White Paper by: Trent Technologies, Inc.
Engineering Research & Development

Beautiful School Buildings

are seldom

Healthy and Sustainable

Trent Technologies, Inc.
15939 FM 2493
Tyler, Texas, 75703
903 509-4843
*www.**TrentTech**.com*

Far too often, we read about school buildings being closed as a result of illness among students, faculty and staff members. Frequently, these illnesses are attributed to mold spores, but the source is not always found or positively identified.

Mold grows almost anywhere there are damp cool surfaces and it proliferates in dark places. In outside and isolated locations, there is usually no strong mechanism for carrying airborne mold spores into occupied spaces and the health threat is minimal. On the other hand, mold spores inside a building can become airborne by convective air movement and circulated throughout the occupied space by the air conditioning unit.

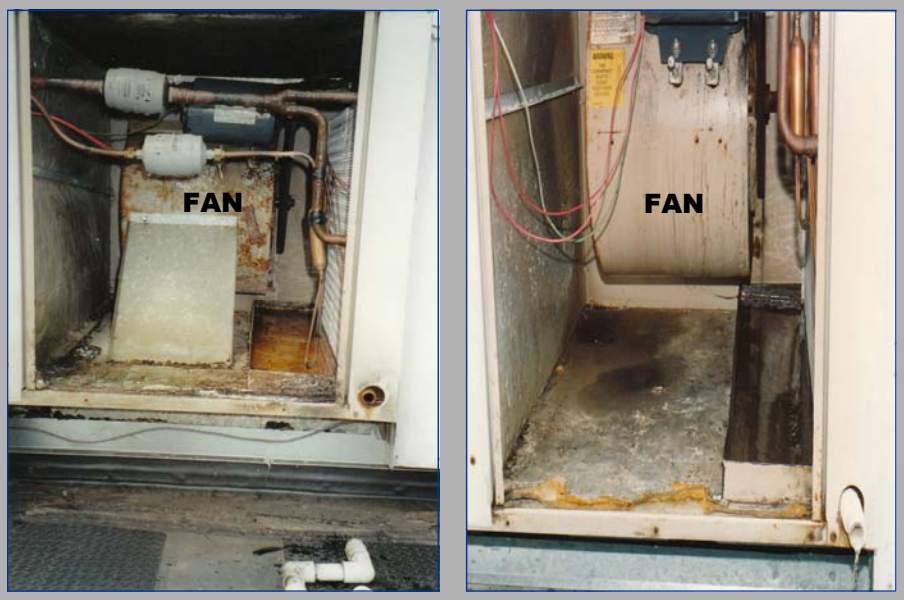
In school buildings, the most common place for mold growth is inside the air conditioning unit where water from condensation is collected in a drain pan. When properly drained away, the flowing water does not promote mold growth. Failure of the drain system, however, prevents removal of the water and allows it to spillover and be blown onto internal components.

The dark, damp surfaces are ideal places for the growth of mold and other pathogens. This is a frequent occurrence resulting in damaged and contaminated air conditioning units like those shown in Figure 1.

Consequently, a majority of air conditioning systems pose serious health threats to building occupants. Mold formation inside air conditioning systems is far more threatening than in any other location because all the air in a conditioned room passes through the air conditioner, over the mold formation and other contaminates, several times per hour. Many in the air conditioning industry, including some equipment manufacturers, incorrectly attribute these contaminated and destructive conditions to poor maintenance by the building owner. Instead, these conditions are the results of failure-prone p-traps commonly used in condensate drain systems. The p-trap failure modes identified in the sidebar - from an **ASHRAE** document - are so numerous and frequent that successful maintenance is virtually impossible, because they require:

- Frequent trap priming in dry winter months and prior to the start of each cooling cycle;
- Periodic cleanout of debris and algae growth in the p-trap;
- Freeze-protection required in some outside locations; and

Figure 1 - Unhealthy, Water Damaged Air Conditioning Units



Visit some of your older facilities and ask your experienced maintenance people how often they see conditions like these.

