - The turn on of the water must be done slowly at first to make sure the drain line is not completely clogged! A completely clogged system could pressurize the pipe and has the potential to separate any fittings that may not have been glued properly. Please adhere to the following instructions and proceed slowly:

1) Do these next steps **outside**. Attach the ZoogFlush Hose Adapter securely to a hose:

2) Make sure the valve is in the off position (horizontal (perpendicular to the hose)). The above picture shows the valve in the OPEN position (in-line with the hose). Turn the valve handle 90 degrees to close the valve.

3) Turn on the hose and verify there are no leaks. If there are leaks, tighten the hose and try again until the leaks stop. The hose valve can also be tightened if needed.

4) Bring the hose and the ZoogFlush Hose Adapter to the AC system and connect the ZoogFlush to the **output** drain line. Verify the O-ring is present (the O-ring should not fall out as we glue them in). Snug the collar hand-tight only, the O-ring seal does not need to be over-tightened:



5) Open the valve a **very small amount** to allow a low flow rate of water to enter the drain line and wait to see if the line backs up with water. If the water seems to be flowing, go to the exit location (or have someone else look) and verify the water is exiting the drain line. (*If the water is not exiting the drain line, the drain line may be completely blocked, and professional help may be needed.)*

   While the water is flowing, there may be some air in the hose which will make an occasional rushing sound – this is normal.

6) If the water is exiting the drain line as expected, the water flow can be increased.
   Slowly turn the valve to increase the flow rate to 25% on, and again verify the water is exiting as expected.
   The water flow can be increased further to 50% and verify the flow is still OK.
   At this point, the drain line should be OK to increase the flow all the way up to 100% and then drop the water down to 25% and then back up to 100%. Do this cycling until only clear water exits the drain line. The whole flushing process usually only takes one to two minutes.

Once flushed, disconnect the ZoogFlush Hose Adapter, and install the two unions and the short length of pipe. You only need to snug the union collars by hand as the O-rings provide the seal and do not need to be overly compressed. There is no pressure to be concerned about with the condensate.

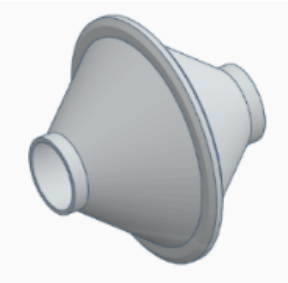
At this point, the line is flushed out and **should now be vacuumed out** if a wet/dry vacuum is available. With the drain line void of water, when the Steramine is dispensed for the first time into the drain line, two cups are dispensed to flood the entire drainage system. With no water in the drain line the Steramine will be at maximum strength which helps to kill the remaining bacteria in the system.

To review the overall drain line clean out process:

1) Upon starting the installation, vacuum out the drain line (see the next section).
2) Install the ZoogFlush kit next so the drain line remains intact.
3) Add a chemical, such as vinegar, bleach, or Drain Solve, directly into the drain pan. This chemical should flow into the drain line and remain there, addressing any buildup while you proceed with the installation.
4) Pour water into the drain pan to flush any remaining chemical out of the drain pan.
5) Flush the drain line with water using the ZoogFlush kit.
6) Vacuum out the drain line.

ZoogOut Universal Vacuum Adapter

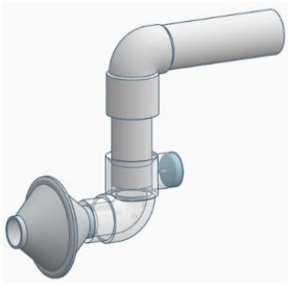
To facilitate vacuuming out the drain line, a "ZoogOut Universal Vacuum Adapter" is provided to vacuum out the drain lines using wet/dry type vacuum. The soft silicone Vacuum Adapter interfaces seamlessly between multiple diameter vacuum hoses and drain lines.



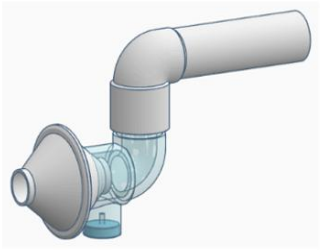
The Vacuum Adapter's pliable exterior will provide an excellent seal between the vacuum hose and a drain line. A high-integrity seal is critical for extracting all of the liquid and bacteria that may be currently residing in the drain lines.

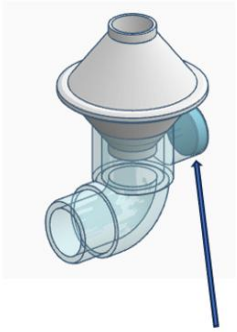
Included with the silicone Vacuum Adapter is a "Vacuum Adapter Holder" that is used not only for long-term storage of the Vacuum Adapter but is also functional. The holder is manufactured from crystal-clear polycarbonate plastic which allows viewing of the water flow.

¾" Pipe



¾" Coupling

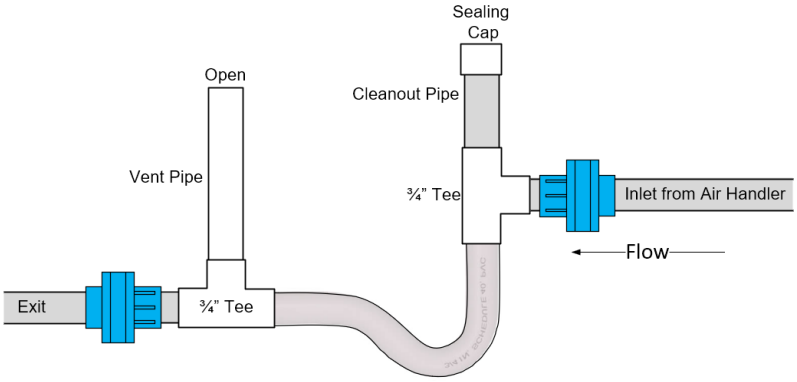




Magnet

The holder can adapt to typical three-quarter-inch PVC drain lines and couplings. The holder provides right-angle options for vacuuming drain lines when there may not be adequate ground clearance or there may be interferences which prohibit connecting the vacuum adapter directly to the drain line.

The Vacuum Adapter Holder contains a magnet that is used to adhere the holder to any steel surface for long-term storage. A good place to store the Vacuum Adapter is right next to the Zoog Zapper!



When a drain line is vacuumed out, the goal is to clear the drain line all the way to the drain pan outlet. Traps are especially susceptible to clogging, so it is imperative that the trap is also vacuumed out.

*If there is a vent tube on the drain line, the vent opening will need to be sealed (**red arrow**) closed as air will be drawn into the vent pipe and the trap will not be cleared. A PVC cap can be used, or the opening can be taped closed temporarily.*

(Do not forget to remove the cap or tape after cleaning!)

Vacuuming Out the Drain Line

Once the drain line is ready to be cleared out:

1) *Remove the filter on the shopvac as the filter is used only for dry vacuuming.*
2) Attach the Vacuum Adapter holder (if needed) onto the drain line.

3) Place the Silicone Vacuum Adapter on the end of the vacuum hose and turn on the shopvac. The Vacuum Adapter will be held in place by the vacuum suction.
4) Place the Vacuum Adapter on the drain line (or on the Vacuum Adapter Holder if being used) and hold the Vacuum Adapter on the drain line for one to two minutes.
5) Liquid will be visible if the Adapter Holder if used. As the pipe is drained out, the water flow will become negligible, and you will see some water vapor only.
6) Turn off the vacuum.
7) ***Remove the cap or tape if either was added to the vent pipe!***

This procedure will clear out most drain lines, however vacuuming the drain lines will only remove what is loose and floating in the drain line. To go one step further, flushing the drain line with the ZoogFlush kit will provide the best drain clearing solution.

Drain System Cleaning Summation

It is crucial to thoroughly clean the entire condensate collection and removal system before installing the Zoog Zapper. Regular maintenance with the ZoogOut Vacuum Adapter and ZoogFlush hose flush kit is essential to help prevent drain line clogs. If possible, vacuum the drain line every month (or two) and perform a hose flush every six months. While we cannot guarantee that a drain line will never clog again due to the unknown internal condition of drain lines, periodic vacuuming, and flushing, combined with the Zoog Zapper's repetitive dispensing, make it easy to maintain a clog-free system. These maintenance tasks only take a few minutes and can prevent future drain line issues!

Section #5 - Details of the Zoog Zapper System Components

Various components are supplied which are designed to accommodate any AC cabinet type encountered. The fittings are needed to allow the dispense tubing to enter the air conditioner cabinet, and to dispense the Steramine throughout the internal drain pan. All the supplied fittings/components are described in detail in the Installation section of this manual.

Reservoir Holder for Integrating the Reservoir, Pump, and Battery Module

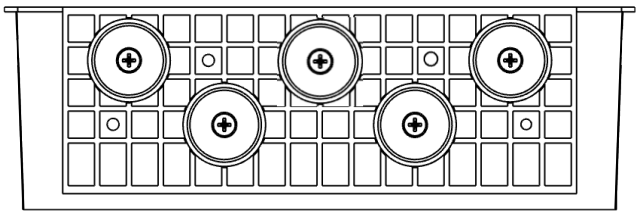
The Reservoir Holder combines the Reservoir, Pump, and optional Battery Module into a single, streamlined assembly for easy installation and operation.

The back surface of the Reservoir Holder features five powerful Neodymium magnets, allowing secure attachment to the air conditioner's metal cabinet without the need for tools or fasteners.

The Battery Module slides into dedicated slots on the bottom of the Reservoir Holder (shown in the picture) and can be inserted from either direction, ensuring flexibility during installation.

The pump can be mounted on either side of the Reservoir Holder to accommodate various installation setups. By default, the pump is positioned on the left side, as shown in the illustration.

Below are front and back views of the Reservoir Holder, highlighting the placement of the Neodymium magnets for a strong and reliable attachment.

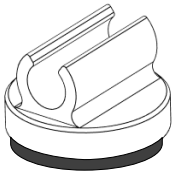


Caution: Care must be exercised when placing the reservoir holder onto the evaporator cabinet as the magnets are extraordinarily strong! Do not place your fingers on the backside of the reservoir holder by the magnets!

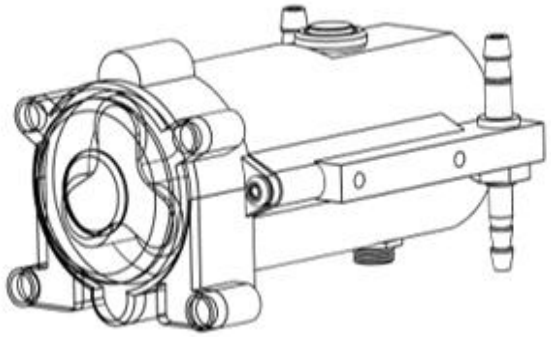
The Reservoir Holder can also be wall mounted if desired. There are access holes designed into the reservoir holder to accommodate four fasteners.

Tube Holders

Multiple tube holders with a Neodymium magnet are supplied to hold the 7mm (1/4") silicone dispense tubing neatly in place:



Peristaltic Pump



- The pump is the core component of the system, featuring self-priming, positive displacement, and vertical pumping capabilities.

- Within the pump lies a custom-designed circuit board featuring a microcontroller, which enhances the system's functionality with additional capabilities.

- Mountable on either side of the Reservoir Holder with two Phillips head screws, allowing for easy swapping between sides based on installation requirements.

- Operates in both forward and reverse directions: forward for dispensing sanitizer, reverse for dissolving/mixing new tablets, as well as evacuating the dispense tubing post-dispensing.

- Tubing length is customizable for extending to longer lengths as needed based on the application.

- Default factory-calibrated to one-half cup per dispensing, ensuring precise quantity control. Additionally, the amount of Steramine dispensed can be increased (or decreased) by the user if desired for other applications as well as easily being able to modify the dispense interval from one day to thirty days. The default dispense setting is every seven days, Full pump control is available to the user through one pushbutton interface.

- The peristaltic pump head contains the dispensed liquid within silicone tubing, ensuring no contact with the pump mechanism and prolonging the pump lifespan. Practically any chemical can be pumped depending on additional applications.

- Silicone tubing within the pump head is rated for one hundred hours of continuous use, equivalent to many years of carefree operation.

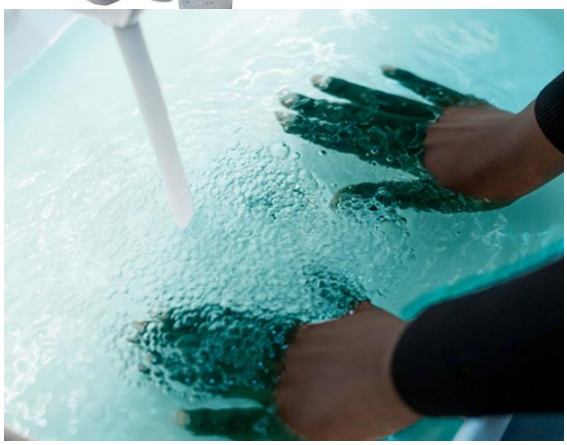
Detailed operational instructions are provided in the manual for user guidance.

Sanitizing Chemical

The sanitizing chemical used is “Steramine. Steramine is widely employed as a disinfectant in food service and healthcare settings.

Steramine is non-irritating to the hands, non-corrosive to all metals, non-staining, odorless and inexpensive. Steramine is used extensively in the food and beverage industry for sanitizing utensils, drinking glasses, countertops, tabletops, etc.

Steramine is formulated with the same active bacteria destroying ingredient as the drain pan tablets approved for manual placement into air conditioner drain pans to prevent bacteria growth, making the Zoog Zapper essentially a dispensing system of the liquid form of these tablets.



Steramine boasts a broad spectrum of activity against various microorganisms, including bacteria, viruses, and fungi, including Zoogloea. Termed a "Quaternary Ammonium Compound," Steramine penetrates the cell membrane of microorganisms like Zoogloea bacteria, disrupting vital functions, and leading to their demise.

Steramine has proven highly effective in preventing Zoogloea growth, posing no concerns when dispensed directly into air conditioner condensate drain pans.

The Zoog Zapper system includes **fifty (50)** Steramine tablets pre-packaged in water-dissolving packets, simplifying usage.

Steramine tablets are extremely cost-efficient, priced at approximately seven cents each, totaling roughly under $4 per refill.

Steramine is available (only) on Amazon for approximately $10 per bottle, with a bottle containing **one hundred and fifty (150)** tablets, lasting over three years based on dispensing one cup of sanitizer per month (1/2 cup twice per month).

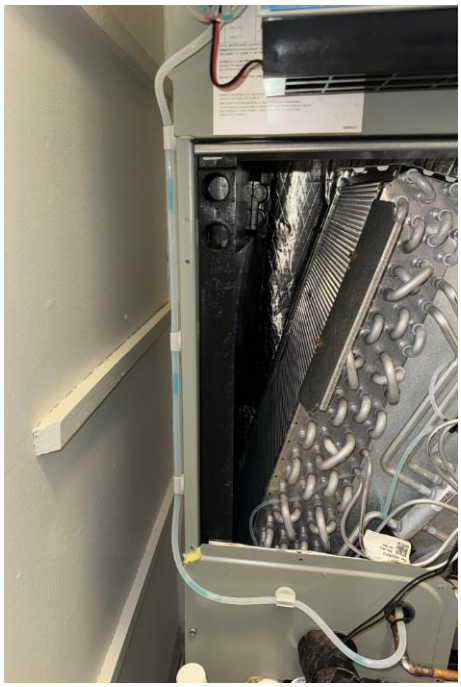
This is a link to the company that manufactures Steramine – and the MSDS Sheet:

https://www.sanitize.com/

Aluminum Tape

A twelve-inch length of Aluminum Tape is included which is sometimes needed for securing the dispense tubing, sealing holes in the AC cabinet and even for securing the AC power adapter wire on a wall and on the AC cabinet. Aluminum tape is very robust and will hold up for many years.

High-Quality "Food Grade" Silicone Tubing



All the tubing used in the system is "Food Grade" quality which is the highest grade available and will last for many years.

A forty-two-inch (1020mm) length of tubing extends from the Pump to the penetration point of the cabinet as shown in the left picture.

A 15" (380mm) length connects from the penetration point to the inside middle of the evaporator coil.

The 15" length is split into two 39"" (1 meter) smaller tubes which can reach to the back of the cabinet to dispense the sanitizer at the far back of the drain pan.

A second 15" length (380mm) connects from the pump to the Reservoir's quick-disconnect fitting.

Rubber Grommet

Used in place of an oval grommet which is used on certain brands of air conditioners (Carrier is one). The existing rubber grommet is replaced with this new Grommet. The new Grommet accommodates the existing copper tube entering the cabinet, up to two sets of wires which are typically for the overflow safety cutoff switches, and the 7mm (1/4") dispense tubing.

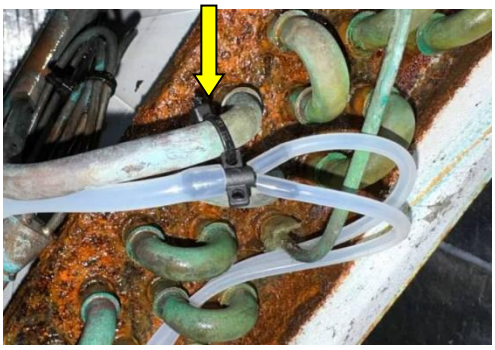
Existing Rubber Grommet:

New Grommet:

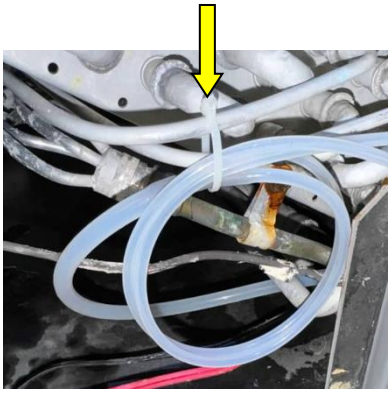
Wire Ties

Two long wire ties are included with the primary use being to secure the rubber grommet collar to the copper pipe (yellow arrow).

Typically, only one wire tie is required, but the second wire tie can also be used to secure the grommet and is explained in the manual.

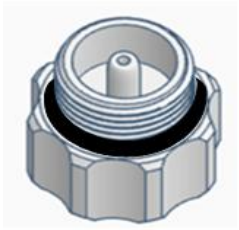


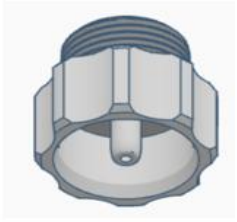
Four smaller wire ties are supplied which are typically used to secure the Two-Port Manifold to the evaporator coils and to loosely secure the 4mm dispense tubing.



Combo Fitting

Used when a spare drain pan outlet (red) is available as shown in the pictures below. If a spare drain outlet is available, this is the preferred method to use.





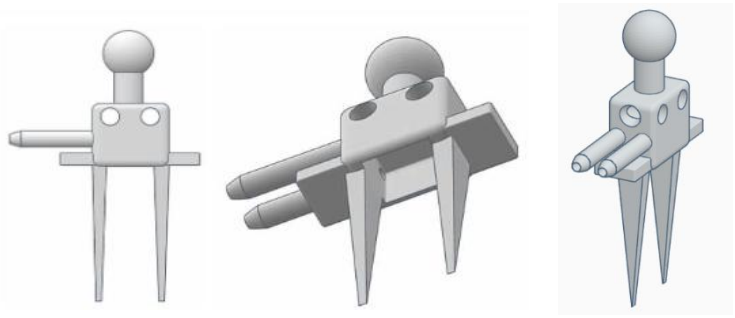
Dispense Nozzles

Two type of dispense nozzles (two of each) are provided. Depending on the type of evaporator coils, orientation of the coils (horizontal or vertical), physical access internally and some additional variables (all explained in the manual) either nozzle can be utilized and in some cases neither nozzle is used.

<u>Which nozzle to use and where to place the nozzles is the most important concept to understand in this manual and is covered in detail.</u>

Single Port Nozzle

Double Port Nozzle

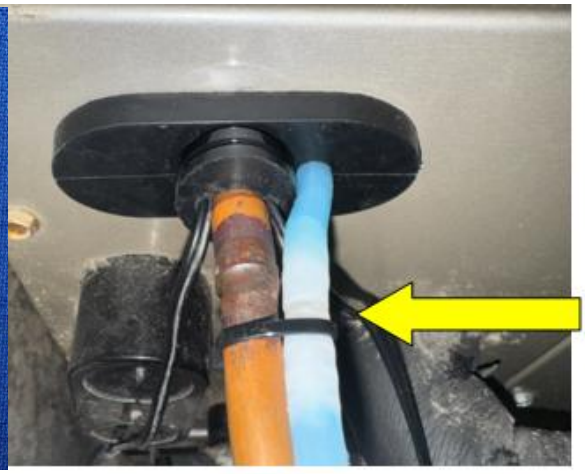


Dual-Port Manifold

This fitting is used inside the AC cabinet and converts the 7mm (1/4”) dispense tube into two 2mm x 4mm dispense tubes. The 4mm tubes will dispense the sanitizer, typically at the rear of the drain pan. The nozzles connect to the ends of these 4mm tubes.

Tube Coupler

This tube coupler is used if either the tubing is to be extended for differing applications, or for connecting to the internal 7MM (1/4") dispense tube (yellow arrow) if the Rubber Grommet is used as shown in the picture.



The wire tie is over the tube coupler, so the silicone tubing is not squeezed.

The tubing can be extended up to fifty feet.

Sanitizing Chemical Reservoir

One-gallon capacity to last six months if the dispense interval is every seven days (default interval), one year if the dispense interval is every fifteen days.

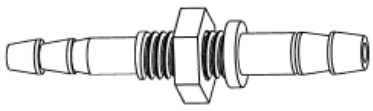
Quick-Disconnect fitting for the suction tube.

Large flip-open lid for easy refilling.

Inexpensive to refill, less than $4.

Bulkhead Mount Tube Coupler

If none of the three pass-thru options can be used, a "fail-safe" (last resort) bulkhead tubing connector is supplied which requires a small 5/16" hole (yellow arrow).



With all four of the available pass-through options (Combo Fitting, Grommet, Bulkhead Mount Tubing Connector, and any "available" opening) the dispense tubing can readily be passed through to the interior drain pan on any brand or type of air conditioner.

Power Sources

The Zoog Zapper pump can be powered by one of three power sources which are batteries, an AC Power Adapter (plug in power supply), or 24VAC supplied from the Air Conditioner's internal transformer via a Power Converter module.

Battery Module

Many AC systems and chiller units are in closets and spaces where no AC power is available. A custom battery holder was developed for these applications. The battery holder slides easily into channels on the bottom of reservoir holder. The battery holder can slide in from either direction depending on which side of the reservoir the pump is mounted on. Six standard "D" cell batteries are required:

AC Power Adapter

A custom-designed AC Power Adapter (wall transformer) can be used if AC power is available.

The Power Adapter is UL listed and provides:

Over-Current Protection

Short-Circuit Protection

Over-voltage protection

High-temperature Operation

LED Indicator

Ten-foot power cable

120VAC/240Vac Operation

24VAC to DC Power Converter

<u>Warning:</u> The 24VAC Power Converter requires wiring expertise and poses a potential shock hazard if mishandled. This option is intended for qualified AC technicians only. Homeowners are advised to use either the AC Power Adapter or Battery Module to power the Zoog Zapper. For safety reasons, wiring instructions for the 24VAC Power Converter are not included in the manual, as untrained individuals should not connect devices to the system's power transformer.

The 24VAC is converted to 12VDC which is the operating voltage of the pump. The pump draws less than three watts when pumping and is a negligible load on a typical 40-watt transformer.

There is a 500mA (1/2 Amp) fuse on the 24VAC input to protect the transformer and the power regulator chip provides short circuit and overload protection.

The power cable to the transformer may be two black wires or a red/black wire, but there is no polarity connecting to the AC output of the transformer. Color of the power cable does not matter.

Section #6 - Mounting the System

"Mounting" the Zoog Zapper pertains to the best location to place the system on both vertical and horizontal AC systems, or even on a wall. The Zoog Zapper should be placed where the system will not be in the way for normal AC system servicing.

Vertical Systems

On a typical vertical (upright) AC only system (no furnace) there will be an upper and lower panel. The lower panel will need to be removed to install the dispense tubing internally and is (should be) removed for periodic servicing/inspection.

The goal is to keep the lower panel clear, so the Reservoir Holder should be placed on the upper panel as shown in the picture. There is enough dispense tubing provided to extend down to the lower panel.

The Reservoir Holder should be placed at the bottom edge of the top panel and will be on the side of the panel determined by which side the copper tubing enters the cabinet.

In the picture the copper tubing enters the cabinet on the left side, so the Reservoir Holder is mounted on the left side of the cabinet.

If batteries are **not** used, the Reservoir Holder should be mounted two inches above the bottom edge of the top panel.

If batteries are to be used, the Reservoir Holder will need to be mounted three inches above the bottom edge of the top panel as additional clearance is needed for the Battery Module.

