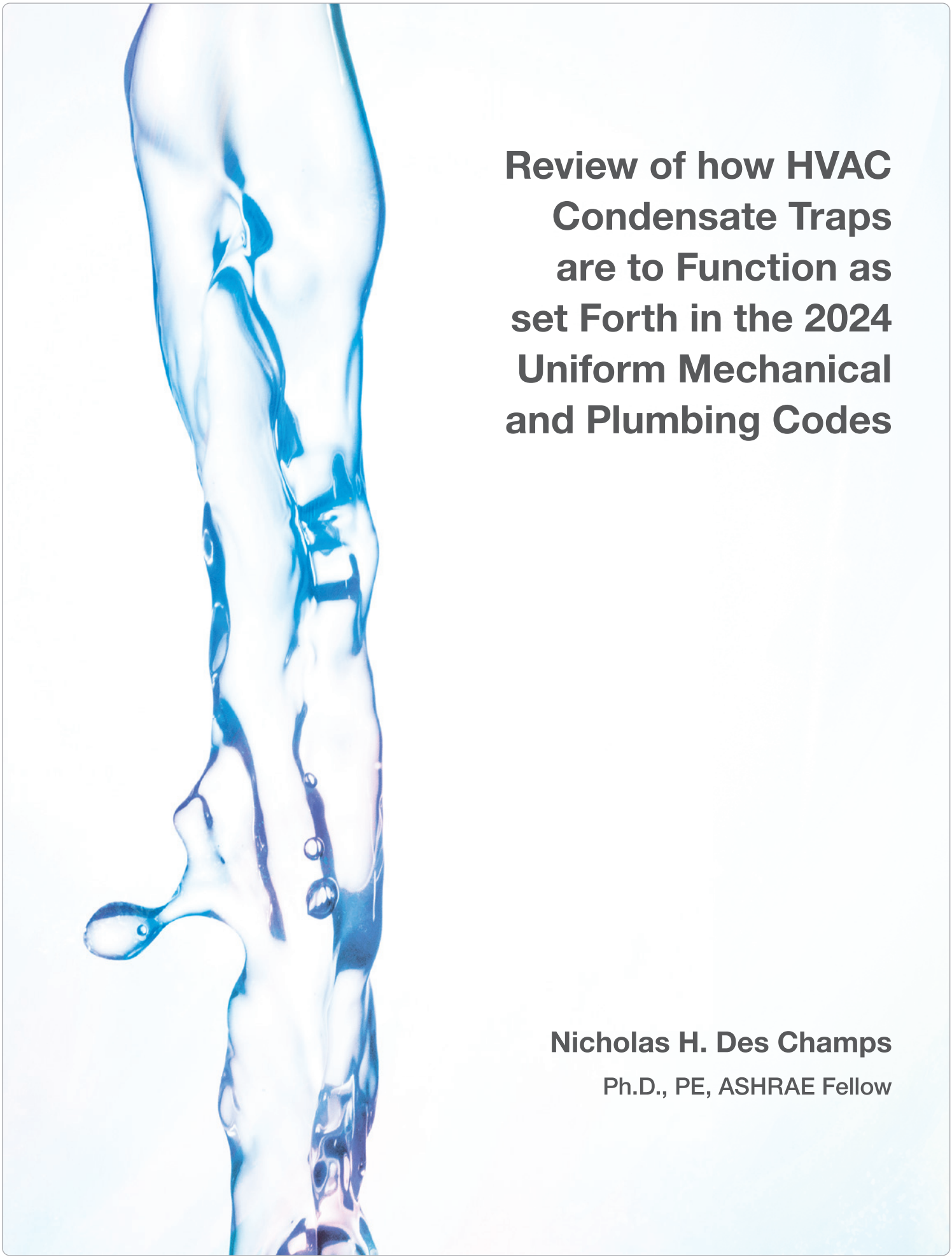

# Review of how HVAC Condensate Traps are to Function as set Forth in the 2024 Uniform Mechanical and Plumbing Codes

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**Abstract**

**The 2024 Uniform Mechanical Code (UMC) and Uniform Plumbing Code (UPC) define, for the first time, how an HVAC condensate trap is to perform. The codes give three choices for trap designs when more than one appliance is connected to a central drain line. For a single appliance drain line connecting to an approved final drain point the manufacturer of the AC equipment must furnish all details of the trap design and drain-line design/layout. If the manufacturer does not supply complete details, then the installation must adhere to the three choices given for multiple drain lines connecting to a common waste pipe.**