ASHRAE Standard 62-89R

[American Society of Heating, Refrigerating and Air Conditioning Engineers]

5.6.4 Drains and Drain Pans. *Condensate traps exhibit many failure modes that can impact on indoor air quality. Trap failures due to freeze-up, drying out, breakage, blockage, and/or improper installation can compromise the seal against air ingestion through the condensate drain line. Traps with insufficient height between the inlet and outlet on draw-through systems can cause the drain to back-up when the fan is on, possibly causing drain pan overflow or water droplet carryover into the duct system. The resulting moist surfaces can become sources of biological contamination. Seasonal variations, such as very dry or cold weather, may adversely affect trap operation and condensate removal.*

Figure 2 - Examples of Failed P-Traps

NO TRAP - NO SEAL
DAMAGE & CONTAMINATION

SHALLOW TRAP
NO SEAL

BLOCKED TRAP
DRAIN PAN OVERFLOW

DRY TRAP - NO SEAL
DAMAGE & CONTAMINATION

LEVEL INLET & OUTLET TRAP
STANDING CONDENSATE

FREEZE RUPTURED TRAP
NO SEAL

- Suitable p-trap geometry which must match the internal pressures - designers often specify only that "drains must be trapped."

Considering that many school districts have hundreds of air conditioning units, the maintenance effort required to perform these duties is unrealistic and seldom if ever achieved. Some examples of the many p-trap failure modes described in the sidebar are shown in Figure 2.

The intended purpose of the p-trap is to provide a drain seal that ensures successful removal of condensate and prevent the ingestion of potentially contaminated outside air. When it fails, which is often, the p-trap does neither. Figure 3 illustrates how these p-trap failures cause damage to the air conditioning system and promote the growth of mold and other unhealthy organisms. It also illustrates how health threatening pathogens are transported into the classroom.

It is highly likely that most of your air conditioning systems are equipped with p-traps in the condensate drain lines. If so, your school is undoubtedly experiencing unnecessary maintenance and operating cost along with health threats to students and other occupants.

Despite the threat to indoor air quality identified by **ASHRAE** and the widespread property damage and system contamination exemplified by the photographs in Figures 1 and 2, the troublesome p-trap remains commonplace. And the industry continues to accept, indeed supports, the use of p-traps in condensate drain systems. Millions of such systems are in use throughout the country, imposing unnecessary burdens on building owners and precluding the possibility of truly healthy and sustainable buildings. Fortunately, in selecting condensate drain systems, there are alternatives to the common p-trap drain seal:

1. P-trap with added features
2. Condensate pump
3. Pneumatic flow control system (**CostGard™** Condensate Drain Seal System—discussed later)

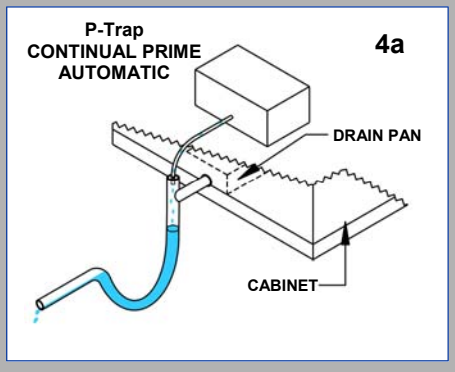
Figure 3 - Effects of P-Trap Failures

P-Trap With Added Features

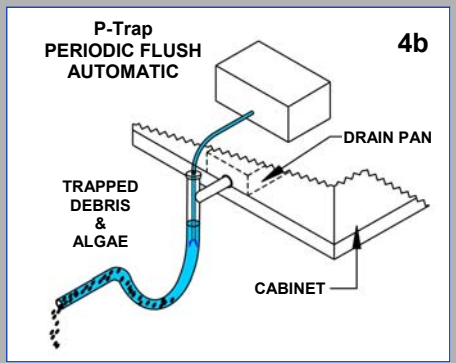
Figure 4 below illustrates how a p-trap might be modified to prevent drying out, blockage and freezing. Unfortunately, each of these added features introduces a new set of failure modes as a result of moving parts—valves, sensors, relays and actuators—and acceptable reliability in these applications is highly questionable.

