The NEWS
Air Conditioning, Heating and Refrigeration

BNP BUSINESS NEWS PUBLISHING CO. — OUR 72ND YEAR OF INDUSTRY SERVICE — $3.00 • MARCH 23, 1998

Inside:

This Week

Refrigerants & Oils I

IAQNEWS

NEWS BRIEF

Honeywell Home and Building Control (H&BC) announced that it recently signed a five-year corporate service agreement with **General Electric Co.** for maintenance services. The $4.5 million agreement renews H&BC's service base at four GE facilities in North America, with the potential to add increased service revenue. H&BC services will include mechanical maintenance, temperature control service, filter service, instrument calibration, and system upgrades.

REGULAR FEATURES

READER ACTION CARD

The Reader Action Card is stitched between pages 8 and 9, and 24 and 25. Circle the appropriate numbers for literature and product information and mail the card.

Union training preference struck down as Minneapolis retools testing procedures

BY IRENE CLEPPER

What do you call a system where a guy can give himself a test, grade his own results, and then issue himself a license? You call it the "old way," now replaced by new procedures in Minneapolis.

A decades-old union-based system for testing technician competency has been swept away by the Minneapolis City Council.

Under terms of an amendment to the Minneapolis Code of Ordinances for Licensing, hvacr and plumbing applicants no longer will be required to complete a state-approved, union-based apprenticeship training program in order to take tests allowing them to work in Minneapolis. Comparable training programs will now qualify.

And that's not the only change. A national testing company, yet to be named, will be preparing the tests for this fall, with input from national and local sources. As of this spring, the tests will be administered and graded by the City's Department of Human Resources, not by part-time, unpaid, city council-appointed boards. The existing tests, which will be administered this spring, are being reviewed and, in some cases, re-phrased for clarity.

> "There are a number of good [hvacr and plumbing] companies that have excellent training programs. Their employees should not be denied the opportunity to take the competency tests." — Steve Minn

OPEN SHOPS OPEN LAWSUIT

These and other changes were instigated by a lawsuit filed in 1996 by five non-union contractors: Standard Heating and Air Conditioning, Quality Refrigeration Inc., Thermex Corp., Advance Energy Services Inc., and Ray N. Welter Heating Co.

The suit named the city and three of its building trade examination boards — gas, sheet metal (warm air), and refrigeration — charging federal antitrust violations and a pattern of pro-union bias in the licensing of plumbers and hvac installers.

Four days before a scheduled court appearance, the city council crafted the new ordinance, and then approved it unanimously.

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Top of the whirl

Lau Industries, Inc., Dayton, Ohio, is installing a 9-ft-dia airflow test chamber to replace two chambers built in the 1950s. The new chamber is consistent with AMCA/ASHRAE standards, and is registered for AMCA Figure 12/15 operation. The flow capacity is greater than 30,000 cfm at an operating pressure of 9-in.-plus wg. According to Lau, the new chamber will allow for reduced air test turnaround time, better test repeatability, and improved test data storage and retrieval.

Milton Garland refuses to put his career on ice

WASHINGTON — Milton Garland officially retired more than 30 years ago, but that hasn't stopped the 102-year-old engineer from working.

"I consider my job a privilege," he said. "I never want to stop working because I'm still learning."

Garland was honored as "America's Oldest Worker" in an award ceremony celebrating "National Employ the Older Worker Week," March 8-14. The award was sponsored by Green Thumb, Inc., in cooperation with the U.S. Department of Labor's Employment and Training Administration, and the U.S. Department of Health and Human Services' Administration on Aging.

In 1920, Garland began working at Frick Co., Waynesboro, Pa., now owned by York International. He continues to work for the company as a senior consultant of technical services and a teacher of refrigeration fundamentals, working about 20 hours per week. He holds 40 refrigeration patents.

Garland says his goal now is to "keep going."

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SPOTLIGHT

Maintain condensate control for healthier hvac

The key to maintaining healthy air-handling units is to keep moisture to a minimum.

BY WARREN C. TRENT, P.E., AND C. CURTIS TRENT, PH.D., TRENT TECHNOLOGIES INC.