Any of you that have been involved in the HVAC industry for the past decade or so have more than likely heard horror stories about the problems associated with removing and discarding condensate formed on air-conditioning cooling coils. Generally, three parameters determine the maximum rate of condensate produced: tonnage, the amount of outdoor air introduced into the AC unit as a percentage of total airflow, and the design ambient dewpoint. Once the maximum rate of condensate flow is known, the diameter and slope of the drainpipe can be determined from generally accepted installation standards. However, the horror stories are more than likely created by the device that is installed within the drain line that is supposed to prevent air from entering or leaving the air handler through the condensate drainpipe. Presently, the most used device for this purpose is the P-trap, a carryover from use on plumbing fixtures, where there is no pressure differential from the inlet of the trap to the outlet – for example, the P-trap under a sink. Once you add a pressure difference across a P-trap, as occurs when removing condensate from an air handler, proper operation of the P-trap becomes very problematic. These problems have persisted for many years, resulting in billions of dollars in **wasted energy and water damage.** But it was neither of these negatives that finally got the attention of the code writers – it turns out that what got their attention is the **potential for poor air quality when using P-traps.** This is a result of intermixing of air between supposed isolated spaces within an occupied building as a direct result of dry P-traps that allow air to freely intermingle between isolated spaces via interconnected piping.

If the fan in the air handler is drawing air through the cooling coil, then a negative pressure (relative to ambient pressure) is produced within the condensate drain pan compartment. When the fan is located upstream and blowing through the cooling coil, positive pressure is produced within the drain pan compartment. In either case, the condensate drain-line system must allow the condensate to leave the AC system without allowing any ambient air or gases, associated with other conditioned spaces, from entering or leaving the AC unit.

Per the 2024 updated Uniform Codes, Section 310.4 Appliance Condensate Drains for UMC and Section 814.4 for UPC, the codes state that:

> ***Condensate drain lines from individual condensing appliances shall be sized as required by the manufacturer's instructions. Condensate drain lines serving more than one appliance connecting to a common indirect waste pipe*** (refer to Figure 1) ***shall have the connections to the indirect waste pipe protected by a sanitary waste valve complying with ASME A112.18.8*** (Figure 2)***, condensate trap complying with IAPMO IGC 196*** (Figure 3)***, or trap with a trap primer*** (Figure 4)***.***

A sampling of facilities having numerous appliance condensate drain lines connected to a larger central drain line would be condominiums, apartment buildings, hospitals, nursing homes, dormitories, hotels, schools, and office buildings. In these types of facilities, when the individual P-traps go dry, then the central drain line exchanges air from the individual spaces to all spaces served by a common connected drain line, and if it is a multistory facility, then the common horizontal drain lines could be connected to a common vertical drain line. For example, if someone decided to fumigate their apartment, then all the residents would know about it. Or, if a resident was isolated in a nursing home because they had influenza, then the isolation is somewhat compromised because of the possibility of viruses spreading due to a faulty AC condensate drain system.

In addition, the UMC Section 310.5 and UPC 814.5 state:

> ***Air-conditioning condensate waste pipes shall connect indirectly to the drainage system through an air gap or an air brake to trapped and vented receptors, dry well, mop sinks, leach pits, or the tailpiece of plumbing fixtures. An individual condensate drain shall be trapped in accordance with the appliance manufacturer's instructions or in accordance with Section 310.4 or 814.4.***

Also, **Section 307.2.4 Traps** in the 2021 International Mechanical Code (IMC) states that:

> ***Condensate drains shall be trapped as required by the equipment or appliance manufacturer.*** (Note: This sentence refers to a single condensate drain line emptying into an approved final drainage point and does not apply to multiple appliances connecting to a common drain.)