The Zoog Zapper as shipped will have the pump mounted on the left side of the Reservoir Holder as most vertical AC units have the copper tubing entering on the left side, as in the picture.

Should the copper tubing be on the right side of the cabinet, the pump will need to be moved to the right side of the Reservoir Holder. There are two Philips-head screws that will need to be removed to move the pump.

A different example of mounting the system on the **left side panel** of an air conditioner is shown here.

The pump was switched from the left side of the Reservoir Holder to the right side, so the pump is now at the front of the side panel for easy access.

If batteries are used, the Battery Module is rotated 180 degrees and slid in from the right side of the Reservoir Holder. The Battery Module slides in from either direction.

The lid will also need to be rotated 180 degrees, so the quick-disconnect fitting is on the right as shown in the picture. The silicone suction tube is long enough for mounting on either side.

Caution required when placing the Reservoir Holder onto the cabinet!!

The magnets are exceptionally powerful!

Before securing the reservoir holder, visually verify the magnets are clear of any metal parts that may have found their way onto the magnets.

Securely hold the Reservoir Holder on the left and right sides with both hands and with your fingers away from the back surface. The palms of your hands should be located on the front corners of the Reservoir Holder with your fingers holding the side surfaces.

Tilt the top edge of the Reservoir Holder away from the cabinet towards you.

Touch the bottom back edge of the Reservoir Holder against the cabinet. Try to get the Reservoir Holder relatively level (you can adjust to level once fastened).

Slowly rotate the Reservoir Holder onto the cabinet and the magnets will grab the surface.

The reservoir holder can be moved/slid into position and can be set to level (with a level).

To remove the reservoir holder, hold the reservoir holder with both hands and rotate the top edge away from the cabinet towards you and the Reservoir Holder will release.

Once the reservoir holder is in place on the cabinet, the dispense tubing should be attached to the **side** of the cabinet, not on the front of the cabinet as again the lower panel typically needs to be removed.

Four magnetic tube holders are used for securing the dispense tube. The tube is routed down to the stationary panel and will connect to one of the “penetrating” tube fittings.

The picture shows the dispense tubing connected to the “Combo Fitting.”

Horizontal Systems

On a horizontal system, the Zoog Zapper can rest on the top of the cabinet or can be placed on the side panel with the magnets. Where the Zoog Zapper is ultimately placed on the air handler is up to the installer and dependent on the particulars and interferences of the AC system design. The system could sit on the top of the unit during the installation and testing and the last step could be to move the Reservoir Holder down onto the side panel, *or not.*

Here are two examples of systems placed on the top of the air handler (both AC powered):

On this system the Zoog Zapper was lowered down and placed on the side panel once the system was completed, there is a gray power cable on the cabinet top right side which interfered:

This system was placed on the right-side panel which did not need to be removed. The left side panel was opened to run the tubing inside:

Wall Mounting

Should mounting the reservoir holder on the cabinet not be practical for whatever reason, the reservoir holder can be mounted on a wall, or other vertical surface. There are four holes in the back wall of the Reservoir Holder that can be used for mounting with screws. A drill template is provided on the website for the hole locations - Click here for the Wall Mounting Template

Adequate wall anchors must be used as the reservoir and batteries can weigh up to twelve pounds!

Plastic anchors should be rated at a minimum of fifty pounds.

If possible, at least one of the screws would be into a beam for extra strength.

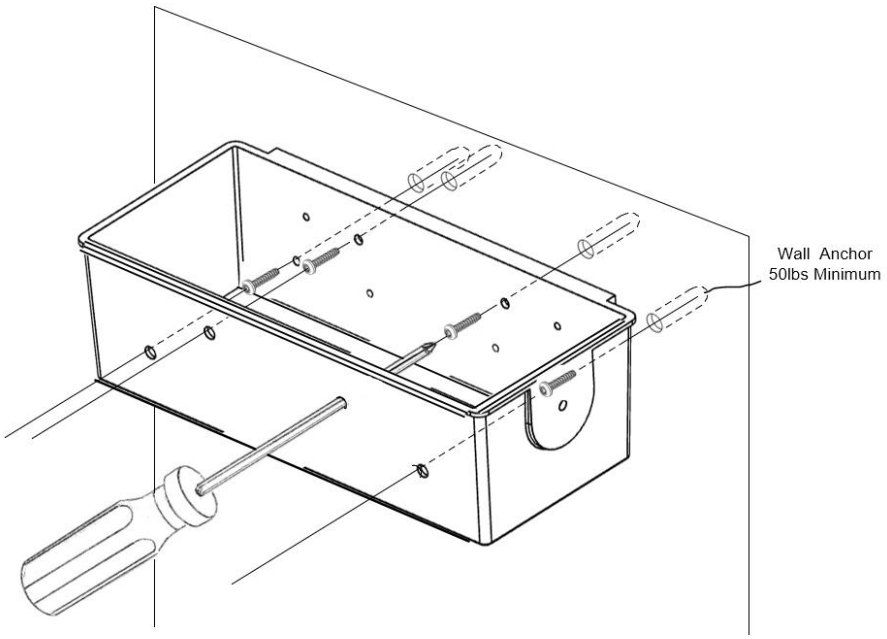
A board could also be mounted to the wall and then the reservoir holder mounted to the board.

For some installations, the reservoir holders were placed on shelves.

There are matching holes in the front face of the reservoir for a screwdriver to be inserted through. If a long screwdriver is used the screwdriver will need to pierce the label on the front of the reservoir.

Hex-head screws can also be used that can be rotated in with a small socket set so the label is not touched.

This diagram shows the mounting holes.



The magnets can be removed if not needed. A Philips head screwdriver is required.

Be careful handling the magnets as the magnets are extraordinarily strong!

What Can Possibly Go Wrong?

Air conditioner cabinets all vary in both panel gauge (thickness of the metal) and the type of surface finish. Newer Trane cabinets have a plastic front panel and metal side panels.

The thicker the metal, the stronger the magnets will attach.

Some cabinets have a "bumpy" finish, while others are smooth. A smooth panel will provide maximum magnetic attraction as a bumpy/grainy surface provides less overall surface contacting the outer ring of the magnet. Some cabinets have a very glossy paint applied; some cabinets are plain flat paint.

The magnets have enough strength to adhere to any metal cabinet, however a bumpy (stamped) surface with a high-gloss (slippery) paint, (Goodman systems primarily) plus possibly labels/stickers in the installation area may not provide enough strength to where the Reservoir Holder may slide/tilt some. With these particular conditions combined, there is not enough "stiction" for the magnets to not prevent sliding. To prevent any movement, the magnets are covered with a thin rubber coating to provide additional friction which has proven to prevent any sliding of the Reservoir Holder.

However, should there be some ***rare*** conditions not encountered previously where the Reservoir Holder still moves, the Reservoir Holder cannot be applied to the panel and an alternative location will need used.

On a horizontally mounted AC unit, the Reservoir Holder can simply be placed on the top surface of the cabinet as shown in the examples.

On vertical units, the Zoog Zapper can possibly be mounted on the floor and the tubing run up to the unit. The pump has no issues pumping up to twenty feet. If placing the system in a secondary drain pan, space the system off of the floor two inches on a block of wood in case the drain pan overflows.

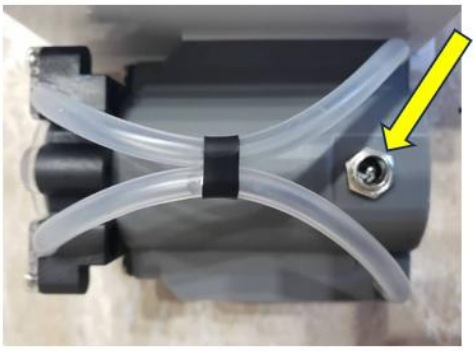
The system can also be mounted on the lower panel of a vertical system instead of the top panel. As a suggestion if placing the system on the lower panel, place the system on the floor temporarily and complete the installation. After the two cups of Steramine are pumped and the pumping is observed/verified, re-install the lower panel, and then place the system into the final mounting location.

Lastly, the system can be mounted on a wall also if possible.

Section #7 - Connecting a Power Source

Once the Reservoir Holder installation is completed, power can be connected. The Zoog Zapper pump can be powered by either batteries, AC power, or the 24VAC to DC Converter.

The pump is protected from power outages by on-board memory that stores operating parameters and timing counters. If power is lost, once power returns the pump will pick up right where the pump was when power dropped out.



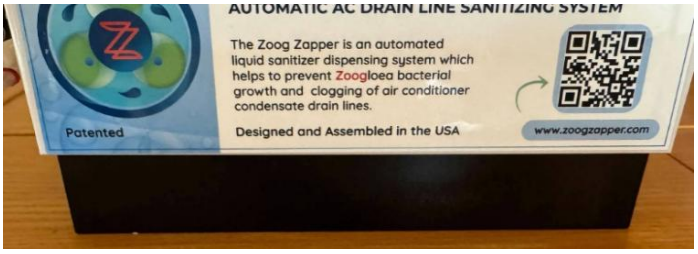
All three power sources plug into the power connector on the bottom side of the pump (yellow arrow). Make sure the power connector is fully inserted into the pump.

When power is plugged into the pump, the LED on the pushbutton switch will flash six times rapidly, and the internal beeper will sound for three seconds.

Should the pump fail to power up – please refer to the troubleshooting section of this manual.

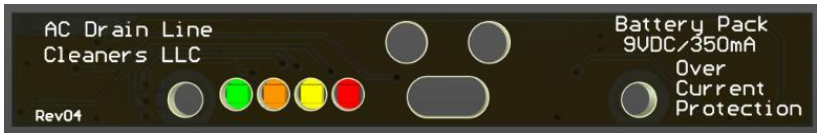
Powering the Zoog Zapper with Batteries

A Battery Module is provided which holds six standard "D" batteries (not supplied). The batteries can last up to two years depending on the dispense interval. The Battery Module slides into slots on the bottom of the Reservoir Holder and can slide in on either the left or right sides depending on the installation.



The circuit board on the battery holder provides over-current protection via an electronic fuse (automatic reset), and there are four distinct color status LED's which indicate the battery state of charge.

The LED colors are green, orange, yellow and red. As the battery charge decays over time, the appropriate LED for that charge level will flash every **15** seconds.

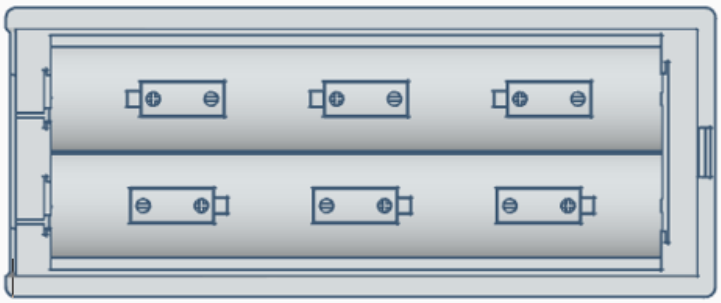


As the battery voltage transitions between levels, two LEDs will flash. For example, as the voltage level falls from the green to the orange voltage range, the green LED will flash first, immediately followed by the orange LED flashing. Once the level drops slightly further, only the orange LED will flash. This sequencing provides a rough indication of where within the ranges the voltage level is currently.

Red = *Almost* Dead. When the red LED is flashing it is time to change the batteries. When the battery voltage falls to the red level, the red LED will flash at two second intervals to be more obvious.

The beeper in the pump housing will beep at a ten second interval when the batteries are in the red power level.

Changing the batteries is quite simple. Unplug the power cable from the pump and slide the Battery Module out. The batteries can be taken out of the Battery Module easily by hand. Flipping the module over will cause the batteries to fall out – so be careful!



There are markings on the battery holder showing battery direction. If the batteries are accidentally installed backwards, nothing will happen as the pump circuit board is protected from reverse polarity.

When new batteries are first inserted (properly), all four LED's will turn on and then off in sequence. Verify all four LEDs are operational.

The green LED will flash every two seconds for two minutes (as part of initial circuit board testing).

After two minutes, the appropriate LED will then flash every fifteen seconds depending on the current state of charge remaining. *Obviously with new batteries the green LED should flash.*

Slide the Battery Module back into the Reservoir Holder and plug the power cable into the pump fully.

Battery Level and Time Remaining

As an approximate reference on how much power and time is left in the batteries:

Green = Full Charge – time remaining – 16+ months

Orange = 80% full – time remaining – 12 months

Yellow = 40% full – time remaining – 6 months

Red = 10% full – time remaining – 2 months.

When the pump runs, all four LED's will begin flashing to signal the pump is running and will turn off in ten seconds.

Factors which will affect battery life are excessive heat and cold which is usually found in attic installations. The batteries should be checked every six months to verify the remaining charge.

When to Slide in the Battery Module

The Battery Module can be slid onto the reservoir holder from either direction for convenience. It is best to **first** mount the Zoog Zapper Reservoir Holder to the cabinet (or wall) and *then* slide the Battery Module in.

The Battery Module will freely slide in and therefore can also freely slide out, which *could* be a problem if the system is being carried. With six "D" batteries installed, the weight of the Battery Module can cause injury should the Battery Module slide out and land on a foot!!

There will be installations that will require the Zoog Zapper system to be installed on the side of the air conditioner cabinet as shown in the picture.

The copper tubes on the left of the Zoog Zapper prevent the battery module from sliding in or out the back (left side).

For this specific reason, the Battery Module was designed to slide in from either direction.

Mounting the Reservoir holder first and then sliding in the Battery Module will prevent any accidents.

Powering the Zoog Zapper with the AC Power Adapter

If there is an AC outlet nearby, you can opt for the Power Adapter to power the Zoog Zapper. With a ten-foot cable, the Power Adapter offers a convenient, flexible, and care-free installation option. Rated for elevated temperature operation up to 145°F (60°C), the Power Adapter is ideal for attic installations where heat and humidity levels are elevated. Hence, for attic installations, using the AC power adapter is recommended instead of batteries.

If there is not a conventional AC outlet available but there is an attic light, some of the light fixtures have an AC power outlet built in. This outlet is ideal for plugging in the AC Power Adapter as shown in the picture on the left.

If there is a light in an attic *but no power outlet,* this simple pull-chain adapter can be used. The existing light bulb is removed from the light fixture socket and the pull-chain adapter is screwed into the light fixture socket. The light bulb is then screwed into the adapter.

The pull chain controls the light only and the AC power outlet on the light fixture is always on. The AC Power Adapter can be plugged into the AC power outlet on the pull-chain fixture.

If there is a pull chain on the existing light fixture, the chain **must** be pulled so the power is always on to the added pull-chain adapter. The light bulb is then controlled by the pull chain on the new light-fixture adapter.

If the existing light fixture does not have a pull chain, there should be a switch somewhere that turns the light on and off. This switch must remain on. Placing tape on the switch in the “On” position will ensure that the switch is not inadvertently switched off!

This adapter can be purchased at hardware stores, Home Depot, Lowes, Amazon, etc.

Routing the AC Power Adapter Wire

The AC Power Adapter is supplied with a generous ten feet of cable. If this cable is not long enough, an inexpensive 2-prong extension cord can be used to extend the length.

What has worked best for securing the power adapter cable is to tape the cable to the AC panel. The Aluminum tape provided is preferred to secure the cable, but the cable is very lightweight, and even Scotch tape will suffice.

Here is an installation example where the AC power adapter was used (neatness counts):

Small staples were used on the wall and aluminum tape was used to secure the cable on the cabinet.

Due to the short length of cable needed, the excess cable was curled up and wire-tied together and then wire-tied to the two pump mounting holes in the left side of the reservoir holder that were available since the pump was moved to the right side of the reservoir holder.

Since every installation is different, when it comes to the AC power adapter cable routing some creativity may be needed, but overall, simply taping the cable in place will work, even on the wall.

This is a link to the small staples:

https://www.homedepot.com/p/Gardner-Bender-3-16-in-Low-Volt-Staple-for-Wood-Applications-White-100-Pack-PSW-160HD/314804401

Connecting the 24VAC to DC Converter

The 24VAC converter connection instructions are not provided for homeowners as the converter needs to be connected to the AC system's internal 24VAC transformer and accessing the internal wiring is required, which is potentially dangerous.

With the 24VAC converter option a ten-foot cable is provided which connects from the pump to the transformer wiring. There is a 500mA (1/2 amp) fast-blow fuse on the input from the transformer and the output to the pump is protected by the power regulator. (The pump is also internally fused).

The polarity of the power cable does not matter connecting to the AC transformer output.

Should the input fuse blow, a new converter will be required as the fuses are not resettable.

There are magnets inside the converter to adhere the converter to the cabinet.

The converter needs to be mounted to the cabinet in the vicinity of the pump as the output cable is eight inches in length.

As a suggestion, the converter can be mounted on the side of the AC cabinet to keep the converter out of the way.

The converter provides a convenient method of powering the system, but again, should only be installed by a professional AC technician!

For convenience, the ten-foot wire can be wrapped around the dispense tubing to hold the wire in place.

Once the tubing is in place, lift a magnet off the surface and slip the wire under the magnet and wrap around.

Section #8 - Installation of the Dispense Tubing

Front Panel Removal

Warning: Turn off the power to the AC system!

If the AC system is operated with the panel open, the evaporator coil will freeze over, and there may be UV lights turned on which are damaging to your eyes and MUST be powered off.

Regardless of whether the AC system is oriented horizontally or vertically, the front panel of the cabinet must be removed to route the dispensing tubing.

On a vertical system, there is an upper and lower panel and only the lower panel needs to be removed. The Zoog Zapper will normally mount on the upper panel.

On a horizontal system, both panels can be removed to have full access to the evaporator coil for inspection.

Typically, a 5/16" or 1/4" nut driver or socket will be needed to remove the panel screws.

One issue that can be encountered when removing a panel is interference as the screws can be blocked by the copper tubing when using the nut drivers. If there are interferences, using a small socket set or vise grips will usually work to get behind the copper tubing.

Place the screws in a container or in a safe place.

Sometimes the screws can be difficult to remove if they have not been removed for a long time as some screws may have rust on them. Take your time if you have difficulty removing the screws.

Aluminum tape may also have been used on the seams of the panel to provide a better seal. Some panels do not seal well for multiple reasons and if air flows through the seams there could be whistling sounds. Covering the panel seams with aluminum tape seals the seams which prevents leaks and noises. If there is aluminum tape on the seams the tape can be cut/sliced (carefully and slowly) with a razor blade.

There may also be a sealing paint/mastic applied to the panels which can also be cut through with a razor blade.

Once the panel is loose, **gently remove** the panel as there may be tubing and wires "intertwined" with the front panel. Place the panel out of the way.

You may encounter a front panel that is "captured" by the drain tubing and the tubes must be removed to be able to get the panel off. These systems (A Rheem is shown) can be more of a challenge. On this particular system the tube on the left was cut at the 90-degree fitting. The panel could then be taken off.

A new 90-degree elbow (shown) was used once the dispense tubing installation was complete and the panel was put back

on. The elbow was not glued so the elbow could be removed at the next servicing so the panel can be removed easily.

On horizontal systems which are hanging from the beams, depending on how well the AC system was adjusted when hung, there could be a problem when the panel is installed back on as the holes may not line up well.

Hole miss-alignment is caused by the AC system basically being crooked (a corner could be too high or low).

If there is miss-alignment the system hangars can be adjusted to square-up the cabinet, or help may be needed to move/jostle the cabinet to align the holes so the screws can be inserted. Moving the cabinet and inserting the screws is difficult for one person to do…

Determining Routing of the Dispense Tubing into the Cabinet

There are four methods to route the dispense tubing into the cabinet. The methods are presented in priority order and should be implemented in that order if possible.

Combo Fitting Installed into a Spare Drain Port

If a spare drain outlet is available, using the Combo Fitting should be used to route the dispensing tube into the cabinet. Installing the Combo Fitting encompasses removing a blank drain plug and inserting the Combo Plug with an attached length of 380mm (15”) 7mm (1/4”) dispense tube.

There are multiple types of plugs that are used, and they can all be removed fairly easily.

Insert the silicone tubing into the drain outlet as shown in the picture. The inside end of the tubing should be in a similar position pointing towards the center to the coil.

On some systems inserting the tubing into the drain outlet and grabbing the other end can be tricky with tubing behind the panel. What works well in that situation is using gravity by lowering the tubing on the inside of the panel down to the drain outlet hole and using needle-nose pliers to reach into the outlet hole, grab the tubing and pull the tubing out of the hole.

Attach the 380mm (15”) length of silicone tubing to the thread-side tubing connector on the Combo Fitting as shown in the picture.

Insert the Combo Fitting into the drain outlet and rotate clockwise (in) until the Combo Fitting is very tight or is inserted all the way up to the O-ring. The silicone tubing will rotate as the Combo Fitting rotates. Once the Combo Fitting is fully inserted, the tubing is to be double-checked to make sure there are no kinks.

Route the end of the tubing through the coils (to anchor the tubing in place) to the center of the coil and leave the tubing there for now. The silicone tubing is rated for very cold and hot temperatures and is not affected by the coil temperatures.

This AC system had two plugged drain ports. The upper plug was removed and the Combo Fitting threaded in.

(A needle-nose pliers was used to remove the plug).

In this installation, the side panel could not be removed with multiple heater-related pipes in the way, so the simplest solution was to use the available spare drain outlet to dispense the Steramine into the drain pan.

While this is not the optimum installation solution as the supplied internal tubing could not be used, dispensing through the spare drain plug will flood the drain outlet area with Steramine to prevent the drain outlet clogging which is still a priority. A four-inch piece of the tubing was used to make sure the Steramine was dispensed far enough inside the drain pan. The plug is shown as originally installed in the unit before removal in the picture (yellow arrow).

The completed installation (this is an early prototype system):

This example is shown as some systems encountered may be too difficult to access internally due to external piping.

Dispensing into the drain pan only will need to suffice if that is the case, and that will/should prevent the drain outlet clogging.

A system like this should periodically be opened by an AC professional to inspect the system.

Another example of using a spare drain port.

Rubber Grommet Installation

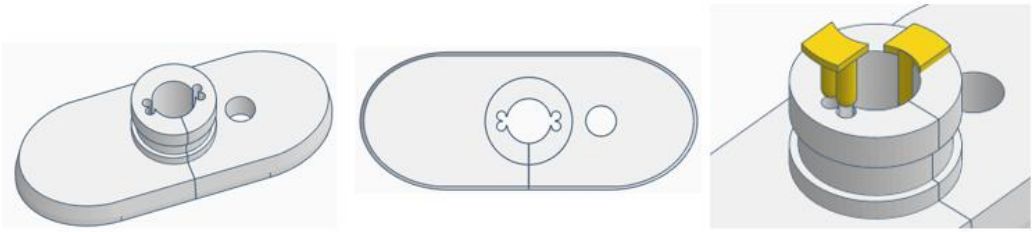
If there is not a spare drain port, the next solution is using the supplied black rubber Grommet if possible.

In the left picture, the copper tube passes through an existing oval grommet and an oval hole in the metal panel. This type of grommet is used on multiple brands of air conditioners.

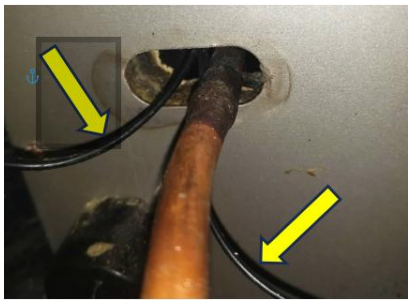
The unused area to the right of the copper tube is an excellent location to feed the silicone tube through.

Along with the copper tube, wires from cutoff switches are sometimes (frequently) routed through the oval grommet. The switch wires need to connect to the internal wiring of the air conditioner and the grommet is a straightforward way to route these wires in.

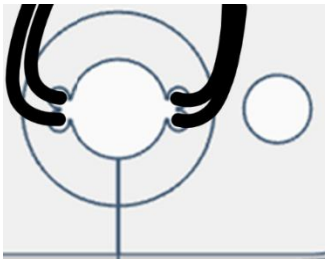
To facilitate using this “through the grommet” method and taking advantage of the oval opening in the cabinet, a custom-designed rubber Grommet is supplied which replaces the existing black rubber grommet. This supplied Grommet will accommodate the existing copper tubing, the 7mm (1/4”) diameter dispense tubing and up to two sets of wires to provide for an efficient and neat installation.



The Grommet has a horizontal slit in the middle which allows the Grommet to be opened and slipped over the existing copper tube. The size of the Grommet is large enough to provide adequate coverage of the panel through-hole no matter where the copper tube is located within the oval cutout which varies per installation.

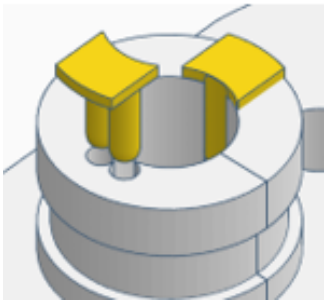


Most air conditioner cabinets lack specific provisions for the cutoff switch wires to enter the cabinet. Installers often resort to using the existing oval grommet to pass the wires through. However, adding wires through the existing rubber grommet can lead to air leakage into the cabinet unless the grommet is properly sealed. The picture shows two sets of wires going through the opening (yellow arrows) which is common.



