

The Ultimate Guide to HVAC Condensate

Unless you're an experienced HVACR professional, most people don't realize that air conditioning, refrigeration, and other HVACR equipment can produce condensate during normal operation.

This article is intended to help provide a basic understanding of condensate, condensate removal, and condensate-related problems in HVAC systems. Ready to learn more? Let's dive in!

Key Takeaways:

- All air conditioning systems produce condensate during normal operation
- Condensate must be drained or pumped from systems to avoid costly damage
- Condensate pumps, drain pans, and drain lines require routine maintenance
- Condensate overflow and leaks can cause water damage, mold growth, and unpleasant odors
- Some condensate is corrosive and requires treatment

What is condensate?

Condensate is created during a change in the state of water from a gas or vapor form into a liquid form. It generally occurs when vapor in warm air encounters a cool surface, which normally occurs in air conditioning systems, refrigeration equipment, and other types of cooling and heating equipment.

To prevent the unwanted collection of condensate water, it should be drained away by gravity through a drain pipe or hose. If gravity drainage is not possible, a condensate pump is used to automatically pump the condensate water to a drainage point or sewer drain.

Other types of equipment that produce condensate include condensing boilers, high-efficiency furnaces, dehumidifiers, ice machines, grocery store refrigeration/freezer display cases (dairy, meat, produce, etc.), convenience store refrigerated beverage display cases, walk-in refrigerators and freezers, steam humidifiers, industrial air dryers, and tankless/instant water heaters.

Where does condensate naturally occur?

In addition to the variety of equipment that produces condensate, condensate also occurs naturally in our daily lives:

- Morning dew in our garden/lawn
- Early morning moisture beads on car windows
- Sweaty droplets on your can or bottle containing a cold beverage
- Water droplets or steamy bathroom mirrors
- Visible breath in cold winter conditions
- Clouds in the sky or fog in the air
- Fog or moisture on glasses and goggles

How does condensation relate to evaporation?

The two terms are related, but they have opposite meanings. While condensation occurs when a gas or vapor changes into liquid form, evaporation happens when a liquid substance changes to a gaseous form. For example, when the morning dew burns off, it does so through the process of evaporation.

- Process of ironing damp clothes
- Process of sweating by the human body
- Line-drying clothes

- Whistling steam from a stovetop kettle
- Puddles drying up
- Melting of a glass of ice

Is it normal for HVAC systems to produce condensate?

Yes. The same process that causes a cold glass of iced tea to form water droplets on its exterior in the summer causes condensation in your air conditioner and other similar equipment.

During normal operation, the evaporator coils of your air conditioning system cools the warm air that passes over it, absorbing heat and moisture from the air, and condensation naturally forms. As the condensation drips off the evaporator coil it then collects in your system's drain pan and eventually drains through the condensate drain line via gravity or to a condensate pump (assuming it's properly maintained and not clogged).

Common issues with condensate water in HVAC systems?

Condensate-related issues can range from high humidity levels that lead to mold, mildew proliferation, and structural damage from drainage water that accumulates and puddles in areas where it does not belong. These issues are typically caused by one of the following problems:

Condensate Drain Pan Problems - Under normal operation, your A/C drain pan collects condensate from the evaporator and sends it to an external drain. However, after years of use, condensate drain pans can corrode or crack leading to water leaks into the A/C unit and excess condensate below the drain pan causing damage to the A/C unit and your home or commercial building.

Clogged or Dislodged Drain Line - If bacteria and fungus build up in the drain line, it can become clogged. It is also common for drain lines to become dislodged or outdoor drain lines to become obstructed. When this happens, your condensation pan is plugged and can overflow, causing damage.

Broken Condensate Pump - In homes and commercial buildings with basements or attics, an automatic condensate pump assists in the removal of condensate water from the system. If the pump is not properly maintained, becomes plugged or fails, condensate water can overflow or leak causing damage.

Dirty Air Filter Leading to a Frozen Evaporator Coil - Dirty HVAC system air filters restrict adequate airflow over the evaporator coil. Without proper airflow, the coil can get too cold and freeze. When this ice melts, dripping into the condensation pan, it can overflow due to the excess volume.

In simple terms, what is a condensate pump?

Condensate pumps are designed to move the condensate water produced by moisture-prone equipment (e.g. air conditioner, furnace, refrigerator, ice machine, etc.) to a holding tank before removing it to a drain or sewer. The holding tank collects the condensate liquid until it rises to a level that raises an internal float switch which automatically activates the pump until the liquid level in the tank is lowered.



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How do condensate pumps work?

Most condensate pumps have a main float switch to automatically start/stop the pump when the water reaches preset levels inside the pump reservoir. The pump will automatically turn on/off when the water level increases/decreases in the reservoir or tank. Some pumps also feature a safety switch that can be wired to the condensate source (air conditioner, furnace, refrigerator, freezer, ice machine, etc.) to automatically shut off the source equipment in case of a blocked discharge line or pump failure.