Suitable condensate control is achieved, and an acceptable hvac maintenance program can be implemented, only when condensate is confined to:

1. Surfaces of the cooling coil;

2. A small and properly sloped condensate drain pan; and

3. A well-drained system, through which condensate flows freely and never stands nor stagnates.

Confining condensate to these three areas allows the system to operate virtually free of excessive maintenance, property damage, and health-threatening biological growth.

When condensate is confined in this manner, the required system maintenance consists of rather simple, periodic scheduled procedures: inspecting, cleaning, and flushing the drain system (pan, seals, and lines).

Unfortunately, far too many systems now in operation are not designed to restrict the spread of condensate, and are not amenable to reasonable maintenance.

A successful maintenance program for these systems must begin with an assessment of the capacity of each to confine condensate to the cooling coil, drain pan, and drain system. Any time condensate spreads beyond these areas, system modification is necessary to ensure that condensate is properly confined, under all operating conditions.

System deficiencies that allow the spread of condensate beyond the cooling coil and the drain system include the following:

- Condensate carryover from cooling coils;
- Condensate drips onto internal hvac system components; and
- Unsuitable drain pan designs.

When these deficiencies are present, no amount of system maintenance can prevent equipment damage, surrounding property damage, and health-threatening biological growth.

Scheduled maintenance has only limited value. It occurs after property damage has been done and biological growth has had its effect. Moreover, the damaging effects begin all over as soon as system operation is resumed. (The design considerations necessary to avoid these conditions in future systems are provided in the McGraw-Hill *HVAC Systems & Components Handbook*.)

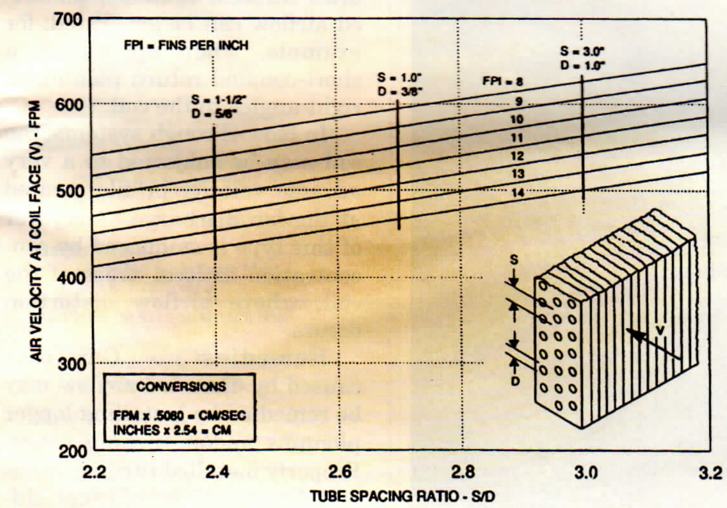

Figure 1. Coil face velocity above which condensate carryover occurs, for a typical cooling coil.

Whenever the above deficiencies appear in any system, they must be remedied before a meaningful maintenance schedule can be defined and implemented. The following paragraphs suggest suitable remedies and define a drain system that can be maintained with reasonable routine and preventive maintenance programs.

SYSTEM DEFICIENCIES AND REMEDIES

Specific system deficiencies that preclude the implementation of a feasible maintenance program, along with remedies to these deficiencies, are reviewed here.

Condensate carryover from cooling coil. Condensate carryover in any observable quantity is incompatible with a practical and acceptable system maintenance program. Damage and contamination begin when carryover occurs; neither will wait for the next scheduled maintenance action.

Condensate carryover occurs when the velocity of the air passing through the cooling coil is sufficient to entrain condensate and blow it off the coil. Any time the system components or other surfaces downstream of the cooling coil become wet, condensate carryover is a possible cause that must be assessed.

The presence of carryover can best be established by visual observation (portholes, fiberoptics, etc.) downstream of the coil, during the cooling operation, when the latent heat load (water removal) is high. The entire surface of the coil must be viewed in order to determine the cause and location of the deficiency. Uniform carryover indicates one deficiency; carryover in local areas indicates other deficiencies.

The three most common causes of condensate carryover are:

1. Unsatisfactory coil design;
2. Dirty cooling coils; and
3. Distorted air velocity profile entering the coil.

Unsatisfactory coil design. Coil design is unsatisfactory when condensate carryover appears somewhat uniformly over the entire face of a clean cooling coil. The following design parameters determine the cooling coil condensate carryover characteristics: airflow of the air handler; height and width of the cooling coil; size and spacing of the coil tubes; and thickness and spacing of fins on the tubes.

