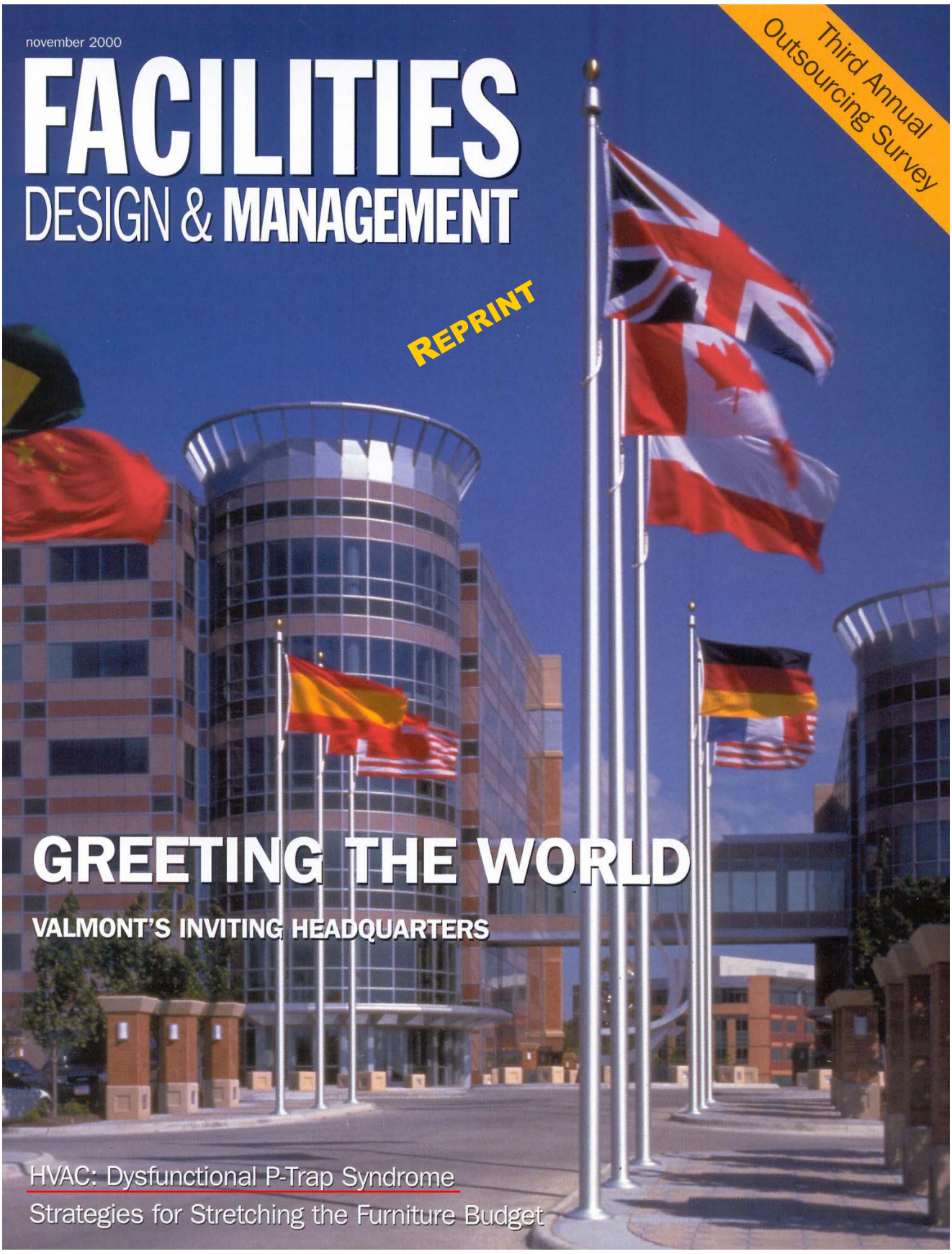
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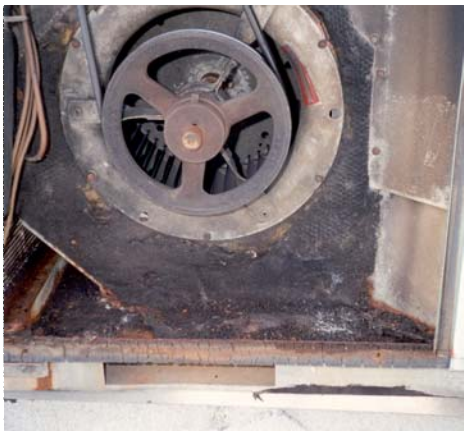
NEW DRAIN SEALS REPLACE THE P-TRAP