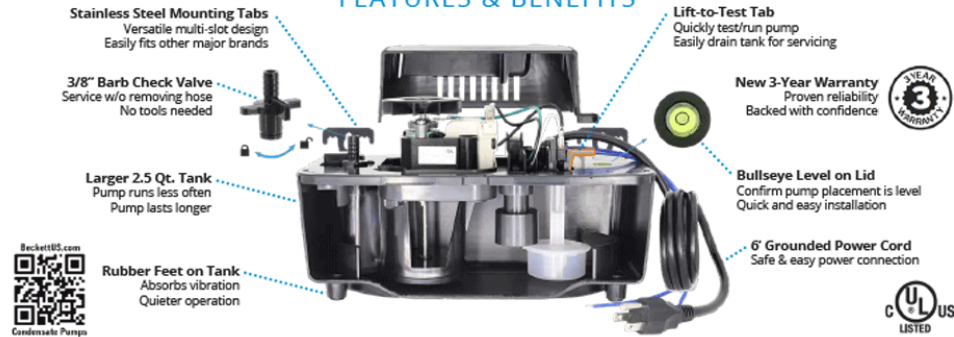
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Choosing a condensate pump

The first step in choosing the right condensate pump is to determine if your application is subject to local condensate handling and disposal regulations. Select a model that operates within these guidelines.

Next, determine the lift required for the pump by identifying where the pump will be mounted and where the discharge or drain point will be. Condensate flow will decrease in accordance with the height it must travel until the maximum lift, or “shut-off” lift, is reached. Select a pump with a maximum lift rating that is suitable for your application.

Check your equipment service manual to determine the condensate output and choose a pump with sufficient capacity. As a general rule, the output flow of the pump should be at least double the input rate from the appliance.

Ascertain your voltage requirements. Most pumps are available in 120V or 230V models. Some commercial-grade pumps are available in 230V and 460V.

If property damage or personal injury can result from an inoperative or leaking pump, choose a condensate pump with an overflow shutoff switch or install one with your pump.

Unless you're replacing an existing condensate pump, it is strongly recommended that you contact an HVAC professional to properly size and select a condensate pump for any new application.

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1 What is the Application or Job Type?	CONDENSATE REMOVAL PUMPS	LOW PROFILE CONDENSATE PUMPS	MINI SPLIT CONDENSATE PUMPS	FLENUM & HIGH TEMPERATURE PUMPS	18-PAN CONDENSATE PUMPS
Common Equipment and Installation Examples	Air conditioners, condensing furnaces, boilers, and dehumidifiers	Air conditioners and condensing furnaces with forced space for pump installation	Wall mounts and ductless mini-split air conditioners	Above-ceiling and below-floor Plenum applications condensing boiler applications	Air conditioners and other equipment with in-pipe condensate return to the only option
Shut Off (Max Lift) Range	12' to 60'	20'	50'	20' to 60'	12'
Flow @ 1 ft. Range	17-476 GPH	140-103 GPH	2.7 GPH	140-476 GPH	80 GPH
Input Voltage	120V, 230V or 480V	120V or 230V	120V or 230V	120V, 230V or 480V	120V
Collection Tank Size	.88 qt. to 1.66L (0.5)	.88 qt. (0.5)	N/A	.88 qt. to 1.66L (0.5)	Included w/ Certain Models
Maximum Water Temp	190° to 212° F	190° to 190° F	104° F	190° to 212° F	80° F
Discharge/Check Valve	3/8" to 1/2"	3/8"	1/4"	3/8" to 1/2"	3/8"

2 Other Considerations

Power Supply	0' Cord w/ Plug for CB11, BK17 & BK22. Hard-wired terminals for larger pumps.	0' Cord w/ Plug	0' Cord (no plug)	0' Power Lead (w/ CL20, hard-wired terminals, for larger pumps).	0' Cord w/ Plug
Safety Switch	Included w/ Most Models	Included w/ Most Models	Yes	Included w/ Most Models	Included w/ Certain Models
PVC Tubing	Included w/ Certain Models	Included w/ Certain Models	Included w/ Certain Models	Included w/ Certain Models	Included w/ Certain Models
UL/CUL Listed	All Models	All Models	All Models	All Models	All Models
UL2043 - Plenum Rated	No	No	No	No	No
Standard Warranty	1-3 Year Warranty	1-Year Warranty	1-Year Warranty	1-Year Warranty	1-Year Warranty

3 Beckett Pump Models

Featured Pumps	CB11, BK17, BK22, CB22, C20, C20S and C20P Pumps	CL20 Pumps	M500 Pumps	CL20, C200 and CP20 Pumps	IPC13 Pumps
Learn More at beckett.com , contact your local distributor or your local sales rep for additional information.					