The supplied Grommet is designed with two sets of double holes molded into the collar which can accommodate two sets of wires.

In this picture, the single hole to the right of the collar is for the 7mm (1/4”) dispense tubing.



The supplied Grommet is shipped with two rubber plugs which are molded to the Grommet. If wires are present, the plug(s) are not used, and the wires are inserted into the holes. If there is only one, or no wires, the plugs are to be inserted into the Grommet to seal the unused holes.

There is a square “groove” on the base of the collar which is for locating a supplied large wire-tie which is used to hold the Grommet securely in position.

Installing the Grommet

To install the new Grommet, the factory installed black rubber grommet is removed.

The grommet can go with the slit up or down depending on where the copper tube in located within the opening. In the left picture, the silicone tube fits on the right side of the copper tube so the slit on the grommet will face down. If the silicone tube were on the left side of the copper tube the grommet would be mounted with the slit facing up.

The 380mm dispense tube is brought through the oval opening in the cabinet and fed through the hole in the Grommet. The tubing is a snug fit in the hole. The tubing should extend approximately two inches out of the Grommet.

The Grommet is then opened up at the slit and placed onto the copper tube.

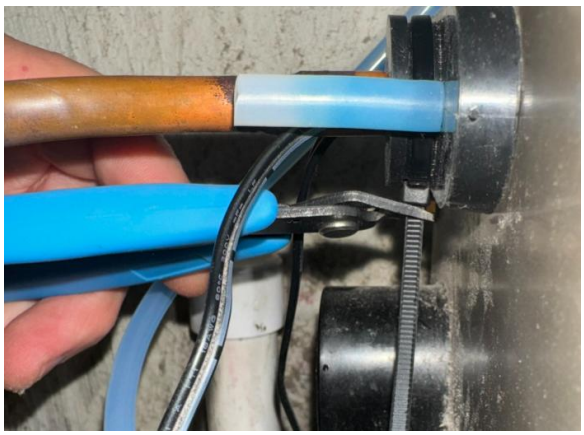
The wires (if present) are then slipped into the Grommet collar holes.

The wire tie can be added around the collar, *but not yet tightened.*

Do not wrap the wire tie around the silicone dispense tube – only the collar!

The Grommet is then pushed against the cabinet firmly.

The wires and the dispense tube can be adjusted as needed for a proper fit, and then the wire tie is pulled tightly to cinch with the locking mechanism on the bottom-side of the collar



The wire tie tail is cut off with a cutting pliers.

The 5mm-to-5mm tube coupler (supplied) is connected to the dispense tube.

The dispense tube from the Zoog Zapper is connected to the other side of the tubing coupler.

The tubing connector can be wire-tied to the copper tube to secure the tubing if desired.

Make sure to place the wire tie on the connector body and not on the tube!

The completed installation of the Grommet.

Depending on the copper tubing shape and the 90-degree bend location, the grommet may not seal completely on the cabinet. If this is the case, aluminum tape can be used to hold the grommet to the surface, and/or a bead of liquid silicone could be used on the backside of the grommet.

This is another picture of the Grommet installed, and the two sealing plugs left attached:

Notice the wire tie is on the tube coupling and not just on the tube.

Additionally, depending on the soldering of the copper tube, the rubber grommet may have a slight gap in the slit, or may not sit snugly against the panel. The second wire tie can be added on the perimeter of the grommet as shown in the picture (yellow arrow). This will pull the grommet together. Push the grommet against the panel while tightening the wire tie.

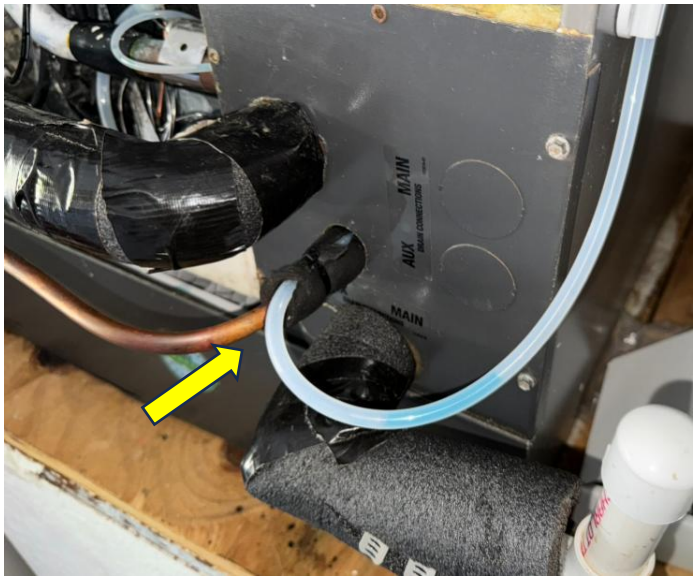
Also, if desired, the bulkhead tube fitting can be used to connect the internal and external tubes together but does take a little more effort to install on the tubing. The wire tie can then be used in the area between the nut and the circular part where the threads are (yellow arrow):

One last thing to mention. Should the copper tube be mounted dead center in the opening, the silicone tube could be close to the metal edge which can be sharp. If this is the case, some aluminum tape can be added to the edge to blunt the edge and can be wrapped around the silicone tube for additional protection.

Any Other Available Through-Openings

Before explaining the third fitting, ***<u>any other</u>*** available through-openings in the panel is a possible candidate to pass the dispensing tubing through to the inside of the cabinet. For example, there may be an area/opening available next to the two copper tubes where they penetrate the metal panel (yellow arrows).

If there is an available opening to "piggy-back" in on, check for any sharp edges that could cut the silicone dispense tubing and wrap the tubing with aluminum tape in that area for safety.



If the dispense tubing goes through some other opening, there may be new air leaks created, and if so, aluminum tape can be used to seal any leaks. Liquid silicone (dispensed from a tube/caulking gun) can also be used to seal openings.

This is a Lennox system which <u>only</u> had an opening around the copper tube. There was a foam piece sealing the opening, and there was plenty of room for the dispense tubing to pass through.

The 5mm tube coupler was used to connect the inner and outer dispense tubes.

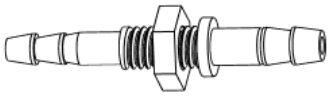
The foam piece was wrapped around both the copper and dispense tubes, and then the supplied two large wire ties were used to secure all three.

The dispense tube wrapped in foam protects the dispense tube from the metal (sharp) edges.

Quite simple to implement!

Bulkhead Tubing Coupler

If all the above solutions are not possible, the supplied Bulkhead Tubing Coupler is the *last resort method* to pass the dispense tubing into the cabinet as drilling a hole is required.



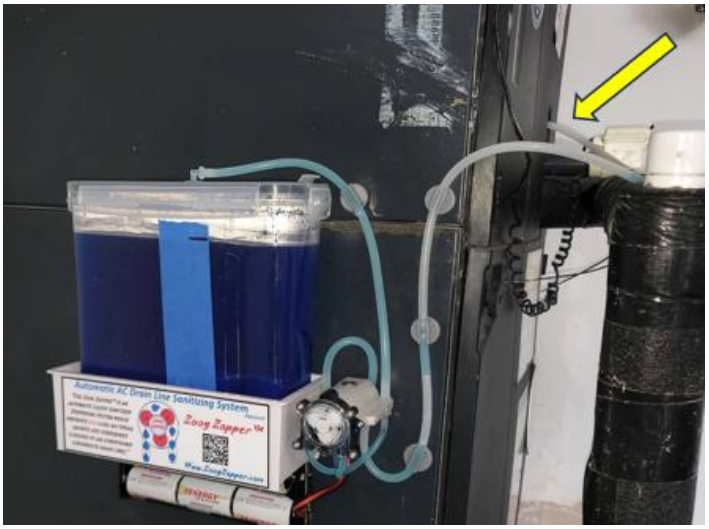
Warning: Care must be taken when drilling to not drill any farther than necessary to create the hole as the evaporator coil is behind the panel!

A small 5/16"" (8mm) hole can be drilled in the *stationary front panel* to install the coupler (yellow arrow).

The coupler has a nut for securing the fitting to the panel. The nut should go on the outside of the panel for ease of installation.

The picture on the left was to drill a hole and install the Bulkhead Tubing Coupler (yellow arrow). The panel that was mounted on a air conditioner locations to bring in the dispense tubing using Grommet, quite easy to drill.

the right is an example of Tubing Connector vertically installed Trane system. There were no the Combo Fitting or therefore the only option drilled is plastic and was



This is the same Trane system as the above picture. The tubing is connected to the Bulkhead Tubing Connector at the center of the cabinet (yellow arrow).

The front face of the Trane system is plastic, so the Zoog Zapper system was mounted via the magnets on the left side of the cabinet which is steel.

The pump and battery holder were moved to the right side of the reservoir for better access to the pushbutton switch along with being able to see the battery status LEDs.

The same location for the Bulkhead Tubing Connector would be used on a horizontally mounted Trane AC unit of the same model.

Section #9 - Determining the Optimum Dispensing Locations

<u>This is the most important section in the manual to understand. The determination of where to place the dispensing nozzles for the optimum dispensing and sanitizing is critical.</u>

Dispensing Steramine exclusively into the external drain piping provides limited effectiveness, as it does not address potential Zoogloea growth inside the evaporator coil drain pan. Such growth can lead to clogs within the drain troughs, increasing the risk of water overflow and hidden leaks.

The most effective method is dispensing directly within the air conditioner cabinet, ensuring the entire internal drain pan, where condensation forms, is sanitized. The Zoog Zapper is specifically designed to sanitize the entire drain pan, targeting critical areas prone to blockages.

By dispensing sanitizer into the back corners of the drain pan, this approach ensures comprehensive coverage, reaching all areas, including the individual drain troughs and the primary condensate drain outlet. This internal dispensing method prevents clogs and sets the Zoog Zapper apart from other systems on the market.

Determining Nozzle Placement Locations

Once the 7mm (1/4”) dispense tubing is routed inside the cabinet, proper nozzle placement is critical to maximize sanitization of the drain pan. Understanding the placement principles and options allows for quick analysis of any AC system to identify the best locations for the nozzles.

The consistent principle across all systems is to position the nozzles to ensure thorough sanitization of the drain pan troughs, ideally placing the nozzles at the far back ends of the troughs. This guarantees coverage of the entire drain pan system, including the drain outlet. Although this manual provides detailed examples and guidelines for nozzle placement, the actual installation process is quick and straightforward, typically taking just a few minutes.

Factors Influencing Nozzle Placement

Several factors may impact placement options, including:

- Cabinet orientation and coil access.
- Interference from refrigerant tubing.
- Placement and configuration of panels.

This section offers insights into various placement possibilities, enabling efficient determination of the optimal locations once the front panel is opened.

Critical Nozzle Placement Rule

The dispensing nozzles must **<u>not</u>** be placed in areas where the nozzles could be submerged in condensate. This is essential because:

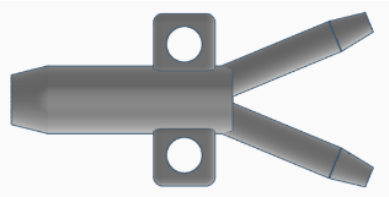
- After sanitizer is dispensed, the pump runs in reverse to purge the tubing of sanitizer by drawing air into the system through the nozzles.

- If the nozzles are submerged, condensate will be drawn into the tubing instead of air, potentially filling the tubing with water.
- This condition can create a siphoning effect, slowly draining the reservoir, which is unacceptable.

If this issue occurs, the nozzles must be relocated to ensure they are not submerged. Proper placement ensures efficient sanitization and prevents unwanted siphoning from the reservoir

Splitting the Incoming Dispense Tube

This fitting is called a “Double-Port Manifold” which splits the 7mm (1/4”) tube into two 4mm (1/8”) diameter tubes.

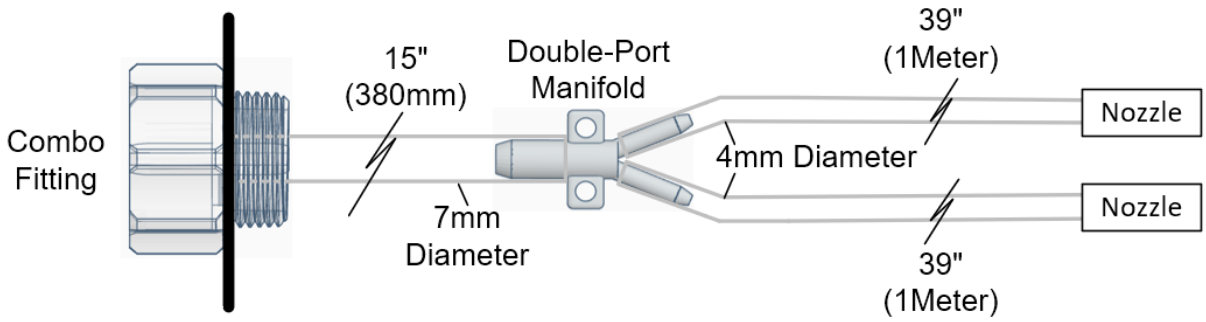


The two 3mm holes in the “wings” of the fitting are for small wire ties to securing the fitting to the internal tubing if needed.

The “Double-Port Manifold” connects to the end of the 380mm (15”) 7mm (1/4”) diameter tube which has been previously inserted.

The 4mm (1/8”) diameter tubes connect to nozzles which dispense the Steramine.

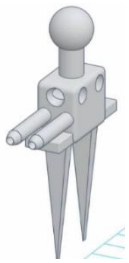
This drawing shows the basic tubing and fittings configuration:



The placement locations and which nozzle to use depending on the physical situation is covered in detail in the following sections.

Dispense Nozzles Types

There are two different nozzles supplied:

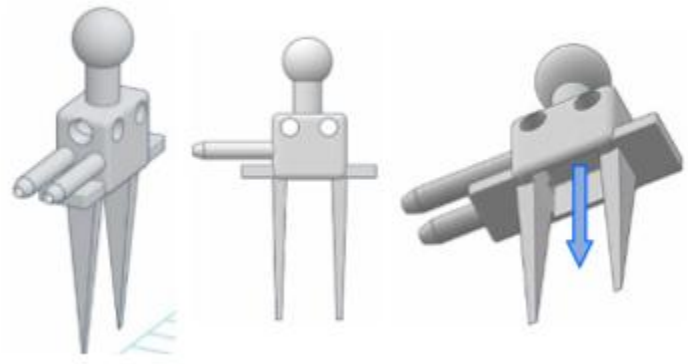


Single-Port:  and Double-Port:

When it comes down to which nozzle to use, *or neither in some circumstances*, and where to place the nozzles, there are many options depending on all of the physical variables encountered including is the air conditioner a vertical or horizontal orientation.

The over-riding determining factor is "can you reach your arm into the back area of the coil?" Some air conditioner units have unrestricted access making nozzle placement straightforward and simple as you can reach easily to the back of the cabinet, and other units have extremely limited access in other areas where placement becomes restricted. However, the tools are supplied so any AC unit can always be accommodated.

Double-Port Nozzle



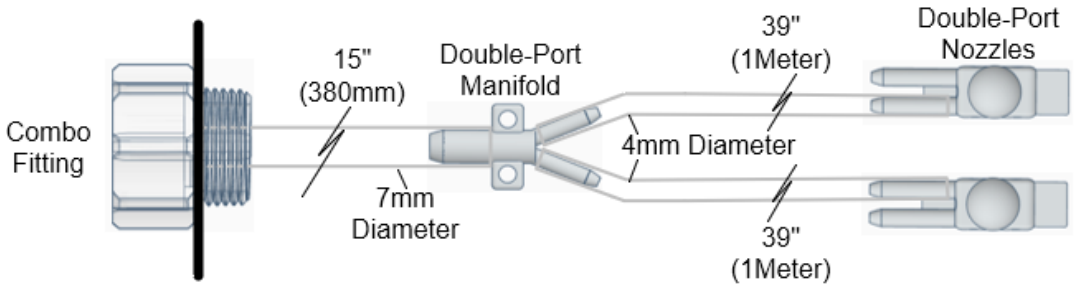
The "Double-Port Nozzle" was designed to be used on either vertical or horizontal oriented coils. Steramine exits this nozzle from the rectangular opening in the bottom surface (blue arrow).

The round ball on the top of the nozzle is for holding the nozzle when hand placing the nozzle.

The nozzle has two "fangs" which are designed to be inserted into the aluminum fins of the coil. Once the fangs are inserted into the fins, the fins will securely lock in the nozzle. The Steramine will be dispensed into the fins and will flow down the fins to the drain pan troughs.

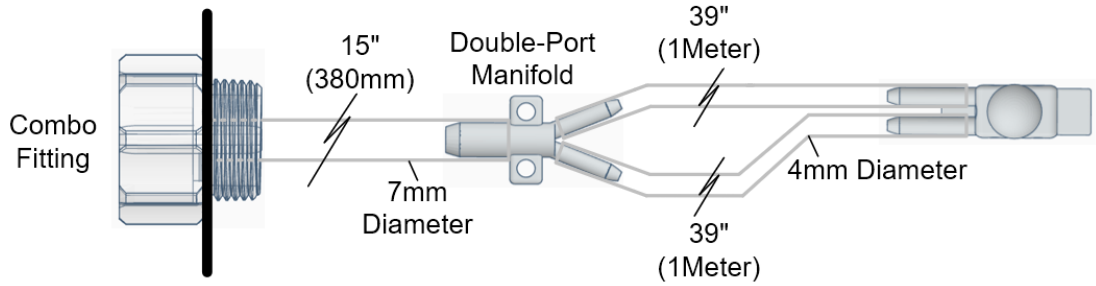
This alternative mounting method allows this nozzle to be placed almost *anywhere* that can be reached inside the cabinet by hand and can be placed into position in mere minutes.

This drawing shows the dispense tubing path and fittings using the Double-Port nozzles if both nozzles are used:



The 1-meter length (39”) of the two 4mm diameter tubes are long enough to reach to the rear of the air conditioner cabinet which, again, is the optimum dispensing location regardless of which nozzle is used.

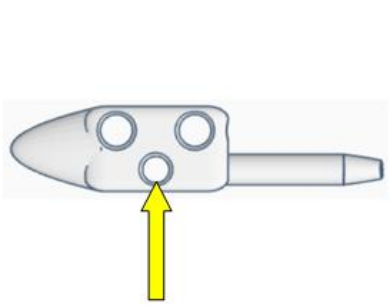
This drawing shows the dispense tubing path and fittings using the Double-Port nozzles if <u>both</u> 4mm tubes are used on one nozzle, which would be used for example on a horizontal system if the nozzle is placed directly into the far corner of the drain pan (examples will be shown):

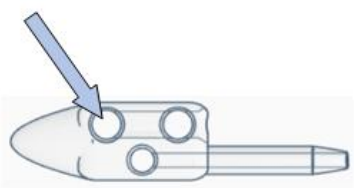


Single-Port Nozzle

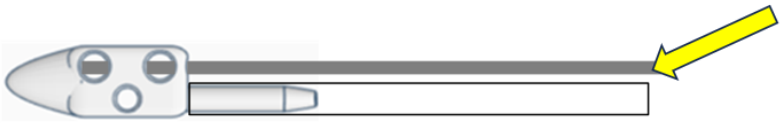
The Single-Port Nozzle is to be used when there are interferences preventing the Double-Port Nozzle from being placed or there is a trough under the coil that the nozzle and tubing can be easily slipped into. There may be instances where one of each nozzle can be used.

On the Single-Port Nozzles the Steramine is dispersed through the lower through-hole (yellow arrow). The upper two 3mm through-holes (blue arrow) are for wire ties (if needed) depending on where the nozzles are ultimately placed inside the cabinet.





To assist in placing the nozzles into any difficult-to-access locations within the cabinet, a steel "placement wire" (yellow arrow) is provided which slips into the hole on the back side of the nozzle:

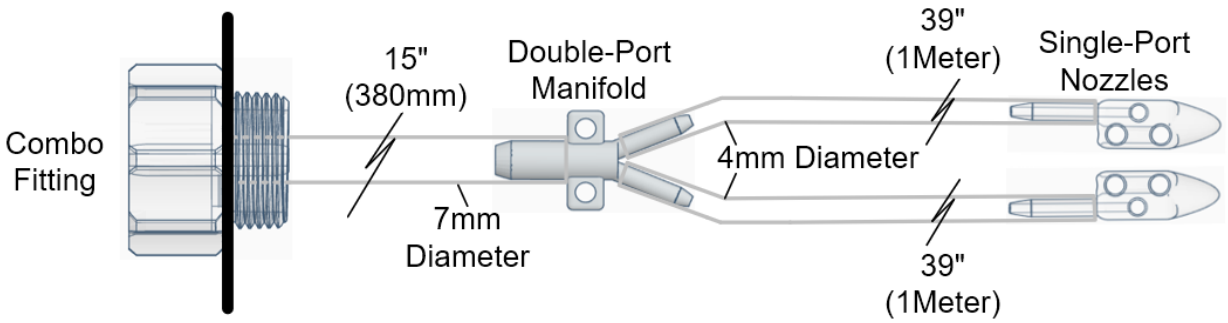


The Single-Port Nozzle is designed to be placed into position using the supplied placement wire if there are interferences and you cannot place the nozzle by hand.

(The wire needs to be straightened before inserting the wire into the nozzle. One end of the wire is straight, the other end is bent for a different purpose.)

By holding the wire in one hand and pulling slightly on the tubing, the nozzle will "lock" on the wire and then the nozzle can be placed into position. After placing the nozzle, the wire is then pulled out of the nozzle with a quick pull leaving the nozzle in position.

This is the typical installation design showing the Single-Port Nozzles:



Priority Of Nozzle Placement and Dispense Locations

Each evaporator coil must undergo an evaluation to determine the optimal locations for nozzle placement and the appropriate type of nozzle to use, or in some cases, whether a nozzle is necessary at all. The primary objective is to ensure that Steramine is dispensed at the far back of the drain pan to sanitize as much of the pan as possible. This section will explain which nozzle to use in which circumstance, and even when to not use a nozzle.

In general, in all air conditioning systems encountered, using the Double-Port Nozzle whenever feasible due to its quick placement is given priority. This nozzle offers maximum flexibility as it can be positioned anywhere on a vertical coil, with emphasis placed on the lower back corner. If accessing this area is difficult, the nozzle can be elevated towards the top of the coil.

When there are interferences and the Double-Port Nozzle cannot be placed by hand, the Single-Port Nozzle is designed to be inserted either below the coil directly in the drain trough, or on top side of the coil at the lower end of the coil. The placement wire included allows for a quick installation in difficult to reach coils.

There are also instances where neither nozzle may be feasible, and no nozzle is used. Examples of each situation are explained in detail to provide a thorough understanding of each situation so the placement solution will be obvious. We will first review how to implement the Double-Port Nozzle on a typical vertically oriented system.

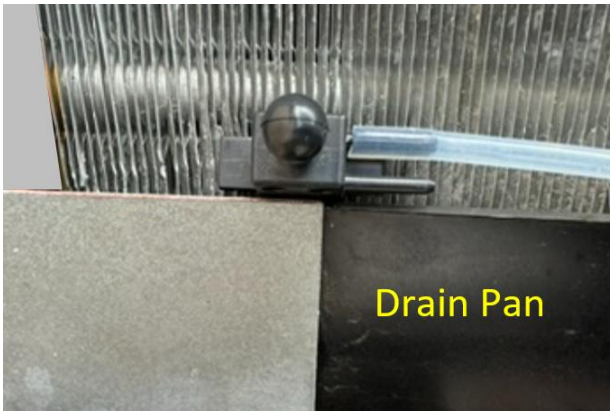
Taking Advantage of the Fins on Coils

The fins on an evaporator coil provide the pathway that transfers condensate that is generated on the coil tubes down into the drain pan. The water basically "clings" to the fins and gravity brings the condensate down to the drain pan troughs.

With the Double-Port Nozzles ejecting the Steramine directly onto the fins from the nozzle cavity, the Steramine will flow the same way down the fins down into the drain pan. Using the Double-Port Nozzle in this manner provides high flexibility in nozzle placement.

The Double-Port Nozzle can be placed using the "fangs" anywhere from the bottom end of the coil to the top end of the coil. The ultimate placement location is determined based on enough access to physically reach into the lower back corners of the cabinet. On some systems there is no room at all to reach into the back. Some systems will be wide open, and the lower back corner is easily accessible. For this reason, two nozzle types are provided to cover the different physical coil configurations.

The ideal location to place the Double-Port Nozzle is in the lower, far back corner of the coil:



The nozzle is inserted into the coils just above the edge of the drain pan. The Steramine will flow down through the fins into the drain pan below.

Only one dispensing tube is used as this nozzle is dispensing on the left side of the "A" frame coil. The second nozzle would be placed on the right side of the coil.

If it is not possible to reach into the bottom corner, the Double-Port Nozzle can be raised towards the top of the coil. The Steramine will flow down the fins *no matter where the nozzle is placed* on the fins from bottom to the top of the coil.