Failure modes identified by **ASHRAE in the sidebar*

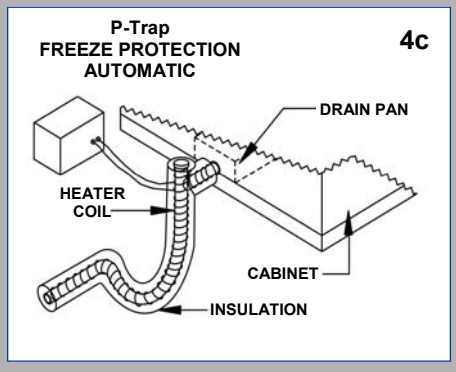
Figure 4 - P-Trap With Added Features



Continual Priming, Figure 4a, illustrates a means of priming that prevents "drying out."*



Periodic Flushing, Figure 4b, illustrates a means for removing debris and algae that cause flow "blockage."*



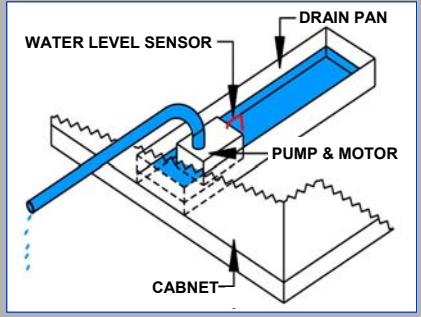
Freeze Prevention, Figure 4c, illustrates a means for preventing "freeze-up"* in outside locations.

Condensate Pump

The condensate pump, Figure 5, is free of many of the failure modes that affect the condensate p-trap, but it exhibits a different set of failure modes due to moving parts:

- The pump impeller may become overloaded and stalled by debris;
- The small motor is subject to failure; and
- The water level sensor necessary for turning the motor on and off is also subject to failure.

Figure 5 - Condensate Pump



The condensate pump is seldom used as a p-trap replacement. It is most commonly used where the plumbing drain is located above the drain pan and a pump is necessary to raise water to that level.

CostGard™ Condensate Drain System

The **CostGard™** Condensate Drain System, which includes a pneumatic seal, is free of all the failure modes common to p-traps and condensate pumps. Its performance is not magic*, it just seems that way. Here is how it works:

The system uses air instead of water to form the drain seal; a feature which prevents the ingestion of outside air, eliminates flow blockage and ensures reliable drainage of condensate.

How it forms the seal against outside air ingestion—during winter operation and at startup—is illustrated in Figure 6a.

During cooling operation when condensate is present, the air that forms the drain seal flows counter to the condensate and, creates a turbulence which ensures that debris which blocks condensate flow is flushed from the system. Figure 6b illustrates that operation.

During winter operation, seal freezing is avoided since the **CostGard™** Condensate Drain Seal does not retain water.

Figure 6c shows a typical installation.

This drain system has no moving parts, it is self-regulating, self-cleaning, and virtually maintenance free.

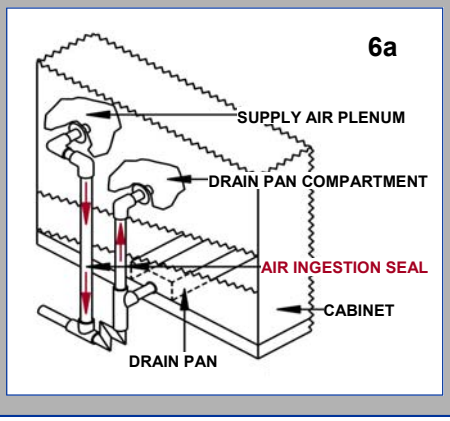
Tens of thousands of **CostGard™** Condensate Drain Systems are in use throughout the country, including every state in the United States. Users include public schools, universities, hospitals, commercial and industrial companies, and the federal government. Not one has failed to operate successfully.

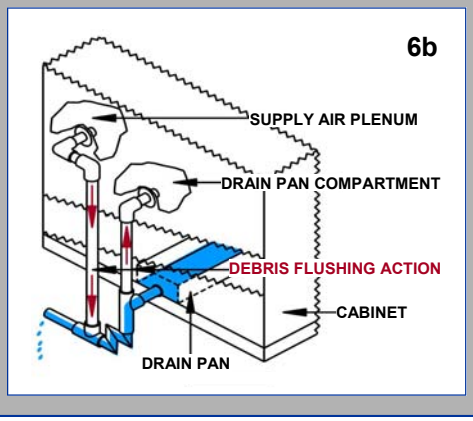
In addition to reducing the health threat to building occupants and the high cost of maintenance, the **CostGard™** Condensate Drain System reduces building life-cycle costs by increasing equipment life and preventing damage to buildings and building contents.