In **Section 307.2.4.1 Ductless mini-split system traps**, it states that:

> ***Ductless mini-split equipment that produces condensate shall be provided with an inline check valve located in the drain line, or a trap.***

The author's interpretation of the new 2024 UMC and UPC Codes and the present IMC Code as they relate to the use of condensate traps is:

> According to the last sentence in Section 310.5, if you do not have explicit instructions, in writing, with diagrams and drawings from the manufacturer on how to design and install a trap, then you must install the condensate trap that meets the requirements of last sentence of Section 310.4. That is, ***an individual condensate drain shall be trapped in compliance with ASME A112.18.8*** (Figure 2), ***condensate trap complying with IAPMO IGC 196*** (Figure 3), ***or trap with a trap primer*** (Figure 4).

Since the codes do not elaborate on what it is that the equipment manufacturer shall supply with the equipment as to ***Condensate drains shall be trapped as required by the equipment or appliance manufacturer*** the author presents below what he considers to be necessary information required from the manufacturer for the contractor to do his job:

1. the manufacturer of the AC equipment must supply the contractor with the following information:
    a. The maximum operating air pressure within the condensate drain pan compartment on the leaving air side of the cooling coil in inches of water column and designate whether negative pressure or positive pressure.
    b. The maximum condensate flow rate expected at any point through the year.

c. A diagram/drawing of the condensate trap with all dimensions necessary to fabricate or purchase the trap that will meet the specified condensate flow and pressure.

d. Also, if the overflow drain is not supplied with an overflow safety switch that cuts off the AC unit, then the design of the overflow drain trap must also be specified by the manufacturer, otherwise the unit will leak air all the time through the overflow drain. Even with a P-trap installed it will operate dry and will leak air until required because of main drain malfunction, and then it will suck water into the condensate pan plenum and blow water all over the inside of the AC unit until it has operated for several hours. The overflow trap should be selected according to ***condensate trap complying with IAPMO IGC 196*** (Figure 3), ***or trap with a trap primer*** (Figure 4), otherwise the overflow will leak air all year.

e. The manufacturer should also specify the diameter of the drain line, the required slope of the drain line, and where to place the trap within the drain line.

2. Also, the drain line should be supported so that there will be no sags or low spots that will hold water and be supported such that the installation is permanent.

3. The 2024 code appears to remove the ability of the installation contractor to make decisions on trap design and installation and places that burden directly on the manufacturer. Or, the manufacturer can simply state in its condensate trap installation instructions to refer to the last sentence of Section 310.4 for condensate trap selection and installation.

***Figure 1.*** ***Multiple Appliances having Individual Condensate Drain Lines with Condensate Traps Complying with IAPMO IGC 196-2018 that Prevent Air Mixing between Occupied Spaces***