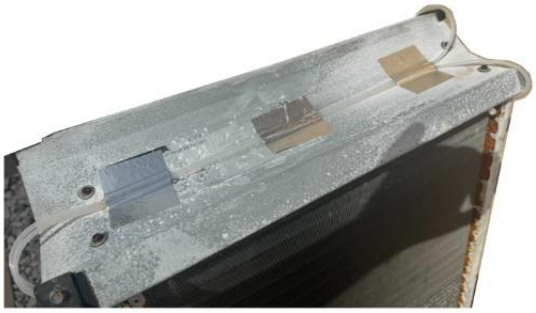
This picture shows the Double-Port Nozzle placed in the middle of the coil.

What is critical is the nozzle is placed all the way in the back of the coil as shown in the picture. The Steramine will flow straight down the fins to the back of the drain pan trough and will then flow to the front of the drain trough sanitizing the entire drain trough.

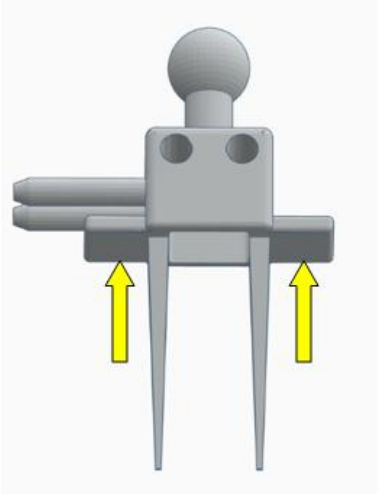
This is an example of placing the Double-Port Nozzle at the *top back* of the "A" frame coil as the top of the coil may be readily accessible.

The nozzles must always be placed at the rear of the coil, so the entire length of the drain trough is sanitized.

If the nozzles are placed at the top of the coil, the two tubes can be brought along the top of the coil connector plate up to the front.



In the picture the two dispense tubes are taped down with aluminum tape to secure them.



To alleviate any concerns about the Double-Port Nozzle staying in place, the fins of an AC coil are not actually "straight" internally and are bent on slight angles, so the sharp edges of the fins will "dig into" the plastic fangs holding the nozzle securely.

There is no damage to the fins from the nozzle's soft plastic.

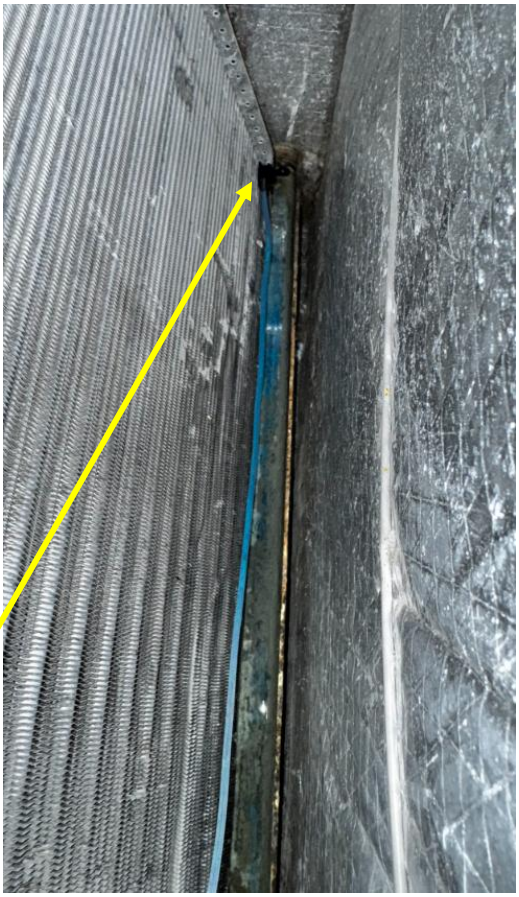
Another feature on the Double-Port Nozzle are two flat pads (yellow arrows) on the outsides of the fangs on which two drops of liquid silicone can be placed. The silicone will "glue" the nozzle to the fins very solidly when the silicone cures.

When inserting the nozzle into the coils the fangs may contact the tube inside and "jam." If this happens raise or lower the nozzle slightly and try again. The nozzle should slide in smoothly and be gripped by the fins.

Whenever the Double Port Nozzle is inserted into the evaporator coil fins, the nozzle should be placed as low as possible on the coil. If this is not possible due to interferences, the nozzles can be raised towards the top of the coil.

Example of Troughs That Do Not Drain Properly

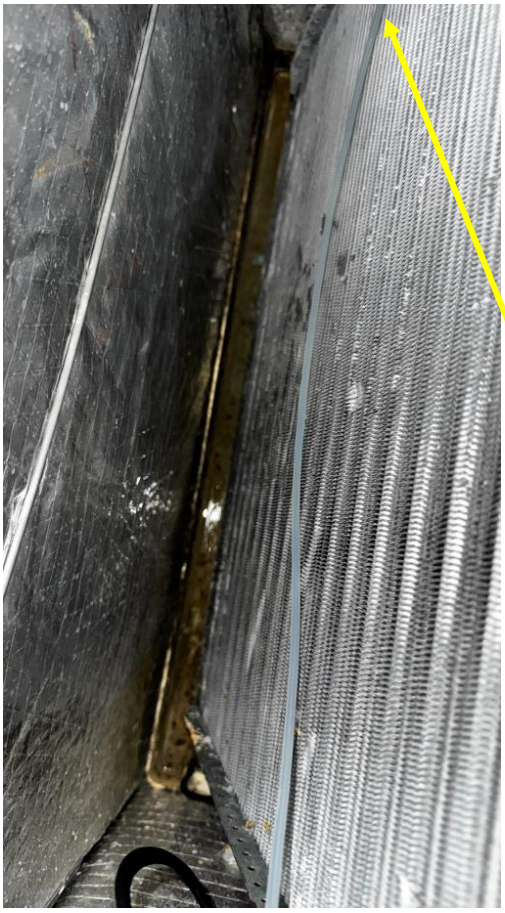
This is an example of a drain pan which is not pitched properly and **always holds water** – and clogged often. There was 3/8" think Zoogloea in both side troughs and the condensate overflowed the Zoogloea in both side troughs and dripped onto the floor.



The condensate could not get to the front trough and drain outlet, so the safety float switch in the front trough would not trip and water just poured onto the floor.

Because the condensate remains in the side drain troughs, the Single-Port Nozzles cannot be used as the nozzles will be submerged. Therefore the Dual-Port Nozzles were used on both sides and placed into the fins of the evaporator.

On the right side of the coil, the back of the evaporator coil was accessible by hand, so the nozzle was placed towards the bottom of the coil, all the way to the back of the coil as shown in the picture (yellow arrow). The ideal location.



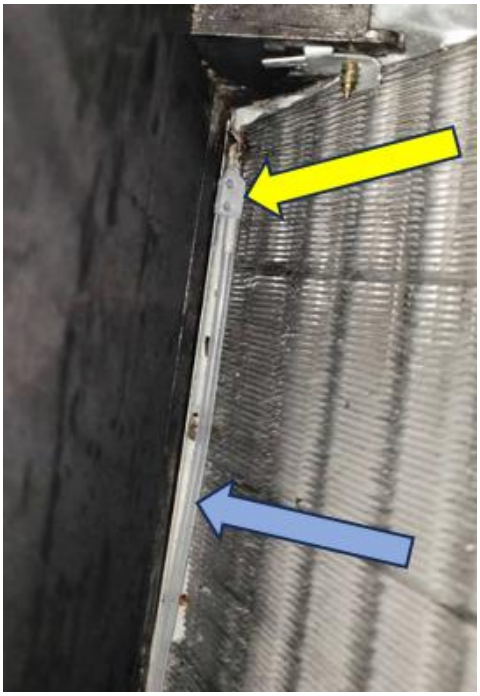
On the left side of the coil, the bottom of the coil was inaccessible by hand due to tubing obstructions. As a result, the Dual-Port Nozzle was installed in the middle of the coil, positioned toward the far back. (The nozzle is not visible in the image but is placed at mid-height.)

Steramine adheres to the fins in the same way condensate does, allowing it to flow down into the drain pan effectively.

The Dual-Port Nozzle is designed to prevent damage to the fins, making it the ideal choice in this scenario. Keeping the nozzle above the drain trough ensures it remains out of standing condensate, which is crucial in preventing siphoning.

Since installing the Zoog Zapper, this system has remained bacteria-free for months—despite the troughs consistently holding about 1/8" of condensate!

Single-Port Nozzle Placement Example



If the Double-Port Nozzle is not able to be placed on a side of the coil due to interferences or there is no room to reach into the back corner, the next alternative is to place the Single-Port Nozzle on **top** of the coil (yellow arrow) in the bottom corner. The Steramine will exit the nozzle and flow down directly into the drain trough.

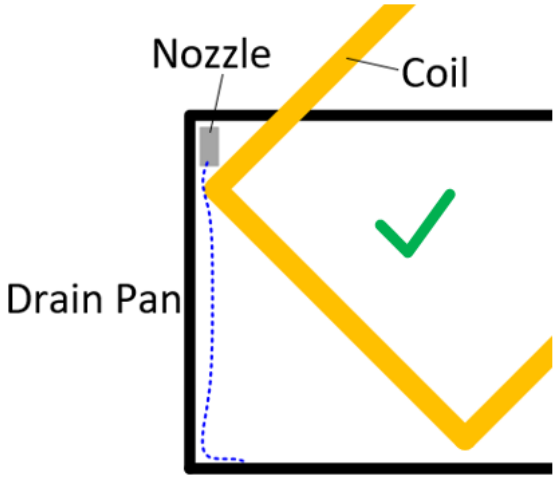
The nozzle is placed all the way at the back of the coil either by hand or using the placement wire.

The dispense tubing can be lowered onto the coil (blue arrow) and brought up to the front of the coil to connect to the 2-Port Manifold.

Verifying the Nozzle Placement on the Top of the Coil

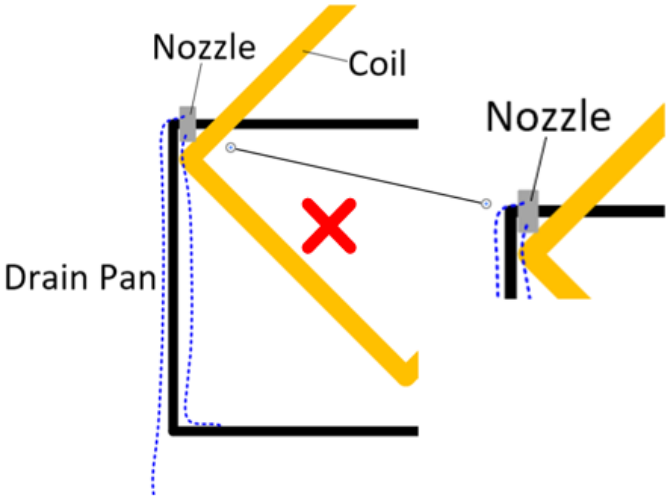
Caution: There is an important requirement that must be verified if the nozzle is placed on the topside of the coil as there are a multitude of drain pan designs.

What needs to be carefully verified is that the Single-Port Nozzle is **below** the top edge of the drain pan. If the nozzle sticks up above the edge of the drain pan, some of the Steramine could dribble out over the drain pan edge and would drop out of the AC unit - which is not where the Steramine is supposed to go!



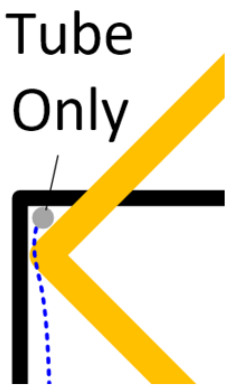
The drain pan edge may not rise high enough on the sides of the coils to create a deep enough "V" shaped space between the drain pan and the fins of the coil to place the nozzle.

In this picture, the nozzle is in the correct position located below the edge of the drain pan. The Steramine (dashed blue line) will drop down into the drain pan properly.



In this picture, there is far less room for the nozzle, and the nozzle is elevated over the edge of the drain pan. The Steramine can dribble out over the edge, which is unacceptable.

In this situation, placing the dispense nozzle in this location is not possible.



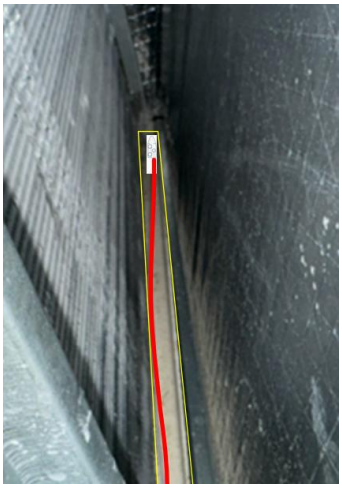
Plan C - There is another viable option if this is the case!

If the drain pan cannot physically accommodate the nozzle, remove the nozzle and place *just the tube onto the coil*.

The tube should always sit low enough (picture) so there is no concern about Steramine dispensing over the edge.

The fluid will flow out of the tube and drop straight down into the drain pan.

The placement wire is used to facilitate placing the tube into the corner.



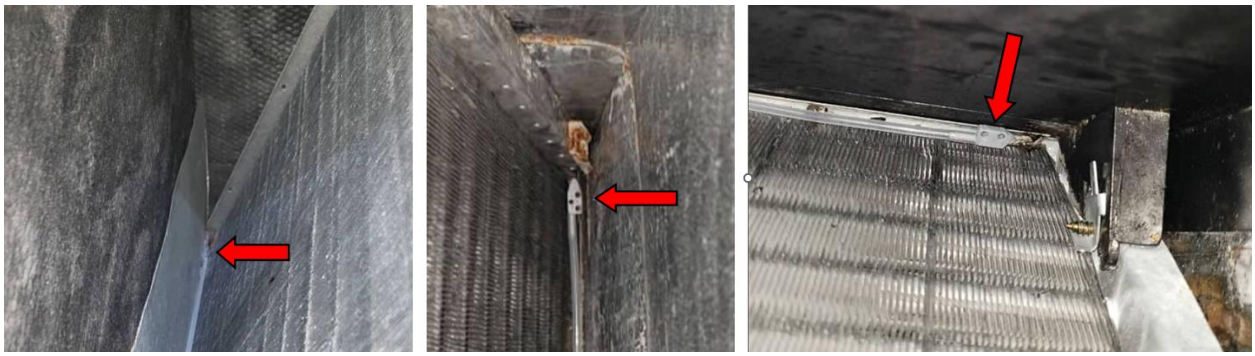
This system (Lennox) had a wide-open drain pan area (highlighted in yellow) on both sides of the coil. The drain pan extended about 1" past the coil and the side edge was up about 1".

The dispense tubing (highlighted in red) and the nozzle is located at the very end of the drain pan trough.

Placing both nozzles was quite simple and quick with no interferences.

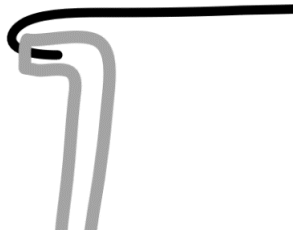
It does not get any easier than this!

Here are some additional pictures showing the Single-Port Nozzle placed above the coils and below the edges of drain pan. *There is also the possibility of using the Double-Port Nozzle:*

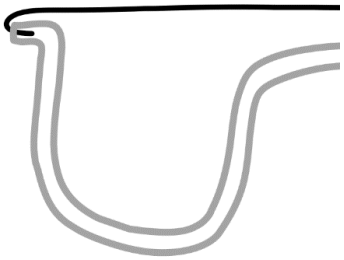


Placing the Dispensing Tube Only – No Nozzle

In some circumstances, the placement wire can be used to place **just the tube** into the back lower corner of the coil. The nozzle is not necessary. This would be done if the top edge of the drain pan were marginal and the Single-Port nozzle may not fit, but just the tube will. The placement wire has a straight end and a "bent" end. The bent end will be used for these next steps:



Place the end of the tube onto the bent wire.



Let the tube hang down. The weight of the tube will keep the tube on the wire.

Place the end of the wire down into the back corner of the coil.

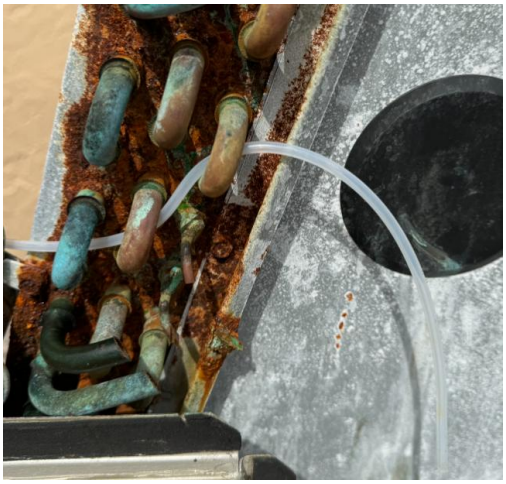
Lower the tube into the gap between the drain pan and the coil.

Slide the wire forward until the wire comes off the tube.

Lower the tube onto the coil all the way to the front of the coil.

The tube should sit down in the “V” groove between the coil and the drain pan (yellow arrow)

Quite simple – and quick!

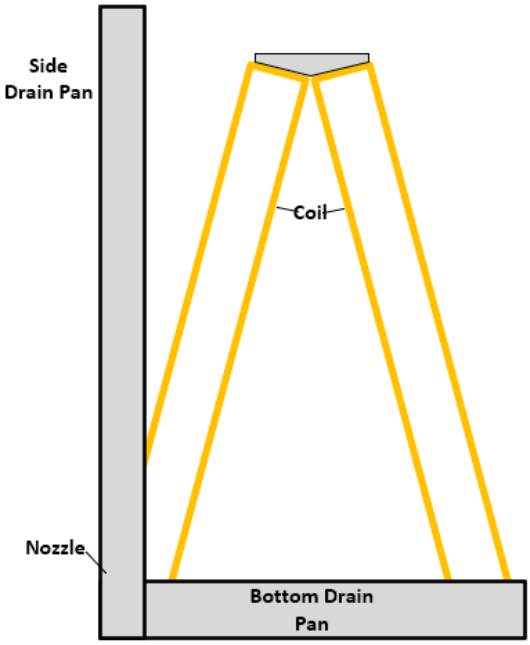


Thread the tube through the coils to the to the center of the coil.

The tube(s) will connect to the Double-Port Manifold.

But Not So Fast – There May be Another Drain Pan

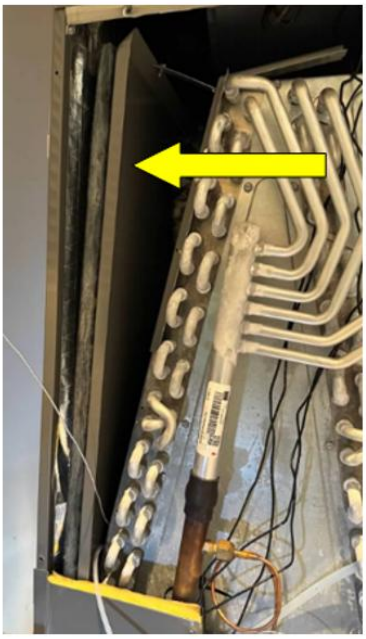
There is one more caveat when it comes to drain pans that needs to be explained, and it is a good thing!



There are <u>many</u> models of air conditioners that can be installed either vertically or horizontally. The drain pan must be able to capture the condensate in both orientations which requires a second, and much larger drain pan for a horizontal installation.

The design of these drain pans is in the shape of an "L" which means the left side of the drain pan has a full, tall, vertical side pan (picture) and not just a bottom drain pan with a low edge.

The tall vertical side drain pan on the left side of the air conditioner will extend up past the top of the coil because when the unit is placed horizontally the side drain pan is used. The left drain pan may be molded as part of the bottom drain pan or could be a separate drain pan that sits inside the bottom drain pan.



In this situation, the bottom drain pan <u>*has no ledge to be concerned about,*</u> so either the nozzle or just the tube can be placed on the topside of the coil with no concerns about the Steramine spilling out over an edge. The entire evaporator coil is sitting/captured inside of the "L" shaped pan and there is no "opening" where the Steramine can drip out from.

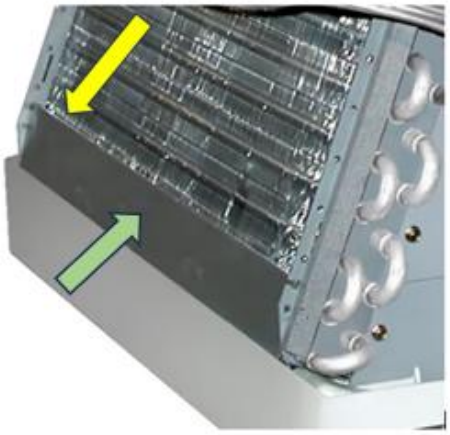
In the picture on the left, the vertical drain pan is visible on the left wall of the cabinet (yellow arrow). The 4mm dispense tubing can be seen at the bottom of the coil entering the cabinet.

With the tall drain pan on the left, there are no concerns placing the nozzle in the far back corner on top of the coil.

Summarizing - When placing the Single-Port Nozzle on the topside of a coil, look first to see if there is a tall drain pan on the left wall. If the left drain pan is tall there is no concern on placing the nozzle at the rear of the coil on the left side. If no side drain pan is present, make sure the nozzle sits below the top edge of the drain pan as previously shown in the above photos – on both sides. If the nozzle does not sit low enough, or you are not sure, the nozzle can be removed and place just the dispense tube by hand or with the placement wire.

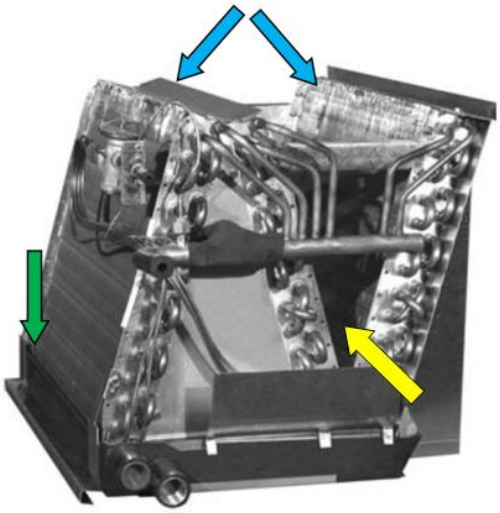
If none of the above are possible or you are unsure, use the Dual-Port Nozzle and place the nozzle into the fins as close to the bottom rear of the coil as possible, which is usually determined by what can be reached by hand.

Other Example Coil Designs



This coil has a secondary black plastic “backsplash” (green arrow) to funnel the condensate into the gray drain pan below.

In this instance, the Single-Port Nozzle would be the best choice to use and can be placed down between the backsplash and the fins (yellow arrow) of the coil as the nozzle is “trapped” by the plastic backsplash.



This coil design is an “N” shaped configuration consisting of three individual coils. The two “V” coils share a common drain trough, and the left coil has its own drain trough.

For the left coil, there is a high black plastic edge. The Single-Port Nozzle or just the tube can be placed in between the plastic edge and the coil using the placement wire (green arrow).

On the “V” coil, both coils meet at the bottom into a common drain trough. If there is no plate covering the opening between the coils, the Single-Port Nozzle can be placed at the back of the “V” where the yellow arrow is pointing. If there is a plate on the opening blocking front access, the dispense tube can possibly be dropped into the “V” at the back. The dispense tubing should be long enough to reach to the far back of the “V.” The Steramine will drip through the coils into the drain trough below.

The Double-Port nozzle can also be inserted into the back top of either coil of the “V” if for some reason the single port nozzle cannot be used.

If neither of these placement options are possible, the Double-Port Nozzle may be able to be placed on the far-right edge of the drain pan on the right side of the far-right coil. There should be room to place the Double-Port Nozzle standing up so the Steramine will drop out of the nozzle into the trough.

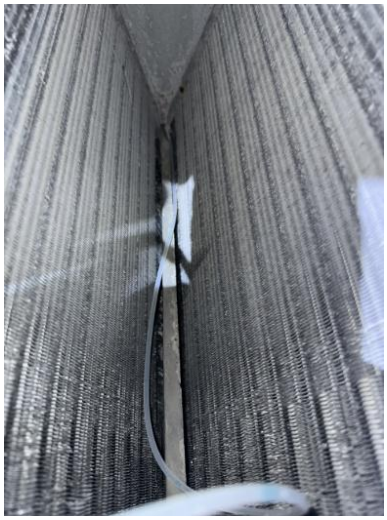
This example system is a Rheem unit which has an “N” coil configuration. This unit was a small coil overall.

Access into the system for the dispense tubing was through a spare drain port (red) which is common on Rheem systems.

This picture shows the side vertical drain pan which also has a support arm fastened to the coil.

There are no concerns placing the Single-Port Nozzle on the left side of this coil.

The nozzle and tube was very easy to place by hand at the rear of the coil.



The second Single-Port Nozzle was placed in the middle of the two coils (left), since the two coils share a common drain trough. The nozzle was placed at the far rear of the two coils.