Figure 1 illustrates, for a typical coil design, the relationship among these parameters. The air velocity at the coil face, shown in this figure, is determined by dividing the air handler airflow by the face area of the coil.

Problem definition: When condensate carryover, due to coil design, occurs in a particular system, it can be remedied only by changing one or more of the parameters included in Figure 1.

Generally, in existing systems, it is not practical to make significant changes in coil geometry. Thus, the most practical way to eliminate condensate carryover is to reduce air velocity at the coil face; that is, reduce airflow.

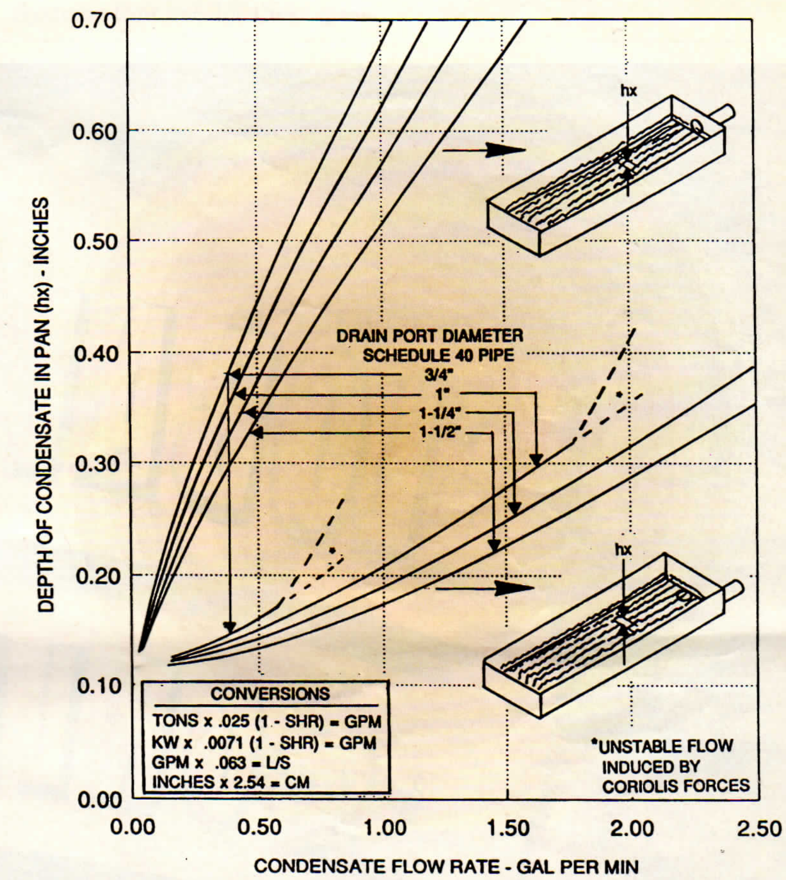

Figure 2. The effect of drain port size and position on condensate flow rate, under the force of gravity.

Remedies: Reduced airflow can be achieved most effectively by changing fan speed, which involves either a change in size of pulleys or a change in the motor speed, if the motor speed is variable.

It is often possible to reduce airflow without causing system problems. Many times hvac systems are oversized. In such cases, reduced fan speed introduces no penalty in cooling performance.

Moreover, total cooling capacity is relatively insensitive to airflow. For example, a reduction in airflow of 20% typically reduces total cooling capacity by about 5% at the rated point. Sensible cooling capacity is reduced more, but latent cooling capacity is increased.

Even in those instances where the total cooling capacity is compromised by reduced airflow, the best choice may be to accept this compromise and eliminate the serious property damage and health problems associated with condensate carryover.

In installations where the coil design is similar to that shown in Figure 1, the reduction in air velocity needed to eliminate carryover can be approximated as follows.

- Compute air velocity at the coil face in feet per minute by dividing the airflow (cfm) by the face area (square feet — height times width) of the cooling coil.
- With the coil face velocity, enter Figure 1 at the spacing ratio and fin spacing determined from coil measurements. The difference between this point and the point where carryover is indicated by Figure 1, indicates the reduction in velocity and, therefore, the airflow reduction required to eliminate carryover.