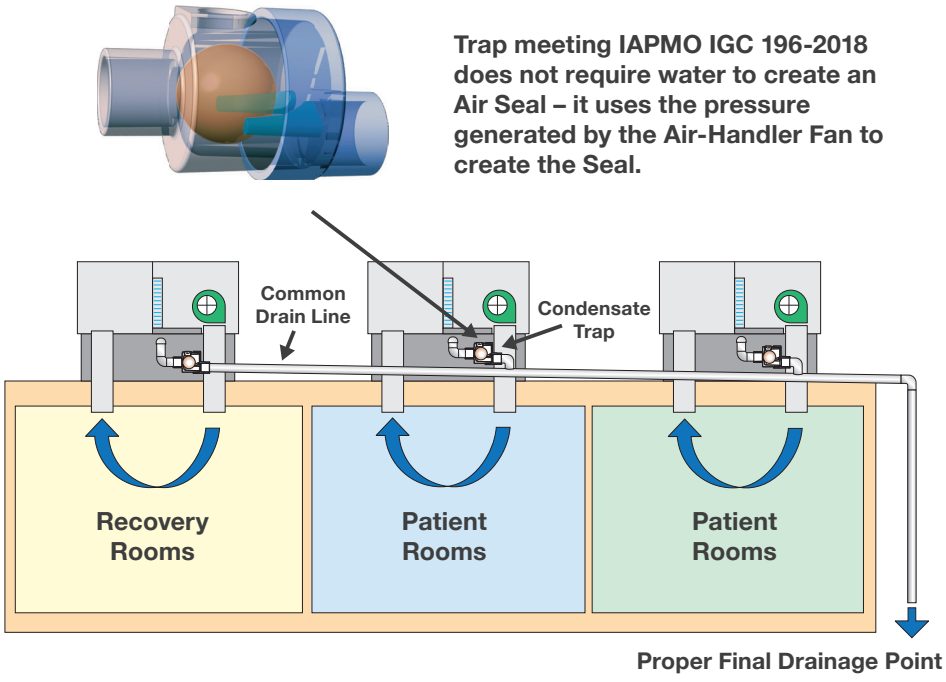


***Figure 2.*** ***Sanitary Waste Valve Complying with ASME A112.18.8.***

***Note:*** Functions as intended only under negative pressure.

***Figure 3.*** ***Trap Complying with IAPMO IGC 196-2018***

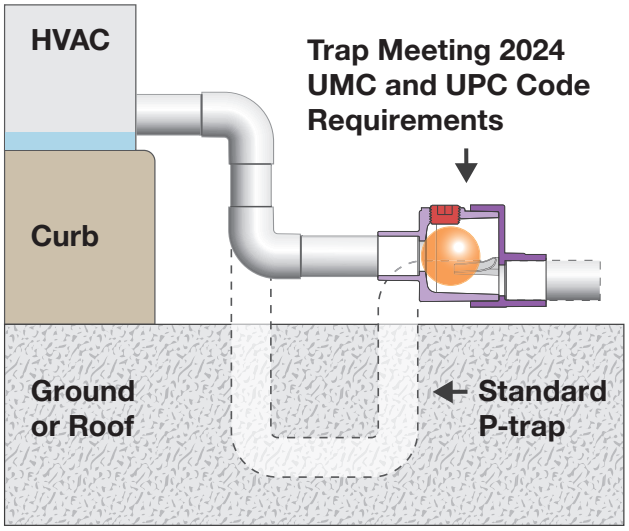
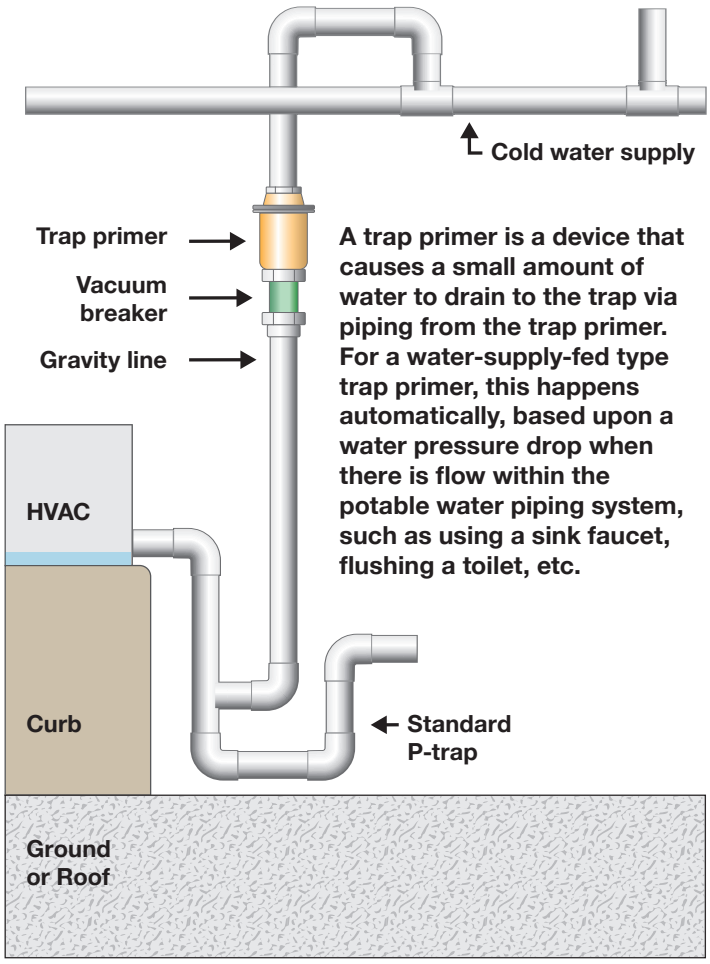
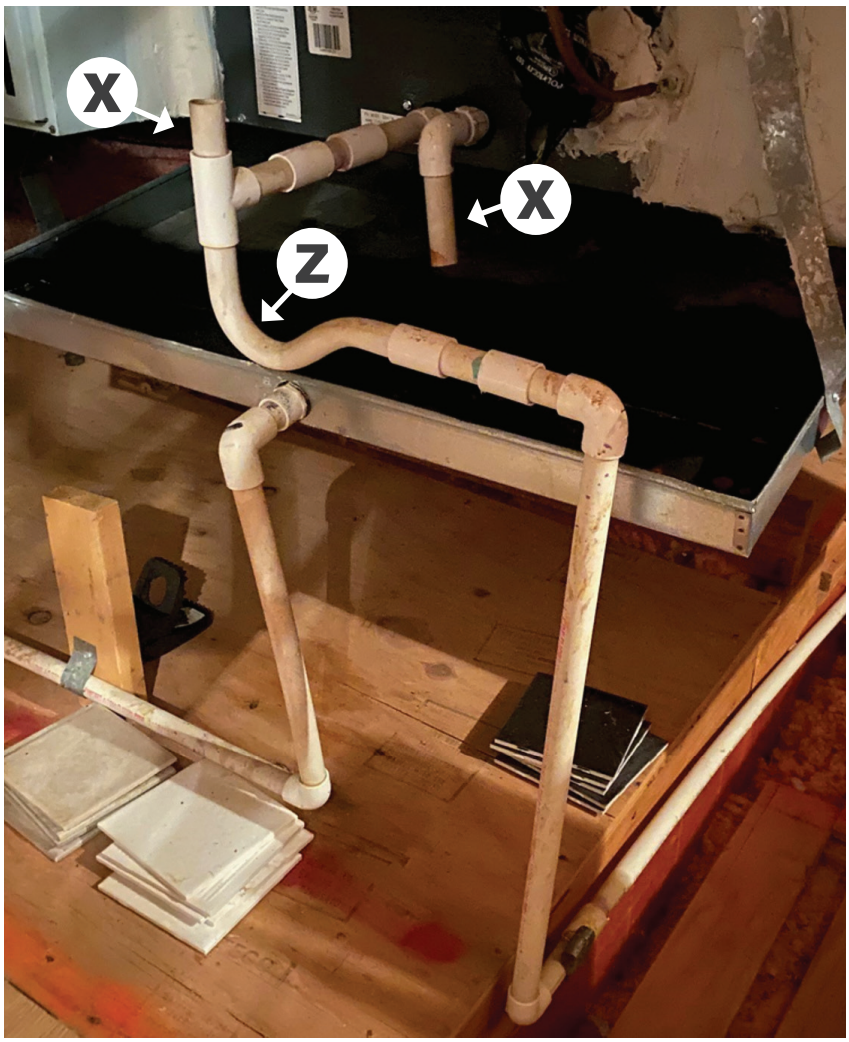