The tubing was lowered down along the coils and was brought up at the front of the coils. In the picture on the left, at the bottom of the picture is the 4mm tubing coming up and out of the coils and then connecting to the Two-Port Manifold.

The excess tubing was coiled up and should not be cut.

AC Power was used as there was an AC outlet nearby.

The pump was moved to the right side of the Reservoir Holder, so the pump is at the front of the AC system.

Completed installation.

Differences in Coil Designs

There are diverse designs of evaporator coils. The primary objective is to sanitize the entire drain pan system by dispensing Steramine at the far end of the drain troughs.

Take, for instance, this inverted “A” coil configuration, resembling a “V” coil, where two coils converge at the bottom into a single trough. In this scenario, using the Double-Port Nozzle with both 4mm tubes connected is ideal, positioned at the bottom rear of the coil for a straightforward installation (yellow arrows).

While the nozzle can be inserted into or placed atop the fins, or even directly into the trough if accessible, obstacles like copper tubing and plastic parts may hinder manual access to the rear of the coil. In such cases, a placement wire facilitates nozzle positioning.

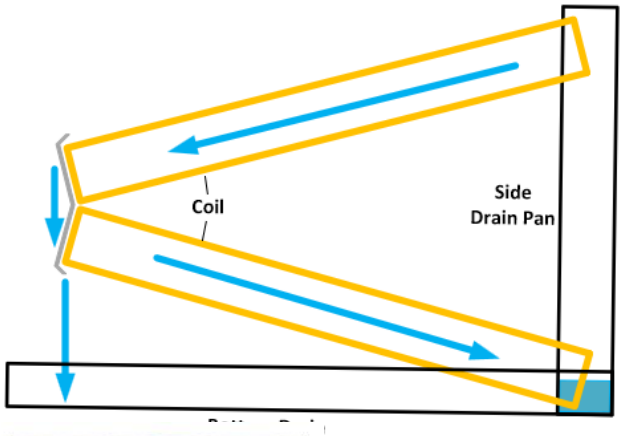
Any excess dispense tubing can be curled up and secured loosely with the wire ties.

Horizontal Units

As explained previously, many AC units are designed for both horizontal and vertical installations. If the AC system is mounted horizontally a large drain pan is required to capture the entire length and width of the coil. The dispensing locations are not as straightforward as a vertical unit due to the myriad coil designs. However, the "Treat the Trough" principle still applies when it comes to dispensing locations.

Basic Horizontal Configuration

When an "A" frame coil is rotated on its side, the condensate (blue arrows) from the upper coil flows down to a coil connector plate (gray) that attaches the two coils together. The majority of the upper coil condensate will cling to the plate and make its way to one end of the plate due to how the plate is pitched at an angle. This condensate will drop down to the bottom drain pan – one way or another - depending on the coil and connecting plate design (examples coming). The condensate from the lower coil flows down to the "Main" drain trough and then flows to the drain outlet.

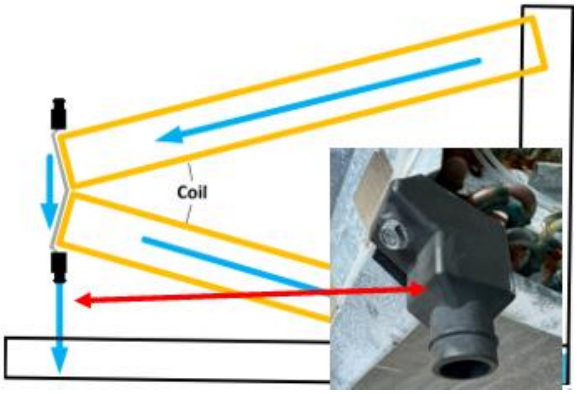


Typically, the connector plate has a channel/trough which carries the condensate to one side of the plate.

When the carrier plate has a built-in channel/trough, there is an opportunity for bacteria to thrive. (yellow arrow)

The goal is to eliminate <u>all of the bacteria</u> growing inside the evaporator coil as the bacteria can proliferate throughout the entire drain system.

Horizontal Coil Example #1



Dependent on design, there may be plastic fittings (picture) that are mounted on the end of the plate, and the condensate will flow out of these fittings.

The fitting has a hose type connection which can/may be used to connect a hose or pipe to direct the condensate down to the drain pan and then to the drain outlet.

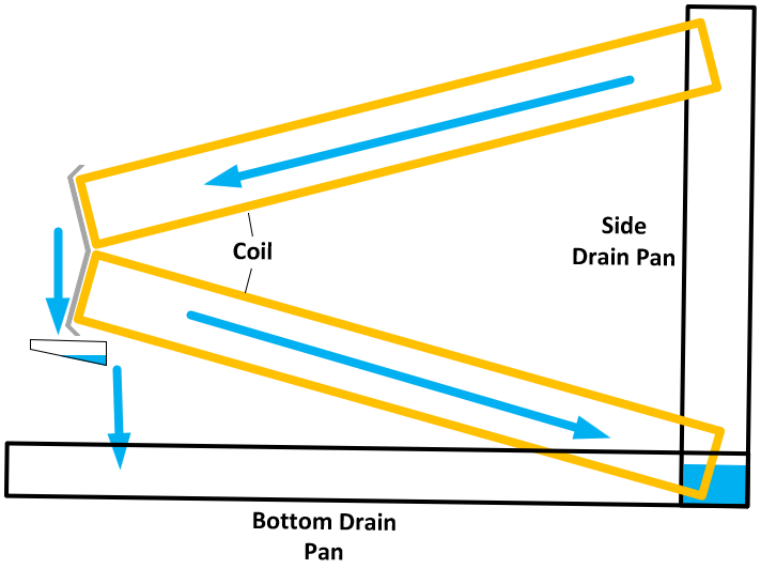
If there is a channel/trough as part of the connection plate, this is where one of the dispensing tubes should be placed – using the Single-Port Nozzle.

The tube can be inserted into the trough and pushed ***all the way to the far end of the trough***. The tube will normally slide right in, and the placement wire can also be used.

This picture shows the tube inserted into the trough.

The other nozzle would be placed directly into the drain pan in the far-right back corner which will sanitize the main drain trough. With this method, both troughs are sanitized.

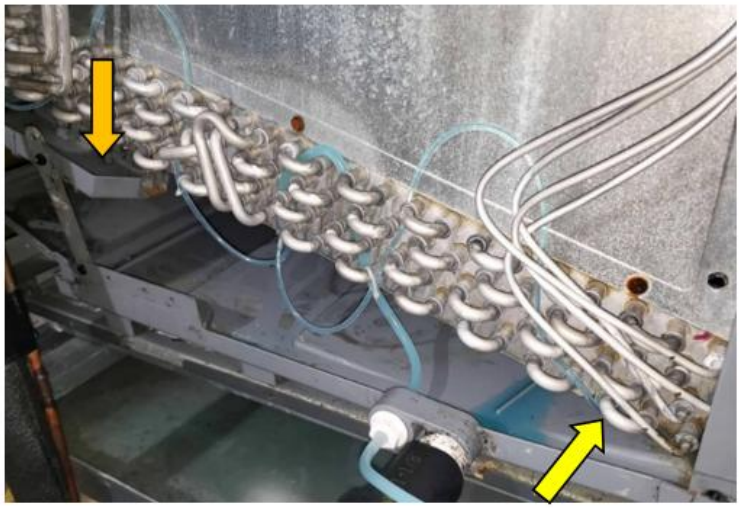
Horizontal Coil Example #2



This coil is the same as Example #1 but has a plastic trough that the condensate collects in.

These troughs also support bacterial growth. The troughs will be pitched to either the back or front sides and may have a fitting or just an opening where the condensate drops out.

In this example the Steramine would be dispensed in both the trough under the connection plate and into the "main" drain trough.



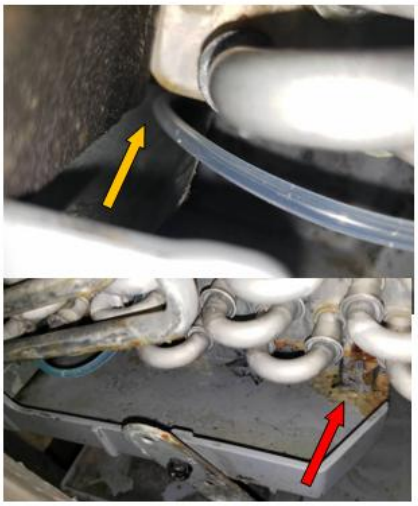
Here is an actual example of this configuration.

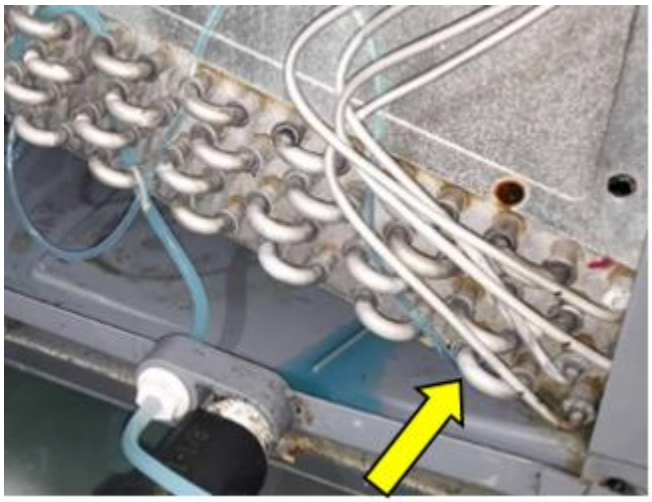
The 7mm dispense tube entered through the spare drain port. The two 4mm tubes are threaded through the coils to support and anchor the tubes.

One Single-Port Nozzle was placed in the far-right back corner of the drain pan (yellow arrow). The second Single-Port Nozzle was placed in the **far back** (high-side) of the plastic trough (orange arrow).

The upper drain trough is pitched down to the front side and is open at the end. The condensate drops down from the trough into the lower drain pan.

The Single-Port Nozzle is slid all the way to the back of the trough so the Steramine will treat the entire trough. In the next pictures, the blue arrow shows the opening on the trough where the condensate exits and falls into the drain pan. The red arrow shows some of the Zoogloea that is growing in the pan. The orange arrow points to where the dispense tube goes up into the trough.





The Steramine deposited into the far-right corner (yellow arrow) flows down to the drain outlet through a trough molded into the drain pan (which is visible in the picture where the blue Steramine is puddling) thereby sanitizing both the area around the drain outlet and the drain outlet itself on the way out of the outlet.

The placement wire was used to reach all the way into the far-right back corner and the Single-Port Nozzle was used.

The logic behind the placement of the two nozzles in these two locations is to dispense the sanitizer where the bacteria is most likely to survive and grow and to sanitize as much of the drain pan as possible.

FYI – this drain pan example above happens to be where these pictures are from. This pan was fully engulfed in Zoogloea along with a fully clogged drain line.

After cleaning the system and installing the Zoog Zapper, this system has been bacteria free for over 24 months so far!

Horizontal Coil Example #3

This is a new system which is clearly all aluminum. There is a coil connecting plate but no obvious trough on the plate visible. There is however a narrow sheet-metal trough/channel under the coils which will carry the condensate to the drain outlet.

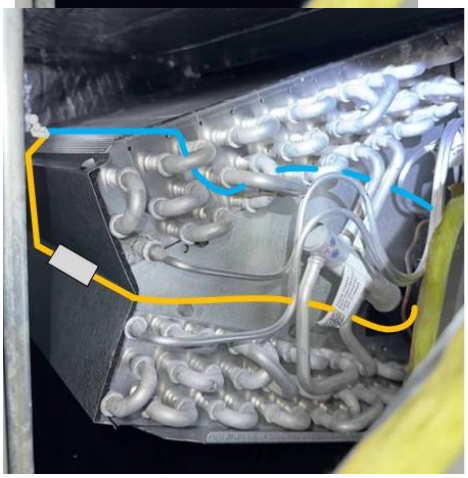
The coil will have a slight angle, so the condensate flows to the near end of the coil and then goes down the channel and falls into the drain pan. Therefore, the best location to dispense the Steramine is on the far side of the coil. But without a trough to run the tubing into, this will require using the Double-Port Nozzle with one tube attached.

The best location to place the nozzle is on the top side of the top coil, all the way to the back side of the coil. The Steramine will be dispensed into the fins and will flow down the fins to the connecting plate and then flow to the near end of the coil.

The yellow arrow indicates where the Double-Port Nozzle should be placed.

This location is easily accessible and ideally all of the connection plate areas where the condensate travels will be sanitized.

The second nozzle needs to be placed in the far back right corner of the drain pan as shown in previous examples. This location will sanitize the entire drain pan trough which receives condensate from the lower coil. The Steramine will then flow to the drain outlet.



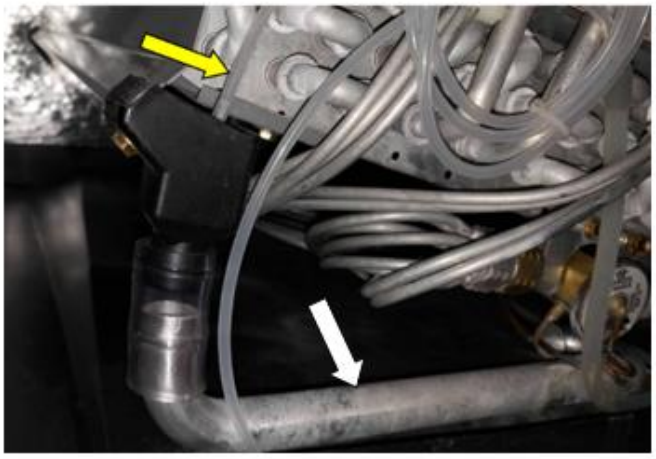
The tubing (blue) can come across the top side of the coil to this side and then be threaded through the coils on the way to the Double-Port Manifold.

OR

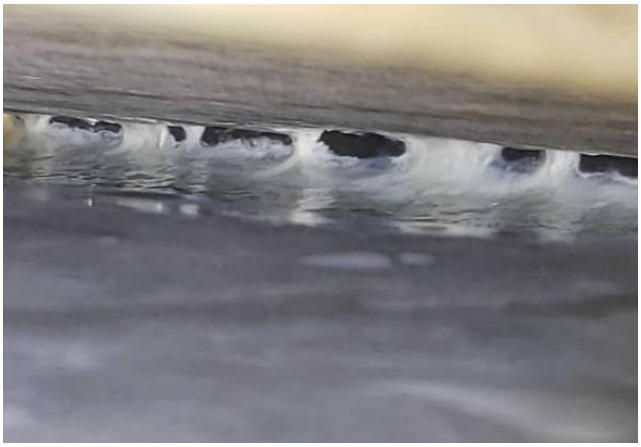
The tubing (orange) could also be brought down onto the connecting plate and be secured with aluminum tape, assuming enough access to reach in to fasten the tape.

Horizontal Coil Example #4

This example of this coil has a metal tube (white arrow) under the plastic fitting. The condensate will fall from the plastic fitting into the tube and the tube deposits the condensate at the drain outlet. Both the tube and trough have a potential to clog, so one of the dispensing tubes with a Single-Port Nozzle was slid all the way into the trough on the connecting plate. The tube (yellow arrow) can be seen in the picture entering the black plastic fitting and then turns into the trough. Dispensing at the far end of the trough will sanitize both the trough and the metal tube. The second nozzle was placed under the lower coil all the way in the back corner of the drain pan.



Dispensing Into the Main Drain Trough



This is a picture of Zoogloea which is growing from the main drain trough up to the lower coil! The trough was almost 100% clogged.

This is the reason the nozzle needs to be placed at the far back of the trough - to prevent this bacterial growth.

Whether the nozzle is placed below or above the coil does not matter.

On this unit, the yellow dot is the ideal location for dispensing the sanitizer and placing the nozzle. However, depending upon the design of the air conditioning cabinet and the ducting, the inside of the coil may not be accessible. Most coils have a side plate as in the picture which blocks all internal access to the coil as shown in the picture.

On some systems there is another access panel to the right of the panel where the coil is. That panel can be removed and then there should be access to inside of the coil.

On some systems the air intake ductwork is on the right side and there is no access to the coil at all. However, if the inside of the coil **is** accessible, *the ideal nozzle placement location is where the yellow dot is located. The Double-Port Nozzle is used, and the installation is very quick.*

The Double-Port Nozzle is inserted into the fins where the yellow dot was shown in the previous picture using the nozzle's "fangs." The 4mm tubes (1 or 2) are laid down on the fins and brought to the side to connect to the Two-Port Manifold.

The Steramine will flow through the fins and drop directly into the drain trough below.

If there is no access to the inside of the coil where the yellow dot is, the Double-Port Nozzle is still used but will need to be placed directly into the drain pan, and in the same location as the yellow dot, *but below the coil*.

The Double-Port Nozzle can be used with both 4mm (1/8") tubes, or with one tube if the second tube is placed elsewhere in a trough as shown in previous examples.

When placing the nozzle into the back corner of the drain pan a hole is provided for insertion of the placement wire (left).

The nozzle is slid into the far back corner and then the placement wire is pulled out.

This picture shows the Double-Port Nozzle inserted all the way back into the far corner of the drain pan.

The two 4mm (1/8") tubes will lay on the drain pan floor and then connect to the Two-Port Manifold.

With the nozzle in this far-back corner location, the Steramine will flood and sanitize the entire drain trough.

Not all horizontal AC systems have a plastic or metal trough on the coil connector plate. If that is the case, the Double-Port Nozzle could be used with both 4mm (1/8”) tubes attached and placed into the far-right back corner of the drain pan.

Therefore, the full dose of Steramine is dispensed directly into the main drain trough and at the farthest rear point. The Steramine will sanitize the main trough and will then flood the area around the drain outlet sanitizing the drain outlet before heading out the drain outlet. Keeping the entire drain pan trough and drain outlet free of Zoogloea is the goal.

Differences in Coil Designs

Here are some pictures showing a different coil configuration to highlight additional examples of nozzle placement locations.

This example is a “hybrid” type configuration of a horizontally mounted air conditioner with a vertical standing coil. The coil is sitting in the drain pan.

There are drain channels on both the front side and the right side of the drain pan. One Single-Port Nozzle was used on both sides of the drain pan.

One nozzle (yellow arrow) was placed at the far left of the drain pan. That nozzle was hung down from the coils and secured with a wire tie. The Steramine will drop into the channel and flow to the right down to the drain outlet. The second nozzle was placed on the right side of the drain pan.

The excess tubing was curled up and very lightly wire-tied.

Placing the Single-Port Nozzle Directly into The Drain Pan Trough

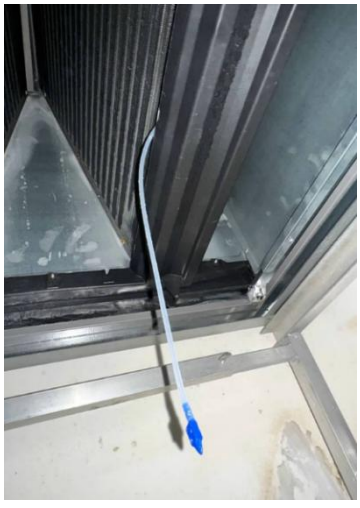
There is one more alternative placement option, which is very quick and convenient depending on the drain pan design. This method is to insert the Single-Port Nozzle directly into the drain trough *underneath* the coil. Since the troughs are wide open to let the condensate out, the Single-Port Nozzle can slip into these drain outlets. This method is what the Single-Port Nozzle was primarily designed for and is very quick and simple. *However, as simple as this method is, there are two potential issues that need to be double-checked (which is easy to do) or there is the possibility of creating an issue.*

This picture shows the drain outlet of the right-side coil on a vertical "A" coil. The yellow arrow points to the drain opening where the condensate comes out which is fully accessible. Ideally the nozzle can be pushed all the way to the rear of this trough. The length of the trough will be in the 20-24" inch range. The nozzle tube is visible entering the trough.

First try to manually push the nozzle by hand into the trough. Most of the time the nozzle will slide feely to the end of the trough and then stop. If the nozzle cannot be manually pushed in, the placement wire is supplied to slide the nozzles into the trough. With the placement wire it is more obvious when the nozzle hits the back wall. When the nozzle is fully inserted, hold the tubing and quickly pull the wire out.

What typically happens on a vertical coil is the left side of the cabinet is where the copper tubes enter and there is a metal panel blocking the left trough. The next priority placement location would then be on the topside of the coil using either nozzle (or no nozzle) that is appropriate.

Quick Double Checks Required



The first double-check is done after inserting the nozzle. The troughs are an open channel, so there is the possibility (anything is possible) that the nozzle could "pop out" of the trough as the wire is inserted (which is why the wire needs to be straight).

Depending on the configuration of the AC system, the troughs can be readily observed from beneath the unit by simply removing the filter, as depicted in the image. If the troughs are accessible, verify the tube is inserted properly in the trough and has not popped out.

The picture on the left shows the tube and nozzle out of the trough. The nozzle and tube can easily be placed by hand at the rear of the trough as there is full accessibility from underneath.

The second double-check is performed to ensure that the nozzles are **not submerged** in condensate. Placing the nozzles atop the coils was prioritized for this reason, as submerging the nozzles could lead to potential siphoning issues, so a quick and simple check is done to verify the nozzles are not submerged.

The drain troughs are sloped down by design to direct condensate from the back of the trough to the front of the drain pan. The back of the trough is the highest point. If an AC cabinet is improperly installed and tilted slightly backwards (not level), there is a risk of condensate pooling around the nozzle area as the condensate will not drain properly, potentially causing submersion of the nozzle (and encouraging bacterial growth).

The potential problem - after Steramine is dispensed, the pump reverses to empty any remaining liquid from the tubing. When the pump reverses, air is pulled into the nozzles as the pump continues to run. The Steramine in the tubing is emptied out and air will be pumped into the reservoir. **If the nozzle is submerged, fluid from the drain trough will be drawn *back into the nozzle* and not air.**

Submerged nozzles will result in liquid-filled tubing afterward, instead of empty tubing. If the tubing remains filled with liquid a siphoning effect could possibly occur, causing Steramine in the reservoir to slowly drain out, drip by drip. The siphoning is relatively quick, and the reservoir can empty in days. Should siphoning happen, the nozzle(s) need to be removed from the trough and moved to the topside of the coils.

The first thing to look at when the panel is removed is how much condensate is in the front trough of the drain pan. Typically, there should be a small amount of water in the trough, approximately 1/8". If the front trough has an elevated level of water present, say 3/8", that is an indication that the system is not pitched properly as the drain pan is retaining an excess of water. If this is the case, the nozzles should **not** be placed under the coils.

If there is a small amount of condensate in the front trough, that is a good sign that besides the system being installed properly, the nozzles can be placed under the coils.

Since the nozzles are not visible when installed under the coil, the simplest way to verify if the nozzles are not submerged is to run the pump in reverse for a brief period of time. Once the tubing installation is complete, press the pushbutton two times on the pump. This will start the pump in reverse and will (should) pull air into the nozzles. Let the pump run for a minute or two to verify no condensate is drawn into the tubing. If there is no condensate in the tubing, the filling process of the reservoir can begin. Press the pushbutton one time to stop the pump.

In normal operation, once the Steramine is fully evacuated from the tube, bubbles should be obvious coming out of the suction tube inside the Reservoir. The bubbles come out at a quick rate. ***If the tube is at least 90% empty after the reverse pumping is completed, siphoning will not be possible.***

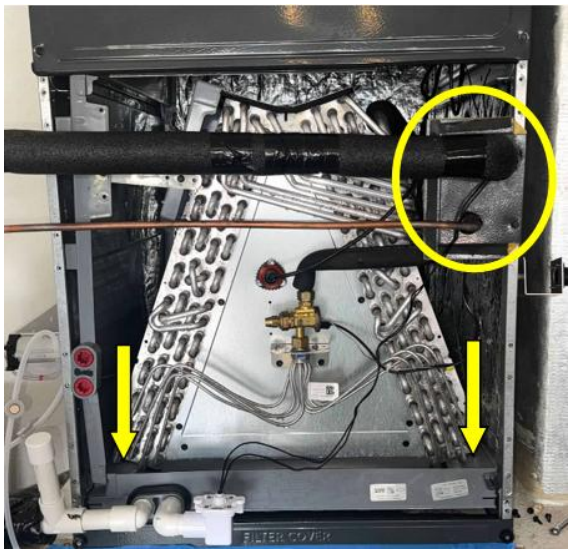
Should there be condensate being drawn back into the tubes, the condensate will be obvious in the tubing. If this is the case, move the nozzles above the coils.

If one of the nozzles (say on the left side coil) is already on the top side of the coil, that nozzle will pull in air so even if the other nozzle pulls in some condensate, there will not be enough condensate overall in the tube to allow siphoning. As long as there is minimal condensate in the dispense tubing siphoning will not occur.

Worst case if siphoning does occur, the drain system will be fine as a large amount of Steramine was dispensed. Move the nozzle(s) to the topside of the coils and refill the reservoir and the system will be good from then on!