At best, however, this process only provides a starting point. The proper airflow reduction is that which eliminates condensate carryover, a condition that must be determined by visual observation or other suitable means.

The installation of moisture eliminators downstream of the coil is not a viable method for preventing carryover. Eliminators add significantly to the

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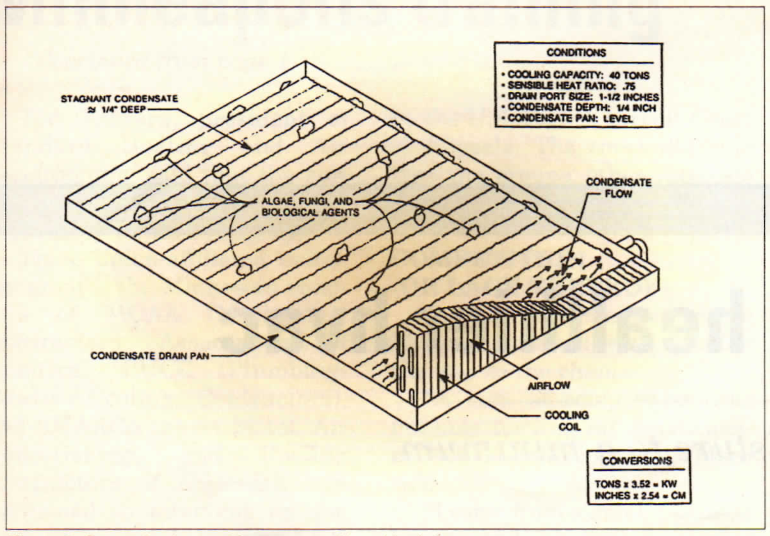

Figure 3. Contamination problems created by wide drain pans.

Condensate control

Continued from page 3

pressure loss in the system and, therefore, reduce airflow. In addition, they introduce another potential growth place for biological contaminants.

DIRTY COILS

Dirty cooling coils. Condensate carryover may sometimes be observed in systems where the cooling coil design is entirely satisfactory. The cause may be dirty coil surfaces.

Because dirt does not always collect uniformly on the cooling coil, carryover may occur in limited local areas of the coil.

Problem definition: Dirt and other foreign material deposited on the surfaces of cooling coils can reduce the area for airflow and increase the air velocity sufficiently to effect condensate carryover.

Unrelated to condensate carryover, dirty coils have other adverse consequences. They reduce heat transfer and decrease system efficiency.

Remedies: Within the industry, the most widely endorsed solution to dirty coil conditions is a maintenance program that involves periodic coil cleaning.

When properly defined and performed regularly, coil cleaning can be adequate to avoid carryover resulting from dirty coils. However, coil cleaning is a costly and time-consuming process.

Furthermore, in many existing systems, the cooling coils are so inaccessible and cleaning is so difficult that it is often deferred until a major problem arises.

Probably the most dependable and cost-effective way to maintain coils in an acceptably clean condition is to use filters with adequate capacity to remove particles that accumulate on the coil, thereby avoiding the need to perform frequent cleaning.

AIR VELOCITY

Distorted air velocity profile entering the cooling coil. Air entering the cooling coil with a non-uniform velocity profile can cause carryover, even when the average face velocity is below where carryover would occur, as indicated in Figure 1.

Carryover caused by this condition can be defined by visual observation. And, the location and source of the distorted airflow can be identified and corrected.

Problem definition: In draw-through systems, distorted airflow can be generated; for example, when air enters a short-coupled return plenum at right angles to the coil.

In blow-through systems, the coil may be subjected to a very adverse velocity profile created at the fan discharge. Carryover of this type is evidenced by concentration in local areas of the coil, where airflow distortion occurs.

Remedies: Carryover caused by distorted airflow may be remedied by installing longer plenums and/or turning vanes. Properly installed turning vanes and longer, more efficient diffusers not only improve the velocity profile; they also can significantly reduce pressure losses.

Turning vanes and longer

MARCH 23, 1998
VOL. 203, NO.12, SERIAL NO. 3597

The Air Conditioning, Heating and Refrigeration NEWS

Air Conditioning, Heating & Refrigeration News (ISSN 0002-2276) is published 52 times a year by Business News Publishing Co., P.O. Box 2600 (755 W. Big Beaver Rd., 48084), Troy, Mich. 48007. Telephone 248-362-3700, FAX: 248-362-0317.