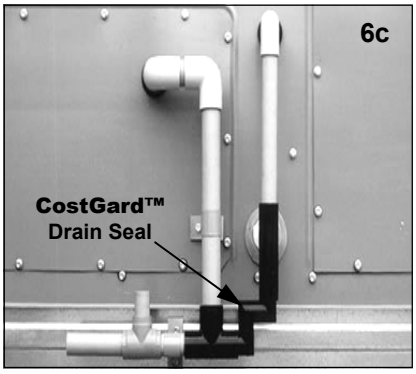
And, it costs less than a typical service call, not including the damage caused by a failed p-trap. For more information about the **CostGard™** Condensate Drain System call us at *903-509-4843* or visit our website at *www.**TrentTech**.com*.

******Any sufficiently advanced technology is indistinguishable from magic.*
– Sir Arthur C. Clarke –

Figure 6 - CostGard™ Condensate Drain System







Authors:

Warren C Trent, MSME; P.E.; CEO, Trent Technologies; Background: 35 years aerospace, more than 15 years research and development of condensate drain systems.

Paul D. Trent, BS; President, Trent Technologies; Background: 30 years business management and marketing, more than 10 years development and marketing of condensate drain systems.

ANSWERS TO SOME LOGICAL QUESTIONS

Specifically, what benefits do CostGard™ Condensate Drain Seals offer?

- Increased equipment life—estimated at more than 30% (less frequent replacement)
- Reduced maintenance (virtually maintenance free)
- Reduced damage to buildings and building contents
- A more healthy environment for students and other building occupants

Who are the benefactors?

- The building owner (the school district) and building occupants are the only benefactors

Who are the non-benefactors?

- Local outside contractors: Loss of business due to reduced need for maintenance, equipment and building clean up, and repair services.
- Equipment manufacturers: Longer equipment life reduces sales
- Designers: Increased equipment life extends the time between system redesign (reduced frequency of design efforts)

From what sources is this product available?

- The **CostGard™** Condensate Drain Seal Kits are available, for all types of air conditioning units, new or existing, from Trent Technologies, Inc. Tyler, TX
- Condensate Drain Seal System Kits are available through Carrier, Lennox, and York when ordered with new equipment

What evidence of user satisfaction can you provide?

- A maintenance supervisor for a Texas school district whose buildings are equipped with several hundred air conditioning units had this to say: *"In the 8 years we have been using the CostGard Condensate Drain Seal System we have not had a single condensate drain pan overflow—a major change from the past."*
- An internal memo of a large commercial user with more than 30,000 **CostGard™** devices installed includes the following: ... *" in the 2-3 yrs. we have been getting the RTUs with the Trent CostGard drains on them, the evaporators are the cleanest we have ever seen them! There is little residue and dirt, but nothing like the old style trap that just clogged up in summer and froze in wintertime. The pans have been clean for the most part and that has helped to eliminate quite a few emergency calls regarding water flowing back into the stores from clogged drains and overflowing evaporator pans. They truly are paying for themselves. . . "*

How do I switch to CostGard™ Condensate Drain Seals on my air conditioning units?

- **For new or remodeled buildings:** Tell your architect and mechanical designer to specify the **CostGard™** Condensate Drain Seal (instead of a p-trap) for all condensate drain systems. If the designer is unfamiliar with this drain seal, we can provide the information needed including a typical specification.
- **For existing buildings:** Tell your maintenance personnel or mechanical contractor to contact us. We can provide the product and installation instructions for units supplied by most major equipment manufacturers. Carrier, Lennox and York can provide the **CostGard™** Condensate Drain System Kits for some of their more recent models.

How can I get more information?

Contact Trent Technologies, Inc., at:
Phone: (903) 509-4843
FAX: (903) 534-8212
E-mail: info@trenttech.com
www.***TrentTech***.com

CostGard™ Condensate Drain Seal System

Some well known *Users*

Lockheed Martin

The Boeing Company

Ford Motor Company

Walgreens Company

Kohl's Department Stores

Kum & Go Convenience Stores

The Hawaiian Electric Company

Longview ISD, Texas

University of Texas System

University of North Carolina – Wilmington

Smithsonian Institution – American History Museum

The White House – Eisenhower Executive Office Building

U.S. Embassy - Kabul, Afghanistan

Tens of thousands of **CostGard™** Condensate Drain Systems are in use throughout the country, including every state in the United States. Users include public schools, universities, hospitals, commercial and industrial companies, and the federal government. Not one has failed to operate successfully.

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