Nozzle Placement Example Directly in the Drain Trough

This system (Daiken) has the copper tubing coming in on the right side of the panel towards the top (yellow circle), so both left and right drain troughs are fully accessible (yellow arrows)



The nozzles can be slid up under the coil with the placement wire all the way to the rear of the coil, which is the ideal location.

The nozzle should then be in an optimum location for dispensing as the entire trough will be sanitized.

This installation had no problems with nozzles directly in the drain trough as the side troughs did not hold condensate so there was *no immersion concern.*

Installing the tubes with the placement wire took only a few minutes.

Many times, the nozzle and tubing can be slid into the trough without the placement wire.

Single Coil System Example

This type of AC system is used in smaller homes and condominiums. There is only one coil which is pitched on an angle and a single drain trough at the bottom of the coil. The system is shown in the picture below with the air filter removed so the coil is visible.

On this type of air conditioner, nozzle placement is to be at both far ends of the drain pan. The Steramine will flow from the ends of the drain pan to the drain outlet in the center of the drain pan, sanitizing the entire drain pan.

This system had a drain pan that consistently held an elevated level of condensate, likely due to improper installation. The pan was not tilted enough, preventing proper drainage.

The drain pan held approximately 3/8" of an inch of condensate. The Single-Port Nozzle was not able to be used due to probable submersion.

The Double Port Nozzle was therefore used, with the nozzle inserted into the coils approximately one inch above the floor of the drain pan. This placement method guarantees that the nozzles are up high enough to prevent any chance of submersion in the condensate and condensate being drawn back into the nozzles.

The yellow arrow points to the nozzle which is inserted into the coils. There was enough room between the drain pan and the coil to insert the nozzle easily. Aluminum tape was used to secure the tubing, so the tubing did not interfere with the filter.

The Steramine is dispensed into the coil directly from the opening in the bottom of the nozzle and by gravity the Steramine will drop/flow directly down into the drain trough.

Based on these types of air conditioners having drain pans that can have condensate present, the Dual-Port Nozzle should always be used and inserted into the coils high enough to be out of the condensate. The height of the nozzles only needs to be approximately one inch above the floor of the drain pan.

Here are some pictures from the completed installation.

The dispense tubing was fastened on the side of the cabinet and brought down the side, then underneath the base plate and then up into the square opening in the base plate of the unit:

The incoming dispense tubing is visible in the lower left corner routed under the base plate.

The excess tubing should not be cut as the system is calibrated with that length of tubing, and in this case the tubing was curled up and secured **lightly** with a wire tie.

One of the magnetic tube holders was used to hold the tubing, the wire tie was added, and the tubing was rested on the ledge of the frame of the air conditioner.

Here is some Zoogloea which is forming in the drain pan:

This installation took 20 minutes for a time reference.

This next installation example was a Carrier system that had the entire drain pan with about 3/8" of condensate. Having that much water in the drain pan continuously means the drain pan is not installed with the proper amount of pitch, so the condensate does not drain out fully.

A system like this with poor drainage means if the Single-Port Nozzles were inserted under the coil, the nozzles would most likely be immersed in condensate which is unacceptable.

Looking at the topside of the coil next, the lip of the drain pan was too low to place the nozzle in the crevasse between the coil and the drain pan. The drain pan edge was too low relative to the coil height.

The next alternative placement was to use the Double-Port Nozzle inserted into the fins (yellow arrow).

The nozzles were placed towards the bottom of the coil, about four inches from the bottom, as both sides of the coil could be reached by hand that far down.

This nozzle placement method was very quick and easy.

Overall, inserting the Double-Port Nozzle is the best method to use when there is any doubt on using the Single-Port Nozzle due to nozzle immersion.

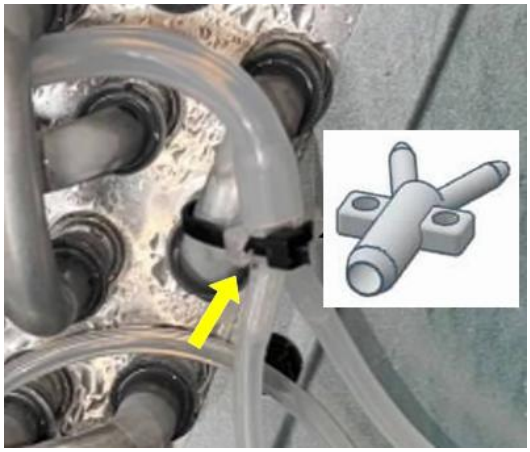
This covers placement of the nozzles in horizontal and vertical systems.

The key factor is where the Steramine is released, emphasizing the need to "Treat the Troughs" since these areas are prone to accumulating Zoogloea.

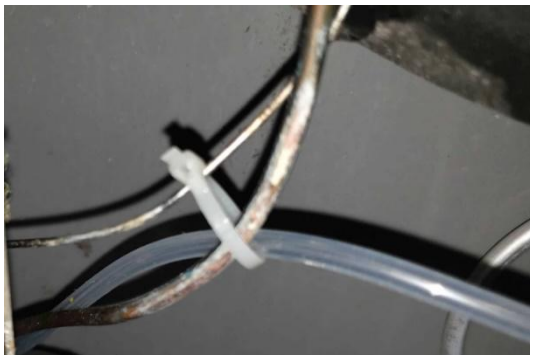
Although the instructions are comprehensive, understanding the underlying principles makes the actual process of selecting and positioning the nozzles, or deciding to use just the tube, quite straightforward and quick, typically taking only a few minutes!

Securing the Dispense Tubing

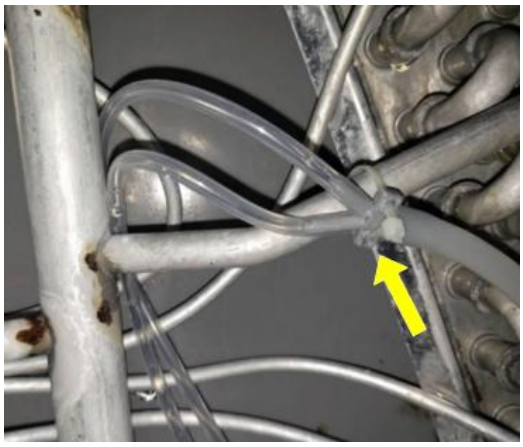
After the nozzles are placed in the dispensing locations, the free end of the tubing can be threaded through the coils to hold the tubing in position. Threading the tubing through the coils helps to "anchor" the tubing and therefore wire ties are *not normally needed* to hold the tubing in place. The two 4mm tubes are then connected to the Double-Port Manifold (yellow arrows).



The tubing installation can be finalized by securing the Double-Port Manifold with a wire-tie if desired. There are holes in the Double-Port Manifold "wings" and one or both holes can be used for a small wire-tie.



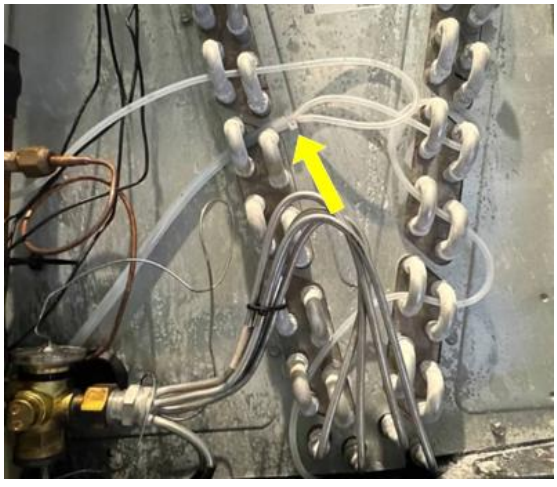
Using wire ties on the tubing has the potential to squeeze shut the tubing which will hinder or prevent dispensing, so if the tubing can be "entwined" in the coil tubes this is a better method. If wire ties *are* used on the tubing the wire ties need to be left "loose" as in the picture just to support the tubing.

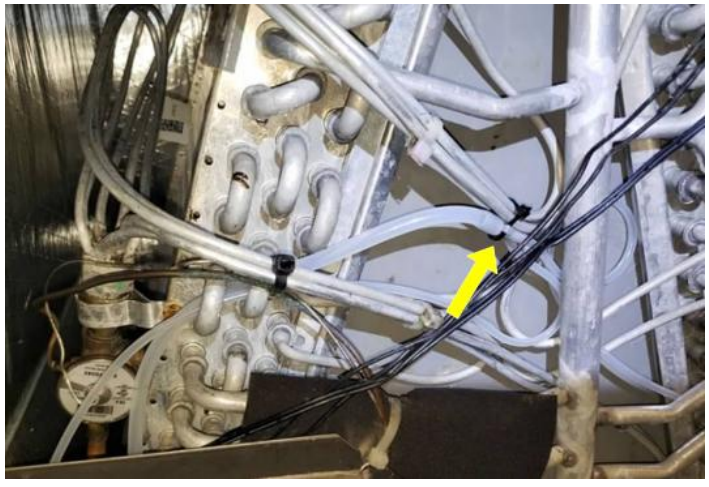


Do not squeeze the tubing with the wire tie as the flow of Steramine will be cut off!!

Avoid placing the tubing in a position where the front cover may crimp it when reinstalled.

Wire ties are provided to lightly secure the tubing, Double-Port Manifold, and nozzles in place if needed.





The Minimum Dispensing Solution

If none of the internal dispensing solutions are possible (*which is highly unlikely*), or for some reason dispensing internally is just not desired, the remaining dispensing location is directly into the PVC drain line.

<u>This method is not the ideal solution</u> as clogging can/will occur inside the air handler drain pan*. If the Steramine is not dispensed internally, it is recommended that the AC system should be opened and cleaned at a minimum every six months.*

As explained previously, depending upon how the drain piping is configured, there could be either a cleanout pipe or a vent pipe sticking up vertically, or both, or neither.

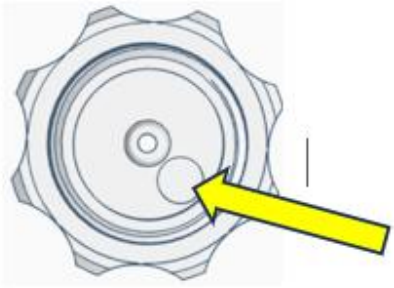
The goal is to dispense the Steramine as close to the drain outlet as possible to sanitize as much of the drain line as possible. A cleanout pipe will have a solid cap (yellow arrow) as the cleanout pipe is always sealed closed.

A vent pipe will either have <u>no cap</u> so the pipe is fully open to atmosphere or could have a cap with a hole drilled through the top to provide venting. The vent allows air into the drain line to facilitate the condensate water draining out of the pipe*.*

In the picture, this system only has a cleanout pipe which is capped closed.

If a cleanout pipe is available *<u>before a trap</u>*, this would be the priority location to dispense as the trap will also be sanitized. If there is only a vent pipe, then dispensing into the vent pipe would be the last resort location.

If there is neither a vent pipe nor a cleanout pipe, (or a trap) the system should be replumbed as drainage of the condensate will be poor and will accelerate Zoogloea growth.



If a cleanout or vent pipe is available, the supplied "Combo Fitting" is utilized. On the side opposite the Combo Fitting's threaded side is a ¾" PVC pipe slip fit which can be used on the ¾" PVC cleanout or vent pipe. Dispensing into either pipe will deliver the Steramine into the drain piping. The Combo Fitting is placed directly onto the PVC pipe with the slip-fit side and NO GLUE is used. The 7mm (1/4") dispense tubing is then connected to the tube fitting on the Combo Fitting.

If there is only a **vent** pipe that will be utilized, there is a thin circular area on the Combo Fitting (yellow arrow) that **<u>MUST</u>** be pushed out with a Philipps screwdriver to allow for venting. Once the hole is opened, place the Combo Fitting onto the vent pipe and connect the dispense tubing. This dispensing method is only adequate to prevent clogging of the outgoing drain line and is not the ideal solution…

This concludes the explanations for the various methods to integrate the dispense tubing into the air conditioner system.

Quick Disconnect Fitting

A quick-disconnect fitting is provided for convenience as the fitting allows for easy removal of the reservoir when refilling is needed. The fitting is the same high-quality type used on medical equipment (Luer-Lock) and is exceptionally reliable.

The fitting must be connected properly to ensure an adequate seal. *If the quick-disconnect fitting is not connected properly (loose), air will enter the fitting, and liquid will not be drawn from the reservoir (the fitting is leaking air) and no fluid will be pumped!*

Below is a "procedure" that should be used to make sure the fitting is connected properly and what matters most is the quick-disconnect fitting is snug, to tight – but only "finger-tight."

When the tube is installed properly, the tube should be angled diagonally so the tube is on the left side of the reservoir as in this picture.

If the tube is installed incorrectly, the tube will end up behind the reservoir, which is more of a cosmetic issue than a functional issue, but ideally the tube is to the left of the reservoir as shown.

What matters most is the fitting is tight.

The procedure is physically simple to do and ideally the tube is installed as in the picture.

Click on this link to view a video of the procedure: Quick Disconnect Fitting Installation

Here are the procedure steps:

a. Hold the quick-disconnect fitting in your right hand. Hold the tubing in your left hand.

b. Place the quick-disconnect fitting into the mating connector receptacle on the lid.

c. While maintaining slight downward pressure on the fitting with your right hand, slowly rotate the tubing and the quick-disconnect fitting counterclockwise (towards you) until you feel the fitting drop down slightly into the receptacle (it will "click" down slightly).

d. Maintaining the slight downward pressure, slowly continue to rotate the quick-disconnect fitting counterclockwise with your fingers. The quick-disconnect fitting will rise slightly while being further rotated and will then drop down (click) once again.

e. Now rotate the tubing and the quick-disconnect fitting clockwise until the fitting tightens.

f. Firmly snug the quick-disconnect fitting with your fingers.

g. Place the magnetic tube holder on the suction tube onto the cabinet to secure the line.

Section #10 - Filling the Reservoir

Before filling the Reservoir, the drain line should be flushed with the Hose Adapter if the drain line was previously filled with a chemical.

The drain line should next be vacuumed out to remove any standing water. This way the initial dose of Steramine will not be diluted and will have maximum affect on any remaining bacteria in the pipe.

Important: Dissolving Steramine Tablets

- **Hot Water Requirement:** Steramine tablets require hot water to dissolve. The water from most kitchen sinks is typically sufficiently hot enough when it becomes uncomfortable to keep your hand immersed. However, avoid using extremely hot, steaming water, as it can degrade the active ingredients in the tablets.
- **Pre-Dissolving Tablets:** If hot water is not available at a particular location, dissolve the 50 Steramine tablets in a one-gallon plastic bottle ahead of time and pour the solution into the reservoir during installation.
- **Using a Microwave:** Water can also be heated in a microwave oven if available.
- **Preventing Clogs:** Ensure the tablets fully dissolve to avoid the risk of clogging the tubing. If undissolved tablets remain when the pump begins dispensing Steramine:
    1. Stop the pump by pressing the pushbutton once.
    2. Press the pushbutton twice to initiate another 7-minute mixing cycle.
    3. This additional mixing time should fully dissolve the tablets before dispensing continues.

Filling the Reservoir

There are two methods available for adding water to the Reservoir:

1. **Direct Fill Method:**
    - Remove the Reservoir from the Reservoir Holder and fill the Reservoir directly at a sink with hot water.
    - After filling, place the Reservoir back into the Reservoir Holder.
2. **Recommended Method:**
    - Leave the Reservoir in the Reservoir Holder and use a container, such as a one-gallon jug, to add water to the Reservoir.
    - A one-gallon jug with a handle offers greater convenience and reduces the risk of spills during transport.

Benefits of Using a One-Gallon Jug

The Reservoir holds up to one gallon (16 cups) of water and can weigh as much as eight pounds when full. Carrying a full Reservoir can be cumbersome, especially in tight spaces like attics or on ceiling rafters. A one-gallon jug simplifies the process, making transportation safer and reducing the likelihood of accidental spills. The wide lid opening on the Reservoir allows for easy filling, and any spills can be wiped up quickly with a paper towel.

Handling Tips

Avoid squeezing the sides of the Reservoir, as applying pressure may cause water to escape through the hole in the quick-disconnect fitting on the lid. To prevent leaks during movement or positioning, cover the quick-disconnect fitting with a finger or secure a paper towel over the fitting.

Steramine Tablet Information

The packet provided of Steramine contains fifty (50) tablets. The entire packet is water-soluble and dissolves completely in water, ensuring even distribution throughout the Reservoir. Remove the packet from the cellophane bag when ready to use.

Steps to Initially Fill the Reservoir

Follow these steps to fill the Reservoir with hot water while it remains in the Reservoir Holder, using a one-gallon container:

1. **Position the Reservoir Correctly**
    - Ensure the molded handle area of the Reservoir is on the right side, with the label facing outward.
    - The dispense tube and quick-disconnect fitting should align with the pump, which is shipped on the left side of the Reservoir Holder. If the pump has been moved to the right side, rotate the lid (not the container) 180 degrees to place the quick-disconnect fitting on the right side.
2. **Secure the Reservoir Flaps**
    - Confirm that all four flaps of the Reservoir lid are locked securely.
3. **Connect the Quick-Disconnect Fitting**
    - Tighten the quick-disconnect fitting to prevent air from entering the system. A loose fitting will result in no fluid being pumped. For detailed guidance, refer to the instructional video: Quick Disconnect Fitting Installation
4. **Fill the Reservoir with Hot Water**
    - Add hot water through the lid opening until the water reaches the bottom edge of the lid flap. Do not fill to the top, as the vent plug in the lid requires space to breathe. *After dispensing the initial two cups of Steramine, the Reservoir can be topped off to increase the volume.*

5. **Add Steramine**
    - Remove the Steramine packet from the cellophane bag and place the packet into the hot water through the opening of the lid.
6. **Initiate the Pump Sequence**
    - Wait for the pump LED to illuminate, then press the pushbutton **twice**.
7. **Monitor the Pump Operation**
    - After four seconds, the pump will start running in reverse (clockwise). Observe the dispense tubing exiting the cabinet to ensure no condensate is being drawn into the tubing. If condensate is present, reposition the dispense nozzles to ensure they are not submerged. A small amount of condensate in the tubing is acceptable, but a full tube of condensate is not.
8. **Mix and Pump Sequence**
    - Pressing the pushbutton twice starts a seven-minute reverse pumping cycle to mix and dissolve the Steramine. Air is pumped into the Reservoir during this process to aid tablet dissolution.
    - After seven minutes, the pump will pause briefly before switching to the forward direction (counterclockwise) to pump **two cups** of Steramine into the drain system. This initial dose ensures a high concentration of Steramine floods the drainage system.
9. **Reverse Pumping and Maintenance Mode**
    - Once the Steramine is dispensed, the pump will run in reverse to evacuate the tubing. Minor traces of Steramine remaining in the tubing are normal.
    - After the initial dose is complete, the pump will automatically operate based on the selected dispensing interval. The default setting dispenses Steramine every seven days.

If desired, additional hot water can be added to the Reservoir to “Top Off” the Reservoir. Add water until the level is at the bottom of the Reservoir lid flaps. If the Steramine level is filled to the lid flaps, there will now be approximately fifteen cups of Steramine which will last seven months if the dispense interval is set at the default interval of every seven (7) days.

Nothing else needs to be done! The system installation is complete.

Section #11 - Re-filling the Reservoir

1. **Vacuum the Drain Line**
    - Before re-filling the Reservoir, vacuum the drain line using the provided ZoogOut vacuum adapter and a wet/dry vacuum.
    - If the system includes a vent tube/pipe after a trap, temporarily seal the tube (tape works well) while vacuuming the drain line. This ensures the trap will also be vacuumed out. *Be sure to remove the seal once vacuuming is complete!*
2. **Filling the Reservoir with Water**
    - Keep the Reservoir in the Reservoir Holder.
    - Open the lid and fill the Reservoir with hot water using a container, such as a one-gallon jug. Fill to the bottom edge of the lid flap, leaving space below the vent plug to allow proper ventilation. Do not fill all the way to the top.
3. **Adding Steramine Tablets**
    - Add fifty **(50)** Steramine tablets to the Reservoir.
    - **Caution:** Wear a mask and gloves when handling Steramine tablets to avoid inhaling any dust that may be present. A standard mask, such as those used for COVID-19 protection, is sufficient.
4. **Initiate the Pump Sequence**
    - Wait for the pump LED to illuminate, then press the pushbutton **twice**.
5. **Mix and Pump Sequence**
    - Pressing the pushbutton twice starts a seven-minute reverse pumping cycle to mix and dissolve the Steramine. Air is pumped into the Reservoir during this process to aid tablet dissolution.
    - After seven minutes, the pump will pause briefly before switching to the forward direction (counterclockwise) to pump **two cups** of Steramine into the drain system. This initial dose ensures a high concentration of Steramine floods the drainage system.
6. **Reverse Pumping and Maintenance Mode**
    - Once the Steramine is dispensed, the pump will run in reverse to evacuate the tubing. Minor traces of Steramine remaining in the tubing are normal.
    - After the two-cup dose is complete, the pump will automatically operate based on the selected dispensing interval. The default setting dispenses Steramine every seven days.

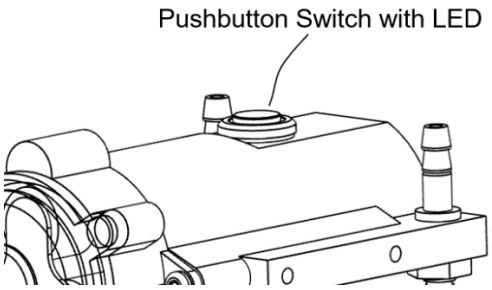
7. **Topping off the Reservoir**
    - If desired, additional hot water can be added to the Reservoir to "Top Off" the Reservoir. Add water until the level is at the bottom of the Reservoir lid flaps. If the Steramine level is filled to the lid flaps, there will now be approximately fifteen cups of Steramine which will last seven months if the dispense interval is set at the default interval of every seven (7) days.
8. **Refilling Partially Full Reservoirs**
    - The Reservoir can be refilled at any time. Adjust the number of Steramine tablets based on the amount of water added:
        - For a half-full Reservoir, add twenty-five (25) tablets.
        - For a three-quarters full Reservoir, add fifteen (15) tablets.
        - For a Reservoir at or below one-quarter full, add the full fifty (50) tablets.
    - **Note:** A stronger Steramine concentration is always beneficial for preventing bacterial buildup.

This is a link to the Steramine on Amazon:

https://www.amazon.com/dp/B0DGS24S7N/?ref_=cm_wl_huc_item

Section #12 - Operator Interface – The Pushbutton Switch

The pump features a momentary pushbutton switch on its top side, accompanied by an integrated LED indicator light. This switch serves as the sole operator interface, offering access to multiple functions through a single pushbutton.



The LED indicator flashes every ten seconds to signal the proper operation of the controller (heartbeat pulse). When the pushbutton is pressed a certain number of times to enter a mode or select a command, the LED flashes back the same number of times to confirm the input. This visual feedback ensures that the operator has pressed the pushbutton the desired number of times.

The pump's microcontroller has internal permanent memory to retain parameters in case of power failure or battery swap.

Note: Whenever the pump is run in the forward (pumping) direction, including when manually pumping, after pumping is complete the pump will reverse direction to evacuate all of the liquid in the tubing. Air (bubbles) will be injected into the reservoir for a brief period of time to ensure the tubing is clear of fluid.

Another feature of the pump is the automatic reverse operation every twenty-four hours, lasting for two seconds. This function exercises the pump to flex the internal silicone tubing, ensuring smooth operation. This short duration operation may be heard and is normal.

Pressing the Pushbutton

1) **Wait for the LED to Illuminate**
    - Before selecting a pushbutton function, ensure the LED on the pushbutton is illuminated. The LED flashes every ten seconds, indicating that the pump microcontroller is functioning properly.
2) **Pressing the Pushbutton**
    - Press the pushbutton firmly to activate a function. For convenience, you can also use the eraser side of a pencil to press the pushbutton.
    - When the pushbutton is fully pressed, the LED will illuminate, confirming that the pump controller has acknowledged the button press.
3) **Pump Operation**
    - If the selected function involves operating the pump, the pump will start after a brief three to four-second pause.
4) **Correcting a Missed Press**
    - **If the Pump Starts by Mistake:**
        - Press the pushbutton once to stop the pump.

- If the pump was running forward (pumping liquid), the pump will stop and then run in reverse to evacuate liquid from the tubing. Wait for the pump to stop completely before trying again.

- **If No Pump Operation Occurs:**
  - Wait 30 seconds and try again. This allows any improperly selected function to timeout, after which the regular ten-second LED flashing will resume.

Resetting the Pump

- If troubleshooting is needed or confusion arises, unplug the power connector from the pump, wait 10 seconds, and then reconnect the power. This will reset the pump, allowing you to try again.

Pushbutton Functions (In a Nutshell)

Continuous Press – Manually dispense liquid while the pushbutton is pressed.

Press one time - Stop the pump if the pump is running (forward or reverse direction).