Subscription Rate: $85 per year in the U.S.; $111.74 per year in Canada (includes postage and $5.74 GST); $164 per year in all other countries, payable in U.S. funds.

Microfilms of The News are available from: University Microfilms, 300 N. Zeeb Rd. Ann Arbor, Mich. 48013.

Trademark Registered U.S. Patent Office.

Periodicals Postage Paid at Troy Mich. and at additional mailing offices.

GST Account: 131263923.

POSTMASTER: Send address changes to Business News Publishing Co., P.O. Box 2600, Troy, Mich.48007.

The Audit Bureau

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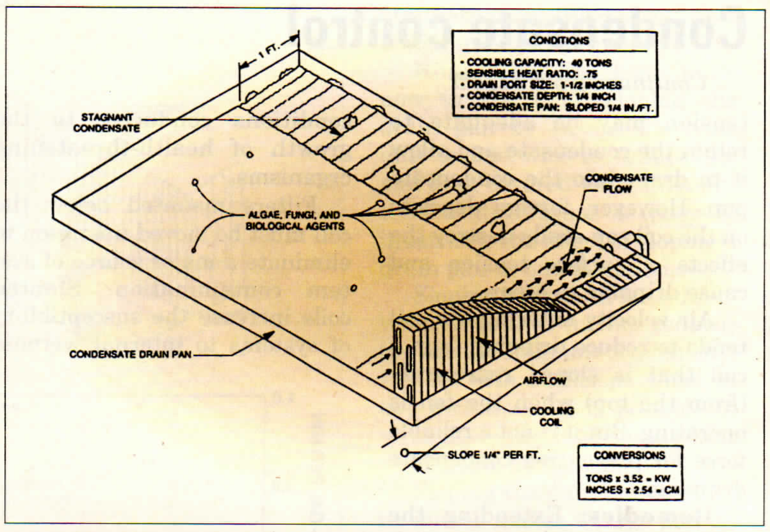

Figure 4. Effects of pan slope on condensate flow and contamination.

plenums require more space, additional hardware, and added costs. Nevertheless, in certain cases, major changes may be necessary to eliminate the detrimental spread of condensate if an effective maintenance program is to be achieved.

CONDENSATE DRIPS

Any hvac system that allows condensate to drip onto internal surfaces and components is subjected to internal damage and the growth of contaminating organisms.

Sloped cooling coils and non-insulated coolant lines (refrigerants or water) are often the source of condensate drips. Systems that exhibit these qualities must be modified, because routine scheduled maintenance does not protect against these conditions, nor does it remedy the causes.

Drips from sloped cooling coils. Sloped cooling coils included in some hvac systems are prone to drip condensate onto surfaces outside the condensate drain pan.

Problem definition: Condensate that drips from a slanted coil onto surfaces outside the drain pan creates destructive and contaminating conditions.

At small slope angles, surface

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tension may be adequate to retain the condensate and allow it to drain into the condensate pan. However, foreign deposits on the coil can easily destroy the effects of surface tension and cause dripping to occur.

Air velocity entering the coil tends to reduce dripping from a coil that is sloped rearwardly (from the top) when the fan is operating. But it is not a reliable force for preventing condensate dripping.

Remedies: Extending the condensate drain pan to catch condensate drips is not a viable solution. It introduces another equally serious condition: large drain pans.

In order to ensure adequate condensate control and a dry system that is free of harmful contaminants, sloped coils must be kept clean at all times and the fan should not be turned off during the cooling period. The air filter must never be placed below the cooling coil, where dripping condensate creates conditions conducive to the growth of health-threatening organisms.

Filters mounted below the coil must be moved upstream to eliminate a major source of system contamination. Slanted coils increase the susceptibility of systems to internal wetness and contamination: as a minimum, a more stringent and high-frequency maintenance program is necessary for these systems.

Drips from non-insulated coolant lines. All too frequently, existing hvac units have non-insulated coolant lines that pass through the cooling airflow passage, causing condensate drips along their paths.