Draw-through HVAC systems with P-traps are causing numerous problems which—during the life of the system—may cost building owners and managers more than the system itself.

By Warren Trent, M.S., P.E. and Curtis Trent, M.S., Ph.D.

Among the countless problems facing facilities owners and managers, some of the most insidious and persistent are those caused by inadequate HVAC condensate removal and control. The primary source of these problems is the condensate P-trap attached to the drain line of draw-through heating, ventilating, and air conditioning (HVAC) systems.

Few people outside the HVAC industry associate the problems of indoor air pollution, excessive maintenance costs, property damage, and system deterioration with the mundane condensate P-trap. However, research and scientific observation have shown that the P-trap is one of the most deceptive, trouble-prone and costly components in the HVAC system. When installed in a draw-through system (the most common commercial and industrial type), it causes numerous problems, which—during the life of the system—may cost building owners and managers more than the system itself. The direct dollar costs and health problems caused by the condensate p-trap are evident to everyone closely involved in the operation and maintenance of draw-through HVAC systems.



Internal damage caused by P-traps includes systems that are wet, dirty, and filled with fungi causing poor air quality.

Over the past several years, we have visited many facilities and inspected hundreds of draw-through HVAC systems. Inspected during the cooling season, the interiors of most of these systems were found to be wet, dirty, and rife with mold and other fungi as a result of dysfunctional condensate p-traps. The effects of these conditions on property damage, equipment life (deterioration), and indoor air pollution are evident to even the most casual observer.

The hundreds of responses (mainly from building owners and managers), which we received following our recent articles in technical publications, support our field observations. Why this deplorable situation is tolerated is not readily apparent. It appears, however, to be either a lack of appreciation for the problem or a great deal of indifference by some members of the industry: equipment manufacturers, system designers, and contractors. Of these, the equipment manufacturers and the system designers are most qualified to provide a remedy.

Solutions go ignored

In dealing with condensate drain problems, the equipment manufacturer has two options: change the design to eliminate the draw-through arrangement or provide an effective and reliable drain seal on each HVAC unit delivered. However, neither solution is likely to be implemented. The draw-through unit offers an efficient airflow path, which the HVAC equipment manufacturer will insist upon retaining. At least one manufacturer has tried internal P-traps, with disastrous results. Seemingly, manufacturers are willing to pass the drain seal problems along to the next in line.

The system designer is the last line of defense for building owners and managers. Unless handled at this level, the drain seal problems and its consequences are passed down, level by level, to the building owners and managers who are forced to live with this expensive problem.

Designers' options in selecting drain seals are somewhat limited. They can choose a P-trap, or pump, find another suitable drain seal, or create a seal design of their own. Generally, the choice has been a condensate P-trap. This is unfortunate, because the P-trap fails building owners and managers and raises questions about the wisdom of decisions made by the designer, as well as the equipment manufacturers.

Since many building and mechanical contractors do not have the technical background necessary to address the condensate seal problem successfully, a suitable design must be precisely defined for them. The instructions that the condensate drain "must be trapped," often stated by the equipment manufacturer or specified by the designer, is unacceptable for contractors.