Press two times – Pump in reverse for seven minutes to mix, dispense two cups of Steramine.

Press three times – Dispense one-half cup of Steramine.

Press four times – Dispense two cups of Steramine.

Press five times – Pump in reverse for seven minutes to mix, no dispensing afterwards.

Press six times – Set the number of days for dispensing (one to thirty days)

Press seven times – Set the length of the tubing and/or increase the amount of liquid pumped.

Pushbutton Functions Explained in Detail

1) **Manual Dispensing**
   - To manually operate the pump in the forward direction, press and hold the pushbutton for four seconds.
   - The pump will dispense liquid as long as the pushbutton remains pressed.
   - When the pushbutton is released, the pump will reverse direction to evacuate liquid from the tubing. Wait until the pump stops completely before pressing the pushbutton again.
2) **Effect on Automatic Pumping**
   - Manual operation does not interfere with the automatic scheduled pumping. Any manual pumping performed is in addition to the scheduled pumping cycles.

Command #1 (Stop the pump (*if the pump is running*))

1) **Stopping the Pump**

- If the pump is running in either the forward or reverse direction, pressing the pushbutton once will stop the pump.

Command #2 (Utilized when filling/refilling the reservoir)

2) **Overview of the Process**

- Pressing the pushbutton twice activates an automatic sequence designed to mix and dispense Steramine.
- The pump first runs in reverse for seven minutes, injecting air (cavitation) into the Reservoir. This bubbling action helps dissolve and thoroughly mix the Steramine tablets, especially when hot water is used. Hot water accelerates the dissolution process.
- After seven minutes, the pump pauses momentarily before switching to forward operation to dispense two cups of Steramine. This ensures the system is fully flooded with the solution.

3) **How to Start the Sequence**

- Wait for the LED indicator on the pump to illuminate.
- Press the pushbutton two times. The LED will flash twice, and after a brief pause, the pump will begin running in reverse.
- At the end of the reverse cycle (seven minutes), the pump will switch to forward operation and dispense two cups of Steramine.

4) **Stopping the Pump**

- To stop the pump at any point during the sequence, press the pushbutton once.

5) **Returning to Normal Operation**

- Once the automatic sequence is complete, the pump will resume its normal operating mode, dispensing Steramine on the programmed schedule. No further user action is required.

Command #3 (Dispense one-half cup of Steramine)

1) **Overview of the Command**

- This function allows manual dispensing of one-half cup of Steramine at any time without affecting the automatic scheduled pumping. Manual pumping is always in addition to the programmed dispensing schedule.

2) **How to Initiate the Sequence**

- Wait for the pump LED indicator to illuminate.

- Press the pushbutton three times. The LED will flash three times, and after a brief pause, the pump will begin dispensing.
- The pump will dispense one-half cup of Steramine, then automatically reverse to evacuate the tubing.

3) Stopping the Pump

- To stop the pump at any time during this process, press the pushbutton once.

4) Returning to Scheduled Pumping

- Once the manual sequence is complete, the pump will resume automatic operation on the designated schedule.

5) Note on Volume Adjustments

- If the default dispensing volume of one-half cup has been increased using Command #7, activating Command #3 will dispense the updated volume.

Command #4 (Dispense two cups of Steramine)

1) Overview of the Command

- This function allows manual dispensing of two cups of Steramine at any time. Manual pumping does not interfere with the automatic scheduled pumping and is always in addition to the programmed intervals.
- This mode is particularly useful when a larger amount of Steramine is desired for enhanced cleaning., or when winterizing a system by adding antifreeze.

2) How to Initiate the Sequence

- Wait for the pump LED indicator to illuminate.
- Press the pushbutton four times. The LED will flash four times, and after a short pause, the pump will begin dispensing.
- The pump will dispense two cups of Steramine, then automatically reverse to evacuate any remaining Steramine from the tubing.

3) Stopping the Pump

- To stop the pump at any time during this process, press the pushbutton once.

4) Returning to Scheduled Pumping

- After completing the manual sequence, the pump will resume normal operation on the designated schedule.

5) Note on Volume Adjustments

- If the default dispensing volume of one-half cup has been increased using Command #7, the increased volume will also apply when activating this command.

Command #5 (Mix the Steramine - NO dispensing afterwards)

1) **Purpose of this Mode**
    - This function is used when refilling the Reservoir but choosing not to dispense two cups of Steramine, as performed in Command #2.
    - Running the pump in reverse for seven minutes ensures the Steramine tablets are thoroughly dissolved and mixed.
    - This mode is ideal for maximizing the Steramine volume in the Reservoir, extending the time between refills, and is useful when additional pumping is unnecessary due to the absence of drain system issues from regular automatic dispensing.
2) **How to Start the Pump**
    - Wait for the pump LED indicator to illuminate.
    - Press the pushbutton five times. The LED will flash five times, and after a short pause, the pump will start running in reverse.
3) **Stopping the Pump**
    - The pump will stop automatically after a seven-minute timer expires.
    - Alternatively, the pump can be stopped manually at any time by pressing the pushbutton once.
4) **Effect on Automatic Scheduling**
    - This mode does not interfere with the regular automatic dispensing cycle. Once the mixing process is complete, the pump will resume its programmed schedule as usual.

Command #6 (Setting the Dispense Mode interval)

1) **Default Dispense Interval**
    - The pump is preset to dispense Steramine every seven days. This schedule is designed to provide optimal protection against clogging, accounting for variables that may contribute to clog formation. Dispensing weekly helps minimize these risks.
2) **Adjusting the Interval**
    - **If the default seven-day interval meets your system's needs, no changes are required.**
    - For air conditioning systems, such as those in homes or condominiums, or chiller systems with minimal history of clogs, the interval can be extended to every fifteen days. Adjusting the interval is simple and takes less than a minute. *If any clogging issues should arise, the dispense interval can be changed back to seven days.*
3) **Customizable Scheduling**
    - The interval can be customized to dispense Steramine anywhere from one to thirty days, allowing for flexibility to meet the specific needs of different systems.

- For systems prone to clogs or requiring more frequent treatment, the interval can be shortened as needed.

4) Long-Term Efficiency

- At a fifteen-day interval, the Steramine in the Reservoir can last up to twelve months, offering long-term protection and low-maintenance operation.

Dispense Interval Suggestions

1) Reservoir Capacity and Initial Setup

- The Reservoir has a total capacity of 16 cups of Steramine, though only 15 cups are available as it cannot be filled to the very top.
- When the Reservoir is first filled and the pushbutton is pressed twice, two cups of Steramine are dispensed after the mixing cycle, leaving 13 cups remaining.

2) Default Dispense Rate

- The default setting dispenses one-half cup of Steramine every seven days, using two cups per month.
- With 13 cups in the Reservoir, the sanitizer will last approximately six months before needing a refill.
- This interval is ideal for systems prone to clogging and the dispense interval does not require adjustment unless specific conditions warrant a change.

3) Adjusting the Dispense Interval

- **For Minimal Clogging or Extended Absences:**
  - Dispensing every 10 days uses 1.5 cups of Steramine per month, extending the refill interval to nine months.
  - This setting is ideal for homeowners who are away for extended periods, such as snowbirds.
  - Topping off the Reservoir during refilling adds two cups, extending the operation to approximately seven months, which may better suit prolonged vacancies.
- **For Severe Clogging Issues:**
  - Start by dispensing every five days to ensure the system is clear, as the drain line may be nearly closed.
  - Once clogs are eliminated for two months, reduce the interval to seven days.
  - If no clogs occur over time, the dispense interval could be increased to every 10 days.
- **Seasonal Adjustments:**
  - In regions with shorter summers, the default seven-day interval should be ideal, as it accommodates a shorter dispensing season.

- For warmer climates like Florida, consider a 15-day interval during winter and return to a seven-day interval in spring when air conditioning use increases, provided there are no clogging issues.

4) General Recommendations

- Frequent dispensing uses more Steramine but provides better protection against Zoogloea bacteria.
- For convenience and maximum effectiveness, leave the system set to the default seven-day interval, which uses two cups of Steramine per month and requires refilling every six months.

For a quick reference, this table shows the dispense interval to use depending on the number of months for a refilling:

Months to Refill	Dispense Interval in Days
6	7
7	8
8	9
9	10
10	12
11	13
12	15

Dispense Interval FYI's

1) Changing the Dispense Interval

- The dispensing interval can be adjusted at any time and takes less than a minute to complete.
- When the interval is changed, the pump controller resets its internal counter to zero and starts the new interval immediately. For instance, if the interval is changed to 10 days today, the system will dispense 10 days **from** today.

2) Increased Frequency and Larger Reservoirs

- For more frequent dispensing, such as daily, a larger reservoir may be required. The Zoog Zapper is compatible with reservoirs of any size, including large containers like a 55-gallon drum.

3) Compatibility with Other Chemicals

- The Zoog Zapper can dispense a variety of chemicals, thanks to the use of silicone tubing that is resistant to most substances.

4) **Power Considerations for Frequent Dispensing**

- For high-frequency dispensing, it is recommended to use AC power, as battery life will deplete more quickly with frequent use.

Changing the Dispense Interval

1) **Initiating the Dispense Interval Change**

- To set a new dispense interval (from 1 to 30 days), wait for the pump LED indicator to illuminate.
- Press the pushbutton six times. The LED will flash six times, confirming the command.

2) **Selecting the Desired Interval**

- The microcontroller will enter "Dispense Interval Select" mode, giving you 10 seconds to begin setting the interval.
- Press the pushbutton once for each day of the desired interval.
    - For example:
        - Press the pushbutton **7 times** to set a 7-day interval.
        - Press the pushbutton **10 times** to set a 10-day interval.

3) **Confirming the New Interval**

- After you press the pushbutton the desired number of times, the LED will flash back the same number of times to confirm the selection.
- After a short delay, the LED will quickly flash six times, signaling that the process is complete.

4) **Returning to Normal Operation**

- The pump will resume normal operation, with the LED flashing every 10 seconds to indicate the system is functioning correctly.

Verifying the Dispense Interval

- If the pushbutton is not pressed within 10 seconds after entering "Dispense Interval Select" mode, the LED will flash to indicate the current dispense interval.
- The number of flashes corresponds to the number of days in the current interval.
- After a short delay, the LED will flash six times quickly, signaling that the process has completed.
- This feature allows you to easily verify the currently set dispense interval without making any changes.

Command #7 (Set tubing length / Volume of fluid dispensed)

This setting only needs to be changed if the length of tubing is extended, or more fluid is desired to be dispensed!

1) **Default Tubing Length**
   - The dispense tubing is set to eight feet by default. This length is calibrated for accurate dispensing of Steramine.
2) **Extending the Tubing**
   - If the tubing is extended (e.g., up to 30 feet) for a different application, the pump must be recalibrated to ensure accurate dispensing.
   - Longer tubing requires more time for the pump to fill the tube with Steramine before dispensing the measured amount (e.g., one-half cup).
3) **Recalibration Requirements**
   - A kitchen measuring cup is needed for precise calibration.
   - Use water instead of Steramine during the calibration process to avoid wasting sanitizer.
4) **Calibration Process**
   - There are two ways to adjust the pump's timing to account for the increased length of tubing or a higher desired dispensing volume.
   - Detailed instructions for these adjustments will ensure the pump delivers the correct amount of fluid, regardless of tubing length.

Choice of Two Calibration Methods

There are two methods to adjust the pump calibration for extended tubing or to increase the amount of liquid dispensed:

1. **Teach Mode (Recommended for Two People)**
    - This method is ideal if two people are available.
    - One person operates the pump while the other is positioned at the air conditioner unit, where the nozzles are located.
    - Teach Mode is efficient and highly accurate, as the pump learns the exact time required to dispense one-half cup of liquid, accounting for the tubing's length and slope.
    - This method ensures precise calibration regardless of the distance between the pump and the nozzles.
2. **Foot Mode (For One Person)**
    - This method can be used when only one person is available.
    - Measure the length of tubing from the pump to the nozzles. Press the pushbutton once for each foot of tubing.
    - Foot Mode may require a few attempts to achieve accurate calibration, but it is practical for single-person setups.

Initiating Teach Mode

1) Preparation

- Gather a kitchen measuring cup for calibration.
- Remove the nozzles temporarily, positioning the tubing to pump directly into the measuring cup.
- Use plain water instead of Steramine for this process.

2) Overview of the Process

- In Teach Mode, the pump runs automatically when the pushbutton is pressed.
- Once the measuring cup reaches the one-half cup line, the user stops the pump by pressing the pushbutton.
- The pump controller records the time required to dispense one-half cup and uses this time for all future dispensing.

3) Step-by-Step Instructions

- Wait for the pump LED indicator to illuminate.
- Press the pushbutton **seven times** to enter Teach Mode.
- The LED will flash **seven times** to confirm the mode is activated.

- Within 10 seconds, press the pushbutton **once** to begin the process.
    - The LED will flash **once**, and the pump will start automatically after a 2-second delay.
- Monitor the water being dispensed into the measuring cup.
- When the water reaches the one-half cup mark, press the pushbutton **once** to stop the pump.
- The pump will pause for 2 seconds, then reverse to evacuate the tubing of fluid.
- After a short delay, the LED will flash **six times**, signaling that the calibration process is complete.

4) Verifying Accuracy

- Empty the measuring cup, then evaluate the calibration by dispensing one-half cup of water (press the pushbutton **three times**).
- If the amount is not accurate within a reasonable range, repeat the Teach Mode process to recalibrate.

5) Completion

- Once calibrated, the recorded time will be used for all automatic and manual dispensing operations.
- This completes the Teach Mode process.

Initiating Foot Mode

1) Purpose of Foot Mode

- Foot Mode is designed for situations where only one person is available to calibrate the pump.
- In this method, the pushbutton is pressed once for every foot of tubing, measured from the pump to the nozzles.

2) Calibration Process

- For example, if the tubing length is 30 feet, the pushbutton must be pressed 30 times.
- This method may require adjustments:
    - If too little liquid is dispensed, increase the number of feet entered and test again.
    - If too much liquid is dispensed, decrease the number of feet entered and repeat the process.
- These "adjust and measure" cycles may take additional time to achieve accurate calibration.

3) Step-by-Step Instructions

- Wait for the pump LED indicator to illuminate.
- Press the pushbutton **seven times** to enter calibration mode.
- The LED will flash **seven times** to confirm the mode is activated.
- Within 10 seconds, press the pushbutton **two times** to select Foot Mode.
    - The LED will flash **two times** to confirm the selection.
- Press the pushbutton **once for each foot** of tubing length, as measured from the pump to the nozzles.
- The LED will flash back the same number of times as the pushbutton was pressed to confirm the entered length.
- After a short delay, the LED will quickly flash **six times**, signaling that the calibration process is complete.

4) Testing and Adjustments

- Evaluate the calibration by dispensing liquid into a measuring cup.
- Adjust the entered tubing length (increase or decrease) as needed and repeat the process until the desired amount of liquid is dispensed accurately.

5) Completion

- Once the calibration is accurate, the pump will use the entered tubing length for all future dispensing operations.

Verify the Accuracy of the Fluid Volume

1) Purpose of Verification

- The entered number of feet determines the pumping time. This time must be verified to ensure the pump dispenses the correct amount of liquid (one-half cup or 4 ounces).

2) Verification Process

- Use **Command #3** to evaluate the pumping manually.
- Position a measuring cup under the nozzles to catch the water, then press the pushbutton **three times** to dispense one-half cup.

3) Adjusting the Number of Feet

- If the measured water level is over or under one-half cup (4 ounces), adjust the number of feet entered during the calibration process.
- Use the following guideline:
    - Each foot corresponds to approximately **0.11 ounces**.
    - Increasing the total feet by **2 feet** will pump an additional **0.22 ounces**, which is nearly one-quarter ounce more.

- Adjust the number of feet as needed, then retest by repeating the verification process.

4) **Repeat the Process**
   - Continue testing and adjusting until the pump consistently dispenses close to one-half cup.
5) **Completion**
   - Once the pumping is accurate, the pump is ready for use with the adjusted settings.

Increasing the Amount of Fluid Dispensed

1) **Overview**
   - Command #7 allows the user to increase the volume of liquid pumped by either "teaching" a longer pumping time or increasing the number of feet in the Foot Mode calibration.
   - Using plain water during calibration is recommended to ensure the correct volume is dispensed before adding Steramine.
2) **Using Teach Mode to Increase Volume**
   - If using Teach Mode, simply allow the measuring cup to fill to the desired amount (e.g., one cup or 8 ounces) and then stop the pump.
   - The pump will memorize the new time and dispense the specified volume for all future operations.
3) **Using Foot Mode to Increase Volume**
   - If the Foot method was used to set the tubing length, increasing the number of feet will extend the pump's runtime and dispense a larger volume of liquid.
   - Each foot adds approximately **0.11 ounces**.
3) **Example Calculation**
   - To increase the dispense volume from the default **½ cup (4 ounces)** to **1 cup (8 ounces)**:
     - Calculate the additional liquid needed: **4 ounces (additional)**.
     - Divide by 0.11 to determine the number of extra feet required: **4 ÷ 0.11 = 36 feet**.
     - Add this to the default tubing length (8 feet): **36 + 8 = 44 feet**.
     - Set the number of feet to **44** to achieve a 1-cup dispense volume.
4) **Verification Process**
   - After adjusting the number of feet, evaluate the pump by pressing the pushbutton three times to dispense and measure the liquid.
   - If the amount pumped is too low, increase the number of feet slightly and test again.
   - If the amount is too high, decrease the number of feet and retest.

5) Finalizing the Setting

- Repeat the process until the pump consistently dispenses the desired volume.
- Once calibrated, the pump will operate with the new volume for all future dispensing.

Verifying the Length of Tubing Set

1. **Purpose of Verification**
    - If the **Foot method** was used to set the controller's memory, verifying the entered number of feet ensures the accuracy of the calibration. The LED will flash the exact number of feet entered.
    - If the **Teach method** was used to set the pump runtime, the LED would flash an approximate number of times based on the pump's recorded runtime. This serves as a helpful common-sense check.
2. **How to Initiate Verification**
    - Wait for the pump LED indicator to illuminate.
    - Press the pushbutton **seven times** to activate Command #7.
    - The LED will flash back **seven times** to confirm the command.
    - Wait 10 seconds. The LED will then flash the current or calculated number of feet stored in memory.
3. **Default and Custom Settings**
    - By default, the LED flashes **eight times**, corresponding to the factory length of 8 feet of tubing.
    - If the settings have been modified, the LED will flash the updated number of feet.
4. **Correcting Errors**
    - If the verification indicates an incorrect setting, use Command #7 to adjust the calibration:
        - For the **Foot method**, update the number of feet entered.
        - For the **Teach method**, re-teach the pump runtime.
5. **Ensuring Accuracy**
    - Repeat the verification process after making changes to confirm the settings are correct.

***This completes the Commands section*.**

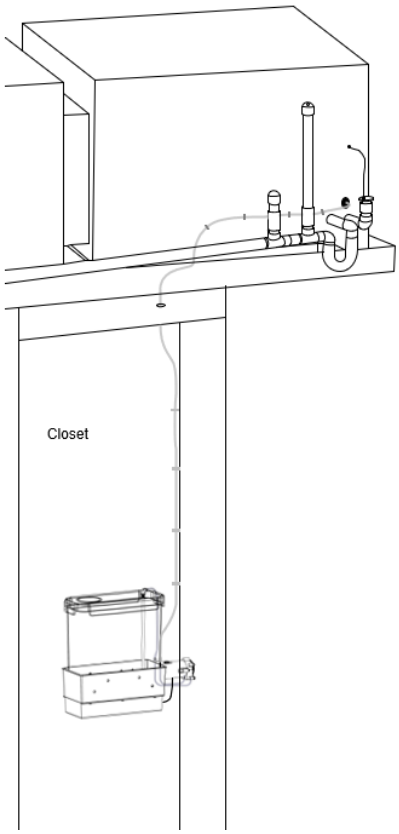
Section #13 - Attic and "Extended" Installations

You only need to read this section if your system tube length will need to be extended.

Many air conditioner systems are installed in attics. While not the ideal environment for an air conditioning system there are some benefits. The main negative issue related to an attic installation is excessive heat, followed by access. Zoogloea growth can be accelerated with heat, including elevated heat within the drain piping.

The Zoog Zapper system can be installed using two different methods to accommodate an attic air conditioning system. The Zoog Zapper system can simply be installed directly on the air conditioning unit in the attic. If the system is installed in the attic, there may be an AC outlet or a light socket available so batteries would not be needed. Batteries will lose some power due to extreme heat and cold, so an AC power source is preferred.

The alternative installation method is to place the system on the floor below the attic and run the dispense tubing up into the attic to the air conditioner. The pump being a positive-displacement design can pump vertically twenty-plus feet.



A typical "extended" installation would be placing the Zoog Zapper in a hallway closet on the floor below the attic. The system can reside on a shelf in the closet. This way the reservoir can be filled without having to go into the attic. If batteries are used the batteries can easily be changed.

If the Zoog Zapper system is installed in a hallway closet, there are specific adjustments required. Extending the tubing is necessary, and the overall length must be properly set to ensure accurate dispensing. Regardless of the tubing length, the tubing must first be filled completely to the nozzles before pumping the ½ cup of Steramine into the AC unit. However, with a longer tubing length, such as twenty-five feet instead of the original eight feet, *more pumping time is needed to fill the twenty-five feet of tubing.*

Command #7 in the "Operator Interface" section explains how to set the length of tubing (it is easy!)

A 5mm-to-5mm tubing connector is provided to connect the dispense tubing to the extension tubing. Tubing can be purchased at Home Depot in twenty-foot lengths ($4.50):

https://www.homedepot.com/p/UDP-0-170-in-I-D-x-1-4-in-O-D-x-20-ft-Clear-Vinyl-Tubing-T10007003/304185165

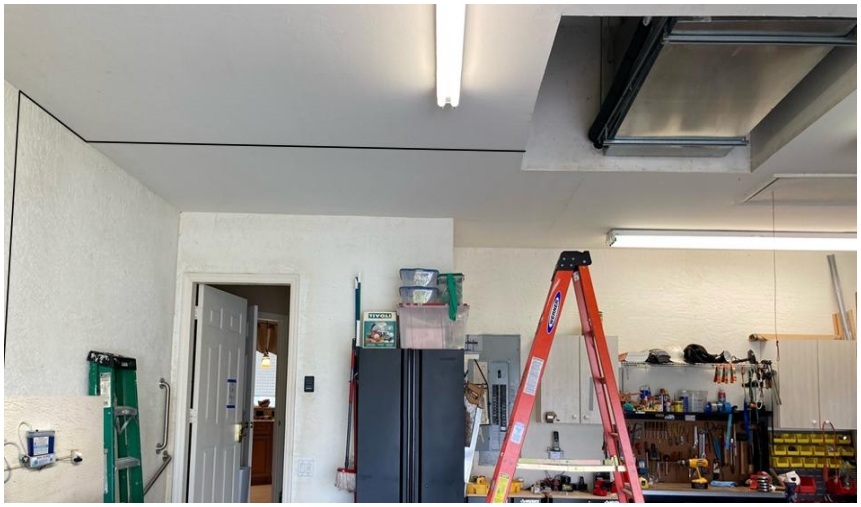
UDP

0.170 in. I.D. x 1/4 in. O.D. x 20 ft. Clear Vinyl Tubing

★★★★½ (53) Questions & Answers (7)

Garage Ceiling Installations

This is another example of the flexibility of the Zoog Zapper system.



This installation is a typical Florida West Coast garage air conditioner which is up inside an alcove in the garage ceiling.

The 80-year-old homeowner completed this installation!

It is exceedingly difficult to maintain such a system based solely on the height of the unit.

The Zoog Zapper was wall mounted, and the tubing was run up to the air conditioner air handler. AC power was available from a wall outlet.

The tubing length total was twenty-eight feet, with a six-foot vertical rise from the Zoog Zapper pump up to the ceiling. Once the system was installed the length of the tubing was set on the pump.

This system was installed six months ago and is functioning well with an extremely happy homeowner who has no more clogs on his system!

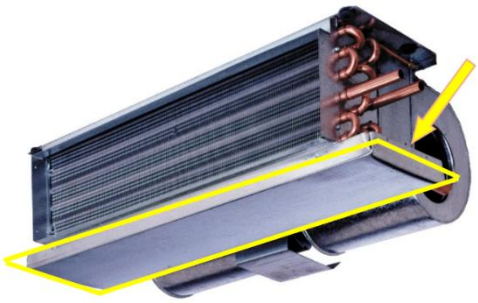
Commercial applications are also possible as the Zoog Zapper is both flexible in the dispense interval, the length of tubing, the amount of Steramine which can be pumped, etc.

Section #14 - Chiller Installations

Chillers systems are commonly used in larger high-rise buildings instead of "traditional" air conditioning systems. A roof-mounted chilled water generating system produces the low-temperature water which is circulated throughout the building to all the units/condominiums. Chillers are much simpler overall than an air conditioner, consisting primarily of a coil, fan, and a drain pan.