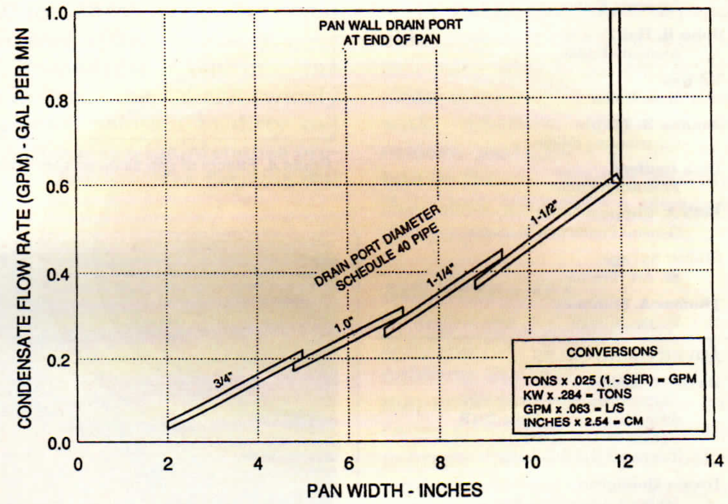

Figure 5. Pan widths suitable for units with various flow rates, and for commonly used port sizes.

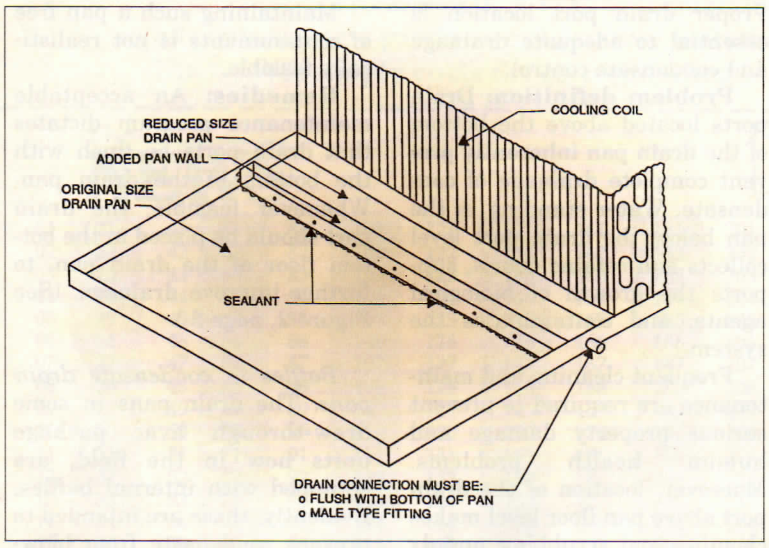

Figure 6. Drain pan reduced in size.

Problem definition: Condensate that drips on surfaces outside the drain pan causes damage to the hvac system and creates conditions conducive to health-threatening biological growth.

Remedies: This condition, much too common in current systems, is simple to remedy. It can and must be eliminated by applying suitable insulation to all bare coolant lines.

UNSUITABLE DRAIN PAN DESIGNS

Condensate drain pans in many hvac systems now in the field are so configured that the necessary maintenance effort varies between very difficult to impractical to perform.

Among the most troublesome features are:

- Large drain pans;
- Primary drain port location; and
- Internal baffling.

Systems that exhibit these characteristics must be modified before a reasonable maintenance program can be implemented.

Large drain pans. Systems that make use of large condensate drain pans (often extended downstream of the cooling coil to protect against condensate carryover) cannot confine the spread of condensate within the boundaries necessary to permit successful maintenance.

Problem definition: As condensate forms and drains into the pan, it will stand there at some finite depth. If the drain pan is level — as is common for systems now in the field — condensate will cover the entire pan.

The precise depth at which condensate stands depends upon the pan geometry, and the rate at which condensate is drained from the pan. Typically, the depth varies between about 1/8 in. (3 mm) and 1/2 in. (12 mm) or greater. (See Figure 2, page 3.)

During system operation, condensate in the drain pan will flow from the area below the cooling coil to the drain port, leaving the remainder — in fact most — of the condensate in a stagnant state. There, it becomes a growth haven for contaminating organisms, as illustrated in Figure 3 (page 4).

Remedies: For hvac units now in the field, sloping the drain pan by tilting the hvac unit is one way to reduce the pan area covered with stagnant condensate. Figure 4 (page 5) illustrates the effect of sloping a drain pan in one direction.