***Figure 4.*** ***P-trap with Trap Primer***



A reason for the last sentence in Section UMC 310.5 is the abundance of poorly designed condensate drain systems. ***Figure 5*** is somewhat typical of a condensate removal system that was field designed and installed. Both the main drain and the overflow drain allow conditioned air to be wasted when the fan is operating. The installed P-trap does not function as a trap, so the condensate line leaks conditioned air all year, as does the overflow drain line. Even if a P-trap was correctly installed on the overflow drain, it would still leak air all the time because there would be no water seal in the trap. The result of such an installation is that under negative pressure, air flowing into the unit prevents condensate from flowing out.

***Figure 5.*** ***Unfortunately, many Installations of Condensate Removal Systems Point to a Lack of Knowledge on how Condensate Traps are Supposed to Operate. X's Leak Air when Fan is Operating. Z does not act as a Trap.***



Below is the **Substantiation by the Technical Correlating Committee (TCC) for these Changes:**

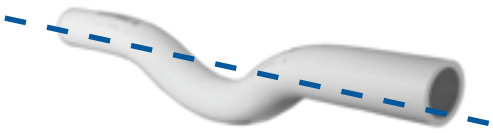
***The primary concern with the connection to an indirect waste pipe from multiple condensate drains*** *(refer to Figure 1)* ***is the free passage of air between spaces. Without a means of preventing the movement of air in the indirect waste pipe, biohazardous airborne materials can easily migrate between spaces in a building. This can result in a medical emergency from exposure to viruses, germs, or chemicals emanating into a space.***