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1 Type of Condensate Removal Pump?	M500 MINI SPLIT CONDENSATE PUMPS	CB12 SMALL CONDENSATE PUMP	CL20 LOW PROFILE CONDENSATE PUMP	BK17 MEDIUM CONDENSATE PUMP	BK22 MEDIUM CONDENSATE PUMP
Shut Off (Max Lift) Range	50'	12.5'	20'	17'	22'
Flow @ 1 ft. Range	2.7 GPH	57 GPH	140-103 GPH	112 GPH	122 GPH
Input Voltage	120V or 230V	120V	120V or 230V	120V or 230V	120V or 230V
Collection Tank Size	N/A	0.68 qt.	.88 qt. (0.5)	2.5 qt.	2.5 qt.
Maximum Water Temp	104° F	190° F	190° to 190° F	190° F	190° F
Discharge/Check Valve	1/4"	3/8"	3/8"	3/8"	3/8"
Common equipment and Installation Examples	Wall mounts and ductless mini-split air conditioners	Air conditioners, condensing furnaces, boilers, and dehumidifiers	Air conditioners, condensing furnaces, boilers, and dehumidifiers	Air conditioners, condensing furnaces, boilers, and dehumidifiers	Air conditioners, condensing furnaces, boilers, and dehumidifiers

2 Other Considerations

Power Supply	0' Cord (no plug)	0' Cord w/ Plug	0' Cord w/ Plug	0' Cord w/ Plug	0' Cord w/ Plug
Safety Switch	Yes	Included w/ Certain Models	Included w/ Certain Models	Included w/ Certain Models	Included w/ Certain Models
PVC Tubing	Included w/ Certain Models	No	No	Included w/ Certain Models	Included w/ Certain Models
UL/CUL Listed	All Models	All Models	All Models	All Models	All Models
UL2043 - Plenum Rated	No	No	Yes, w/ CL20ULP	No	No
Standard Warranty	1-Year Warranty	1-Year Warranty	1-Year Warranty	3-Year Warranty	3-Year Warranty

3 Beckett Pump Models

Featured Pumps	M500ULC, M500ACC	CB12UL, CB12LDA	CL20UL, CL20ULHP, CL20LA, CL20LH	BK17UL, BK17ULB, BK17TUL	BK22UL, BK22TUL, BK22LDA, BK22LH
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[Beckett Condensate Pump Selection Guide](#)

What are the risks of not properly disposing of condensate in HVAC systems and other equipment?

When condensate water is not properly removed from a system it can overflow or leak, causing a range of problems and damage.

- Water damage due to overflowing condensate pans or plugged drain lines
- Damage to HVAC equipment and surrounding structures
- Mold, algae or scale buildup leading to foul odors and plugged drain lines
- Mold and mildew growth due to excessive moisture and leaks
- Equipment and pipe corrosion related to untreated corrosive condensate

How much condensate does an air conditioner, furnace or other cooling equipment produce?

It depends on the application, size, and type of equipment. Normally, the amount of condensate that drains from an A/C system can range from 5-20 gallons per day, depending on its size, how long the unit runs, and how much moisture is in the air.

Properly designed and maintained systems should easily drain the condensate via a gravity drain line or an automatic condensate removal pump. However, problems and damage can occur when condensate overflows or leaks occur due to lack of maintenance or equipment failure.

What type of condensate can be corrosive?

Conventional furnaces and A/C systems do not produce corrosive condensate because the combustion gases are sent directly to the flue from the combustion chamber. However, in high-efficiency condensing furnaces, the exhaust gases are passed through a second heat exchanger which in turn produces a corrosive condensate.

These hot gases get a chance to cool down within the condensing furnace system so no heat goes to waste (e.g. high-efficiency). When the temperature of the combustion gases drops, they condense and form a condensate that is usually corrosive, requiring treatment or neutralization before being passed into a drain or sewer line.

About Beckett Corporation

Beckett Corporation is a pump and pump accessories manufacturer using market-driven information to design innovative products for the HVAC, Refrigeration, and OEM markets. By employing state-of-the-art equipment, technology, and lean manufacturing practices to shorten cycle times, we deliver the highest quality products. For over 70 years, Beckett pumps have stood the test of time with proven reliability, ease of installation, long-term durability, and exceptional value. Learn more about [Beckett Condensate Pumps](#) at www.BeckettUS.com.

Bios

Jose Leon is a Senior Project Manager of Engineering at Beckett Corporation. Jose has a B.S. Degree in Mechanical Engineering from the University of Texas and extensive training in ISO 9000 Quality Management. For over 23 years, Jose has

worked with Beckett's product management, product engineering, and manufacturing teams.

Russell Nelson is the OEM/HVAC Product Manager at Beckett Corporation. For over 30 years, Russell has worked in the water pump industry in various capacities, including 15 years in product management specializing in new product development. His expertise and tenure within Beckett's engineering department provide an invaluable resource to the company and its customers.