Sloping the pan in both directions, of course, further reduces the area of stagnant condensate. Hence, with sufficient slope in two directions, it is possible to virtually eliminate stagnant condensate in the pan.

Sloping the pan, however, by no means makes a large pan an acceptable remedy for condensate carryover. Carryover droplets deposited on the pan will not drain readily to the drain port. Instead, they will be held in place by surface tension, providing another potential source of biological contamination.

The equipment damage and contamination problems caused by large drain pans now in the field can be remedied by simply reducing the pan size to that required to catch the condensate and accommodate flow in the pan.

The length of the pan must be sufficient to cover the base of the cooling coil. The pan area is then fixed by pan width — the distance the pan extends away from the cooling coil.

The width of the drain pan must be sufficient to accommodate the maximum condensate flow rate, yet not so wide as to allow condensate to stagnate. Pan widths considered acceptable for systems with various cooling capacities and condensate drain sizes are shown in Figure 5 (page 6).

The most effective way to reduce large pans to a suitable size depends upon the specific system involved. Where possible, the most desirable pan is one constructed of a durable, nonmetallic material or stainless steel.

Often, however, the most

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practical way to effect pan size reduction is to install a wall inside the current drain pan, as illustrated in Figure 6 (page 7). In some cases it may be necessary to relocate the drain port and place it at the end of the pan, as indicated.

If the pan and attachments already in place are constructed of ferric metals, they must be replaced or treated with durable (long-life) protective coatings. This is because under some conditions, the presence of iron accelerates the growth of certain harmful bacteria.

Condensate drainage can be enhanced and protection against the formation of water puddles can be realized by tilting the hvac unit toward the drain port, as discussed above. A slope of ¼-in./ft (2 cm/m) is usually adequate. However, the unit should be tilted only with the approval of the equipment manufacturer.

DRAIN PORTS

Primary drain port location. Proper drain port location is essential to adequate drainage and condensate control.

Problem definition: Drain ports located above the bottom of the drain pan inherently prevent complete drainage of condensate. Water standing in the pan below the drain port level collects and retains debris, supports the growth of biological agents, and contaminates the system.

Frequent cleaning and maintenance are required to prevent serious property damage and human health problems. Moreover, location of the drain port above pan floor level makes cleaning and scrubbing unduly difficult and time-consuming.

Maintaining such a pan free of contaminants is not realistically feasible.

Remedies: An acceptable maintenance program dictates that drain ports be flush with the bottom of the drain pan. Whenever feasible, the drain port should be placed in the bottom floor of the drain pan, to further improve drainage. (See Figure 2, page 3.)

Baffles in condensate drain pans. The drain pans in some draw-through hvac package units now in the field, are equipped with internal baffles. Evidently, these are intended to prevent condensate from blowing into the system, where it can cause damage to internal components and promote health-threatening biological growth.

In most draw-through systems in the field today, condensate blowing is a serious problem that arises when no seal has been installed, or when the seal depends upon a trap that is dry; for example, during initial system startup, or startup for summer cooling. (Traps become dry in winter due to evaporation and/or freeze-plug expulsion.)

Problem definition: During these operating conditions, baffles can reduce, although they rarely eliminate, condensate blowing when no drain seal is present. But they present a significant maintenance problem.

More surface area is exposed to condensate, and the potential for system contamination is magnified. And, because of the small air and water passages in the baffles, condensate pans seldom drain well, and condensate flow is often blocked by debris.

Frequent cleaning of baffled systems is therefore imperative. Yet, the interiors of baffle arrangements are so inaccessible that reasonable maintenance procedures usually are not feasible.

Remedies: The implementation of a practical maintenance program requires the removal of troublesome baffles and the use of a reliable and effective drain seal that eliminates the condensate blowing, for which the baffles were initially installed.

This article was excerpted with permission from "Condensate Control," by authors Warren and Curtis Trent, in the HVAC Maintenance and Operations Handbook, *published by The McGraw-Hill Companies (Copyright 1998). Warren Trent is ceo and Curtis Trent is president of Trent Technologies, Inc., Tyler, Texas, manufacturer of the CostGard™ condensate control device (drain seal). They may be contacted at 535 WSW Loop 323, Suite 301, Tyler, Texas 75701-9453; 903-509-4843; 903-561-0169 (fax).*