Indeed, this statement relieves neither the equipment manufacturer nor the system designer of the responsibility for problems caused by dysfunctional P-traps in the field. In fact, this statement may even be construed as an indictment, because the condensate P-trap is well recognized as an unsuitable drain seal.

Typically, specifications leave the selection and sizing of condensate P-traps to contractors. Even the best possible P-trap design is unsatisfactory as a drain seal, and these conditions are made worse when contractors are free to install any trap geometry they choose.

P-trap problems

Nevertheless, inadequate specifications continue to dominate the industry. For example, the HVAC specifications prepared by a highly reputable architectural and engineering firm, for a new building—with 51 draw-through air handlers—reads as follows:

SECTION 15855-7

Outdoor Central Station 2.02

The unit condensate system shall be trapped outside the unit roof curb to provide adequate condensate drainage at specified pressure. (No pressure was specified.)

Air Handling Units 2.03

... contractor shall provide condensate pan and drain connections to cooling coil of sufficient size to contain and remove coil condensate. (No design details were provided in the spec.)

These specifications—typical throughout the industry—leave the selection and sizing of the condensate trap to contractors. Even the best possible P-trap design is unsatisfactory as a drain seal. These conditions are made even worse when contractors are free to install any trap geometry they choose. Thus, the resulting deplorable conditions and cost the P-trap imposes on building owners and managers should surprise no one.

> Contractors have said 30 to 40 percent of their service calls are for condensate P-traps.

The reader may feel that we are overly concerned about the problems with condensate P-traps. If so, we refer you to the "Public Review Draft of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62-89R." Paragraph 5.6.4 Drains and Drain Pans, which contains the following informative language:

"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 [poor design] *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."*

For numerous reasons, the ASHRAE Standard 62-89R has been withdrawn and replaced with ASHRAE Standard 62-99. Nevertheless, the technical content and the informative language in Standard 62-89R will have a significant impact on the industry, in the future, both technically and legally.

As an indication of the future, the January 1995 issue of the *ASHRAE Journal* contains some pertinent comments—by attorneys—addressed to designers about the relevance of ASHRAE Standard 62-89R and other design standards. We interpret these comments in the *Journal* article to mean that the only justification for designers and others to deviate from good technical design practices—including those stated in ASHRAE 62-89R—is the demand of the building owner. In this case, the owner accepts responsibility for that aspect of the design. It would be very risky, indeed, to allow contractors to make any design decisions, for which the system designer will bear the ultimate responsibility.

Different perspectives

Despite the serious deficiencies of the condensate P-trap, we find that many contractors and HVAC equipment manufacturers are negative toward the use of more effective and reliable drain seals. We attribute the attitude of contractors to one or both of the following reasons: they are reluctant to embrace any new product that could possibly add to their installation efforts, increase labor costs, and potentially reduce their profits; and/or the maintenance effort required by contractors in the future could be decreased significantly, thus, reducing their business level and profits.

Many outside the HVAC contractor group, including ourselves, find the latter reason hard to believe. But we have had numerous contractors to tell us outright that they would never install a trouble-free drain seal on their own, because it would reduce their business. Some have said that 30 to 40 percent of their service calls are for servicing condensate P-traps.

The negative attitude of the HVAC equipment manufacturers is not easily understood. Indications are that most manufacturers are well aware of the importance of an effective and reliable condensate drain seal. They are also aware of the expensive problems caused by the con-

The Fluidic Flow Control Device replaces the condensate P-trap. It is self cleaning (no flow blockage) and self regulating. With this device, facilities managers can achieve dry and clean HVAC systems.

densate P-trap. Yet, they continue to contend that the P-trap is a satisfactory drain seal and, indeed, tout it as the accepted industry standard. It is this industry standard that is causing numerous problems including those enumerated in the ASHRAE Standard 62-89R quoted above. These problems are costing building owners and managers billions of dollars annually, in terms of service calls, maintenance effort, surrounding property damage, and human health factors (e.g. sick building syndrome and other well-known building-related illnesses). In addition, it is estimated that these problems decrease the life of HVAC equipment as much as 25 percent. In other words, replacing the P-trap with an effective drain seal would increase the equipment life to 20 years, compared to the 15 years median life quoted in the *1999 ASHRAE Applications Handbook*. Whether this is a factor in their position or not, increasing equipment life is not necessarily desirable for manufacturers. In the long run it, of course, means a reduced production rate and perhaps lower profits.