***Since the connection of the condensate is indirect, there are no hard piping connections that close off the piping between different building spaces. There needs to be a means or mechanism that isolates the open piping while still allowing the pipe to serve as an indirect waste pipe. This mechanism would prevent the movement of contaminated air between different spaces in the building. Two currently available devices that would provide the isolation of air movement through an indirect waste pipe are sanitary waste valves and condensate traps. These devices are regulated by ASME A112.18.8 and IAPMO IGC 196 respectively. Both devices will isolate the air movement and are proven by testing and listing to referenced standards.***

***To a lesser degree, a water seal trap could provide isolation of air movement. The problem with a trap is that if the trap loses the water seal, the trap provides no protection against air movement. Condensate drains may not operate for months, thus leaving the trap with no source of water for refilling due to evaporation. For that reason, the only possible means of accepting a water seal trap as an alternative to the two devices is to mandate a trap seal primer valve. While the alternative of a trap with trap seal primer is included in the acceptable means of protection from air movement, it is the poorest of the three methods identified.***

***Note:*** If the P-trap is not designed properly for the application a trap primer may not prevent it from operating dry. Many one-piece P-traps purchased from big box stores and wholesalers ***(Figure 6)*** do not have sufficient depth to hold condensate within the “U” section when the fan is operating above 1/2" WC. Therefore, the trap always leaks air when plenum pressure is greater than 1/2 to 5/8" WC.

***Figure 6.***



If the total air conditioning system consists of one air handling unit and one primary condensate drain line that terminates at a code allowed drainage point, then a standard P-trap can be used if it is installed per the AC manufacturer's instructions. This will usually result in considerable loss of conditioned air during the period that the trap is dry, around 6 - 7 months of the year in parts of the country and most of the time in arid areas. In addition, other common problems associated with P-traps will occur. As already mentioned, it is the manufacturers' responsibility to supply the full specifications for the condensate trap design and the complete installation instructions. If the manufacturer fails to supply this information, then the condensate drain line and the trap should be installed per Section 310 Condensate Wastes and Control for 2024 UMC and Section 814 Condensate Wastes and Control for 2024 UPC. In other words, the trap must be installed using one of the three methods shown in Figures 2, 3, or 4.

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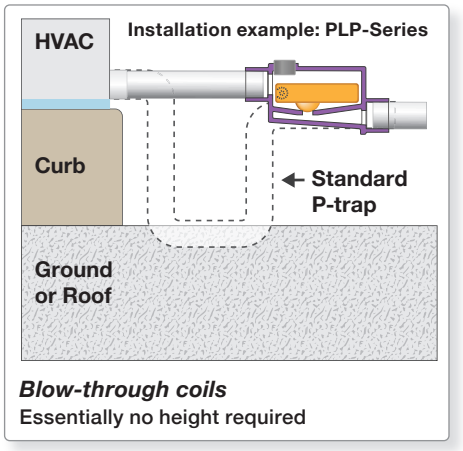
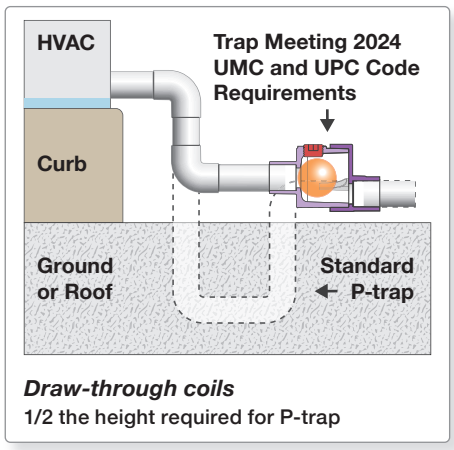



***Blow-through coils***
Essentially no height required




***Draw-through coils***
1/2 the height required for P-trap

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***2024 Uniform Mechanical Code***

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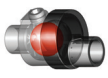
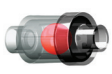

RLC-Series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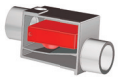
RLC-HF Series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