Chilled water circulates through the coil with the fan blowing air through the coil into the living spaces. A chiller does not provide dehumidification like a freon-based air conditioner; however, chiller systems generate condensate just like refrigerant-based air conditioning systems and are therefore susceptible to Zoogloea bacteria clogging, both inside the drain pan and in the drain lines. The Zoog Zapper can be installed on chiller systems to provide sanitation and help prevent system clogging.

Chiller systems are typically installed in very physically confined areas, so mounting the Zoog Zapper is more of a challenge. Depending on the location of the chiller and available space, the Zoog Zapper may or may not be mounted close to the chiller. Sometimes there may be a chiller located in a closet ceiling and the Zoog Zapper can be mounted on a closet shelf with the dispense tubing run up to the chiller. The dispense tubing can be extended if the Zoog Zapper needs to be located/mounted farther away from the chiller than the length of supplied tubing can reach.



Placement of the dispense nozzles is much simpler on a chiller system. The drain pans are rectangular in shape (yellow rectangle) and are sloped slightly towards the drain outlet on the right front corner. There are no "troughs" in a chiller drain pan. The Steramine just needs to be dispensed into the drain pan (yellow arrow) and ideally at the back of the drain pan so the whole pan is flooded. Typically, there is a cutoff switch in the main drain pan.

Here are some examples of chiller installations.

The dispense tube is routed to the chiller and is placed into the drain pan area. The tube is held with the magnetic tube holders.

The tube (yellow arrow) is suspended above the drain pan and drops the Steramine directly into the drain pan.

Ideally the tube dispenses the Steramine towards the back of the drain pan as far as possible from the drain outlet.

This system was extended to a total of fourteen feet, so the Two-Port manifold and the dispense nozzles were not needed. The 7MM dispense tubing dispenses directly into the trough.

The Zoog Zapper (a prototype unit shown) was placed on a shelf in the closet and the dispense tube was extended to reach the chiller area.

This chiller system is installed in a very confined space with only about eighteen inches in height.

In the picture on the left the copper tubes of the coil are visible.

The drain pan is not visible but is under the silver metal plate at the bottom of the picture.

This picture shows the two 4mm dispensing tubes draped over the copper supply lines.

The nozzles are “parked” about three inches above the pan and at the rear of the drain pan.

The Steramine will fall from the nozzles into the drain pan.

This picture shows the Zoog Zapper (on the left) located up inside the chiller area.

The reservoir can be reached through a closet hatchway to be refilled and the batteries checked. There was no power source in this area.

Chiller systems, while different in their construction from traditional air conditioner systems, are also able to be sanitized by the Zoog Zapper system and help prevent clogging.

Section #15 – System With Condensate Pumps

Condensate Pumps will be found on AC systems that do not have a typical gravity-based drain line configuration. Pumps can also be found on systems that have had clogging issues, and it was decided to pump the condensate out instead of relying on a gravity-based drainage system. Some AC systems are installed in locations that have zero slope to drain so a pump must be added. This section is to give a quick overview of what to look for when your system has a pump as there are still drainage issues on systems with pumps and additional complications that are inherent when a pump is required.

The advantage of a pump is to force the condensate out through a problematic drain line. The disadvantage of a pump is Zoogloea buildup within the drain piping **to** the pump and internal bacteria buildup in the pump reservoir, plus the drain pan may still clog…

The two AC systems in the left picture were moved from the attic of the home down into an "AC Room." The two AC systems were moved into basically the middle of the home, so two condensate pumps were required to expel the condensate. The pumps can be seen located in the secondary drain pan on the floor (white arrows).

Both pumps have their drain tubes running up into the attic and then over to the side of the house. The homeowner added a chemical solution faithfully each month into the drain line as instructed by the AC Engineer who designed the overall setup and said the homeowner should never have a clog with the overall design.

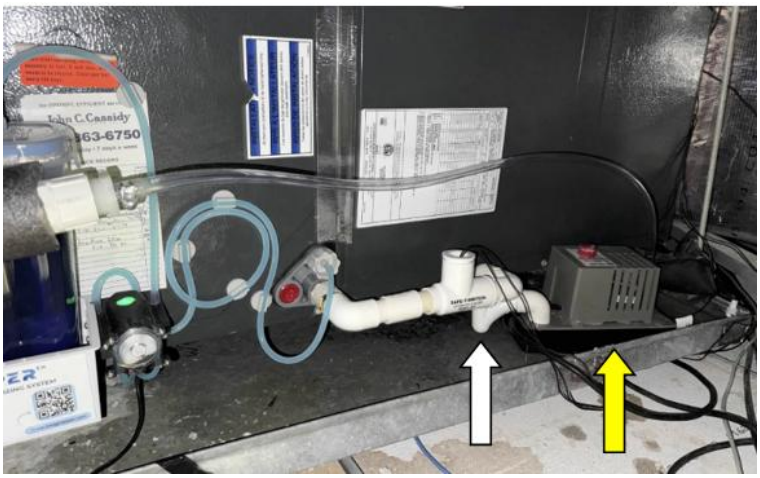
However – there was still Zoogloea in the drain pan, drain line and in the pump (surprise) so the homeowner requested that two Zoog Zappers be installed.

Upon initial inspection, the pump reservoirs of both pumps contained a large amount of Zoog.

The pumps, drain pan and drain line were thoroughly cleaned and the Zoog Zapper installed.

These systems were installed properly with traps and vents <u>*which are still needed with pumps.*</u> However, the traps are "constructed" traps with 90-degree elbows which is not the ideal design. "P" traps should have been used and if there are any clogging issues in the future related to the traps, they will be changed out with "P" traps.

<u>Systems with pumps can still clog in the drain pan, the piping going to the pump and the pump reservoir can also fill with Zoogloea!</u>



Here is a system installed in an office that had limited ceiling height, and a pump was required (yellow arrow).

There is a small "V" shaped trap used (arrow), so overall this is a correct installation.

The clear output tube goes into a drain line to the outside.

A second AC system *in the same office* had a similar setup, but a trap was not installed.

The second AC system had a large quantity of bacteria in the drain pan which was most likely caused by condensate being held in the drain pan for prolonged periods of time while the AC was running as with no trap the condensate cannot escape the pull from the blower suction. Once the AC turns off, the condensate will be released into the drain line.

A Running trap was added to improve the drainage. As soon as the condensate is generated the goal is for the condensate to exit the drain pan immediately.

The Running trap is located far enough away from the drain outlet and is lower than the drain outlet so the condensate in the drain trap will not be affected by the blower suction. A vent is not needed as the condensate drops into the pump right after the trap.

This is an attic installed system that was placed directly on the ceiling joists/beams instead of being hung up in the air, so there was no slope for the drain line.

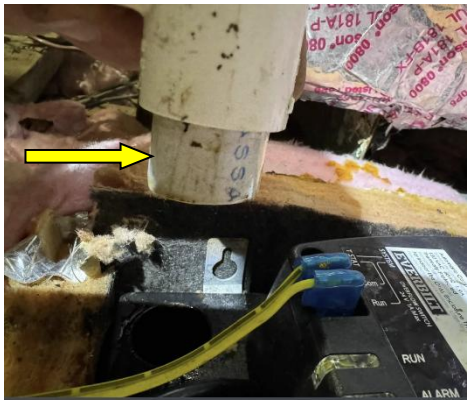
The system had clogged previously and had lots of rust in the secondary drain pan, indicating water overflowing the drain pan. The pump had a large quantity of Zoogloea and needed to be cleaned.

Due to a total lack of slope for the drain line, a pump (yellow arrow) was needed to be used. The pump had to be placed directly on the ceiling drywall to get the pump lower than the drain pan!

The pump has insulation surrounding the perimeter and at the bottom to prevent condensation as any condensation generated from the cold condensate in the reservoir would drop directly onto the ceiling!

A trap was not originally installed, so a Running trap was added (shown), which is however close to the AC system. Some slope was used on the trap to help with draining and to increase the resistance within the pipe so the condensate would not be pulled backwards into the cabinet. This AC system was a smaller unit, so the blower suction was not strong enough to pull the condensate out of the trap. Since the output of the trap went directly into the pump reservoir a vent was not needed.

(This is important) The length of ¾" pipe going down into the reservoir (arrow) was cut just long enough (3/4") to pass through the reservoir cover. This way the condensate could freely drop into the reservoir and with air in the reservoir this configuration would act similar to a vent. If the length of the pipe were longer and went down to the bottom of the reservoir, as the reservoir filled with water the end of the pipe would be submersed and would be sealed by the condensate. This seal would create a "double trap" scenario which would hinder the flow of condensate or possibly stop the flow of condensate. The condensate from the drain line needs to flow freely down into the reservoir.



This particular drain scenario is presented because while the plumbing looks overall relatively simple, an understanding of the principles of the drain line design is needed. The basics of a "trap/vent" being required still applies when a pump is required. A "P" trap could probably also have been used if there was adequate vertical room.

The output tube of the pump connected into the existing drain line that was for the previous AC system. The drain line was raised up from the floor as the previous AC system was installed (properly) hanging in the air as this system should have been! The drain line did not have a vent, so a vent was added to assist in the condensate outflow.

These types of systems are shown for informational purposes as condensate pumps have been the traditional "go-to" solution for problematic clogging drains and will be encountered. Condensate pump installations can be a more challenging installation, and an improper installation can cause another level of issues for a homeowner. The main item to look for is that a trap and vent still needs to be used!

I have removed pumps and restored systems to how they were originally, as originally the system did not have a trap and vent – which was most likely caused the clogging in the first place.

With a trap and vent now installed and the Zoog Zapper dispensing regularly, these systems have been clog-free. The pump was a band-aid and did not address the root cause of the clogging problem. Adding a pump when not truly needed provides additional locations to clog.

Pumps should be checked monthly for bacteria buildup and if a large amount of bacteria is present the pump should be cleaned. With pumps, once the reservoir is full the pump turns on and empties the reservoir so there may be a brief period of time that the sanitizer is in the reservoir which will limit the sanitizer's effectiveness. That said, all of the installations that have condensate pumps (over 10) have not had any further clogging issues!

Section #16 - Cold Weather Options

What To Do Come Cold Weather

The pump circuit board features a temperature sensor that stops automatic pumping if the temperature drops below 55°F (12.8°C). Manual pumping remains unaffected by this sensor.

Steramine crystallizes below 50°F and freezes at freezing temperatures. Steramine will revert back to a fully liquid state when the temperature is above the crystallizing temperature.

When the AC system will no longer be needed when fall/winter comes, remove the reservoir, and pour out any remaining Steramine. Leave the system powered on!

It is highly advisable to keep the pump powered on as the pump runs in reverse for two seconds daily to prevent the tubing from sticking due to prolonged inactivity. Freezing weather does not harm the pump. In spring, refill the reservoir with Steramine, check the batteries if applicable, and the system is ready for use.

If the pump is powered off during winter, the internal tubing may stick together.

In spring, if the tubing is stuck closed, the pump will rotate but will not pump liquid until the tube reopens. To ensure the pump tube is not stuck, follow these steps:

1. Fill the reservoir with water to one-quarter full.

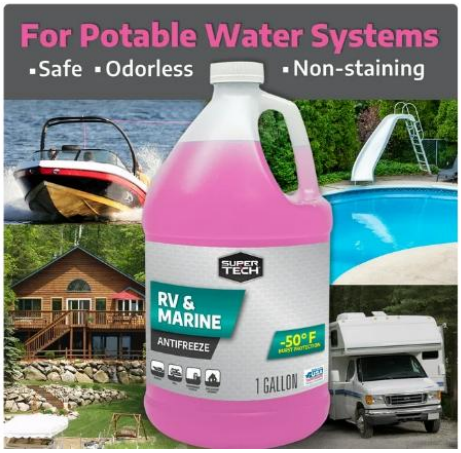
2. Press the pushbutton twice to activate Command #2, which runs the pump in reverse for seven minutes and then pumps two cups of liquid.

If you see air bubbling quickly in the reservoir, the tubing is open (good!). If water is pumped after the seven-minute reverse cycle, the system is ready to go and follow the refilling instructions.

The tubing will usually open after the seven-minute reversal period. If pumping two cups fails, press the pushbutton twice again and see if the tube opens. If the tube remains closed, consult the Troubleshooting section for manual tube opening instructions.

Adding Anti-Freeze

The Zoog Zapper can pump almost any chemical since the liquid travels inside the tubing and there is no contact with the pump mechanism.



When freezing weather is approaching, some AC companies winterize the drain lines by adding anti-freeze. Although PVC drain lines are not very susceptible to cracking because they can expand and the ends are open, it may be prudent to add anti-freeze as a precaution.

A common non-toxic RV anti-freeze (picture) available at Walmart for $3.98, can be used.

To pump the anti-freeze, follow these steps:

1) Remove the Steramine from the reservoir.

2) Fill the reservoir with the anti-freeze solution to one-quarter full.

3) Press the pushbutton five times to pump two cups. After the pump stops, press the pushbutton again five times to pump an additional two cups. *(Four cups should be sufficient to fill the drain line with anti-freeze. Adjust the amount as needed based on the length and design of the drain line.)*

4) Empty the reservoir of the anti-freeze and leave the system powered on so the pump rotates daily. The system will be ready for use in the spring.

Section #17 - Trouble Shooting

This section is to answer any potential problems. If there are any issues you cannot find a solution to, please email me at rich@acdrainlinecleaners.com and I will respond promptly.

The Drain Line is Clogged Again!

A drain line still clogging can be caused by a few factors and there are multiple options available to prevent the clogging. As previously mentioned, the internal state of the drain line is an unknown and may be heavily clogged to the point that the line needs to be flushed out with a hose. But first things first – where is the clog?

The front panel of the cabinet should be removed to make sure that the drain pan and drain outlet are clear. Checking the drain pan first eliminates the possibility of the drain outlet being clogged and then the focus can shift to the drain line.

Drain Pan Clogged?

Odds are, the drain pan is not clogged with consistent Steramine dispensing, however, should the drain pan outlet be clogged, the dispense interval will need to be increased. If the dispense interval has not been changed, the interval is currently set to every seven days. Change the interval to every five days (see Command #6 in the Commands Section).

If the drain pan is clogged, the blockage will need to be cleared. Using a Wet/Dry vacuum is the best way to clean out the drain pan. If a vacuum is not available, now may be a good time to buy an inexpensive one - https://www.homedepot.com/p/Bucket-Head-5-Gallon-1-75-Peak-HP-Wet-Dry-Shop-Vacuum-Powerhead-with-Filter-Bag-and-Hose-compatible-with-5-Gal-Homer-Bucket-BH0100/202017218

(A five-gallon bucket would also need to be purchased)

If a Wet/Dry vacuum is not available, paper towels can be used as best you can, and then slowly pour a gallon of hot water into the drain pan so the water flows out and check the exit point of the drain line to see if the water flows readily out.

Vacuum out the drain line using the supplied ZoogOut Vacuum Adapter (remove the vacuum filter in the vacuum). Slowly add a gallon of hot water into the drain pan to refill the drain line and vacuum out the line again.

If the Reservoir is low, refill the reservoir with hot water and add **fifty (50)** tablets of Steramine and press the pump pushbutton two times. After the seven-minute mix cycle, two cups of Steramine will be dispensed. Dispensing two cups combined with increasing the dispensing interval is all that should be done for now and hopefully the clogging will end. The reservoir will need to be refilled in six months based on dispensing one-half cup every week.

Is the Trap Clogged?

Traps, while necessary for proper drain line operation, by design are prone to clogging so the trap is always suspect. Clearing a trap is best done (again) with a wet/dry vacuum and/or the compressed CO2 gun as shown in Section Two.

Another method to try to clear a trap is to pour hot water into the drain pan or into a clean out pipe so there is a volume of water in the piping. If there is a vent pipe after the trap, the pipe needs to be sealed closed, and tape can be used for this purpose. Once both steps are completed, use the Wet/dry vacuum to try to clear the water in the pipes. If the piping is clear, water that is poured into the drain pan should flow out of the exit point. If a clog still exists in the drain system, the water will back up into the drain pan. If this happens, try once again to vacuum at the exit point to see if the line will clear. Remove the tape or cap from the vent tube if the vent was sealed. Increase the dispense interval to five days for now to see if the clogging ends.

Drain Line Clogged?

If the drain pan is clear, and the trap (if present) is believed to be clear, the clog is somewhere in the drain line. Drain lines are always the "wildcard" in the equation as you cannot tell how clogged a line is unless you cut the pipe.

We will assume first that the clog is just a "blob" somewhere in the line. The first step is to vacuum the line with the ZoogOut vacuum adapter – with a powerful vacuum (remove the filter). Poor hot water into the drain pan to fill the pipe, then vacuum. The water helps pull the bacteria out. Do this "fill and vacuum" procedure for a second time since you are all setup. Pour the water in a third time and the water should drain freely at the exit point. If the water does drain readily, close the panel, and change the dispense interval to five days. Some systems just clog very quickly so increasing the dispense interval will hopefully solve the problem.

If the water drains out slowly, the most apparent issue is that the drain line has a significant amount of bacteria which restricts the pipe opening, as in the above picture. The pipe will need to be cut to check the internal condition. A coupling is all that is needed to connect the two pipes back together.

A drain line that is as bad as in the picture will need to be flushed with a hose for starters. Section Four of this manual shows how flush the drain line with the ZoogFlush kit, otherwise professional assistance may be required.

Whatever piping is accessible can be removed and replaced with new piping. When the pipe is cut, that is the time to attempt to flush the system. The pipe can be filled with water and the CO2 system attempted, but the CO2 is more for "blobs," not a chronically closed pipe.

Sometimes a new drain line must be run as the existing pipe cannot be cleared – but again, it may take professional help to attempt to clear the line and is much less expensive than a new drain line install.

Once the drain is cleared/replaced, change the dispense interval to every five days.

NOTE: Whenever water is added into the drain pan, there is the possibility that water will make its way into the cutoff switch tube. Depending on the design of the tubing, once the water goes into the cutoff switch tube, the water may not be able to get out of the tube – so the cutoff switch will be "tripped," and the air conditioner will not run. The cutoff switch should be checked as the last step and any water inside the tube needs to be removed so the cutoff switch is not activated.

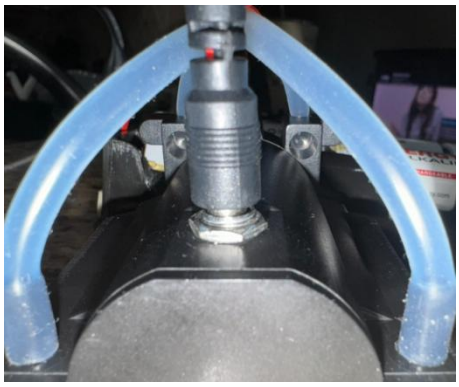
Power Issues

Pump Does Not Power On.

When any of the three power sources are initially plugged into the pump, the motor controller will flash the LED on the pushbutton switch six times rapidly and the pump will beep.

After startup, the LED will flash every ten seconds if the pump controller does not sense a problem.

The simplest check of the pump is to unplug the incoming power connector, wait 10 seconds, and then plug the connector back in. The LED should flash, and the pump will beep.



Make sure that the power connector is fully inserted. There is the possibility that the connector has some internal interference, and the connector was not fully inserted all the way in and has vibrated out some.

This is a picture of a fully inserted connector. There is no large gap between the connector body and the connector on the pump in the picture.

If the pump does not turn on, what needs to be determined is the power source OK or is the power source the problem.

If the power source is the plug-in AC Adapter, there is a blue LED that should be illuminated (arrow) when power is on.

If the LED is not on, verify that the outlet the AC Adapter is plugged into is OK (plug something else into the outlet).

If the AC Adapter is bad, let us know and we will send you a new adapter.

If operating on batteries, check the LED indicators on the Battery Module circuit board (where the power cable is connected to). When the six "D Cell" batteries are inserted properly the four LEDs on the circuit board will illuminate in a test pattern (make sure all four LEDs illuminate) and then the LEDs will flash the appropriate color based on the power level of the batteries.

One battery can be pulled and then re-inserted which will (should) power up the LEDs. If the LED's do not come on then there is a circuit board problem, and we will send you a new Battery Module.

Even if the batteries are completely depleted, there is usually enough power to light the LEDs, and only the Red LED will blink. If the Red LED is blinking, the batteries need to be replaced.

The voltage can also be measured on the power connector with a voltmeter to verify the power source is operational.

Make sure the voltmeter is set to read "DC."

The AC Power Adapter will read approximately 9.15VDC.

New batteries will read approximately 9.50VDC.

The 24VAC Converter will read approximately 9.50VDC.

The inside of the connector is positive, the barrel outside is negative as shown in the picture.

If the power source is confirmed good and fails to turn on the pump, please contact us for a replacement pump.

Pump Does Not Flash the LED

If the Pump is not flashing the LED every ten seconds, either the power is disconnected or if on battery power the batteries may be dead. If on AC power, the Power Adapter may have failed or the AC outlet is not on, or lastly, the LED has failed.

The quickest test is to press and hold the pushbutton and see if the Pump operates. Once the pushbutton is pressed down continuously, there is a four second delay and then the Pump should start running.

If the Pump does operate, the LED has probably failed. Contact us and we will send you a new Pump. This way the system will keep operating.

If the Pump does **not** operate, please refer to the "Pump Does Not Power On" section and verify that there is power.

Beeping is heard from the Pump

There are two reasons for the Pump to beep consistently which are low battery and a pump problem.

If the batteries are in the "Red" level the beeper will sound every ten seconds. Changing the batteries is required.

If there is a Pump problem, the beeper will sound every fifteen seconds and will beep three times with three different tones. If this should be the case please contact us for a replacement pump.

Pump is running late in the evening or while sleeping

Over time, the microcontroller in the pump may drift in timing and the pump ends up running later in the day. This can be corrected by a simple resetting of the pump.

Whatever time you would like to have the pump run – that is the time of day you perform the reset. If you want the pump to run at noon every day (approximately) perform the reset at noon.

The steps to reset the pump:

1) Wait for the pump LED to illuminate.
2) Press the pushbutton six times.
    a. The LED will flash back six times.
3) Wait ten seconds.
    a. After ten seconds, the LED will flash the number of days for the dispense interval.
        i. The default interval is seven days.
            1. Remember the number of times the LED flashes.
    b. The LED will then flash six times quickly (function completed).
4) Wait once again for the pump LED to illuminate.
5) Press the pushbutton six times.
    a. The LED will flash back six times rapidly.
6) Press the pushbutton the number of days the interval was set to.
7) The LED will flash back as many times as you pressed the pushbutton.
8) The LED will flash back six times rapidly (function completed).

The “reset” is complete and the pump timers will be reset to now pump at approximately the same time that you performed the reset operation.

The Pump Rotates but Does Not Pump, Nor Emits Bubbles Running in Reverse

Troubleshooting and Fixing a Closed Pump Tube

If the Pump runs in the forward direction (counterclockwise) and no fluid is dispensed, or if it runs in reverse without emitting bubbles from the dispense tube, the Pump's internal tubing may be stuck closed. This can occur after extended periods of inactivity, either between manufacturing and installation or during extended periods when the Pump is powered off.

Step 1: Open the Tubing by Running the Pump in Reverse

1. **Run the Pump in Reverse:**
    - Press the pushbutton **five times** to run the Pump in reverse for seven minutes.
    - During this process, observe whether air bubbles are emitted into the Reservoir.
2. **Repeat if Necessary:**
    - If no bubbles appear after the first cycle, press the pushbutton **five times** again to run the Pump in reverse for another seven minutes.
    - Typically, this process will open the tubing.
3. **Test the Pump:**
    - Hold the pushbutton continuously to run the Pump in forward mode.
    - If the tubing is open, Steramine should flow from the Reservoir through the Pump. Let it run for about 10 seconds to confirm fluid flow.
    - Release the pushbutton, and the Pump will reverse to return the fluid to the Reservoir.
4. **Regular Maintenance:**
    - The Pump automatically runs for two seconds daily to prevent tubing from sticking during normal operation.

Step 2: Manual Tube Adjustment (If Necessary)

If the tubing remains closed, manual adjustment is required. Follow these steps:

1. **Open the Pump Housing:**
    - Remove the four Phillips screws on the Pump cover and lift the cover off.
    - Mark the top center of the tubing with a Sharpie to ensure it can be reinstalled in the same orientation. Take a picture of the tubing placement for reference.
2. **Release the Tubing:**
    - Pull the tubing out of the housing.
    - Identify any pinched areas in the tubing. Use your fingers to gently massage and work out these areas until the tubing is fully open.

3. **Reinstall the Tubing:**
    - Align the Sharpie mark with the top center of the Pump housing.
    - Start on the left side where the tubing enters the housing. Push the tubing into the cavity while rotating the rollers to guide it into place.
    - Ensure the tubing follows the path between the rollers as you rotate them.
    - Take your time; if you encounter issues, start over.

Final Steps

Once the tubing is reinstalled and open, evaluate the Pump again by running it in both forward and reverse directions. With regular operation, the tubing will remain functional and prevent future sticking.