As a matter of fact, increased equipment life benefits primarily building owners and managers. Except for the potential liabilities associated with water damage and health problems caused by dysfunctional P-traps, increased equipment life is a negative factor for equipment manufacturers, designers, and contractors. For example, imagine the agony associated with reducing the production rate of a factory from say 200,000 to 150,000 units annually, along with a corresponding reduction in design requirements and contractor installation work.

Until the industry successfully addresses the P-trap problem, building owners and managers will have to contend with the problems it brings: wet, dirty and contaminated HVAC systems. Many within the industry are aware of the deplorable conditions of HVAC systems in this country, but few have identified the true cause. For example, ASHRAE, EPA, and OSHA attribute these conditions to poor maintenance by the building owners and managers. Moreover, each of the agencies has proposed elaborate and expensive maintenance management programs to be imposed on building owners and managers. These programs are well meant but misguided, and they will be costly for the building owners and managers to implement. The fact is that successful maintenance of draw-through HVAC systems, which use P-traps, is neither realistic nor practical. Indeed, under many very common conditions, it is virtually impossible to keep the interior of these systems dry and clean regardless of the maintenance effort. See: R. Rosaler. *HVAC Maintenance and Operations Handbook*, McGraw-Hill Companies, New York, 1998. p. 653.

Simply stated, the lack of maintenance is not the primary cause of deteriorating and contaminated HVAC systems. Instead, it is the deficiencies in system designs. The most serious and prevalent deficiency is the use of the condensate P-trap as a drain seal.

Evidently, within the present industry environment, the only way for building owners and managers to remedy this ever-present headache is to take action on their own. They can do this by demanding that an effective and reliable condensate drain seal be installed on all existing draw-through systems, and by requiring its inclusion in all future designs.

Progressive building owners and managers, nationwide, have already done this at numerous facilities, including office buildings, industrial plants, retail stores, restaurants, schools, hospitals, nursing homes, university health centers, and homes with heat pumps and electric furnaces.

Generally, these building owners and managers are those with competent maintenance personnel who are capable of evaluating the advantages offered by an effective and reliable drain seal and have the management skills necessary to operate an effective maintenance program. These users are realizing cost savings in operations, not including accompanying health benefits, estimated to be comparable to the savings being achieved from aggressive energy management programs.

It is both desirable and realistic for building owners and managers to demand that a proven effective and reliable condensate drain seal be incorporated in all their draw-through HVAC systems. If designers are unable to provide a proven drain seal of their own, at least one is now in production and readily available. It is the "Fluidic Flow Control Device," (a scientifically designed drain seal which utilizes the basic principles of fluid flow) described in detail in: N. Grimm, and R. Rosaler. *HVAC Systems and Components Handbook*, New York: McGraw-Hill Companies, 1998. 2.3.24.

This drain seal was designed and developed specifically to replace the condensate P-trap. It is simple and has no moving parts. It is self-cleaning (no flow blockage) and self-regulating. Its effectiveness and reliability have been proved in the field. Thousands are in operation throughout the United States, in all types of buildings. Production units have been in operation since 1993. Not one has failed to perform successfully.

Thus, it is now possible for building owners and managers, who wish to alleviate their costliest problem, achieve dry and clean HVAC systems, reduce operating costs, prolong equipment life, and improve indoor air quality, to proceed with confidence.

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